REPORT ON

TAILINGS STORAGE FACILITY
DIKE DESIGN
MEADOWBANK GOLD PROJECT

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EXECUTIVE SUMMARY

This report presents the design for the dikes of the Tailings Storage Facility (TSF) at the Meadowbank Gold Project, Nunavut. The report includes design criteria, site conditions, results of technical analyses and also Drawings and Specifications issued for review.

The TSF dikes are built around and across the basin formed by dewatering the northwest arm of Second Portage Lake. Major structures include the Central Dike and Divider Dike, along with a series of smaller Saddle Dams.

The TSF dike section includes a rockfill embankment with an upstream impermeable liner anchored in a cut-off trench through foundation soils. Construction is by the downstream method and is staged to allow management of tailings and water in separate basins during the first years of mine life.

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1.0 INTRODUCTION

This report presents the detailed design for the dikes of the Tailing Storage Facility (TSF) at the Meadowbank Gold Project, Nunavut. The Meadowbank Gold Project site is owned by Agnico-Eagle Mines Limited (AEM) and is located approximately 80 km north of the Hamlet of Baker Lake, Nunavut. A site location map is included on Drawings in Appendix VIII.

Tailings generated at the site will be stored in the basin formed by dewatering the northwest arm of Second Portage Lake. The TSF dikes are built around and across the basin, and include:

- The Central Dike;
- The Divider Dike (previously named Stormwater Dike); and
- Saddle Dams.

The Central Dike and Saddle Dams are permanent structures. The Divider Dike separates tailings management in the north basin (North Cell) and water management in the south basin (South Cell) for the first three years of production, after which time both basins contain tailings. Drawings showing the dikes are included in Appendix VIII.

The report includes:

- Design criteria;
- Site conditions and available geotechnical data;
- Results of technical analyses;
- Construction sequence including dewatering requirements and raise elevations;
- Construction techniques;
- Specifications; and
- Drawings.

Construction materials are primarily generated from materials on site. The typical dike section includes a rockfill with a 3 horizontal (H): 1 vertical (V) upstream face with bituminous geomembrane liner, filters, and cut-off trench. The main characteristics of the dikes are presented in Table 1.1.

TABLE 1.1: Summary of TSF Dike Characteristics

Cell	Dike	Crest Elevation (masl)	Maximum Height at Rockfill Crest Center Line (m)	Rockfill Width at Crest (m)	Crest Length (m)	Maximum Base Width (m)
North Cell	**Divider Dike**					
	Stage 1	140	12	10	850	60
	Stage 2	150	22		1070	105
	Saddle Dam 1					
	Stage 1	141	7	10	180	40
	Stage 2	150	16		380	80
	Saddle Dam 2					
	Stage 2	150	8	10	485	50
	Saddle Dam 6					
	Stage 2	150	4	10	260	40
South Cell	**Central Dike**					
	Stage 1	135	33	10	775	160
	Stage 2	145	41		940	200
	Stage 3	150	44		1025	225
	Saddle Dam 3					
	Stage 2	145	7	10	180	45
	Stage 3	150	12		305	65
	Saddle Dam 4					
	Stage 2	145	7	10	420	45
	Stage 3	150	12		555	65
	Saddle Dam 5					
	Stage 2	145	11	10	218	55
	Stage 3	150	16		245	80

*Max. base width shown for rockfill only. Central Dike and Saddle Dams have upstream slopes of 3H: 1V and downstream slopes of 1.5H: 1 V. Divider Dike has an upstream slope of 3H: 1V, and downstream slopes at angle of repose.

2.0 DESIGN CRITERIA

2.1 Introduction

This section presents criteria used in the design of the TSF dikes.

General design criteria include:

- Maintain adequate setback from open pits, roads, and runways;
- Accommodate tailings generated during mine life;
- Meet or exceed required factors of safety for dam stability;
- Integrate dike construction schedule with the lake dewatering sequence and tailings deposition;
- Allow for water handling and management during lake dewatering and possible dredge spoils; and
- Minimize construction effort and cost.

The design must consider all aspects of constructability including seasonal supply of materials, construction season and schedule, stability, thermal effects, deformation, seepage and resistance to external and internal erosion forces.

Table 2.1 presents a summary of design criteria for the TSF.

TABLE 2.1: Summary of Design Criteria

Design Criteria	Value and/or Description	Source or Comments
Mine Life	11 years (2 years prior to startup and 9 years for active mining)	AEM
Mine Production	29.3 Mt	AEM
Plant start-up date	Q1 2010	AEM
Production Rate	• Month 1 60% • Month 2 70% • Month 3 80% • 8,500 tpd thereafter	AEM
Specific Gravity of Tailings	3.1	Laboratory test values 2004
Volume of Tailings	22.4 Mm^3	29.3 Mt at 1.31 t/m^3 including a bulking factor of 1.2 to account for ice
Minimum water volume required for process plant start-up	750,000 m^3	AEM
Minimum setback from Third Portage Pit to downstream toe of Central Dike	60 m	See Note 1.
Maximum size of haul trucks on dike	Caterpillar 777	See Note 2
Cat 777 Width	6.05 m	Caterpillar website http://www.cat.com
Tire diameter (27.00R49) of Caterpillar 777	2.5 m	Caterpillar website http://www.cat.com
Minimum rockfill crest width	10 m	See Note 2.
Maximum wave height, post mine life	Wave conditions and setup due to 1 in 1,000 year return period wind	Coastal Engineering Manual, CDA (2007)
Maximum lake ice thickness, post mine life	1.5 m to 2.5 m	Based on geotechnical field investigations (Golder 2002a, 2003c, 2006a, 2008c)
Minimum freeboard	Central Dike and Saddle Dams: 2.0 m during operations, 1.0 m at closure Divider Dike: 1.0 m	Settlement and overtopping (CDA 2007)
Canadian Dam Association Hazard Classification	Central Dike: High Saddle Dams: High Divider Dike: Significant.	Canadian Dam Association Dam Safety Guidelines (2007)
Design seismic event (1 in 2500 year return period)	• Peak ground acceleration = 0.06 g	2005 National Building Code of Canada, CDA (2007)

Design Criteria	Value and/or Description	Source or Comments
Minimum factor of safety for slope stability	• End of construction prior to filling 1.3 • Steady state seepage with maximum tailings deposition – 1.5 • Pseudostatic conditions – 1.0 • Post closure – 1.5	CDA (2007)
Dike Seepage Collection System	3 months storage capacity 3 m sump depth (min.)	Allows intermittent pumpback during winter conditions

Note 1. A nominal setback of 60 m between the downstream toe of the dike and the ultimate pit crest has been assumed. See Golder 2007a.

Note 2. If dikes act as haul roads then crest width must comply with Mine Health and Safety Regulations N.W.T. for minimum width of haul roads (NWT and Nunavut 1995). For single lane traffic the minimum width is twice the width of the widest haulage vehicle used on the road; for double lane traffic the minimum width is three times the width of the widest haulage vehicle. A shoulder barrier of at least three-quarters the height of the largest tire on any vehicle using the road is required.

2.2 Dam Classification

Table 2.2 presents Dam Classification categories according to the Canadian Dam Association (CDA 2007).

TABLE 2.2: Dam Classification (CDA 2007, Table 2-1, p.26)

Dam class	Population at risk	Incremental losses		
		Loss of Life	**Environmental and cultural values**	
Low	None	0	Minimal short-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat. Loss of marginal habitat only. Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat. Restoration or compensation in kind highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very High	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat. Restoration or compensation in kind possible but impratical	Very high economic losses affecting important infrastructure or services
Extreme	Permanent	More that 100	Major loss of *critical* fish or wildlife habitat. Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services

Dam classification will depend on operation of the TSF. The Central Dike and Saddle Dams are “High” consequence of failure structures due to potential for economic loss and environmental damages caused by release of tailings fluids or solids. The Divider Dike is a “Significant” consequence of failure structure because release of tailings fluids or solids is unlikely to cause loss of life or significant environmental or economic damage.

2.3 Setback of Central Dike

The distance from the downstream toe of the Central Dike to the Portage Pit crest is the "setback." The purpose of the setback is to isolate the dikes from potential failures occurring through the pit wall at ultimate mining depth, to isolate the dikes from the effects of blasting in the Portage Pit, to provide a working area, and to allow for seepage collection.

A minimum setback of 60 m was selected based on pit wall stability analyses presented in Golder (2007a).

2.4 Freeboard

Freeboard is the minimum vertical distance between the still water surface elevation in the reservoir (lake) and the top of the containment structure. This safety margin is maintained at all time in order to restrict overtopping of the containing structure by large waves, including due consideration of wind and wave setup, and wave run up. (CDA 2007).

The Canadian Dam Association Dam Safety Guidelines (CDA 2007, Section 6.4) states that the crest level for an embankment structure should be set so that the structure is protected against the most critical of the following cases:

- No overtopping by 95% of the waves caused by the most critical wind with a frequency of 1/1000 year when the reservoir (lake) is at its maximum normal elevation; and

- No overtopping by 95% of the waves caused by the most critical wind when the reservoir is at its maximum extreme level during the passage of the Inflow Design Flood, IDF (1/3 between 1/1000 and PMF. CDA 2007, Table 6-1 p.62).

Additional considerations for the Freeboard are:

- Freeboard should be sufficient to prevent heave of the crest due to frost action (CDA 2007, page 71);

- Final freeboard, including camber, should be sufficient to accommodate expected settlement of the crest and cracks caused by frost action (CDA 2007, page 71); and

- The dam (dike) should be designed to retain the reservoir safely despite any cracking that may be induced by arching, settlement, or hydraulic fracturing (CDA 2007, page 71).

In addition to freeboard, the upstream slopes and abutments of the dike should have adequate protection against erosion and possible breaching due to wave and ice action. The downstream slopes should be protected where necessary against the erosive action of runoff, seepage, flows, traffic, frost, and burrowing animals (CDA 2007, Section 6.6, p. 71).

The minimum freeboard between tailings and liner crest is set at 2.0 m for the Central Dike and Saddle Dams during operations and 1.0 m following closure. The minimum freeboard for operation of the Divider Dike is 1.0 m.

2.5 Crest Width

The dike crest width will depend on:

- Roadway requirements;
- Constructability; and
- Requirement to operate the tailings pipeline on the crest of the dike.

Minimum rockfill crest width is set at 10.0 m. Crests may be widened by downstream placement and compaction of rockfill for use as haul roads.

Where dike crests are used as haul roads, the crest width should comply with Mine Health and Safety Regulations for Nunavut (NWT and Nunavut 1995), for minimum width of haul roads. For single lane traffic the minimum width is twice the width of the widest haulage vehicle used on the road; for double lane traffic the minimum width is three times the width of the widest haulage vehicle. A shoulder barrier of at least three-quarters the height of the largest tire on any vehicle using the road is required.

The design vehicle used as a basis for sizing the roads is a Caterpillar 777 with a width of 6.05 m, tire diameter of 2.5 m Caterpillar 27.00R49 tire.

Based on Mine Health and Safety Regulations (NWT and Nunavut 1995), the minimum width of roadway (excluding safety berms) is:

- 18.2 m surface for two way traffic, and
- 12.1 m surface for one way traffic.

An additional width for safety berms is required on haul roads. The minimum height of safety berms is 1.9 m.

2.6 Slope Stability

Canadian Dam Association Dam Safety Guidelines (CDA 2007) for static and seismic assessment of slope stability are included in Table 2.3 and Table 2.4 respectively.

TABLE 2.3: Factors of Safety for Slope Stability, Static Assessment (CDA 2007, Section 6.6, p. 70)

Loading Conditions	Minimum Factor-of-Safety	Slope
End of construction before reservoir filling	1.3	Downstream and Upstream
Long-term (steady-state seepage, normal reservoir level)	1.5	Downstream
Full or partial rapid drawdown	1.2 to 1.3	Upstream

TABLE 2.4: Factors of Safety for Slope Stability, Seismic Assessment (CDA 2007, Section 6.6, p. 70)

Loading Conditions	Minimum Factor-of-Safety
Pseudo-static	1.0
Post-earthquake	1.2-1.3

CDA (1999, Section 8.4, p.8-13) states that dams (dikes) on permafrost shall meet the same stability requirements as embankment dams and shall remain stable in spite of large foundation settlements.

2.7 Design Earthquake

Canadian Dam Safety Guidelines (CDA 2007) states that dams shall be designed to withstand an Earthquake Design Ground Motion (EDGM) without release of the reservoir. Selection of the EDGM is based on the consequence of failure of the dam. For a Dike falling in the High category the suggested design earthquake level is 1/2500 or annual probability exceedance (AEP) of one in two thousand five hundreds years (CDA 2007, Table 6.1, p.62).

2.8 Seepage and Drainage Control

CDA (2007, Section 6.6, p. 71) states:

"Seepage exit gradients should be within acceptable limits for the embankment and foundation materials. The usual techniques used to reduce seepage through the pervious units are impermeable upstream blankets, cut-off trenches, grout curtains, sheet pile walls, slurry trench cut-off walls, and other thin cut-offs. Strategically placed granular filter materials can also be used to provide an acceptable exit condition."

Criteria used for filter design included those in Fell et al. (2005) and the U.S. Army Corps (2004). In addition to using established empirical design criteria such as $d_{15filter}/d_{85soil} \leq 4$, laboratory evidence of filter performance is also considered for filter gradation design (Eldridge and Gilmer 2002).

Criteria for the impermeable element within the dike section include:

- A low value of hydraulic conductivity to limit seepage quantities;
- Constructability – must be able to efficiently construct in cold or freezing conditions to meet the construction schedule; and
- Must be able to function in a very cold environment without degradation.

Bedrock foundation grouting shall be applied where necessary to control seepage through fractured bedrock and to control piping of tailings and foundation soils into open fractures at the bedrock surface.

A seepage collection and management system is required to manage risks associated with potential release of tailings solids or supernatant.

3.0 SITE CLIMATE AND HYDROLOGICAL CONDITIONS

3.1 Introduction

The project site is located along the southern boundary of the Northern Arctic Ecozone in the District of Keewatin. The climate in the Northern Arctic Ecozone is dry and cold, and is described as a polar desert. The closest climate station to the Meadowbank site is at Baker Lake, at 64.3°N Latitude and 96.1°W Longitude, approximately 80 km to the south.

3.2 Climate Data

Meteorological data has been collected at Meadowbank since 1997. Longer term climate data are available from the regional climate station at Baker Lake. Tables 3.1 and 3.2 summarize the monthly climate data (AMEC 2003, 2005b).

TABLE 3.1: Summary of Monthly Climate Data

Month	Mean Monthly					
	Maximum[1] Air Temperature (°C)	Minimum[1] Air Temperature (°C)	Minimum Relative Humidity (%)	Maximum Relative Humidity (%)	Wind Speed (km/h)	Soil Temperature[1] (°C)
January	-29.1	-35.5	67.1	75.9	16.3	-25.5
February	-27.8	-35.2	66.6	76.5	16.0	-28.1
March	-22.3	-30.5	68.4	81.4	16.9	-24.9
April	-13.3	-22.5	71.3	90.1	17.3	-18.1
May	-3.1	-9.9	75.7	97.2	18.9	-8.0
June	7.6	0.0	62.6	97.2	16.4	2.0
July	16.8	7.2	47.5	94.3	15.1	10.5
August	13.3	6.4	59.2	97.7	18.4	9.3
September	5.7	0.9	70.8	98.6	19.3	3.6
October	-5.0	-10.6	83.1	97.4	21.4	-2.8
November	-14.8	-22.0	80.6	91.1	17.9	-11.7
December	-23.3	-29.9	73.3	82.7	17.7	-19.9

Note. Mean soil temperature is reported by AMEC to be measured at a depth between 0.2 m and 0.3 m below ground surface, but should be confirmed. Installation details such as slope aspect, surficial cover, site drainage and annual snow cover are not available.

[1] Sources: AMEC (2003 and 2005a).

TABLE 3.2: Estimated Average Monthly Temperature and Precipitation for Meadowbank Site

Month	Mean [1] Temperature (°C)	Average Precipitation (mm)			Lake Evaporation (mm)
		Rainfall [1]	Snowfall	Total	
January	-32.4	0	11.2	11.2	0
February	-31.7	0	10.5	10.5	0
March	-26.3	0.1	14.6	14.6	0
April	-17.7	2.3	16.7	19.0	0
May	-6.3	9.8	11.3	21.1	0
June	3.7	14.5	3.9	18.4	8.8
July	12.1	36.7	0.0	36.7	99.2
August	9.7	45.5	0.9	46.4	100.4
September	3.4	30.1	8.8	38.9	39.5
October	-7.4	3.5	30.3	33.8	0.1
November	-17.9	0	23.6	23.6	0
December	-25.8	0	15.0	15.0	0

Note. Monthly averages have been rounded. Mean temperatures and rainfall are based on site data (1997 to 2004). Snowfall is based on adjusted Baker Lake data (1946 to 2004) and reported as water equivalent. Adjusted small lake evaporation was estimated from pan evaporation data (2002 to 2004).
[1]Source: AMEC (2003, 2005a and 2005b).

The prevailing winds at Meadowbank (1997 to 2003 data) for both the winter and summer months are from the northwest. A maximum daily wind gust of 83 km/h was recorded on May 21, 2002. Estimates of wave heights on Third Portage Lake during one such event were reportedly on the order of 2 to 3 ft (0.6 m to 0.9 m) based on communication with site personnel during 2002.

Estimates of extreme annual rainfall, snowfall and total precipitation at the site are shown in Table 3.3.

TABLE 3.3: Estimates of Extreme Rainfall, Snowfall, and Total Precipitation at Meadowbank Camp

Return Period (Years)	Condition	Rainfall (mm)	Snowfall (cm)	Total Annual Precipitation (mm)
100	Wet	245	265	452
50	Wet	232	252	433
25	Wet	218	237	411
10	Wet	195	212	376
5	Wet	175	189	343
2	Average	139	145	285
5	Dry	108	104	233
10	Dry	93.6	84.4	208
25	Dry	79.2	64.6	183
50	Dry	70.4	52.4	168
100	Dry	62.9	41.8	155

Source: AMEC (2003 and 2005a)

The annual precipitation at the site generally falls as rain between June and September while snow falls generally between October and May. However, snowfall may occur at any time of the year. Table 3.4 presents a comparison of annual total precipitation data at Baker Lake and the Meadowbank site (AMEC 2003). Meadowbank total annual rainfall averaged 85% of the Baker Lake total over common periods of record.

TABLE 3.4: Comparison of Annual Total Precipitation (1998 to 2003)

Year	Baker Lake			Meadowbank Camp		
	Adjusted[1] Rainfall (mm)	Adjusted[1] Snowfall (mm)	Adjusted[1] Total Precipitation (mm)	Adjusted[1] Rainfall (mm)	Estimated Adjusted[1] Snowfall (mm)	Estimated Adjusted[1] Total Precipitation (mm)
1998	250.7	246.5	497.1	210.7	207.2	417.8
1999	251.4	189.1	440.6	243.3	183.0	426.3
2000	152.6	243.8	396.5	142.2	227.2	369.5
2001	158.1	173.9	332.1	117.4	129.2	246.6
2002	236.8	221.5	479.0	181.2	169.5	386.1
2003	147.4	138.9	300.8	120.8	113.9	246.3
Mean	199.5	202.3	407.7	169.3	171.7	348.8

[1]Rainfall, snowfall, and total precipitation values at Baker Lake and at the Meadowbank Camp have been adjusted for undercatch based on undercatch adjustment factors for Baker Lake, as reported by AMEC (2003).

3.2.1 Windspeed Data

There is a long-term Environment Canada meteorological site at Baker Lake, referred to as “Baker Lake A”. A mean hourly wind rose using the Baker Lake data from 1963 to 2002 was presented in the baseline hydrology report (AMEC 2003). This wind rose included year round data. Due to winter freeze-up and icing over of the lakes, it is appropriate to use summer winds only for prediction of wave data.

A mean hourly wind rose using data from May to October for 2002 was also presented in (AMEC 2003) and these data were adopted for the present report, assuming that they are representative of a typical open water season. These hourly data were downloaded from Environment Canada (2006). Based upon these data, average hourly wind speeds ranged from 10 to 50 knots (5.1 to 25.7 m/s). Winds from the south occurred about 4.4% of the time and from the southeast occurred about 11.4% of the time.

The Environment Canada climate normals for Baker Lake indicate that winds blow predominantly from the northwest about 10 months of the year. During June and July, winds blow predominantly from the east and north, respectively.

Maximum hourly windspeeds are available for the Baker Lake A station from the Environment Canada climate normals. Maximum summer winds have typically occurred from the west and the north and have ranged up to 121 km/hr (33.6 m/s). However, the highest hourly average windspeed on record occurred on February 19, 1959 and was from the southeast (124 km/hr or 34.4 m/s).

3.3 Permafrost

The Meadowbank Gold Project site is located within the zone of continuous permafrost. The land surface in the project area is underlain by continuous permafrost, while lakes that are deeper than about 2 m will be underlain by a talik, or zones of permanently unfrozen ground. Based on thermal studies carried out to date, the depth of permafrost is estimated to be on the order of 450 m to 550 m. The depth of the active layer ranges from about 1.3 m in areas with soils and up to about 4 m adjacent to lakes. The depth of permafrost and of the active layer will vary based on proximity to lakes, soils thickness, vegetation, climate conditions and slope direction.

Based on ground conductivity surveys and compilation of regional data, the ground ice content is expected to be low (0% to 10%). Ice lenses and ice wedges are locally present on land, as indicated by ground conductivity, and by permafrost features such as palsas. These areas of local ground ice are generally associated with low lying areas of poor drainage.

Lake ice thicknesses of between 1.5 m and 2.5 m have been encountered during geotechnical investigations in mid to late spring. It is possible that mid-winter ice thickness will be greater; however, no data relating to ice thickness currently exists for the mid-winter period.

Ground temperatures have been monitored at Baker Lake since 1997 as part of the Circumpolar Active Layer Monitoring (CALM) program. Table 3.5 presents ranges in the recorded mean annual ground temperature at an estimated depth of 2 m for the Baker Lake CALM station.

TABLE 3.5: Range in Mean Annual Ground Temperature – Baker Lake CALM Site (1998 to 2001)

Site Number	Latitude	Longitude	Elevation (m)	Location (km)	Mean Annual Ground Temperature (2 m depth) (°C)
C20	64º 19.6'N	96º 2.5'W	50	70 km South of Meadowbank	-6.6 to -8.4

The mean annual ground temperatures recorded at the station in Baker Lake are comparable to those estimated at the Meadowbank site (see below). Annual thaw depths at the CALM site are reported in Table 3.6.

TABLE 3.6: Annual Thaw Depth at the Baker Lake CALM Site

Thaw Depth in Centimetres (Baker Lake CALM Site)						
Station	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Baker Lake C20	120	170	174	189	193	207

Thermistors installed in coarse gravels and sands with a peat layer of 0 to 15 cm

Thermal studies at the Meadowbank site were initiated during the 1996 summer exploration drilling program with the installation of two thermistor cables in exploration boreholes drilled on the Third Portage Peninsula. These studies have continued with the installation of additional thermistor cables during field investigations in 1997, 1998, 2002, 2003 and 2006.

To date, twenty three thermistor cables have been installed to characterize and monitor the thermal conditions and permafrost at the project site. The thermistors have been located to characterize the thermal regime at the project site both inland (away from the influence of deep lakes) and adjacent to the lakes. The thermistors were monitored during periods of time that the camp was open. Generally, data were collected from March through to September.

Thermistor cables were installed at the north and south abutment areas of the Central Dike and Divider Dike with the purpose of characterizing ground thermal conditions. Table 3.7 summarizes thermistor locations and Table 3.8 summarizes the geothermal data near dike abutments. Plots of temperature profiles from selected thermistors for the TSF area are included in Appendix I.

TABLE 3.7: Summary of Thermistor Locations

Borehole	Ground Slope	Slope Aspect	Offset from Nearest Water Body	Drilling Direction (with respect to shoreline)	Comments
03GT-BZ-1	~1% to 2%	south facing	30 m	towards	Third Portage Peninsula
TP97-196	<1%	east facing	22 m	towards	Bay Zone Island
03GT-SPEC-F1	**5% to 8%**	**north facing**	**200 m**	**parallel**	**base of north facing slope, south of Divider Dike**
03GT-GI-7	~9%	east facing	27 m	towards	east shore of South Camp Island in lee of slope
03GT-GPIT-2	~1%	west facing	8 m	towards	west shore of Goose Island
03GT-Therm-1	~21%	south facing	500 m	vertical	crest of south facing slope 500 m from nearest small lake, and 1000 m from nearest large lake
GT01-NP-1	~23%	west to southwest facing	31 m	towards	west to southwest shore, south end of North Portage Deposit
GT01-NP-3	~12%	west facing	155 m	away	north end of North Portage Deposit
03GT-PS-2	<1%	west facing	330 m	vertical	thin felsenmeer and till; bedrock near surface
03GT-PS-3	<1%	-	460 m	vertical	thin felsenmeer and till; bedrock near surface

Borehole	Ground Slope	Slope Aspect	Offset from Nearest Water Body	Drilling Direction (with respect to shoreline)	Comments
02GT-03	~11%	south facing	25 m	towards	north abutment of East Dike, in lee of slope with heavy snow accumulation
02GT-04	~11%	northeast facing	33 m	towards	south abutment of East Dike.
03GT-TD-1	**~21%**	**west facing**	**30 m**	**towards**	**Central Dike north abutment**
03GT-TD-5A	**~1%**	**north facing**	**40 m**	**towards**	**Central Dike south abutment**
03GT-TF-1	<1%	-	250 m	vertical	thin felsenmeer and till; bedrock near surface
TP98-261	~5%	east facing	38 m	perpendicular	installed across Bay Fault, beneath water course between Third Portage and Mainland
TP96-154	~7%	west facing	150 m	away	Third Portage Deposit area
TP96-155	~7%	west facing	105 m	away	Third Portage Deposit area
GT02-VLT-2	~8%	east facing	48 m	towards	Vault Deposit drilled towards very small lake; small bowl shaped depression
GT03-VLT-4	<1%	east to southeast facing	110 m	towards	Vault Deposit drilled towards Vault Lake
02GT-09	**~7%**	**east facing**	**30 m**	**towards**	**Divider Dike south abutment on outcrop of quartzite, no soil**
02GT-10	**~9%**	**southwest facing**	**37 m**	**towards**	**Divider Dike north abutment**
06GT-TD2A	**N/A**	**lake bottom**	**0 m**	**vertical**	**vibrating wire piezometer located under Second Portage Lake at proposed Central Dike location**

Bold designates installations within or near the TSF.

TABLE 3.8: Summary of Data at Dike Thermistors

Borehole	Location	Vertical Depth of Installation (below ground surface) (m)	Depth of Zero Annual Amplitude (m)	Zero Amplitude Temp. (°C)	Vertical Depth of Active Layer (m)
03GT-BZ-1	Bay Zone	43.1	insufficient data	insufficient data	insufficient data
03GT-GI-7	Goose Island	42.9	Thermistor data unreliable		
02-GT03	East Dike, north abutment	22.9	20 - 30	-2.5	3.5
02-GT04	East Dike, south abutment	23.0	20 - 30	-6.5	1.3
02GT-09	**Divider Dike, south abutment**	**22.1**	**indeterminate**		**3.8**
02GT-10	**Divider Dike, north abutment**	**22.5**	**20 - 30**	**-5.5**	**3.0**
03GT-TD5A	**Central Dike, south abutment**	**42.5**	**insufficient data**	**insufficient data**	**2.8**
03GT-TD-1	**Central Dike, north abutment**	**44.2**	**insufficient data**	**insufficient data**	**1.3**
06GT-TD2A	**Central Dike, Second Portage Lake Bottom**	**95.0**	**n/a**	**n/a**	**n/a**

Bold designates installations within or near the TSF. N/A indicates the estimations of certain geothermal properties are Not Applicable due to the proximity of installation to lake body. Insufficient data indicates that insufficient data have been collected to estimate certain geothermal properties, and may indicate that equilibrium conditions have not been reached. Additional data should be collected at the next opportunity.

During packer testing of the permafrost/talik interface at borehole 02GT-09, the packer equipment became lodged and subsequently frozen within the borehole. The thermistor cable was folded back on itself and installed to the depth of the frozen equipment.

Vertical depth of 06GT-TD2A refers to depth below lake bottom.

A thermistor was installed to provide background data relating to the regional thermal regime. The thermistor corresponds to borehole 03GT-Therm-1 (Table 3.7) located 500 m north from Second Portage Lake (7216728.230 N, 639261.070 E, Elev 157.0 masl).

3.4 Projected Climate Change

The climate change considered in this report follows the worst case "high sensitivity" models described in the latest Intergovernmental Panel on Climate Change (IPCC 2007). These models predict an increase of 6.4°C to the maximum average air temperature (MAAT) by the year 2100 for a site located at 65°N latitude.

Table 3.9 presents a summary of reported climate change predictions used on a number of northern projects which have been reported in the engineering and scientific literature.

TABLE 3.9: Summary of Reported Climate Change Rates Used in Northern Projects Engineering Studies

Reference	Increase in MAAT by Year 2100 (°C)	Notes
IPCC(2007)	6.4	For site at 65° North Latitude
Hayley (2004)	4.7	Used in design studies for the Inuvik Regional Health Center. Reported as increase of 0.47°C per decade.
Hayley and Cathro (1996)	5.0	Used for Raglan Dam analyses.
Burn (2003)	6.0	For use in the Western Arctic for pipeline design projects. Reported as increase of 1.75°C over a 29 year period

3.5 Hydrological Conditions

Maximum and minimum expected lake water elevations are shown in Table 3.10.

TABLE 3.10: Lake Elevation Variations

Return Period	Maximum Water Level (masl)		
	Third Portage Lake	Second Portage Lake	Difference (m)
100 yr wet	134.19	133.39	0.80
10 yr wet	134.14	133.28	0.86
average	134.09	133.17	0.92
10 yr dry	134.03	133.08	0.95
100 yr dry	133.99	132.98	1.01

Source: AMEC 2005a p. 7 and p.11

Lake water elevations in the northwest arm of Second Portage Lake were higher than normal in October 2008 (see Appendix III for 2008 bathymetry survey results), likely due to dewatering dike construction.

4.0 GEOLOGICAL AND GEOTECHNICAL CONDITIONS

4.1 Topography and Bathymetry

The general site area consists of low, rolling hills with numerous small lakes. The topography in the immediate vicinity of the main deposits (Third Portage, North Portage, and Goose Island Deposits) is of generally low relief with a range in elevation of about 70 m. Elevations vary from about 133 masl along the Second Portage Lake shoreline and 134 masl along the Third Portage Lake shoreline to maximum elevations of approximately 200 masl to the northwest of the Portage area deposits.

Bathymetric surveys were conducted by Golder in 2002, 2003, 2006 and 2008 for lake areas adjacent to and over the main deposits at Meadowbank. The lake bottom has a similar topography to the adjacent land. Water depths reach a maximum of 38 m in Second Portage Lake.

Detailed bathymetry surveys of proposed footprint areas for the Central Dike and Divider Dike were conducted in September and October 2008 (described in Appendix III). Results of the survey are incorporated in the Drawings in Appendix VIII.

4.2 Quaternary Geology

The project area is covered by laterally extensive deposits of glacial till. Glaciofluvial sand and gravel deposits reportedly occur on the north shore of Second Portage Lake. Crysolic soils dominate on land and lakebed sediment overlies till in the lakes.

Surface materials are predominantly sandy silty tills that are overlain in local areas by concentration of boulders and cobbles. Minor and local areas with patterned ground are identified.

4.3 Bedrock Geology

Regional geology is illustrated in Figure 4.1. The Meadowbank Project site is underlain by a sequence of Archaean greenstone (ultramafic and mafic flow sequences) and metasedimentary rocks that have undergone polyphase deformation resulting in the superposition of at least two major structural events. Enclosed within the greenstone are volcaniclastic sediments, felsic-to-intermediate flows and tuffs, sediments (greywackes) and oxide iron formations. The sequence also contains sericite schists, which are believed to be altered felsic flows or dikes. The ultramafic rocks are variably altered, containing serpentinite, chlorite, actinolite and talc. The ore in the Portage deposit is hosted in iron formation rocks.

There are four main rock types including iron formation (IF), intermediate volcanic (IV), ultramafic volcanic (UM) (serpentinized and non-serpentinized) and quartzite (QTZ).

4.4 Geotechnical Conditions

Available geotechnical data for the Meadowbank site are summarized here. Borehole locations are shown in Drawings in Appendix VIII.

4.4.1 Lakebed Sediments

Thickness of lakebed sediments has not been characterized.

Three lakebed sediment samples from the Meadowbank site were provided to Golder's Geotechnical Laboratory in Burnaby, BC from ALS Laboratories. Composite samples were tested for grain size, water content, organic content and specific gravity.

Organic contents varied from 6.7%, 6.8% and 16.5%. Water contents for disturbed samples were 306%, 490% and 667%. Liquid Limit of the sediments was 109% and Plasticity Index was 5.7%.

The Specific Gravity of sediments was 1.69 with organics present and 2.52 without.

Grain size analysis test results are presented in Figure 4.2 and indicate that the lakebed sediments are primarily silt and clay sized particles. Laboratory data sheets for the 2006-2007 testing are included in Appendix I.

Lakebed Sediments: Strength

Seabed Terminal Impact Newton Gradiometer (STING) tests results for dynamic bearing strength profile of lake sediments corresponding to the East Dike location are presented in Table 4.1. A 1 m long steel shaft and foot instrumented for vertical acceleration and water pressure measurements are dropped onto the lakebed. Results indicate a limited thickness of soft sediments underlain by a harder material – typically inferred to be a rocky till or bedrock.

TABLE 4.1: STING Penetrometer Testing Results (Golder 2007b)

Lake	Easting	Northing	Soil Thickness (m)	Dynamic Bearing Strength (kPa)
Second Portage	639416	7213795	0.2	<20
Second Portage	639345	7213916	0.1	20-50
Second Portage	638708	7214795	0.2	increasing with depth to 300 kPa
Third Portage	638312	7212033	0.25	Penetration depths of 0.25 m at 300 kPa
Third Portage	638641	7213032	0.15	20 - 200
Third Portage	638799	7212833	0.23	20 - 100

4.4.2 Glacial Deposits

Observations and thicknesses of on-land and lakebed soils overlying bedrock are summarized in Tables I-1 and I-2 in Appendix I. Thickness of soils in boreholes on land varied from 0 to 5.1 m with an average of 2 m where present. Drilling observations for lakebed soils indicate thickness of 0 to 18.1 m with an average of 3.8 m. Historic drilling observations are summarized in Tables I-1, I-2 and I-3 in Appendix I and select borehole logs are included in Appendix II. Additional information from investigations of the till on Third Portage Peninsula in 2007 is reported in Golder (2008a).

Till Gradation

Typical gradations of till are shown in Figure 4.3. Laboratory test results are included in Appendix I.

Values of Specific Gravity for till samples were between 2.63 and 2.70.

Moisture Density relation testing conducted of samples of till from the Meadowbank site are presented in Table 4.2.

TABLE 4.2: Moisture – Density Test Results from Second Portage Trench Area

Sample	Optimum Moisture Content* (%)	Maximum Dry Density ρ_{dry} (kg/m^3)	Corrected for Oversize Particles	
			Optimum Moisture Content (%)	Maximum Dry Density ρ_{dry} (kg/m^3)
1	6.4	2217	5.4	2309
2	7.5	2123	6.4	2211
3, 6 & 7 Combined	7.1	2142	5.6	2272
4	9.3	2085	7.4	2212
5	7.6	2095	7.1	2139
8	5.5	2211	4.7	2295
9 & 10	7.7	2101	7.5	2118
11	8.5	2062	7.9	2109
12	7.9	2119	6.5	2232
Meadowbank Airstrip	13.2	1856	11.3	1948
Average	8.1	2101	7.0	2185

*Standard Proctor

Till moisture content and Plasticity Indices are presented in Table 4.3.

TABLE 4.3: Till Moisture Content and Plasticity Indices

Borehole	Sample	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Reference
02GT-07	3	10.5	17	11	6	Golder 2002b
	5	13.1	16	13	3	
	6	11.1	17	13	4	
Third Portage Peninsula Trenches	Till Spoil 1	4.4	15	15	Non-plastic	Golder 2006 Lab Testing–Appendix I
	Till Spoil 2	5.7			Non-plastic	
	Till Spoil 3	5.9	17	16	1	
	Till. Grassland 4	14.8	19	18	1	
	Till Spoil 5	5.3	16	16	Non-plastic	
	Till Spoil 6 & 7	5.0			Non-plastic	
	Till Spoil 8	4.2			Non-plastic	
	Till Spoil 9-10	7.0			Non-plastic	
	Till Spoil 11	10.9	18	17	1	
	Till Spoil 12	8.2	19	18	2	
Third Portage Peninsula	TP01 SA2	5.8			Non-plastic	Golder 2008a
	TP02 SA5	8.7			Non-plastic	
	TP03 SA6	9.4	31	27	4	
	TP03 SA7	14.8	22	22	Non-plastic	
	TP06 SA16	7.1	18	14	4	
	TP10 SA24	12.1	20	15	5	
	TP12 SA27	9.51			Non-plastic	
	TP14 SA29	9.6	22	18	4	
	TP14 SA30	5.8	19	16	3	
	TP15 SA32	26.6	38	28	10	
	TP16 SA34	5.7	17	15	2	
	TP19 SA39	7.3			Non-plastic	
Average		9.1	20	17	3.2*	

* calculated for plastic results

Till Strength

The available in-situ till strength information corresponds to boreholes 02GT-07 and 02GT-08 at the location of the Divider Dike alignment (Drawings in Appendix VIII). Samples from the Third Portage Peninsula area were also tested in laboratory studies (Appendix I, Golder 2008a).

A 5.9 m thick deposit of soil with the upper 2.9 m comprising silt, sand and clay was present in Borehole 02GT-07. A 4.2 m thick deposit of soil with upper 1.6 m comprising clay, silt, sand and gravel was present in Borehole 02GT-08. Standard penetration test results are presented Table 4.4 (Golder 2002b).

TABLE 4.4: Standard Penetration Test Results from Boreholes 02GT-07 and 02GT-08

Sample	Depth Below Ice Surface		Blow Count, N (blows/0.3 m)
	From (m)	To (m)	
02GT-07			
Sa#1	3.60	4.05	15
Sa#2	4.05	4.50	11
Sa#3	4.50	4.95	11
Sa#4	4.95	5.40	35
Sa#5	5.40	5.85	15
Sa#6	5.85	6.30	14
02GT-08			
Sa#1	4.10	4.55	56 (Refusal)
Sa#2	5.25	5.70	94 (Refusal)
Sa#3	6.50	7.10	Shelby Tube Attempted – no recovery
Sa#4	7.10	7.55	29

Laboratory strength testing parameters are shown in Table 4.5.

TABLE 4.5: Strength Test Results for Till

Borehole	Sample	Friction Angle (degrees)	Cohesion (kPa)	Test Type	Reference
02GT-07	3,5,6	32	22	Consolidated Drained Direct Shear	Golder (2002b)
Third Portage Trench	59644 59645 59646	37	17	Consolidated Drained Direct Shear	Golder (2002b)
Third Portage Trench	3,6,7	33	0	Consolidated Undrained Triaxial Test	Appendix I
TP02	5	38	20	Consolidated Drained Triaxial Test	Golder 2008a (Loose)
TP02	5	38	30	Consolidated Drained Triaxial Test	Golder 2008a (Dense)
TP02	5	39	3	Undrained Triaxial Test	Golder 2008a (Loose)
TP02	5	40	10	Undrained Triaxial Test	Golder 2008a (Dense)

Values of Young's modulus of till material derived from Triaxial and Bender Element tests are summarized in Table 4.6.

TABLE 4.6: Summary Young's Modulus from Triaxial and Bender Element Tests

Test	Till Density	Confining Pressure (kPa)	Young's Modulus Loading (MPa)	Young's Modulus Unloading (MPa)
Triaxial	Loose	70	5	21
		149	12	49
		496	36	
	Dense	68	23	119
		146	51	245
		495	84	348
Bender Element*	Loose (Loading)	34.5	137	
		60	159	
		120	254	
		240	489	
		580	831	
		750	1071	
	Dense (Unloading)	580		986
		240		616
		120		406
		60		226

*Bender Element gives small strain modulus.

Till Hydraulic Conductivity and Consolidation Response

Till hydraulic conductivity testing included:

- Borehole 02GT-03 interval El. 132 to 133 masl in bouldery till with k = $3x10^{-6}$ m/s;
- Borehole 02GT-07 interval El. 126 to 127 masl with k = $1x10^{-7}$ m/s; and
- Results of laboratory consolidation testing of till samples from the Third Portage Peninsula trench area are summarized in Figure 4.4. Samples from 2006 were scalped of larger sizes to allow laboratory testing. Samples from 2007 were prepared by scalp and replace method. Hydraulic conductivity values derived from progress of consolidation varied from approximately 5 x 10^{-7} m/s to 2 x 10^{-10} m/s from 0 to 660 kPa. Values of hydraulic conductivity from constant head tests conducted following stages of consolidation included:

- $k = 7x10^{-10}$ m/s, (TP10 SA24 at 80 kPa confining stress, 2007); and

- $k = 5x10^{-11}$ m/s, (TP12 SA27 at 660 kPa confining stress, 2007).

Values of coefficient of consolidation varied from approximately 1.4×10^{-2} cm^2/s to 5.5×10^{-2} cm^2/s.

Results of 2006 and 2007 laboratory testing are included in Appendix I and in Golder (2008a).

Ice Rich Soils

Observations during fuel tank farm construction in 2006 indicated that near surface soils on land flowed when thawed. The behaviour indicates near surface water contents that are wet of the liquid limit at this specific location. However, the till delineation program carried out on Third Portage Peninsula during the summer of 2007 encountered no frozen material and till water contents were below the Liquid Limit.

4.4.3 Bedrock

There is a considerable amount of information available for the rock mass at Meadowbank from boreholes drilled at the site. Select borehole locations are shown on Drawings in Appendix VIII. Limited information is available for near surface rock along the TSF dike alignments. Bedrock elevations are summarized in Table I-3 in Appendix I.

The rock mass is generally of good quality. Rock Quality Designation (RQD), tunnelling parameter Q' and Rock Mass Rating (RMR) are presented for each rock type in Table 4.7 with unconfined compressive strength (UCS) testing results. Discontinuity properties are summarized in Table 4.8.

TABLE 4.7: Summary of Rock Properties

Rock Type	Pit	RQD		UCS (MPa) (Lab Testing)	Q'		RMR (from Q')		mi
		Mean	Median		Mean	Median	Mean	Median	
IF	Goose	97/95*	98/100*	137 to 248	17/32*	21/44*	69/75*	71/78*	20
	Portage South	92	97	(avg. 175)	14	17	68	69	
	Portage North	93	96		16	16	69	69	
	Vault	89	91		16	14	69	68	
IV	Goose	97/93*	99/100*	51 to 148	18/36*	20/38*	70/76*	71/77	18
	Portage South	92	97	(avg. 94)	11	12	66	66	
	Portage North	86/92**	91/97**		10/18**	11/12**	65/70**	66/66**	
	Vault	91	98		11	11	66	66	
UMV	Goose	86/81*	92/87*	40 to 92	8/14*	11/16*	63/68*	66/69*	10
	Portage South	85	92	(avg. 66)	9	14	64	68	
	Portage North	64	73	Serpentinized avg. 32	4	5	56	58	
	Vault	-	-		-	-	-	-	
QTZ	Goose	-	-	70 to 140	-	-	-	-	20
	Portage South	84	89	(avg. 107)	14	14	68	68	
	Portage North	-	-		-	-	-	-	
	Vault	-	-		-	-	-	-	

*Based on Data Collected by Cumberland/ Golder 2003d **IV/IVCL / IV/IVCS, RQD = Rock Quality Designation, UCS = Unconfined Compressive Strength, Q' = modified NGI tunnelling parameter, RMR = Rock Mass Rating, mi = a material constant for intact rocks

TABLE 4.8: Summary of Main Rock Discontinuity Properties

Designation	Portage & Goose Island Deposits			Vault Deposit		
	Dip (º)	Dip Direction (º)	Average Spacing (m)	Dip (º)	Dip Direction (º)	Average Spacing (m)
Foliation	12-72	255-300	0.5 -1.5	21-23	136-164	0.5-0.8
Orthogonal	76-10	067-121	1.4-12	60-70	333-336	2.8-8.1
CJ1	43-79	201-237	2.5-11.4	83-85	197-209	1.7-7.4
CJ2	36-81	025-068	2.5-8.3	80-82	040-053	
CJ3	65-86	125-148	1.2-9.5	-	-	-
CJ4	58 -73	299-340	1.0-7.0	-	-	-
East-dipping	-	-	-	67-81	086-108	3.7-6.1
South-dipping	-	-	-	45-48	174-198	3.7-6.1
Cross	46-63	002-031	0.4-19.4	73	253	4.4
Cross	62-88	341-350		-	-	-
Cross	26-62	170-191		-	-	-
Flat	-	-	-	10-13	330-335	8.3

The 2007 till delineation program provided information on the bedrock surface condition beneath the till on Third Portage Peninsula. The exposed rock was generally IF with limited weathering, small steps and undulations.

Bedrock – Hydraulic Conductivity

A summary of bedrock hydraulic conductivity test data is shown in Table I-5. Figure 4.5 plots hydraulic data versus elevation. Tests along the Central Dike alignment are plotted in Drawings in Appendix VIII and indicate values of hydraulic conductivity on the order of 10^{-5} to 10^{-6} m/s in the rock below the dike to a depth of about 20 m and to greater depths near the Second Portage Fault.

Second Portage Fault

The Second Portage Fault is located just north of the Third Portage Peninsula area and trends northwest, parallel to the northwest arm of Second Portage Lake, as shown in Figure 4.1. The Second Portage Fault passes below the alignment of the Central Dike, but is not known to intersect the Divider Dike. Borehole 06GT-TD1 was drilled across the fault. Hydraulic conductivity test results from 06GT-TD-1 ranged from $3x10^{-9}$ m/s to more than $3x10^{-5}$ m/s.

The Second Portage Fault is interpreted as a discrete, narrow focused brittle-ductile fault. The potential for fault reactivation is considered to be very low. The project area is in a zone of low seismic activity, Seismic Zone '0 '. The Second Portage Fault is on the order of 1.7 to 1.9 billion years in age (Pehrsson 2001; Rainbird et al. 2005). Pehrsson et al. (2005) reports that the structures in the deposit area have not been demonstrably reactivated by orogenic events in the area. McMartin and Dredge (2005) report that these structures do not localize post-glacial rebound. The potential for fault reactivation is low due to the type, or character, of the faults, the absence of evidence for reactivation despite known tectonism and the low seismic activity of the area. Consequently, there is a very low risk for potential damage to the Central Dike associated with reactivation of the Second Portage Fault.

4.5 Tailings

Laboratory test data for tailings include Specific Gravity and particle size from hydrometer analyses for Third Portage and Vault deposit tailings and also thermal conductivity testing.

Values of Specific Gravity included 3.34 for Third Portage tailings and 2.85 for Vault tailings and 2.97 for a composite sample of all ore types.

Thermal conductivity of tailings was 1.98 W/m^{o}C at 16^{o}C and 3.2 W/m^{o}C at -18.0^{o}C and 77.5% saturation.

Laboratory test data sheets are included Appendix I.

4.6 Ground Water - Hydrogeology

In areas of continuous permafrost there are two groundwater flow regimes: a shallow groundwater regime located in the active layer near the ground surface and a deep groundwater regime beneath the permafrost.

4.6.1 Shallow Groundwater Flow Regime

From late spring to late summer the active layer thaws, creating the shallow groundwater regime. Within the active layer the water table is expected to follow the topography. Locally, groundwater in the active layer flows directly to Second and Third Portage Lakes or flows to local depressions and ponds that drain or flow directly to Second and Third Portage Lakes.

Permafrost reduces the hydraulic conductivity of the rock by at least one or two orders of magnitude (Anderson and Morgenstern 1973; Burt and Williams 1976). Consequently, hydraulic conductivity in permafrost will be very low compared to unfrozen rock at the Meadowbank site. The shallow groundwater flow regime therefore has negligible hydraulic connection with the groundwater regime located below the deep permafrost except where taliks exist beneath large waterbodies.

4.6.2 Deep Groundwater Flow Regime

In areas of continuous permafrost the deep groundwater regime is connected to surface by taliks located beneath large lakes. Taliks exist beneath lakes that do not freeze to the bottom in winter. If a lake is large enough, the talik extends down to the deep groundwater regime. At Meadowbank, analyses have predicted that open taliks extending to the deep groundwater regime will occur beneath lakes that do not freeze completely when the diameter is roughly 570 m or greater for round lakes or the width is at least 320 m for elongated lakes. Based on these analyses, open taliks exist beneath Third and Second Portage lakes, including Second Portage Northwest Arm.

The water elevation of lakes with open taliks provides the hydraulic head required to drive deep groundwater flow. The presence of the thick, low permeability permafrost beneath land located between large lakes results in negligible recharge to the deep groundwater flow from these areas. Smaller lakes have isolated, or closed, taliks that do not extend down to the deep groundwater regime and thus do not influence the groundwater flow in the deep regime. Consequently, recharge to the deep groundwater flow regime is limited to the open taliks beneath large lakes. Generally, groundwater will flow from higher elevation lakes to lakes located at lower elevations.

4.7 Seismicity

The Meadowbank Gold Project is located in an area of low seismicity.

Peak horizontal ground accelerations for the Meadowbank site are summarized in Table 4.9.

TABLE 4.9: Peak Ground Acceleration for the Meadowbank Site

Return Period of Seismic Event (years)	Peak Ground Acceleration (g)
100	0.007
475	0.021
1,000	0.035
2,475	0.06[D]

Source: National Building Code of Canada (2005), Appendix IV.
[D] Design event

5.0 DIKE DESIGN

The ultimate crest elevation of 150 masl for the TSF dikes has been selected to store the life of mine (LOM) reserve estimate of 29.3 Mt tailings production.

The design of the dikes allows the raising sequence to be changed to accommodate changes in the mine plan without affecting the performance of the structure. Alignments have been selected to allow raises above 150 masl by downstream construction.

5.1 Central Dike

5.1.1 Design Concept

The purpose of the Central Dike is to retain the tailings and limit seepage towards the Portage Pit. The Central Dike is a High consequence of failure structure due to potential for environmental damage and economic loss.

The Central Dike design presented here includes three stages with 135, 145, and 150 masl crest elevations to satisfy criteria to store a minimum of 2 years of tailings production between raises. However, the design allows flexibility to adjust staging schedule and crest elevation.

The Central Dike section includes a compacted rockfill embankment with upstream impermeable element, granular filters and cut-off (shown in Drawings in Appendix VIII). The Central Dike crest will be used to support the tailings pipeline and spigots and can be widened for use as a haul road.

Foundation soils include lakebed sediments and till overlying bedrock. Soft and ice rich soils will be removed from the Central Dike footprint after lake dewatering. The bulk of the Central Dike will be constructed of run-of-mine rockfill that will be placed and compacted in lifts on the till overlying bedrock. Compaction of rockfill is required to limit settlement of the crest and liner. Rockfill embankment side slopes for the Central Dike are 3 horizontal (H): 1 vertical (V) for the upstream face and 1.5 H: 1 V for the downstream face. The 3H: 1V upstream face has been selected to facilitate liner installation.

Zones of permeable granular materials may exist within the foundation till as layers or as channels. High permeability materials that can transmit large flows can have dimensions that are too small to detect with conventional drilling methods. An engineered cut-off is therefore required to limit flow through foundation soils. A trench is excavated along the upstream toe of the rockfill through foundation soils to bedrock and an impermeable liner is installed.

The bedrock surface in the trench excavation is cleaned, mapped and a low strength concrete slab poured. The concrete slab provides a non-erodible smooth surface to allow mating of the liner to an uneven bedrock surface and facilitates consolidation grouting of the near surface bedrock. A bituminous geomembrane (BGM) liner is anchored to the concrete slab in the base of the trench and extended up the face of the trench and dike. Bituminous geomembranes have been successfully installed on mine sites in northern Canada at temperatures down to about -25^{o}C. (Breul et al. 2006).

The near surface bedrock may be highly fractured and fine grained materials including tailings or till may be lost into fractures in the bedrock under high hydraulic gradients. The near surface bedrock is grouted to a nominal depth of 25 m and to greater depths in the Second Portage Fault. Grouting is completed through the concrete slab in the base of the trench excavation.

A two zone granular filter that can prevent movement of tailings through the rockfill will be placed between the liner and the rockfill. Filters on the upstream rockfill act as a bedding for the liner and are therefore compacted. Filters are also placed below the rockfill near the upstream toe to prevent movement of foundation till into the rockfill.

A liner cover is placed over the liner and additional material is placed on the cover to prevent damage by ice loading/ponded water against the face of the dike, to prevent scour due to tailings deposition and to prevent uplift of the liner by water accumulating within the rockfill in areas where the foundation below the rockfill slopes down towards the liner.

A seepage collection system is required between the Central Dike and the Portage Pit to collect and manage seepage through the dike and foundation during mine operations.

At the end of mine life the Portage Pit is allowed to fill with water to the same head as Third Portage Lake, resulting in a water head of 134.1 masl against the downstream face (pit side) of the Central Dike. The tailings profile is ultimately expected to freeze through into the foundation.

5.1.2 Construction Materials

Rockfill

The Central Dike rockfill will be constructed of non potentially acid producing (NPAG) IV rock. Use of UM rockfill below the waterline is avoided due to susceptibility to leaching of arsenic.

Filters

Filters are composed of non-potentially acid generating (NPAG) intermediate volcanic (IV) rock. The filter has two zones designated as Coarse Filter and Fine Filter, which are designed to prevent movement of tailings and/or till into the rockfill.

Gradations of dike filter materials were designed on the basis of available grain size data, which are presented in Figure V-1 in Appendix V. Figure V-1 includes rockfill gradations predicted from blasting design (Golder 2004a) representing the coarsest expected gradations for UM and IV rock types, hydrometer test data for tailings generated from Portage and Vault deposits in 2004 and gradation limits for samples of till from across the site.

Coarse Filter

The Coarse Filter is designed to prevent movement of Fine Filter material into the rockfill. The Coarse Filter was designed based on criteria in Fell et al. (2005) and on gradations of materials produced during East Dike construction in 2008 by running quarried IV rock through a primary crusher. Gradation limits for the Coarse Filter are presented in Figure V-1 in Appendix V and listed in both Table 5.1 and in the Specifications in Appendix VII.

TABLE 5.1: Recommended Coarse Filter Gradation for TSF Dikes

Size (mm)	%Passing	%Passing
200		100
152		86
76	100	50
25	50	18
13	32	5
4.8	18	0
2.0	10	

Fine Filter

The Fine Filter gradation is designed to prevent tailings and/or till from moving into the Coarse Filter. Gradation limits for the Fine Filter are presented in Figure V-1 in Appendix V and listed in both Table 5.2 and in the Specifications in Appendix VII.

TABLE 5.2: Recommended Fine Filter Gradation for TSF Dikes

Size (mm)	%Passing	%Passing
76		100
25	100	68
13	75	56
4.8	55	40
2.0	43	30
0.43	23	10
0.075	8	5

The Fine Filter gradation is based on the typical gradation of the Zone 2B material in concrete faced rockfill dams. Laboratory testing of this gradation has demonstrated it to be internally stable under high gradients and able to retain materials with 100% passing the No. 200 sieve (Eldridge and Gilmer 2002), making it suitable for use in the TSF dikes. Crushing, screening and washing will likely be required to produce the Fine Filter.

Liner

The liner is a bituminous geomembrane (BGM) such as Coletanche ES3 or equivalent, which allows placement in cold weather conditions and the use of coarser gradation materials for liner bedding and liner cover (relative to lighter plastic geomembranes).

Liner Cover

The liner is covered to protect against surface traffic, erosion from tailings deposition and ice action for water ponded against the dike. The liner cover is a crushed granular material that may be placed in cold conditions at low moisture content. Light compaction by vehicle traffic reduces consolidation related drag on the liner face. As an alternative to a granular liner cover, till may be placed directly against the liner if the till is processed to remove oversize materials (moisture conditioning is not required). Till placed directly against the liner should not contain frozen material or angular lumps.

Additional material is placed over the liner cover at selected locations to provide protection against the dam face and to prevent uplift by water ponded in the rockfill, if required. The material placed over the liner cover can be till obtained from pit stripping activities or the cut-off trench excavation, or may be PAG or NPAG rockfill, or tailings.

5.1.3 Stability Analysis

Analyses were conducted to determine the stability of the Central Dike during construction, mine operation and post closure conditions prior to freezing. Upstream and downstream failure modes were examined under static and pseudostatic earthquake loading conditions.

All factors of safety (FoS) are above design criteria. Design of temporary open trench excavations based on results of future investigations is required.

Methodology and Assumptions

Stability analyses were performed using the GeoSlope SLOPE/W, Version 6.22 computer program for general solution of slope stability by two dimensional limit equilibrium methods.

Compacted rockfill produces a free draining, internally stable structure. Cooke (1993) states:

> "Considering experience, testing and judgement, a value of 45^{o} may be assumed for compacted rockfill of sound rock. The shear strength decreases with increased confining pressure, as determined in triaxial testing. For stability analysis this can be taken into account. However, since no rockfill is known to have experienced a structural failure, an analysis on an assumed failure plane is academic. For the CFRD, analyses are not needed. The upstream slope may be 1.3 Horizontal: 1 Vertical since upstream failure is not possible. For the downstream shell, which receives only small water loading, the slope could be 1.3 Horizontal: 1 Vertical, but 1.4 Horizontal: 1 Vertical is used on high dams to take into account the reduced strength under confining pressures." Cooke continues "Seismic loading results in crest zone deformation, settlement and ravelling, and not in a slope stability failure. For extreme seismic loading a wider crest and greater freeboard is a more effective response than flatter slopes."

Slope stability analyses for the Central Dike have therefore been focussed on potential slip surfaces that involve the foundation materials rather than shallow slip surfaces that are contained completely within the compacted rockfill.

Sections for slope stability analysis are shown in Figures V-2 to V-8 in Appendix V and listed in Table 5.3. Analysis sections for design models are based on sections with steep upstream foundation slopes (approximate chainage 3+275), maximum dike height (also chainage 3+275) and steep downstream foundation slope (approximate chainage 2+950).

TABLE 5.3: Sections for Slope Stability Analysis – Central Dike

Phase	Crest Elevation (masl)	Rockfill Width at Crest (m)	Height of Rockfill (m)
Construction	135	10	27
Stage 1	135	10	27
Stage 2	145	10	37
Stage 3	150	10	42
Stage 3 with steep downstream foundation slope	150	10	21
Closure	150	-	42
Closure with steep downstream foundation slope	150	-	21

Station 3+275 represents highest dike section with steep foundation (sloping down in upstream direction), Station 2+950 represents steep downstream foundation slope (sloping down in downstream direction).

Other model geometry parameters are listed in Table 5.4

TABLE 5.4: Stability Analysis Model Geometry – Central Dike

Parameter	Value
Embankment upstream slope	3 Horizontal: 1 Vertical
Embankment downstream slope	1.5 Horizontal: 1 Vertical
Slope of pit wall	1:1
Minimum setback from pit crest to dike toe	60 m
Final lake elevation	134.1 masl

The maximum height section on steepest upstream foundation (Station 3+275) was modeled with boundary conditions of:

- end of construction case with no tailings for Stage 1 and also with tailings at 2 m below dike crest for each stage of operation;

- water table at lakebed surface and also with water ponded within the rockfill to the elevation of the downstream toe; and

- no lake and lake present for closure.

The steepest downstream foundation slope (Station 2+950) was modelled for Stage 3 operations with an upstream boundary condition of tailings at 148 masl and water table at ground surface and for closure with 2 m rockfill cover over tailings and a downstream lake with water to elevation 134.1 masl.

Material Properties

The material properties assumed for stability analysis are listed in Table 5.5.

TABLE 5.5: Material Properties for Slope Stability Analysis

Material	Bulk Unit Weight (kN/m^3)	Effective Stress Parameters		Undrained Strength Su (kPa)	Reference
		Cohesion, c (kPa)	Angle of Internal Friction (^{o})		
Compacted Rockfill, Filter Saturated	22.2	0	45	Not Applicable	Cooke 1993
Compacted Rockfill, Filter Unsaturated	19.8	0	45	Not Applicable	Cooke 1993
Till	21.4	0	32	varied	Table 4.5
Tailings*	18.0	0	0-30	Not Applicable	Assume range of strength values
Bituminous Geomembrane liner	11.9		35		Soprema (2007) states 40^o
Bedrock	n/a	n/a	n/a	n/a	Assumed impenetrable

*Materials were modeled as unfrozen with respect to strength parameters. The unit weight of tailings assumes an ice content, but is not reflected in strength parameters.

For pseudostatic conditions a coefficient of horizontal acceleration of 0.04 g (equal to two thirds peak ground acceleration corresponding to a predicted 1 in 2,500 year event) was applied (US Corps of Engineers 1984).

Results

Results of stability analyses are summarized in Table 5.6 and illustrated in Figures V-2- to V-8 in Appendix V.

All FoS are above design criteria. FoS design criteria are listed in Tables 2.3 and 2.4.

TABLE 5.6: Stability Analysis Results Summary – Central Dike

Phase	Crest Elevation (masl)	FoS for Drained Conditions static (pseudostatic)	
		Upstream Failure Mode	Downstream Failure Mode
Stage 1 Construction	135	2.1 (1.8)	2.1 (1.9)
Stage 1 Operation	135	>5	2.1 (1.9)
Stage 2 Operation	145	>5	2.0 (1.8)
Stage 3 Operation	150	>5	2.0 (1.8)
Post Closure	150	>5	1.9 (1.5)
Stage 3 Operation on steep downstream foundation slope	150	>5	1.7 (1.5)
Post Closure on steep downstream foundation slope	150	>5	1.7 (1.5)

Station 3+275 represents highest dike section with steep foundation (sloping down in upstream direction), Station 2+950 represents steep downstream foundation slope (sloping down in downstream direction).

Tailings against the upstream slope of the dam stabilize the dike against upstream failure modes.

Stability of the trench excavation at the upstream toe of the Central Dike during construction has not been analysed. Further design of the excavation may be required, depending on thickness of soil and groundwater conditions.

5.1.4 Seepage Analysis

The Central Dike was modelled to predict rates of seepage for use in sizing seepage collection systems. Hydraulic gradients were also examined to determine the need for internal erosion control measures.

Predicted seepage rates for the Central Dike are presented in Table 5.7.

TABLE 5.7: Summary of Predicted Seepage Rates - Central Dike

Stage	Tailings Beach Length (m)	Tailings Elevation at Dike (masl)	Calculated Seepage Rate		
			Liner[b] (m^3/day)	Foundation (m^3/day)	Total (m^3/day)
1	0	133	0.02	600	600
2[a]	250	143	0.06	550	550
3[a]	500	148	0.07	425	440[c]

[a]Pit development is predicted to lower the water table near the pit. The effect may prevent collection of seepage at the downstream dike toe during later phases of pit development. [b]Seepage through the bituminous geomembrane liner was estimated as a constant rate of 100 L/ha/day based on average rates reported for liners in landfill applications (Bonaparte et al. 2002). [c]Total seepage for Stage 3 includes seepage reporting from Saddle Dam 5.

Methods

Seepage modeling was completed using a 2D finite element numerical code, SEEP/W Version 6.22 by GeoSlope. Typical sections used in the analyses are shown in Figures V-9 to V-12 in Appendix V. Seepage rate curves were calculated for upstream boundary conditions shown in Table 5.8 and compared with the preliminary tailings deposition plan in Appendix VI.

TABLE 5.8: Upstream Boundary Conditions for Seepage Modeling – Central Dike

Tailings Elevation at Dike (masl)	Tailings Beach Length (m)
130	0, 250, 500
135	0, 250, 500
140	0, 250, 500
148	0, 250, 500

The tailings pond at the dike face is an upset case for the Central Dike. The tailings pond will typically be operated several hundred metres to the north west (see Appendix VI).

Downstream boundary conditions included a pressure equal to zero boundary to simulate a drain at the downstream rockfill toe and a review by drainage boundary at approximately 80 m setback representing the Portage Pit.

Detailed predictions of thermal performance influence on seepage and solute transport for the closure case are considered in Golder (2008b), with results summarized in Section 5.1.6.

The values of hydraulic conductivity used for analyses are summarized in Table 5.9.

TABLE 5.9: Material Properties for Seepage Analysis

Material	Hydraulic Conductivity (m/s)			K ratio Khorizontal Kvertical	Reference
	Minimum Observed Values	Maximum Observed Values	Analyses		
Till	$7x10^{-8}$	$2x10^{-4}$	10^{-7}	1	Falling head tests from 2002, Section 4.4.2
Rockfill and Filter	-	-	10^{-2}	1	Experience with similar materials
Liner Cover			4×10^{-4}		Assumed
Upper Bedrock	$2x10^{-7}$	$5x10^{-5}$	$5x10^{-6}$	1	2003 and 2006 investigations[a,b,c]
Lower Bedrock	$3x10^{-9}$	10^{-6}	$2x10^{-7}$	1	2002, 2003 and 2006 investigations[a,b,c]
Grouted Bedrock	Not applicable	Not applicable	5×10^{-7}	1	Grouting performance criterion of 4 lugeons
Tailings	Not applicable	Not applicable	5×10^{-7}	1	assumed
Bituminous Geomembrane Liner			Impermeable[d]		See Note [d]

[a]Golder 2003c Appendix II, [b]Golder 2006d Appendix III, [c]No discernable difference in hydraulic conductivity of the various rock types. The hydraulic conductivity appears to vary with depth. The hydraulic conductivity of shallow exfoliated and weathered bedrock, regardless of rock type, is generally higher than the deeper less fractured rock, [d]Seepage through the bituminous geomembrane liner was estimated as a constant rate of 100 L/ha/day based on average rates reported for liners in landfill applications (Bonaparte et al. 2002).

Freezing of the tailings, dam fill, or foundation was not considered in the seepage analysis and this is conservative with respect to predicting volume of flow. The Central Dike will be constructed primarily on lakebed soils and therefore on talik. Talik is

unfrozen ground underlying water bodies within the continuous permafrost zone. Frozen ground will reduce the area available for flow and the assumption of unfrozen ground therefore makes estimates of seepage conservative with respect to total volume. Anisotropy of the tailings was not considered.

Unit seepage rates for different head differences across the dike were applied in proportion to chainage and summed to estimate the total seepage with maximum tailings elevation for each stage.

Results

Modeled sections showing typical predicted water table locations and contours of total hydraulic head are presented in Figures V-9- to V-12 in Appendix V. Predicted unit and total seepage rates are presented in Figure V-13 and summarized in Table 5.7.

Water seeping through the dike foundation during earlier stages of pit development will collect within the rockfill of the Central Dike, as indicated in Figures V-9 and V-10 in Appendix V.

Water may drain to the pit without emerging from the downstream toe of the rockfill during later stages of pit development. Figures V-11 and V-12 in Appendix V indicate that the amount of seepage collected at the downstream toe of the Central Dike will be a function of development of the Portage Pit adjacent to the Central Dike, as well as length of the tailings beach.

Higher hydraulic gradients are present at the upstream toe of the Central Dike rockfill. Filters are therefore placed to prevent till from moving into the rockfill.

5.1.5 Settlement Analysis

Predicted settlements for the Central Dike indicate that 2 m freeboard is sufficient to allow for consolidation settlement of the foundation and rockfill.

Mechanisms for settlement of the crest of the Central Dike include:

- Consolidation of foundation soils under the weight of the rockfill embankment (major component).

- Consolidation of both foundation soils and rockfill without additional loading, due to creep and due to wetting of the rockfill by both water ponded within the rockfill and by Third Portage lake during closure (minor component).

- Elastic response of the rockfill embankment due to self-weight loading. Elastic response occurs more or less instantaneously during construction and is therefore mitigated by addition of rockfill to the design elevation (minor component).

- Thawing of ice rich foundation soils. Foundation preparation ensures ice rich soils and soft lakebed sediments are removed prior to rockfill placement.

Settlements were estimated for consolidation of the foundation soils and for settlement of the rockfill.

Methods and Assumptions

Crest settlement was estimated as the sum of:

- Settlement of till foundation soils in response to weight of the rockfill embankment by one dimensional consolidation analysis; and

- Settlement of rockfill over the long term estimated at 1% of embankment height.

Material properties are presented in Table 5.10.

TABLE 5.10: Material Properties for Settlement Analysis

Material	Unit Weight (kN/m^3)	Compression Index, C_c		Initial Void Ratio, *e*		Source
		Range	Value for Analysis	Range	Value for Analysis	
Compacted Rockfill	19.8	n/a	Assume settlement = 1% of total height	n/a	n/a	experience with similar materials
Till	21.4	0.018 to 0.095	0.095	0.26 to 0.63	0.63	Laboratory data for reconstituted samples Golder 2008a

Geometry of the maximum height section is presented in Table 5.11.

TABLE 5.11: Summary of Elevations for Settlement Analysis – Central Dike

Materials	Stage 3 Centerline
Rockfill Crest Elevation (masl)	150
Till Foundation Elevation (masl)	108
Bedrock Elevation (masl)	90

Results

Maximum predicted settlement of the Central Dike crest is presented in Table 5.12.

TABLE 5.12: Settlement Analysis Result – Central Dike

Materials	Settlement (m)
Rockfill	0.42
Till Foundation	1.2
Total	1.6

Staging of rockfill placement allows partial consolidation of foundation soils to occur prior to construction of the next stage. For example, the rockfill placed during Stage 2 construction will load the area underlying the liner placed during Stage 3 construction. Consolidation settlement experienced by the Stage 3 liner is thereby reduced relative to placement of a single rockfill lift of maximum height. The consolidation in the till foundation induced by a raise of rockfill from 145 masl to 150 masl is on the order of 0.05 m. Placement of rockfill well in advance of the liner can pre-load the foundation and eliminate a portion of consolidation settlement that otherwise may affect liner performance.

5.1.6 Thermal Analysis

The TSF dikes are designed to operate in seasonally frozen and unfrozen conditions. Due to the climate of the Meadowbank Site, and the nature of continuous permafrost in the area, the closure concept for the TSF has included permafrost aggradation into the tailings.

Freezing for closure is discussed here, followed by technical analyses to predict freezing of lakebed soils following dewatering.

Closure

Thermal analyses for long term performance of the Central Dike and TSF were previously reported in Golder (2008b). Coupled seepage/thermal analysis presented in Golder (2008b) indicates that water flowing from the tailings will increase the time for tailings to freeze completely. The impact of heat transfer from water flow will be minimized by the expected low hydraulic conductivity of the tailings. Water flux out of the TSF will initially be controlled by the hydraulic gradient between the tailings and the Portage Pit areas. Upon mine closure and flooding of the Portage Pit, the hydraulic gradient between the two areas will gradually reduce as the lake level rises and the tailings drain. Hydrostatic equilibrium will occur within about 10 years causing flux from the tailings area to practically cease. After that, the freezing front will progressively advance into the tailings and the tailings will freeze within a period of about 40 years after closure.

While analyses indicate that the TSF will freeze in the long term, it is designed to operate in seasonally freezing and warming conditions. Freezing after closure reduces long term water management requirements. Should climate change preclude permafrost encapsulation, then changes to the TSF closure concept would be required, including:

- TSF Dike seepage collection works will be required over a longer term; and

- The TSF closure cover design would be updated to suit warmer climate conditions. For example, the cover could be designed to control the flow of water through the tailings such as in a climate similar to northern Saskatchewan.

It is noted that the dikes will be instrumented to monitor temperatures within the fills and foundations in order to track the development of freezing conditions within the structures during operations and following closure.

Construction

Thermal analyses were conducted to estimate the rate of development of permafrost and freezing of the lakebed following dewatering. Construction schedule for the Central Dike should consider time of exposure of the lakebed between dewatering and construction as soils and bedrock are predicted to progressively freeze with time.

Methods and Assumptions

Thermal analyses were performed using a 1D mesh with GeoSlope TEMP/W, Version 6.22. The model section is presented in Figure V-14, Appendix V and includes 10 m of till over fractured bedrock.

Table 5.13 presents material properties assumed for thermal analyses. The thermal properties of the materials were primarily defined based on the Johansen equation and adjusted based on mineralogy and the geotechnical properties of each material, as well reported values from other projects. The basic literature used included: GeoSlope (2004), Johansen (1975), MEND (1998) and Nidal et al. (2000).

TABLE 5.13: Material Properties for Thermal Analysis

Material	Volumetric Water Content	Thermal Conductivity (W/m^oC)		Volumetric Heat Capacity ($MJ/m^{3o}C$)	
		Frozen	Unfrozen	Frozen	Unfrozen
Till	0.31	2.4	1.8	2.0	2.6
Fractured Bedrock	0.05	2.7	2.7	2.7	2.7

Boundary conditions included an estimated ground temperature function generated from a 6 year climate dataset (Golder 2007c). The temperature function is presented in Table 5.14 and Figure V-14 in Appendix V.

TABLE 5.14: Ground Surface Temperature Function

Month	Surface Boundary Condition Ground Temperature (°C)
	Estimated Normal Yearly Function
January	-26.3
February	-25.2
March	-23.3
April	-16.6
May	-6.7
June	1.4
July	9.8
August	10.5
September	5.1
October	-3.3
November	-12.8
December	-19.5

Thermal modeling was completed in three steps.

First, a steady state analysis was performed to generate initial thermal conditions for the transient analysis based on a uniform ground temperature of 4°C.

Second, an initial transient analysis was performed to transition near ground surface temperatures to the November temperature listed in Table 5.14.

Third, transient analyses were run to identify the depth of the active layer for an 8 year period under an applied upper boundary condition as presented in Table 5.14 and a lower boundary condition of a geothermal gradient of 0.038 J/s (Golder 2007c).

Results

Analyses indicate frost penetration of the lakebed till in the first year of exposure will be on the order of 2 to 3 m and up to 5 m following the second winter of exposure. The depth of frost penetration is illustrated in Figure V-15 in Appendix V, which presents the zero isotherm as a function of depth and time.

Construction schedule for the Central Dike should consider time of exposure of the lakebed following dewatering for excavation of the trench and for grouting of bedrock as the talik freezes.

5.1.7 Wave Action and Rip Rap Protection

The Central Dike will be operated with tailings against the dam face and the reclaim water pond several hundred metres from the dam (see Appendix VI). Wave action overtopping the upstream face of the dam is therefore not a concern.

Water will be against the downstream face of the Central Dike after the Portage Pit is flooded during closure. The final water surface elevation will be 134.1 masl. The freeboard above the lake level will be approximately 16 m for a dike crest elevation of 150 m.

The downstream face of the Central Dike comprises compacted rockfill which will be resistant to erosion and rip-rap protection will not be required.

Wave Hindcast

Wave heights corresponding to the overwater windspeeds were estimated using the simplified procedure in the Coastal Engineering Manual (US Army Corps of Engineers 2006). Preliminary calculations were undertaken using wind durations of 1, 2 and 3 hours and it was determined that waves will be fetch limited due to the short overwater fetch lengths.

A detailed hindcast to derive wave heights corresponding to different return periods was not undertaken. Rather, wave heights corresponding to the largest recorded windspeeds during the 2002 open water season were calculated. The maximum recorded windspeed of 124 km/hr was also used to hindcast waves from each of the relevant overwater fetches, and these hindcasted waves were used to derive estimates of the potential maximum wave runups. The 1/1,000 year wind event was 83 km/hr, and the design windspeed of 124 km/hr is therefore conservative with respect to expected wave height and run-up.

Fetch lengths and maximum water depths are included in Table 5.15.

TABLE 5.15: Fetch Length and Maximum Water Depth

Dike	Fetch Direction	Fetch (km)	Maximum water depth at dike (m)
Central Dike	east	0.5 km	12 m
Central Dike	southeast	0.7 km	12 m

Wave Runup

Wave runup was estimated using Hughes (2003) assuming rough slopes and is estimated with respect to the still water line (SWL) for downstream sideslopes for the Central dike of 1.5 H :1 V.

The procedure derives estimates of wave runup corresponding to $Ru_{2\%}$, which is defined as the runup exceeded by 2% of the incoming waves. For example, for every 100 waves, 2 of them will result in runup equal to or exceeding this estimate. The results for each fetch are tabulated in Table 5.16 below.

TABLE 5.16: Estimated Wave Runup For Second Portage Lake

Dike	Fetch	Wind speed (m/s)	Wave Height Hmo (m)	Wave Period Tp (s)	Runup (m), Above Still Water Line
Central Dike	SE	20.6	0.3	1.3	0.4
		34.4	0.6	1.72	1.0
	E	15.4	0.5	1.5	0.8
		34.4	0.2	1.1	0.3

Riprap Revetment Design

Revetment design was undertaken for the erosion protection works on the dikes. Revetment was designed using the Coastal Engineering Manual methodology (US Army Corps of Engineers 2006, Part 6-Chapter 5).

The maximum estimated incident wave heights given in Table 5.16 were used to estimate the required riprap sizes for each of the incident fetches. For construction simplicity, it was then assumed that a single revetment would be specified.

Central Dike (Lake Side)

M50 = 40.5 kg, D50 = 285 mm

The run-of-mine rockfill will exceed this gradation and additional protection of the face of the dam will not be required.

5.2 Divider Dike

Basic design concepts and analyses for the Divider Dike are presented here. The Divider dike is shown in plan and in section on Drawings in Appendix VIII.

5.2.1 Design Concept

The Divider Dike divides the lake basin into a tailings management area and a water management area for approximately three years. The Divider Dike is a significant consequence of failure structure and does not include granular filters to prevent the movement of tailings solids at defects or leaks in the liner. Compaction requirements are also reduced relative to higher consequence structures because settlement of the rockfill and liner are less critical.

The Divider Dike is a rockfill embankment with an upstream liner and cut-off trench. The Divider Dike will be constructed by stripping the lakebed sediments and soft soils from the footprint, then dumping a rockfill (width may be adjusted to suit construction by mine haul truck) along the alignment. The upstream face is graded to 3 H: 1 V and prepared with a liner bedding. A cut-off trench is excavated through the till to bedrock along the upstream toe of the rockfill and a bituminous geomembrane liner is anchored in the trench and extended up the upstream face of the embankment. The trench is backfilled and the liner is covered for protection against ice damage. Additional material, either rockfill, tailings or till is placed against the upstream face to limit damage by ice on water ponded against the dike face.

Stability of the Divider Dike is a concern with respect to the possibility of a worst-case catastrophic failure releasing tailings and ponded water and causing a wave that impacts the Portage Pit.

Seepage through the Divider Dike is not considered to be critical. Should major seepage develop then seepage collection ditches may be installed downstream of the dike.

5.2.2 Construction Materials

The Divider Dike section includes a rockfill embankment, a bituminous geomembrane liner, liner bedding and liner cover materials.

The rockfill used in the Divider Dike may be either PAG or NPAG material. At the end of mine operations the Divider dike is partially buried by tailings from both upstream and downstream directions.

Liner bedding is 150 mm minus material. The finished bedding surface is subject to approval by the liner installer. The liner cover is 75 mm minus material.

The liner is a bituminous geomembrane liner such as Coletanche ES3, or equivalent.

5.2.3 Stability Analysis

Stability analyses conducted for the Divider Dike assessed failures through the foundation soils. Calculated FoS exceed the design criteria.

A sensitivity analysis of undrained strength in the till foundation was also conducted.

Methods and Assumptions

Stability analyses were performed using the GeoSlope SLOPE/W, Version 6.22 computer program for general solution of slope stability by two dimensional limit equilibrium methods.

Model geometry parameters are listed in Table 5.17. Sections are shown in Figures V-16 to V-18 in Appendix V. A sensitivity analysis for undrained strength of the foundation till strength was carried out for the construction case of an open trench excavation at the upstream toe of the embankment.

TABLE 5.17: Stability Analysis Model Geometry – Divider Dike

Parameter	Value
Crest Elevation (masl)	140, 150
Rockfill Crest Width (m)	10
upstream slope	3 Horizontal:1 Vertical
downstream slope	1.32 Horizontal:1 Vertical

The material properties assumed for the analysis are listed in Table 5.5.

Results

Results for stability analyses are presented in Figures V-16 to V-18 in Appendix V.

Results for analyses are presented in Table 5.18.

TABLE 5.18: Stability Analysis Results Summary – Divider Dike

Crest El. (masl)	FoS for Drained Conditions	
	Upstream Failure Mode Static (pseudostatic)	Downstream Failure Mode static (pseudostatic)
140	2.5 (2.2)	2.2 (1.9)
150	>5	1.7 (1.6)

Analyses of undrained conditions (construction case) for Divider Dike trench excavation indicate FoS near 1 for excavation sideslopes of 1.5 H: 1 V at undrained till strengths of between 40 and 50 kPa, shown in Figure V-18 in Appendix V.

5.3 Saddle Dams

Basic design concepts and analyses for the Saddle Dams are presented here. The Saddle Dams are shown in plan and section on Drawings in Appendix VIII.

5.3.1 Design Concept

The Saddle Dams are permanent structures that retain tailings and limit seepage to the environment over the long term. The Saddle Dams are High consequence of failure structures. The Saddle Dams are connected by unlined rockfill roads in the north end of the TSF. The Saddle Dams can be used as a pipe berm for tailings deposition and may be widened to act as haul roads during construction.

Saddle Dams are built on land above the lake surface. Concerns for stability and settlement therefore include thawing of ice rich foundation soils and other foundation soil failures. Ice rich soils are removed prior to construction as part of foundation preparation. Additional material is placed over the liner cover on the upstream face at locations were water may pond against the dike.

Seepage collection systems are installed downstream of the dikes at select locations.

5.3.2 Construction Materials

Construction materials for the Saddle Dams are the same as the Central Dike. The Saddle Dams are built on land above the lake surface elevation and are constructed of NPAG rockfill. Rockfill roads connecting the Saddle Dams that are contained within the TSF may be constructed of PAG materials.

Filters for Saddle Dam construction are the same as the Central Dike with gradations as described in Section 5.1.2.

5.3.3 Stability Analysis

Stability analyses for the Saddle Dams were conducted for failure modes involving foundation soils.

Analyses indicate FoS exceed the design criteria.

Methods and Assumptions

Stability analyses were performed using GeoSlope SLOPE/W, Version 6.22, a computer program for general solution of slope stability by two dimensional limit equilibrium methods.

Model sections for analysis of the Saddle Dams were based on ground slopes and staging of Saddle Dam 1 for the maximum height section near Station 0+250 are shown in Figures V-19 to V-21 in Appendix V. Dike sections are shown in the Drawings in Appendix VIII.

Model geometry parameters are listed in Table 5.19.

TABLE 5.19: Stability Analysis Model Geometry – Saddle Dams

Parameter	Value
Height (m)	14
Rockfill Crest Width (m)	10
upstream slope	3 Horizontal:1 Vertical
downstream slope	1.5 Horizontal:1 Vertical

Material properties assumed for analysis are listed in Table 5.5.

Upstream and downstream failure modes were modelled for static and pseudostatic earthquake loading conditions. For pseudostatic conditions a coefficient of horizontal acceleration of 0.04 g (equal to two thirds peak ground acceleration corresponding to a predicted 1 in 2,500 year event) was applied (US Corps of Engineers 1984).

Results

Analysis results indicate FoS exceed design criteria for static and pseudostatic conditions.

Analysis results are summarized in Table 5.20 and illustrated in Figures V-19 to V-21 in Appendix V.

TABLE 5.20: Stability Analysis Results Summary – Saddle Dams

Phase	Crest El. (masl)	FoS for Drained Conditions static (pseudostatic)	
		Upstream Failure Mode	Downstream Failure Mode
Construction	141	2.4 (2.1)	3.1 (2.6)
Stage 1	141	>5	3.1 (2.6)
Stage 2	150	>5	2.3 (2.0)
Closure	--	>5	2.3 (2.0)

5.3.4 Seepage Analysis

A typical Saddle Dam section was modelled to predict rates of seepage during operations for use in sizing seepage collection systems. Hydraulic gradients were also examined to determine the need for internal erosion control measures.

Methods and Assumptions

Seepage modeling was done using a 2D finite element numerical code, SEEP/W Version 6.22. Sections used in the analyses are shown in Figures V-22 to V-25 in Appendix V.

Material properties assumed for analyses are summarized in Table 5.9.

The Saddle Dams will be constructed on land over permafrost. The assumption of unfrozen ground makes estimates of seepage conservative with respect to total volume.

Boundary conditions for the models are summarized in Table 5.21.

Upstream boundary conditions included water tables were modelled at the surface of the tailings beach and with a pond at 250 m and 500 m from the dike. A pond at the dike represents the worst case scenario for seepage.

Downstream boundary conditions included a zero pressure head, representing a seepage collection system.

TABLE 5.21: Boundary Conditions for Seepage Modeling – Saddle Dams

Tailings Elevation at Dike (masl)	Tailings Beach Length (m)
135	0, 250, 500, supernatant pond only
138	
140	
143	
145	
148	

Results

Modeled sections showing typical predicted water table locations and contours of total hydraulic head are presented in Figures V-22- to V-25 in Appendix V.

Predicted seepage rates for the Saddle Dams are summarized in Table 5.22.

TABLE 5.22: Summary of Predicted Seepage Rates – Saddle Dams

Saddle Dam	Crest Elevation (masl)	Tailings Elevation at Dike (masl)	Beach Length (m)	Pond Elevation (masl)	Seepage through Liner (m^3/day)	Seepage through Foundation (m^3/day)	Total Seepage (m^3/day)
1	141	139	250+	135	0.04	10	10
	150	148	250	146	0.07	60	60
2*	150	143	supernatant pond only	143	n/a	<5	<5
3	145	144	supernatant pond only	144	--	--	--
	150	144	supernatant pond only	144	0.06	100	100
4	145	n/a	n/a	126	--	--	--
	150	147	250 to 500	144	0.1	60	60
5**	145	n/a	n/a	126	--	--	--
	150	148	500+	144	0.06	14	14
6	150	148	500+	143	n/a	n/a	n/a

*Saddle Dam 2 seepage will report to area downstream of Saddle Dam 3. ** Seepage through Saddle Dam 5 will report to Central Dike rockfill.

Seepage collection systems are required for Saddle Dams 1, 3 and 4. Water will flow laterally within the rockfill (up or down chainage) and emerge as a function of topography and ice build up within the rockfill. Seepage from Saddle Dam 5 will drain laterally within the rockfill and will report to the Central Dike rockfill.

5.4 Foundation Seepage Cut-off

Till foundation soils may contain zones of permeable materials that act as flow pathways in the dike foundation. Flow pathways in foundation soils are cut off by excavation of a trench through foundation soils to bedrock and installation of an impermeable liner that is anchored in the trench and extended up the face of the dike. Methods for anchoring the liner in the trench are discussed here.

5.4.1 Central Dike

The cut-off through foundation soils for the Central Dike is an excavation to bedrock. Bedrock and soil conditions in the excavation are logged and a lean concrete mat is poured on the bedrock surface. The base of the excavation is wide enough to be used as a working area. The concrete mat provides a place to seat packers for grouting of near surface bedrock. An impermeable liner is bonded to the lean concrete mat surface and extended up the face of the dike. Grouting may be undertaken when the trench is open,

or after it has been backfilled, provided the precise location (vertical and horizontal) of the lean concrete mat is recorded.

A separate measure considered for the Central Dike design is a vertical cut-off wall installed by slurry trench method. Due to the hydraulic gradients present at the base of the dike, the trench backfill would be either soil cement bentonite or cement bentonite to produce a cemented cut-off wall that prevents migration of soil or tailings particles. The bituminous liner would be anchored in the cut-off wall. Grouting of bedrock would be completed through the cut-off wall. Construction of a vertical slurry trench excavation would be complicated by the presence of boulders in the foundation. Large boulders are difficult to remove without over-excavation or trench collapse.

Investigations to characterize foundation soils are required to optimize the cut-off design.

5.4.2 Saddle Dams and Divider Dike

The cut-off design for the Saddle Dams and Divider Dike is a trench excavation at the upstream toe of the embankment. The bituminous liner is anchored in the cut-off trench by one of two methods. The method presented includes excavating to bedrock then placing a fine-grained, low permeability layer on the bedrock to provide a surface on which to bed the liner. The base of the excavation is wide enough to allow equipment to operate in the trench. The liner is placed on the bedding and the trench is backfilled with similar low permeability material. In non-freezing conditions the liner bedding and trench backfill may be till that is sufficiently compacted to provide a stable surface. In freezing conditions a mixture of finer granular material, such as the Fine Filter, and powdered bentonite may be used. The end of the liner is terminated in the trench within finer material to prevent preferential flow around the end of the liner.

The second method for anchoring the liner in the cut-off trench includes exposure, cleaning and scaling of the bedrock surface; application of dental concrete to provide a smooth surface; and bonding of the liner to the concrete/bedrock surface.

5.5 Instrumentation and Monitoring

Instrumentation is required in the Central Dike and Saddle Dams:

- To provide early warning of the development of potentially adverse trends such as excessive pore water pressure, seepage and/or deformation; and

- To compare performance with the predictions made during the design studies with respect to stability, deformation, seepage and thermal analyses.

All instrumentation will be read manually immediately following installation and during construction. An automatic field data acquisition system will allow the collection of data from the piezometers and thermistors during operation.

Instrumentation type, number and location is provided in the Specifications and Drawings in Appendix VII and Appendix VIII, respectively.

Rational for instrumentation design is documented here.

5.5.1 Piezometers

Piezometers provide the following information:

- During construction – measurement of pore water pressures in the foundation which may have developed during placement of fills or tailings; and

- During operations – determine the effects of blast induced ground acceleration and velocities and deformation of the embankment and foundation; monitoring of pore water pressure and groundwater gradients under the dike and near the upstream toe, simultaneously with permafrost penetration into the dike fill and foundation and open pit deepening.

Piezometers are shown on Drawings in Appendix VIII.

5.5.2 Thermistor Strings

The thermistors are used to monitor the freezing within the foundation and fill.

Thermistors are shown on Drawings in Appendix VIII.

5.5.3 Survey Prisms

Survey prisms are installed at intervals along the crest centerline of each stage for the Central Dike and Saddle Dams, as shown on Drawings in Appendix VIII, to measure the vertical and lateral movements associated with fill settlement and foundation soil consolidation during operation. Accurate measurements will require the use of high resolution surveying equipment and a network of stable control monuments.

5.5.4 Survey Control Monuments

Survey control monuments are installed at locations shown on the Drawings in Appendix VIII to provide control points for surveys.

5.5.5 Seismograph

Blast monitoring will be carried out using a portable seismograph at the crest and/or the downstream toe of the Central Dike that will measure both velocities and accelerations induced by blasting in the Portage Pit.

5.5.6 Automated Data Acquisition System

The proposed instrumentation system includes multi-level vibrating wire piezometers and thermistors. The automatic data acquisition system will be used to collect data from these instruments. Software enables graphic data interpretation, visualization of fill and foundation behaviour and alarm management.

The required system includes one data logger and instrumentation cabin per instrumented section. The instrumentation cabins require electrical power supply for the data logger terminals and heating to keep the system at a temperature greater than 0^{o}C.

5.5.7 Monitoring Frequency

Monitoring frequency will be described in a separate Operations, Maintenance and Surveillance Manual.

5.6 Geotechnical Investigations

Geotechnical investigations required include:

- Investigation of Central Dike and Divider Dike and Saddle Dam foundations, particularly along cut-off alignments;
- Lakebed soils thickness and nature to be characterized by drilling investigations from ice surface and by drilling or trenching after lake dewatering;
- Investigation of foundation conditions for the Saddle Dams by trench excavation completed (may be completed during foundation preparation). Ice rich soils are removed in order to found the dike on ice-poor soils or bedrock;
- Mapping of bedrock and soil conditions in upstream cut-off trench excavation footprint for Central Dike, Divider Dike and Saddle Dams; and
- Hydraulic conductivity testing of the bedrock below the foundation of the Central Dike may be conducted during grouting operations.

6.0 CONSTRUCTION AND OPERATION

TSF dike construction schedule and raise sequence are designed on the basis of the lake dewatering sequence and preliminary tailings deposition planning.

6.1 Lake Dewatering

Table 6.1 summarizes estimates of total volume of water inside the proposed dewatering dikes for Second Portage Lake Arm, Third Portage Lake and Vault Lake.

TABLE 6.1: Lake Volumes Inside Dewatering Dikes

Location	Lake Section	Volume (Mm^3)
Second Portage Lake Arm* (elevation 133.4 masl)	Northwest Basin (future North Cell)	2.3
	Main Basin (future South Cell)	10.7
	East Basin (adjacent East Dike)	2.3
	Total Second Portage Lake Arm within East Dike and West Channel Dike	15.3
Third Portage Lake	Inside Bay Goose Dike	0.5
Vault Lake (elevation 139.4 m masl)	Total Vault Lake within Vault dewatering dike	2.2
Total		**18.0**

Volume estimates are based on site bathymetry from Golder (2004b and 2006a). *Second Portage Lake Arm volumes are based on Golder (2004b and 2006a) and on bathymetry survey conducted by Golder in 2008, described in Appendix III.

TSF Dike foundations exposed during dewatering are summarized in Table 6.2.

TABLE 6.2: TSF Dike Foundation Elevations

Dike	Minimum Foundation Elevation (masl)
Saddle Dams	133.5 masl
Divider Dike Stage 1	127.5 masl
Central Dike Stage 1	96 masl

6.2 Tailings Deposition Plan

Preliminary tailings deposition planning was completed to allow planning of staging of the TSF dike construction (presented in Section 6.3). Results of preliminary tailings deposition planning are presented in Appendix VI.

It is noted that detailed deposition planning has not been completed and is required:

- to define requirements to operate a reclaim pond;
- to consider restrictions imposed by freezing conditions including sequencing of deposition and requirements for multiple tailings discharge lines; and
- to promote management to facilitate closure of the facility such that tailings beaches are configured to promote drainage towards a closure spillway.

It is noted that detailed planning will be more beneficial when additional tailings parameters are available from measurement and verification of tailings performance following deposition. Parameters of interest include in-situ density and deposition slope angles.

Raising sequence of the TSF dikes should be verified against the detailed deposition plan and adjusted if required.

6.3 TSF Dike Construction Sequence and Raise Schedule

The criteria adopted for TSF dike design include:

- one year of storage following mill start-up; and
- 2 years minimum storage for each raise thereafter.

A suggested raising sequence prepared on the basis of preliminary deposition planning in Appendix VI is presented in Table 6.3. The TSF is divided into North and South Cells that may be operated independently.

TABLE 6.3: Proposed TSF Dike Raise Sequence

Year	Area	Crest Elevation (masl)							
		Saddle Dam						Divider Dike	Central Dike
		1	2	3	4	5	6		
-1 (2009)	North Cell Stage 1	141						140	
1 (2010)	North Cell Stage 2	150	150				150	150	
3 (2012)	South Cell Stage 1								135
5 (2014)	South Cell Stage 2			145	145	145			145
7 (2016)	South Cell Stage 3			150	150	150			150

The crest elevations in Table 6.3 are suggested elevations only. The design allows flexibility to change stage elevations.

Rockfill roads around the perimeter of the north cell are built in Year -1.

6.3.1 TSF Dike Construction Activities

Saddle Dams

The Saddle Dams are a series of lined rockfill structures connected by unlined rockfill roads used for piping and spigots associated with tailings deposition. The Saddle Dams are constructed of compacted rockfill placed in lifts.

Construction tasks for the Saddle Dams will include (not listed in order):

- Foundation preparation;
- Rockfill placement including compaction by vibratory roller and re-sloping of the upstream face;
- Filter placement and compaction by vibratory roller;
- Upstream cut-off trench excavation;
- Bituminous geomembrane liner placement;
- Placement of cover over the liner and placement of additional material required for protection against ice or as ballast against uplift pressures from water ponded in the rockfill;

- Installation of instrumentation; and
- Construction of seepage collection works.

Where mine haul trucks are used for construction the crest of the dike may be widened to accommodate truck traffic.

Divider Dike

Construction of the Divider Dike will include (not listed in order):

- Foundation preparation;
- Rockfill embankment construction;
- Liner bedding placement;
- Cut-off trench excavation;
- Bituminous liner placement;
- Trench backfill; and
- Liner cover placement and placement of additional material required for protection against ice on the reclaim pond.

Where mine haul trucks are used for construction the crest of the dike may be widened to accommodate truck traffic. Ice removal may be required, depending on construction season and lake dewatering.

Central Dike

Construction of Central Dike includes (not listed in order):

- Foundation preparation. Soft lakebed soils and ice rich soils are removed to limit differential settlements that may adversely impact liner performance;
- Rockfill placement including compaction by vibratory roller and re-sloping of the upstream face: rockfill is compacted to reduce settlement that may adversely impact liner performance;
- Filter placement and compaction;

- Cut-off trench excavation at the upstream toe of the rockfill embankment;
- Geological mapping of the trench excavation;
- Pouring of concrete mat on bedrock;
- Bedrock grouting through the concrete mat;
- Bituminous geomembrane liner placement;
- Trench backfill and liner cover placement;
- Placement of additional material on the upstream face to counteract pressure due to water ponded in the rockfill;
- Installation of instrumentation;
- Construction of seepage collection works at the downstream toe; and
- Where mine haul trucks are used for construction the crest of the dike may be widened to accommodate truck traffic.

6.4 Quantities

The quantities of materials required for dike construction are presented in the Drawings in Appendix VIII.

6.5 OMS Manual

An Operations, Maintenance and Surveillance (OMS) Manual is required for operation of the TSF dikes. Manual preparation will follow Mining Association of Canada guidelines (MAC 2003).

6.6 Water Handling and Seepage Management

Seepage collection systems for the TSF dikes include trenches and sumps downstream of the dikes. Rates of pumping are recorded to document seepage quantities during operations.

6.6.1 Central Dike

Lakebed bathymetry shown in Drawings in Appendix VIII indicates that drainage of the area between the pit and the Central Dike will be towards the dike.

Seepage through the Central Dike and foundations is therefore expected to pond within the rockfill against the bituminous geomembrane liner. Seepage from Saddle Dam 5 will also report to the Central Dike rockfill.

Rainfall and snowmelt on the rockfill will collect within the rockfill. Rainfall and snowmelt from the catchment immediately to the east of the Central Dike is expected to drain west to the dike toe.

Seepage collection ditches and sumps will be excavated into the till downstream of the Central Dike. Excavation can be during foundation preparation or during operations based on observed drainage. The trench will only collect drainage from the catchment to the east of the Central Dike until water ponded within the dike rises to the elevation of the downstream dike toe.

6.6.2 Divider Dike

No seepage collection system has been designed for the Divider Dike.

6.6.3 Saddle Dams

The foundation topography and the drainage area near the Saddle Dams will govern the location of a seepage collection system. Collection trenches and sumps are installed downstream of the rockfill during foundation preparation or during operations. Initial sizing of the collection system is based on predicted flows in Table 5.22. The seepage collection can be re-sized if required during operations. Seepage models will be calibrated based on observed flows to aid in design.

7.0 CLOSURE

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

If you have any questions please do not hesitate to contact us.

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O:\ACTIVE_2008\1428\08-1428-0029 MEADOWBANK TSF DIKE DESIGN\3400 REPORTING\RPT VER 0\CHANGES AFTER WP\DOC 784 1215_08 RPT-DETAILED DESIGN OF TAILINGS STORAGE FACILITY DIKE-MEADOWBANK VER 0.DOC

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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 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, including but not limited to proposed construction techniques, schedule, and safety and equipment capabilities.

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 all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample 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. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not 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. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

630000 635000 640000 645000 650000

7230000 7225000 7220000 7215000

PDF

PIPEDREAM LAKE

FARSIDE LAKE

WALLY LAKE

VAULT DEPOSIT

SECOND PORTAGE FAULT

NORTH PORTAGE

CAMP

THIRD PORTAGE

BAY ZONE

GOOSE ISLAND

THIRD PORTAGE LAKE

BAY ZONE FAULT

N

LEGEND

- Lake
- Fault Line
- Gold Deposit
- Meadowbank Camp Site

ROCK TYPE

- Granite, Granodiorite
- Gabbro
- Quartzite, Conglomerate
- Quartz arenite, metasediments
- Ultramafic
- Foliated Diorite, Gabbro
- Intermediate to Felsic Volcaniclastics
- Iron Formation
- Felsic Volcanics
- Mafic Volcanics

REFERENCE

Data provided by Cumberland Resources Ltd.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 14

1,600 0 1,600

SCALE 1:80,000 METRE

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

REGIONAL GEOLOGY

Golder Associates
Burnaby, B.C.

PROJECT No. 008-1428-0029			SCALE AS SHOWN	REV. 0
DESIGN	BW	10 Dec. 2008		
GIS	AL	10 Dec. 2008		
CHECK				
REVIEW				

FIGURE 4.1

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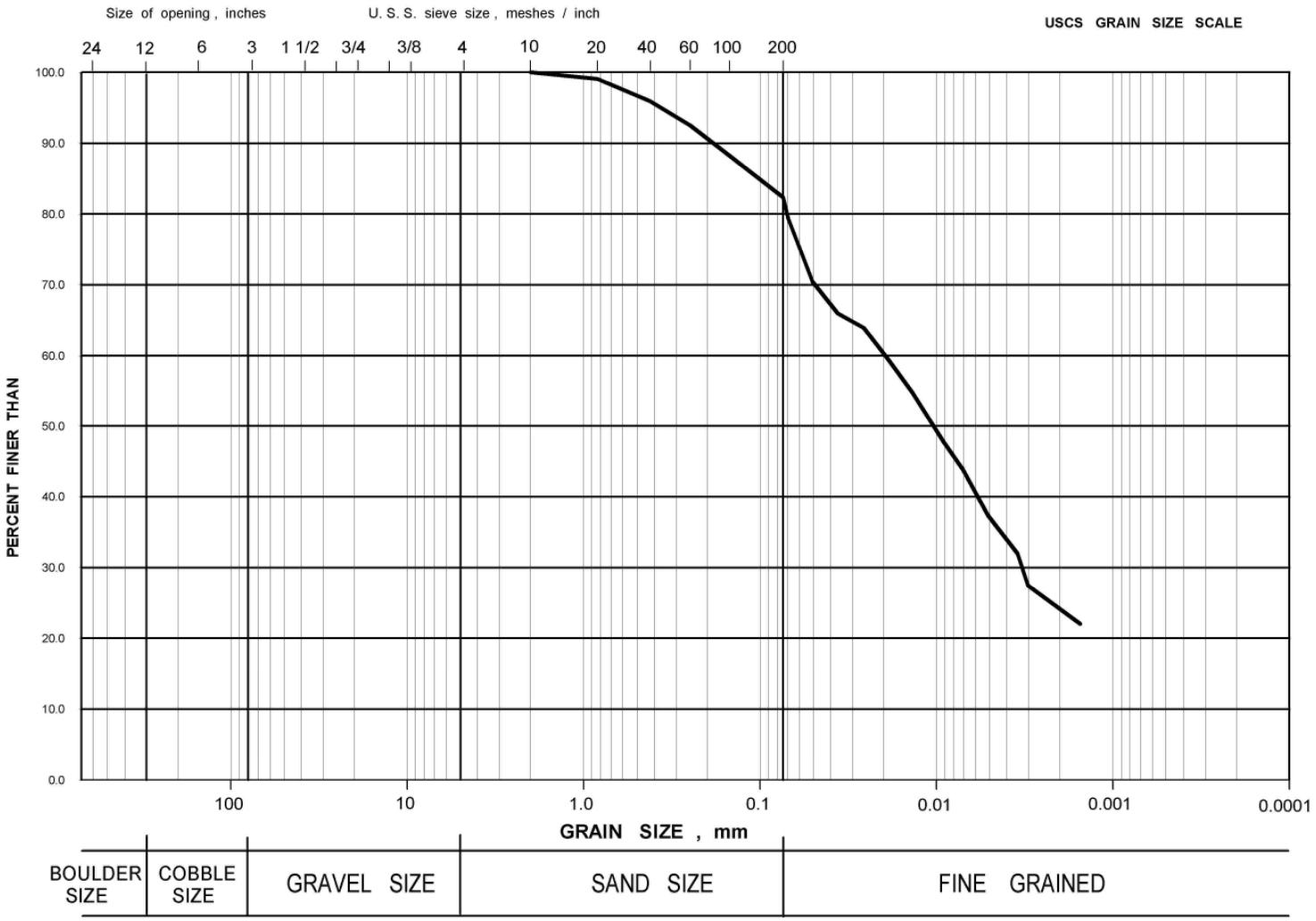


Note: Composite Sample

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

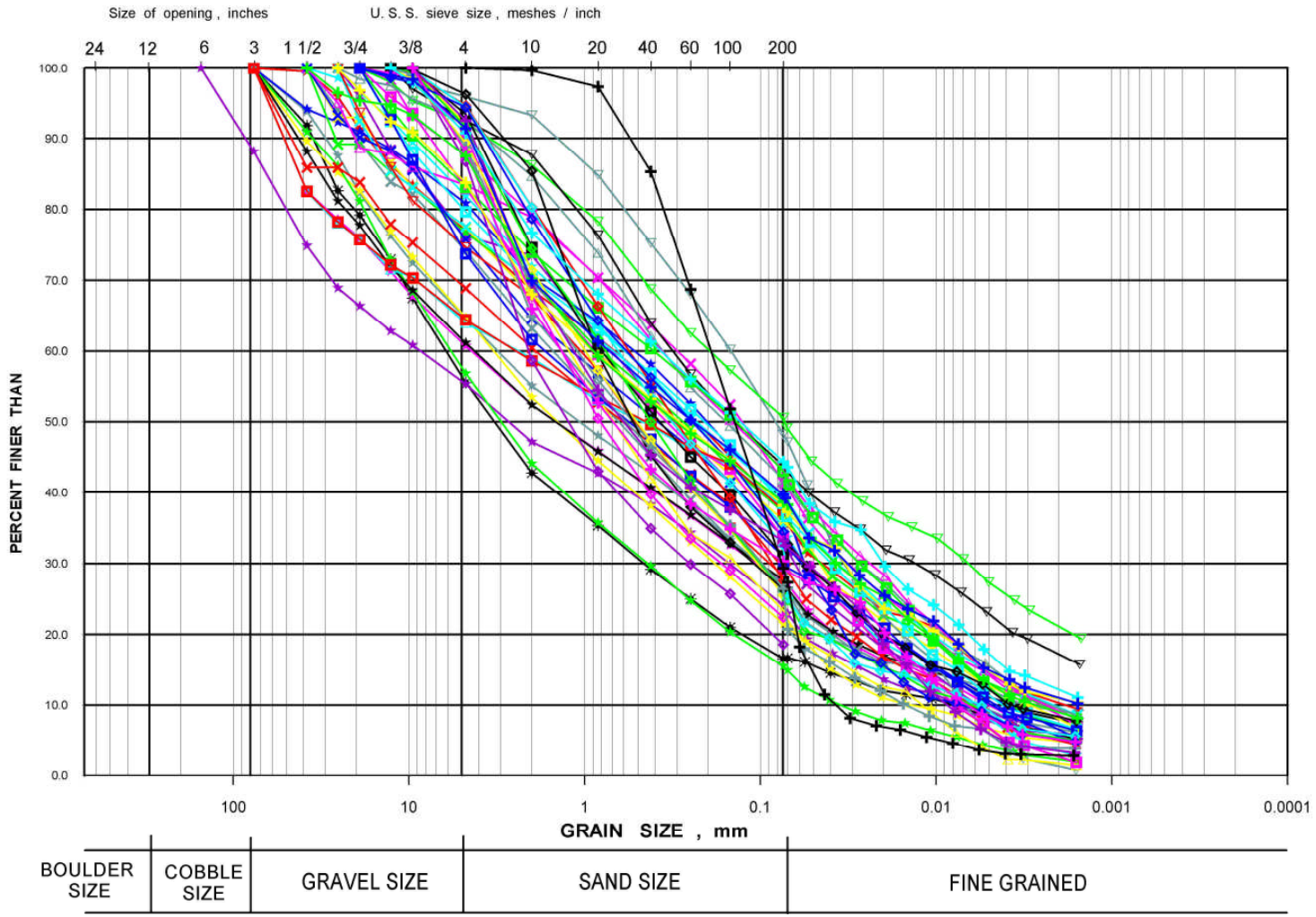
TITLE

GRAIN SIZE LAKEBED SEDIMENTS

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----	
DESIGN	BW	09DEC08	SCALE NTS	REV.0
CADD	BW	09DEC08		
CHECK	--	-		
REVIEW				

FIGURE 4.2



Note: Pre-August 2007 data shown

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

GRAIN SIZE TILL

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----	
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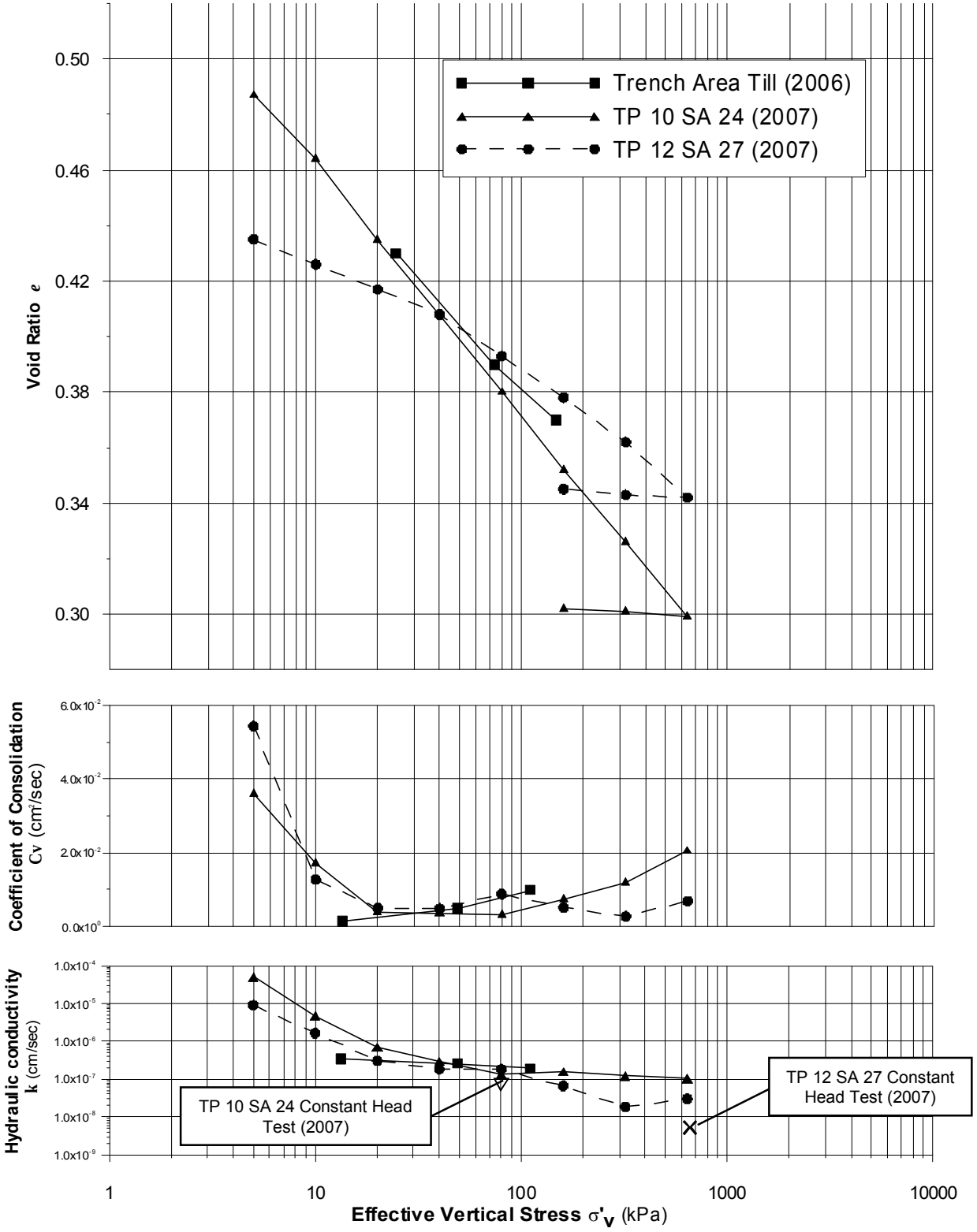
CADD	BW	09DEC08		
CHECK	--	-		
REVIEW				

FIGURE 4.3



Note: Constant head hydraulic conductivity test data presented for comparison

PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

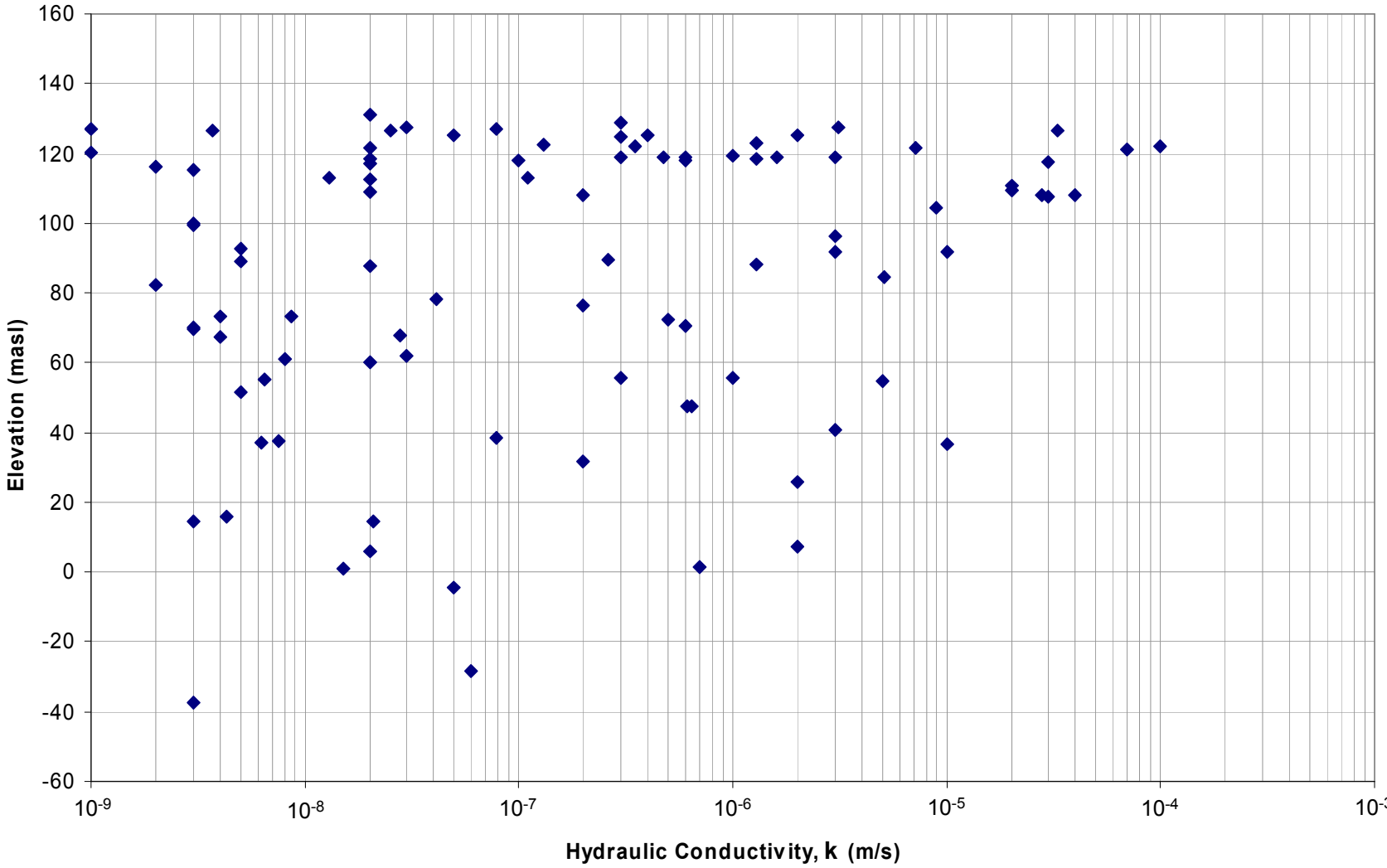
TITLE

SUMMARY TILL CONSOLIDATION TEST

PROJECT No. 08-1428-0029			FILE No. ----	
DESIGN	BW	09DEC08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK	--	-		
REVIEW				

FIGURE 4.4

REVISION DATE:09DEC08 BY: BEW FILE:O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Figures\Figure 4-4.pdf



Note: data tabulated in Appendix I

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

BEDROCK HYDRAULIC CONDUCTIVITY VS. ELEVATION

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----	
DESIGN	BW	09DEC08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK	--	-		
REVIEW				

FIGURE 4.5

APPENDIX I

SITE DATA SUMMARY

TABLE I-1: Summary of On-land Borehole Observations of Soil Overlying Bedrock

Borehole	Ground Surface El. (masl)	Bedrock Surface El. (masl)	Thickness (m)	Description of Soils
02GT-01	131.50	126.40	5.10	Cobbles and gravel
02GT-03	135.74	132.74	3.00	Boulder Till
02GT-04	136.92	133.07	3.85	Cobbles and gravel with some sand
03GT-GI-7	139.35	134.97	4.38	Gravel and cobbles
03GT-PS-1	149.16	147.76	1.40	Boulders and cobbles with silty sand and trace gravel over cobbles with gravel and trace silt
03GT-PS-4	149.33	148.68	0.65	Cobbles and boulders with some gravel
03GT-PS-5	144.68	140.08	4.60	Cobbles and boulders with some angular gravel
03GT-PS-7	149.82	149.37	0.45	Cobbles and boulders with trace gravel and 0.05 m of organics
03GT-PS-9	147.47	146.72	0.75	Cobbles and boulders with trace gravel
03GT-PS-10	148.14	147.49	0.65	Cobbles and boulders with some gravel
03GT-PS-11	149.58	148.88	0.70	Cobbles and boulders with trace gravel
02GT-09			**1.5**	**Inferred boulders (TILL)**
02GT-10			**1.5**	**Silty sand and gravel with cobbles and boulders (TILL)**
03GT-TD-1	**134.34**	**132.27**	**2.07**	**Loose cobbles and round gravel with occasional boulders**
03GT-Spec-F1	**138.89**	**138.19**	**0.7**	**Cobbles and some angular gravel**
08-MB-GD-17	133.2	132.4	0.8	0.1 m layer of brown rootlet mat, organics, otherwise poor recovery

Note: The data in bold correspond to Tailings Storage Facility location.

TABLE I-2: Summary of Soil Depth and Description for Boreholes Drilled in Lakes

Borehole	Thickness of Soils Encountered (m)	Description
02GT-02A	2.7	Loose, homogenous, wet, dark grey, well graded, clean sand
02GT-02B	3.1	Loose, homogenous, wet, dark grey, well graded, clean sand
02GT-05	**1.5**	**Lake bottom sediments and coarse sand, cobble and gravel**
02GT-07	**0.45**	**Loose, yellow silty clay**
02GT-08	**4.2**	**Dense yellow clay, silt, sand and gravel over loose gravel and cobbles over loose grey green, white rounded to sub-rounded cobbles, coarse gravel and sand**
02GT-11	**1.6**	**Lake bottom sediments and till**
03GT-BZ-2	2.16	Loose cobbles and gravel with trace sand
03GT-BZ-3	1.20	Gravel and cobbles
03GT-BZ-5	2.74	Cobbles and boulders with some gravel, trace sandy silt
03GT-BZ-6	4.43	Boulders and cobbles with some gravel, trace sand and silt
03GT-GI-1	3.31	Boulder over cobbles and gravel with trace of clay and sand
03GT-GI-2	3.60	Cobbles and gravel over silty clay with some sand and trace gravel over sandy clay with gravel over sandy clay and gravel with cobbles
03GT-GI-3	1.25	Cobbles and gravel
03GT-GI-4	1.81	Cobble and gravel with trace sand and clay
03GT-GI-5	1.84	Gravel
03GT-GI-6	5.90	Loose cobbles and gravel with trace sand
03GT-GI-8	3.52	Cobbles and boulder with some gravel

Borehole	Thickness of Soils Encountered (m)	Description
03GT-GPIT-1	10.45	Cobbles and gravel
03GT-GPIT-3	14.30	Gravel and cobbles with trace and clay and sand
03GT-GPIT-4	14.94	Cobbles and gravel with trace coarse sand, silty fine grained sand over medium to fine grained sand
03GT-SE-1	4.58	Stiff layered moist light brown and grey greasy silty clay with little gravel over gravel and cobbles
03GT-SE-2	1.54	Cobbles and gravel
03GT-TD-2	**5.33**	**Cobbles and gravel**
03GT-TD-3	**14.40**	**Green mud over cobbles and gravel with trace sand and clay**
03GT-TD-4	**5.84**	**Cobbles and gravel with trace of sand**
03GT-TD-6	**18.13**	**Cobbles and gravel**
03GT-Spec-F2	1.61	Gravel
06GT-TD1	**10.5**	**Cored boulders**
06GT-TD2	**14.4**	**Fine gravel over boulder and cobbles**
06GT-TD3	**16.21**	**Boulder and cobbles with trace of silt, coarse sand to fine gravel over clay silt and sand layer over cobbles**
08-MB-GD-01	3.5	Rounded to sub-angular Gravel, cobble (110 mm) granitic. Grey SAND with some angular gravel and trace silt (Till) Cobble (77mm) intermediate volcanics.
08-MB-GD-02	0.6	Driller notes possible boulder.
08-MB-GD-03	2.3	Grey GRAVEL
08-MB-GD-04	3.4	GRAVEL, Cobbles (110, 110, 130, 220 mm) fresh, very strong, intermediate volcanics.

Borehole	Thickness of Soils Encountered (m)	Description
08-MB-GD-05	2.5	Boulder (730 mm) Fresh, very strong, dark grey, intermediate volcanics, with pyrite stringers, pink granitic gravel fragments.
08-MB-GD-06	1.5	Boulder (1200 mm) grey pink granite.
08-MB-GD-07	3.0	Gravel, quartz and granite
08-MB-GD-08	0.3	Angular gravel, granitic
08-MB-GD-09	0.5	No recovery
08-MB-GD-10	4.5 (unconfirmed)	Pink, coarse to fine GRAVEL, granitic, slightly weathered. Boulder (480 mm), pink Granite. Cobble (165 mm) granitic, with gravel.
08-MB-GD-11	0.5	Cobble (180 mm), grey and pink, granitic gravel / angular rock fragments.
08-MB-GD-13	3.8	Fresh, pink and grey GRAVEL, granitic. Cobble (85 mm) granitic. Boulder (755 mm), fresh, grey-green, very strong, ultramafic, with quartzite and talc.
08-MB-GD-14	3.2	Gravel, sand and clayey silt, with cobbles (90,95 mm), with quartzite (TILL).
08-MB-GD-15	4.1	BOULDERS (500 mm granitic, 350 and 380 mm intermediate volcanics) and COBBLES (80, 85, 185 mm intermediate volcanics, 110 mm granitic) with angular gravel fragments
08-MB-GD-16	1.5	Grey-pink coarse GRAVEL granitic.
08-MB-GD-18	0.1	Grey-pink coarse GRAVEL granitic.
08-MB-GD-19	1.0	Grey, sub-angular GRAVEL, granitic cobble (265 mm)
08-MB-GD-20	1.6	Slightly to moderately weathered, grey-pink, coarse to sub-angular GRAVEL, granitic and intermediate volcanic.

Borehole	Thickness of Soils Encountered (m)	Description
08-MB-GD-21	4.5	Grey SAND, some gravel with trace silt. Sub-angular to sub-rounded, grey-pink, strong GRAVEL, granitic.
08-MB-GD-22	1.1	Pink-grey, sub-angular GRAVEL and COBBLES, granitic.

Note: The data in bold correspond to Tailings Storage Facility location.

TABLE I-3: Borehole Observations of Bedrock Surface Elevation, Till Surface Elevation, and Boulder Presence

Borehole Number	Bedrock Elevation (masl)	Till Elevation (masl)	Thickness of soils (m)	Boulders Present (Y/N)	Location	Reference
G02-NP-1	136.22	N/A	N/A	N/A	North Portage Pit	Golder (2002b)
GT02-NP-2	127.57	136.87	9.3	Y	North Portage Pit	
GT02-NP-3	142.34	146.84	4.5	Y	North Portage Pit	
G02-TP-01	134.09	N/A	N/A	N/A	Third Portage Lake	
GT02-TP-2	135.31	N/A	N/A	N/A	Third Portage Lake	
02GT-07	N/A	4.5 below reference elevation	0.45	N	N/A	
MRC02-01	N/A	at reference elevation	1.8	N	N/A	
MRC02-02	N/A	0.7m below reference elevation	1.52	N	N/A	
MRC02-03	N/A	2.64 m below reference elevation	0.36	N	N/A	
MRC02-04	N/A	at reference elevation	1.2	N	N/A	
MRC02-360	N/A	0.95m below reference elevation	1.05	N	N/A	
MRC02-284	N/A	at reference elevation	0.45	N	N/A	
MRC02-365	N/A	at reference elevation	1.6	N	N/A	
MRC02-362	N/A	at reference elevation	2.1	Y	N/A	
MRC02-04	N/A	1.2m below reference elevation	1.5	Y	N/A	

Borehole Number	Bedrock Elevation (masl)	Till Elevation (masl)	Thickness of soils (m)	Boulders Present (Y/N)	Location	Reference
MRC02-01	N/A	1.8m below reference elevation	1.5	Y	N/A	
MRC02-01	N/A	at reference elevation	1.5	Y	N/A	
MRC02-364	N/A	1.0m below reference elevation	0.1	Y	N/A	
MRC02-366	N/A	at reference elevation	1.4	Y	N/A	
MRC02-363	N/A	1.1m below reference elevation	0.5	Y	N/A	
MRC02-367	N/A	at reference elevation	1.1	Y	N/A	
MRC02-02	N/A	0.7 below reference elevation	1.5	Y	N/A	
MRC02-282	N/A	at reference elevation	0.7	Y	N/A	
MRC02-283	N/A	at reference elevation	0.6	Y	N/A	
MRC02-359	N/A	at reference elevation	1	Y	N/A	
MRC02-361	N/A	at reference elevation	0.8	N	N/A	
02GT-01	126.4	none		N	East Dike	Golder (2002a)
02GT-02A	125.88	none		N	East Dike	
02GT-02B	125.48	none		N	East Dike	
02GT-03	132.74	135.07	2.33	Y	East Dike	

Borehole Number	Bedrock Elevation (masl)	Till Elevation (masl)	Thickness of soils (m)	Boulders Present (Y/N)	Location	Reference
02GT-04	133.07	136.04	2.97	Y Below 2.75m	East Dyke	
02-GT-05	120.28	none		N	Central Dike	
02-GT-07	120.87	126.12	3	Y	Stormwater Dike	
02GT-08	124.3	none		N	Stormwater Dike	
02GT-09	135.58	136.77	1.19	Y	Stormwater Dike	
02GT-10	135.16	136.16	1	Y	Stormwater Dike	
02GT-11	112.88	114.48	1.6	N	West of Central Dike	
03GT-BZ-2	126.34	none		N	Bay Zone	Golder (2003d)
03GT-BZ-3	131.35	none		N	Bay Zone	
03GT-BZ-5	125.59	none		Y	Bay Zone	
03GT-BZ-6	125.4	none		Y	Bay Zone	
03GT-GI-1	129.08	none		Y	Goose Island Dike	
03GT-GI-2	129.49	none		N	Goose Island Dike	
03GT-GI-3	122.2	none		N	Goose Island Dike	
03GT-GI-4	131.58	none		N	Goose Island Dike	
03GT-GI-5	129.74	none		N	Goose Island Dike	
03GT-GI-6	121	none		N	Goose Island Dike	
03GT-GI-7	130.59	none		N	Goose Island Dike	
03GT-GI-8	125.4	none		N	Goose Island Dike	

Borehole Number	Bedrock Elevation (masl)	Till Elevation (masl)	Thickness of soils (m)	Boulders Present (Y/N)	Location	Reference
03GT-GPIT-1	119.481	none		N	Goose Island Pit	
03GT-GPIT-2	132.22	none			Goose Island Pit	
03GT-GPIT-3	115.83	none		N	Goose Island Pit	
03GT-GPIT-4	113.47	none		N	Goose Island Pit	
03GT-PS-1	146.36	none		Y	Plant site	
03GT-PS-2	147.14	none		N	Plant site	
03GT-PS-3	148.05	none		N	Plant site	
03GT-PS-4	148.03	none		N	Plant site	
03GT-PS-5	135.48	none		N	Plant site	
03GT-PS-6	146.63	none		N	Plant site	
03GT-PS-7	148.92	none		Y	Plant site	
03GT-PS-8	143.72	none		N	Plant site	
03GT-PS-9	145.97	none		Y	Plant site	
03GT-PS-10	146.84	none		Y	Plant site	
03GT-PS-11	148.18	none		Y	Plant site	
03GT-SE-1	124.67	none		N	East Dike	
03GT-SE-2	131.16	none		N	East Dike	
03GT-TD-1	**132.27**	**none**		**Y**	**Central Dike north abutment**	
03GT-TD-2	**110.89**	**none**		**N**	**Central Dike north abutment**	

Borehole Number	Bedrock Elevation (masl)	Till Elevation (masl)	Thickness of soils (m)	Boulders Present (Y/N)	Location	Reference
03GT-TD-3	**Below 94.60**	**none**		**N**	**Central Dike**	
03GT-TD-4	**112.32**	**none**		**N**	**Central Dike**	
03GT-TD-6	**91.34**	**none**		**N**	**Central Dike**	
03GT-Spec-F1	**137.93**	**none**		**N**	**Between 2nd and 3rd Port Lakes**	
03GT-Spec-F2	125.93	none		N	East Dike	
06GT-TD1	**96.64**	**N/A**		**Y**	**Central Dike**	**Golder (2006d)**
06GT-TD2	**91.21**	**N/A**		**Y**	**Central Dike**	
06GT-TD2A	**93.56**	**N/A**		**Y**	**Central Dike**	
06GT-TD3	**112.98**	**N/A**		**N**	**Central Dike**	
08-MB-GD-01	128.6	132.1	3.5	N	East Dike	Golder (2008)
08-MB-GD-02	130.4	131.0	0.6	N		
08-MB-GD-03	128.0	130.3	2.3	N		
08-MB-GD-04	125.7	129.1	3.4	N		
08-MB-GD-05	125.0	127.5	2.5	Y		
08-MB-GD-06	127.8	129.3	1.5	Y		
08-MB-GD-07	128.7	131.7	3	N		
08-MB-GD-08	128.5	128.8	0.3	N		
08-MB-GD-09	128.3	128.8	0.5	N		
08-MB-GD-10	NC	130.6	4.5	Y		

Borehole Number	Bedrock Elevation (masl)	Till Elevation (masl)	Thickness of soils (m)	Boulders Present (Y/N)	Location	Reference
08-MB-GD-11	131.4	131.9	0.5	N		
08-MB-GD-13	125.3	129.1	3.8	Y		
08-MB-GD-14	128.4	131.6	3.2	N		
08-MB-GD-15	126.6	130.7	4.1	Y		
08-MB-GD-16	130.5	132.0	1.5	N		
08-MB-GD-17	132.4	*133.2 not confirmed	0.8	N		
08-MB-GD-18	130.2	130.3	0.1	N		
08-MB-GD-19	126.3	127.3	1	N		
08-MB-GD-20	128.1	129.7	1.6	N		
08-MB-GD-21	126.9	131.4	4.5	N		
08-MB-GD-22	128.7	129.8	1.1	N		

Note: The data in bold correspond to Tailings Storage Facility location. See Golder 2008 for investigations specific to the Portage Peninsula area.

TABLE I-4: Summary of Till Gradations

Borehole	Depth (m)	% Gravel (>#4)	% Sand (>#200 & <#4)	% Silt (>0.002 mm & <#200)	% Clay (<0.002 mm)	Moisture Content (%)	Reference
Third Portage Trench spoil (59644)	N/A	26	43	24	7	4.4	Golder (2002b)
Third Portage Trench spoil (59645)	N/A	20	41	32	7	4	
Third Portage Trench spoil (59646)	N/A	17	40	37	6	2.7	
MRC02-01-2001	0-1.8	11	60	24	6	3.1	
MRC02-03	2.64-3.0	9	68	22		1.5	
MRC02-04	0-1.2	11	62	23	4	1.4	
MRC02-360	0.95-2.0	7	61	27	5	2.6	
MRC02-284	0-0.45	11	64	21	4	3	
MRC02-365	0-1.6	5	63	24	8	3.6	
MRC02-362	0-2.0	4	70	18	8	4.8	
MRC02-04	1.2-2.7	11	62	23	4	0.8	
MRC02-01-2002	1.8-3.3	12	58	25	5	2.9	
MRC02-01-2003	3.3-4.9	7	59	30	3	0.5	
MRC02-364	1-1.1	6	60	30	5	1.3	
MRC02-366	0-1.4	6	63	24	8	3.7	
MRC02-363	N/A	7	69	18	7	2.8	
MRC02-367	0-1.0	8	65	21	5	3.6	

Borehole	Depth (m)	% Gravel (>#4)	% Sand (>#200 & <#4)	% Silt (>0.002 mm & <#200)	% Clay (<0.002 mm)	Moisture Content (%)	Reference
02GT-02	**128.58**	**3**	**93**	**4**		**16.3**	
02GT-07-3	128.12	16	46	27	11	10.5	
02GT-07-4	127.67	12	49	30	9	11.4	
02GT-07-5	127.22	9	46	33	12	13.1	
02GT-07-6	126.79	9	52	29	10	11.1	
02GT-07-7	125.89	0	71	26	3	19.6	
GT02-TP-1	40.291	4	56	34	6	N/A	
Till Spoil 1	N/A	45	37	13	6	4.4	Golder Laboratory Testing 2006
Till Spoil 2	N/A	35	38	20	7	5.7	
Till Spoil 3	N/A	44	31	18	7	5.9	
Till. Grassland 4	N/A	39	33	22	6	14.8	
Till Spoil 5	N/A	23	41	26	10	5.3	
Till Spoil 6 & 7	N/A	34	44	16	6	5	
Till Spoil 8	N/A	43	40	15	2	4.2	
Till Spoil 9-10	N/A	18	46	34	2	7	
Till Spoil 11	N/A	19	42	33	6	10.9	
Till Spoil 12	N/A	39	33	20	8	8.2	
06-1413-034/3000-SA 9	N/A	25	48	18	10	N/A	Sampled Aug-29-06 by Golder, previously unreported
06-1413-034/3000-SA 2	N/A	25	42	27	6	17.2	

Borehole	Depth (m)	% Gravel (>#4)	% Sand (>#200 & <#4)	% Silt (>0.002 mm & <#200)	% Clay (<0.002 mm)	Moisture Content (%)	Reference
051413036-SA1	N/A	18	48	28	6	24.1	Reported in 05-1413-036/4000 – Aug 29 2005 Letter to CRL
051413036-SA2	N/A	13	48	30	9	11.2	
051413036-SA3	N/A	14	48	28	9	23.6	
051413036-SA4	N/A	15	49	28	8	23	
051413036-SA5	N/A	26	45	24	5	11.8	
051413036-SA6	N/A	4	54	33	8	20.5	
CJC04-034-002		36	27	38		N/A	Sept 13 2004 Site Visit Report
CJC04-034-003		15	52	31	2	N/A	
MRC02-151-2472	N/A	6	70	22	2	N/A	

Note: The data in bold correspond to Tailings Storage Facility location. See also Golder 2008

TABLE I-5: Summary of Bedrock Hydraulic Conductivity Test Data

Borehole	Reference Elevation (masl)	Down Hole Depth from ground surface or ice surface		Inclination (degrees)	Azimuth (degrees)	End of Borehole (down the hole depth m)	Vertical Depth		Elevation		Rock Unit	Hydraulic Conductivity (m/s)
		from (m)	to (m)				from (m)	to (m)	from (masl)	to (masl)		
06GT-TD1**	135.1	44.5	67.0	-89.4	-	204.0	44.5	67.0	91	68	Quartzite	$>3x10^{-05}$
	135.1	60.5	83.5	-89.4	-	204.0	60.5	83.5	75	52	Intermediate Volcanic And Quartzite	$>3x10^{-05}$
	135.1	80.5	113.0	-89.4	-	204.0	80.5	113.0	55	22	Quartzite	$5x10^{-06}$
	135.1	98.5	113.0	-89.4	-	204.0	98.5	113.0	37	22	Quartzite	$1x10^{-05}$
	135.1	109.5	144.0	-89.4	-		109.5	144.0	26	-9	Quartzite and Intermediate Volcanic	$2x10^{-06}$
	135.1	139.5	174.0	-89.4	-		139.5	174.0	-4	-39	Quartzite and Wack, Ultra Mafics	$5x10^{-08}$
	135.1	172.5	204.0	-89.4	-		172.5	204.0	-37	-69	Intermediate Volcanic	$3x10^{-09}$
06GT-TD-2A	135.1	43.5	60.0	-89.3	-	201.0	43.5	60.0	92	75	Intermediate Volcanic	$3x10^{-06}$
	135.1	58.5	81.0	-89.3	-		58.5	81.0	77	54	Intermediate Volcanic/ Quartzite	$2x10^{-07}$
	135.1	79.5	105.0	-89.3	-		79.5	105.0	56	30	Quartzite, Intermediate Volcanic, Ultra Mafics	$3x10^{-07}$
	135.1	103.5	135.0	-89.3	-		103.5	135.0	32	0	Quartzite	$2x10^{-07}$
	135.1	133.5	164.0	-89.3	-		133.5	164.0	2	-29	Quartzite, 0.3m Sand Seam	$7x10^{-07}$
	135.1	163.5	201.0	-89.3	-		163.5	201.0	-28	-66	Intermediate Volcanic	$6x10^{-08}$
06GT-TD-3	135.1	25.5	45.0	-89.6	-	126.0	25.5	45.0	110	90	Intermediate Volcanic	$2x10^{-05}$
	135.1	43.5	66.0	-89.6	-		43.5	66.0	92	69	Intermediate Volcanic	$1x10^{-05}$
	135.1	64.5	81.0	-89.6	-		64.5	81.0	71	54	Intermediate Volcanic, Iron Formation	$6x10^{-07}$
	135.1	79.5	96.0	-89.6	-		79.5	96.0	56	39	Intermediate Volcanic	$1x10^{-06}$
	135.1	94.5	117.0	-89.6	-		94.5	117.0	41	18	Quartzite, Intermediate Volcanic	$3x10^{-06}$
03GT-BZ-2	134	10.9	15.4	-90.0	-	15.4	10.9	15.4	123	119	Intermediate Volcanics	$1.3x10^{-06}$
03GT-BZ-3	134	6.4	9.4	-90.0	-	9.4	6.4	9.4	128	125	Intermediate Volcanics	$3.1x10^{-06}$
03GT-BZ-5	134	8.6	16.1	-90.0	-	16.1	8.6	16.1	125	118	Ultra Mafics	$5x10^{-08}$
03GT-BZ-6	134	11.6	16.1	-90.0	-	16.1	11.6	16.1	122	118	Ultra Mafics	$1.3x10^{-07}$
03GT-GI-1	134	7.6	12.1	-90.0	-	12.1	7.6	12.1	126	122	Intermediate Volcanics	$2.5x10^{-08}$
03GT-GI-2	134	7.5	12.0	-90.0	-	12.0	7.5	12.0	126	122	Intermediate Volcanics	$3.7x10^{-09}$
03GT-GI-3	134	15.4	18.4	-90.0	-	18.4	15.4	18.4	119	116	Intermediate Volcanics	$1.3x10^{-06}$
03GT-GI-5	134	7.6	12.1	-90.0	-	12.1	7.6	12.1	126	122	Ultra Mafics	$3.3x10^{-05}$

Borehole	Reference Elevation (masl)	Down Hole Depth from ground surface or ice surface		Inclination (degrees)	Azimuth (degrees)	End of Borehole (down the hole depth m)	Vertical Depth		Elevation		Rock Unit	Hydraulic Conductivity (m/s)
		from (m)	to (m)				from (m)	to (m)	from (masl)	to (masl)		
03GT-GI-6	134	15.0	18.8	-90.0	-	18.8	15.0	18.8	119	115	Quartzite	$4.7x10^{-07}$
03GT-GPIT-1	132.92	106.8	150.3	-62.0	51.0	150.3	94.3	132.7	39	0	Ultra Mafics	$7.8x10^{-08}$
	132.92	61.8	150.3	-62.0	51.0		54.5	132.7	78	0	Ultra Mafics	$4.1x10^{-08}$
	132.92	22.8	150.3	-62.0	51.0		20.1	132.7	113	0	Ultra Mafics	$1.1x10^{-07}$
03GT-GPIT-3	133.01	22.7	33.2	-61.0	133.0	150.2	19.9	29.1	113	104	Ultra Mafics	$1.3x10^{-08}$
	133.01	97.7	150.2	-61.0	133.0		85.5	131.4	48	2	Iron Formation-Intermediate Volcanics	$6.4x10^{-07}$
	133.01	97.7	150.2	-61.0	133.0		85.5	131.4	48	2	Iron Formation-Intermediate Volcanics	$6.1x10^{-07}$
	133.01	49.7	150.2	-61.0	133.0		43.5	131.4	90	2	Iron Formation-Mafics-Volcanics	$2.6x10^{-07}$
	133.01	28.7	150.2	-61.0	133.0		25.1	131.4	108	2	Iron Formation-Mafics-Volcanics	$2x10^{-07}$
03GT-GPIT-4	129.77	108.7	149.2	-58.0	291.0	149.1	92.2	126.6	38	3	Iron Formation-Mafics	$7.6x10^{-09}$
	129.77	87.7	149.2	-58.0	291.0		74.4	126.6	55	3	Iron Formation-Mafics	$6.5x10^{-09}$
	129.77	66.7	149.2	-58.0	291.0		56.6	126.6	73	3	Iron Formation-Mafics	$8.6x10^{-09}$
	129.77	24.7	149.2	-58.0	291.0		21.0	126.6	109	3	Iron Formation-Mafics	$2x10^{-08}$
03GT-TD-2	**133**	**24.9**	**29.4**	**-90.0**	**-**	**29.4**	**24.9**	**29.4**	**108**	**104**	**Ultra Mafics**	**$2.8x10^{-05}$**
03GT-TD-4	**133**	**24.8**	**29.3**	**-90.0**	**-**	**29.3**	**24.8**	**29.3**	**108**	**104**	**Intermediate Volcanics**	**$4x10^{-05}$**
03GT-TD-6	**132.58**	**47.8**	**52.3**	**-90.0**	**-**	**52.3**	**47.8**	**52.3**	**85**	**80**	**Intermediate Volcanics**	**$5.1x10^{-06}$**
03GT-SE-1	133	11.3	15.8	-90.0	-	15.8	11.3	15.8	122	117	Quartzite	$7.2x10^{-06}$
03GT-SE-2	133	5.8	10.3	-90.0	-	10.3	5.8	10.3	127	123	Intermediate Volcanics	$7.9x10^{-08}$
03GT-SPEC-F2	132.20	15.9	35.4	-58.0	232.0	174.4	13.5	30.0	119	102	Mainly Ultra Mafics	$1.6x10^{-06}$
	132.20	51.9	74.4	-58.0	232.0		44.0	63.1	88	69	Mainly Ultra Mafics	$1.3x10^{-06}$
	132.20	75.9	104.4	-58.0	232.0		64.3	88.5	68	44	Mainly Ultra Mafics	$2.8x10^{-08}$
	132.20	111.9	135.9	-58.0	232.0		94.9	115.2	37	17	Mainly Ultra Mafics	$6.3x10^{-09}$
	132.20	138.9	147.9	-58.0	232.0		117.8	125.4	14	7	Mainly Ultra Mafics	$2.1x10^{-08}$
	132.20	154.9	174.4	-58.0	232.0		131.3	147.9	1	-16	Ultra Mafics-Iron Formation	$1.5x10^{-08}$
	132.20	136.9	174.4	-58.0	232.0		116.1	147.9	16	-16	Ultra Mafics-Iron Formation	$4.3x10^{-09}$
02GT-01	132.5	7.5	9.5	-90.0	-	9.5	7.5	9.5	125	123	Intermediate Volcanic	$2x10^{-06}$
	132.5	7.5	9.5	-90.0	-		7.5	9.5	125	123	Intermediate Volcanic	$4x10^{-07}$
02GT-02	132.48	10.5	12.5	-90.0	-	12.5	10.5	12.5	122	120	Intermediate Volcanic	$3.5x10^{-07}$

Borehole	Reference Elevation (masl)	Down Hole Depth from ground surface or ice surface		Inclination (degrees)	Azimuth (degrees)	End of Borehole (down the hole depth m)	Vertical Depth		Elevation		Rock Unit	Hydraulic Conductivity (m/s)
		from (m)	to (m)				from (m)	to (m)	from (masl)	to (masl)		
02GT-04	136.04	6.5	8.5	-50.3	22.0	30.1	5.1	6.6	131	129	Intermediate Volcanic	$2x10^{-08}$
	136.04	9.5	17.5	-50.3	22.0		7.4	13.6	129	122	Intermediate Volcanic	$3x10^{-07}$
	136.04	18.5	29.5	-50.3	22.0		14.4	22.9	122	113	Intermediate Volcanic	$2x10^{-08}$
GT-02-05	**132.5**	**15.0**	**17.0**	**-90.0**	**-**	**17.0**	**15.0**	**17.0**	**118**	**116**	**Intermediate Volcanic**	**$3x10^{-05}$**
02GT-07	**132.621**	**13.5**	**15.5**	**-90.0**	**-**	**15.5**	**13.5**	**15.5**	**119**	**117**	**Quartzite**	**$1x10^{-06}$**
02GT-08	**132.6**	**10.5**	**12.5**	**-90.0**	**-**	**17.0**	**10.5**	**12.5**	**122**	**120**	**Intermediate To Felsic Volcaniclasitics**	**$1x10^{-04}$**
	132.6	**11.5**	**17.0**	**-90.0**	**-**		**11.5**	**17.0**	**121**	**116**	**Intermediate To Felsic Volcaniclasitics**	**$7x10^{-05}$**
	132.6	**13.5**	**17.0**	**-90.0**	**-**		**13.5**	**17.0**	**119**	**116**	**Granite**	**$3x10^{-06}$**
02GT-09	**136.77**	**24.5**	**30.5**	**-48.4**	**79.0**	**30.8**	**18.3**	**22.8**	**118**	**114**	**Ultra Mafics Volcanic**	**$2x10^{-08}$**
02GT-10	**136.29**	**15.5**	**28.0**	**-48.7**	**238.0**	**30.0**	**11.6**	**21.0**	**125**	**115**	**Intermediate Volcanic**	**$3x10^{-07}$**
	136.29	**21.5**	**30.0**	**-48.7**	**238.0**		**16.1**	**22.5**	**120**	**114**	**Intermediate Volcanic**	**$1x10^{-09}$**
02GT-11	**132.78**	**25.0**	**27.0**	**-90.0**	**-**	**27.0**	**25.0**	**27.0**	**108**	**106**	**Ultra Mafics Volcanic**	**$3x10^{-05}$**
	132.78	**22.0**	**27.0**	**-90.0**	**-**		**22.0**	**27.0**	**111**	**106**	**Ultra Mafics Volcanic**	**$2x10^{-05}$**
NP02-401	132.91	135.0	158.0	-66.4	113.9	158.0	125.5	144.7	7	-12	Intermediate Volcanic	$2x10^{-06}$
	132.91	129.0	158.0	-66.4	113.9		118.2	144.7	15	-12	Intermediate Volcanic	$3x10^{-09}$
	132.91	66.0	158.0	-66.4	113.9		60.5	144.7	72	-12	Intermediate Volcanic	$5x10^{-07}$
NP02-412	133.24	31.0	39.0	-68.3	109.1	69.0	28.8	36.2	104	97	Ultra Mafics	$9x10^{-06}$
	133.24	40.0	69.0	-68.3	109.1		37.1	64.1	96	69	Intermediate Volcanic	$3x10^{-06}$
GT02-NP-1	136.87	25.5	111.0	-59.9	251.0	111.0	21.6	96.0	115	41	Iron Formation/Ultra Mafics/ Intermediate Volcanic	$3x10^{-09}$
	136.87	55.5	111.0	-59.9	251.0		48.0	96.0	89	41		$5x10^{-09}$
	136.87	73.5	111.0	-59.9	251.0		63.6	96.0	73	41	Intermediate Volcanic	$4x10^{-09}$
	136.87	88.5	111.0	-59.9	251.0		76.6	96.0	60	41	Chloritic Intermediate Volcanic	$2x10^{-08}$

Borehole	Reference Elevation (masl)	Down Hole Depth from ground surface or ice surface		Inclination (degrees)	Azimuth (degrees)	End of Borehole (down the hole depth m)	Vertical Depth		Elevation		Rock Unit	Hydraulic Conductivity (m/s)
		from (m)	to (m)				from (m)	to (m)	from (masl)	to (masl)		
GT02-NP-2	136.87	12.0	16.5	-50.2	292.0	109.5	9.2	12.7	128	124	Mafic	$3x10^{-08}$
	136.87	25.5	30.0	-50.2	292.0		19.6	23.0	117	114	Quartzite/Mafic Volcanic	$2x10^{-08}$
	136.87	31.5	42.0	-50.2	292.0		24.2	32.3	113	105	Ultra Mafics	$2x10^{-08}$
	136.87	64.5	81.0	-50.2	292.0		49.1	62.2	88	75	Ultra Mafics/Fault	$2x10^{-08}$
	136.87	87.0	109.5	-50.2	292.0		66.8	84.1	70	53	Iron Formation/Intermediate Volcanic/ Ultra Mafics	$3x10^{-09}$
	136.87	99.0	109.5	-50.2	292.0		76.0	84.1	61	53	Ultra Mafics	$8x10^{-09}$
TP98-258	133.5	18.5	173.0	-58.0	112.0	173.0	15.7	146.7	118	-13	Intermediate Volcanic-Highly Fractured	$1x10^{-07}$
	133.5	18.5	38.0	-58.0	112.0		15.7	32.2	118	101	Intermediate Volcanic	$6x10^{-07}$
	133.5	39.5	173.0	-58.0	112.0		33.5	146.7	100	-13	Iron Formation	$3x10^{-09}$
	133.5	75.5	173.0	-58.0	112.0		64.0	146.7	70	-13	Ultra Mafics-Bz Fault 82.33 To 88.10	$3x10^{-09}$
	133.5	96.5	173.0	-58.0	112.0		81.8	146.7	52	-13	Ultra Mafics	$5x10^{-09}$
	133.5	150.5	173.0	-58.0	112.0		127.6	146.7	6	-13	Intermediate Volcanic/Iron Formation	$2x10^{-08}$
TP98-261	134.79	9.5	152.0	-56.0	112.0	101.0	7.9	126.0	127	9	Quartzite-Highly Fractured	$1x10^{-09}$
	134.79	22.5	152.0	-56.0	112.0		18.7	126.0	116	9	Intermediate Volcanic/Ultra Mafics	$2x10^{-09}$
	134.79	42.5	152.0	-56.0	112.0		35.2	126.0	100	9	Intermediate Volcanic/Iron Formation	$3x10^{-09}$
	134.79	63.5	152.0	-56.0	112.0		52.6	126.0	82	9	Ultramafics-Bz Fault 73.5 To 76.8	$2x10^{-09}$
	134.79	81.5	152.0	-56.0	112.0		67.6	126.0	67	9	Intermediate Vol./Iron Formation/ Ultra Mafics	$4x10^{-09}$
TP98-265	133.41	18.5	50.0	-52.0	112.0	152.0	14.6	39.4	119	94	Int. Volcanic/Iron Formation-Highly Fractured	$3x10^{-07}$
	133.41	18.5	101.0	-52.0	112.0		14.6	79.6	119	54	Int. Volcanic/Iron Formation-Highly Fractured	$6x10^{-07}$
	133.41	51.5	101.0	-52.0	112.0		40.6	79.6	93	54	Intermediate. Volcanic/Iron Formation	$5x10^{-09}$
	133.41	90.5	101.0	-52.0	112.0		71.3	79.6	62	54	Intermediate. Volcanic/ Ultra Mafics-Bz Fault 92.87 to 93.22	$3x10^{-08}$

** Drilling targeted fault zone. The data in bold correspond to Tailings Storage Facility location.

LAKE BED SEDIMENTS WATER CONTENT

Project Number : 06-1413-089 **Tech :** TM

Laboratory Determination of Water Content of Soil and Rock
ASTM D 2216-92

Borehole						
Sample Number	**WAL-1**		**TPS-1**			
Depth (m)						
CONTAINER NUMBER						
MASS WET SOIL + TARE	232.1		267.6			
MASS DRY SOIL + TARE	125.4		147.0			
MASS OF WATER	106.7		120.6			
MASS OF CONTAINER	109.4		122.4			
MASS OF DRY SOIL	16.0		24.6			
Water Content W (%)	**666.9**		**490.2**			

Borehole						
Sample Number						
Depth (m)						
CONTAINER NUMBER						
MASS WET SOIL + TARE						
MASS DRY SOIL + TARE						
MASS OF WATER						
MASS OF CONTAINER						
MASS OF DRY SOIL						
Water Content W (%)						

Borehole						
Sample Number						
Depth (m)						
CONTAINER NUMBER						
MASS WET SOIL + TARE						
MASS DRY SOIL + TARE						
MASS OF WATER						
MASS OF CONTAINER						
MASS OF DRY SOIL						
Water Content W (%)						

Meadowbank Mining Corporation
Meadowbank Gold Project

LAKE BED SEDIMENTS ORGANIC CONTENT

Project Number : **06-1413-089** **Tech :** **TM**

Moisture, Ash and Organic Matter of Peat and Other Organic Soils
ASTM D 2974-87 Method C

Borehole						
Sample Number	**Combined TPS-1 & WAL-1**					
Depth (m)						
Tare Number						
Mass of Soil @ 105^0 C + Tare	90.83					
Mass Soil @ 440^0 C + Tare	84.30					
Mass of Organics	6.53					
Mass of Tare	51.14					
Mass of soil @ 105^0 C	39.69					
Organic Content (%)	**16.45**					

Borehole						
Sample Number						
Depth (m)						
Tare Number						
Mass of Soil @ 105^0 C + Tare						
Mass Soil @ 440^0 C + Tare						
Mass of Organics						
Mass of Tare						
Mass of soil @ 105^0 C						
Organic Content (%)						

Borehole						
Sample Number						
Depth (m)						
Tare Number						
Mass of Soil @ 105^0 C + Tare						
Mass Soil @ 440^0 C + Tare						
Mass of Organics						
Mass of Tare						
Mass of soil @ 105^0 C						
Organic Content (%)						

Recommended Standard Furnace Time @ 440^0 C for Different Soil Types

Sandy Soils	1 Hr
Clay Soils	2 Hr
Organic Soils	3 Hr
Peat	4 Hr

Meadowbank Mining Corporation
Meadowbank Gold Project

Project Number : **06-1413-081** **Tech :** **TM**

Moisture, Ash and Organic Matter of Peat and Other Organic Soils
ASTM D 2974-87 Method C

Borehole						
Sample Number	**TE-1 Sed**	**TE-1 Sed**				
Depth (m)						
Tare Number						
Mass of Soil @ 105^0 C + Tare	41.87	43.05				
Mass Soil @ 440^0 C + Tare	40.88	42.03				
Mass of Organics	0.99	1.02				
Mass of Tare	27.28	27.78				
Mass of soil @ 105^0 C	14.59	15.27				
Organic Content (%)	**6.79**	**6.68**				

Borehole						
Sample Number						
Depth (m)						
Tare Number						
Mass of Soil @ 105^0 C + Tare						
Mass Soil @ 440^0 C + Tare						
Mass of Organics						
Mass of Tare						
Mass of soil @ 105^0 C						
Organic Content (%)						

Borehole						
Sample Number						
Depth (m)						
Tare Number						
Mass of Soil @ 105^0 C + Tare						
Mass Soil @ 440^0 C + Tare						
Mass of Organics						
Mass of Tare						
Mass of soil @ 105^0 C						
Organic Content (%)						

Recommended Standard Furnace Time @ 440^0 C for Different Soil Types

Sandy Soils	1 Hr
Clay Soils	2 Hr
Organic Soils	3 Hr
Peat	4 Hr

Meadowbank Mining Corporation
Meadowbank Gold Project

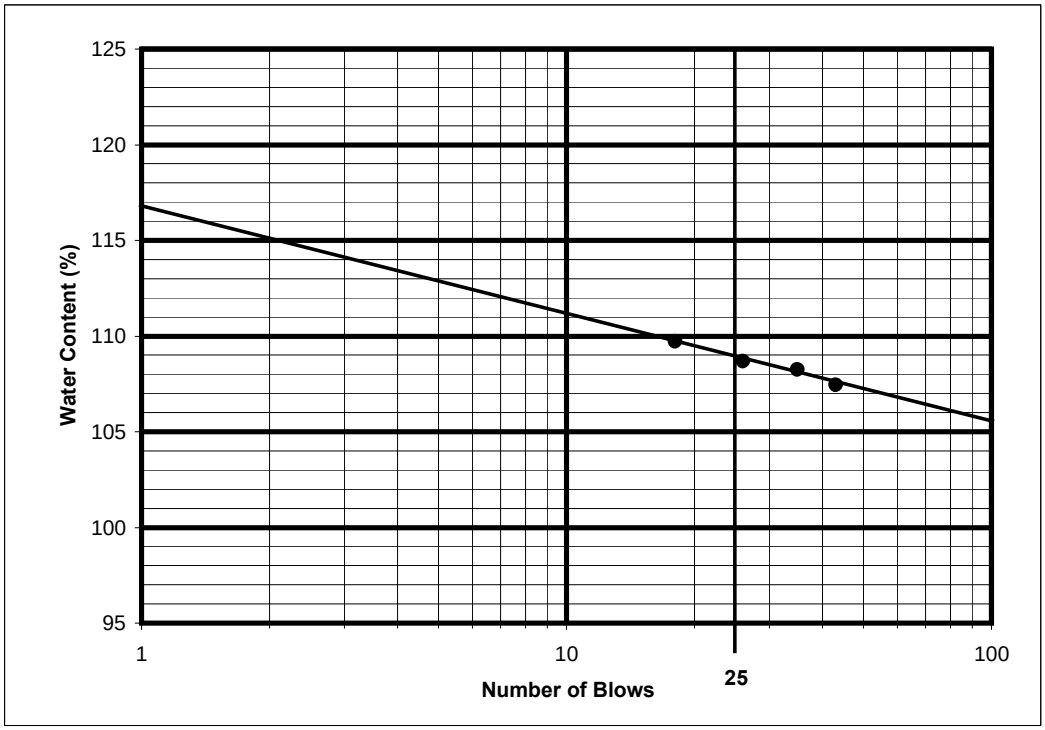
LAKE BED SEDIMENTS ATTERBERG LIMITS

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**43**	**18**	**35**	**26**		
MASS WET SOIL + TARE	35.45	30.39	35.48	35.09		491.90
MASS DRY SOIL + TARE	31.69	27.00	32.59	31.58		401.60
MASS OF WATER	3.76	3.39	2.89	3.51		90.30
MASS OF CONTAINER	28.19	23.91	29.92	28.35		372.10
MASS OF DRY SOIL	3.50	3.09	2.67	3.23		29.5
WATER CONTENT W (%)	**107.4**	**109.7**	**108.2**	**108.7**		**306.1**

TYPE OF TEST	PL	PL	SAMPLE	TPE-1 Sed
CONTAINER NUMBER				
MASS WET SOIL + TARE	31.65	33.57		
MASS DRY SOIL + TARE	29.62	31.78	LIQUID LIMIT (%)	108.9
MASS OF WATER	2.03	1.79	PLASTIC LIMIT (%)	103.2
MASS OF CONTAINER	27.67	30.03	PLASTICITY INDEX (%)	5.7
MASS OF DRY SOIL	1.95	1.75	W% Natural (%)	306.1
WATER CONTENT W (%)	**104.1**	**102.3**	LIQUIDITY INDEX	35.56



SAMPLE DESCRIPTION : OH

Meadowbank Mining Corporation
Meadowbank Gold Project

LAKE BED SEDIMENTS SPECIFIC GRAVITY

SPECIFIC GRAVITY OF SOLIDS

Project No. :	06-1413-089	**Client :**	Meadowbank Mining Corporation	**Sample Number :**	WAL-1 & TPS-1
Sch No.	13	**Project :**	Dike Design	**Date :**	25/01/2007
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

Specific Gravity of Fine Fraction (ASTM D 854-02)

Percentage Passing #4 Sieve		100	
Test Number		1	2
Flask Number		1	1
Air Removal Method		Vacuum	Vacuum
Mass of Flask (g)	M_p	179.42	179.42
Mass of Flask + Dry Soil (g)		213.12	212.61
Mass of Dry Soil (g)		33.70	33.19
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	698.66	698.11
Test Temperature (g)	T_t	18.0	18.0
Mass of Flask + Water (g)	$M_{\rho w,t}$	678.22	678.22
Number of Evaporating Dish			
Mass of Dish + Dry Soil (g)		33.70	33.19
Mass of Dish (g)		0.00	0.00
Mass of Oven Dry Soil (g)	M_s	33.70	33.19
Temperature Coefficient	K	1.0004	1.0004
Density of Solids (g/cm^3)	ρ_s	2.54	2.50
Specific Gravity at Test Temperature	G_t	2.55	2.50
Specific Gravity at 20ºC	$G_{20°C}$	**2.55**	**2.50**
AVERAGE SPECIFIC GRAVITY		**2.52**	

Specific Gravity of Coarse Fraction (ASTM C 127-88)

Percentage Retained on #4 Sieve		0
Mass of Sample in Water (g)	**A**	
Mass of Sample @ SSD (g)	**B**	
Mass of Oven Dryed Sample (g)	**C**	
Bulk G (Oven Dry)	**C/(B-A)**	
Bulk G (SSD)	**B/(B-A)**	
Apparent	**C/(C-A)**	
Absorbtion (%)	**(B-C)/C**	

Specific Gravity of Total Sample

COMBINED SPECIFIC GRAVITY	$G_{avg@20°C}$	**2.52**

Remarks:

Method used: Method A Procedure for Moist Specimens

Sample Description:

SPECIFIC GRAVITY OF SOLIDS

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**Sample :**	TPN-1
Sch No.	288	**Project :**	Dike Design		INUG-1
Lab Work:	TM	**Location:**	Meadowbank Gold Project		SP-1 Sed
Test ID:	Test 1			**Date :**	07/12/2006

Specific Gravity of Fine Fraction (ASTM D 854-02)

Percentage Passing #4 Sieve		100	
Test Number		1	2
Flask Number		1	1
Air Removal Method		Vacuum	Vacuum
Mass of Flask (g)	M_p	179.44	179.44
Mass of Flask + Dry Soil (g)		245.01	245.29
Mass of Dry Soil (g)		97.32	97.23
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	716.96	718.55
Test Temperature (g)	T_t	19.0	18.0
Mass of Flask + Water (g)	$M_{\rho w,t}$	678.14	678.22
Number of Evaporating Dish			
Mass of Dish + Dry Soil (g)		97.32	97.23
Mass of Dish (g)		0.00	0.00
Mass of Oven Dry Soil (g)	M_s	97.32	97.23
Temperature Coefficient	K	1.0002	1.0004
Density of Solids (g/cm^3)	ρ_s	1.66	1.71
Specific Gravity at Test Temperature	G_t	1.67	1.71
Specific Gravity at 20ºC	$G_{20°C}$	**1.67**	**1.71**
AVERAGE SPECIFIC GRAVITY		**1.69**	

Specific Gravity of Coarse Fraction (ASTM C 127-88)

Percentage Retained on #4 Sieve		0
Mass of Sample in Water (g)	**A**	
Mass of Sample @ SSD (g)	**B**	
Mass of Oven Dryed Sample (g)	**C**	
Bulk G (Oven Dry)	**C/(B-A)**	
Bulk G (SSD)	**B/(B-A)**	
Apparent	**C/(C-A)**	
Absorbtion (%)	**(B-C)/C**	

Specific Gravity of Total Sample

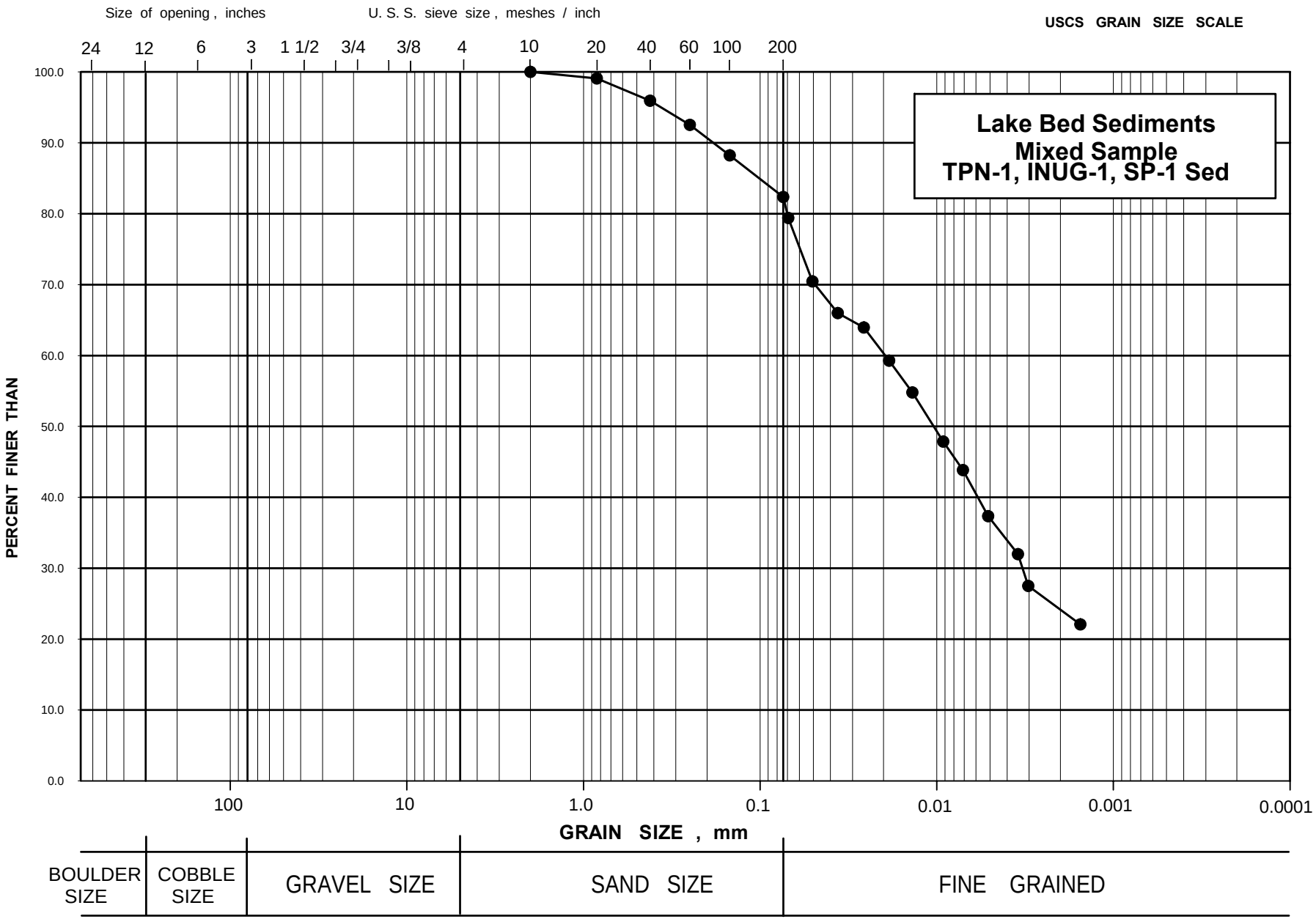
COMBINED SPECIFIC GRAVITY	$G_{avg@20°C}$	**1.69**

Remarks:

Method used: Method A Procedure for Moist Specimens

Sample Description:

LAKE BED SEDIMENTS GRADATION AND HYDROMETER



Project No. 06-1411-042 **Drawn** PK **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**Sample :**	TPN-1
Sch#	288	**Project :**	Dike Design		INUG-1
Lab Work:	TM	**Location:**	Meadowbank Gold Project		SP-1 Sed

First Sieving
Total Weight (g) = 44.2

Hydrometer: (Minus #10)
Before Wash (g) = 44.2
After Wash (g) = 8.2

Residual No. 200 (g) = 0.4
Total minus 200 (g) = 36.4
Gs (assumed) = 2.70

Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	0.0					**38.1**	**100.0**
1"	0.0					**25.4**	**100.0**
3/4"	0.0					**19.1**	**100.0**
1/2"	0.0					**12.7**	**100.0**
3/8"	0.0					**9.52**	**100.0**
#4	0.0					**4.76**	**100.0**
#10	0.0					**2.00**	**100.0**
#20			0.4	0.9	0.9	**0.840**	**99.1**
#40			1.4	3.2	3.2	**0.420**	**95.9**
#60			1.5	3.4	3.4	**0.250**	**92.5**
#100			1.9	4.3	4.3	**0.149**	**88.2**
#200			2.6	5.9	5.9	**0.074**	**82.4**
Pan			36.4	82.4	82.4		

HYDROMETER ANALYSIS

Hydrometer No.: 8589 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	38.0	18.0		-2.51	35.5	**0.0693**	**79.4**
1	34.0	18.0		-2.51	31.5	**0.0506**	**70.5**
2	32.0	18.0		-2.51	29.5	**0.0363**	**66.0**
4	31.1	18.0		-2.51	28.6	**0.0259**	**64.0**
8	29.0	18.0		-2.51	26.5	**0.0186**	**59.3**
15	27.0	18.0		-2.51	24.5	**0.0138**	**54.8**
35	23.9	18.0		-2.51	21.4	**0.0092**	**47.9**
60	22.0	18.5		-2.41	19.6	**0.0071**	**43.8**
120	19.1	18.5		-2.41	16.7	**0.0051**	**37.3**
270	16.6	19.0		-2.30	14.3	**0.0035**	**32.0**
360	14.6	19.0		-2.30	12.3	**0.0030**	**27.5**
1440	13.0	15.0		-3.12	9.9	**0.0015**	**22.1**

TILL WATER CONTENT

Project Number : 06-1413-081 **Tech :** TM

Laboratory Determination of Water Content of Soil and Rock
ASTM D 2216-92

Borehole	Till Spoil	Till Spoil	Till	Till, Grassland	Till Spoil	Till Spoil
Sample Number	1	2	3	4	5	6 & 7
Depth (m)						
CONTAINER NUMBER						
MASS WET SOIL + TARE	12396.0	12923.4	13376.3	13779.6	12648.0	18496.0
MASS DRY SOIL + TARE	11936.7	12295.4	12704.8	12164.4	12072.4	17672.5
MASS OF WATER	459.3	628.0	671.5	1615.2	575.6	823.5
MASS OF CONTAINER	1492.0	1234.6	1269.6	1216.8	1230.1	1134.7
MASS OF DRY SOIL	10444.7	11060.8	11435.2	10947.6	10842.3	16537.8
Water Content W (%)	**4.4**	**5.7**	**5.9**	**14.8**	**5.3**	**5.0**

Borehole	Till Spoil			Till, Trenches		
Sample Number	8	9 & 10	11	12		
Depth (m)						
CONTAINER NUMBER						
MASS WET SOIL + TARE	14752.3	15848.8	18746.3	19462.2		
MASS DRY SOIL + TARE	14213.9	14909.6	17042.3	18083.1		
MASS OF WATER	538.4	939.2	1704.0	1379.1		
MASS OF CONTAINER	1425.9	1472.6	1425.9	1218.2		
MASS OF DRY SOIL	12788.0	13437.0	15616.4	16864.9		
Water Content W (%)	**4.2**	**7.0**	**10.9**	**8.2**		

Borehole						
Sample Number						
Depth (m)						
CONTAINER NUMBER						
MASS WET SOIL + TARE						
MASS DRY SOIL + TARE						
MASS OF WATER						
MASS OF CONTAINER						
MASS OF DRY SOIL						
Water Content W (%)						

Meadowbank Mining Corporation
Meadowbank Gold Project

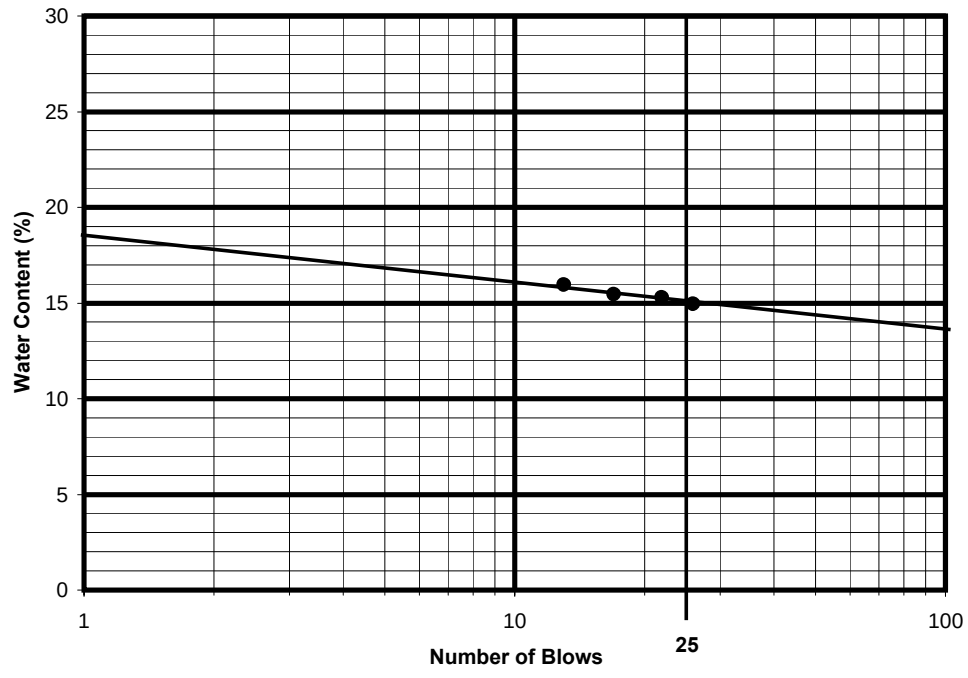
TILL ATTERBERG LIMITS

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**26**	**22**	**17**	**13**		
MASS WET SOIL + TARE	28.97	46.92	44.32	50.34		12396.00
MASS DRY SOIL + TARE	26.86	44.50	42.06	47.34		11936.70
MASS OF WATER	2.11	2.42	2.26	3.00		459.30
MASS OF CONTAINER	12.76	28.67	27.42	28.53		1492.00
MASS OF DRY SOIL	14.10	15.83	14.64	18.81		10444.7
WATER CONTENT W (%)	**15.0**	**15.3**	**15.4**	**15.9**		**4.4**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	1
MASS WET SOIL + TARE	31.27	38.04	DEPTH	
MASS DRY SOIL + TARE	30.27	36.81	LIQUID LIMIT (%)	15.0
MASS OF WATER	1.00	1.23	PLASTIC LIMIT (%)	15.1
MASS OF CONTAINER	23.68	28.65	PLASTICITY INDEX (%)	---
MASS OF DRY SOIL	6.59	8.16	W% Natural (%)	4.4
WATER CONTENT W (%)	**15.2**	**15.1**	LIQUIDITY INDEX	---



SAMPLE DESCRIPTION : **Non Plastic Result**

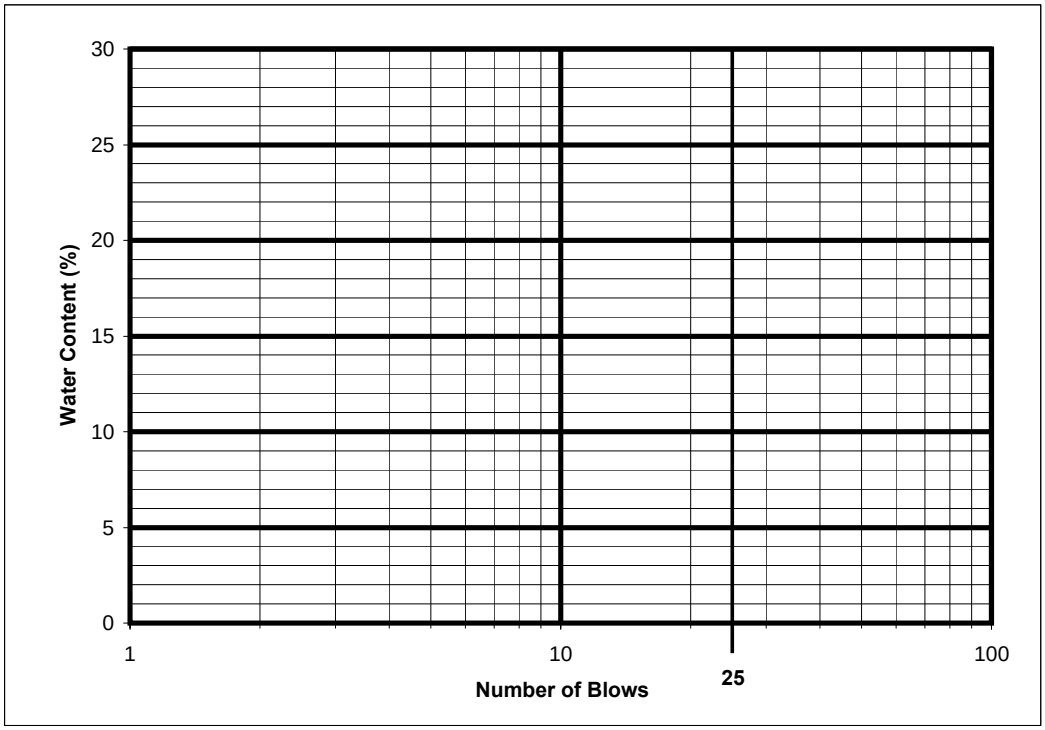
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS						
MASS WET SOIL + TARE						12923.40
MASS DRY SOIL + TARE						12295.40
MASS OF WATER						628.00
MASS OF CONTAINER						1234.60
MASS OF DRY SOIL						11060.8
WATER CONTENT W (%)						**5.7**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	2
MASS WET SOIL + TARE			DEPTH	
MASS DRY SOIL + TARE			LIQUID LIMIT (%)	NA
MASS OF WATER			PLASTIC LIMIT (%)	NA
MASS OF CONTAINER			PLASTICITY INDEX (%)	NA
MASS OF DRY SOIL			W% Natural (%)	5.7
WATER CONTENT W (%)			LIQUIDITY INDEX	NA



SAMPLE DESCRIPTION : **Non Plastic Result**
Could not achieve 25 blows

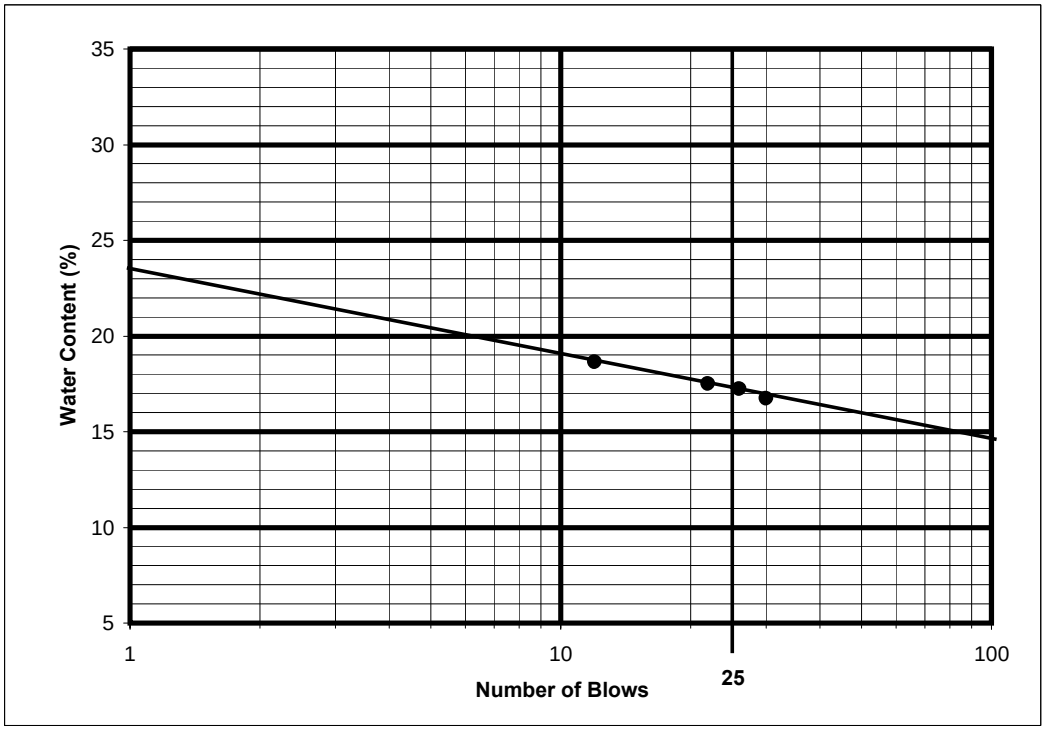
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**30**	**26**	**22**	**12**		
MASS WET SOIL + TARE	43.57	51.84	46.59	50.31		13376.30
MASS DRY SOIL + TARE	41.39	48.76	43.92	46.92		12704.80
MASS OF WATER	2.18	3.08	2.67	3.39		671.50
MASS OF CONTAINER	28.36	30.88	28.67	28.75		1269.60
MASS OF DRY SOIL	13.03	17.88	15.25	18.17		11435.2
WATER CONTENT W (%)	**16.7**	**17.2**	**17.5**	**18.7**		**5.9**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	3
MASS WET SOIL + TARE	38.72	40.86	DEPTH	
MASS DRY SOIL + TARE	37.25	39.43	LIQUID LIMIT (%)	17.2
MASS OF WATER	1.47	1.43	PLASTIC LIMIT (%)	16.0
MASS OF CONTAINER	27.97	30.57	PLASTICITY INDEX (%)	1.2
MASS OF DRY SOIL	9.28	8.86	W% Natural (%)	5.9
WATER CONTENT W (%)	**15.8**	**16.1**	LIQUIDITY INDEX	-8.36



SAMPLE DESCRIPTION : CL

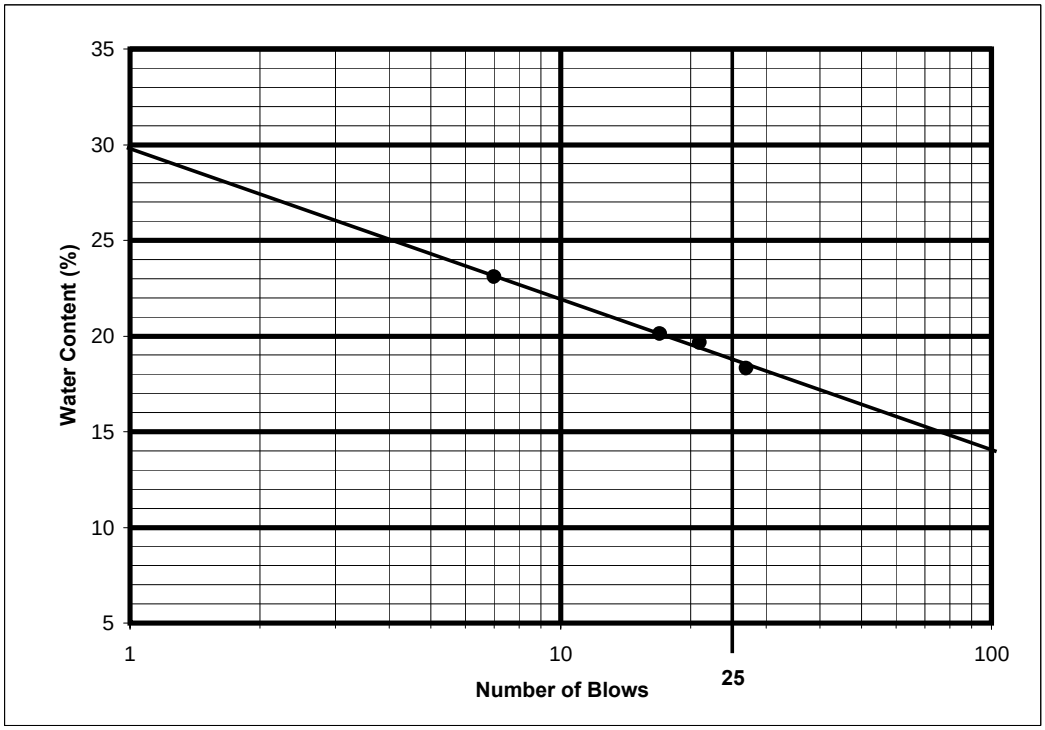
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**7**	**17**	**21**	**27**		
MASS WET SOIL + TARE	44.13	43.24	46.86	47.16		13779.60
MASS DRY SOIL + TARE	41.27	40.70	43.86	44.26		12164.40
MASS OF WATER	2.86	2.54	3.00	2.90		1615.20
MASS OF CONTAINER	28.89	28.07	28.58	28.41		1269.60
MASS OF DRY SOIL	12.38	12.63	15.28	15.85		10894.8
WATER CONTENT W (%)	**23.1**	**20.1**	**19.6**	**18.3**		**14.8**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	4
MASS WET SOIL + TARE	42.47	40.03	DEPTH	
MASS DRY SOIL + TARE	40.56	38.37	LIQUID LIMIT (%)	18.8
MASS OF WATER	1.91	1.66	PLASTIC LIMIT (%)	18.0
MASS OF CONTAINER	29.95	29.17	PLASTICITY INDEX (%)	0.8
MASS OF DRY SOIL	10.61	9.20	W% Natural (%)	14.8
WATER CONTENT W (%)	**18.0**	**18.0**	LIQUIDITY INDEX	-4.11



SAMPLE DESCRIPTION : CL

Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**26**	**17**	**14**	**10**		
MASS WET SOIL + TARE	16.96	21.93	19.36	19.59		12648.00
MASS DRY SOIL + TARE	14.79	19.01	16.78	16.86		12072.40
MASS OF WATER	2.17	2.92	2.58	2.73		575.60
MASS OF CONTAINER	1.50	1.49	1.51	1.50		1230.10
MASS OF DRY SOIL	13.29	17.52	15.27	15.36		10842.3
WATER CONTENT W (%)	**16.3**	**16.7**	**16.9**	**17.8**		**5.3**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	5
MASS WET SOIL + TARE	11.61	9.40	DEPTH	
MASS DRY SOIL + TARE	10.26	8.32	LIQUID LIMIT (%)	16.3
MASS OF WATER	1.35	1.08	PLASTIC LIMIT (%)	15.8
MASS OF CONTAINER	1.54	1.60	PLASTICITY INDEX (%)	0.5
MASS OF DRY SOIL	8.72	6.72	W% Natural (%)	5.3
WATER CONTENT W (%)	**15.5**	**16.1**	LIQUIDITY INDEX	-20.00

SAMPLE DESCRIPTION : CL

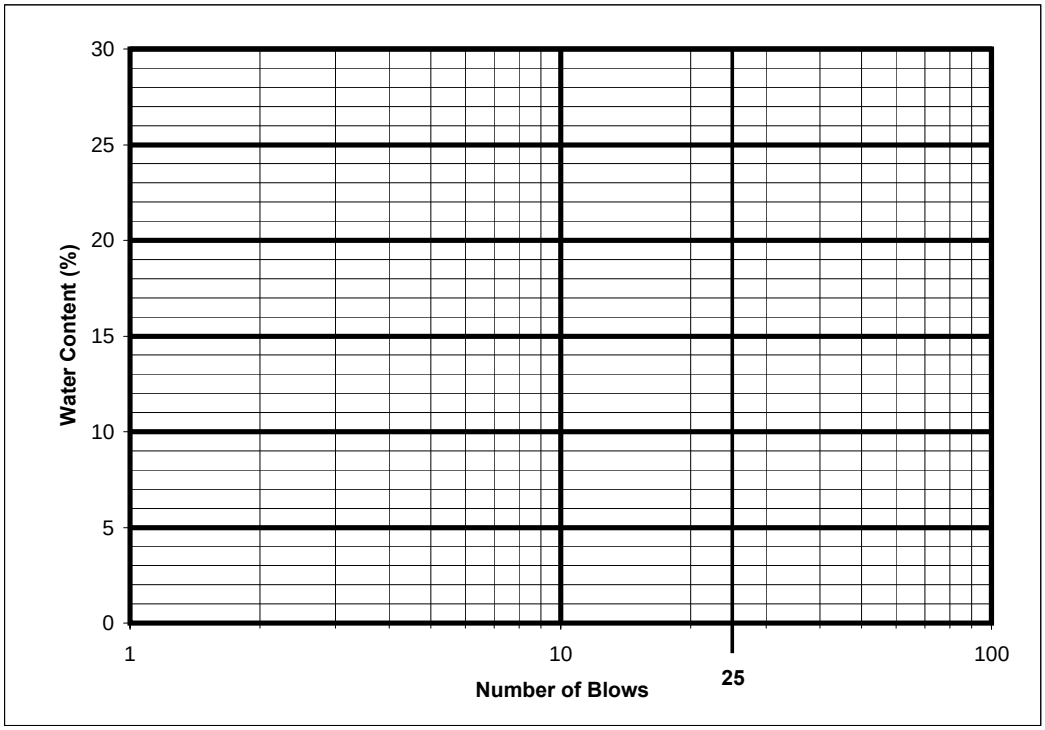
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS						
MASS WET SOIL + TARE						18496.00
MASS DRY SOIL + TARE						17672.50
MASS OF WATER						823.50
MASS OF CONTAINER						1134.70
MASS OF DRY SOIL						16537.8
WATER CONTENT W (%)						**5.0**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	6 & 7
MASS WET SOIL + TARE			DEPTH	
MASS DRY SOIL + TARE			LIQUID LIMIT (%)	NA
MASS OF WATER			PLASTIC LIMIT (%)	NA
MASS OF CONTAINER			PLASTICITY INDEX (%)	NA
MASS OF DRY SOIL			W% Natural (%)	5.0
WATER CONTENT W (%)			LIQUIDITY INDEX	NA



SAMPLE DESCRIPTION : **Non Plastic Result**
Could not achieve 25 blows

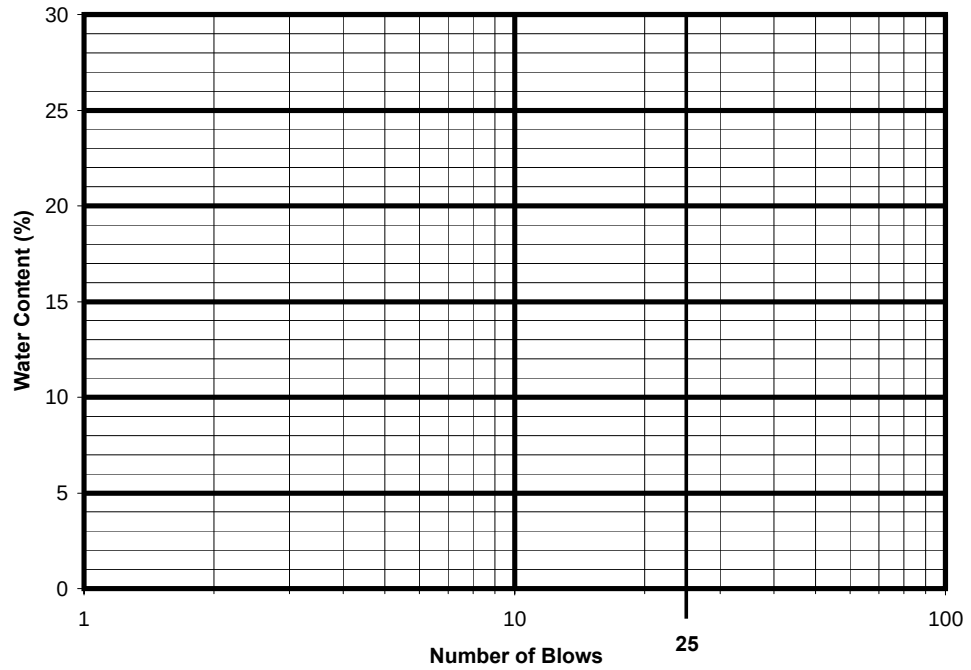
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS						
MASS WET SOIL + TARE						14752.30
MASS DRY SOIL + TARE						14213.90
MASS OF WATER						538.40
MASS OF CONTAINER						1425.90
MASS OF DRY SOIL						12788.0
WATER CONTENT W (%)						**4.2**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	8
MASS WET SOIL + TARE			DEPTH	
MASS DRY SOIL + TARE			LIQUID LIMIT (%)	NA
MASS OF WATER			PLASTIC LIMIT (%)	NA
MASS OF CONTAINER			PLASTICITY INDEX (%)	NA
MASS OF DRY SOIL			W% Natural (%)	4.2
WATER CONTENT W (%)			LIQUIDITY INDEX	NA



SAMPLE DESCRIPTION : **Non Plastic Result**
Could not achieve 25 blows

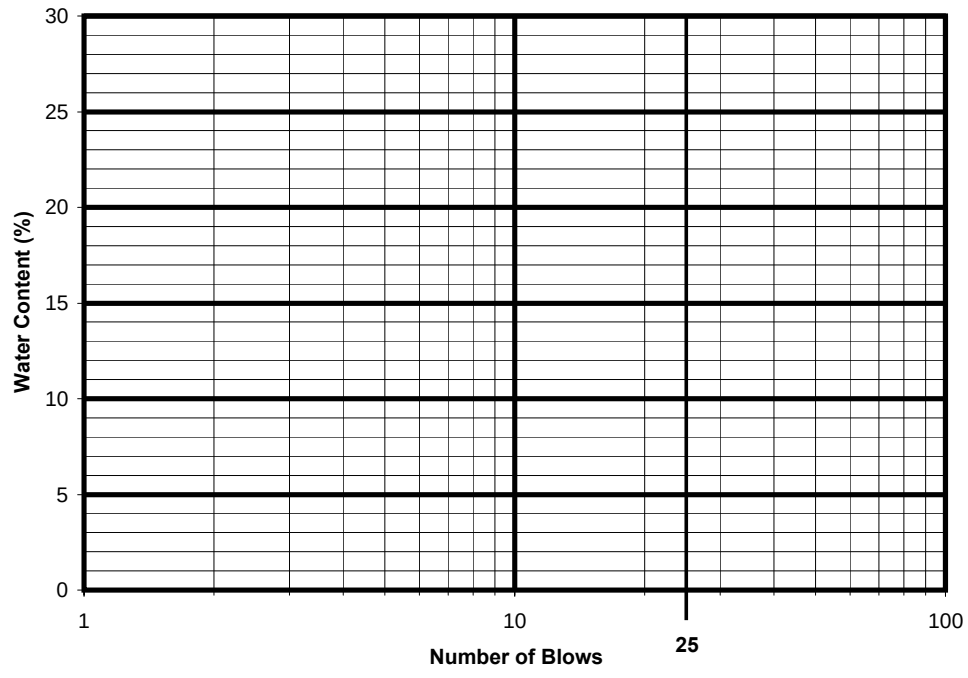
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS						
MASS WET SOIL + TARE						15848.80
MASS DRY SOIL + TARE						14909.60
MASS OF WATER						939.20
MASS OF CONTAINER						1472.60
MASS OF DRY SOIL						13437.0
WATER CONTENT W (%)						**7.0**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	9 & 10
MASS WET SOIL + TARE			DEPTH	
MASS DRY SOIL + TARE			LIQUID LIMIT (%)	NA
MASS OF WATER			PLASTIC LIMIT (%)	NA
MASS OF CONTAINER			PLASTICITY INDEX (%)	NA
MASS OF DRY SOIL			W% Natural (%)	7.0
WATER CONTENT W (%)			LIQUIDITY INDEX	NA



SAMPLE DESCRIPTION : **Non Plastic Result**
Could not achieve 25 blows

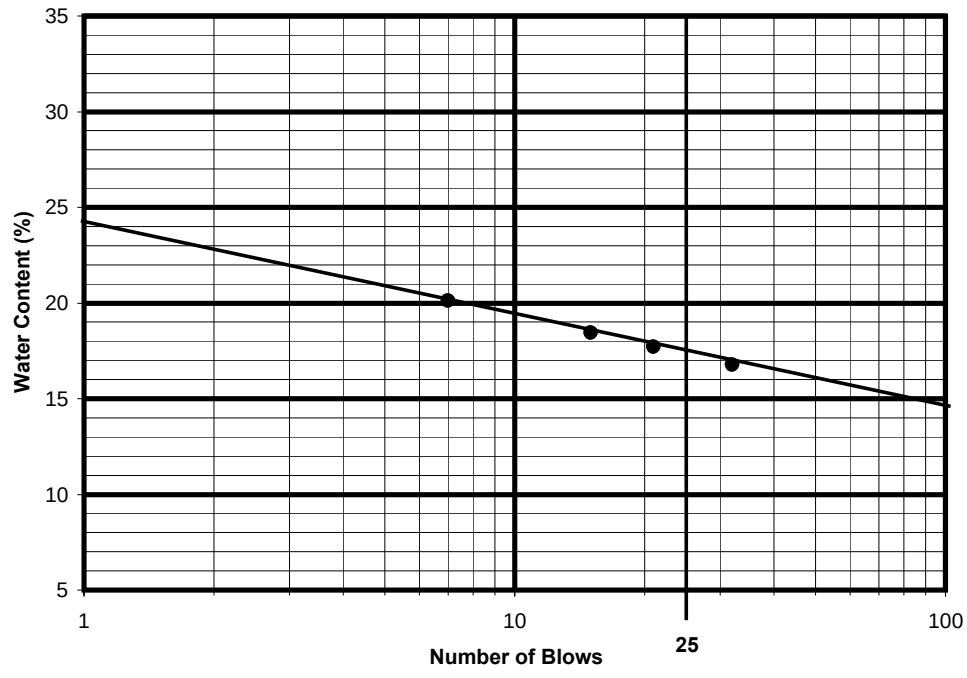
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**7**	**15**	**21**	**32**		
MASS WET SOIL + TARE	45.93	50.04	43.27	47.60		18746.30
MASS DRY SOIL + TARE	43.05	47.06	40.95	44.88		17042.30
MASS OF WATER	2.88	2.98	2.32	2.72		1704.00
MASS OF CONTAINER	28.73	30.89	27.85	28.66		1425.90
MASS OF DRY SOIL	14.32	16.17	13.10	16.22		15616.4
WATER CONTENT W (%)	**20.1**	**18.4**	**17.7**	**16.8**		**10.9**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	11
MASS WET SOIL + TARE	36.56	19.18	DEPTH	
MASS DRY SOIL + TARE	35.45	18.21	LIQUID LIMIT (%)	17.5
MASS OF WATER	1.11	0.97	PLASTIC LIMIT (%)	16.8
MASS OF CONTAINER	28.66	12.57	PLASTICITY INDEX (%)	0.7
MASS OF DRY SOIL	6.79	5.64	W% Natural (%)	10.9
WATER CONTENT W (%)	**16.3**	**17.2**	LIQUIDITY INDEX	-8.06



SAMPLE DESCRIPTION : CL

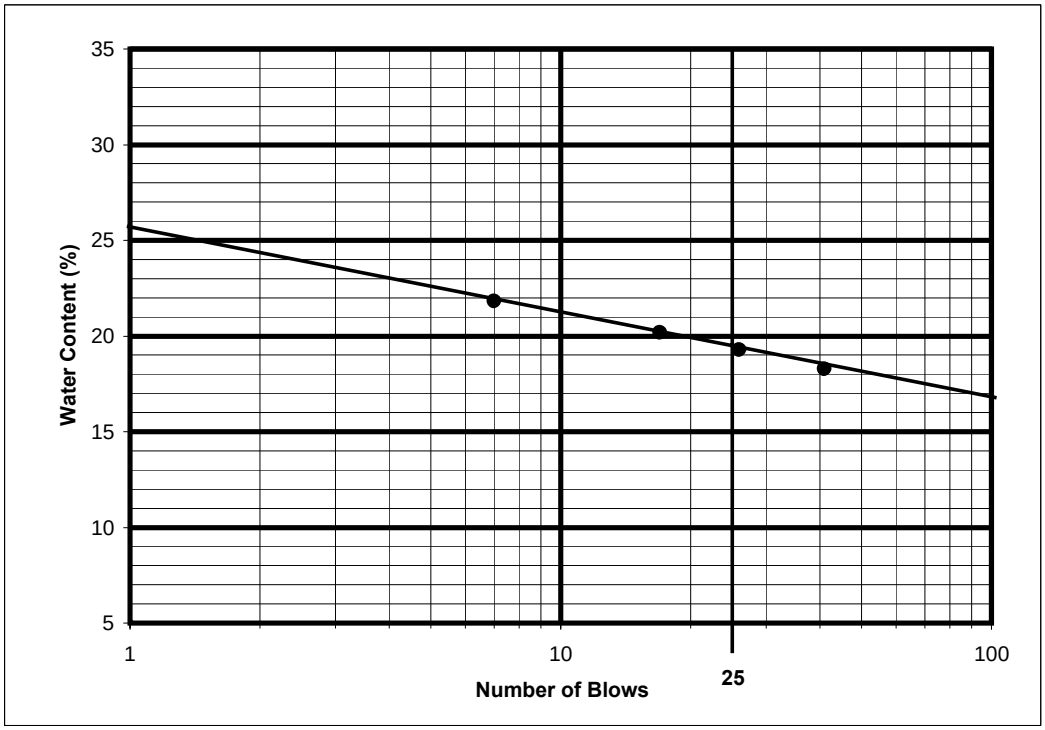
Meadowbank Mining Corporation
Meadowbank Gold Project

Project # 06-1413-081 **Tech : TM**

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318-93

TYPE OF TEST	LL	LL	LL	LL		W% Nat.
CONTAINER NUMBER						
NUMBER OF BLOWS	**7**	**17**	**26**	**41**		
MASS WET SOIL + TARE	46.50	46.20	45.36	46.10		19462.20
MASS DRY SOIL + TARE	43.34	43.47	42.62	43.31		18083.10
MASS OF WATER	3.16	2.73	2.74	2.79		1379.10
MASS OF CONTAINER	28.87	29.95	28.42	28.05		1218.20
MASS OF DRY SOIL	14.47	13.52	14.20	15.26		16864.9
WATER CONTENT W (%)	**21.8**	**20.2**	**19.3**	**18.3**		**8.2**

TYPE OF TEST	PL	PL	BOREHOLE NO.	Lake Bed Till
CONTAINER NUMBER			SAMPLE	12
MASS WET SOIL + TARE	36.42	37.44	DEPTH	
MASS DRY SOIL + TARE	35.44	36.11	LIQUID LIMIT (%)	19.4
MASS OF WATER	0.98	1.33	PLASTIC LIMIT (%)	17.6
MASS OF CONTAINER	29.85	28.57	PLASTICITY INDEX (%)	1.8
MASS OF DRY SOIL	5.59	7.54	W% Natural (%)	8.2
WATER CONTENT W (%)	**17.5**	**17.6**	LIQUIDITY INDEX	-5.18



SAMPLE DESCRIPTION : CL

Meadowbank Mining Corporation
Meadowbank Gold Project

TILL SPECIFIC GRAVITY

SPECIFIC GRAVITY OF SOLIDS

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**Borehole :**	Lake Bed Till
Sch No.	277	**Project :**	Dike Design	**Sample Number :**	1
Lab Work:	SK	**Location:**	Meadowbank Gold Project	**Depth :**	
Test ID:	Test 1			**Date :**	Nov 22 2006

Specific Gravity of Fine Fraction (ASTM D 854-02)

Percentage Passing #4 Sieve		55.5	
Test Number		1	2
Flask Number		1	2
Air Removal Method		Vacuum	Vacuum
Mass of Flask (g)	M_p	179.44	172.65
Mass of Flask + Dry Soil (g)		279.90	273.09
Mass of Dry Soil (g)		100.46	100.44
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	739.30	732.84
Test Temperature (g)	T_t	28.6	29.5
Mass of Flask + Water (g)	$M_{\rho w,t}$	677.05	670.01
Number of Evaporating Dish		1	2
Mass of Dish + Dry Soil (g)		117.45	117.53
Mass of Dish (g)		16.99	17.09
Mass of Oven Dry Soil (g)	M_s	100.46	100.44
Temperature Coefficient	K	0.9979	0.9976
Density of Solids (g/cm^3)	ρ_s	2.63	2.67
Specific Gravity at Test Temperature	G_t	2.64	2.68
Specific Gravity at 20°C	$G_{20°C}$	**2.6**	**2.7**
AVERAGE SPECIFIC GRAVITY		**2.7**	

Specific Gravity of Coarse Fraction (ASTM C 127-88)

Percentage Retained on #4 Sieve		44.5
Mass of Sample in Water (g)	**A**	430.6
Mass of Sample @ SSD (g)	**B**	690.7
Mass of Oven Dryed Sample (g)	**C**	686.5
Bulk G (Oven Dry)	**C/(B-A)**	2.64
Bulk G (SSD)	**B/(B-A)**	2.66
Apparent	**C/(C-A)**	**2.68**
Absorbtion (%)	**(B-C)/C**	0.01

Specific Gravity of Total Sample

COMBINED SPECIFIC GRAVITY	$G_{avg@20°C}$	**2.67**

Remarks:

Method used: Method A Procedure for Moist Specimens

Sample Description:

SPECIFIC GRAVITY OF SOLIDS

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**Borehole :**	Lake Bed Till
Sch No.	277	**Project :**	Dike Design	**Sample Number :**	2
Lab Work:	SK	**Location:**	Meadowbank Gold Project	**Depth :**	
Test ID:	Test 1			**Date :**	

Specific Gravity of Fine Fraction (ASTM D 854-02)

Percentage Passing #4 Sieve		64.7	
Test Number		1	2
Flask Number		1	2
Air Removal Method		Vacuum	Vacuum
Mass of Flask (g)	M_p	179.44	172.65
Mass of Flask + Dry Soil (g)		280.18	278.84
Mass of Dry Soil (g)		100.74	106.19
Mass of Flask + Soil + Water (g)	$M_{\rho ws,t}$	740.60	737.22
Test Temperature (g)	T_t	23.3	23.6
Mass of Flask + Water (g)	$M_{\rho w,t}$	677.72	670.70
Number of Evaporating Dish		1	2
Mass of Dish + Dry Soil (g)		117.54	123.05
Mass of Dish (g)		16.80	16.86
Mass of Oven Dry Soil (g)	M_S	100.74	106.19
Temperature Coefficient	K	0.9993	0.9992
Density of Solids (g/cm^3)	ρ_s	2.66	2.68
Specific Gravity at Test Temperature	G_t	2.67	2.68
Specific Gravity at 20°C	$G_{20°C}$	**2.7**	**2.7**
AVERAGE SPECIFIC GRAVITY		**2.7**	

Specific Gravity of Coarse Fraction (ASTM C 127-88)

Percentage Retained on #4 Sieve		35.3
Mass of Sample in Water (g)	**A**	523.3
Mass of Sample @ SSD (g)	**B**	821.8
Mass of Oven Dryed Sample (g)	**C**	816.1
Bulk G (Oven Dry)	**C/(B-A)**	2.73
Bulk G (SSD)	**B/(B-A)**	2.75
Apparent	**C/(C-A)**	**2.79**
Absorbtion (%)	**(B-C)/C**	0.01

Specific Gravity of Total Sample

COMBINED SPECIFIC GRAVITY	$G_{avg@20°C}$	**2.71**

Remarks:

Method used: Method A Procedure for Moist Specimens

Sample Description:

TILL STANDARD PROCTOR

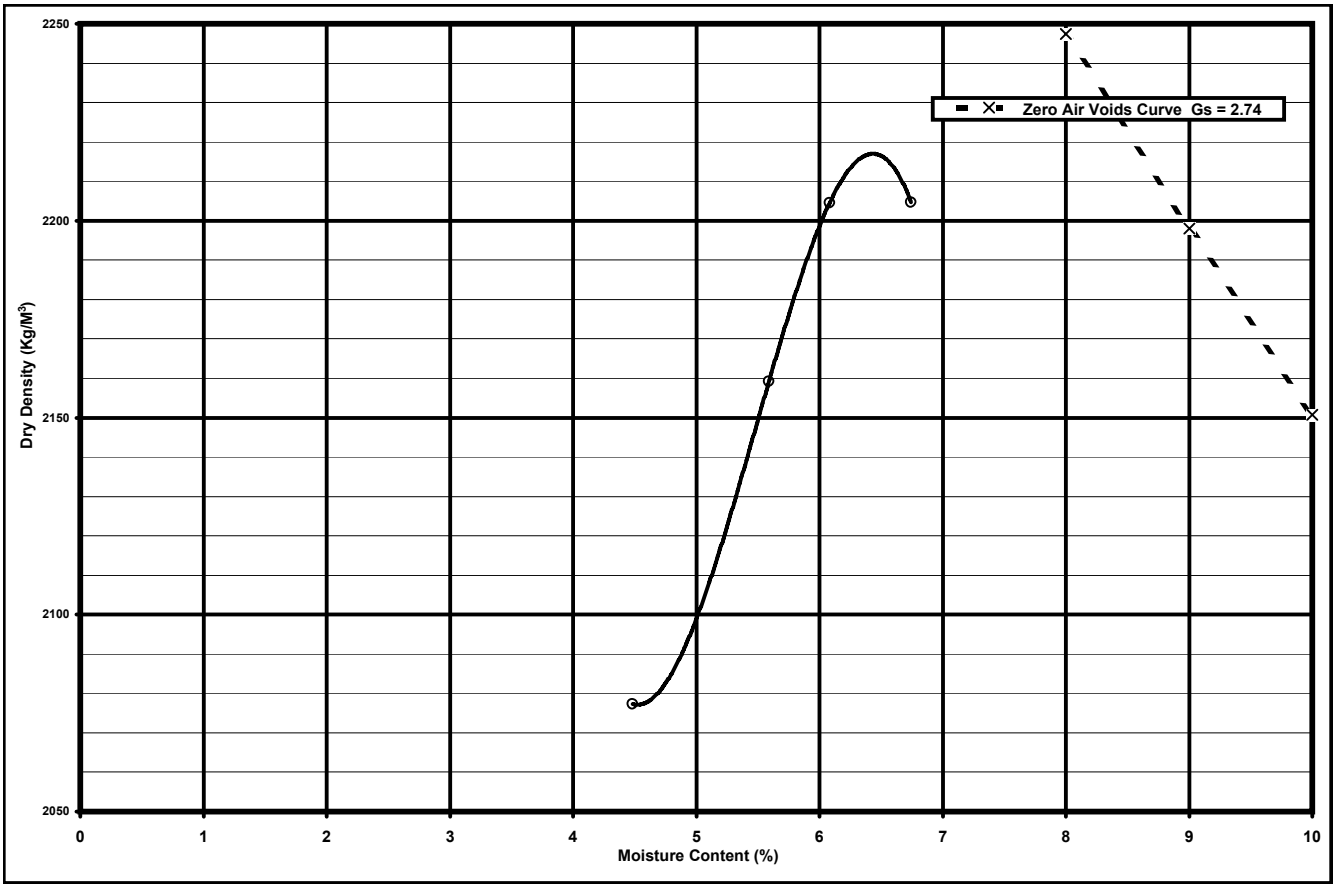
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corporation	Sample	1	*Method*	**C**	
Project	Dike Design		Second Portage, Lake Trench,	*Optimum WC =*	**6.4**	%
Location	Meadowbank Gold Project		Lake Bed Till	*Max ρ_{dry} =*	**2217**	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*		
Schedule #	13				*Correction for oversize particles*		
Proctor Type (S/M)	S				*Optimum WC =*	**5.4**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2309**	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*			*Percent Oversize :*		
WT SOIL WET + MOULD	10252	10484	10609	10640			SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			*Coarser Fraction*		
WT OF SOIL WET	4610	4842	4967	4999			P_c =	20.8	%
WET DENSITY (Kg/M^3)	2170	2280	2339	2353			Gs =	2.74	assumed
DRY DENSITY (Kg/M^3)	*2077*	*2159*	*2205*	*2205*			W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	435.2	372.7	423.0	514.7			P_f =	79.2	%
WT OF DRY SOIL + TARE	425.6	358.9	404.8	494.4			Gs =	2.74	assumed
WEIGHT OF WATER	9.6	13.8	18.2	20.3			W_f =	6.4	%
TARE WEIGHT	211.5	112.0	105.6	193.4			Zero Air Voids Curve Gs =		2.74
WEIGHT OF DRY SOIL	214.1	246.9	299.2	301.0			Bulk Gs =	2.74	
MOISTURE CONTENT (%)	*4.5*	*5.6*	*6.1*	*6.7*			Saturation =	100.0	%



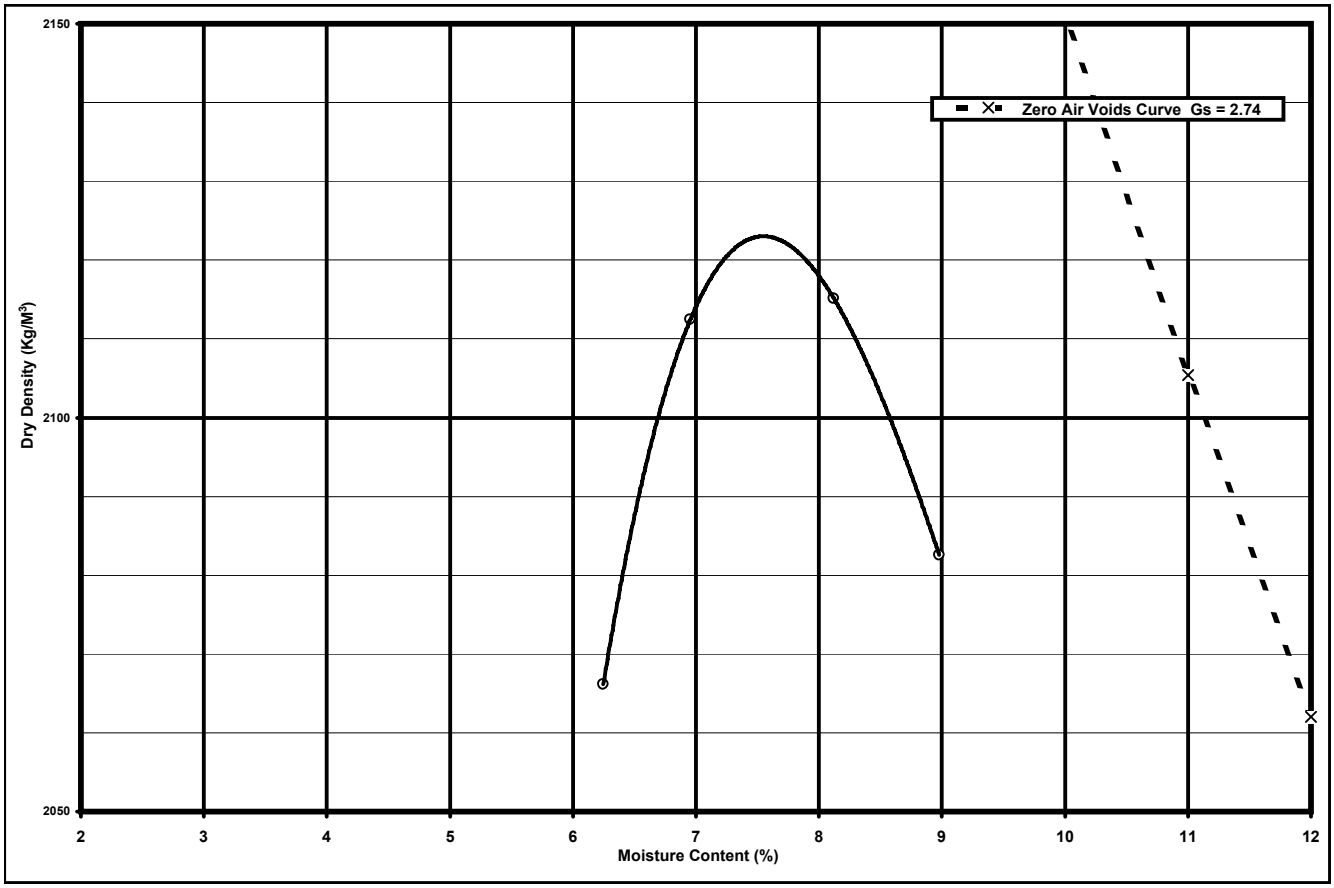
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corporation	Sample	2	*Method*	**C**	
Project	Dike Design		Second Portage, Trench,	*Optimum WC =*	**7.5**	%
Location	Meadowbank Gold Project		Lake Bed Till	*Max ρ_{dry} =*	**2123**	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*		
Schedule #	13				*Correction for oversize particles*		
Proctor Type (S/M)	S				*Optimum WC =*	**6.4**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2211**	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*			*Percent Oversize :*		
WT SOIL WET + MOULD	10305	10441	10499	10462			SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			*Coarser Fraction*		
WT OF SOIL WET	4663	4799	4857	4821			P_c =	17.7	%
WET DENSITY (Kg/M^3)	2195	2259	2287	2270			Gs =	2.74	assumed
DRY DENSITY (Kg/M^3)	***2066***	***2112***	***2115***	***2083***			W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	394.3	552.9	510.1	481.2			P_f =	82.3	%
WT OF DRY SOIL + TARE	377.6	530.7	487.7	450.8			Gs =	2.74	assumed
WEIGHT OF WATER	16.7	22.2	22.4	30.4			W_f =	7.5	%
TARE WEIGHT	110.3	211.5	211.8	112.2			Zero Air Voids Curve Gs =		**2.74**
WEIGHT OF DRY SOIL	267.3	319.2	275.9	338.6			Bulk Gs =	2.74	
MOISTURE CONTENT (%)	***6.2***	***7.0***	***8.1***	***9.0***			Saturation =	100.0	%



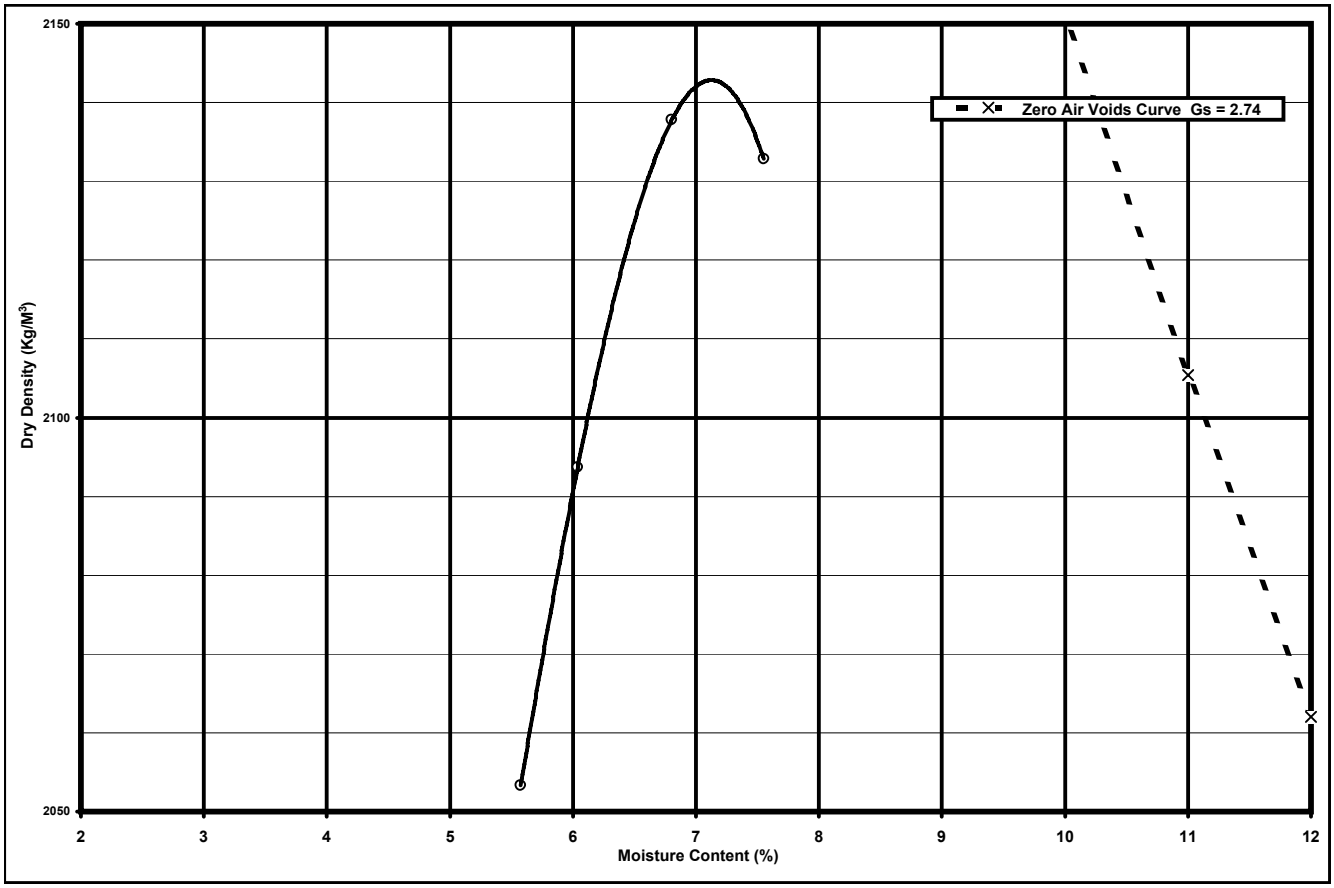
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corporation	Sample	3, 6 & 7 Combined	*Method*	**C**	
Project	Dike Design		Second Portage, Lake Trench,	*Optimum WC =*	**7.1**	%
Location	Meadowbank Gold Project		Lake Bed Till	*Max ρ_{dry} =*	**2142**	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*		
Schedule #	13				*Correction for oversize particles*		
Proctor Type (S/M)	S				*Optimum WC =*	**5.6**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2272**	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*			*Percent Oversize :*		
WT SOIL WET + MOULD	10246	10357	10492	10514			SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			*Coarser Fraction*		
WT OF SOIL WET	4605	4716	4850	4872			P_c =	26.3	%
WET DENSITY (Kg/M^3)	2168	2220	2283	2294			Gs =	2.74	assumed
DRY DENSITY (Kg/M^3)	***2053***	***2094***	***2138***	***2133***			W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	339.3	475.1	349.1	546.4			P_f =	73.7	%
WT OF DRY SOIL + TARE	327.2	460.1	334.0	522.9			Gs =	2.74	assumed
WEIGHT OF WATER	12.1	15.0	15.1	23.5			W_f =	7.1	%
TARE WEIGHT	110.2	211.7	112.1	211.6			Zero Air Voids Curve Gs =		**2.74**
WEIGHT OF DRY SOIL	217.0	248.4	221.9	311.3			Bulk Gs =	2.74	
MOISTURE CONTENT (%)	***5.6***	***6.0***	***6.8***	***7.5***			Saturation =	100.0	%



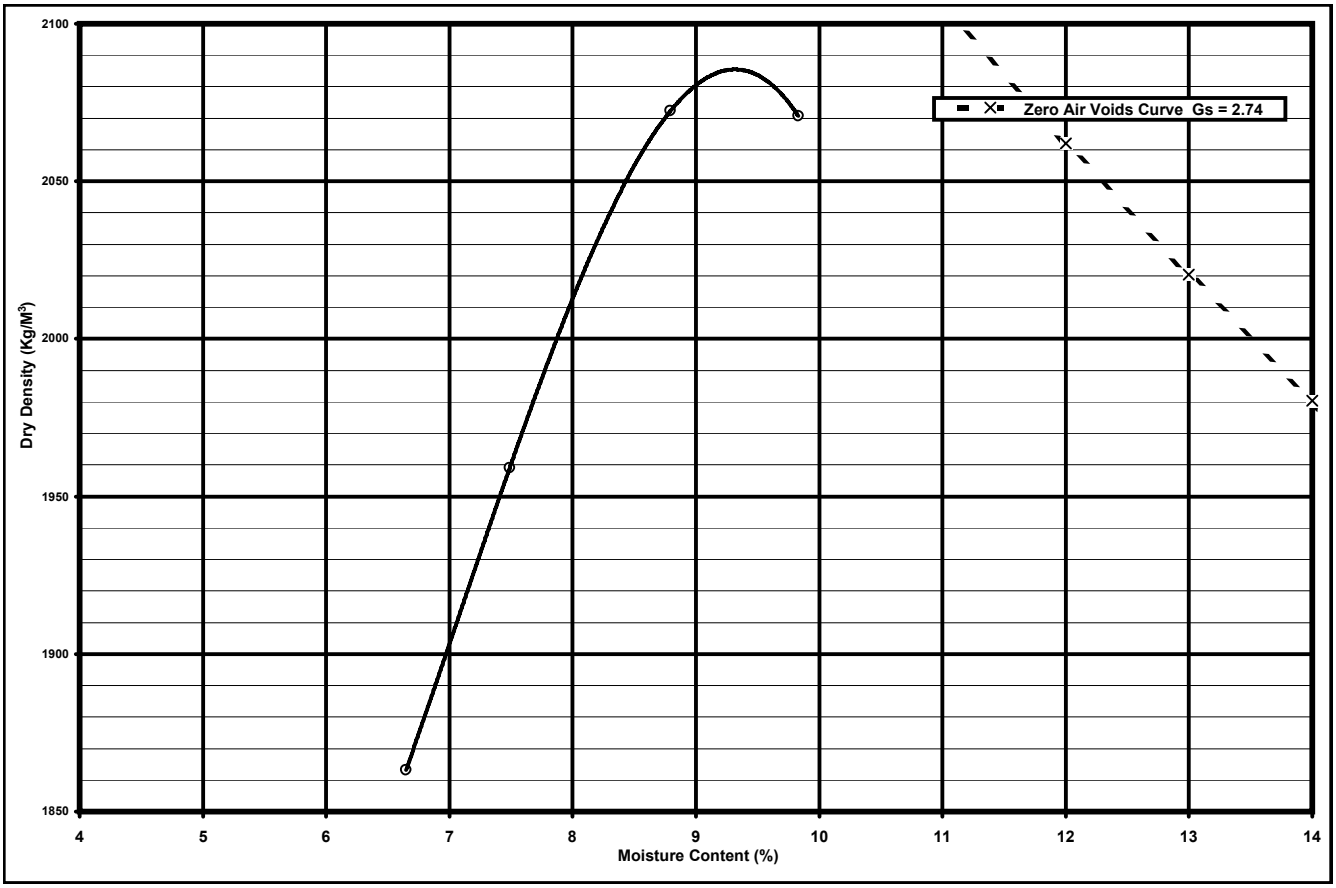
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corporation	Sample	4	*Method*	**C**	
Project	Dike Design		Second Portage, Lake Trench,	*Optimum WC =*	**9.3**	%
Location	Meadowbank Gold Project		Lake Bed Till	*Max ρ_{dry} =*	**2085**	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*	
Schedule #	13				*Correction for oversize particles*	
Proctor Type (S/M)	S				*Optimum WC =*	**7.4**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2212**	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*			*Percent Oversize :*		
WT SOIL WET + MOULD	9862	10114	10431	10472			SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			*Coarser Fraction*		
WT OF SOIL WET	4221	4473	4789	4831			P_c =	24.1	%
WET DENSITY (Kg/M^3)	1987	2106	2255	2274			Gs =	2.74	assumed
DRY DENSITY (Kg/M^3)	*1863*	*1959*	*2072*	*2071*			W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	335.0	398.5	381.8	552.3			P_f =	75.9	%
WT OF DRY SOIL + TARE	320.7	378.4	360.0	520.2			Gs =	2.74	assumed
WEIGHT OF WATER	14.3	20.1	21.8	32.1			W_f =	9.3	%
TARE WEIGHT	105.6	110.0	112.1	193.6			Zero Air Voids Curve Gs =		2.74
WEIGHT OF DRY SOIL	215.1	268.4	247.9	326.6			Bulk Gs =	2.74	
MOISTURE CONTENT (%)	*6.6*	*7.5*	*8.8*	*9.8*			Saturation =	100.0	%



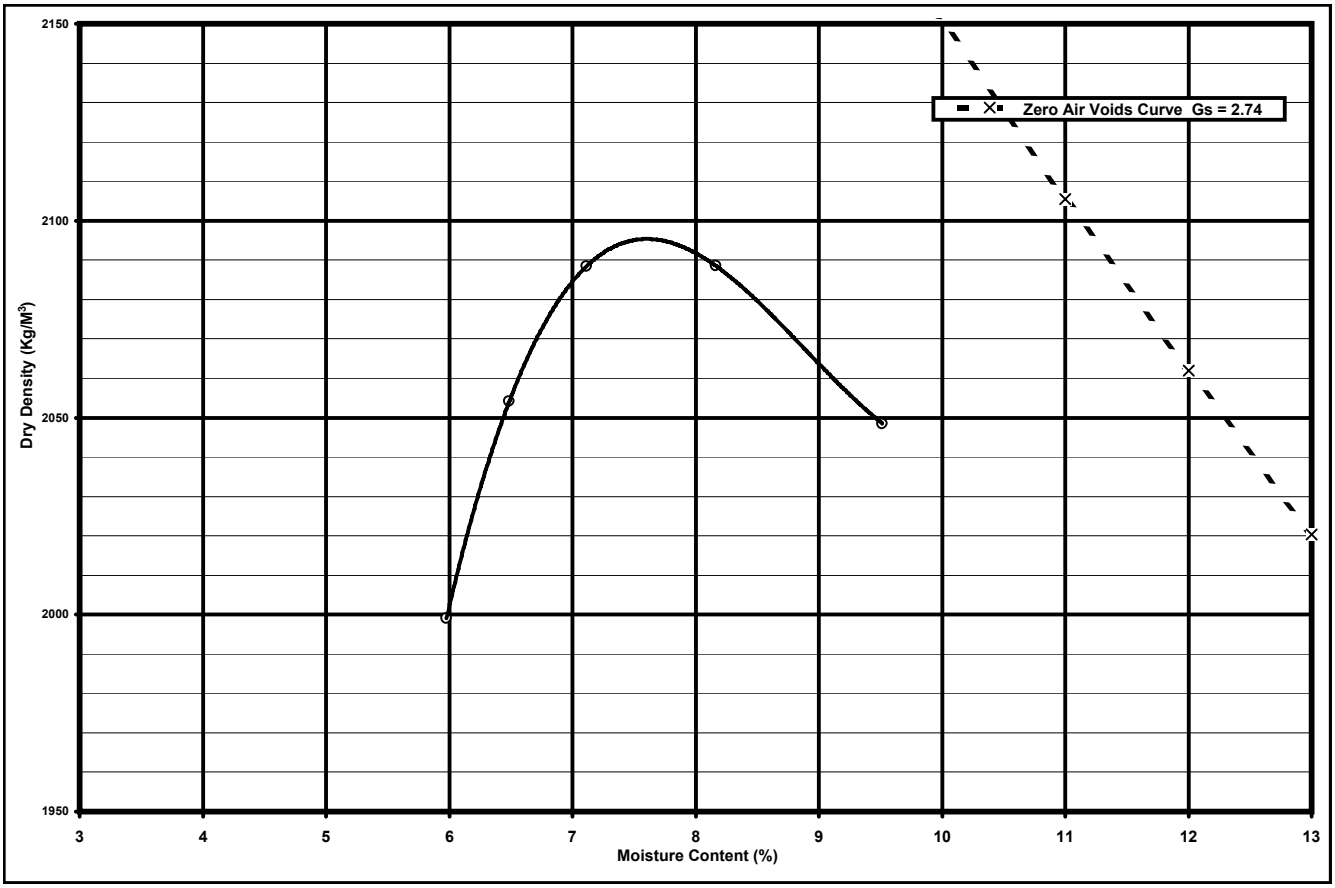
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corporation	Sample	5	*Method*	**C**	
Project	Dike Design		Second Portage, Lake Trench,	*Optimum WC =*	**7.6**	%
Location	Meadowbank Gold Project		Lake Bed Till	*Max ρ_{dry} =*	**2095**	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*		
Schedule #	13				*Correction for oversize particles*		
Proctor Type (S/M)	S				*Optimum WC =*	**7.1**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2139**	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*	*5*		*Percent Oversize :*		
WT SOIL WET + MOULD	10142	10288	10440	10407	10393		SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642	5642		*Coarser Fraction*		
WT OF SOIL WET	4500	4646	4798	4765	4751		P_c =	8.7	%
WET DENSITY (Kg/M³)	2119	2187	2259	2243	2237		Gs =	2.74	assumed
DRY DENSITY (Kg/M³)	***1999***	***2054***	***2089***	***2049***	***2088***		W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	503.6	540.7	621.6	666.0	542.2		P_f =	91.3	%
WT OF DRY SOIL + TARE	486.1	520.6	590.7	626.5	518.1		Gs =	2.74	assumed
WEIGHT OF WATER	17.5	20.1	30.9	39.5	24.1		W_f =	7.6	%
TARE WEIGHT	193.4	210.8	212.1	211.4	179.3		Zero Air Voids Curve Gs =		**2.74**
WEIGHT OF DRY SOIL	292.7	309.8	378.6	415.1	338.8		Bulk Gs =	2.74	
MOISTURE CONTENT (%)	***6.0***	***6.5***	***8.2***	***9.5***	***7.1***		Saturation =	100.0	%



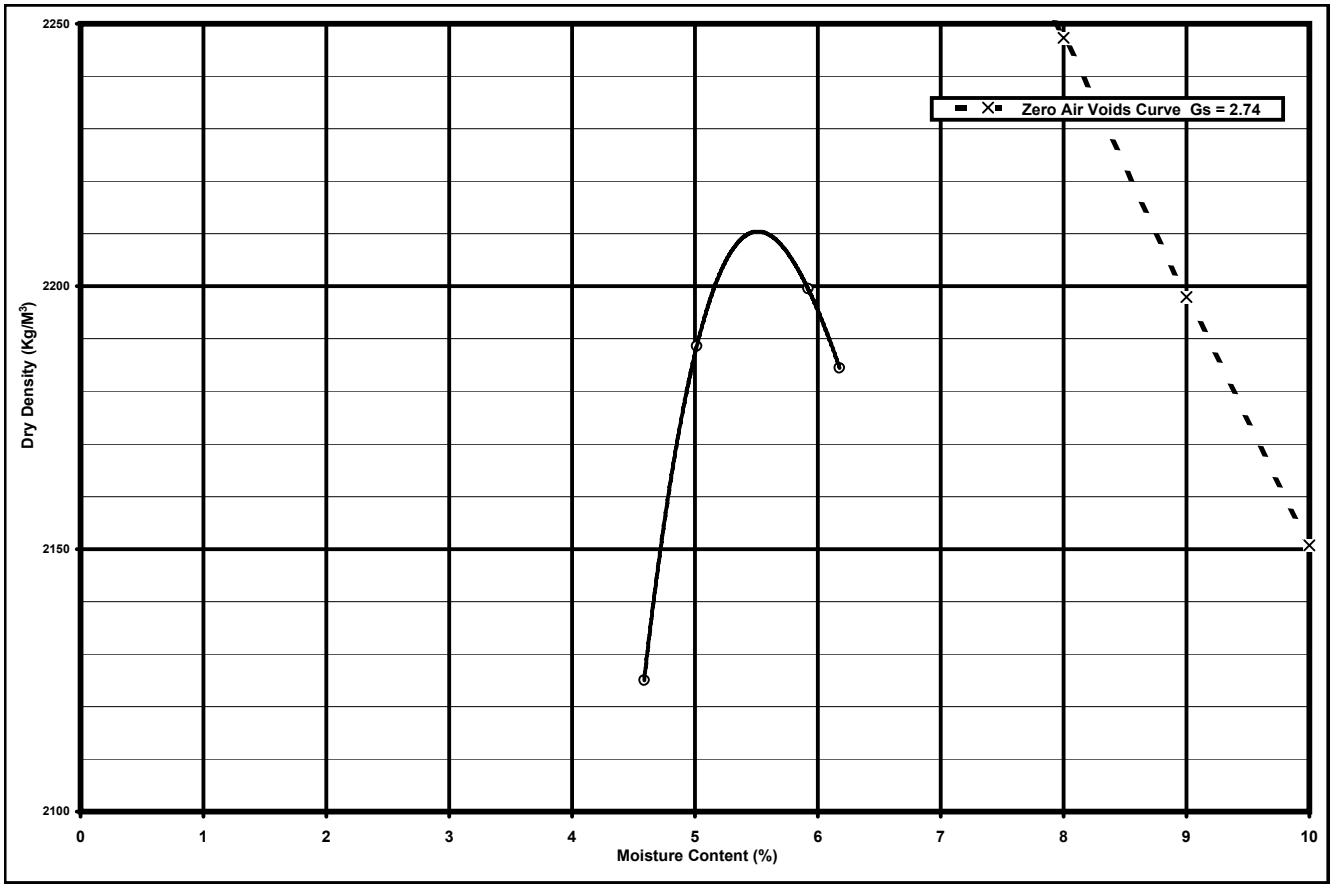
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		**ASTM D 698-91 Standard Proctor**		
Client	Meadowbank Mining Corporation	Sample	8	***Method***	**C**	
Project	Dike Design		Second Portage, Lake Trench,	***Optimum WC =***	**5.5**	%
Location	Meadowbank Gold Project		Lake Bed Till	***Max ρ_{dry} =***	**2211**	Kg/M³

Technician	TM	**Sample Description :**			***ASTM D 4718-87***		
Schedule #	13				***Correction for oversize particles***		
Proctor Type (S/M)	S				***Optimum WC =***	**4.7**	%
		Mould Volume =	0.002124	m^3	***Max ρ_{dry} =***	**2295**	Kg/M³

TRIAL NO.	***1***	***2***	***3***	***4***			***Percent Oversize :***		
WT SOIL WET + MOULD	10362	10524	10590	10568			**SCREEN SIZE :**	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			***Coarser Fraction***		
WT OF SOIL WET	4721	4882	4949	4927			**P_c =**	18.9	%
WET DENSITY (Kg/M³)	2222	2298	2330	2319			**Gs =**	2.74	assumed
DRY DENSITY (Kg/M³)	***2125***	***2189***	***2200***	***2185***			**W_c =**	1.5	%

CONTAINER NO.							***Finer Fraction***		
WT OF WET SOIL + TARE	569.2	580.7	564.4	571.2			**P_f =**	81.1	%
WT OF DRY SOIL + TARE	553.5	563.1	544.7	548.4			**Gs =**	2.74	assumed
WEIGHT OF WATER	15.7	17.6	19.7	22.8			**W_f =**	5.5	%
TARE WEIGHT	211.2	212.2	211.9	179.3			**Zero Air Voids Curve Gs =**		**2.74**
WEIGHT OF DRY SOIL	342.3	350.9	332.8	369.1			**Bulk Gs =**	2.74	
MOISTURE CONTENT (%)	***4.6***	***5.0***	***5.9***	***6.2***			**Saturation =**	100.0	%



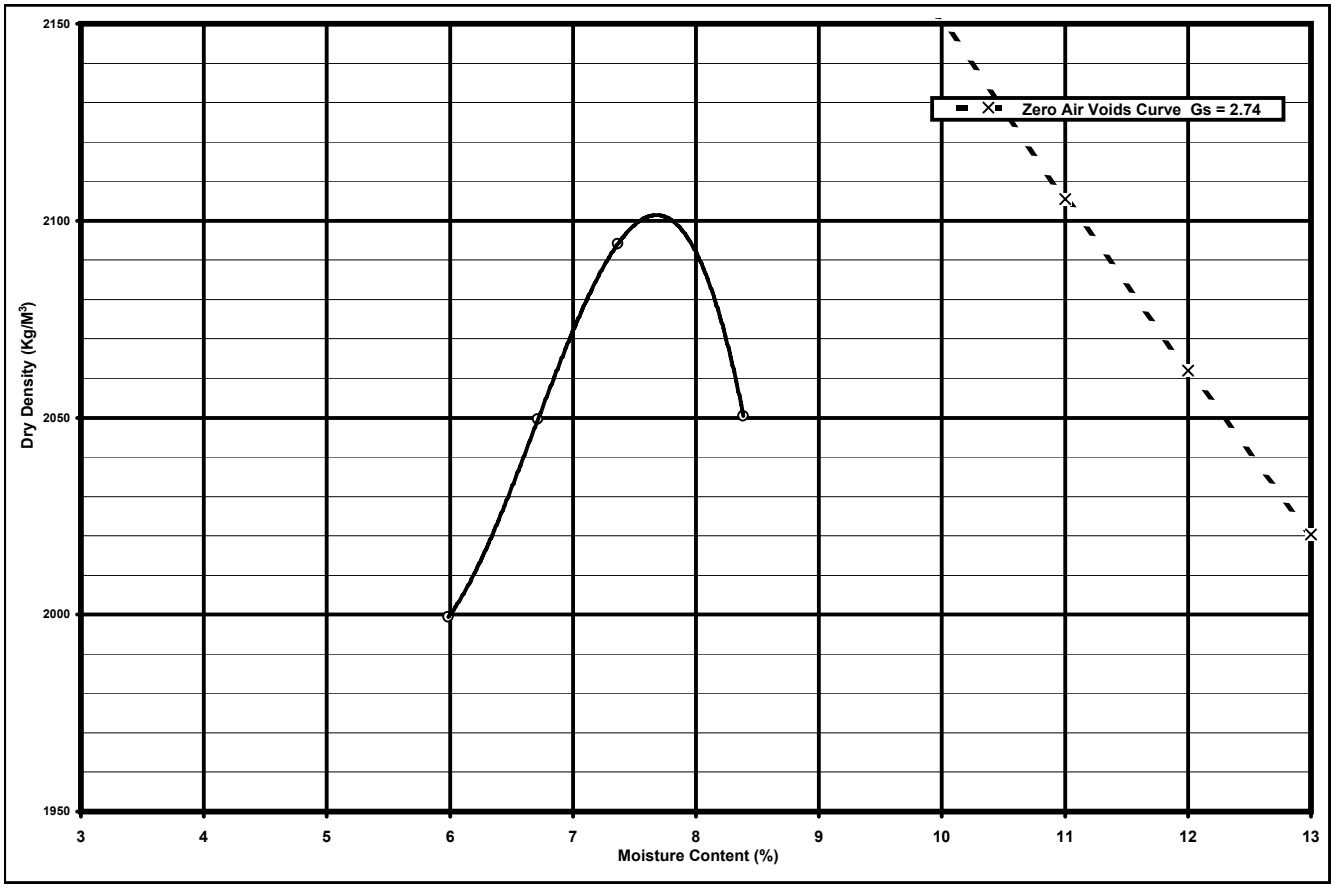
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		**ASTM D 698-91 Standard Proctor**		
Client	Meadowbank Mining Corporation	Sample	9 & 10	***Method***	**C**	
Project	Dike Design		Second Portage, Lake Trench	***Optimum WC =***	**7.7**	%
Location	Meadowbank Gold Project		Lake Bed Till	***Max ρ_{dry} =***	**2101**	Kg/M³

Technician	TM	**Sample Description :**			***ASTM D 4718-87***		
Schedule #	13				***Correction for oversize particles***		
Proctor Type (S/M)	S				***Optimum WC =***	**7.5**	%
		Mould Volume =	0.002124	m^3	***Max ρ_{dry} =***	**2118**	Kg/M³

TRIAL NO.	***1***	***2***	***3***	***4***			***Percent Oversize :***		
WT SOIL WET + MOULD	10143	10287	10417	10362			**SCREEN SIZE :**	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			***Coarser Fraction***		
WT OF SOIL WET	4501	4646	4776	4720			**P_c =**	3.4	%
WET DENSITY (Kg/M³)	2119	2187	2248	2222			**Gs =**	2.74	assumed
DRY DENSITY (Kg/M³)	***1999***	***2050***	***2094***	***2050***			**W_c =**	1.5	%

CONTAINER NO.							***Finer Fraction***		
WT OF WET SOIL + TARE	384.9	471.5	597.6	342.3			**P_f =**	96.6	%
WT OF DRY SOIL + TARE	369.5	454.0	571.1	324.0			**Gs =**	2.74	assumed
WEIGHT OF WATER	15.4	17.5	26.5	18.3			**W_f =**	7.7	%
TARE WEIGHT	112.2	193.4	211.3	105.8			**Zero Air Voids Curve Gs =**		**2.74**
WEIGHT OF DRY SOIL	257.3	260.6	359.8	218.2			**Bulk Gs =**	2.74	
MOISTURE CONTENT (%)	***6.0***	***6.7***	***7.4***	***8.4***			**Saturation =**	100.0	%



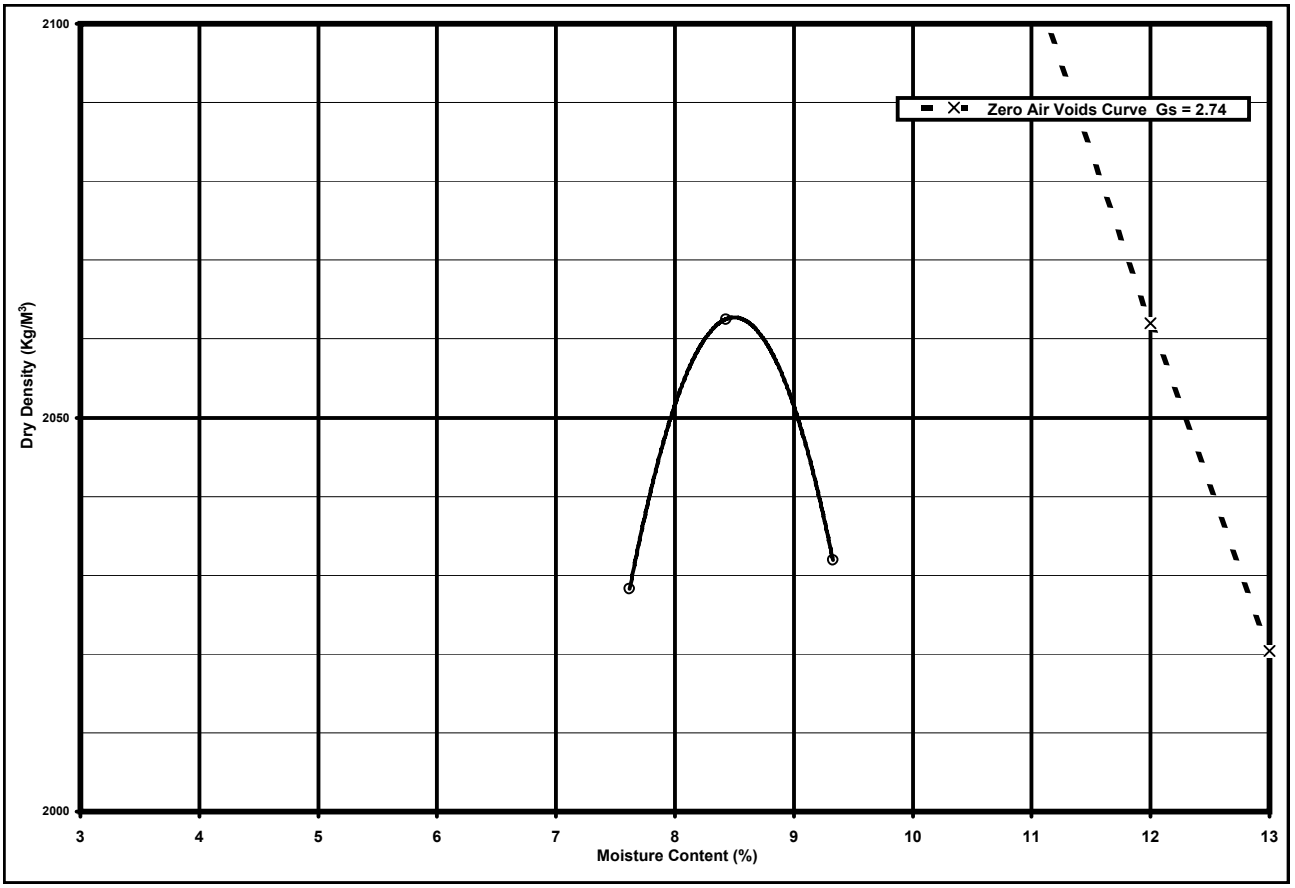
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**			ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corpora	Sample	11		*Method*	**C**	
Project	Dike Design		Lake Bed Till		*Optimum WC =*	**8.5**	%
Location	Meadowbank Gold Project				*Max ρ_{dry} =*	**2062**	Kg/M³

Technician	TM	**Sample Description :**			*ASTM D 4718-87*		
Schedule #	13				*Correction for oversize particles*		
Proctor Type (S/M)	S				*Optimum WC =*	**7.9**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2109**	Kg/M³

TRIAL NO.	*1*	*2*	*3*				*Percent Oversize :*		
WT SOIL WET + MOULD	10278	10392	10360				SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642				*Coarser Fraction*		
WT OF SOIL WET	4636	4750	4718				P_c =	9.0	%
WET DENSITY (Kg/M³)	2183	2236	2221				Gs =	2.74	assumed
DRY DENSITY (Kg/M³)	*2028*	*2063*	*2032*				W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	400.2	305.4	442.0				P_f =	91.0	%
WT OF DRY SOIL + TARE	385.6	289.9	422.4				Gs =	2.74	assumed
WEIGHT OF WATER	14.6	15.5	19.6				W_f =	8.5	%
TARE WEIGHT	194.0	106.0	212.3				Zero Air Voids Curve Gs =		2.74
WEIGHT OF DRY SOIL	191.6	183.9	210.1				Bulk Gs =	2.74	
MOISTURE CONTENT (%)	*7.6*	*8.4*	*9.3*				Saturation =	100.0	%



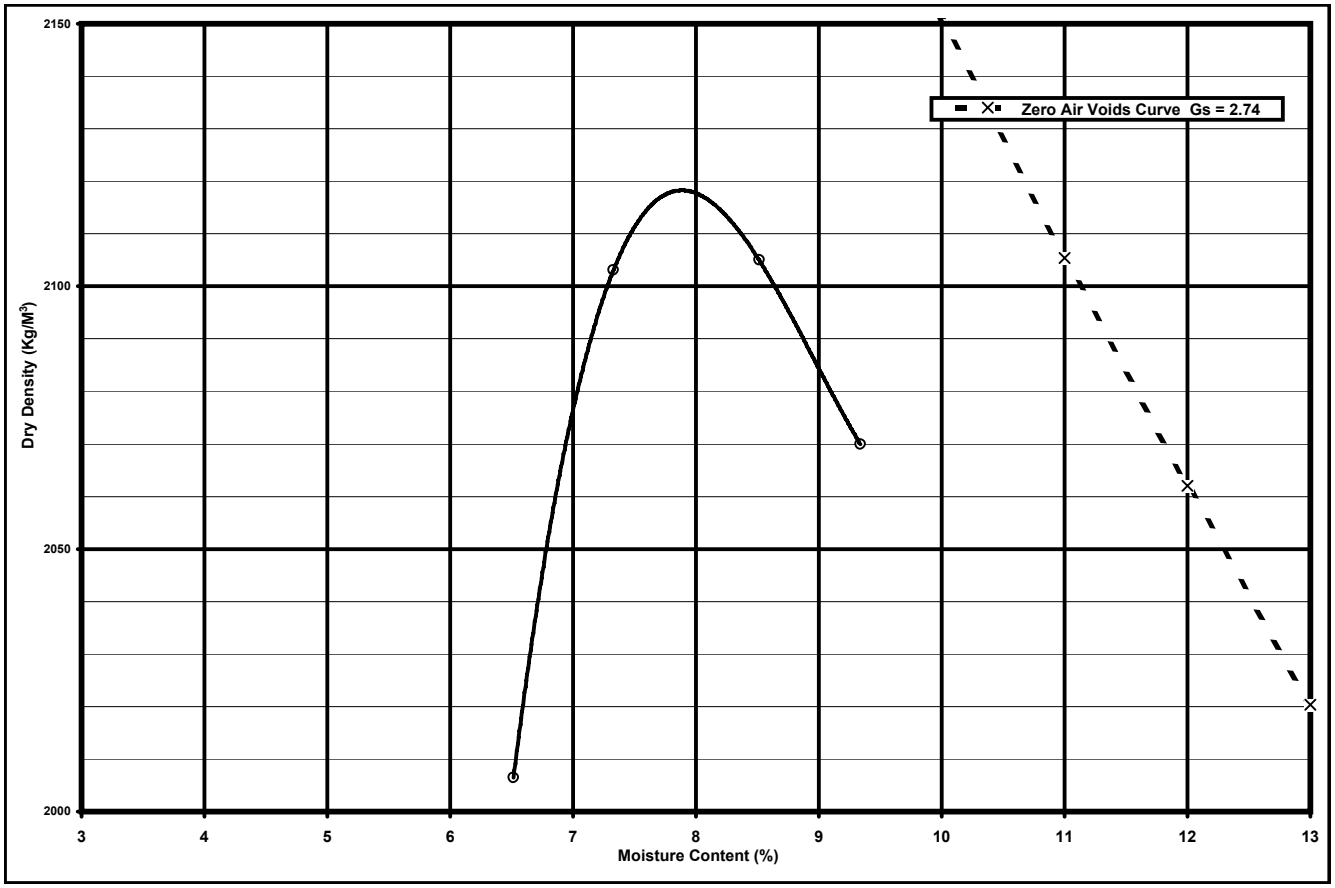
Test Method for Laboratory Compaction Charateristics of Soil

Project #	06-1413-089	**Sample Identification :**		ASTM D 698-91 Standard Proctor		
Client	Meadowbank Mining Corporation	Sample	12	*Method*	**C**	
Project	Dike Design		Second Portage, Lake Trench,	*Optimum WC =*	**7.9**	%
Location	Meadowbank Gold Project		Lake Bed Till	*Max ρ_{dry} =*	**2119**	Kg/M³

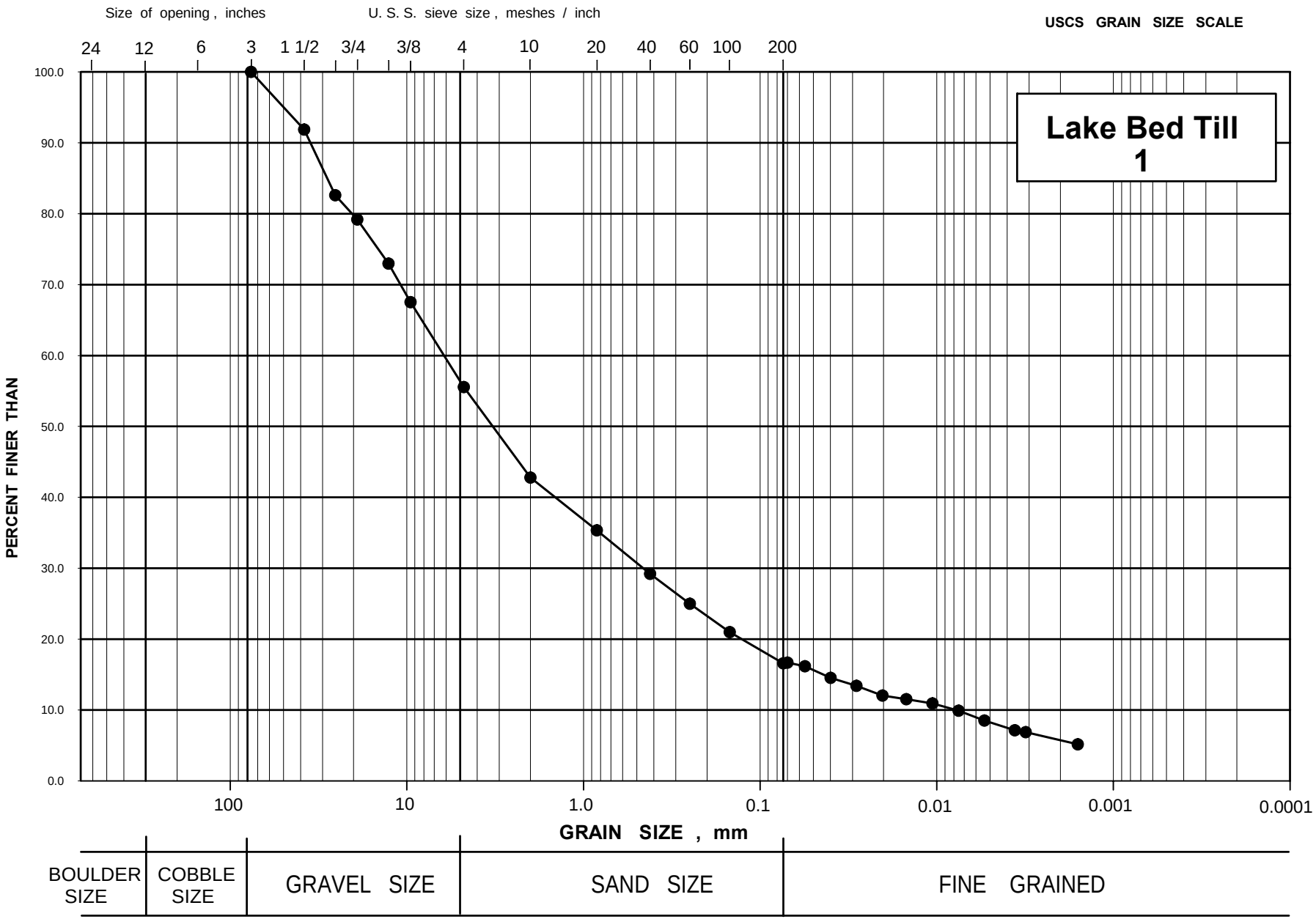
Technician	TM	**Sample Description :**			*ASTM D 4718-87*		
Schedule #	13				*Correction for oversize particles*		
Proctor Type (S/M)	S				*Optimum WC =*	**6.5**	%
		Mould Volume =	0.002124	m^3	*Max ρ_{dry} =*	**2232**	Kg/M³

TRIAL NO.	*1*	*2*	*3*	*4*			*Percent Oversize :*		
WT SOIL WET + MOULD	10181	10436	10494	10449			SCREEN SIZE :	19.00	mm
WEIGHT OF MOULD	5642	5642	5642	5642			*Coarser Fraction*		
WT OF SOIL WET	4540	4794	4852	4807			P_c =	22.3	%
WET DENSITY (Kg/M^3)	2137	2257	2284	2263			Gs =	2.74	assumed
DRY DENSITY (Kg/M^3)	***2007***	***2103***	***2105***	***2070***			W_c =	1.5	%

CONTAINER NO.							*Finer Fraction*		
WT OF WET SOIL + TARE	560.7	536.7	527.5	604.5			P_f =	77.7	%
WT OF DRY SOIL + TARE	539.4	507.6	502.7	569.4			Gs =	2.74	assumed
WEIGHT OF WATER	21.3	29.1	24.8	35.1			W_f =	7.9	%
TARE WEIGHT	212.5	110.5	211.4	193.5			Zero Air Voids Curve Gs =		2.74
WEIGHT OF DRY SOIL	326.9	397.1	291.3	375.9			Bulk Gs =	2.74	
MOISTURE CONTENT (%)	***6.5***	***7.3***	***8.5***	***9.3***			Saturation =	100.0	%



TILL GRADATION AND HYDROMETER



Project No. 06-1413-081. **Drawn** ..... TM **Reviewed** .... LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-1**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	1
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 10410.8

Hydrometer: (Minus #10)
Before Wash (g) = 49.5
After Wash (g) = 30.3

Residual No. 200 (g) = 0.0
Total minus 200 (g) = 19.2
Gs = 2.67

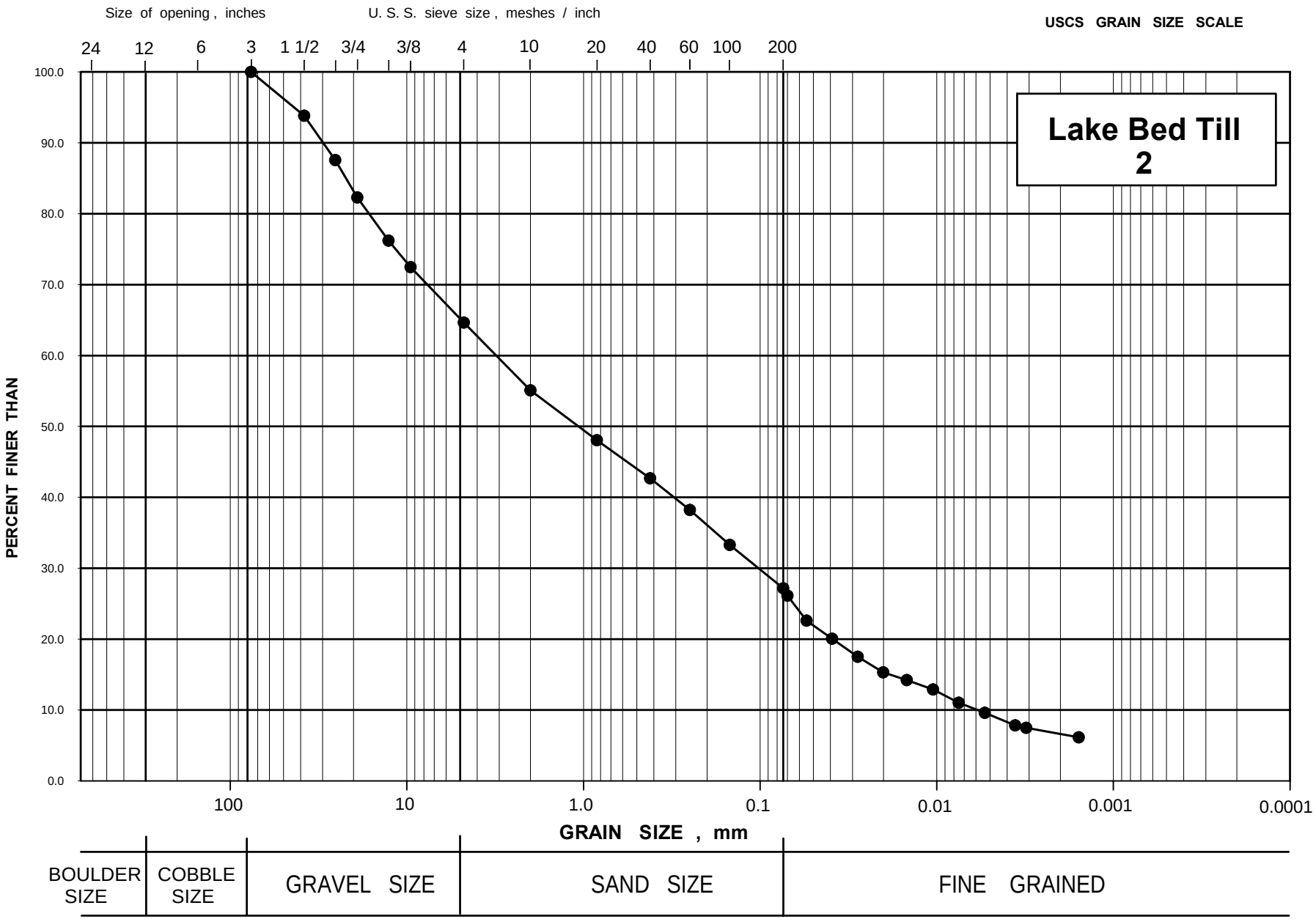
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	848.0	8.1			8.1	**38.1**	**91.9**
1"	962.2	9.2			9.2	**25.4**	**82.6**
3/4"	356.7	3.4			3.4	**19.1**	**79.2**
1/2"	646.9	6.2			6.2	**12.7**	**73.0**
3/8"	565.8	5.4			5.4	**9.52**	**67.5**
#4	1249.1	12.0			12.0	**4.76**	**55.5**
#10	1327.6	12.8			12.8	**2.00**	**42.8**
#20			8.6	17.4	7.4	**0.840**	**35.4**
#40			7.1	14.3	6.1	**0.420**	**29.2**
#60			4.9	9.9	4.2	**0.250**	**25.0**
#100			4.6	9.3	4.0	**0.149**	**21.0**
#200			5.1	10.3	4.4	**0.074**	**16.6**
Pan			19.2	38.8	16.6		

HYDROMETER ANALYSIS

Hydrometer No.: 8589 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	21.7	19.0		-2.30	19.4	**0.0700**	**16.7**
1	21.1	19.0		-2.30	18.8	**0.0558**	**16.2**
2	19.2	19.0		-2.30	16.9	**0.0400**	**14.5**
4	17.9	19.0		-2.30	15.6	**0.0285**	**13.4**
8	16.3	19.0		-2.30	14.0	**0.0203**	**12.0**
15	15.5	20.0		-2.10	13.4	**0.0149**	**11.5**
30	14.8	20.0		-2.10	12.7	**0.0106**	**10.9**
60	13.5	20.5		-2.00	11.5	**0.0075**	**9.9**
120	11.9	20.5		-2.00	9.9	**0.0054**	**8.5**
270	10.3	20.5		-2.00	8.3	**0.0036**	**7.1**
360	9.9	21.0		-1.90	8.0	**0.0031**	**6.9**
1440	8.7	17.0		-2.71	6.0	**0.0016**	**5.2**



Project No. 06-1413-081. **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-2**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	2
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 11026.2

Hydrometer: (Minus #10)
Before Wash (g) = 49.3
After Wash (g) = 25.0

Residual No. 200 (g) = 0.0
Total minus 200 (g) = 24.3
Gs = 2.71

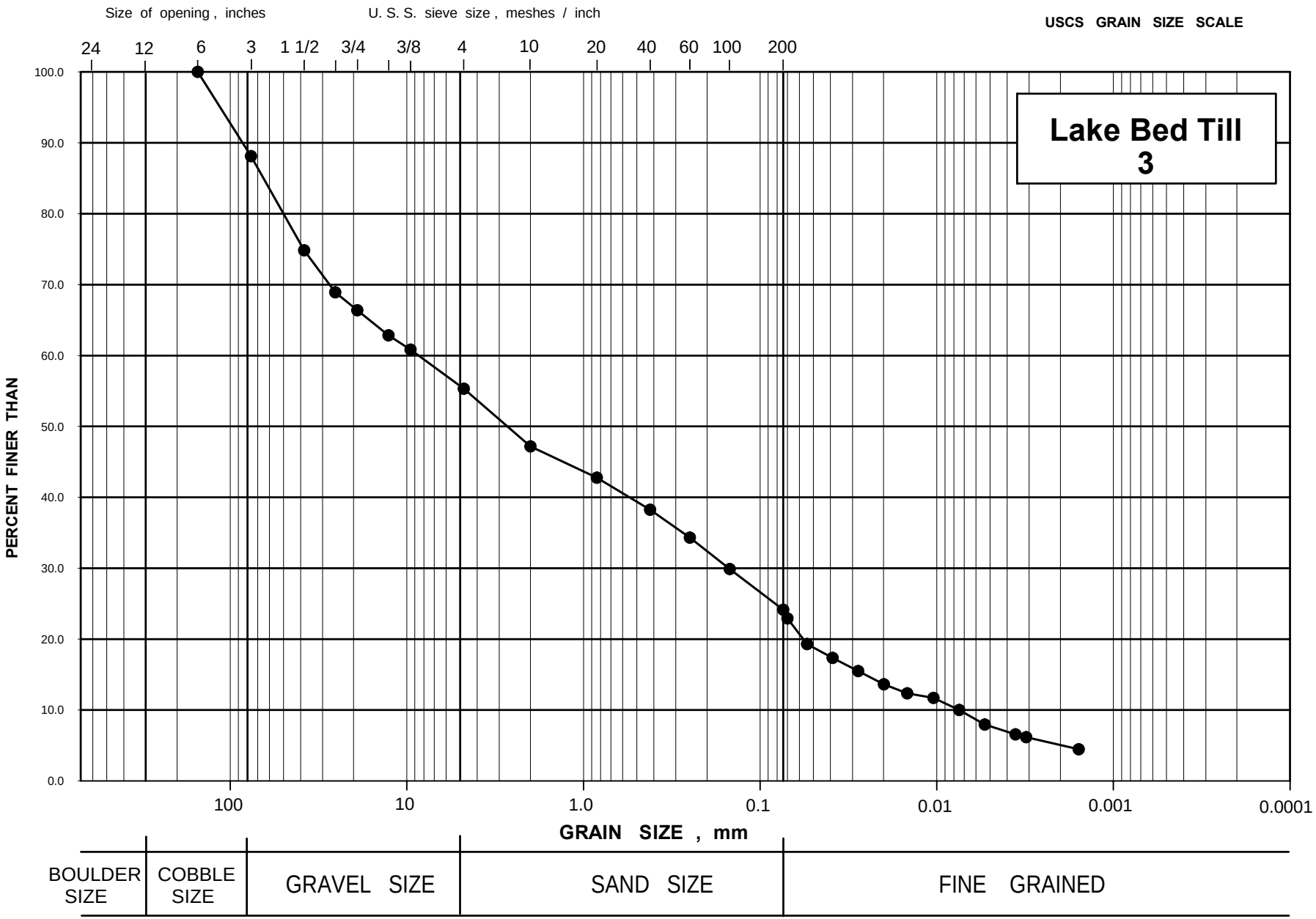
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	681.2	6.2			6.2	**38.1**	**93.8**
1"	688.3	6.2			6.2	**25.4**	**87.6**
3/4"	583.1	5.3			5.3	**19.1**	**82.3**
1/2"	671.8	6.1			6.1	**12.7**	**76.2**
3/8"	410.4	3.7			3.7	**9.52**	**72.5**
#4	861.7	7.8			7.8	**4.76**	**64.7**
#10	1054.4	9.6			9.6	**2.00**	**55.1**
#20			6.3	12.8	7.0	**0.840**	**48.1**
#40			4.8	9.7	5.4	**0.420**	**42.7**
#60			4.0	8.1	4.5	**0.250**	**38.2**
#100			4.4	8.9	4.9	**0.149**	**33.3**
#200			5.5	11.2	6.1	**0.074**	**27.2**
Pan			24.3	49.3	27.2		

HYDROMETER ANALYSIS

Hydrometer No.: 8589 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	26.0	19.0		-2.30	23.7	**0.0700**	**26.1**
1	22.8	19.0		-2.30	20.5	**0.0546**	**22.6**
2	20.5	19.0		-2.30	18.2	**0.0392**	**20.1**
4	18.2	19.0		-2.30	15.9	**0.0281**	**17.5**
8	16.2	19.0		-2.30	13.9	**0.0201**	**15.3**
15	15.0	20.0		-2.10	12.9	**0.0148**	**14.2**
30	13.8	20.0		-2.10	11.7	**0.0105**	**12.9**
60	12.0	20.5		-2.00	10.0	**0.0075**	**11.0**
120	10.7	20.5		-2.00	8.7	**0.0053**	**9.6**
270	9.1	20.5		-2.00	7.1	**0.0036**	**7.8**
360	8.7	21.0		-1.90	6.8	**0.0031**	**7.5**
1440	8.3	17.0		-2.71	5.6	**0.0016**	**6.2**



Project No. 06-1413-081. **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-3**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	3
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 11381.4

Hydrometer: (Minus #10)
Before Wash (g) = 50.2
After Wash (g) = 24.9

Residual No. 200 (g) = 0.4
Total minus 200 (g) = 25.7
Gs (assumed) = 2.70

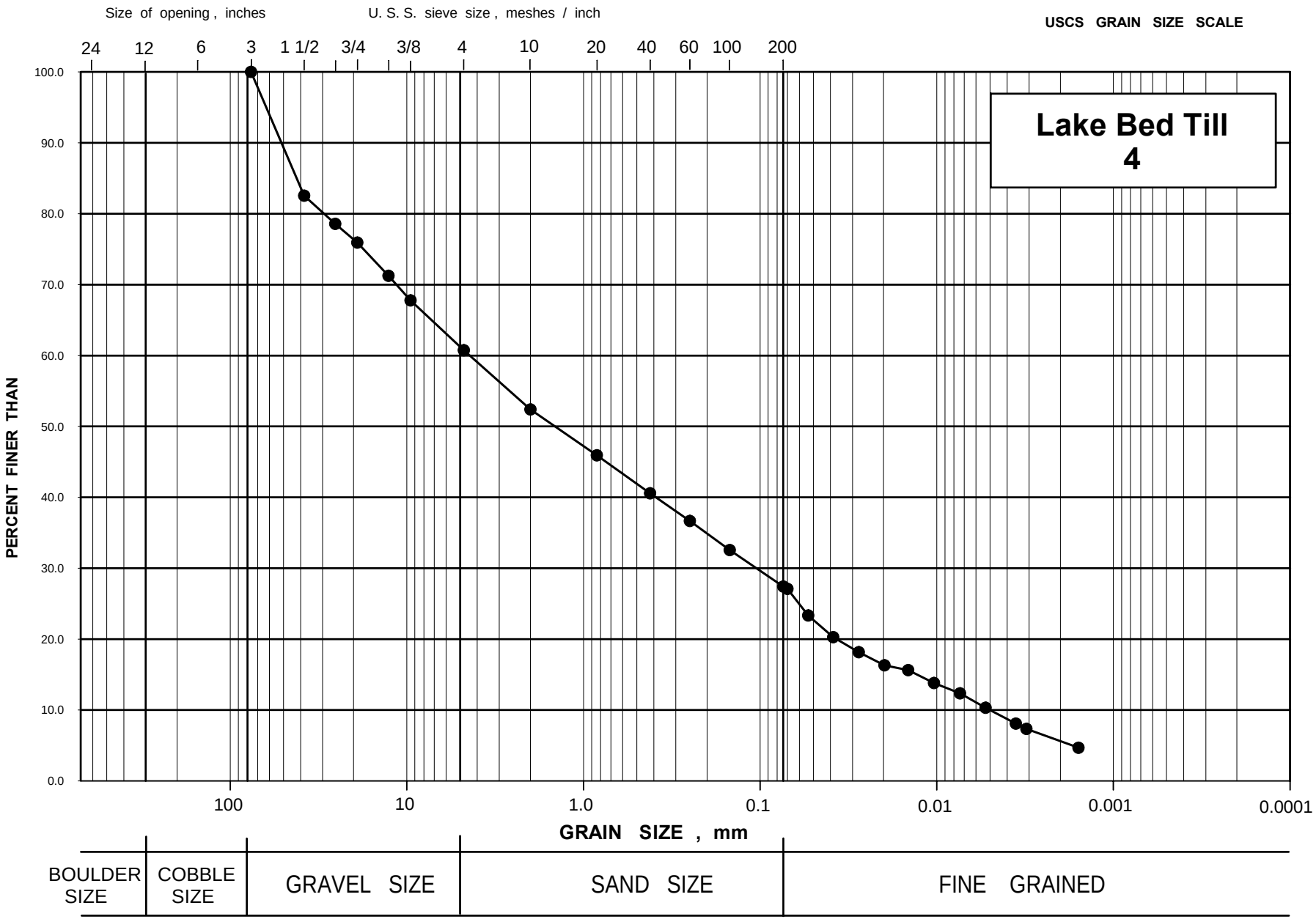
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	1354.0	11.9			11.9	**76.2**	**88.1**
1 1/2"	1510.3	13.3			13.3	**38.1**	**74.8**
1"	672.1	5.9			5.9	**25.4**	**68.9**
3/4"	288.8	2.5			2.5	**19.1**	**66.4**
1/2"	401.9	3.5			3.5	**12.7**	**62.9**
3/8"	230.4	2.0			2.0	**9.52**	**60.8**
#4	627.4	5.5			5.5	**4.76**	**55.3**
#10	926.4	8.1			8.1	**2.00**	**47.2**
#20			4.7	9.4	4.4	**0.840**	**42.8**
#40			4.8	9.6	4.5	**0.420**	**38.3**
#60			4.2	8.4	3.9	**0.250**	**34.3**
#100			4.7	9.4	4.4	**0.149**	**29.9**
#200			6.1	12.2	5.7	**0.074**	**24.2**
Pan			25.7	51.2	24.2		

HYDROMETER ANALYSIS

Hydrometer No.: 87024 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	28.0	19.0		-3.33	24.7	**0.0700**	**22.9**
1	24.1	19.0		-3.33	20.8	**0.0543**	**19.3**
2	22.0	19.0		-3.33	18.7	**0.0389**	**17.4**
4	20.0	19.0		-3.33	16.7	**0.0279**	**15.5**
8	18.0	19.0		-3.33	14.7	**0.0200**	**13.6**
15	16.3	20.0		-3.00	13.3	**0.0147**	**12.4**
30	15.6	20.0		-3.00	12.6	**0.0104**	**11.7**
60	13.6	20.5		-2.83	10.8	**0.0075**	**10.0**
120	11.4	20.5		-2.83	8.6	**0.0053**	**8.0**
270	9.9	20.5		-2.83	7.1	**0.0036**	**6.6**
360	9.3	21.0		-2.67	6.6	**0.0031**	**6.2**
1440	8.8	17.0		-3.99	4.8	**0.0016**	**4.5**



Project No. 06-1413-081. **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-4**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	4
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 10768.1

Hydrometer: (Minus #10)
Before Wash (g) = 51.0
After Wash (g) = 24.3

Residual No. 200 (g) = 0.0
Total minus 200 (g) = 26.7
Gs (assumed) = 2.70

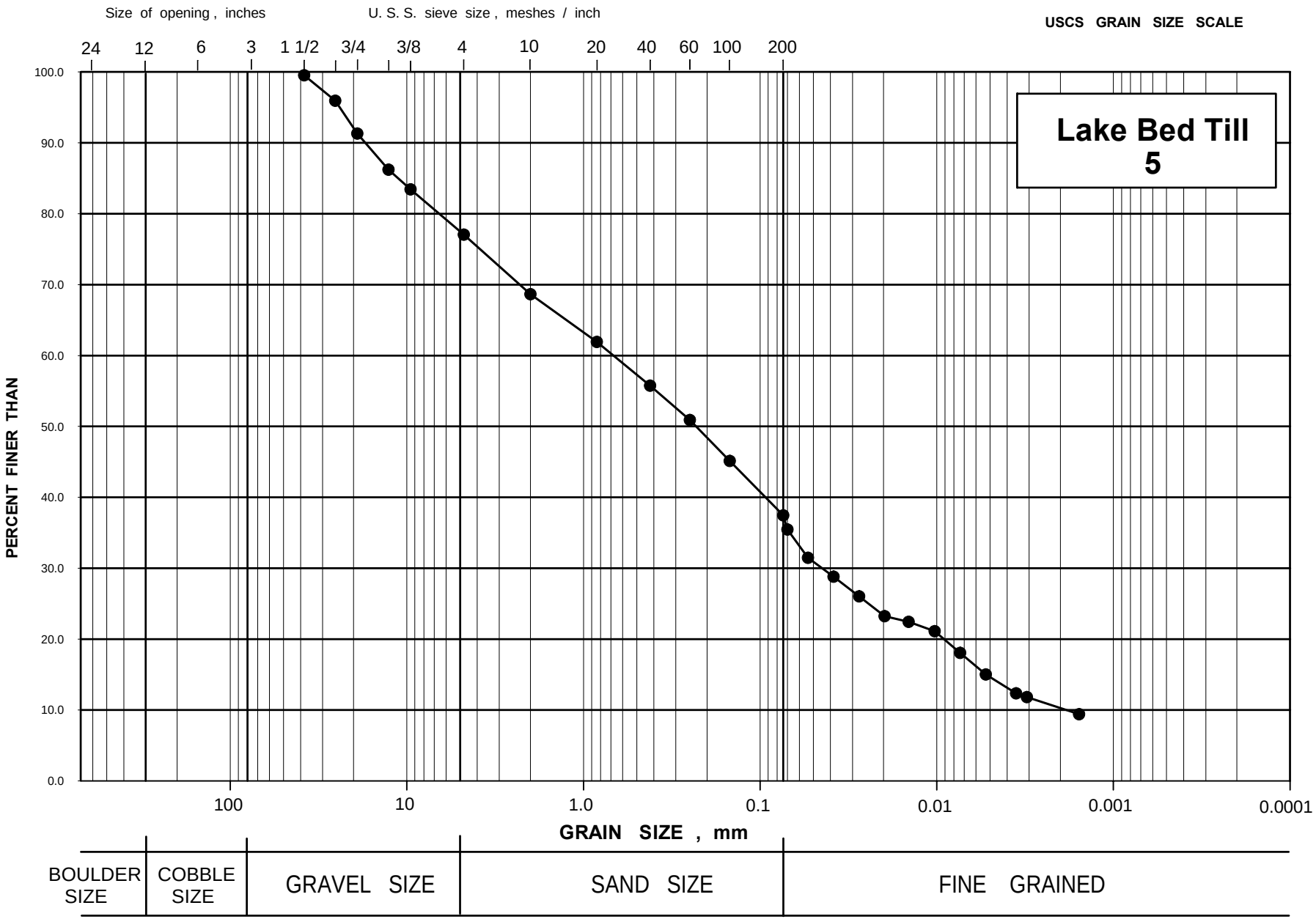
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	1881.5	17.5			17.5	**38.1**	**82.5**
1"	425.4	4.0			4.0	**25.4**	**78.6**
3/4"	284.2	2.6			2.6	**19.1**	**75.9**
1/2"	506.1	4.7			4.7	**12.7**	**71.2**
3/8"	372.7	3.5			3.5	**9.52**	**67.8**
#4	756.3	7.0			7.0	**4.76**	**60.8**
#10	901.1	8.4			8.4	**2.00**	**52.4**
#20			6.3	12.4	6.5	**0.840**	**45.9**
#40			5.2	10.2	5.3	**0.420**	**40.6**
#60			3.8	7.5	3.9	**0.250**	**36.7**
#100			4.0	7.8	4.1	**0.149**	**32.6**
#200			5.0	9.8	5.1	**0.074**	**27.4**
Pan			26.7	52.4	27.4		

HYDROMETER ANALYSIS

Hydrometer No.: 87024 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	30.0	19.0		-3.33	26.7	**0.0700**	**27.1**
1	26.3	19.0		-3.33	23.0	**0.0534**	**23.3**
2	23.3	19.0		-3.33	20.0	**0.0386**	**20.3**
4	21.2	19.0		-3.33	17.9	**0.0277**	**18.1**
8	19.4	19.0		-3.33	16.1	**0.0198**	**16.3**
15	18.4	20.0		-3.00	15.4	**0.0145**	**15.6**
30	16.6	20.0		-3.00	13.6	**0.0104**	**13.8**
60	15.0	20.5		-2.83	12.2	**0.0074**	**12.4**
120	13.0	20.5		-2.83	10.2	**0.0053**	**10.3**
270	10.8	20.5		-2.83	8.0	**0.0036**	**8.1**
360	9.9	21.0		-2.67	7.2	**0.0031**	**7.3**
1440	8.6	17.0		-3.99	4.6	**0.0016**	**4.7**



Project No. 06-1413-081 **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-5**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	5
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 10816.6

Hydrometer: (Minus #10)
Before Wash (g) = 51.1
After Wash (g) = 23.7

Residual No. 200 (g) = 0.5
Total minus 200 (g) = 27.9
Gs (assumed) = 2.70

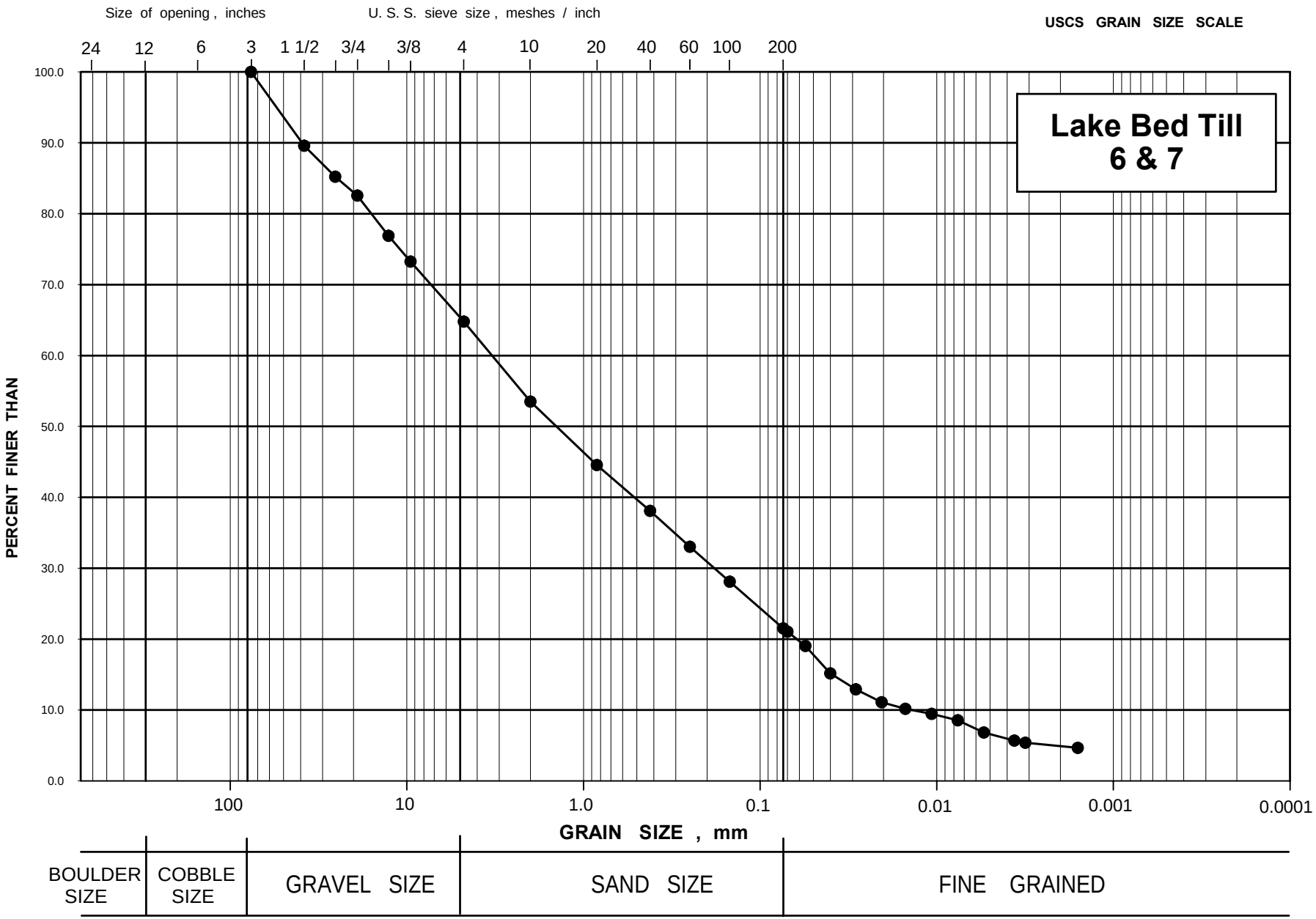
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	51.6	0.5			0.5	**38.1**	**99.5**
1"	389.2	3.6			3.6	**25.4**	**95.9**
3/4"	499.5	4.6			4.6	**19.1**	**91.3**
1/2"	551.4	5.1			5.1	**12.7**	**86.2**
3/8"	300.4	2.8			2.8	**9.52**	**83.4**
#4	689.0	6.4			6.4	**4.76**	**77.1**
#10	911.2	8.4			8.4	**2.00**	**68.6**
#20			5.0	9.8	6.7	**0.840**	**61.9**
#40			4.6	9.0	6.2	**0.420**	**55.7**
#60			3.6	7.0	4.8	**0.250**	**50.9**
#100			4.3	8.4	5.8	**0.149**	**45.1**
#200			5.7	11.2	7.7	**0.074**	**37.5**
Pan			27.9	54.6	37.5		

HYDROMETER ANALYSIS

Hydrometer No.: 8589 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	29.0	19.0		-2.30	26.7	**0.0700**	**35.5**
1	26.0	19.0		-2.30	23.7	**0.0536**	**31.5**
2	24.0	19.0		-2.30	21.7	**0.0384**	**28.8**
4	21.9	19.0		-2.30	19.6	**0.0275**	**26.0**
8	19.8	19.0		-2.30	17.5	**0.0197**	**23.2**
15	19.0	20.0		-2.10	16.9	**0.0145**	**22.4**
30	18.0	20.0		-2.10	15.9	**0.0103**	**21.1**
60	15.6	20.5		-2.00	13.6	**0.0074**	**18.1**
120	13.3	20.5		-2.00	11.3	**0.0053**	**15.0**
270	11.3	20.5		-2.00	9.3	**0.0036**	**12.4**
360	10.8	21.0		-1.90	8.9	**0.0031**	**11.8**
1440	9.8	17.0		-2.71	7.1	**0.0016**	**9.4**



Project No. 06-1413-081. **Drawn** ..... TM **Reviewed** .... LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-6**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	6 & 7
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 16491.9

Hydrometer: (Minus #10)
Before Wash (g) = 52.0
After Wash (g) = 31.4

Residual No. 200 (g) = 0.3
Total minus 200 (g) = 20.9
Gs (assumed) = 2.70

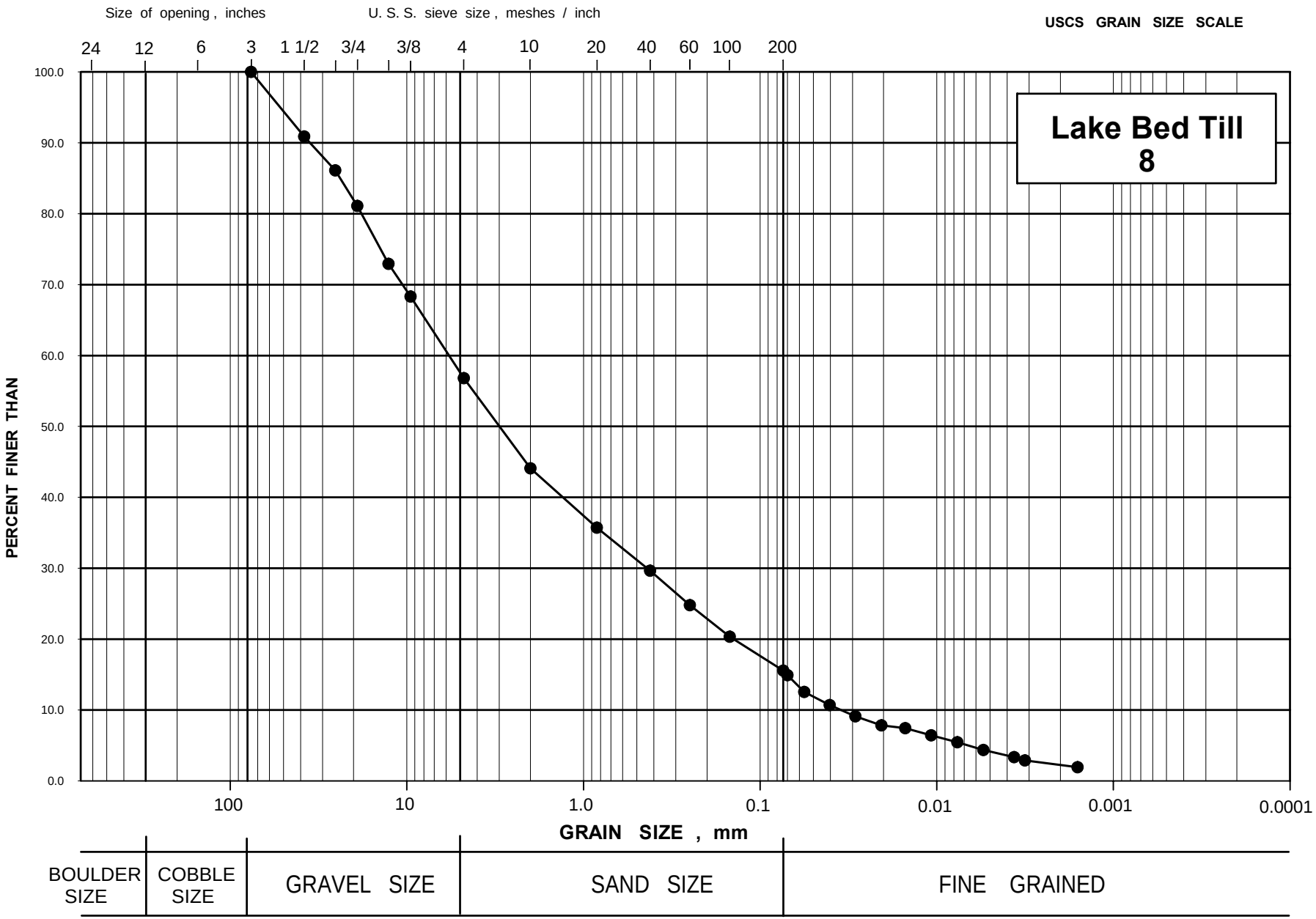
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	1718.2	10.4			10.4	**38.1**	**89.6**
1"	721.2	4.4			4.4	**25.4**	**85.2**
3/4"	438.5	2.7			2.7	**19.1**	**82.5**
1/2"	934.6	5.7			5.7	**12.7**	**76.9**
3/8"	599.2	3.6			3.6	**9.52**	**73.2**
#4	1398.0	8.5			8.5	**4.76**	**64.8**
#10	1857.6	11.3			11.3	**2.00**	**53.5**
#20			8.7	16.7	9.0	**0.840**	**44.6**
#40			6.3	12.1	6.5	**0.420**	**38.1**
#60			4.9	9.4	5.0	**0.250**	**33.0**
#100			4.8	9.2	4.9	**0.149**	**28.1**
#200			6.4	12.3	6.6	**0.074**	**21.5**
Pan			20.9	40.2	21.5		

HYDROMETER ANALYSIS

Hydrometer No.: 8589 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	23.0	19.0		-2.30	20.7	**0.0700**	**21.1**
1	21.0	19.0		-2.30	18.7	**0.0554**	**19.0**
2	17.2	19.0		-2.30	14.9	**0.0401**	**15.2**
4	15.0	19.0		-2.30	12.7	**0.0287**	**12.9**
8	13.2	19.0		-2.30	10.9	**0.0205**	**11.1**
15	12.1	20.0		-2.10	10.0	**0.0151**	**10.2**
30	11.4	20.0		-2.10	9.3	**0.0107**	**9.5**
60	10.4	20.5		-2.00	8.4	**0.0076**	**8.6**
120	8.7	20.5		-2.00	6.7	**0.0054**	**6.8**
270	7.6	20.5		-2.00	5.6	**0.0036**	**5.7**
360	7.2	21.0		-1.90	5.3	**0.0032**	**5.4**
1440	7.3	17.0		-2.71	4.6	**0.0016**	**4.7**



Project No. 06-1413-081 **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-7**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	8
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 12741.8

Hydrometer: (Minus #10)
Before Wash (g) = 51.6
After Wash (g) = 34.1

Residual No. 200 (g) = 0.7
Total minus 200 (g) = 18.2
Gs (assumed) = 2.70

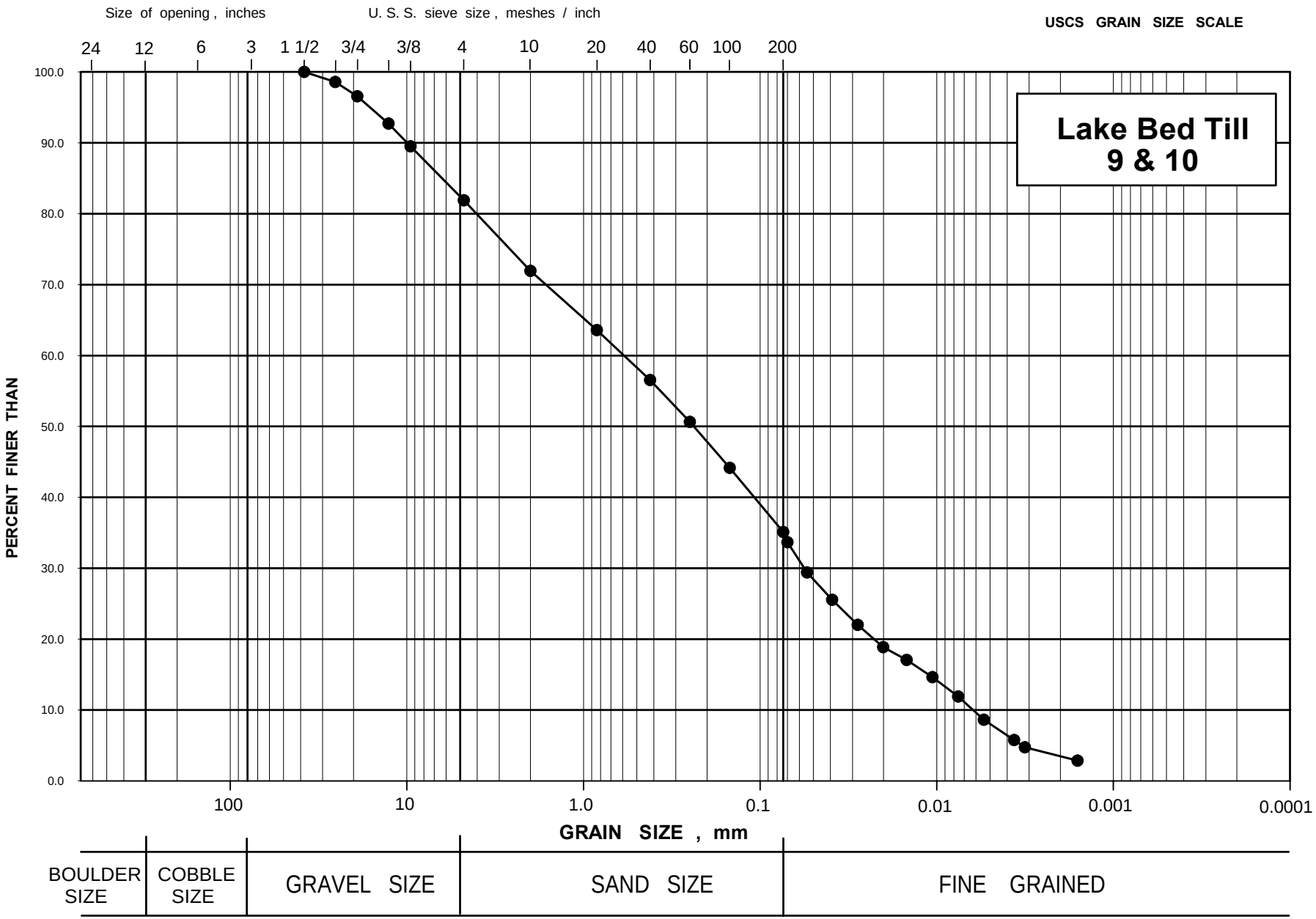
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	1160.6	9.1			9.1	**38.1**	**90.9**
1"	609.7	4.8			4.8	**25.4**	**86.1**
3/4"	636.2	5.0			5.0	**19.1**	**81.1**
1/2"	1042.6	8.2			8.2	**12.7**	**72.9**
3/8"	586.1	4.6			4.6	**9.52**	**68.3**
#4	1466.3	11.5			11.5	**4.76**	**56.8**
#10	1621.7	12.7			12.7	**2.00**	**44.1**
#20			9.8	19.0	8.4	**0.840**	**35.7**
#40			7.1	13.8	6.1	**0.420**	**29.7**
#60			5.7	11.0	4.9	**0.250**	**24.8**
#100			5.2	10.1	4.4	**0.149**	**20.3**
#200			5.6	10.9	4.8	**0.074**	**15.6**
Pan			18.2	35.3	15.6		

HYDROMETER ANALYSIS

Hydrometer No.: 87024 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	21.0	19.0		-3.33	17.7	**0.0700**	**14.9**
1	18.2	19.0		-3.33	14.9	**0.0564**	**12.6**
2	16.0	19.0		-3.33	12.7	**0.0404**	**10.7**
4	14.1	19.0		-3.33	10.8	**0.0289**	**9.1**
8	12.6	19.0		-3.33	9.3	**0.0206**	**7.8**
15	11.8	20.0		-3.00	8.8	**0.0151**	**7.4**
30	10.6	20.0		-3.00	7.6	**0.0107**	**6.4**
60	9.3	20.5		-2.83	6.5	**0.0076**	**5.5**
120	8.0	20.5		-2.83	5.2	**0.0054**	**4.4**
270	6.8	20.5		-2.83	4.0	**0.0037**	**3.4**
360	6.1	21.0		-2.67	3.4	**0.0032**	**2.9**
1440	6.3	17.0		-3.99	2.3	**0.0016**	**1.9**



Project No. 06-1413-081. **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-8**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	9 & 10
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 13210.9

Hydrometer: (Minus #10)
Before Wash (g) = 50.0
After Wash (g) = 25.9

Residual No. 200 (g) = 0.3
Total minus 200 (g) = 24.4
Gs (assumed) = 2.70

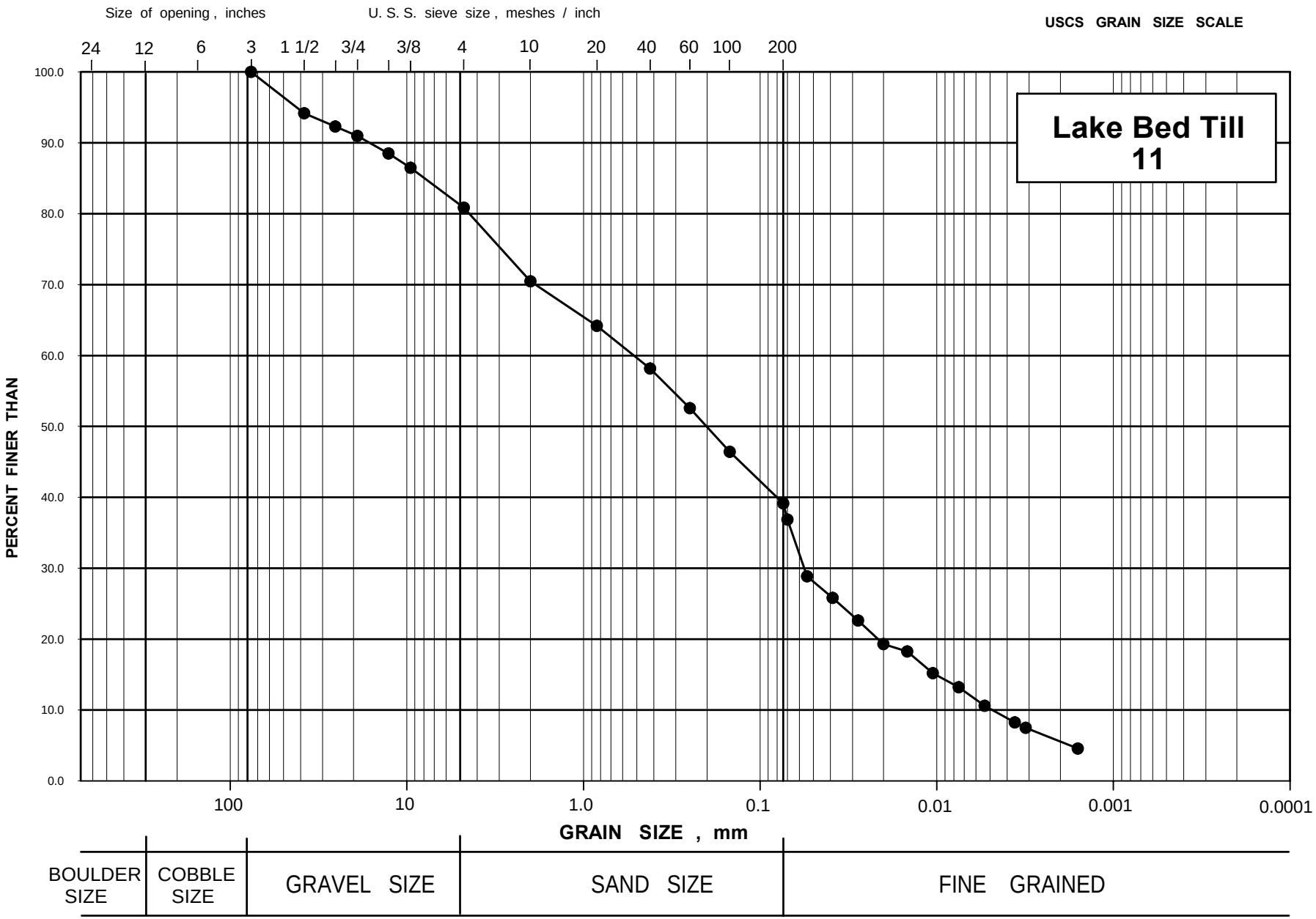
Size (USS)	Weight Retained (g)	Retained (%)	Weight Retained (g)	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	0.0					**38.1**	**100.0**
1"	185.5	1.4			1.4	**25.4**	**98.6**
3/4"	268.2	2.0			2.0	**19.1**	**96.6**
1/2"	509.4	3.9			3.9	**12.7**	**92.7**
3/8"	423.2	3.2			3.2	**9.52**	**89.5**
#4	1005.7	7.6			7.6	**4.76**	**81.9**
#10	1316.3	10.0			10.0	**2.00**	**71.9**
#20			5.8	11.6	8.3	**0.840**	**63.6**
#40			4.9	9.8	7.0	**0.420**	**56.5**
#60			4.1	8.2	5.9	**0.250**	**50.6**
#100			4.5	9.0	6.5	**0.149**	**44.2**
#200			6.3	12.6	9.1	**0.074**	**35.1**
Pan			24.4	48.8	35.1		

HYDROMETER ANALYSIS

Hydrometer No.: 87024 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	Hydrometer Reading	Temperature (ºC)		Composite Correction	Corrected Reading	Diameter (mm)	Percentage Passing
0.5	27.0	19.0		-3.33	23.7	**0.0700**	**33.7**
1	24.0	19.0		-3.33	20.7	**0.0543**	**29.4**
2	21.3	19.0		-3.33	18.0	**0.0391**	**25.6**
4	18.8	19.0		-3.33	15.5	**0.0281**	**22.0**
8	16.6	19.0		-3.33	13.3	**0.0201**	**18.9**
15	15.0	20.0		-3.00	12.0	**0.0148**	**17.1**
30	13.3	20.0		-3.00	10.3	**0.0106**	**14.7**
60	11.2	20.5		-2.83	8.4	**0.0076**	**11.9**
120	8.9	20.5		-2.83	6.1	**0.0054**	**8.6**
270	6.9	20.5		-2.83	4.1	**0.0037**	**5.8**
360	6.0	21.0		-2.67	3.3	**0.0032**	**4.7**
1440	6.0	17.0		-3.99	2.0	**0.0016**	**2.9**



Project No. 06-1413-081. **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-9**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	11
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 15616.4

Hydrometer: (Minus #10)
Before Wash (g) = 50.4
After Wash (g) = 23.1

Residual No. 200 (g) = 0.7
Total minus 200 (g) = 28.0
Gs (assumed) = 2.70

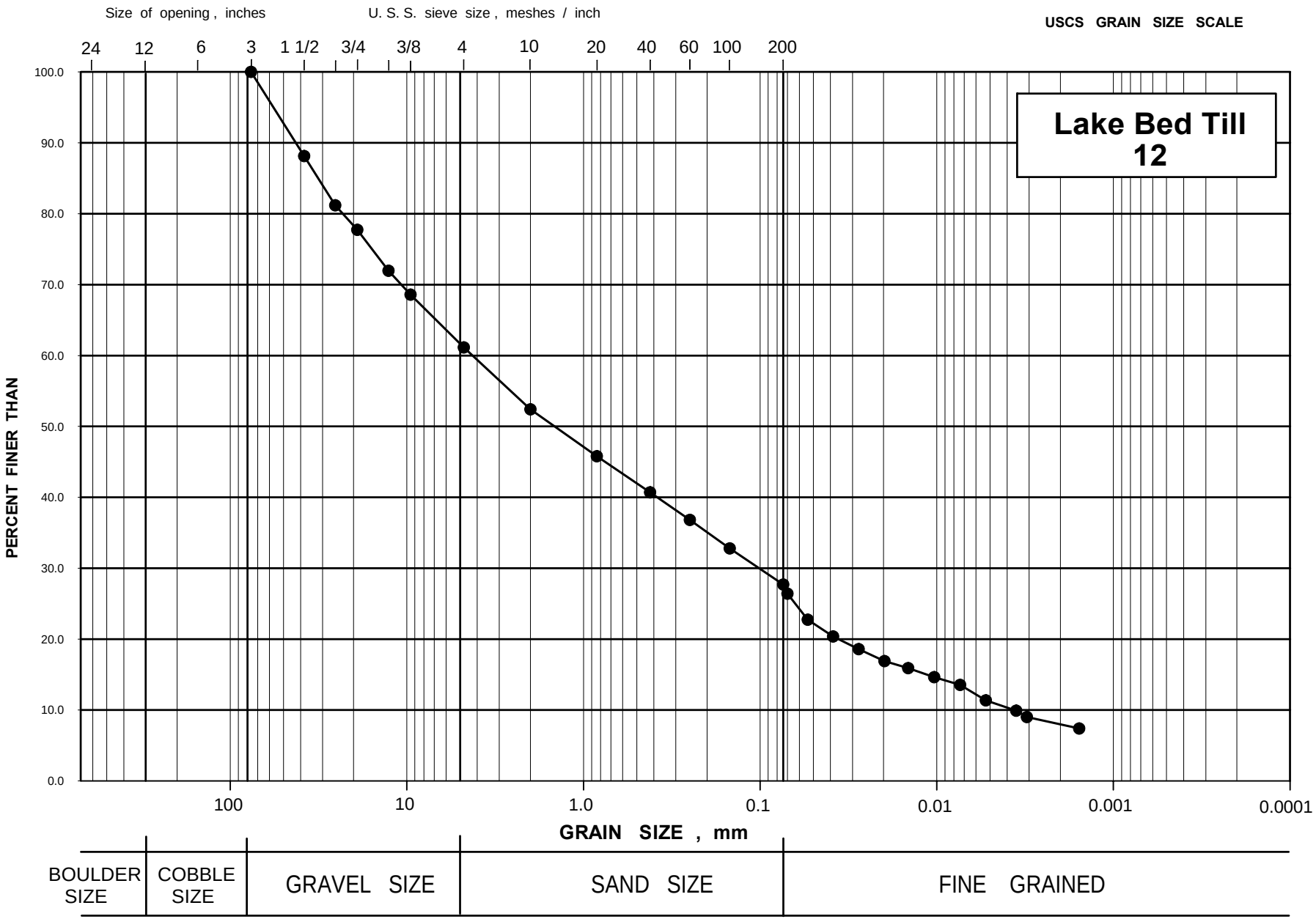
Size (USS)	**Weight Retained** (g)	**Retained** (%)	**Weight Retained** (g)	**Retained** (%)	**% Retained Total**	**Diameter** (mm)	**% Passing**
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	911.4	5.8			5.8	**38.1**	**94.2**
1"	291.6	1.9			1.9	**25.4**	**92.3**
3/4"	206.9	1.3			1.3	**19.1**	**91.0**
1/2"	388.5	2.5			2.5	**12.7**	**88.5**
3/8"	312.9	2.0			2.0	**9.52**	**86.5**
#4	879.9	5.6			5.6	**4.76**	**80.8**
#10	1620.2	10.4			10.4	**2.00**	**70.5**
#20			4.5	8.9	6.3	**0.840**	**64.2**
#40			4.3	8.5	6.0	**0.420**	**58.2**
#60			4.0	7.9	5.6	**0.250**	**52.6**
#100			4.4	8.7	6.2	**0.149**	**46.4**
#200			5.2	10.3	7.3	**0.074**	**39.2**
Pan			28.0	55.6	39.2		

HYDROMETER ANALYSIS

Hydrometer No.: 87024 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	**Hydrometer Reading**	**Temperature** (ºC)		**Composite Correction**	**Corrected Reading**	**Diameter** (mm)	**Percentage Passing**
0.5	30.0	19.0		-3.33	26.7	**0.0700**	**36.9**
1	24.2	19.0		-3.33	20.9	**0.0542**	**28.9**
2	22.0	19.0		-3.33	18.7	**0.0389**	**25.8**
4	19.7	19.0		-3.33	16.4	**0.0279**	**22.6**
8	17.3	19.0		-3.33	14.0	**0.0200**	**19.3**
15	16.2	20.0		-3.00	13.2	**0.0147**	**18.3**
30	14.0	20.0		-3.00	11.0	**0.0105**	**15.2**
60	12.4	20.5		-2.83	9.6	**0.0075**	**13.2**
120	10.5	20.5		-2.83	7.7	**0.0054**	**10.6**
270	8.8	20.5		-2.83	6.0	**0.0036**	**8.2**
360	8.1	21.0		-2.67	5.4	**0.0031**	**7.5**
1440	7.3	17.0		-3.99	3.3	**0.0016**	**4.6**



Project No. 06-1413-081 **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-10**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**BH :**	Lake Bed Till
Sch#	277	**Project :**	Dike Design	**Sample :**	12
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 16782.5

Hydrometer: (Minus #10)
Before Wash (g) = 52.4
After Wash (g) = 25.2

Residual No. 200 (g) = 0.5
Total minus 200 (g) = 27.7
Gs (assumed) = 2.70

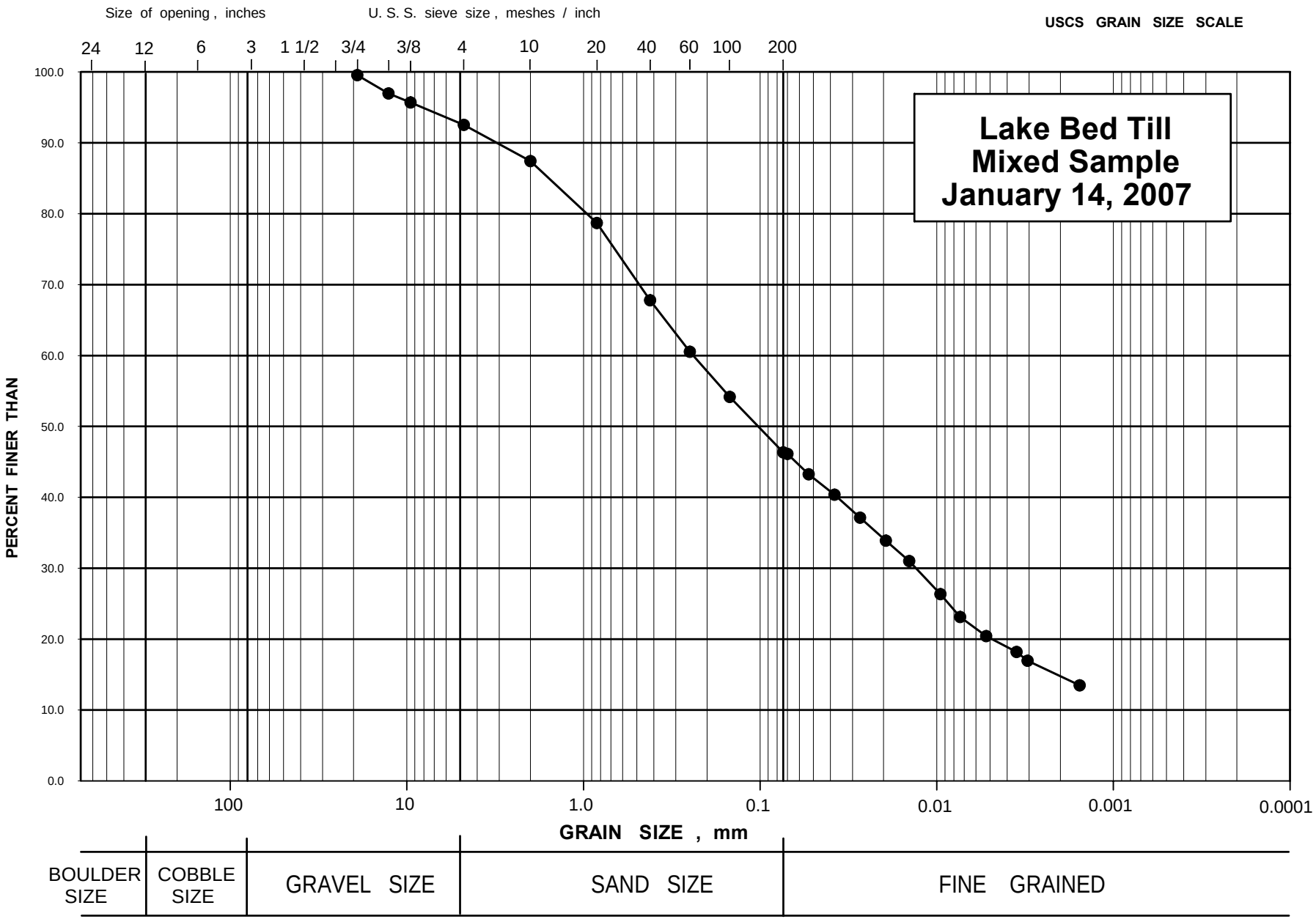
Size (USS)	**Weight Retained** (g)	**Retained** (%)	**Weight Retained** (g)	**Retained** (%)	**% Retained Total**	**Diameter** (mm)	**% Passing**
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	1992.1	11.9			11.9	**38.1**	**88.1**
1"	1166.2	6.9			6.9	**25.4**	**81.2**
3/4"	578.3	3.4			3.4	**19.1**	**77.7**
1/2"	969.0	5.8			5.8	**12.7**	**72.0**
3/8"	565.8	3.4			3.4	**9.52**	**68.6**
#4	1248.8	7.4			7.4	**4.76**	**61.1**
#10	1466.3	8.7			8.7	**2.00**	**52.4**
#20			6.6	12.6	6.6	**0.840**	**45.8**
#40			5.1	9.7	5.1	**0.420**	**40.7**
#60			3.9	7.4	3.9	**0.250**	**36.8**
#100			4.0	7.6	4.0	**0.149**	**32.8**
#200			5.1	9.7	5.1	**0.074**	**27.7**
Pan			27.7	52.9	27.7		

HYDROMETER ANALYSIS

Hydrometer No.: 8589 **Dispersion Method:** Stirring **Dispersion Period (min):**

Comments:

Time (min)	**Hydrometer Reading**	**Temperature** (ºC)		**Composite Correction**	**Corrected Reading**	**Diameter** (mm)	**Percentage Passing**
0.5	29.0	19.0		-2.30	26.7	**0.0700**	**26.4**
1	25.3	19.0		-2.30	23.0	**0.0538**	**22.7**
2	22.9	19.0		-2.30	20.6	**0.0387**	**20.4**
4	21.1	19.0		-2.30	18.8	**0.0277**	**18.6**
8	19.4	19.0		-2.30	17.1	**0.0198**	**16.9**
15	18.2	20.0		-2.10	16.1	**0.0145**	**15.9**
30	16.9	20.0		-2.10	14.8	**0.0104**	**14.6**
60	15.7	20.5		-2.00	13.7	**0.0074**	**13.6**
120	13.5	20.5		-2.00	11.5	**0.0053**	**11.4**
270	12.0	20.5		-2.00	10.0	**0.0036**	**9.9**
360	11.0	21.0		-1.90	9.1	**0.0031**	**9.0**
1440	10.2	17.0		-2.71	7.5	**0.0016**	**7.4**



Project No. 06-1413-081 **Drawn** TM **Reviewed** LL **Date** 03/09/07	Golder Associates	**GRAIN SIZE DISTRIBUTION** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure** **I-11**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-081	**Client :**	Meadowbank Mining Corporation	**Sample :**	Lake Bed Till Mixed Samples
Sch#	288	**Project :**	Dike Design		January 14, 2007
Lab Work:	TM	**Location:**	Meadowbank Gold Project		

First Sieving
Total Weight (g) = 3840.3

Hydrometer: (Minus #10)
Before Wash (g) = 48.1
After Wash (g) = 22.7

Residual No. 200 (g) = 0.1
Total minus 200 (g) = 25.5
Gs (assumed) = 2.70

Size (USS)	**Weight Retained** (g)	**Retained** (%)	**Weight Retained** (g)	**Retained** (%)	**% Retained Total**	**Diameter** (mm)	**% Passing**
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	0.0					**38.1**	**100.0**
1"	0.0					**25.4**	**100.0**
3/4"	17.8	0.5			0.5	**19.1**	**99.5**
1/2"	99.1	2.6			2.6	**12.7**	**97.0**
3/8"	48.8	1.3			1.3	**9.52**	**95.7**
#4	120.9	3.1			3.1	**4.76**	**92.5**
#10	196.6	5.1			5.1	**2.00**	**87.4**
#20			4.8	10.0	8.7	**0.840**	**78.7**
#40			6.0	12.5	10.9	**0.420**	**67.8**
#60			4.0	8.3	7.3	**0.250**	**60.5**
#100			3.5	7.3	6.4	**0.149**	**54.2**
#200			4.3	8.9	7.8	**0.074**	**46.3**
Pan			25.5	53.0	46.3		

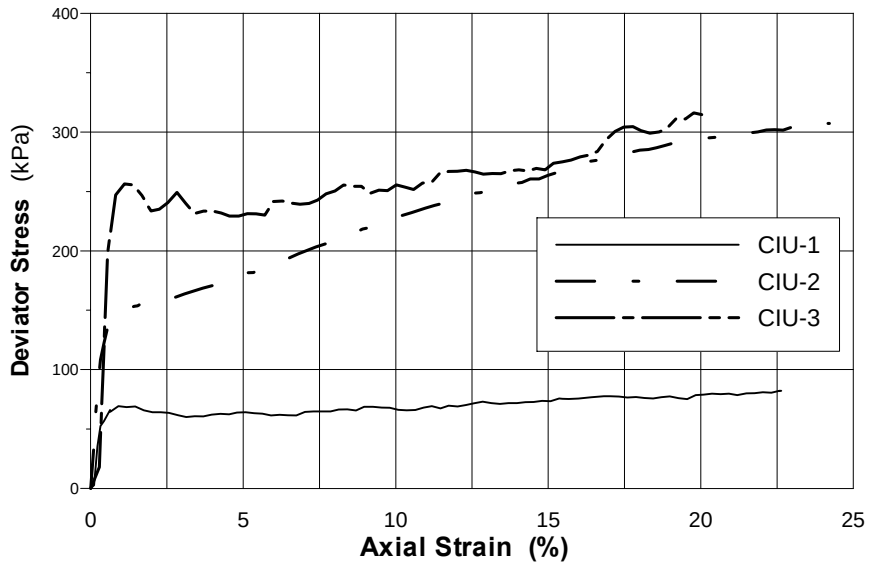
HYDROMETER ANALYSIS

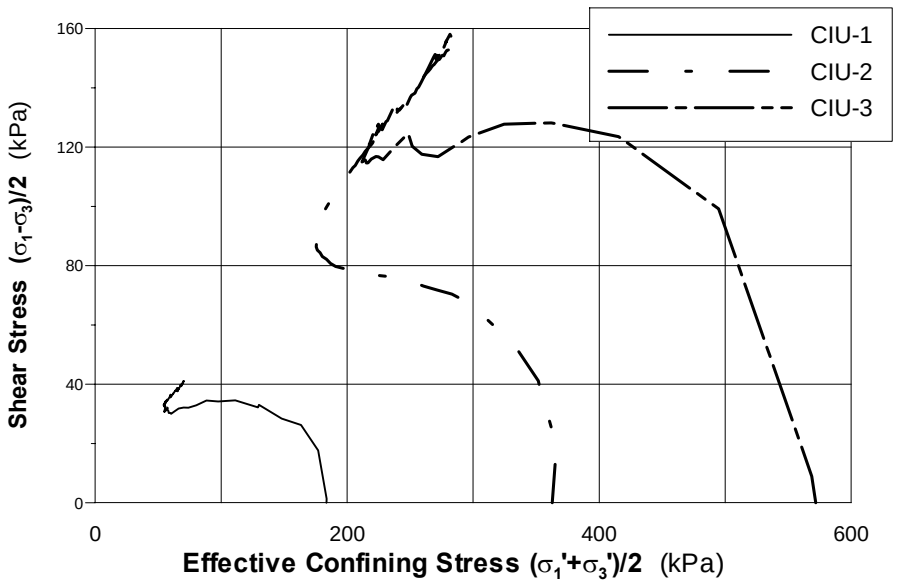
Hydrometer No.: 87024 **Dispersion Method:** Stirring **Dispersion Period (min):**

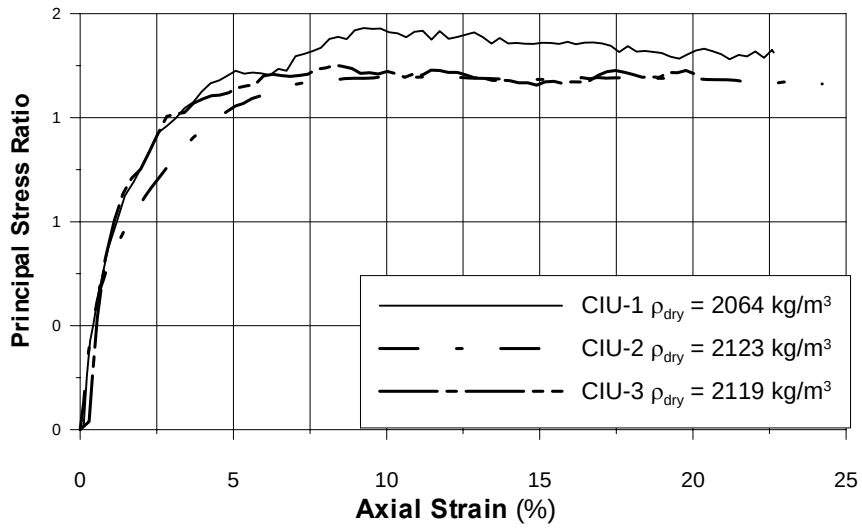
Comments:

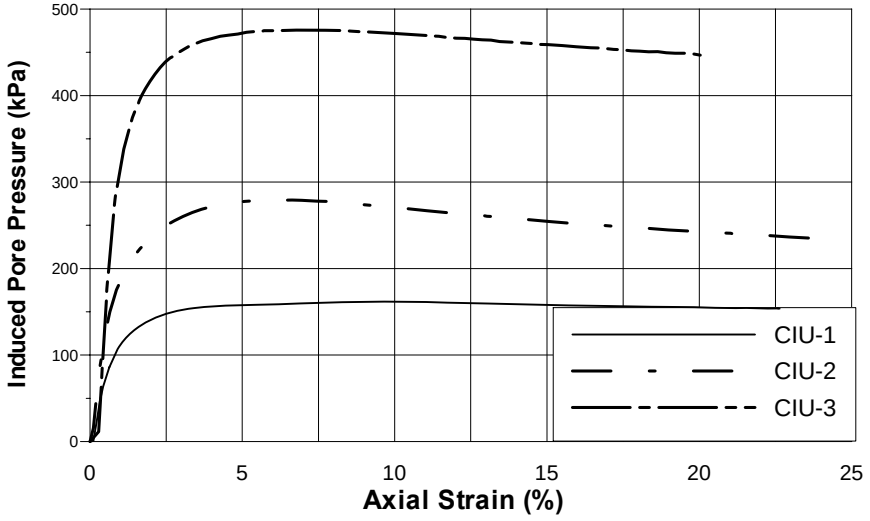
Time (min)	**Hydrometer Reading**	**Temperature** (ºC)		**Composite Correction**	**Corrected Reading**	**Diameter** (mm)	**Percentage Passing**
0.5	28.0	22.0		-2.34	25.7	**0.0700**	**46.1**
1	26.4	22.0		-2.34	24.1	**0.0531**	**43.2**
2	24.8	22.0		-2.34	22.5	**0.0380**	**40.4**
4	23.0	22.0		-2.34	20.7	**0.0272**	**37.1**
8	21.2	22.0		-2.34	18.9	**0.0194**	**33.9**
15	19.6	22.0		-2.34	17.3	**0.0143**	**31.0**
35	17.0	22.0		-2.34	14.7	**0.0095**	**26.4**
60	15.2	22.0		-2.34	12.9	**0.0074**	**23.1**
120	13.7	22.0		-2.34	11.4	**0.0053**	**20.4**
270	12.3	22.5		-2.17	10.1	**0.0035**	**18.2**
360	11.6	22.5		-2.17	9.4	**0.0031**	**16.9**
1440	10.5	20.0		-3.00	7.5	**0.0016**	**13.5**

TILL TRIAXIAL









Golder Associates

Project No. 06-1413-081
Drawn AS
Reviewed
Date 03/09/07

CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL TEST
TILL SAMPLES 3, 6 AND 7 COMPOSITE
Meadowbank Mining Corporation
Meadowbank Gold Project

Figure I-12

Undrained Triaxial Compression Test

Project No. :	06-1413-081/5000	**Client :**	Meadowbank Mining Corporation	**Location :**	
Sch No.		**Project :**	Dike Design	**Type :**	Lake Bed Till
Lab Work:	ROB	**Location:**	Meadowbank Gold Project	**Depth :**	
Test ID:	CIU - 1				

Equipment

Machine:	Trautwein
Chamber:	C2
Load Cell:	205856
Axial DCDT:	LP-175
Cell Pressure:	PS-3118
Back Pressure:	PS-3125
Pore Pressure:	PS-2232

Specimen Geometry

	Initial	Final
Height (mm) =	128.13	99.13
Diameter (mm) =	73.05	83.05
Area (cm^2) =	41.91	54.17
Volume (cm^3) =	537.02	537.02

Phase Relationships

	Initial	Final
e =	**0.32**	**0.32**
ρ_{sat} (kg/m^3) =	**2308**	**2308**
ρ_{dry} (kg/m^3) =	**2064**	**2064**
Gs =	2.73	

Strength Results

q_{MAX} (kPa) :	82.2
Strain @ =	22.63
η_{MAX} =	1.54
Strain @ =	9.25
B Value	0.96
Target Mean Effective Stress (kPa)	183.55

Axial Strain (%)	Load (kN)	ΔU (kPa)	Cell Pressure (kPa)	Pore Pressure (kPa)	A_c (cm^2)	σ_1' (kPa)	σ_3' (kPa)	p' (kPa)	q (kPa)	Stress ratio η		
0.00	0.00	0.00	955.98	772.4	41.9	183.6	183.6	183.6	0.0	0.00		
0.11	0.01	0.92	955.55	773.3	42.0	185.0	182.2	183.1	2.8	0.02		
0.22	0.15	23.72	955.42	796.1	42.0	194.7	159.3	171.1	35.4	0.21		
0.32	0.22	46.31	955.86	818.7	42.0	189.6	137.1	154.6	52.5	0.34		
0.44	0.24	63.63	955.68	836.1	42.1	176.4	119.6	138.6	56.8	0.41		
0.63	0.28	86.38	955.85	858.8	42.2	163.0	97.0	119.0	66.0	0.55		
0.63	0.27	86.21	955.75	858.6	42.2	161.5	97.1	118.6	64.4	0.54		
0.91	0.29	106.71	955.63	879.1	42.3	145.7	76.5	99.6	69.2	0.70		
1.18	0.29	119.71	955.53	892.1	42.4	131.8	63.4	86.2	68.4	0.79		
1.46	0.29	129.23	955.37	901.7	42.5	122.7	53.7	76.7	69.0	0.90		
1.74	0.28	135.89	955.52	908.3	42.7	113.1	47.2	69.2	65.9	0.95		
2.03	0.27	141.34	955.57	913.8	42.8	106.0	41.8	63.2	64.2	1.02		
2.30	0.28	145.24	955.67	917.7	42.9	102.2	38.0	59.4	64.2	1.08		
2.57	0.27	148.61	955.42	921.0	43.0	97.9	34.4	55.6	63.6	1.14		
2.87	0.27	150.98	955.44	923.4	43.2	93.7	32.0	52.6	61.7	1.17		
3.14	0.26	152.87	955.40	925.3	43.3	90.2	30.1	50.1	60.1	1.20		
3.41	0.26	154.13	955.44	926.6	43.4	89.7	28.9	49.2	60.8	1.24		
3.69	0.26	155.52	955.91	928.0	43.5	88.7	28.0	48.2	60.7	1.26		
3.97	0.27	156.01	955.50	928.4	43.6	89.2	27.1	47.8	62.1	1.30		
4.25	0.27	156.88	955.48	929.3	43.8	88.8	26.2	47.1	62.7	1.33		
4.54	0.27	157.34	955.45	929.8	43.9	88.1	25.7	46.5	62.5	1.34		
4.79	0.28	157.57	955.63	930.0	44.0	89.5	25.6	46.9	63.8	1.36		
5.08	0.28	157.87	955.44	930.3	44.2	89.4	25.1	46.6	64.2	1.38		
5.36	0.28	157.92	955.53	930.3	44.3	88.6	25.2	46.3	63.4	1.37		
5.63	0.28	158.24	955.52	930.7	44.4	87.8	24.8	45.8	62.9	1.37		
5.91	0.27	158.60	955.42	931.0	44.5	85.9	24.4	44.9	61.5	1.37		
6.19	0.28	158.66	955.85	931.1	44.7	86.6	24.8	45.4	61.9	1.36		
6.47	0.28	158.99	955.32	931.4	44.8	85.6	23.9	44.5	61.7	1.39		
6.74	0.28	159.35	955.81	931.8	44.9	85.5	24.0	44.5	61.4	1.38		
7.02	0.29	159.70	955.46	932.1	45.1	87.6	23.3	44.8	64.3	1.44		
7.30	0.29	160.27	955.98	932.7	45.2	88.2	23.3	44.9	64.9	1.44		
7.57	0.29	160.58	955.91	933.0	45.3	87.7	22.9	44.5	64.8	1.46		
7.86	0.29	160.61	955.56	933.0	45.5	87.3	22.5	44.1	64.8	1.47		
8.13	0.30	161.09	955.63	933.5	45.6	88.6	22.1	44.3	66.5	1.50		
8.42	0.30	161.11	955.41	933.5	45.8	88.4	21.9	44.1	66.6	1.51		
8.70	0.30	161.50	955.72	933.9	45.9	87.4	21.8	43.7	65.6	1.50		
8.96	0.32	161.28	955.54	933.7	46.0	90.6	21.8	44.7	68.7	1.54		
9.25	0.32	161.89	955.89	934.3	46.2	90.3	21.6	44.5	68.7	1.54		
9.54	0.32	161.80	955.72	934.2	46.3	89.6	21.5	44.2	68.1	1.54		
9.80	0.32	161.92	955.77	934.3	46.5	89.4	21.4	44.1	68.0	1.54		
10.08	0.31	161.99	955.63	934.4	46.6	87.3	21.2	43.2	66.1	1.53		
10.36	0.31	161.78	955.46	934.2	46.8	87.1	21.3	43.2	65.8	1.52		
10.64	0.31	161.31	955.48	933.7	46.9	87.8	21.7	43.8	66.0	1.51		
10.91	0.32	161.40	955.59	933.8	47.0	89.8	21.8	44.4	68.0	1.53		
11.18	0.33	160.94	955.39	933.4	47.2	91.2	22.0	45.1	69.2	1.53		
11.47	0.32	160.58	955.45	933.0	47.3	89.9	22.5	44.9	67.4	1.50		
11.73	0.33	160.78	955.43	933.2	47.5	91.9	22.2	45.5	69.7	1.53		
12.03	0.33	160.40	955.73	932.8	47.6	91.9	22.9	45.9	69.0	1.50		
12.30	0.34	160.17	955.69	932.6	47.8	93.3	23.1	46.5	70.2	1.51		
12.57	0.34	159.98	955.68	932.4	47.9	94.8	23.3	47.1	71.6	1.52		
12.85	0.35	159.68	955.55	932.1	48.1	96.5	23.4	47.8	73.0	1.53		
13.14	0.35	159.47	955.53	931.9	48.3	95.5	23.6	47.6	71.8	1.51		
13.42	0.34	159.33	955.97	931.8	48.4	95.4	24.2	47.9	71.2	1.48		
13.70	0.35	158.95	955.09	931.4	48.6	95.4	23.7	47.6	71.7	1.51		
13.97	0.35	158.72	955.55	931.1	48.7	96.2	24.4	48.4	71.8	1.49		

Axial Strain (%)	Load (kN)	ΔU (kPa)	Cell Pressure (kPa)	Pore Pressure (kPa)	A_c (cm^2)	σ_1' (kPa)	σ_3' (kPa)	p' (kPa)	q (kPa)	Stress ratio η		
14.25	0.35	158.60	955.66	931.0	48.9	97.2	24.6	48.8	72.6	1.49		
14.52	0.36	158.40	955.60	930.8	49.0	97.6	24.8	49.0	72.8	1.48		
14.80	0.36	158.04	955.58	930.5	49.2	98.8	25.1	49.7	73.7	1.48		
15.07	0.36	158.09	955.39	930.5	49.4	98.3	24.9	49.4	73.4	1.49		
15.36	0.37	157.71	955.81	930.1	49.5	101.4	25.7	50.9	75.7	1.49		
15.63	0.37	157.41	955.47	929.8	49.7	100.9	25.6	50.7	75.2	1.48		
15.91	0.38	157.56	955.50	930.0	49.8	101.2	25.5	50.8	75.7	1.49		
16.18	0.38	157.12	955.49	929.5	50.0	102.0	25.9	51.3	76.0	1.48		
16.47	0.39	156.98	955.46	929.4	50.2	103.1	26.1	51.7	77.0	1.49		
16.75	0.39	156.94	955.55	929.4	50.3	103.6	26.2	52.0	77.4	1.49		
17.03	0.39	156.75	955.53	929.2	50.5	103.9	26.4	52.2	77.5	1.49		
17.32	0.39	156.49	955.52	928.9	50.7	103.9	26.6	52.4	77.3	1.48		
17.59	0.39	156.15	955.75	928.6	50.9	103.7	27.2	52.7	76.5	1.45		
17.87	0.39	156.47	955.42	928.9	51.0	103.5	26.5	52.2	77.0	1.48		
18.15	0.39	156.20	955.63	928.6	51.2	103.2	27.0	52.4	76.2	1.45		
18.43	0.39	155.76	954.92	928.2	51.4	102.4	26.7	52.0	75.7	1.46		
18.70	0.40	155.86	955.54	928.3	51.6	104.1	27.3	52.9	76.8	1.45		
18.98	0.40	155.55	955.64	928.0	51.7	105.2	27.7	53.5	77.5	1.45		
19.27	0.39	155.55	955.61	928.0	51.9	103.6	27.6	53.0	76.0	1.43		
19.56	0.39	155.30	955.32	927.7	52.1	102.7	27.6	52.6	75.1	1.43		
19.83	0.41	155.31	955.99	927.7	52.3	106.9	28.3	54.5	78.6	1.44		
20.10	0.41	155.16	955.41	927.6	52.5	106.8	27.8	54.1	79.0	1.46		
20.37	0.42	155.00	955.28	927.4	52.6	107.6	27.9	54.5	79.8	1.47		
20.65	0.42	154.76	955.27	927.2	52.8	107.5	28.1	54.5	79.4	1.46		
20.92	0.42	154.31	955.34	926.7	53.0	108.3	28.6	55.2	79.7	1.44		
21.20	0.42	154.28	955.70	926.7	53.2	107.6	29.0	55.2	78.6	1.42		
21.50	0.43	154.28	955.53	926.7	53.4	108.8	28.8	55.5	80.0	1.44		
21.77	0.43	154.17	955.70	926.6	53.6	109.2	29.1	55.8	80.1	1.44		
22.04	0.44	154.33	955.47	926.8	53.8	109.8	28.7	55.7	81.0	1.45		
22.31	0.43	153.67	955.59	926.1	54.0	110.1	29.5	56.4	80.6	1.43		
22.58	0.44	154.01	955.29	926.4	54.1	110.9	28.9	56.2	82.1	1.46		
22.63	0.45	153.84	955.53	926.3	54.2	111.4	29.3	56.7	82.2	1.45		

Undrained Triaxial Compression Test

Project No. :	06-1413-081/5000	**Client :**	Meadowbank Mining Corporation	**Location :**	
Sch No.		**Project :**	Dike Design	**Type :**	Lake Bed Till
Lab Work:	ROB	**Location:**	Meadowbank Gold Project	**Depth :**	
Test ID:	CIU - 2				

Equipment

Machine:	Trautwein
Chamber:	C1
Load Cell:	205858
Axial DCDT:	LP-175
Cell Pressure:	PS-3118
Back Pressure:	PS-3125
Pore Pressure:	PS-2232

Specimen Geometry

	Initial	Final
Height (mm) =	118.39	89.72
Diameter (mm) =	69.53	79.87
Area (cm^2) =	37.97	50.10
Volume (cm^3) =	449.50	449.50

Phase Relationships

	Initial	Final
e =	**0.29**	**0.29**
ρ_{sat} (kg/m^3) =	**2345**	**2345**
ρ_{dry} (kg/m^3) =	**2123**	**2123**
Gs =	2.73	

Strength Results

q_{MAX} (kPa) :	308.2
Strain @ =	23.80
η_{MAX} =	1.36
Strain @ =	11.10
B Value	0.95
Target Mean Effective Stress (kPa)	362.69

Axial Strain (%)	Load (kN)	ΔU (kPa)	Cell Pressure (kPa)	Pore Pressure (kPa)	A_c (cm^2)	σ_1' (kPa)	σ_3' (kPa)	p' (kPa)	q (kPa)	Stress ratio η		
0.00	0.00	0.00	1090.60	727.9	38.0	362.7	362.7	362.7	0.0	0.00		
0.11	0.14	15.48	1090.64	743.4	38.0	385.0	347.3	359.8	37.7	0.10		
0.21	0.31	52.34	1090.84	780.3	38.0	392.8	310.6	338.0	82.2	0.24		
0.32	0.41	85.55	1090.50	813.5	38.1	385.4	277.0	313.2	108.3	0.35		
0.44	0.47	112.21	1090.52	840.1	38.1	373.4	250.4	291.4	123.0	0.42		
0.55	0.51	133.35	1090.57	861.3	38.2	364.0	229.3	274.2	134.7	0.49		
0.66	0.54	150.02	1090.67	877.9	38.2	353.5	212.7	259.7	140.8	0.54		
0.77	0.55	163.57	1090.76	891.5	38.3	343.0	199.3	247.2	143.7	0.58		
0.87	0.56	175.27	1090.64	903.2	38.3	333.8	187.5	236.2	146.3	0.62		
0.99	0.57	184.74	1090.64	912.7	38.3	326.7	178.0	227.6	148.7	0.65		
1.10	0.58	193.31	1090.76	921.2	38.4	321.3	169.5	220.1	151.8	0.69		
1.21	0.58	200.38	1090.68	928.3	38.4	313.5	162.4	212.8	151.2	0.71		
1.32	0.59	207.02	1090.60	934.9	38.5	308.4	155.7	206.6	152.8	0.74		
1.43	0.59	213.10	1090.82	941.0	38.5	303.1	149.8	200.9	153.3	0.76		
1.53	0.59	218.41	1090.79	946.3	38.6	298.2	144.5	195.7	153.7	0.79		
1.65	0.60	223.08	1090.69	951.0	38.6	294.9	139.7	191.4	155.2	0.81		
1.77	0.60	227.69	1090.83	955.6	38.7	289.6	135.2	186.7	154.4	0.83		
1.88	0.60	231.52	1090.49	959.4	38.7	286.0	131.1	182.7	155.0	0.85		
1.98	0.61	235.05	1090.50	963.0	38.7	284.4	127.5	179.8	156.9	0.87		
2.10	0.61	238.98	1090.64	966.9	38.8	281.1	123.7	176.2	157.4	0.89		
2.21	0.61	242.07	1090.50	970.0	38.8	278.9	120.5	173.3	158.3	0.91		
2.31	0.61	244.83	1090.48	972.7	38.9	275.9	117.7	170.4	158.1	0.93		
2.58	0.62	251.60	1090.63	979.5	39.0	270.6	111.1	164.3	159.5	0.97		
2.85	0.63	256.86	1090.60	984.8	39.1	267.4	105.8	159.7	161.6	1.01		
3.13	0.64	261.45	1090.67	989.4	39.2	265.7	101.3	156.1	164.4	1.05		
3.40	0.65	265.47	1090.61	993.4	39.3	263.4	97.2	152.6	166.2	1.09		
3.69	0.67	268.71	1090.70	996.6	39.4	263.0	94.1	150.4	168.9	1.12		
3.96	0.67	271.36	1090.39	999.3	39.5	261.7	91.1	148.0	170.5	1.15		
4.22	0.68	273.60	1090.61	1001.5	39.6	261.8	89.1	146.6	172.7	1.18		
4.51	0.70	275.30	1090.78	1003.2	39.8	263.7	87.6	146.3	176.1	1.20		
4.78	0.71	276.48	1090.74	1004.4	39.9	264.5	86.4	145.7	178.1	1.22		
5.07	0.73	277.64	1090.82	1005.6	40.0	266.7	85.3	145.8	181.5	1.24		
5.33	0.73	278.39	1090.57	1006.3	40.1	266.0	84.3	144.9	181.8	1.25		
5.60	0.74	279.02	1090.64	1006.9	40.2	268.8	83.7	145.4	185.1	1.27		
5.88	0.76	279.06	1090.55	1007.0	40.3	271.3	83.6	146.1	187.7	1.28		
6.15	0.77	279.50	1090.93	1007.4	40.5	274.4	83.5	147.1	190.8	1.30		
6.43	0.78	279.23	1090.62	1007.1	40.6	276.6	83.5	147.9	193.2	1.31		
6.71	0.80	279.42	1090.66	1007.3	40.7	279.9	83.3	148.8	196.5	1.32		
6.98	0.81	278.78	1090.45	1006.7	40.8	282.9	83.8	150.1	199.1	1.33		
7.25	0.83	278.36	1090.63	1006.3	40.9	286.7	84.4	151.8	202.3	1.33		
7.52	0.84	278.09	1090.65	1006.0	41.1	288.9	84.6	152.7	204.3	1.34		
7.79	0.85	277.46	1090.68	1005.4	41.2	292.1	85.3	154.2	206.8	1.34		
8.08	0.87	276.50	1090.30	1004.4	41.3	296.1	85.9	156.0	210.2	1.35		
8.36	0.88	275.92	1090.67	1003.8	41.4	299.1	86.8	157.6	212.3	1.35		
8.62	0.89	274.92	1090.51	1002.8	41.6	302.5	87.7	159.3	214.8	1.35		
8.91	0.91	274.19	1090.72	1002.1	41.7	307.0	88.6	161.4	218.4	1.35		
9.18	0.92	273.26	1090.77	1001.2	41.8	309.7	89.6	163.0	220.1	1.35		
9.44	0.93	272.25	1090.70	1000.2	41.9	313.4	90.5	164.8	222.8	1.35		
9.73	0.95	271.25	1090.59	999.2	42.1	317.6	91.4	166.8	226.1	1.36		
10.00	0.96	270.42	1090.85	998.3	42.2	320.2	92.5	168.4	227.6	1.35		
10.28	0.98	269.63	1090.72	997.5	42.3	323.7	93.2	170.0	230.5	1.36		
10.56	0.99	268.71	1090.55	996.6	42.5	326.5	93.9	171.4	232.5	1.36		
10.83	1.00	267.67	1090.67	995.6	42.6	329.9	95.1	173.4	234.8	1.35		
11.10	1.01	266.86	1090.52	994.8	42.7	332.9	95.7	174.8	237.1	1.36		
11.38	1.02	265.93	1090.57	993.8	42.8	335.7	96.7	176.4	239.0	1.35		

Axial Strain (%)	Load (kN)	ΔU (kPa)	Cell Pressure (kPa)	Pore Pressure (kPa)	A_c (cm^2)	σ_1' (kPa)	σ_3' (kPa)	p' (kPa)	q (kPa)	Stress ratio η		
11.66	1.04	264.86	1090.68	992.8	43.0	339.1	97.9	178.3	241.1	1.35		
11.95	1.05	264.07	1090.60	992.0	43.1	341.4	98.6	179.5	242.7	1.35		
12.22	1.06	263.16	1090.69	991.1	43.3	345.5	99.6	181.6	245.9	1.35		
12.48	1.08	262.55	1091.04	990.5	43.4	348.8	100.6	183.3	248.2	1.35		
12.76	1.08	261.54	1090.59	989.5	43.5	350.1	101.1	184.1	249.0	1.35		
13.03	1.10	260.58	1090.57	988.5	43.7	353.1	102.1	185.8	251.1	1.35		
13.32	1.11	259.61	1090.49	987.5	43.8	355.9	103.0	187.3	252.9	1.35		
13.60	1.12	258.67	1090.67	986.6	43.9	359.2	104.1	189.1	255.1	1.35		
13.86	1.13	257.84	1090.55	985.8	44.1	361.6	104.8	190.4	256.8	1.35		
14.14	1.14	257.22	1090.61	985.1	44.2	363.0	105.5	191.3	257.5	1.35		
14.41	1.16	256.42	1090.65	984.3	44.4	367.0	106.3	193.2	260.7	1.35		
14.69	1.16	255.58	1090.17	983.5	44.5	367.3	106.7	193.5	260.6	1.35		
14.98	1.18	254.71	1090.50	982.6	44.7	371.4	107.9	195.7	263.5	1.35		
15.24	1.19	253.92	1090.44	981.8	44.8	374.2	108.6	197.1	265.6	1.35		
15.51	1.20	253.23	1090.54	981.1	44.9	375.6	109.4	198.1	266.2	1.34		
15.79	1.21	252.51	1090.52	980.4	45.1	377.9	110.1	199.4	267.8	1.34		
16.07	1.22	251.81	1090.54	979.7	45.2	381.0	110.8	200.9	270.1	1.34		
16.35	1.25	251.11	1090.64	979.0	45.4	387.0	111.6	203.4	275.4	1.35		
16.63	1.26	250.22	1090.70	978.1	45.5	388.9	112.6	204.7	276.3	1.35		
16.88	1.27	249.76	1090.50	977.7	45.7	391.2	112.8	205.6	278.4	1.35		
17.17	1.28	249.04	1090.55	976.9	45.8	393.2	113.6	206.8	279.6	1.35		
17.46	1.29	248.45	1090.44	976.4	46.0	395.4	114.1	207.8	281.3	1.35		
17.72	1.31	247.83	1090.48	975.7	46.1	397.8	114.7	209.1	283.0	1.35		
18.00	1.32	247.12	1090.68	975.0	46.3	400.5	115.6	210.6	284.9	1.35		
18.28	1.33	246.52	1090.63	974.4	46.5	401.5	116.2	211.3	285.3	1.35		
18.55	1.34	245.75	1090.43	973.7	46.6	403.5	116.8	212.3	286.8	1.35		
18.82	1.35	245.24	1090.63	973.2	46.8	406.2	117.5	213.7	288.7	1.35		
19.09	1.36	244.48	1090.63	972.4	46.9	408.9	118.2	215.1	290.6	1.35		
19.37	1.37	243.77	1090.56	971.7	47.1	410.0	118.9	215.9	291.1	1.35		
19.65	1.39	243.30	1090.83	971.2	47.3	412.8	119.6	217.3	293.1	1.35		
19.92	1.40	242.73	1090.66	970.6	47.4	414.2	120.0	218.1	294.2	1.35		
20.20	1.40	242.04	1090.38	969.9	47.6	415.6	120.4	218.8	295.2	1.35		
20.49	1.41	241.68	1090.57	969.6	47.8	416.6	121.0	219.5	295.7	1.35		
20.76	1.42	241.08	1090.64	969.0	47.9	418.7	121.6	220.7	297.1	1.35		
21.03	1.43	240.75	1090.72	968.7	48.1	420.2	122.1	221.4	298.1	1.35		
21.32	1.44	239.90	1090.56	967.8	48.3	421.9	122.7	222.5	299.1	1.34		
21.58	1.45	239.52	1090.95	967.4	48.4	422.7	123.5	223.2	299.1	1.34		
21.87	1.46	238.84	1090.68	966.8	48.6	424.2	123.9	224.0	300.2	1.34		
22.15	1.47	238.53	1090.93	966.4	48.8	426.3	124.5	225.1	301.8	1.34		
22.42	1.48	237.89	1090.88	965.8	48.9	427.0	125.1	225.7	302.0	1.34		
22.70	1.48	237.08	1090.70	965.0	49.1	427.4	125.7	226.3	301.7	1.33		
22.96	1.50	236.64	1090.55	964.5	49.3	430.0	126.0	227.3	304.0	1.34		
23.24	1.51	236.19	1090.62	964.1	49.5	431.7	126.5	228.2	305.2	1.34		
23.52	1.52	235.29	1090.53	963.2	49.6	432.9	127.3	229.2	305.6	1.33		
23.80	1.54	234.96	1090.52	962.9	49.8	435.9	127.6	230.4	308.2	1.34		
24.06	1.54	234.68	1090.80	962.6	50.0	435.4	128.2	230.6	307.2	1.33		
24.22	1.54	234.15	1090.76	962.1	50.1	436.1	128.7	231.2	307.4	1.33		

Undrained Triaxial Compression Test

Project No. :	06-1413-081/5000	**Client :**	Meadowbank Mining Corporation	**Location :**	
Sch No.		**Project :**	Dike Design	**Type :**	Lake Bed Till
Lab Work:	ROB	**Location:**	Meadowbank Gold Project	**Depth :**	
Test ID:	CIU - 3				

Equipment

Machine:	Trautwein
Chamber:	C1
Load Cell:	194249
Axial DCDT:	LP-175
Cell Pressure:	PS-3118
Back Pressure:	PS-3125
Pore Pressure:	PS-2232

Specimen Geometry

	Initial	Final
Height (mm) =	121.90	97.49
Diameter (mm) =	67.74	75.75
Area (cm^2) =	36.04	45.07
Volume (cm^3) =	439.36	439.36

Phase Relationships

	Initial	Final
e =	**0.29**	**0.29**
ρ_{sat} (kg/m^3) =	**2343**	**2343**
ρ_{dry} (kg/m^3) =	**2119**	**2119**
Gs =	2.73	

Strength Results

q_{MAX} (kPa) :	316.2
Strain @ =	19.77
η_{MAX} =	1.40
Strain @ =	8.29
B Value	0.99
Target Mean Effective Stress (kPa)	572.02

Axial Strain (%)	Load (kN)	ΔU (kPa)	Cell Pressure (kPa)	Pore Pressure (kPa)	A_c (cm^2)	σ_1' (kPa)	σ_3' (kPa)	p' (kPa)	q (kPa)	Stress ratio η		
0.00	0.00	0.00	1440.36	868.3	36.0	572.0	572.0	572.0	0.0	0.00		
0.29	0.06	11.52	1439.64	879.9	36.1	577.6	559.8	565.7	17.9	0.03		
0.56	0.72	176.32	1440.34	1044.7	36.2	594.0	395.7	461.8	198.3	0.43		
0.82	0.90	279.87	1440.11	1148.2	36.3	539.0	291.9	374.3	247.1	0.66		
1.11	0.93	338.28	1440.42	1206.6	36.4	490.2	233.8	319.3	256.4	0.80		
1.39	0.93	374.53	1439.59	1242.9	36.6	452.2	196.7	281.9	255.5	0.91		
1.68	0.90	398.77	1439.93	1267.1	36.7	419.6	172.8	255.1	246.8	0.97		
1.97	0.86	416.28	1439.90	1284.6	36.8	388.8	155.3	233.1	233.6	1.00		
2.25	0.87	430.26	1440.30	1298.6	36.9	376.8	141.7	220.1	235.1	1.07		
2.53	0.89	440.69	1440.43	1309.0	37.0	372.0	131.4	211.6	240.6	1.14		
2.83	0.92	447.89	1439.99	1316.2	37.1	373.0	123.8	206.8	249.2	1.21		
3.12	0.89	454.39	1440.23	1322.7	37.2	357.5	117.5	197.5	240.0	1.22		
3.40	0.86	459.20	1440.18	1327.5	37.3	344.1	112.6	189.8	231.5	1.22		
3.70	0.87	463.33	1439.82	1331.7	37.4	341.6	108.1	186.0	233.4	1.26		
3.98	0.88	465.83	1440.04	1334.2	37.5	339.6	105.9	183.8	233.7	1.27		
4.28	0.87	468.42	1440.04	1336.8	37.7	335.2	103.3	180.6	231.9	1.28		
4.55	0.87	469.76	1439.79	1338.1	37.8	331.0	101.7	178.1	229.3	1.29		
4.85	0.87	471.19	1440.06	1339.5	37.9	329.9	100.5	177.0	229.3	1.30		
5.14	0.88	473.07	1440.22	1341.4	38.0	330.1	98.8	175.9	231.3	1.31		
5.43	0.88	473.98	1440.14	1342.3	38.1	329.1	97.8	174.9	231.3	1.32		
5.71	0.88	474.84	1439.79	1343.2	38.2	326.6	96.6	173.3	230.0	1.33		
5.99	0.93	474.99	1440.35	1343.3	38.3	338.6	97.0	177.5	241.6	1.36		
6.28	0.93	475.14	1439.93	1343.5	38.5	338.5	96.4	177.1	242.0	1.37		
6.58	0.93	475.54	1440.27	1343.9	38.6	336.6	96.4	176.4	240.2	1.36		
6.86	0.93	475.74	1440.51	1344.1	38.7	335.8	96.4	176.2	239.3	1.36		
7.16	0.93	475.63	1440.12	1344.0	38.8	336.1	96.1	176.1	240.0	1.36		
7.44	0.95	475.30	1440.34	1343.6	38.9	339.6	96.7	177.7	242.9	1.37		
7.72	0.97	475.61	1440.14	1344.0	39.1	344.2	96.2	178.9	248.1	1.39		
8.01	0.98	475.53	1440.50	1343.9	39.2	347.1	96.6	180.1	250.5	1.39		
8.29	1.00	475.00	1440.40	1343.3	39.3	352.6	97.1	182.2	255.5	1.40		
8.58	1.00	474.57	1440.16	1342.9	39.4	351.6	97.3	182.0	254.4	1.40		
8.88	1.01	473.64	1440.35	1342.0	39.6	352.8	98.4	183.2	254.4	1.39		
9.15	0.99	473.52	1440.31	1341.9	39.7	346.7	98.5	181.2	248.3	1.37		
9.45	1.00	473.08	1440.70	1341.4	39.8	350.4	99.3	183.0	251.1	1.37		
9.73	1.00	472.17	1440.14	1340.5	39.9	350.3	99.6	183.2	250.7	1.37		
10.02	1.02	471.66	1440.29	1340.0	40.1	355.9	100.3	185.5	255.6	1.38		
10.31	1.02	471.36	1440.44	1339.7	40.2	354.4	100.7	185.3	253.7	1.37		
10.59	1.01	470.32	1440.52	1338.7	40.3	353.6	101.9	185.8	251.7	1.35		
10.88	1.04	469.79	1440.39	1338.1	40.4	359.4	102.3	188.0	257.1	1.37		
11.17	1.05	468.97	1440.34	1337.3	40.6	360.8	103.0	188.9	257.8	1.36		
11.45	1.08	468.39	1440.26	1336.7	40.7	369.1	103.5	192.1	265.6	1.38		
11.72	1.09	467.16	1439.75	1335.5	40.8	371.1	104.3	193.2	266.9	1.38		
12.02	1.09	466.28	1439.95	1334.6	41.0	372.4	105.3	194.3	267.0	1.37		
12.31	1.10	466.02	1440.06	1334.4	41.1	373.5	105.7	195.0	267.8	1.37		
12.59	1.10	465.11	1439.93	1333.4	41.2	372.9	106.5	195.3	266.4	1.36		
12.87	1.10	464.46	1440.16	1332.8	41.4	372.1	107.4	195.6	264.7	1.35		
13.16	1.10	463.99	1440.00	1332.3	41.5	372.9	107.7	196.1	265.2	1.35		
13.45	1.10	462.50	1439.79	1330.8	41.6	373.9	108.9	197.3	264.9	1.34		
13.75	1.12	461.84	1440.19	1330.2	41.8	377.6	110.0	199.2	267.6	1.34		
14.03	1.12	461.31	1440.08	1329.7	41.9	378.7	110.4	199.9	268.3	1.34		
14.31	1.12	460.46	1440.02	1328.8	42.1	378.5	111.2	200.3	267.3	1.33		
14.61	1.14	459.94	1440.39	1328.3	42.2	381.6	112.1	201.9	269.5	1.33		
14.90	1.14	458.65	1440.02	1327.0	42.4	381.2	113.0	202.4	268.2	1.32		
15.17	1.16	458.82	1440.46	1327.2	42.5	387.0	113.3	204.5	273.7	1.34		
15.47	1.17	458.12	1440.09	1326.5	42.6	388.7	113.6	205.3	275.0	1.34		

Axial Strain (%)	Load (kN)	ΔU (kPa)	Cell Pressure (kPa)	Pore Pressure (kPa)	A_c (cm^2)	σ_1' (kPa)	σ_3' (kPa)	p' (kPa)	q (kPa)	Stress ratio η		
15.75	1.18	456.97	1440.87	1325.3	42.8	392.0	115.6	207.7	276.5	1.33		
16.04	1.20	456.22	1440.16	1324.6	42.9	394.9	115.6	208.7	279.3	1.34		
16.33	1.21	455.49	1440.15	1323.8	43.1	396.8	116.3	209.8	280.5	1.34		
16.61	1.23	455.07	1440.35	1323.4	43.2	400.7	116.9	211.5	283.7	1.34		
16.91	1.28	454.46	1440.55	1322.8	43.4	411.7	117.7	215.7	294.0	1.36		
17.19	1.31	453.44	1439.99	1321.8	43.5	418.8	118.2	218.4	300.6	1.38		
17.47	1.33	453.03	1440.13	1321.4	43.7	423.0	118.8	220.2	304.2	1.38		
17.77	1.34	451.69	1440.18	1320.0	43.8	424.8	120.1	221.7	304.7	1.37		
18.04	1.32	451.43	1439.90	1319.8	44.0	421.3	120.1	220.5	301.2	1.37		
18.34	1.32	450.59	1439.90	1318.9	44.1	420.1	121.0	220.7	299.1	1.36		
18.64	1.33	450.63	1440.11	1319.0	44.3	421.3	121.1	221.2	300.2	1.36		
18.91	1.35	449.33	1440.71	1317.7	44.4	427.1	123.0	224.4	304.1	1.36		
19.21	1.39	448.96	1440.29	1317.3	44.6	434.6	123.0	226.9	311.6	1.37		
19.50	1.39	448.88	1440.14	1317.2	44.8	433.9	122.9	226.6	311.0	1.37		
19.77	1.42	448.30	1440.13	1316.6	44.9	439.7	123.5	228.9	316.2	1.38		
20.03	1.42	446.66	1439.96	1315.0	45.1	439.8	125.0	229.9	314.8	1.37		

TILL CONSOLIDATION

One-Dimensional Consolidation Properties of Soils of Soils - ASTM D 2436 - 96

Project No. :	06-1413-081/4000	**Client :**	Meadowbank Mining Corporation	**Borehole:**	
Sch No.		**Project :**	Dike Design	**Sample:**	Lake Bed Till
Lab Work:	ROB/LL	**Location:**	Meadowbank Gold Project	**Depth :**	

Equipment

Machine:	Sigma-1
Mach No.	Station 1
Ring No.	Large
Lever Arm Ratio	0.0
Drainage:	Double-sided

Specimen Geometry

	Initial	Final
Height (mm) =	71.21	62.15
Diameter (mm) =	152.40	152.40
Area (cm^2) =	182.41	182.41
Volume (cm^3) =	1298.93	1133.65

Phase Relationships

	Initial	Final
Wet Wt (g) =	2701.80	2566.60
Dry Wt (g) =	2305.10	2305.10
w (%) =	**17.21**	**11.34**
e =	**0.54**	**0.34**
ρ_{wet} (kg/m^3) =	**2080**	**2264**
ρ_{drv} (kg/m^3) =	**1775**	**2033**
S (%) =	**87.3**	**90.4**

Remarks

ASTM Method:	B - Constant Time Increment
Method for Cv :	Casagrande
H_{avg} :	Half the specimen height
Time Increment:	

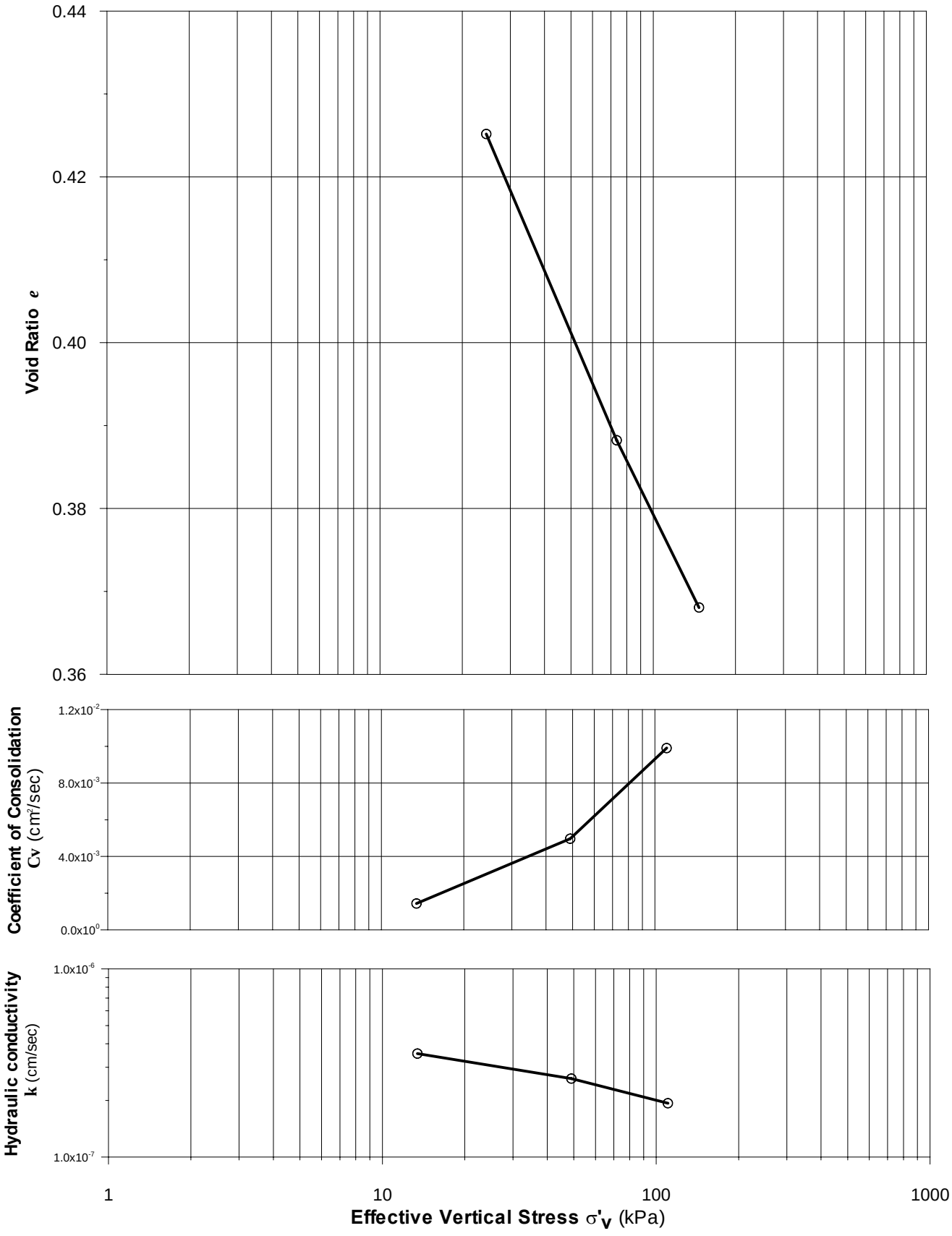
Sample Properties

G_s =	2.73	Calculated
H_s (mm) =	46.29	

Stress (kPa)	**ΔH** (mm)	**Corrected d_f** (mm)	**ε Σ ΔH / Ho** (%)	**H-H_s** (mm)	**e (H-H_s)/H_s**	**Stress $_{avg}$** (kPa)	**e_{avg}**	**H_{avg}** (mm)	**t 50** (min)	**Cv** (cm^2/sec)	**k** (cm/sec)
2.3	1.49	69.75	2.05	23.46	**0.51**						
24.5	4.25	65.97	7.36	19.68	**0.43**	**13.4**	**0.47**	67.86	105.000	**1.4E-03**	**3.5E-07**
73.5	2.01	64.26	9.76	17.97	**0.39**	**49.0**	**0.41**	65.11	28.000	**5.0E-03**	**2.6E-07**
147.0	1.11	63.32	11.07	17.04	**0.37**	**110.2**	**0.38**	63.79	13.500	**9.9E-03**	**1.9E-07**

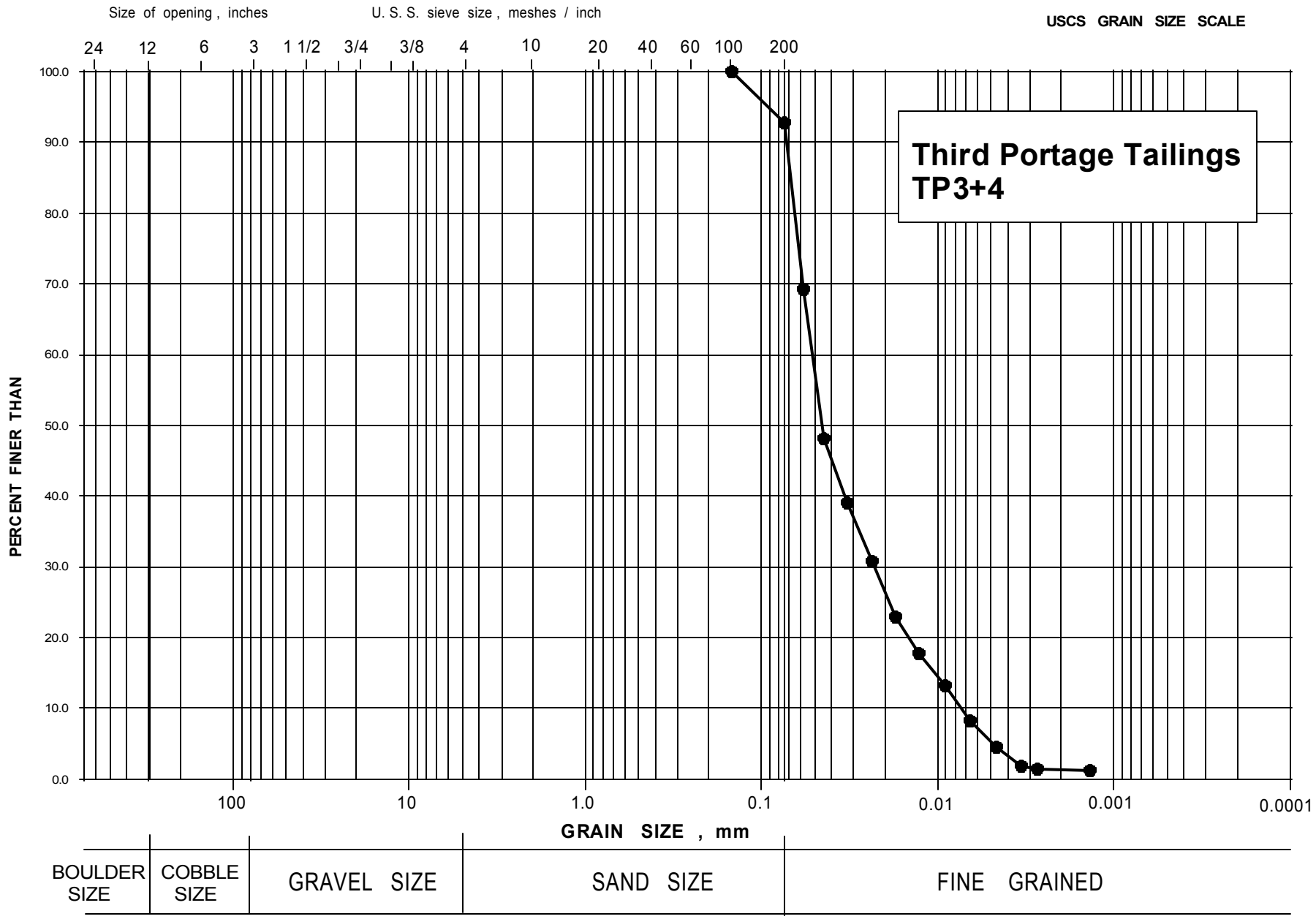
Comments:

Sample Description :



Golder Associates	Project No. 06-1413-081 Drawn ROB Reviewed LL Date 01/09/07	**ONE-DIMENSIONAL CONSOLIDATION LABORATORY TEST RESULTS OF TILL** **Meadowbank Mining Corporation** **Meadowbank Gold Project**	**Figure I-13**

TAILINGS



Project No. 06-1413-089 **Drawn** TM **Reviewed** LL **Date** 15/03/07	Golder Associates	GRAIN SIZE DISTRIBUTION Meadowbank Mining Corporation Meadowbank Gold Project	**Figure I-14**

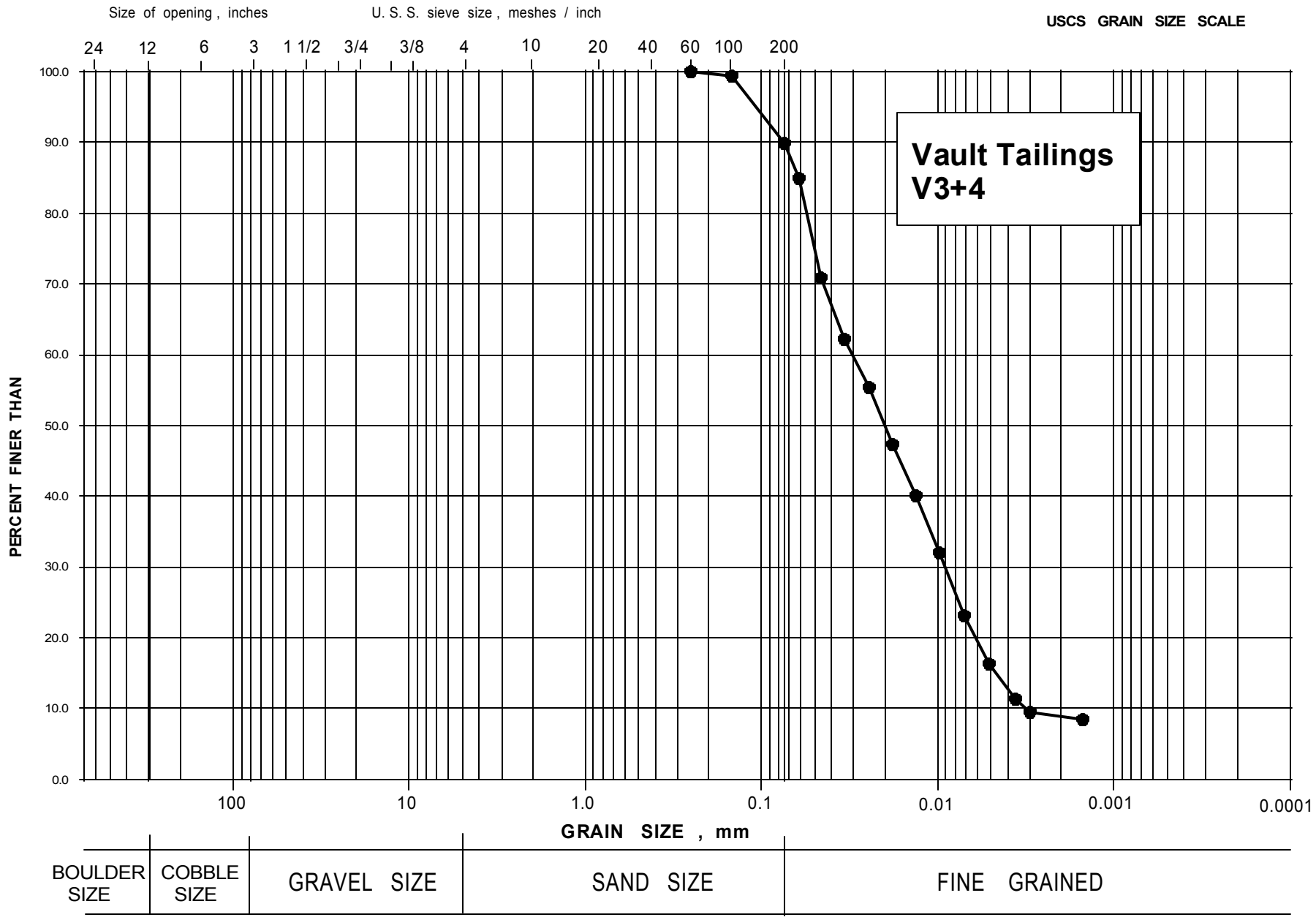
PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-089	**Client:**	Meadowbank		Third Portage Tailings		
Sch#	25	**Project :**	Dike Design		TP3+4		
Lab Work:	TM	**Location:**	Meadowbank				
	1ST SIEVING		**Hydrometer: (Minus #10)**		Residual #200	1.9	
	Total Weight	46.2	Before Wash	46.2	Total -200	42.9	
			After Wash	5.2	Gs	3.34	

Size (USS)	Weight Retained	Retained (%)	Weight Retained	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	0.0					**38.1**	**100.0**
1"	0.0					**25.4**	**100.0**
3/4"	0.0					**19.1**	**100.0**
1/2"	0.0					**12.7**	**100.0**
3/8"	0.0					**9.52**	**100.0**
#4	0.0					**4.76**	**100.0**
#10	0.0					**2.00**	**100.0**
#20			0.0			**0.840**	**100.0**
#40			0.0			**0.420**	**100.0**
#60			0.0			**0.250**	**100.0**
#100			0.0			**0.149**	**100.0**
#200			3.3	7.1	7.1	**0.074**	**92.9**
Pan			42.9	92.9	92.9		

HYDROMETER ANALYSIS

Time (min)	Hydrometer Reading	Temperature (°C)		Composite Correction	Hydrometer Corrected	Diameter (mm)	% Passing
0.5	40.0	18.0		-4.04	36.0	**0.0580**	**69.2**
1	29.0	18.0		-4.04	25.0	**0.0447**	**48.0**
2	24.3	18.0		-4.04	20.3	**0.0327**	**39.0**
4	20.0	18.0		-4.04	16.0	**0.0238**	**30.7**
8	15.9	18.0		-4.04	11.9	**0.0172**	**22.8**
15	13.1	19.5		-3.84	9.3	**0.0128**	**17.8**
30	10.7	19.5		-3.84	6.9	**0.0092**	**13.2**
60	8.1	20.0		-3.77	4.3	**0.0066**	**8.3**
120	6.0	20.5		-3.70	2.3	**0.0047**	**4.4**
240	4.4	22.0		-3.48	0.9	**0.0033**	**1.8**
360	4.2	22.0		-3.48	0.7	**0.0027**	**1.4**
1440	4.1	19.0		-3.48	0.6	**0.0014**	**1.2**



Project No. 06-1413-089 **Drawn** TM **Reviewed** LL **Date** 15/03/07	Golder Associates	GRAIN SIZE DISTRIBUTION Meadowbank Mining Corporation Meadowbank Gold Project	**Figure I-15**

PARTICLE SIZE ANALYSIS OF SOILS ASTM D 422-63

Project No. :	06-1413-089	**Client :**	Meadowbank		Vault Tailings		
Sch#	25	**Project :**	Dike Design		V3+4		
Lab Work:	TM	**Location:**	Meadowbank				
	1ST SIEVING		**Hydrometer: (Minus #10)**		Residual #200	2.4	
	Total Weight	48.5	Before Wash	48.5	Total -200	43.5	
			After Wash	7.4	Gs	2.85	

Size (USS)	Weight Retained	Retained (%)	Weight Retained	Retained (%)	% Retained Total	Diameter (mm)	% Passing
							100.0
6"	0.0					**152.4**	**100.0**
3"	0.0					**76.2**	**100.0**
1 1/2"	0.0					**38.1**	**100.0**
1"	0.0					**25.4**	**100.0**
3/4"	0.0					**19.1**	**100.0**
1/2"	0.0					**12.7**	**100.0**
3/8"	0.0					**9.52**	**100.0**
#4	0.0					**4.76**	**100.0**
#10	0.0					**2.00**	**100.0**
#20			0.0			**0.840**	**100.0**
#40			0.0			**0.420**	**100.0**
#60			0.0			**0.250**	**100.0**
#100			0.3	0.6	0.6	**0.149**	**99.4**
#200			4.6	9.5	9.5	**0.074**	**89.9**
Pan			43.5	89.7	89.7		

HYDROMETER ANALYSIS

Time (min)	Hydrometer Reading	Temperature (°C)		Composite Correction	Hydrometer Corrected	Diameter (mm)	% Passing
0.5	47.0	18.0		-4.04	43.0	**0.0612**	**85.0**
1	39.9	18.0		-4.04	35.9	**0.0461**	**70.9**
2	35.5	18.0		-4.04	31.5	**0.0338**	**62.2**
4	32.0	18.0		-4.04	28.0	**0.0246**	**55.3**
8	28.0	18.0		-4.04	24.0	**0.0179**	**47.4**
15	24.1	19.5		-3.84	20.3	**0.0134**	**40.1**
30	20.0	19.5		-3.84	16.2	**0.0097**	**32.0**
60	15.5	20.0		-3.77	11.7	**0.0071**	**23.2**
120	11.9	20.5		-3.70	8.2	**0.0051**	**16.2**
240	9.2	22.0		-3.48	5.7	**0.0037**	**11.3**
360	8.3	22.0		-3.48	4.8	**0.0030**	**9.5**
1440	7.8	19.0		-3.48	4.3	**0.0015**	**8.5**

SPECIFIC GRAVITY OF SOILS

ASTM D 854-92

Project # 06-1413-089
Third Portage Tailings
TP3+4

Sch# : 25
Tested By : TM/RLD
Calculated By : TM/RLD
Checked By : LL

TEST NUMBER		1	2			
BOTTLE NUMBER		2	3			
AIR REMOVAL METHOD		Vacuum	Vacuum			
WEIGHT OF BOTTLE , g.		172.69	173.97			
INITIAL WEIGHT OF BOTTLE + SOIL, g.		248.48	249.51			
INITIAL WEIGHT OF SOIL, g		75.79	75.54			
WEIGHT OF BOTTLE + SOIL + WATER, g.	W_1	723.73	724.89			
TEMPERATURE, ^{0}C	T	20.0	20.0			
WEIGHT OF BOTTLE + WATER, g.	W_2	671.24	672.39			
EVAPORATING DISH NUMBER		34	L3			
WEIGHT OF DISH + DRY SOIL, g.		430.42	421.31			
WEIGHT OF DISH, g.		355.41	346.48			
WEIGHT OF SOIL, g.	W_s	75.01	74.83			
Correction Factor @ Temperature T	G_k	1.0000	1.0000			
$G_K W_S$		75.01	74.83			
$W_1 - W_2$		52.49	52.50			
$W_S-(W_1-W_2)$		22.52	22.33			
SPECIFIC GRAVITY OF SOIL	G_s	**3.33**	**3.35**			

$G_S = (G_{K*}W_S)/((W_S-(W_1-W_2)) = \underline{\mathbf{3.34}}$ (average value)

REMARKS :
(1) Method A - Oven Dried Procedure
(2) Passing the #10 sieve (2.00 mm)

SPECIFIC GRAVITY OF SOILS

ASTM D 854-92

Project # 06-1413-089
Vault Tailings
V3+4

Sch# : 25
Tested By : TM/RLD
Calculated By : TM/RLD
Checked By : LL

TEST NUMBER		1	2			
BOTTLE NUMBER		1	4			
AIR REMOVAL METHOD		Vacuum	Vacuum			
WEIGHT OF BOTTLE , g.		179.52	172.72			
INITIAL WEIGHT OF BOTTLE + SOIL, g.		253.28	254.29			
INITIAL WEIGHT OF SOIL, g		73.76	81.57			
WEIGHT OF BOTTLE + SOIL + WATER, g.	W_1	725.84	724.14			
TEMPERATURE, °C	T	20.0	20.0			
WEIGHT OF BOTTLE + WATER, g.	W_2	678.05	671.37			
EVAPORATING DISH NUMBER		27	20			
WEIGHT OF DISH + DRY SOIL, g.		425.56	441.73			
WEIGHT OF DISH, g.		351.94	360.46			
WEIGHT OF SOIL, g.	W_s	73.62	81.27			
Correction Factor @ Temperature T	G_k	1.0000	1.0000			
$G_K W_S$		73.62	81.27			
$W_1 - W_2$		47.79	52.77			
$W_S-(W_1-W_2)$		25.83	28.50			
SPECIFIC GRAVITY OF SOIL	G_s	**2.85**	**2.85**			

$$G_S = (G_{K*}W_S)/((W_S-(W_1-W_2)) = \underline{\mathbf{2.85}}$$ (average value)

REMARKS :

(1) Method A - Oven Dried Procedure

(2) Passing the #10 sieve (2.00 mm)

Thermal Conductivity by Needle Probe-Results

Project:	Thermal Conductivity, Meadowbank Gold	**Date:**	28-Jan-07
Project No.	E12101081	**Technician**	BL
Client:	Golder Associates Ltd.		

Test:	Test 1 (Room Temp)		
Specimen:	Tailings	**Bulk Density (Mg/m3):**	2.04
Initial Temp	16.04	**Water Content (%):**	19.2
Thermal Probe No.	2	**Dry Density (Mg/m3):**	1.7116
Total Applied Voltage:	2.502	**Void Ratio:**	0.74
Measured current (A):	1.7	**Saturation (%):**	77.5
Probe Length (mm):	150		

Measurements

Total Voltage V [Volt]	2.502
Heater Resistance R (Ohm)	1.6
Resistance of Heater plus wires R_{total} [Ohms]	1.657
Probe Length, l [mm]	150
Current on Screen of DC Power Supply (Amp)	1.7

Calculations

$i = V/R_{total}$ [A]	1.51
Q = (Ri)*i^2 [W]	3.65
q = Q/l [W/m]	24.32

Thermal Conductivity
K = q/(4PI*(T2-T1))*ln(t2/t1)

Best Fit to Temperature Data

y = 0.9756Ln(x) + 17.73
R2 = 0.9965

T2 [°C]	17.73
T1 [°C]	24.47
t2 [sec]	1
t1 [sec]	1000
K [W/m°C] =	**1.98**

Remarks:

Thermal Resistivity (cm oC/W)= 50

Data presented herein is for the sole use of the stipulated Client. EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA.

This report has been prepared by an EBA engineer to recognized Industry standards, unless otherwise noted.No other warranty is made. Should engineering interpretation be required, EBA will provide it upon written request.

Thermal Conductivity by Needle Probe-Results

Project:	Thermal Conductivity, Meadowbank Gold	**Date:**	04-Feb-08
Project No.	E12101081	**Technician**	BL
Client:	Golder Associates Ltd.		

Test:	Test 2 (Chest Freezer Temp)		
Specimen:	Tailings	**Bulk Density (Mg/m3):**	2.04
Initial Temp	-18.04	**Water Content (%):**	19.2
Thermal Probe No.	2	**Dry Density (Mg/m3):**	1.7116
Total Applied Voltage:	2.502	**Void Ratio:**	0.74
Measured current (A):	1.7	**Saturation (%):**	77.5
Probe Length (mm):	150		

Measurements

Total Voltage V [Volt]	2.502
Heater Resistance R (Ohm)	1.6
Resistance of Heater plus wires R_{total} [Ohms]	1.657
Probe Length, l [mm]	150
Current on Screen of DC Power Supply (Amp)	1.7

Calculations

$i = V/R_{total}$ [A]	1.51
Q = (Ri)*i^2 [W]	3.65
q = Q/l [W/m]	24.32

Thermal Conductivity
K = q/(4PI*(T2-T1))*ln(t2/t1)

Best Fit to Temperature Data

y = 0.6021Ln(x) - 16.142
R2 = 0.9939

T2 [°C]	-16.14
T1 [°C]	-11.98
t2 [sec]	1
t1 [sec]	1000
K [W/m°C] =	**3.21**

Remarks:

Thermal Resistivity (cm oC/W)= 31

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EBA Engineering Consultants Ltd.

MOISTURE - DENSITY RELATIONSHIP

ASTM D698, D1557, or D2049

Project: Thermal Conductivity, Meadowbank Gold, Golder

Project No.: E12101081

Client: Golder Associates Ltd.

Soil Description: SILT, tr. sand - dark greenish grey

Sample Location: Shipped from CEMI, 2 pails with chemical edution on top; tailing

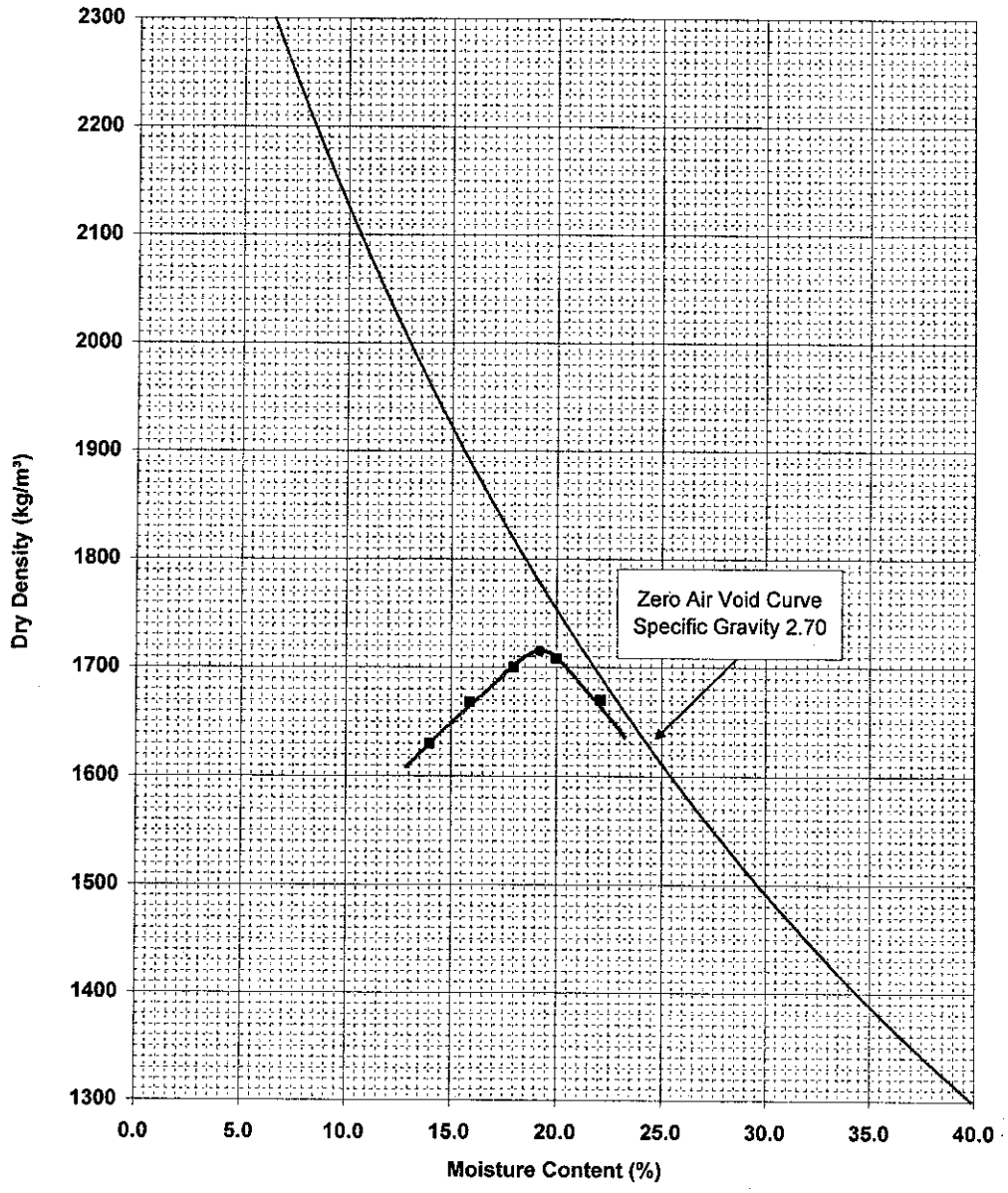
Sample Number: 2481

Date Tested: 08/01/14

Moisture Content (as received): 27.0%

Maximum Dry Density: 1715 kg/m³

Optimum Moisture Content: 19.2%



STANDARD PROCTOR

ASTM D698

Hammer Mass: 2.494 kg

Hammer Drop: 304.8 mm

Number of Layers: 3

Number of Blows/Layer: 25

Diameter of Mould: 101.4 mm

Height of Mould: 116.3 mm

Mould Volume: 0.000938 m³

Compactive Effort: 593.5 kJ/m³

REVIEWED BY:

REMARKS:

Data presented herein is for the sole use of the stipulated client. EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA.

The testing services reported herein have been performed by an EBA technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

SPECIFIC GRAVITY OF SOIL
(ASTM Designation D854)

Project: Thermal Conductivity ; Borehole Number: N/A

Address: Meadowbank Gold, Golder Depth: N/A

Sample Number: _____ Lab Number: _____

Project Number: E1210108 1 Sample Description: Tailings, silt,

Date Tested: Jan 15/08 By: mc grey with supernatant

TRIAL	1	2	3
Pycnometer Number	H	D	
Weight of Soil, Pycnometer & Water (Wb)	176.87	177.24	
Weight of Pycnometer	60.45	59.95	
Weight of Dry Soil (Wo)	25.03	26.44	
Temperature of Soil & Water (T x °C)	19.60	19.60	
*Weight of Pycnometer & Water @T x °C			
Specific Gravity (Gs)	2.971	2.975	
Average Specific Gravity	2.973		

* *From Calibration Curve*

$$Gs = \frac{Wo}{Wo + Wa + Wb}$$

Where: Wo = Dry weight of soil

Wa = Weight of pycnometer & water @T x °C (Calibration Curve)

Wb = Weight of pycnometer, soil & water @ T x °C

Gs = Specific gravity of soil sample

Remarks: Avg. specific Gravity = 2.973.

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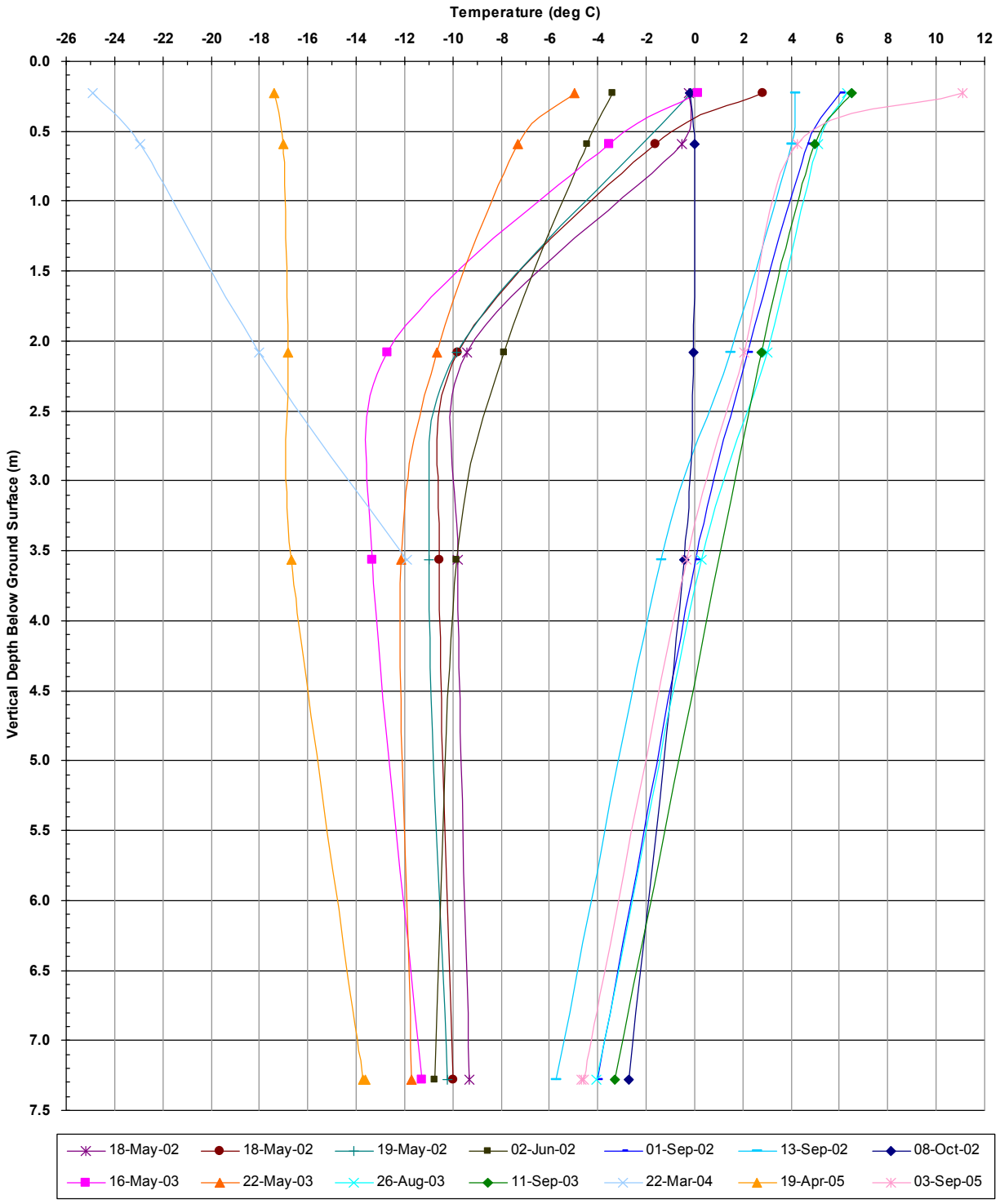
The testing services reported herein have been performed by an EBA technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

THERMISTORS



Installation Details	
Date of Installation	17-May-02
Collar Northing	7215348.931
Collar Easting	637858.526
Collar Elevation	136.770
UTM Azimuth	79.43
Inclination	-48.37

Note:
1. During packer testing in the area of the permafrost/talik interface at borehole 02GT-09, the packer equipment became lodged and subsequently frozen within the borehole. The thermistor cable was folded back on itself and installed to the depth of the frozen equipment.

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

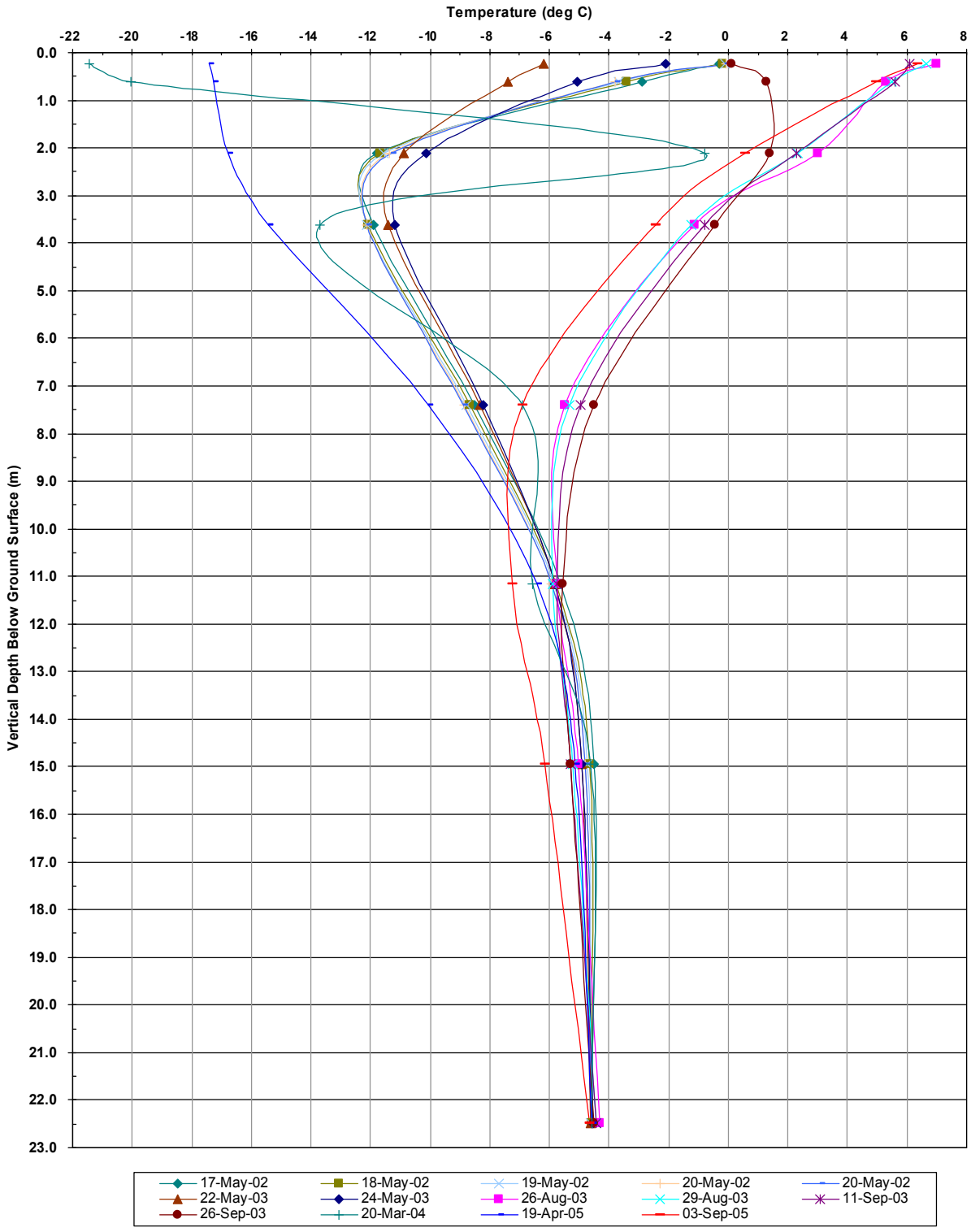
TITLE

TSF DESIGN
BOREHOLE THERMISTOR 02GT-09

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----		
DESIGN	GJ	1DEC08	SCALE NTS		REV. 0
CADD	GJ	1DEC08	**FIGURE I-16**		
CHECK					
REVIEW					

REVISION DATE: December 1, 2008 BY: GJ FILE:O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix I Site Data Summary\Thermistors within TSF.ppt



Installation Details	
Date of Installation	13-May-02
Collar Northing	7215480.044
Collar Easting	638274.736
Collar Elevation	136.290
UTM Azimuth	238.00
Inclination	-48.69

PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

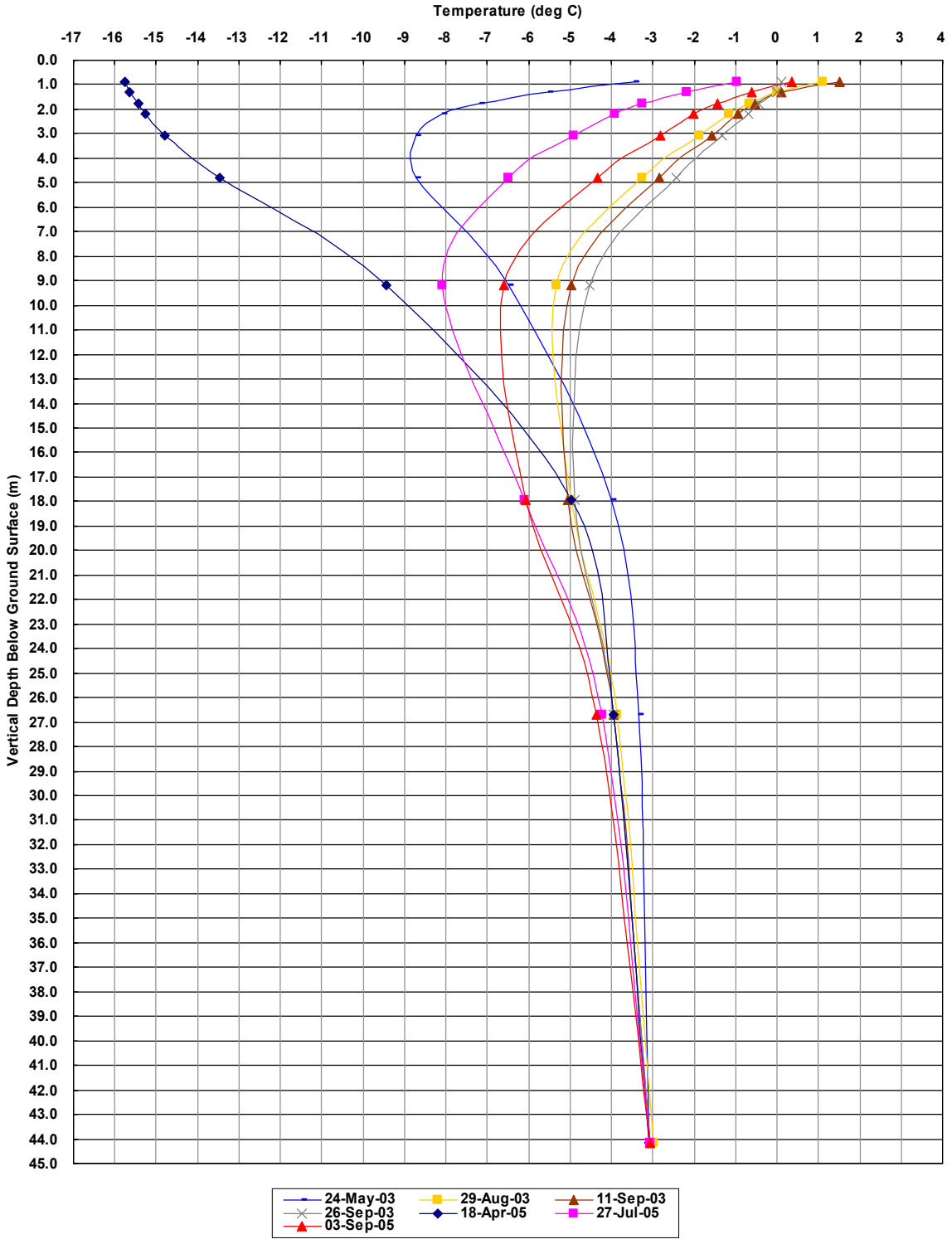
TITLE

TSF DESIGN
BOREHOLE THERMISTOR 02GT-10

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----		
DESIGN	GJ	1DEC08	SCALE NTS		REV. 0
CADD	GJ	1DEC08	**FIGURE I-17**		
CHECK					
REVIEW					

REVISION DATE: December 1, 2008 BY: GJ FILE:O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix I Site Data Summary



Installation Details	
Date of Installation	21-May-03
Collar Northing	7214846.638
Collar Easting	638841.538
Collar Elevation	135.910
UTM Azimuth	223.26
Inclination	-56.66

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

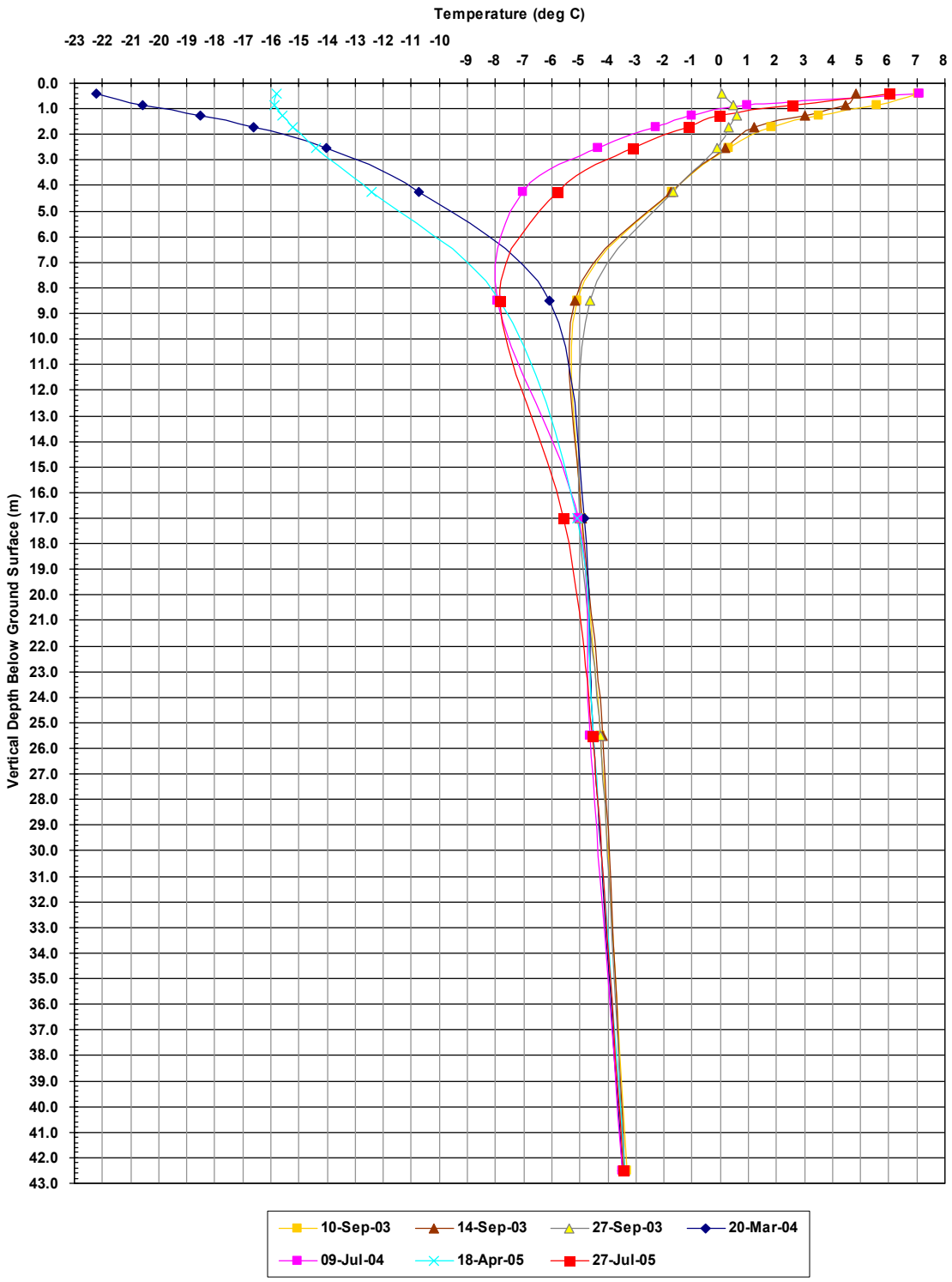
TSF DESIGN
BOREHOLE THERMISTOR 03GT-TD-1

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----	
DESIGN	GJ	1DEC08	SCALE NTS	REV. 0
CADD	GJ	1DEC08		
CHECK				
REVIEW				

FIGURE I-18

REVISION DATE: December 1, 2008 BY: GJ FILE:O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix I Site Data Summary



Installation Details	
Date of Installation	11-Aug-03
Collar Northing	7214123.121
Collar Easting	638774.600
Collar Elevation	135.996
UTM Azimuth	33.35
Inclination	-58.24

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

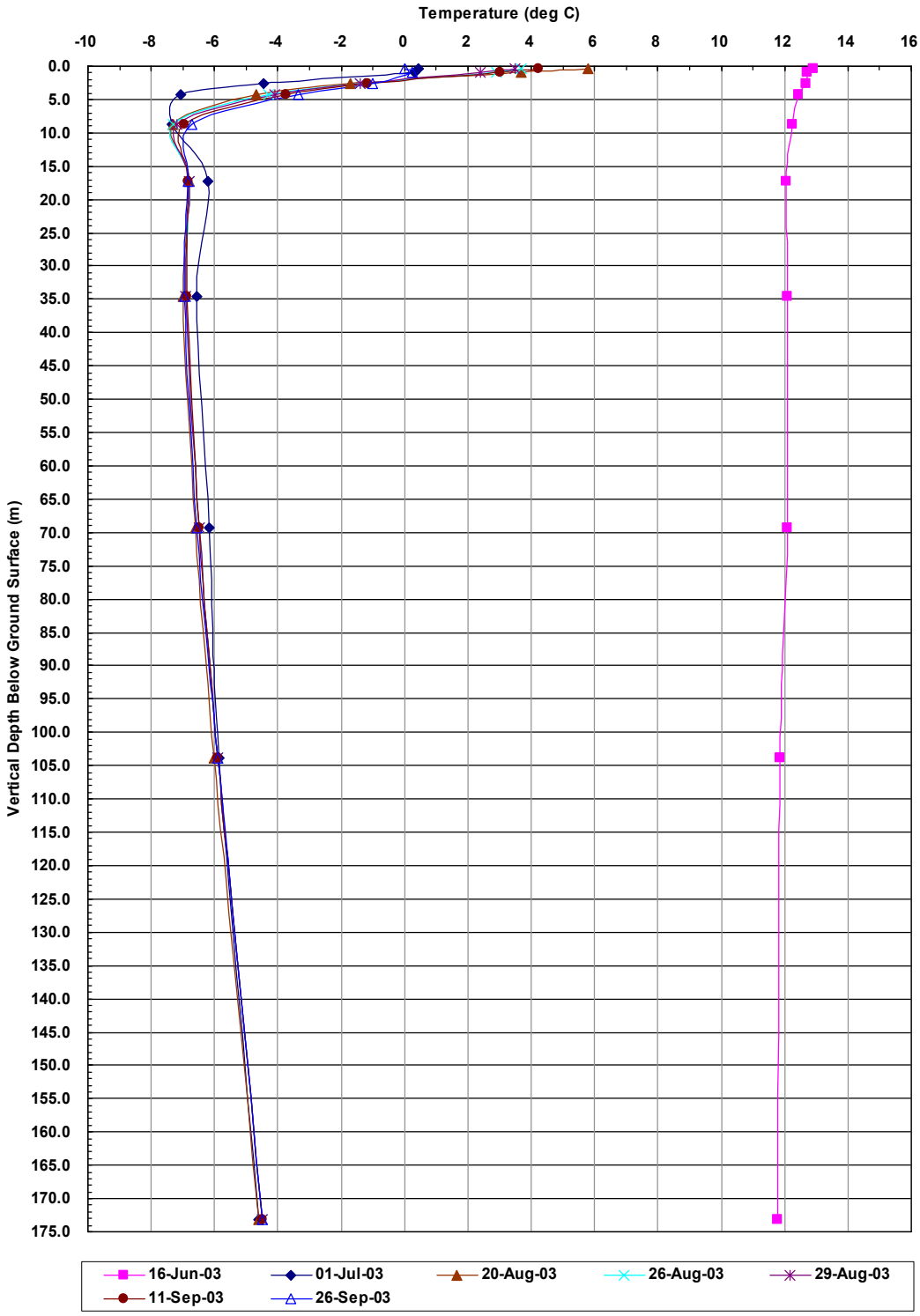
TITLE

TSF DESIGN
BOREHOLE THERMISTOR 03GT-TD-5A

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----		
DESIGN	GJ	1DEC08	SCALE NTS		REV. 0
CADD	GJ	1DEC08	**FIGURE I-19**		
CHECK					
REVIEW					

REVISION DATE: December 1, 2008 BY: GJ FILE:O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix I Site Data Summary



Installation Details	
Date of Installation	14-Jun-03
Collar Northing	7215120.294
Collar Easting	637626.671
Collar Elevation	139.233
UTM Azimuth	328.31
Inclination	-60.60

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN
BOREHOLE THERMISTOR 03GT-SPEC-F1

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----		
DESIGN	GJ	1DEC08	SCALE NTS		REV. 0
CADD	GJ	1DEC08	**FIGURE I-20**		
CHECK					
REVIEW					

REVISION DATE: December 1, 2008 BY: GJ FILE:O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix I Site Data Summary

APPENDIX II

BOREHOLE LOGS

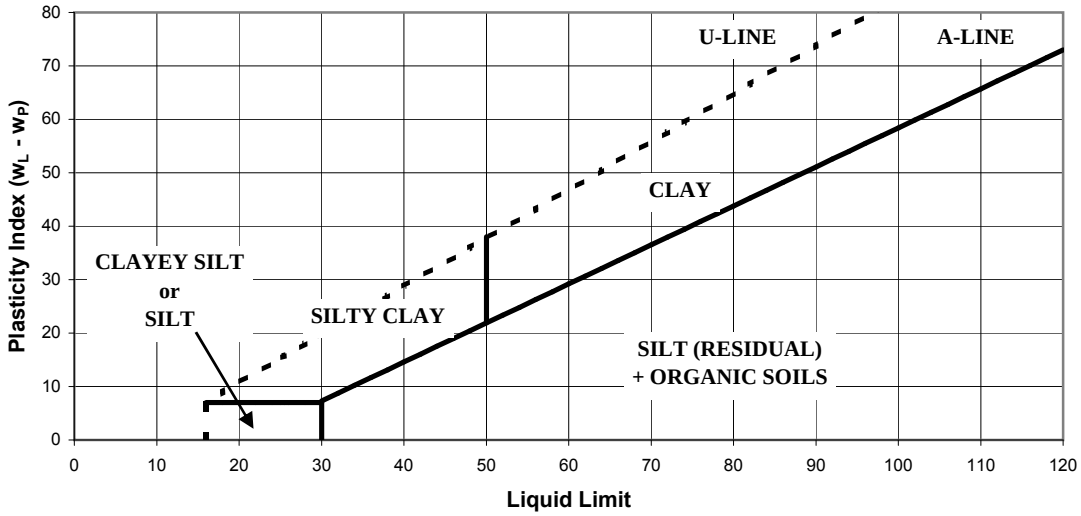
Golder Associates Soil Classification System

Step 1	Step 2	Step 3				Step 4	
		Define Primary Constituent				Define Secondary / Minor Constituents	
Organic/ Inorganic	Determination of Behaviour	Criteria			Major Constituent	Percent by Mass	Modifiers
			Particle Size Range mm	USS Sieve			
Inorganic <5% Organics	Cobbles and Boulders		> 300	> 12"	BOULDER	"contains"	
			300 - 75	12" - 3"	COBBLE		
	Cohesionless Soil (based on field assessment of plasticity, toughness and dry strength)	%Gravel > %Sand > %Silt	75 - 4.75 75 - 19 19 - 4.75	3" - #4 3" - 0.75" 0.75" - #4	GRAVEL Coarse Fine	> 30%	"and" (cohesionless) "with" (cohesive)
		%Sand > %Gravel > %Silt	4.75 - 0.075 4.75 - 2.0 2.0 - 0.425 0.425 - 0.075	#4 - #200 #4 - #10 #10 - #40 #40 - #200	SAND Coarse Medium Fine	20% - 30% 12 - 20% 5 - 12% 0 - 5%	(-ey) or (-y) Some Little Trace
		%Silt > %Gravel > %Sand	< 0.075	< #200	SILT Non-plastic		
	Cohesive Soil (based on field assessment of plasticity, toughness and dry strength)	Plasticity (Atterberg Limits)				> 30%	"with" *(cohesionless)*
		Below A-Line LL < 30			CLAYEY SILT	20% - 30% 12 - 20% 5 - 12% 0 - 5%	(-ey) or (-y) Some Little Trace
		Above A-Line LL < 50			SILTY CLAY		
		Above A-Line LL > 50			CLAY		
Organic > 5% Organics		Organic Content	Appearance				
	Organic Matter	75% to 100%	woody, mats, fibres, *etc.*		FIBROUS PEAT		
			amorphous		FINE GRAINED PEAT		
	Highly Organic Soils	30% to 75%	spongy		SILTY PEAT		
			visible sand		SANDY PEAT		
	Organic Soils	5% to 30%	tough thread		ORGANIC CLAYEY SILT		
			weak or no thread		ORGANIC SAND OR SILT		

Soil Description

relative density/consistency, structure, field moisture condition, colour, odour, shape/angularity, (minor)-*y* (PRIMARY CONSTITUENT), *and/with** (SECONDARY CONSTITUENT), *modifier* (minor constituents), *contains* (cobbles, boulders, debris, *etc* .)
(GEOLOGIC FORMATION) *eg.* (TILL)

Golder Plasticity Chart



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

S:\FINALDAT\ABBREV\2000\LOFA-D00.DOC

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. General

π	3.1416
in x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
v	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s/\rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p)/I_p$
I_C	consistency index = $(w_l - w)/I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e)/(e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio = σ'_p/σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

* density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

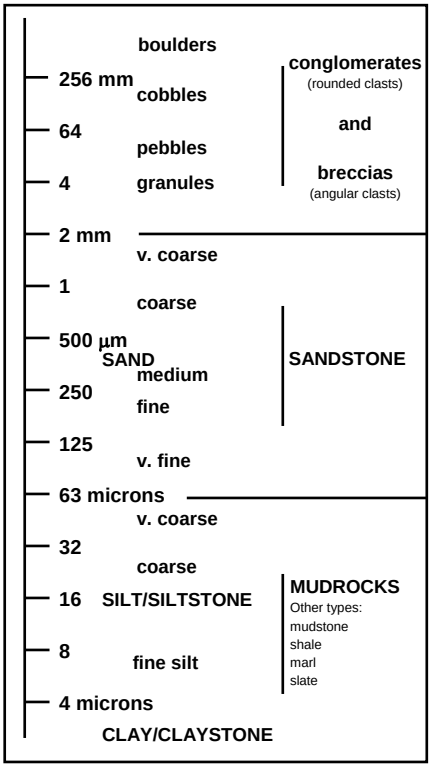
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

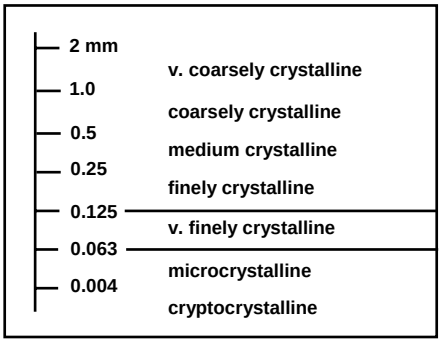
Term	Description	Symbol
Fresh	No visible sign of rock material weathering; perhaps slight discolouration on major discontinuity surfaces.	W1
Slightly Weathered	Discolouration indicates weathering of rock material on discontinuity surfaces. All the rock material may be discoloured by weathering and may be somewhat weaker than in its fresh condition.	W2
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	W3
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	W4
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	W5

GRAIN AND CRYSTAL SIZE CLASSIFICATION

Grain-Size Classes and Siliciclastic Rocktypes



Informal Terms of Describing Crystalline Rocks



Notes:

1. Gradation boundaries and descriptive names differ from those used to describe soil.
2. v. fine SAND grains are typically the smallest size visible to the unaided eye.

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

CORE CONDITION

Total Core Recovery (TCR)
The cumulative length of all core recovered in the core tube divided by the length drilled.

Solid Core Recovery (SCR)
The cumulative length of solid core, regardless of length, recovered at full diameter and expressed as a fraction (percentage) of the total core run.

Rock Quality Designation (RQD)
The cumulative length of intact core recovered in lengths greater than 10 cm over the total length of the core run expressed as a percentage.

DISCONTINUITY DATA

Fracture Frequency
A count of the number of naturally occurring discontinuities (physical separations) in the rock core.

Dip with Respect to (W.R.T.) Core Axis
The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^{o} angle is horizontal.

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DESCRIPTION OF BEDDING THICKNESS

Description	Bedding Plane Spacing
very thickly bedded	> 2 m
thickly bedded	0.6 – 2 m
medium bedded	0.2 – 0.6 m
thinly bedded	60 mm – 0.2 m
very thinly bedded	20 – 60 mm
laminated	6 – 20 mm
thinly laminated	< 6 mm

DISCONTINUITY SPACING

Description	Discontinuity Spacing
extremely close spacing	< 20 mm
very close spacing	20 – 60 mm
close spacing	60 – 200 mm
moderate spacing	200 – 600 mm
wide spacing	600 mm – 2 m
very wide spacing	2 – 6 m
extremely wide spacing	> 6 m

COMPRESSIVE STRENGTH

Grade	Material	Comp. Strength (MPa)
S1	very soft clay	< 0.025
S2	soft clay	0.025 – 0.05
S3	firm clay	0.05 – 0.1
S4	stiff clay	0.1 – 0.25
S5	very stiff clay	0.25 – 0.5
S6	hard clay	> 0.5
R0	extremely weak rock	0.25 – 1.0
R1	very weak rock	1.0 – 5.0
R2	weak rock	5.0 – 25
R3	medium strong rock	25 – 50
R4	strong rock	50 – 100
R5	very strong rock	100 – 250
R6	extremely strong rock	> 250

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-05

SHEET 1 OF 3

LOCATION: Causeway Alignment, North Hole

BORING DATE: 17 May, 2002

DATUM: Local

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. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ice Surface		132.78									
				0.00									
1		Ice.											
2				130.78									
				2.00									
3													
4													
5	LY38 - HQ3												
6		Water.											
7													
8													
9													
10													

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-05

SHEET 2 OF 3

LOCATION: Causeway Alignment, North Hole

BORING DATE: 17 May, 2002

DATUM: Local

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. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		Water. *(continued)*									
				121.78							
11	LY38 - HQ3			11.00							
		Inferred lake bottom sediments and coarse sand, cobbles and gravel. (OVERBURDEN)									
12				120.28							
		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-05

SHEET 3 OF 3

LOCATION: Causeway Alignment, North Hole

DRILLING DATE: 17 May, 2002

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.3 (5 10 15 20)	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX (R4 R3 R2 R1)	WEATH-ERING INDEX (W1 W2 W3 W4)	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		120.28													
13		Slightly weathered, light grey, foliated, fine to medium grained, medium strong, INTERMEDIATE VOLCANICS, with quartz.		12.50	1									BC,,			
														BC,,			
14				118.78													
	Boart-Longyear LY38 - HQ/HW			14.00										FO,PL,R			
														FO,PL,R			
15														FO,PL,R			15.0m to 17.0m Falling Head Packer Test k=2.6X10-3 cm/s
		Fresh, light grey, foliated, fine to medium grained, strong, INTERMEDIATE VOLCANICS, with quartz.			2									FO,PL,R			
16														F,PL,R			
17				115.78													
		End of DRILLHOLE.		17.00													
18																	
19																	
20																	
21																	
22																	

DRILLHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-06

SHEET 1 OF 1

LOCATION: Causeway

BORING DATE: 17 May, 2002

DATUM: Local

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. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ice Surface		133.00							
		Ice.		0.00							
				131.00							
	LY38 - HQ3	Water.		2.00							
				90.30							
		End of DRILLHOLE.		42.70							
		HOLE ABANDONED. Lake Bottom at Approximately 42.7m depth. - casing set to bottom, NQ rods lowered to start drilling. - entire drill string and casing lost.									

DEPTH SCALE

1 : 250

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14-1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-07

SHEET 1 OF 3

LOCATION: West Dyke

BORING DATE: 13 May, 2002

DATUM: Local

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 (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ice Surface		132.62							
0				0.00							
1		Ice.									
				130.82							
2				1.80							
		Water.									
3				129.02							
		Loose, yellow, silty CLAY. [LAKE BOTTOM SEDIMENTS]		3.60	1	50 DO	15				
4				128.57							
				4.05	2	50 DO	11				
					3	50 DO	11				
5	LY38 - HQ3	Firm, massive, grey, silty, sandy clay. (TILL) [OVERBURDEN] - at 4.05m to 4.5m yellow to grey, silty, sandy clay with gravel.			4	50 DO	35				
					5	50 DO	15				
6					6	50 DO	14				5.8m to 7.1m Falling Head Packer Test
				126.12							
				6.50							
7											
		Inferred loose, wet, grey, green, white, pink, rounded to subrounded COBBLES, GRAVEL and coarse SAND. (i.e. cobbles, gravel, and inferred boulders contained within a sand matrix.) [OVERBURDEN]			7	WS					
8											
9				123.12							
				9.50							
10											

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-07

SHEET 2 OF 3

LOCATION: West Dyke

BORING DATE: 13 May, 2002

DATUM: Local

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 (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	LY38 - HQ3	Inferred grey, green, white, pink, rounded to subrounded COBBLES, GRAVEL and coarse SAND. (i.e. cobbles, gravel, and inferred boulders contained within a sand matrix.) [OVERBURDEN] *(continued)*									
11				120.87							
12		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.									
13											
14											
15											
16											
17											
18											
19											
20											

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-07

SHEET 3 OF 3

LOCATION: West Dyke

DRILLING DATE: 13 May, 2002

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		120.87													
12	Boart-Longyear LY38 - HQ/HW	Slightly weathered, light grey-green, foliated, fine to medium grained, medium strong to strong, SILICIFIED INTERMEDIATE VOLCANICS.		11.75	1									BC,,			
13		- Transitional into quartzite?			2									BC,, FO,C,R J,PL,SM FO,PL,SM 4x Fe ,PL,SM FO,W,R			13.04m to 13.33m Sample Taken. 13.5m to 15.5m Packer Test k=1.2x10-4 cm/s
14		Fresh, white, fine grained, strong to very strong, QUARTZITE.		118.97 13.65										FO,PL,SM Sericite J,PL,R			13.74m to 13.90m Sample Taken.
15		- Fracture surfaces are silicified.			2									FO,PL,R Sericite FO,PL,SM Sericite FO,PL,SM Sericite J,PL,R			15.30m to 15.5m Sample Taken.
				117.12													
		End of DRILLHOLE.		15.50													
16																	
17																	
18																	
19																	
20																	
21																	

ROCK STRENGTH INDEX: R4 R3 R2 R1

WEATHERING INDEX: W1 W2 W3 W4

DRILLHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-08

SHEET 1 OF 2

LOCATION: West Dyke

BORING DATE: 14 May, 2002

DATUM: Local

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 (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ice Surface		132.60							
0	LY38 - HQ3	Ice.		0.00							
1											
2				130.30							
3		Water.		2.30							
4				128.50							
5		Dense, yellow, CLAY, SILT, SAND and GRAVEL. (Inferred) - Sa #1: Su est. = 25 kPa		4.10	1	50 DO	56				
					2	50 DO	94				
6		Loose, gravel and cobbles. [OVERBURDEN]		126.90 5.70							
				126.10							
7		Inferred loose, grey-green, white, rounded to sub-rounded, COBBLES, coarse GRAVEL and SAND. (Inferred) [OVERBURDEN]		6.50	3	SH					
					4	50 DO	29				
8				124.30							
9		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.									
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-08

SHEET 2 OF 2

LOCATION: West Dyke

DRILLING DATE: 14 May, 2002

DATUM: Local

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		124.30													
		Slightly weathered, white to light grey, massive, fine to medium grained, medium strong, QUARTZ VEIN, with sulphides.		8.30										BC,,			
				123.80													
		- Vein has open vuggy fractures.		8.80	1									BC,,			
9														J,PL,R Fe VN,W,VR Fe VN,W,R Fe J,PL,SM			9.38m to 9.50m Sample Taken.
														BC,,			
														BC,,			
10														BC,, Fe			
		Fresh, white to grey, massive, fine grained to medium grained, strong, silicified, INTERMEDIATE to FELSIC VOLCANICLASTICS.												BC,, Fe J,PL,R Fe			10.50m to 12.50m Falling Head Test k=1.1x10-2 cm/s
		- Sporadic quartz veins throughout which are vuggy.												J,PL,SM J,PL,SM Fe			
11					2									J,PL,SM 2x Fe			
		- Open fractures have up to 2mm aperature and are vuggy.												J,PL,SM Fe			
														J,PL,SM Fe			
		- Fe staining on all fracture surfaces.												J,, J,, BC,,			11.5m to 17.0m Falling Head Test k=7.3x10-3 cm/s
		- 2 to 3 joint sets; 1 Foliation. - 2 Sets are at high angles and are relatively closely spaced (centimetre to metre scale).												BC,, J,W,R Fe Cl J,PL,SM Fe FO,, FO,,			
12														J,PL,SM 2x Fe FO,PL,SM QZ			12.20m to 12.35m Sample Taken.
		- Less Iron staining below approx. 12m.															
														J,PL,SM			
13														J,PL,SM			
					3									FO,PL,SM Fe			
														BC,,			
														BC,, J,PL,SM			13.5m to 17.00m Falling Head Test k=3.7x10-4 cm/s
														J,I,VR J,PL,SM			
				118.65										FO,PL,SM Fe ,, 13.95m-15.5m MB			
14				13.95													
					4												
15		Fresh, pinkish-grey, massive, medium grained, strong to very strong, GRANITE.															
		- RQD is not indicative of quality of rock. Run #4 was re-cored and rock was mechanically broken.															
16					5									J,PL,SM Fe J,PL,SM			16.42m to 16.60m Sample Taken.
				115.60													
17		End of DRILLHOLE.		17.00													
18																	

Boart-Longyear LY38 - HQ/HW

DRILLHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-09

SHEET 1 OF 4

LOCATION: West Dyke

BORING DATE: 15 May, 2002

DATUM: Local

INCLINATION: -48.368° AZIMUTH: 79°

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 (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1})	WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ice Surface		136.77									
0	LY38 - HQ3	Inferred boulders. (TILL) [OVERBURDEN].		0.00									
1				135.58									
2		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.											
3													
4													
5													
6													
7													
8													
9													
10													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-09

SHEET 2 OF 4

LOCATION: West Dyke

DRILLING DATE: 15 May, 2002

DATUM: Local

DRILL RIG: LY38

INCLINATION: -48.368° AZIMUTH: 79°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		135.58													
				1.60										FO,U,R			Thermistor TC-4 installed from ground surface to 15.0m depth.
2		Fresh, light grey, foliated, fine to medium grained, medium strong to strong, QUARTZITE.			1									FO,U,R			
														FO,U,R			
				134.91													
				2.50													Nodal Down Hole Depths
																	1 0.3m
																	2 0.8m
3														FO,U,R			3 2.8m
																	4 4.8m
														FO,U,R			5 9.8m
																	6 14.8m
														FO,U,R			7 9.8m
4		Fresh, light grey, foliated, fine to medium grained, strong, QUARTZITE.			2												8 -0.2m
														FO,U,R			
														FO,U,R			
5														FO,U,R			
				132.66													
				5.50										FO,U,R			
6														FO,U,R			
														FO,U,R			
														FO,U,R			
														FO,U,R			
7		Fresh, light grey, foliated, fine to medium grained, strong, QUARTZITE.			3									FO,U,R			
														FO,PL,SM			
8																	
				130.42													
				8.50													
9														FO,U,R			
																	9.5m to 14.5m Falling Head Test No responce
10		Fresh, light grey, foliated, fine to medium grained, strong, QUARTZITE.			4									FO,U,R			
														FO,U,R			
11														FO,U,R			
														FO,U,R			
				128.18													11.50m to 11.75m UCS #1
				11.50	5												
		CONTINUED NEXT PAGE															

Boart-Longyear LY38 - HQ/HW

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

DRILLHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-09

SHEET 3 OF 4

LOCATION: West Dyke

DRILLING DATE: 15 May, 2002

DATUM: Local

DRILL RIG: LY38

INCLINATION: -48.368° AZIMUTH: 79°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
12		Fresh, light grey, foliated, fine to medium grained, strong, QUARTZITE. *(continued)*			5												
13																	
14				125.94													
				14.50													
15	Boart-Longyear LY38 - HQ/HW													FO,U,R			
16					6									FO,U,R F,PL,R			16.22m to 16.50m Sample Taken.
17		Fresh, light grey, foliated, fine to medium grained, strong to very strong, QUARTZITE.															
18														FO,PL,R ,PL,R Orthogonal			
19					7									,PL,R Orthogonal FO,PL,R			
				122.42 19.20										,PL, Contact FO,U,SM FO,PL,SM Fe FO,PL,VR			
20		Fresh, grey, thinly laminated (foliated), fine grained, medium strong, interbedded IRON Fm and ULTRAMAFIC VOLCANICS. - Weak magnatite banding. - 19.60m Vuggy quartz/hematite bands up to 3mm. - Fine grained disseminated sulphide throughout.												FO,PL,SM			
21					8									J,I,VR CaCO3			
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

DRILLHOLE 022-14-1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-09

SHEET 4 OF 4

LOCATION: West Dyke

DRILLING DATE: 15 May, 2002

DATUM: Local

DRILL RIG: LY38

INCLINATION: -48.368° AZIMUTH: 79°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
									80 60 40 20	80 60 40 20	80 60 40 20	5 10 15 20	0 30 60 90		R4 R3 R2 R1	W1 W2 W3 W4	
22	Boart-Longyear LY38 - HQ/HW	Fresh, grey, thinly laminated (foliated), fine grained, medium strong, interbedded IRON Fm and ULTRAMAFIC VOLCANICS.			8									FO,PL,SM FO,PL,SM FO,PL,R CaCO3, Py FO,PL,SM FO,PL,R			
23		- Weak magnatite banding. - 19.60m Vuggy quartz/hematite bands up to 3mm.		119.21										FO,PL,R S FO,PL,VR BC,,			
		- Fine grained disseminated sulphide throughout *(continued)*		23.50										BC,, ,PL,VR Contact			
24																	
25					9									FO,I,VR			24.5m to 30.8m Falling Head Test k=2.1x10-6cm/s 25.00m to 25.24m Sample Taken.
26		Fresh, green, laminated, fine to medium grained, silicified and chloritized, medium strong, ULTRAMAFIC VOLCANICS.												FO,PL,R FO,W,R			
27														FO,PL,SM			
28					10									FO,U,SM FO,PL,SM 4x FO,PL,SM Sericite			
29														FO,PL,SM			
				114.72													
30		Fresh, white, massive to weakly foliated, fine to medium grained, very strong, QUARTZITE.		29.50	11												
31		End of DRILLHOLE.		113.75 30.80													

NOTES
WATER LEVELS
INSTRUMENTATION

DRILLHOLE 022-14-1.GPJ GLDR_CAN.GDT 13/12/02

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-10

SHEET 1 OF 4

LOCATION: West Dyke

BORING DATE: 13 May, 2002

DATUM: Local

INCLINATION: -48.693° AZIMUTH: 238°

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 (20 40 60 80); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1})	WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		136.29									
0	LY38 - HQ3	Silty sand and gravel, with cobbles and boulders. (TILL)		0.00	1	50DO	50						
1													
				135.16									
2		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.											
3													
4													
5													
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14--1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-10

SHEET 2 OF 4

LOCATION: West Dyke

DRILLING DATE: 13 May, 2002

DATUM: Local

DRILL RIG: LY38

INCLINATION: -48.693° AZIMUTH: 238°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		135.16												
				1.50									BC,,			Thermistor TC-3 installed to 30.0m depth.
2					1											Nodal Down Hole Depth
													BC,,			1 0.3m
													FO,PL,R			2 0.8m
													J,W,VR Fe			3 2.8m
													J,PL,SM Fe			4 4.8m
3													BC,,			5 9.8m
													BC,,			6 14.8m
													FO,C,SM Fe			7 19.8m
		Fresh, grey, weakly laminaed to thickly bedded, medium strong INTERMEDIATE VOLCANICS.											J,PL,SM Fe Cl			8 29.8m
													FO,PL,SM			
		- Foliation surfaces have iron staining.											J,PL, Fe			
													BC,,			
													BC,,			
													J,,			
													J,I,R CL			
													J,,			
4					2								FO,PL,SM 4x Fe			
													FO,PL,SM			
													J,ST,R Fe			
													FO,PL,SM Fe			
													FO,PL,SM Fe			
													FO,PL,SM Fe			
													FO,PL,SM			
													J,PL,SM Fe			
													FO,PL,R			
													FO,PL,SM 2x Fe			
													FO,PL,SM			
													FO,PL,SM 3x			
5													FO,PL,R Fe			
													FO,PL,SM Fe			4.90m to 5.05m Sample Taken.
													J,PL,R Fe			
				132.16									FO,PL,SM Fe			
				5.50									BC,,			
													BC,,			
													J,PL,SM CL			
													J,PL,R Fe			
6													J,PL,R Fe			
													J,PL,R Fe			
													J,U,R Fe			
													J,PL,R Fe			
													BC,,			
	Boart-Longyear															
	LY38 - HQ3												BC,,			
		Slightly weathered, grey, foliated, fine to medium grained, medium strong INTERMEDIATE VOLCANICS.			3								J,PL,R Fe			
7													J,PL,R Fe			
													J,PL,R Fe			
													J,PL,R Fe			
													J,PL,R Fe			
													J,PL,R Fe			
													J,PL,R			
													BC,,			
8													BC,,			
													J,PL,R Fe			
													J,PL,R Fe			
				129.90												
				8.50									J,PL,R			
9													J,PL,R Fe			
													J,PL,R Fe			9.5m to 14.5m Falling Head Test - No response
													J,PL,R			
10		Fresh, grey, foliated, fine to medium grained, strong INTERMEDIATE VOLCANICS.			4								J,PL,R			
													J,PL,R			
													J,PL,R			
													J,PL,R			
													J,PL,R			
11													J,PL,R Fe			
													J,PL,R			
				127.65												
		CONTINUED NEXT PAGE														

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

DRILLHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-10

SHEET 3 OF 4

LOCATION: West Dyke

DRILLING DATE: 13 May, 2002

DATUM: Local

DRILL RIG: LY38

INCLINATION: -48.693° AZIMUTH: 238°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.3 (5 10 15 20)	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX (R4 R3 R2 R1)	WEATHERING INDEX (W1 W2 W3 W4)	NOTES WATER LEVELS INSTRUMENTATION
12	Boart-Longyear LY38 - HQ3	Fresh, grey, foliated, fine to medium grained, medium strong INTERMEDIATE VOLCANICS.		11.50										J,PL,R J,U,R J,PL,R Fe J,U,R Fe J,PL,R Fe			
13					5									J,PL,R Fe J,PL,R Fe J,PL,R Fe J,PL,R J,PL,R Fe J,PL,R Fe J,PL,R			
14				125.39										J,PL,R Fe BC,, BC,, J,PL,R Fe J,PL,SM J,PL,SM			
15		Fresh, grey, foliated, fine to medium grained, medium strong INTERMEDIATE VOLCANICS.		14.50										J,PL,R Fe J,PL,R Fe J,PL,R Fe J,PL,R J,PL,R J,PL,R Fe BC,, BC,, J,PL,R			15.5m to 28.0m Falling Head Test k=3.1x10-5cm/s
16					6									J,PL,R Fe J,PL,R J,PL,R Fe J,PL,R Fe			
17				123.14										J,PL,R Fe J,PL,R Fe J,PL,R Fe BC,,			
18		Fresh, grey, foliated, fine to medium grained, medium strong INTERMEDIATE VOLCANICS. - 18.5m to 18.80m Fault zone contains clay rich Breccia, weathered weak, soapy texture.		17.50										BC,, J,PL,R Fe J,, J,, J,, J,,			
19					7												
20				120.89													
21				20.50	8									J,PL,R J,PL,R			
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

DRILLHOLE 022-14-1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-10

SHEET 4 OF 4

LOCATION: West Dyke

DRILLING DATE: 13 May, 2002

DATUM: Local

DRILL RIG: LY38

INCLINATION: -48.693° AZIMUTH: 238°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR, % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
									80 60 40 20	80 60 40 20	80 60 40 20	5 10 15 20	0 30 60 90		R4 R3 R2 R1	W1 W2 W3 W4	
22														J,PL,R			21.5m to 30.0m Falling Test k=1.1x10-7cm/s
														J,PL,R Fe			
														J,PL,R Fe			
					8												
														J,PL,R Fe			
23														J,PL,R Fe			
														FO,W,R			
														FO,PL,R			
														FO,PL,R Fe			
24														FO,PL,SM			
														FO,PL,SM			
														FO,PL,SM			
														FO,PL,SM			
														FO,PL,SM			
														VN,I,R			
25		Fresh, grey, foliated, fine to medium grained, strong INTERMEDIATE VOLCANICS.			9									FO,PL,R			24.70m to 24.90m Sample Taken.
	Boart-Longyear	- 23.86m Iron Staining.												J,I,VR Fe			
	LY38 - HQ3	- 25.6m Iron Staining.												FO,PL,SM			
		- 26.0m Foliation surfaces are sericitic.															
26		- 28.10m Vuggy quartz vein.												VN,W,SM			
		- 28.5m Iron staining on foliation surfaces. *(continued)*												J,C,SM			
														FO,PL,SM			
27														FO,PL,SM			
														FO,PL,SM			
28					10									FO,PL,SM			
														FO,PL,SM			
29														J,PL,R Fe			
														J,PL,SM Fe			
														FO,PL,SM			
														FO,PL,SM Fe			
														FO,PL,SM Fe			
					11									FO,PL,SM Fe			
30				113.75										J,W,VR Fe Cl			
		End of DRILLHOLE.		30.00													
31																	

DRILLHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-11

SHEET 1 OF 3

LOCATION: Causeway

BORING DATE: 10 May, 2002

DATUM: Local

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. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ice Surface		132.78									
0	LY38 - HQ3			0.00									
1		Ice.											
2				130.78 / 2.00									
3													
4													
5													
6		Water.											
7													
8													
9													
10		*CONTINUED NEXT PAGE*											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-11

SHEET 2 OF 3

LOCATION: Causeway

BORING DATE: 10 May, 2002

DATUM: Local

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 (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-3} 10^{-2} 10^{-1}) / WATER CONTENT PERCENT (Wp W Wl, 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10											
11											
12											
13											
14		Water. *(continued)*									
15	LY38 - HQ3										
16											
17											
18				114.48							
				18.30							
19		Inferred lake bottom sediments and overburden (TILL) [OVERBURDEN]									
				112.88							
20		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

BOREHOLE 022-14~1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 022-1427A Task 2000

RECORD OF DRILLHOLE: 02GT-11

SHEET 3 OF 3

LOCATION: Causeway

DRILLING DATE: 10 May, 2002

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		112.88												
20	Boart-Longyear LY38 - HQ/HW	Slightly weathered, green, very thinly laminated, vuggy, fine grained, weak to medium strong ULTRAMAFIC VOLCANICS. - Quartz veins occur every 0.2 to 0.3m these are up to several centimetres in width and very vuggy with Iron staining. - Broken core areas are characterized by vuggy vein.		19.90	1								BC,,			
21													BC,,			
													BC,, ,, Lost Core 21.0-21.3m			
22					2								BC,, J,PL,SM			22.0m to 27.0m Falling Head Test k=1.6x10-3 cm/s
													FO,PL,SM Fe			
													FO,PL,SM Fe VN,I,VR			
													FO,W,SM			
													BC,,			
23													BC,, J,PL,R			
													J,PL,R			
													J,I,VR			
													,ST,VR Orthogonal			23.68m to 23.80m Sample Taken.
24													FO,C,SM Fe			
					3								BC,, BC,,			
													J,W,VR			
				107.78									BC,,			
25				25.00									BC,, J,PL,SM			
					3								,PL,VR Orthogonal FO,PL,SM			25.0m to 27.0m Falling Head Test k=2.8x10-3 cm/s
26		Fresh, green, very thinly laminated, fine grained, medium strong ULTRAMAFIC VOLCANICS. - Core is pitted and vuggy locally, much less than previous interval.											J,W,R			25.90m to 26.12m Sample Taken.
													FO,PL,SM			
27				105.78												
		End of DRILLHOLE.		27.00												
28																
29																

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CJC/JRT

CHECKED:

DRILLHOLE 022-14-1.GPJ GLDR_CAN.GDT 13/12/02

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-1

SHEET 1 OF 6

LOCATION: Tailings Dyke 2nd Portage Abutment
N: 7214846.638 E: 638841.538

BORING DATE: 20-21 May 2003

DATUM: Local

Reference: Ground Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		134.34											
0	HQ3	Ground Surface Loose Cobbles and rounded Gravel with occasional boulders (Granite).		0.00				1							
1															
2				132.27											
		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.													
3															
4															
5															
6															
7															
8															
9															
10															

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

CORE RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-1

SHEET 2 OF 6

LOCATION: Tailings Dyke 2nd Portage Abutment
N: 7214846.638 E: 638841.538

DRILLING DATE: 20-21 May 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -56.66° AZIMUTH: 223°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		132.27													
3	Boart-Longyear HQ3	Bedrock Fresh to slightly weathered, massive medium to coarse grained, pinkish white, QUARTZITE.		2.48 131.43	1									JN,PL,Ro Fe JN,CU,Ro Fe JN,CU,Ro Fe JN,ST,Ro Fe JN,ST,Ro Fe JN,PL,Ro Fe JN,UN,Ro Fe JN,UN,Ro Fe	R5 R4 R3 R2 R1	W1 W2 W3 W4	
4		Fresh to slightly weathered, massive medium to coarse grained, pinkish white QUARTZITE.		3.48 130.18	2									JN,IR,Ro JN,IR,Ro Fe JN,CU,Ro Se Fe JN,ST,Ro Fe JN,CU,Ro Se JN,PL,Ro Fe JN,IR,Ro Qz			
5				4.98										JN,PL,Ro Fe			
6		Fresh, massive medium to coarse grained, pinkish white, QUARTZITE.			3									JN,IR,Ro JN,IR,Ro JN,PL,Ro Fe			
				128.93										JN,PL,SM Bt			
7				6.48										FO,ST,Ro FO,PL,Ro Fe CJ,IR,Ro Fe			
					4									CJ,PL,Ro x2 Fe FO,CU,Ro			
8		Fresh, medium grained, closely foliated, whitish grey, strong, QUARTZITE.												FO,PL,Ro JN,PL,Ro Se			
					5									JN,IR,Ro JN,PL,Ro JN,PL,Ro			
9														FO,ST,Ro Se CJ,PL,Ro Se FO,PL,Ro FO,PL,Ro			
				126.42													
10		Fresh, fine grained, moderate to closely foliated, strong, white grey, QUARTZITE with sercite alteration and iron staining along discontinuities.		9.48	6									FO/JN,IR,Ro Fe Se JN,IR,Ro Fe Se JN,IR,Ro Fe Se FO,PL,Ro Fe Se FO,UN,Ro Fe Se FO,UN,Ro Se FO,CU,Ro x2 Se FO,PL,Ro			
				125.17													
11		Fresh, fine grained, moderate to closely foliated, strong, white grey, QUARTZITE with sercite alteration and iron staining along discontinuities. Foliation wavy and folding.		10.98	7									FO,CU,Ro Se FO,CU,Ro Se FO,IR,Ro Se FO,IR,Ro Se FO,CU,Ro Se Fe FO,IR,Ro Se Fe JN,CU,Ro Fe JN,PL,Ro x2 Ca			
12				123.91													
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-1

SHEET 3 OF 6

LOCATION: Tailings Dyke 2nd Portage Abutment
N: 7214846.638 E: 638841.538

DRILLING DATE: 20-21 May 2003

DATUM: Local

INCLINATION: -56.66° AZIMUTH: 223°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
				12.48										JN,PL,Ro			
														FO,UN,Ro Se Fe			
13					8												
														FO,IR,Ro Se Fe			
														FO/JN,IR,Ro Se Fe			
														JN,PL,Ro Fe Se			
		Fresh, fine grained, moderate to closely foliated, strong, white grey, QUARTZITE with sercite alteration and iron staining along discontinuities. Foliation crenulated and folding.															
14														JN,PL,Ro			
					9									FO,UN,Ro Fe Se			
														FO,UN,Ro Fe Se			
15														FO,CU,SM			
				121.41													
				15.48										JN,CU,Ro Fe Se			
														JN,PL,Ro Se			
16		Fresh, fine grained, moderate to closely foliated, white-grey, strong, QUARTZITE with sericiite alteration.			10												
														FO,PL,Ro Se			
														JN,PL,Ro Se			
														JN,PL,Ro			
														FO,PL,Ro Se			
17				120.16													
				16.98										JN,PL,Ro			
														FO,PL,Ro Se			
														JN,PL,Ro			
	Boart-Longyear HQ3	Fresh, fine grained, moderate to closely foliated, white-grey, strong, QUARTZITE with sericite alteration. Wavy foliation with near vertical joints with vugs.			11									FO,PL,Ro x7 Se			
18														JN,ST,Ro Qz			
														JN,ST,Ro Qz			
														FO,PL,Ro Se			
				118.90										FO,PL,Ro			
				18.48										FO,CU,Ro Se			
														JN,PL,Ro			
19		Fresh, fine grained, closely foliated, whitish grey, strong, QUARTZITE.			12									FO,UN,Ro			
														FO,ST,Ro Se			
														JN,IR,Ro			
														JN,CU,Ro Se			
														FO,PL,Ro Se			
				117.65										FO,PL,Ro			
20				19.98										FO,CU,Ro			
														FO,CU,Ro			
		Fresh, fine grained, closely foliated, white-grey, sercite QUARTZITE with iron staining along some discontinuities.			13									JN,ST,Ro Fe Se			
														JN,PL,Ro Fe Se			
21														FO,CU,Ro Se			
														FO,CU,Ro Se			
				116.40										FO,CU,Ro			
				21.48													
		Fresh, fine grained, closely foliated, white-grey, sercite QUARTZITE with iron staining along some discontinuities.			14									FO,CU,Ro x2 Se			
22														FO,CU,Ro Se			
														JN,PL,SM Se			
														FO,CU,RO Se			

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-1

SHEET 4 OF 6

LOCATION: Tailings Dyke 2nd Portage Abutment
N: 7214846.638 E: 638841.538

DRILLING DATE: 20-21 May 2003

DATUM: Local

INCLINATION: -56.66° AZIMUTH: 223°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
23	Boart-Longyear HQ3	Fresh, fine grained, closely foliated, white-grey, sercite QUARTZITE with iron staining along some discontinuities. *(continued)*		115.14 22.98	14								FO,PL,Ro Se FO,IR,Ro FO,UN,Ro Se			
24		Fresh, fine grained, closely foliated, white-grey, sercite QUARTZITE with iron staining along some discontinuities. Joints with vugs perpendicular to core axis.		113.89 24.48	15								JN,PL,Ro Fe FO,PL,Ro Fe JN,PL,Ro JN,PL,Ro Se FO,CU,SM Fe FO,UN,Ro Se FO,PL,SM Se			
25													JN,IR,Ro x2 Se JN,CU,Ro Se JN,CU,Ro Se			
26		Fresh, fine grained, closely foliated, white-grey, sercite QUARTZITE with iron staining along some discontinuities. Joints with vugs perpendicular to core axis. Numerous sub vertical to vertical discontinuities. Foliation wavy and folded in places.			16								JN,IR,Ro Se FO,UN,Ro Se JN,PL,SM Se JN,PL,SM Se FO,UN,SM Se FO,CU,SM Se			
27				111.38 27.48	17								FO/JN,IR,SM Se FO,UN,SM Se JN,PL,SM Se			
28		Fresh, fine grained, closely foliated, white, strong, sercite altered QUARTZITE with iron staining and trace vugs along occasional healed discontinuities.		110.13 28.98	18								FO,PL,Ro Se Su JN,ST,Ro Fe JN,UN,Ro FO,UN,SM Fe			
29					19								FO,PL,Ro FO,PL,SM FO,UN,SM			
30													FO,PL,Ro			
31		Fresh, fine grained, closely foliated, white with pink banding, strong, sercite altered QUARTZITE with iron staining and trace vugs along occasional healed discontinuities.			20								FO,PL,Ro FO,IR,Ro FO,PL,Ro Fe FO,CU/ST,Ro			
32				107.53 32.09	21								CO,IR,Ro Fe CO,IR,Ro Fe			
		Fresh, fine grained, closely foliated, medium grey, medium to strong, MAFICS.			22								FO,IR,Ro Fe FO,IR,Ro Fe JN,CU,Ro Fe			

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DEPTH SCALE
1 : 50

LOGGED: JC/PP
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-1

SHEET 5 OF 6

LOCATION: Tailings Dyke 2nd Portage Abutment
N: 7214846.638 E: 638841.538

DRILLING DATE: 20-21 May 2003

DATUM: Local

INCLINATION: -56.66° AZIMUTH: 223°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
33	Boart-Longyear HQ3	Fresh, fine grained, closely foliated, medium grey, medium to strong, MAFICS. *(continued)*		106.37	22									JN,IR,Ro JN,PL,Ro JN,UN/IR,Ro FO,PL,Ro FO,PL,Ro x3 Fe	R5 R4 R3 R2 R1	W1 W2 W3 W4	
34		Slightly to moderately weathered, fine grained, closely foliated and highly fractured, grey and brown, weak, MAFICS with heavy oxidization from 35.42 to 36.00 m.		33.48 105.12	23									FO,PL,Ro x15 Go Fe			
35		Moderately weathered, fine grained, highly fractured, weak to very weak, brown-grey, MAFICS with heavy oxidization and gouge throughout.		34.98	24									FO,PL,Ro x3 Fe Go FO,PL,Ro x5 Fe Go JN,CU,Ro Sa Fe CO,PL,Ro Go Cl FO,PL,Ro x3 Fe			
36					25									JN,IR,Ro Sa Fe JN,CU,Ro Fe Go			
37				103.31										JN,IR,Ro Fe Go			
		Fresh, medium to fine grained, closely foliated, pinkish white, strong, QUARTZITE with chloritized band from 38.16 to 38.25.		37.14	26									CO,PL,SM Go FO,IR,Ro Se JN,IR,Ro Fe JN,IR,Ro Fe FO,CU,Ro			
38				102.61													
		Fresh, medium to fine grained, closely foliated, greyish white, strong, QUARTZITE with iron staining from 39.96 to 40.18.		37.98	27									JN,IR,Ro JN,CU,Ro FO,IR,Ro Qz Bt FO,ST,Ro FO,IR,Ro JN//OR,PL,Ro Fe			
39				101.36										FO,IR,Ro Se FO,PL,Ro			
		Fresh, medium to fine grained, closely foliated, greyish white, strong, QUARTZITE with iron staining from 41.00 to 41.15.		39.48	28									FO,IR,Ro FO,PL,Ro Fe FO,PL,Ro CJ,IR,Ro FO,PL,Ro Se Fe			
40				100.11													
41		Fresh, fine grained, closely foliated, light grey, strong, INTERMEDIATE VOLVCANICS - QUARTZITE with black to dark grey banding.		40.98	29									FO,CU,Ro FO,CU,Ro Fe FO,PL,Ro Fe OR/CJ,PL,SM x2 FO,IR,Ro Fe FO,PL,SM Fe			
42														OR/CJ,PL,Ro Fe OR/CJ,PL,Ro Fe			
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-1

SHEET 6 OF 6

LOCATION: Tailings Dyke 2nd Portage Abutment
N: 7214846.638 E: 638841.538

DRILLING DATE: 20-21 May 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -56.66° AZIMUTH: 223°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
43		Fresh, fine grained, closely foliated, light grey, strong, INTERMEDIATE VOLVCANICS - QUARTZITE with black to dark grey banding *(continued)*			30									FO,IR,Ro JN/OR,PL,Ro FO,CU,Ro Qz			
44					31									FO,IR,Ro JN,CU,Ro JN,PL,Ro			
45				96.35										FO,PL,Ro			
46	Boart-Longyear HQ3	Fresh, fine grained, closely foliated, brownish red, strong, INTERMEDIATE VOLCANICS.		45.48	32									JN,UN,Ro JN,ST,Ro			
47														FO,UN,SM JN,PL,Ro JN,CU,Ro			
48				93.84	33									JN,UN,Ro Se FO,PL,Ro			
49		Fresh, fine grained, closely foliated wavy, light grey, strong, INTERMEDIATE VOLCANICS.		48.48 93.00	34									FO,IR,Ro			
50		End of BOREHOLE.		49.48													
51																	
52																	

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-2

SHEET 1 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214712 E: 638772

BORING DATE: 19-May-03

DATUM: Local
Reference: Ice Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE: RUN No.	RECOVERY %	GRADATION %: GRAVEL	SAND	FINES	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
		Ice Surface		133.00											
0				0.00											
1		ICE													
2				131.19											
				1.81											
3															
4															
5	HQ3														
6		LAKE WATER													
7															
8															
9															
10		*CONTINUED NEXT PAGE*													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-2

SHEET 2 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214712 E: 638772

BORING DATE: 19-May-03

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10													10^{-6} 10^{-5} 10^{-4} 10^{-3}; Wp W Wl; 10 20 30 40		
11															
12															
13		LAKE WATER *(continued)*													
14															
15	HQ3														
16															
				116.22 / 16.78											
17															
18		Cobbles and gravel mixture of granite, quartz and volcanics.													
19															
20		*CONTINUED NEXT PAGE*													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-2

SHEET 3 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214712 E: 638772

BORING DATE: 19-May-03

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE: RUN No.	RECOVERY % (80 60 40 20)	GRADATION %: GRAVEL	SAND	FINES	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	HQ3	Cobbles and gravel mixture of granite, quartz and volcanics.*(continued)*													
21															
22				110.89											
		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.													
23															
24															
25															
26															
27															
28															
29															
30															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-2

SHEET 4 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214712 E: 638772

DRILLING DATE: 19-May-03

DATUM: Local

DRILL RIG: LY38

INCLINATION: -90°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH / % RETURN / COLOUR	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX
		Continued from SOIL LOG.		110.89											
				22.11									JN,PL,Ro		
		Fresh, fine to coarse grained, moderate to closely foliated, light green, medium strong, serecite altered felsic volcanic with trace stringers of sphalerite. Contact between felsic volcanic and ultra mafic unit at 23.36m.			1			80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90	JN,PL,Ro FO,UN,Ro Ca CO,PL,SM FO,PL,SM FO,UN,Ro	R5 R4 R3 R2 R1	W1 W2 W3 W4
23				109.60											
				23.40											
24					2								FO,PL,SM Go FO,PL,SM Go		
													FO,UN,SM Go		
25	Boart-Longyear HQ3	Fresh, fine to coarse grained, moderate to closely foliated, light green, weak, ULTRAMAFICS with coarse-grained calcite filled fragments.			3								FO,UN,SM FLT,PL,Ro Go,Br		
26													JN,PL,Ro Ca		
				106.60											
				26.40											
27					4										
28		Fresh, fine to coarse grained, moderate to closely foliated, light green, weak, ULTRAMAFICS with coarse-grained calcite filled fragments, clay gouge along some pieces.			5										
29				103.60											
		End of BOREHOLE.		29.40											
30															
31															
32															

NOTES
WATER LEVELS
INSTRUMENTATION

24.90m to 29.40m
Falling Head
Packer Test
k=2.8x10-3 cm/s

DEPTH SCALE
1 : 50

LOGGED: JC/PP

CHECKED: CJC

Golder Associates

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-3

SHEET 1 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214516 E: 638752

BORING DATE: 18-19 May-2003

DATUM: Local

Reference: Ice Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	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
0		Ice Surface		133.00 0.00											
1	HQ3	ICE													
2				130.78 2.22											
3															
4															
5															
6		LAKE WATER													
7															
8															
9															
10		*CONTINUED NEXT PAGE*													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-3

SHEET 2 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214516 E: 638752

BORING DATE: 18-19 May-2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY % (80, 60, 40, 20)	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	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															
11															
12															
13															
14															
15	HQ3	LAKE WATER *(continued)*													
16															
17															
18															
19															
20		*CONTINUED NEXT PAGE*													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-3

SHEET 3 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214516 E: 638752

BORING DATE: 18-19 May-2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	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															
21															
22		LAKE WATER *(continued)*													
23															
24	HQ3			109.00 / 24.00											
25		Green mud from lake bottom, with trace cobbles and gravel.													
26				106.60 / 26.40											
27															
28		Mixture of COBBLES and gravel composed of granite and volcanics.													
29															
30		*CONTINUED NEXT PAGE*													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP
CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-3

SHEET 4 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214516 E: 638752

BORING DATE: 18-19 May-2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
30		Mixture of COBBLES and gravel composed of granite and volcanics. *(continued)*		102.10 / 30.90											
31		COBBLES and GRAVEL with trace sand, clay (granite and quartz).		100.60 / 32.40											
32	HQ3														
33								1							
34															
35		COBBLES and GRAVEL composed of quartz and granite.						2							
36															
37								3							
38				94.60 / 38.40											
39		End of BOREHOLE.													
40															

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

CORE: RECOVERY % 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-4

SHEET 1 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214353 E: 638775

BORING DATE: 18-May-03

DATUM: Local

Reference: Ice Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ice Surface		133.00 / 0.00											
0		ICE													
1															
2				131.02 / 1.98											
3															
4															
5	HQ3														
6		LAKE WATER													
7															
8															
9															
10		*CONTINUED NEXT PAGE*													

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-4

SHEET 2 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214353 E: 638775

BORING DATE: 18-May-03

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10															
11															
12		LAKE WATER *(continued)*													
13															
14															
15	HQ3			118.16 / 14.84				1							
16															
17		COBBLES and GRAVEL composed of mainly granite with trace sand.													
18															
19															
20		*CONTINUED NEXT PAGE*													

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-4

SHEET 3 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214353 E: 638775

BORING DATE: 18-May-03

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	HQ3	COBBLES and GRAVEL composed of mainly granite with trace sand. *(continued)*		112.32				1	80 60 40 20						
		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.													
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															

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

LOGGED: JC/PP

CHECKED: CJC

Golder Associates

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-4

SHEET 4 OF 4

LOCATION: Tailings Dyke 2nd Portage
N: 7214353 E: 638775

DRILLING DATE: 18-May-03

DATUM: Local

DRILL RIG: LY38

INCLINATION: -90°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		112.32													
				20.68													
21		Slightly to moderately weathered, highly fractured, brownish grey, weak to medium strong, INTERMEDIATE VOLCANICS with iron staining throughout.			1												Little to no water return in bedrock.
22					2												
23																	
24					3												
	Boart-Longyear HQ3			108.17													
				24.83													24.83m to 29.33m Falling Head Packer Test k=4.0x10-3 cm/s
25					4									JN,PL,Ro Fe,Go,Sa			
26														JN,PL,Ro Fe			
27		Slightly to moderately weathered, highly fractured, brownish grey, weak to medium strong, INTERMEDIATE VOLCANICS with iron staining throughout, and gouge material and clay like sandy gravel in discontinuities.			5									JN,PL,Ro x5 Fe,Go,Sa			
28														JN,PL,Ro Fe,Go			
					6									SHR/FLT,PL,Ro Go,Sa,Gr			
29				103.67										JN,PL,Ro Fe,Sa			
		End of BOREHOLE.		29.33													
30																	

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/PP

CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-5A

SHEET 1 OF 6

LOCATION: Tailings Dyke
N: 7214123.121 E: 638774.6

DRILLING DATE: 10-Aug-03
DRILL RIG: LF-70
DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		135.97											
0	HQ3	Overburden: Coarse gravel and cobbles of Intermediate Volcanic rocks, slightly weathered, rounded (possibly cored / broken boulder)		0.00	1	RC		1							
3				133.16											
		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.													

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TS/MT
CHECKED: CJC

CUSTOM LOG 3 03-1413-427_OCT1_2003.GPJ GLDR_CAN.GDT 5/11/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-5A

SHEET 2 OF 6

LOCATION: Tailings Dyke
N: 7214123.121 E: 638774.6

DRILLING DATE: 10-Aug-03

DATUM: Local

INCLINATION: -58.24° AZIMUTH: 33°

DRILL RIG: LF-70

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		133.16													
				3.30										FO,PL,SM BR			
														JN,PL,SM			
					2									JN,PL,SM			
4														FO,UN,SM			
		Slightly weathered, closely foliated, gray, fine grained, medium strength, INTERMEDIATE VOLCANICS (foliation parallel to core dip / some vuggy joints)															
														JN,PL,SM			
5														JN,UN,SM			
					3									JN,PL,RO QZ			
6				130.86													
				6.00										JN,PL,SM			
														JN,UN,SM			
					4												
7																	
8	Boart-Longyear HQ3													JN,PL,SM			
					5									FO,UN,SM			
		Fresh, closely foliated with quartz veinlets, gray green, fine grained, medium strength, INTERMEDIATE VOLCANICS															
														JN,PL,SM			
9														JN,IR,SM QZ			
														JN,PL,SM x2 CH			
					6												
10														JN,PL,RO CH QZ			
														FO,PL,SM x2			
														FO,UN,SM CH			
														JN,PL,SM QZ			
11				126.61										JN,PL,RO HE			
				11.00										JN,PL,SM			
		Fresh, closely foliated with quartz veinlets, gray green, fine grained, medium strength, INTERMEDIATE VOLCANICS (core 'slatey' at end of run - flat dipping foliation broken up)			7												
				125.76													
12				12.00													
														JN,PL,SM QZ CH			
		Fresh to slightly weathered portions, closely foliated, fine grained, medium strength, INTERMEDIATE VOLCANICS			8												
13														FO,PL,RO x3 BR			
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TS/MT

CHECKED: CJC

DRILLHOLE 03-1413-427_OCT1_2003.GPJ GLDR_CAN.GDT 5/11/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-5A

SHEET 3 OF 6

LOCATION: Tailings Dyke
N: 7214123.121 E: 638774.6

DRILLING DATE: 10-Aug-03

DATUM: Local

INCLINATION: -58.24° AZIMUTH: 33°

DRILL RIG: LF-70

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
				124.49	8												
				13.50										JN,PL,SM			
14					9									JN,PL,SM x2			
														JN,PL,SM			
15														JN,PL,SM			
					10									FO,PL,RO x3 BR			
16														JN,PL,SM			
														FO,UN,RO BR			
														FO,PL,RO BR			
17					11									JN,PL,RO JN,PL,RO			
														JN,PL,RO			
														JN,PL,RO			
18	Boart-Longyear HQ3	Fresh, closely foliated, fine grained, medium strength, INTERMEDIATE VOLCANICS			12									JN,PL,SM x2			
19																	
														JN,PL,SM			
20					13									JN,PL,SM			
21														JN,ST,SM			
														JN,PL,SM CA			
					14												
22														JN,PL,SM CL			
														JN,PL,RO			
					15									JN,PL,SM FO,PL,SM			
23																	
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TS/MT

CHECKED: CJC

DRILLHOLE 03-1413-427_OCT1_2003.GPJ GLDR_CAN.GDT 5/11/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-5A

SHEET 4 OF 6

LOCATION: Tailings Dyke
N: 7214123.121 E: 638774.6

DRILLING DATE: 10-Aug-03

DATUM: Local

DRILL RIG: LF-70

INCLINATION: -58.24° AZIMUTH: 33°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
									80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90		R5 R4 R3 R2 R1	W1 W2 W3 W4	
24	Boart-Longyear HQ3	Fresh, closely foliated, fine grained, medium strength, INTERMEDIATE VOLCANICS *(continued)*			15									JN,PL,SM x4			
														JN,IR,SM			
														JN,PL,SM CA			
														JN,PL,SM			
25					16									JN,PL,SM			
														JN,PL,SM CA			
														JN,PL,SM x2 CA			
26					17									JN,PL,SM			
														FO,PL,SM			
27														FO,PL,RO QZ			
					18									JN,PL,SM			
28														FO,ST,SM			
														JN,PL,SM			
														JN,UN,SM			
29					19									FO,UN,RO x2			
30														JN,UN,SM			
					20									FO,UN,RO SU			
31														JN,PL,SM			
32					21									JN,PL,SM			
														FO,UN,RO			
														JN,PL,SM			
33					22									FO,PL,SM CA			

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TS/MT

CHECKED: CJC

DRILLHOLE 03-1413-427_OCT1_2003.GPJ GLDR_CAN.GDT 5/11/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-5A

SHEET 5 OF 6

LOCATION: Tailings Dyke
N: 7214123.121 E: 638774.6

DRILLING DATE: 10-Aug-03

DATUM: Local

INCLINATION: -58.24° AZIMUTH: 33°

DRILL RIG: LF-70

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
								80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90		R5 R4 R3 R2 R1	W1 W2 W3 W4	
34	Boart-Longyear HQ3	Fresh, closely foliated, fine grained, medium strength, INTERMEDIATE VOLCANICS *(continued)*			22								FO,PL,SM FO,PL,SM JN,PL,SM JN,PL,SM			
35					23								FO,PL,SM x3 FO,UN,SM JN,PL,RO			
36					24								JN,PL,SM JN,PL,SM JN,PL,SM			
37													FO,PL,SM JN,PL,SM QZ FO,PL,SM x2			
38					25								FO,UN,SM CA FO,UN,SM FO,PL,SM x2 FO,PL,SM CA JN,ST,SM			
39					26								FO,UN,SM x3			
40													JN,PL,SM JN,PL,SM JN,PL,RO			
41					27								JN,PL,SM			
42					28								JN,PL,SM JN,PL,SM JN,PL,SM JN,PL,SM			
43		*CONTINUED NEXT PAGE*														

DRILLHOLE 03-1413-427_OCT1_2003.GPJ GLDR_CAN.GDT 5/11/03

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TS/MT

CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-5A

SHEET 6 OF 6

LOCATION: Tailings Dyke
N: 7214123.121 E: 638774.6

DRILLING DATE: 10-Aug-03

DATUM: Local

INCLINATION: -58.24° AZIMUTH: 33°

DRILL RIG: LF-70

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
									80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90		R5 R4 R3 R2 R1	W1 W2 W3 W4	
44	Boart-Longyear HQ3	Fresh, closely foliated, fine grained, medium strength, INTERMEDIATE VOLCANICS *(continued)*			28									JN,PL,SM JN,PL,SM			
														JN,UN,SM JN,PL,SM QZ			
45					29									JN,UN,SM JN,PL,SM			
														JN,PL,SM QZ			
46					30									FO,ST,SM			
														JN,IR,RO			
														JN,UN,SM JN,PL,RO			
47					31									JN,PL,RO QZ JN,UN,RO FO,PL,SM JN,PL,SM JN,PL,SM QZ JN,PL,SM x2 QZ			
														JN,PL,RO			
48														JN,PL,SM			
														JN,UN,SM			
49					32									JN,ST,SM QZ FO,PL,SM JN,PL,SM QZ			
50					33									JN,PL,SM			
														FO,UN,SM			
51				92.60										JN,PL,SM			
		End of BOREHOLE.		51.00													
52																	
53																	

DRILLHOLE 03-1413-427_OCT1_2003.GPJ GLDR_CAN.GDT 5/11/03

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TS/MT
CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-6

SHEET 1 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

BORING DATE: 21-22 May 2003

DATUM: Local

Reference: Ice Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ice Surface		132.58											
0				0.00											
1		ICE													
2				130.49											
				2.09											
3															
4															
5	NO														
6		LAKE WATER													
7															
8															
9															
10		*CONTINUED NEXT PAGE*													

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-6

SHEET 2 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

BORING DATE: 21-22 May 2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY % (80, 60, 40, 20)	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	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															
11															
12															
13															
14															
15	NQ	LAKE WATER *(continued)*													
16															
17															
18															
19															
20		*CONTINUED NEXT PAGE*													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-6

SHEET 3 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

BORING DATE: 21-22 May 2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE: RUN No.	RECOVERY %	GRADATION %: GRAVEL	SAND	FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	NO	LAKE WATER *(continued)*													
21															
22															
23				109.47 / 23.11											
24		COBBLES and Gravel													
25															
26				106.24 / 26.34											
27		GRAVEL and granite cobbles, trace silt, trace clayey silt						1							
28				104.74 / 27.84	1	RC									
29		GRAVEL, some cobbles, trace clayey silt.						2							
30		Ultra mafic BOULDERS, little cobbles, trace gravel.		103.24 / 29.34	2	RC		3							
		CONTINUED NEXT PAGE													

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-6

SHEET 4 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

BORING DATE: 21-22 May 2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE: RUN No.	RECOVERY %	GRADATION %: GRAVEL	SAND	FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
30		Ultra mafic BOULDERS, little cobbles, trace gravel *(continued)*		101.74 / 30.84				3							
31		GRAVEL		100.24 / 32.34				4							
32															
33		Ultra mafic COBBLES, some gravel. WASH SAMPLE: Grey, fine, silt with coarse SAND.		98.74 / 33.84	6 3	WS RC		5							
34		COBBLES, some gravel.						6							
35	NQ			97.24 / 35.34											
36		COBBLES, little gravel, trace silt.			4	RC									
37		COBBLES with trace sub angular gravel		95.74 / 36.84											
38															
39		COBBLES with trace sub angular gravel WASH SAMPLE: Grey, fine grained, silty SAND.		94.24 / 38.34											
40		*CONTINUED NEXT PAGE*													

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

CORE RECOVERY %: 60 80 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS
CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-TD-6

SHEET 5 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

BORING DATE: 21-22 May 2003

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
40	NQ	COBBLES with trace sub angular gravel; WASH SAMPLE: Grey, fine grained, silty SAND. *(continued)*													
41				91.34	5	WS									
		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.													
42															
43															
44															
45															
46															
47															
48															
49															
50															

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS
CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-6

SHEET 6 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

DRILLING DATE: 21-22 May 2003

DATUM: Local

INCLINATION: -90°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (cm/min)	FLUSH / COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		91.34												
				41.24									JN,CU,VR Go,Fe			
42					1								JN,ST,Ro Go,Fe JN,PL,Ro Go,Fe JN,ST,Ro Go,Fe			
													JN,ST,Ro x10 Br			
43					2								JN,CU,Ro GO			
													JN,ST,Ro Go,Fe JN,PL,Ro Go,Fe			
44																
45					3											
													JN,PL,SM Br			
46	Boart-Longyear NQ	Slightly to moderately weathered, thinly bedded, medium to fine grained, green, weak to very weak, (faulted) ULTRAMAFIC (Epidote), iron stained, quartz veinlets.											OR,ST,Ro Br			
													JN,PL,SM			
47													JN,PL,SM JN,PL,SM			
					4								JN,ST, JN,PL,Ro Br JN,PL,Ro Br JN,PL,Ro QZ			47.84m to 52.34m Falling Head Packer Test k=5.1x10-4 cm/s
48													JN,PL,Ro Br JN,PL,Ro Br			
49													JN,ST,Ro Go,Fe			
50					5								JN,PL,SM Fe			
51																
		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS

CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-TD-6

SHEET 7 OF 7

LOCATION: Tailings Dyke 2nd Portage
N: 7214515.522 E: 638751.681

DRILLING DATE: 21-22 May 2003

DATUM: Local

INCLINATION: -90°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
52	Boart-Longyear NQ	Slightly to moderately weathered, thinly bedded, medium to fine grained, green, weak to very weak, (faulted) ULTRAMAFIC (Epidote), iron stained, quartz veinlets. *(continued)*		80.24	5									JN,IR,Ro Br,Go,Fe JN,PL,SM Br JN,PL,Ro Br			
		End of BOREHOLE.		52.34													
53																	
54																	
55																	
56																	
57																	
58																	
59																	
60																	
61																	

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC/TS/CS
CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF BOREHOLE: 03GT-SPEC-F1

SHEET 1 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

BORING DATE: 10-14 June 2003

DATUM: Local

Reference: Ground Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	CORE: RUN No.	CORE: RECOVERY %	GRADATION %: GRAVEL	GRADATION %: SAND	GRADATION %: FINES	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		138.89											
	HQ3	COBBLES and some angular GRAVEL		0.00 / 138.19											
1		Bedrock Encountered. Refer to ROCK LOG for continuation of rock description.													
2															
3															
4															
5															
6															
7															
8															
9															
10															

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40

CORE RECOVERY %: 80 60 40 20

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS

CHECKED: CJC

CUSTOM LOG 2 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 2 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003
DRILL RIG: LY38
DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
		Continued from SOIL LOG.		138.19													
				0.80													
1		Start of Bedrock		137.93													
		Start of core run - Fresh to moderately weathered, closely foliated, greenish grey, fine grained, low to medium strength, INTERMEDIATE VOLCANICS with some quartz and trace pyrite		1.10	1									JN,PL,Ro Si,Ch JN,PL,Ro Bl,Su			
2														JN,UN,Ro Qz,Ch			
				136.62													
		Fresh to moderately weathered, closely foliated, greenish grey, fine grained, low to medium strength, INTERMEDIATE VOLCANICS with some quartz and trace pyrite, vuggy in section with high quartz content		2.60	2									JN,PL,VR Fe,Si			
3														FO,PL,SM x3			
4				135.31										FO,PL,SM x2			
		Fresh, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with some quartz		4.10	3									FO,PL,SM VN,PL,Ro Qz,Su FO,PL,SM Qz,Si FO,PL,SM			
5														JN,PL,Ro x2 Qz			
														JN,IR,Ro Qz			
														JN,PL,Ro Qz,Si,Ch			
6					4									JN,PL,Ro			
														JN,PL,Ro Qz			
														JN,UN,Ro Qz,Ca			
7				132.70													
		Slightly to moderately weathered, fine grained, greyish green, medium to weak strength, INTERMEDIATE VOLCANICS with some iron staining and vuggy sections parallel to foliation		7.10	5									FO,PL,Ro Fe,Qz JN,PL,Ro Fe			
8														JN,PL,Ro FO,PL,Ro Fe,Qz			
														FO,PL,Ro Fe,Qz FO,PL,SM Qz,Ch			
														JN,PL,Ro Fe,Qz FO,UN,Ro Fe,Ch			
9					6									FO,PL,Ro Fe,Ch JN,PL,Ro Fe JN,PL,Ro Fe,Ch			
														FO,PL,Ro Fe			
10				130.09										FO,PL,SM x6 Bl,Ch FO,PL,SM Fe			
		Fresh to slightly weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with smooth shiny discontinuity surfaces		10.10	7									FO,PL,SM			
														FO,PL,SM			
		CONTINUED NEXT PAGE															

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 3 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
11	Boart-Longyear HQ3	Fresh to slightly weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with smooth shiny discontinuity surfaces *(continued)*			7				80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90	FO,PL,SM FO,PL,SM Qz FO,PL,SM VN,IR,Ro Qz FO,PL,SM x8	RS R4 R3 R2 R1	W1 W2 W3 W4	
12					8									FO,PL,Ro Fe,Ch FO,PL,Ro Ch JN,IR,Ro Fe,Qz,Ch FO,PL,SM Ch FO,PL,SM x3			
13					9									FO,PL,SM Ch FO,PL,SM Ch FO,PL,SM Ch FO,PL,SM Ch FO,PL,SM x2 Ch FO,PL,Ro x2 Fe JN,PL,Ro x2			
14				126.17 14.80										FO,PL,SM FO,PL,SM Ch FO,PL,SM Ch JN,PL,SM JN,IR,Ro Fe			
15					10												
16														FO,PL,Ro Qz FO,PL,Ro Fe			
17					11									JN,PL,Ro Qz			
18		Fresh to slightly weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with smooth shiny discontinuity surfaces, vuggy in sections												JN,PL,Ro Qz JN,PL,Ro Fe,Ch JN,PL,Ro JN,PL,Ro Qz JN,PL,SM Fe			
19					12									FO,PL,SM Fe,Ch FO,PL,SM FO,PL,SM			
20					13									FO,PL,SM FO,PL,SM FO,IR,SM JN,IR,Ro JN,PL,SM JN,IR,Ro			
					14												
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 4 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003
DRILL RIG: LY38
DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
21	Boart-Longyear HQ3	Fresh to slightly weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with smooth shiny discontinuity surfaces, vuggy in sections *(continued)*			14								JN,PL,Ro			
22													JN,IR,Ro Qz			
													JN,UN,Ro			
													JN,PL,Ro			
					15								JN,PL,Ro			
23													JN,PL,Ro			
													JN,PL,Ro Fe			
													JN,PL,Ro			
													FO,ST,Ro			
24													FO,PL,Ro			
					16								OR,PL,Ro			
25				117.02												
		Fresh to slightly weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS, vuggy in sections, wavy calcite banding		25.10									JN,PL,Ro			
26					17								JN,UN,Ro			
				115.71									JN,CU,Ro			
				26.60									JN,UN,Ro Qz,Ch			
27													JN,UN,Ro Qz			
					18								JN,PL,Ro			
28													JN,UN,Ro			
		Fresh to slightly weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS, vuggy in sections, wavy calcite banding, occasional cubic pyrite			19								JN,UN,Ro Ch			
29													JN,PL,Ro Ch			
													JN,PL,Ro Qz,Ch			
30					20								JN,IR,Ro			
													JN,PL,Ro			

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 5 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
									80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90		R6 R4 R3 R2 R1	W1 W2 W3 W4	
31				111.79	20									VN,PL,VR			
				31.10										JN,UN,Ro			
														JN,PL,Ro Ca,Ch			
														FO,PL,SM x2 Ca,Ch			
32					21									FO,CU,Ro Qz			
														JN,IR,Ro Qz			
														JN,UN,Ro Qz			
33														FO,PL,Ro			
														FO,PL,Ro Qz,Fe			
34					22												
														JN,IR,Ro			
														FO,CU,Ro			
														JN,IR,Ro			
35					23									JN,PL,SM			
														JN,PL,SM Ca			
														FO,PL,SM Ca			
36	Boart-Longyear HQ3	Fresh to slightly weathered, closely foliated, greenish grey, medium to fine grained, medium strength, INTERMEDIATE VOLCANICS, vuggy in sections, wavy calcite banding, occasional cubic pyrite												JN,CU,SM Qz			
														FO,CU,SM Qz,Ch			
					24									JN,IR,Ro			
														JN,CU,Ro Qz			
37														FO,CU,Ro Qz			
														FO,CU,SM Ch,Qz			
					25									JN,PL,SM Qz			
38														JN,PL,Ro Qz			
														JN,PL,Ro Qz,Ch			
														FO,CU,Ro Qz,Ch			
39														JN,PL,Ro Ch,Fe			
					26									FO,PL,Ro Ch			
														JN,PL,Ro Ch			
40																	
					27												
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 6 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
41	Boart-Longyear HQ3	Fresh to slightly weathered, closely foliated, greenish grey, medium to fine grained, medium strength, INTERMEDIATE VOLCANICS, vuggy in sections, wavy calcite banding, occasional cubic pyrite *(continued)*			27				60 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90	FO,PL,Ro Ch JN,UN,Ro JN,UN,Ro	R5 R4 R3 R2 R1	W1 W2 W3 W4	
42					28									FO,PL,SM Ch FO,PL,SM Ch FO,PL,SM Ch JN,PL,SM Qz,Ch			
43					29									FO,ST,Ro			
44														VN,IR,VR Qz,Fe,Ch JN,CU,Ro Qz,Fe,Ch			
45					30									JN,PL,Ro JN,PL,Ro Br FO,PL,Ro Br			
46														JN,PL,Ro Qz JN,PL,Ro Qz JN,PL,Ro Ch,Fe JN,PL,Ro			
47					31									JN,PL,Ro Fe JN,PL,Ro Fe			
48					32									JN,PL,Ro Qz,Fe,Ch JN,CU,Ro Fe JN,PL,Ro Ch JN,PL,Ro Fe,Ch			
49				96.11										JN,PL,Ro Qz,Ch,Su			
50		Fresh, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with some iron banding (rust colour) parallel to foliation		49.10	33									VN,IR,Ro Qz,Ch FO,PL,SM Qz,Fe FO,PL,SM x2 Qz FO,PL,SM x2 VN,PL,SM Qz,Ch			
					34												
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 7 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D %	FRACT INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
51	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with some iron banding (rust colour) parallel to foliation *(continued)*			34								JN,PL,Ro Qz JN,UN,Ro Fe,Ch			
52													VN,PL,SM Qz,Ch			
53					35								FO,PL,Ro Ch FO,PL,Ro Fe,Ch JN,PL,Ro x2 JN,PL,Ro Qz,Fe			
54					36								JN,PL,SM FO,PL,SM Ch FO,PL,SM Ch FO,UN,SM Ch			
55													JN,IR,Ro			
56					37								JN,PL,Ro FO,PL,Ro FO,UN,Ro Fe			
57					38								JN,PL,Ro JN,PL,Ro FO,CU,Ro x2			
58																
59					39								FO,PL,Ro FO,PL,SM Ch			
60					40								JN,PL,Ro JN,PL,Ro Cl JN,PL,Ro Cl,Br FO,CU,Ro FO,PL,SM Ch			

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 8 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
61	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with some iron banding (rust colour) parallel to foliation *(continued)*			40								JN,PL,Ro			
62					41								FO,PL,Ro Ch			
63													FO,PL,Ro Fe			
64					42								JN,PL,Ro JN,PL,Ro Qz,Fe			
65													JN,PL,Ro			
66					43								FO,PL,SM Ch			
67													JN,PL,Ro			
68					44								FO,PL,SM Ch			
69					45								JN,UN,SM			
70					46								JN,PL,Ro Qz			
													JN,PL,Ro Ch			
					47								JN,PL,Ro Ca,Su			
		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 9 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH / % RETURN / COLOUR	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
								100 80 60 40 20 0	100 80 60 40 20 0	100 80 60 40 20 0	2 4 6 8	0 30 60 90		R5 R4 R3 R2 R1	W1 W2 W3 W4	
71	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with some iron banding (rust colour) parallel to foliation *(continued)*			47								VN,UN,SM Ca			
72					48								JN,UN,SM JN,ST,Ro JN,IR,Ro			
73													JN,UN,Ro x2 Su			
74					49								JN,UN,Ro x2 Su			
75					50								FO,PL,Ro JN,UN,Ro			
76																
77					51								FO,ST,Rc JN,PL,Ro Su CJ,PL,Ro JN,ST,Ro Qz JN,IR,Ro Si			
78					52								JN,PL,Ro Su FO,UN,Ro Su FO,PL,SM JN,IR,Ro			
79																
80					53								JN,IR,Ro FO,ST,SM			
					54											

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 10 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
81	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with some iron banding (rust colour) parallel to foliation *(continued)*			54									JN,PL,SM JN,UN,SM			
82					55									JN,PL,SM JN,UN,SM JN,PL,SM			
83														JN,UN,Ro JN,IR,Ro			
84					56									JN,UN,Ro JN,PL,Ro Ca JN,PL,Ro Ch JN,ST,Ro Ch,Su			
85														JN,CU,Ro Qz JN,UN,Ro JN,PL,SM			
86					57									JN,PL,SM			
87				62.78	58									JN,UN,SM JN,PL,Ro			
88		Moderately weathered, closely foliated, greenish grey, fine grained, medium strength, INTERMEDIATE VOLCANICS with 2 cm of sandy silt with trace clay in most discontinuities, discoloured rock throughout interval (Possible Fault Zone).		87.35 62.13	59									JN,ST,Ro FO,CU,SM JN,PL,Ro Ch JN,IR,SM Cl,Si,Sa			
89		Slightly to moderately weathered, fine to medium grained, closely foliated, reddish white to reddish green, weak to medium strong, INTERMEDIATE VOLCANICS with iron staining and sandy silt / clayey infilling in discontinuities (Possible Fault Zone).		88.10 60.82	60									JN,IR,Ro Cl,Si,Sa JN,CU,Ro Cl,Si,Sa JN,IR,SM Si FO,PL,SM Fe,Su JN,PL,Ro x3 Si,Fe,Cl FO,PL,Ro Fe,Ch			
90		Slightly to moderately weathered, greenish grey to yellowish white, weak to medium strong, INTERMEDIATE VOLCANICS with some quartz and some oxidized iron, some clay (highly weathered material) (Possible Fault Zone).		89.60	61									FO,PL,Ro Qz,Ch JN,PL,Ro x2 Fe,Qz,Ch JN,PL,Ro JN,PL,Ro Fe			

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 11 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
91	Boart-Longyear HQ3			59.52	61								VN,PL,Ro Qz			
				91.10									JN,PL,VR x2 Qz,Fe,Ch			
													JN,UN,Ro Fe,Qz			
													FO,PL,SM x2 Ch			
92					62								JN,UN,Ro Qz,Fe,Su			
													FO,PL,SM Ch			
													FO,PL,Ro Qz,Br			
93		Fresh to slightly weathered, closely foliated and very vuggy, greenish grey, medium strong, INTERMEDIATE VOLCANICS, with some quartz and trace iron staining			63								FO,UN,Ro He			
													JN,PL,Ro Ch,Su			
													JN,CU,Ro Ch,Su			
													FO,CU,SM Ch,Su			
94													FO,CU,SM Ch,Su			
													JN,CU,SM Ch,Su			
													JN,PL,SM Qz,Ch			
													VN,IR,Ro Qz			
				56.38									JN,IR,SM Ch,Su			
95				94.70	64								JN,PL,SM Qz			
													JN,PL,SM Ch,Cl			
													JN,PL,SM Cl,Qz			
96		Fresh to slightly weathered, massive, white with greenish grey, fine grained, medium strong QUARTZITE with intermediate volcanics inter-dispersed.											FO,PL,SM x2 Cl,Ch			
													FO,PL,SM x3 Cl,Ch			
					65								JN,CU,SM Cl			
97				54.29									JN,CU,SM Ch			
				97.10									FO,PL,Ro Ch			
													FO,PL,VR Ch			
					66								VN,IR,Ro Qz			
98													FO,ST,Ro Ch			
													FO,PL,SM x2 Ch			
		Fresh to slightly weathered, closely foliated, greenish grey and white, fine grained, medium strong, INTERMEDIATE VOLCANICS with Quartz veins.											FO,PL,Ro Ch			
													FO,PL,Ro Ch			
													VN,IR,Ro Qz			
													JN,PL,Ro x2 Ch			
99													VN,PL,Ro Ch,Qz			
					67								VN,PL,Ro Qz,Su			
													VN,PL,Ro x2 Qz,Ca			
100				51.68									FO,PL,Ro Ch			
				100.10												
		Fresh, closely foliated, greenish grey, fine grained, medium strong, INTERMEDIATE VOLCANICS.			68								FO,PL,Ro			
													FO,PL,Ro			

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS

CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 12 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	COLOUR % RETURN / FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
101		Fresh, closely foliated, greenish grey, fine grained, medium strong, INTERMEDIATE VOLCANICS. *(continued)*			68								FO,PL,SM x2			
102					69								JN,PL,Ro Sl,Su FO,PL,SM Ch FO,PL,SM			
103					70								FO,PL,SM Ch FO,PL,SM x2 FO,PL,SM FO,PL,SM FO,PL,SM VN,PL,SM Qz FO,PL,Ro Fe FO,PL,SM FO,PL,SM Fe,Su VN,PL,SM Qz			
104				47.76 104.60												
105	Boart-Longyear HQ3				71								FO,PL,SM x2 FO,PL,SM VN,UN,Ro Qz,Su JN,PL,SM JN,IR,Ro Qz JN,UN,Ro Qz JN,PL,Ro Si,Qz			
106													JN,UN,Ro Qz,Ch JN,UN,SM			
107					72								JN,PL,Ro			
108		Fresh, massive to sparsely foliated, white to greenish grey, medium strong, INTERMEDIATE VOLCANICS with quartz (50%)			73								JN,PL,SM Qz JN,PL,Ro Qz JN,PL,Ro JN,PL,Ro Qz JN,CU,Ro JN,PL,Ro JN,PL,Ro			
109													JN,PL,Ro			
110					74								JN,UN,SM JN,PL,SM JN,PL,SM JN,PL,SM JN,PL,Ro JN,PL,Ro			
					75											

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS

CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 13 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
111					75								JN,PL,Ro			
													JN,UN,Ro			
112													FO,PL,Ro			
													JN,UN,Ro			
					76								JN,PL,Ro Su			
113													JN,PL,Ro Qz,Su			
													JN,PL,Ro			
114													JN,IR,Ro			
					77								JN,PL,Ro			
													JN,IR,Ro			
													JN,PL,Ro			
115													JN,PL,Ro			
													JN,PL,Ro			
													FO,PL,Ro			
	Boart-Longyear HQ3	Fresh, massive to sparsely foliated, white to greenish grey, medium strong, INTERMEDIATE VOLCANICS with quartz (50%)*(continued)*			78								JN,IR,Ro x2			
116													FO,PL,Ro			
													JN,PL,Ro Su,Qz			
													JN,IR,Ro Su			
													JN,PL,SM Su			
													JN,PL,SM Su			
117													JN,PL,SM			
													JN,IR,Ro			
					79								JN,PL,SM			
													JN,UN,Ro			
													OR,PL,SM x2			
118													JN,PL,SM			
													JN,PL,SM Ca			
													JN,PL,SM Ca			
													JN,PL,SM Ca			
													JN,UN,SM x3 Ca			
					80								JN,CU,SM Ca			
119													JN,UN,SM Ca			
													JN,PL,SM			
													JN,CU,SM			
													JN,PL,SM Ca			
													JN,CU,Ro			
120													JN,CU,SM Ch			
													OR,PL,SM x2			
					81								JN,PL,SM			
													JN,PL,SM x3			
													JN,UN,Ro Ch,Su			
		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 14 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
121	Boart-Longyear HQ3	Fresh, massive to sparsely foliated, white to greenish grey, medium strong, INTERMEDIATE VOLCANICS with quartz (50%)(*continued*)		33.38	81								JN,IR,SM Ch			
				121.10									FO,PL,SM Su FO,PL,SM Su FO,UN,SM			
122		Fresh, massive to sparsely foliated, white to greenish grey, medium to fine grained, INTERMEDIATE VOLCANICS with quartz (50%)			82								JN,UN,SM JN,PL,SM JN,CU,SM JN,IR,Ro JN,IR,SM JN,PL,Ro			
				32.07												
123		Fresh, massive to sparsely foliated, greenish grey, fine grained medium strong, INTERMEDIATE VOLCANICS with quartz (50%) and occasional cubic pyrite.		122.60	83								JN,PL,SM Ch JN,PL,SM JN,PL,SM x2 Ch JN,PL,SM x2 Ch JN,IR,Ro Su JN,CU,Ro JN,UN,Ro JN,IR,Ro Su			
124													JN,UN,SM x2			
				29.46	84								JN,PL,SM FO,PL,SM FO,PL,Ro			
125													JN,UN,Ro JN,PL,Ro			
				125.60									JN,PL,Ro			
126		Fresh, medium to fine grained, closely foliated to massive, whitish grey, medium strong, INTERMEDIATE VOLCANICS, with reddish brown banding			85								JN,PL,Ro Bt JN,PL,Ro			
127				28.15									JN,PL,Ro			
				127.10												
128					86								JN,PL,SM Bt JN,PL,SM Bt			
129		Fresh, medium to fine grained, closely foliated to massive, whitish grey, medium strong, INTERMEDIATE VOLCANICS, with reddish brown banding, and distinct biotite veinlets.			87								JN,PL,SM JN,PL,Ro JN,UN,Ro JN,PL,Ro Bt			
130					88								JN,CU,Ro JN,ST,Ro			
		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 15 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003
DRILL RIG: LY38
DRILLING CONTRACTOR: Boart-Longyear

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
131	Boart-Longyear HQ3	Fresh, medium to fine grained, closely foliated to massive, whitish grey, medium strong, INTERMEDIATE VOLCANICS, with reddish brown banding, and distinct biotite veinlets. *(continued)*			88			80 60 40 20	80 60 40 20	80 60 40 20	2 4 6 8	0 30 60 90	JN,PL,Ro	R5 R4 R3 R2 R1	W1 W2 W3 W4	
													JN,PL,Ro			
132													JN,PL,SM			
					89								JN,UN,Ro			
													JN,PL,Ro			
133				22.93												
				133.10												
134		Fresh, sparsely foliated to massive, greyish white, fine grained, medium strong to strong, INTERMEDIATE VOLCANICS.			90											
													JN,PL,SM x2			
135													JN,PL,SM			
					91								JN,PL,Ro			
													JN,PL,SM			
136				20.31									JN,PL,Ro			
				136.10									JN,PL,SM			
													JN,PL,Ro			
137		Fresh, closely foliated, greyish white, fine grained, medium strong to strong, INTERMEDIATE VOLCANICS.			92								FO,PL,Ro			
													JN,PL,Ro			
													JN,PL,Ro			
138													JN,PL,Ro x2			
													JN,PL,Ro			
					93								FO,PL,Ro			
													FO,PL,Ro			
139				17.70									FO,PL,SM x2 Bt			
				139.10									FO,PL,SM x2 Bt			
		Fresh, closely foliated, greenish grey, fine grained, medium strong, INTERMEDIATE VOLCANICS, with biotite along foliation.			94								JN,PL,SM Bt,Ch			
140													JN,IR,Ro Ch			
													JN,PL,Ro			
													FO,PL,SM Bt,Ch			
					95								FO,PL,Ro x2 Bt,Ch			
													FO,PL,SM Cl			

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 16 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	COLOUR % RETURN FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
141	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey, fine grained, medium strong, INTERMEDIATE VOLCANICS, with biotite along foliation *(continued)*			95								FO,PL,SM Bt,Ch FO,PL,SM Bt,Ch FO,PL,SM Bt,Ch FO,PL,SM Bt		
142					96								FO,PL,SM Bt FO,PL,SM Bt FO,PL,SM Bt FO,PL,SM x2 Bt		
143				13.78									FO,PL,SM Bt FO,PL,SM Bt FO,UN,Ro x2 Ch,Bt		
144				143.60	97								FO,PL,SM Bt FO,PL,SM Bt FO,PL,SM Bt,Ch VN,PL,Ro Bt,Ch FO,PL,SM Ch,Cl FO,PL,SM Bt,Ch JN,PL,Ro Bt,Ch JN,PL,Ro Bt,Ch		
145					98								FO,PL,SM Bt,Ch FO,PL,SM Bt,Ch FO,CU,SM Bt FO,PL,SM Ch FO,PL,SM Ch JN,PL,VR Ch		
146													FO,PL,SM Bt,Ch JN,IR,Ro Bt		
147		Fresh, closely foliated, greenish grey to greenish white, fine grained, medium strong, INTERMEDIATE VOLCANICS with sections of quartz (glassy).			99								FO,PL,Ro FO,PL,Ro Ch VN,UN,Ro Ch,Qz FO,PL,Ro Qz		
148													FO,PL,Ro Qz JN,PL,Ro		
149					100								JN,PL,Ro		
150					101								JN,PL,Ro		
		CONTINUED NEXT PAGE													

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 17 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
151	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey to greenish white, fine grained, medium strong, INTERMEDIATE VOLCANICS with sections of quartz (glassy). *(continued)*			101									JN,UN,Ro			
152					102									JN,IR,Ro			
153					103									JN,PL,Ro JN,ST,Ro JN,ST,Ro			
154														JN,PL,Ro			
155					104									JN,PL,Ro JN,CU,Ro JN,PL,Ro			
156														JN,CU,SM JN,ST,Ro JN,PL,Ro			
157					105									JN,PL,SM JN,PL,SM JN,PL,Ro			
158					106									JN,PL,Ro Ch,Qz JN,ST,Ro JN,PL,Ro			
159														JN,UN,SM			
160					107									JN,UN,SM Ch JN,PL,SM			
					108									JN,IR,Ro			
		CONTINUED NEXT PAGE															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 18 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
161					108								JN,CU,Ro			
													JN,CU,SM			
162													JN,PL,Ro			
					109								JN,PL,SM			
163													JN,IR,Ro			
													FO,PL,SM			
164					110								JN,PL,SM			
													VN,PL,Ro Qz			
165		Fresh, closely foliated, greenish grey to greenish white, fine grained, medium strong, INTERMEDIATE VOLCANICS with sections of quartz (glassy). *(continued)*			111								FO,UN,Ro FO,CU,SM			
													JN,IR,SM			
166	Boart-Longyear HQ3												VN,IR,Ro Qz			
					112								FO,PL,SM x3 Bt			
167													FO,PL,SM x2			
													FO,PL,SM			
													FO,PL,SM			
													FO,PL,Ro			
168													FO,PL,Ro			
													FO,UN,Ro			
					113								JN,IR,Ro			
													JN,IR,Ro			
169													FO,PL,Ro x2			
													JN,IR,Ro			
													FO,PL,Ro			
170				-9.22 170.00	114								FO,PL,SM			
		Fresh, fine grained, closely foliated, greenish grey, weak to medium strong, INTERMEDIATE VOLCANICS with quartz veins (greasy feel to the rock).											FO,PL,SM			
													FO,PL,SM			
					115											
		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS

CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 19 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
171	Boart-Longyear HQ3			-10.31 / 171.25	115								FO,PL,SM FO,PL,SM x2 JN,UN,SM JN,PL,Ro JN,PL,Ro FO,PL,Ro	R5 R4 R3 R2 R1	W1 W2 W3 W4	
172													JN,ST,Ro Cl FO,IR,Ro			
173					116								JN,PL,SM JN,ST,Ro JN,PL,Ro			
174		Fresh, closely foliated, greenish grey to greyish white, fine to medium grained, medium strong, INTERMEDIATE VOLCANICS with sections of high quartz content.			117								FO,PL,Ro JN,IR,Ro FO,PL,SM FO,UN,SM			
175													FO,PL,SM FO,PL,SM JN,PL,Ro			
176				-14.97 / 176.60	118								FO,PL,SM FO,UN,SM FO,ST,SM FO,PL,Ro			
177					119								JN,UN,SM Qz JN,CU,SM JN,UN,SM x3 JN,IR,SM x2			
178													FO,PL,SM FO,PL,SM FO,PL,SM Cl			
179		Fresh to slightly weathered, fine grained, closely foliated, greenish grey to blackish grey, weak to medium strong, MAFICS, with black biotite banding.			120								FO,UN,Ro FO,PL,SM x2 Cl JN,PL,Ro Cl FO,PL,SM x2 JN,PL,SM x12 FO,PL,SM FO,PL,SM FO,PL,SM x4 JN,PL,SM Qz JN,UN,SM			
180					121								FO,PL,SM FO,PL,SM FO,PL,Ro Cl FO,PL,SM x8 FO,PL,SM JN,UN,Ro x2 JN,UN,Ro			

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 20 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

INCLINATION: -60.6° AZIMUTH: 328°

DRILL RIG: LY38

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
181	Boart-Longyear HQ3	Fresh to slightly weathered, fine grained, closely foliated, greenish grey to blackish grey, weak to medium strong, MAFICS, with black biotite banding *(continued)*			121									FO,PL,SM FO,PL,SM x4	R5 R4 R3 R2 R1	W1 W2 W3 W4	
182				-20.20 182.60	122									FO,PL,SM JN,PL,SM FO,PL,SM FO,PL,SM FO,UN,SM VN,UN,SM Qz FO,UN,SM FO,PL,SM x3			
183					123									JN,PL,SM FO,PL,SM Bl,Cl VN,UN,SM Qz FO,UN,SM			
184																	
185					124									FO,PL,SM FO,PL,SM x2 FO,PL,Ro FO,PL,SM x2			
186		Fresh to slightly weathered, closely foliated, greenish grey to white grey, fine grained MAFICS, with quartz veins.			125									FO,PL,SM FO,PL,SM FO,PL,SM Ch FO,PL,SM			
187																	
188					126									FO,CU,SM FO,CU,SM			
189					127									VN,UN,SM Qz FO,PL,SM FO,PL,SM FO,PL,SM x3			
190				-26.73 190.10										FO,PL,SM x2 FO,PL,SM x2 FO,PL,SM FO,PL,SM x3 FO,PL,SM x2			
		Fresh, closely foliated, greenish grey, fined grained, medium strong, INTERMEDIATE VOLCANICS with quartz veins (joint surfaces smooth and shiny).			128												

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS
CHECKED: CJC

DRILLHOLE 03-1413-427.GPJ GLDR_CAN.GDT 22/8/03

PROJECT No.: 03-1413-427

RECORD OF DRILLHOLE: 03GT-SPEC-F1

SHEET 21 OF 21

LOCATION: Between 2nd /3rd Port Lakes
N: 7215120.294 E: 637626.671

DRILLING DATE: 10-14 June 2003

DATUM: Local

DRILL RIG: LY38

INCLINATION: -60.6° AZIMUTH: 328°

DRILLING CONTRACTOR: Boart-Longyear

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED CH-CHLORITIZED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	COLOUR & % RETURN	FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX	WEATHERING INDEX	NOTES WATER LEVELS INSTRUMENTATION
191	Boart-Longyear HQ3	Fresh, closely foliated, greenish grey, fined grained, medium strong, INTERMEDIATE VOLCANICS with quartz veins (joint surfaces smooth and shiny). *(continued)*			128									JN,PL,Ro Qz FO,PL,Ro Qz FO,PL,SM Ch FO,PL,SM Ch			
192					129									FO,PL,SM FO,PL,SM FO,PL,Ro Qz,Ch FO,UN,SM FO,CU,SM			
193														FO,UN,SM FO,PL,SM			
194				-30.65 194.60	130									JN,PL,Ro FO,PL,SM Ch FO,PL,SM x7			
195					131									FO,PL,SM FO,PL,SM FO,PL,SM FO,PL,SM Bt			
196																	
197		Fresh, closely foliated, greenish grey to dark grey, fine grained, medium strong, ULTRA MAFICS.			132									FO,PL,SM Bt FO,PL,SM x2			
198																	
199					133									FO,PL,SM FO,PL,SM			
200				-35.88 200.60	134									FO,PL,SM FO,PL,SM			
		End of BOREHOLE.															

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CS/TS

CHECKED: CJC

DRILLHOLE 03-1413-427 GPJ GLDR_CAN.GDT 22/8/03

GEOPHYSICAL RECORD OF BOREHOLE TD1

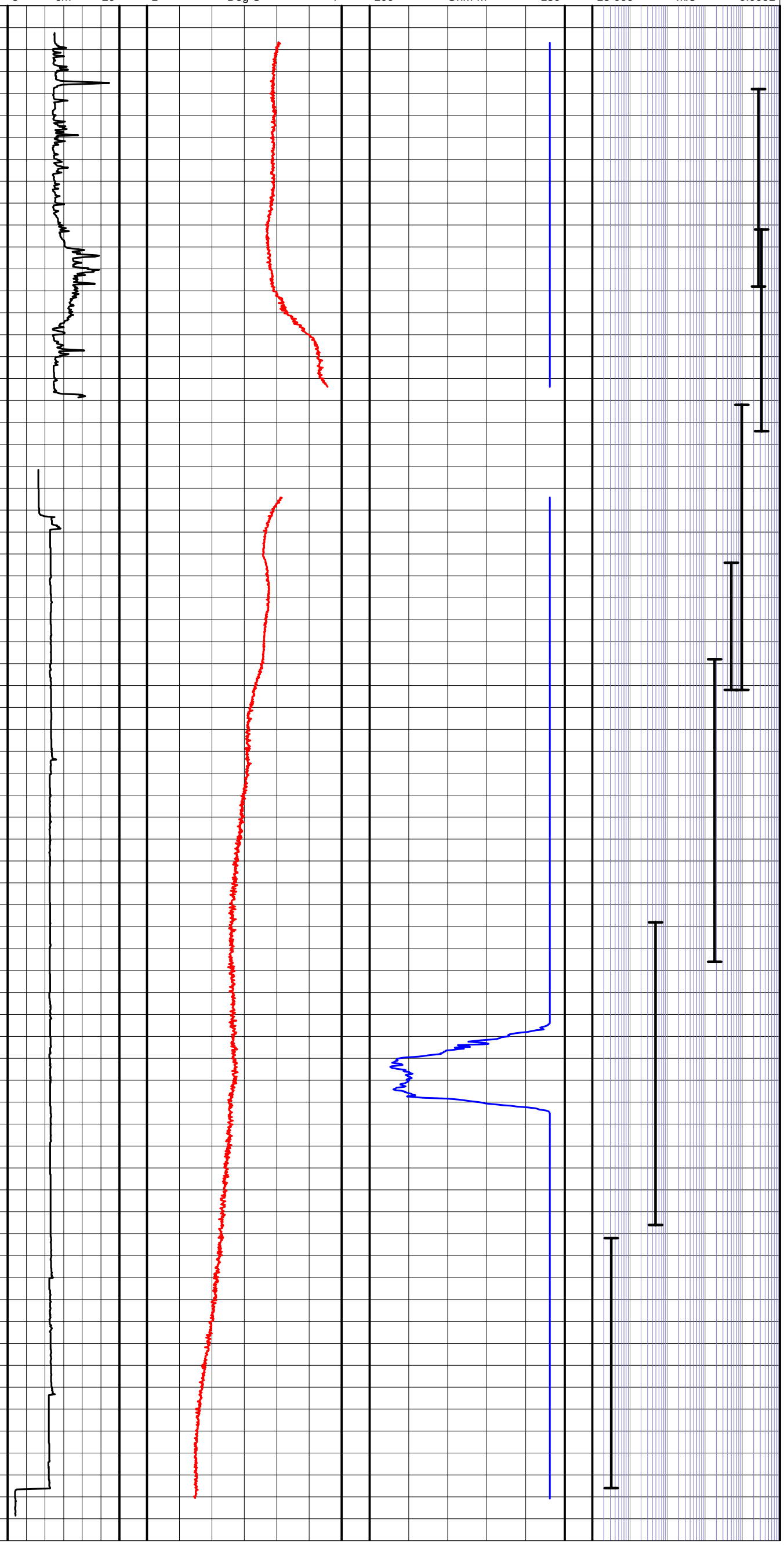
PROJECT REF. *06-1413-034*

LOCATION *Meadowbank*

LOG DATE *May 14th, 2006*

LOG REF. *Top of Drill Chuck*

Depth 1m:500m	OTV - Oriented to High Side	Caliper	Fluid Temperature	Fluid Resistivity	Hydraulic Conductivity
	0° 90° 180° 270° 0°	5 cm 20	1 Deg C 4	100 Ohm-m 150	1e-009 m/s 0.0001



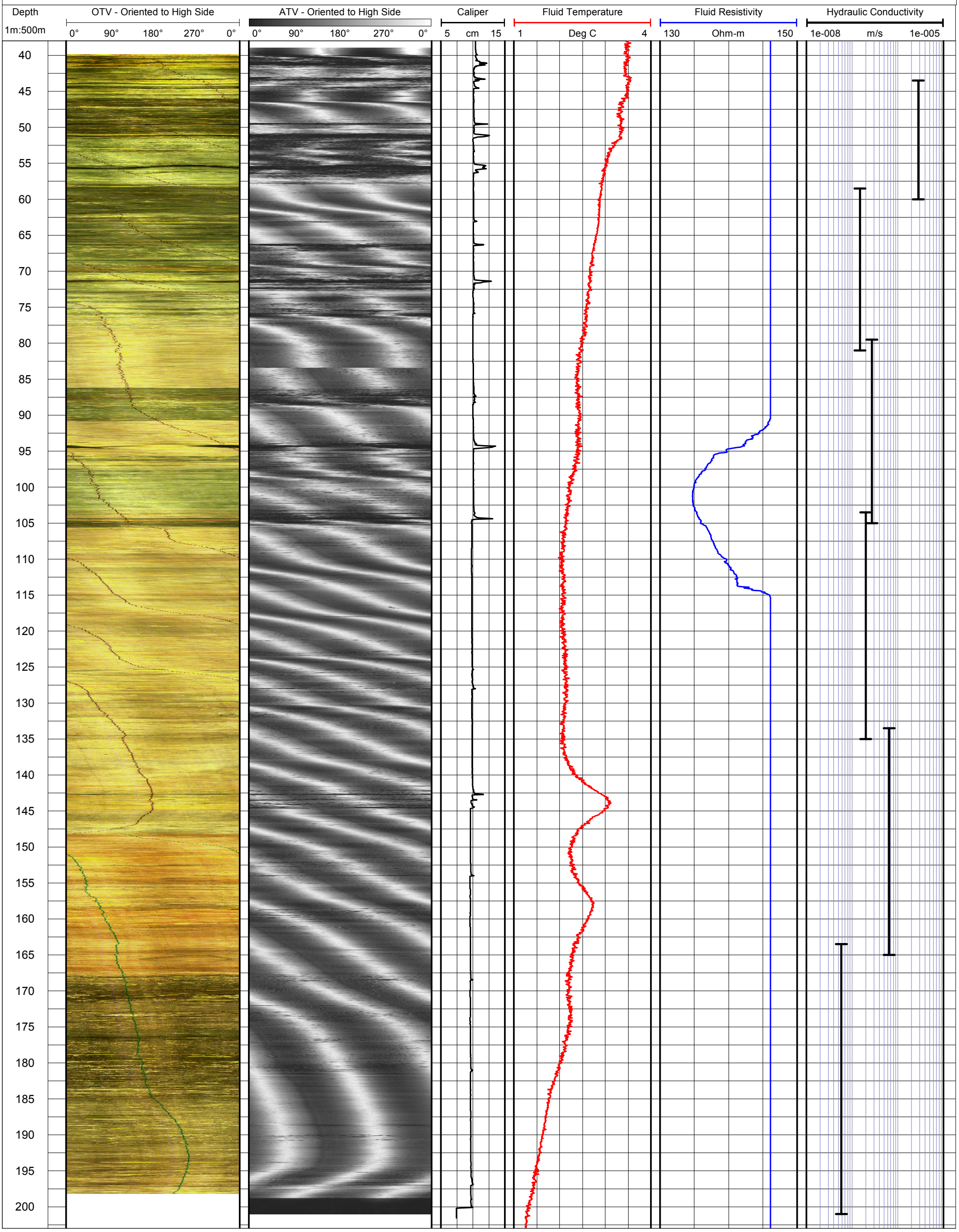
GEOPHYSICAL RECORD OF BOREHOLE TD2A

PROJECT REF. *06-1413-034*

LOCATION *Meadowbank*

LOG DATE *May 22nd, 2006*

LOG REF. *Top of Drill Chuck*



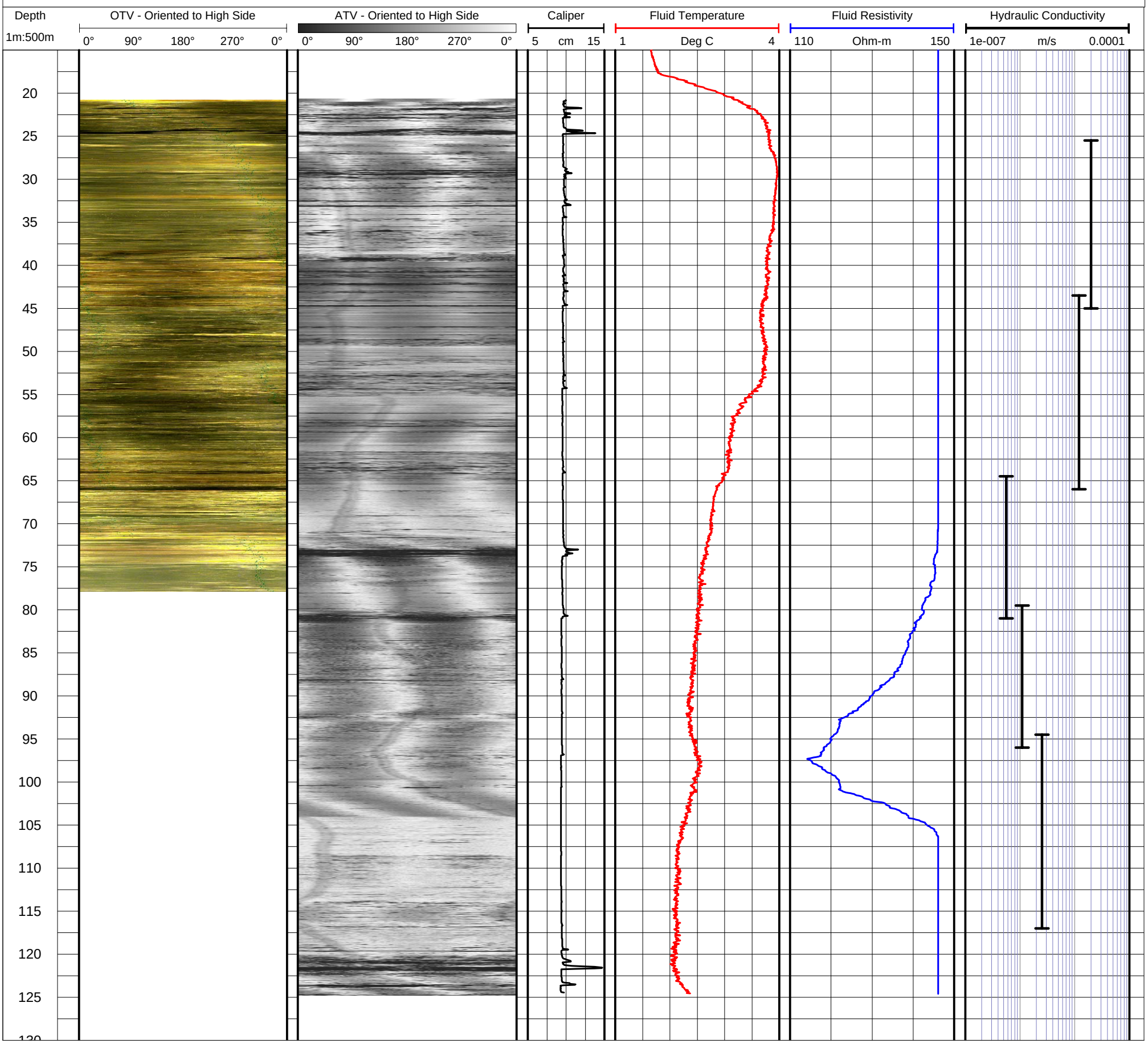
GEOPHYSICAL RECORD OF BOREHOLE TD3

PROJECT REF. *06-1413-034*

LOCATION *Meadowbank*

LOG DATE *May 26th, 2006*

LOG REF. *Top of Drill Chuck*



APPENDIX III

2008 BATHYMETRIC SURVEY

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Agnico-Eagle Mines Limited (AEM) to conduct bathymetric surveys at the Meadowbank Gold Project in Nunavut. This Appendix summarizes the methods and results of bathymetric investigations in Second Portage Lake near the Tailings Storage Facility (TSF) area.

1.1 Scope of Work

The Meadowbank Gold Project is located in an area of extensive lakes, including deposits that are adjacent to or even beneath the lake surface. The results presented below encompass surveys undertaken to determine the lake bottom topography.

In consultation with AEM, the requested scope of work was as follows:

- General bathymetry of Second Portage Lake to be used for design of the Divider Dike (formerly the Stormwater Dike) and Central Dike;

- General bathymetry before construction of the East Dike on Second Portage Lake; and

The following techniques were used for completing this scope of work:

- Survey planning at required line spacing using Hypack software;
- Navigation using real-time differential GPS (DGPS) for general bathymetry;
- Vertical elevations relative to the geodetic elevation provided by AEM;
- Survey quality, 200-235 kHz single-beam echosounding;
- Computer based recording and processing of all data using Hypack; and
- Production of bathymetric contours using Surfer and AutoCAD software.

2.0 FIELD OPERATIONS

The field surveys were completed during three periods: July 14 to 28, 2008; August 12 to September 1, 2008; and September 23 to October 7, 2008.

The surveys were carried out in a variety of boats including; 2 inflatable Zodiac boats provided by Golder, aluminum launches provided by Azimuth, and a large aluminum minesite boat. For the majority of the lake surveys, the large aluminum boat powered by a 25 horsepower outboard motor was used for safety reasons. However, the survey of the

East Dike and West Channel Dike construction used the 10ft zodiac boat with a small 2 horsepower electric motor for greater maneuverability within the dike trench.

2.1 Survey Coverage

The boundaries of the areas to be surveyed were determined prior to mobilization in consultation with AEM. The general bathymetric work was undertaken at line spacings between 5 m and 25 m, depending on the particular survey requirements and location. For the areas of proposed dike construction, line spacings of 5 m or 10 m were used.

2.2 Vertical and Horizontal Datum

During the bathymetric surveys, the water surface elevation of each lake was determined by AEM surveyors. This elevation was then used to reference all of the bathymetric data. AEM surveyors reported that the survey datum for the mine site control points is geodetic, and therefore relative to mean sea level.

Horizontal positions for all the general bathymetry figures are UTM Zone 14 cartesian map coordinates. These are determined directly from the WGS84 positions produced by the GPS receivers and navigation software.

2.3 Navigation

Hypack Max software produced by Coastal Oceanographics was used for navigation. During the surveys, the vessel position was continuously plotted on a laptop screen showing the planned and actual survey lines. The vessel position and single-beam bathymetric data were acquired digitally and stored on the navigation computer.

The GPS antenna used for navigation was installed directly above the bathymetry transducer to minimize offset errors. The relatively low horizon allowed the GPS antenna to obtain very good satellite coverage throughout the surveys.

Post-processing of the data included removal of outliers and erroneous GPS positions due to temporary loss of satellites and random errors. The bathymetry data collected on each line are considered to be of very good quality. The average speed of the survey vessel varied between survey locations, but the speed was appropriate for producing the best compromise between bottom detection and survey coverage.

2.4 Bathymetry Survey Navigation

The bathymetry surveys for dike locations were positioned using Differential GPS (DGPS) receivers. Real-time corrections were obtained using the WAAS differential correction system. These corrections were received by the Trimble DGPS receiver, providing continuous sub-meter accurate positioning. The receiver outputs a variety of NMEA strings, including WGS84 latitude and longitude positions at a rate of 5 per second.

2.5 Singlebeam Echosounder

The bathymetry was obtained using an Ohmex Sonarmite echosounder with a 235 kHz transducer. This provides high-resolution bottom detection at a rate of 2 Hz. The depth accuracy of the echosounder is on the order of 1% of the recorded depth. In the field, the echosounder was operated using the default 1500 m/s to record and display the nominal depth. Bar check calibrations were performed at each survey location by dropping a weight and tape to the lakebed and comparing the measured value to the recorded value.

3.0 RESULTS AND INTERPRETATION

3.1 Positioning

The Differential and RTK DGPS positioning equipment provided high quality location fixes continuously throughout the surveys. Occasional loss of the base station correction signal occurred during the survey due to rough water conditions or blocking of the radio signal behind nearby topographical highs and machinery. During these periods, the system was set to use the existing correction for up to four minutes, or until the base station corrections were available again.

The quality of the horizontal positioning was consistently within the required survey parameters (< 1 m accuracy). During surveying, the differentially corrected GPS positions had a Horizontal Dilution of Precision (HDOP) of approximately 0.8 m and the RTK positioning an HDOP of less than 10 cm. Occasionally the HDOP of both GPS systems increased to 2 m or more, usually due to temporary loss of satellites, or by excessive wave action affecting GPS lock. During processing or the data, any point with an HDOP greater than 2 m was removed.

Vertical control was referenced to elevations of the lake surface. The elevations of the lake surfaces provided to Golder by onsite AEM surveyors are as follows:

TABLE III-1: Lake Surface Elevations for Second Portage Lake

Date	Lake Surface Elevation (m)
July 17, 2008	133.06
August 12, 2008	133.00
August 16, 2008	133.06
August 17, 2008	133.06
August 18, 2008	133.05
August 22, 2008	133.06
August 28, 2008	133.12
September 25, 2008	133.33
October 6, 2008	133.43

3.2 Bathymetric Results

The bathymetric surveys provided the anticipated coverage according to plans. The resulting bathymetric data are presented as a series of contour maps in Figures III-1 to III-6, also showing the surrounding land topography. The water depths are contoured to 0.5 m intervals and sun shaded to enhance visualization. Each bathymetric map is accompanied by a survey trackline map to show where the data is dense and where the data is sparse, and should be considered in the appropriate use of the bathymetric contours.

The bathymetric maps have been combined with historic data to produce a single bathymetric surface for Second Portage Lake in the area of the TSF. The combined surface is shown in the drawings in Appendix VIII. Discussion of each survey site follows.

3.2.1 Second Portage Lake - East Dike

The preliminary design bathymetry for the East Dike was conducted in July, 2008. The bottom elevation data and trackline information is provided in Figures III-1 and III-2. As mentioned on the figure, this data is of high quality and therefore usable for design purposes. Surveys for this area were undertaken over four consecutive days, and included detailed bathymetry at 1 m line spacings along the original dike alignment.

3.2.2 Second Portage Lake - Central Dike

The preliminary design bathymetry for the Central Dike was conducted in September, 2008. The bottom elevation data and trackline information are provided in Figures III-3 and III-4. Survey for this area was undertaken over four consecutive days and included detailed bathymetry at 5 m line spacing along the proposed dike alignment.

3.2.3 Second Portage Lake – Divider Dike

The preliminary design bathymetry for the Divider Dike (formerly the Stormwater Dike) was conducted in October, 2008. The bottom elevation data and trackline information is provided in Figures III-5 and III-6. The survey for this dike was undertaken in a single day and provides bathymetry data at 10 m – 25 m line spacing along the proposed dike alignment.

4.0 DISCUSSION AND SUMMARY OF INTERPRETED RESULTS

The bathymetric surveys were completed as planned, providing contour maps of the underwater topography. Echosounder depths, at measurement points, are considered to be well within the required tolerance for the recorded depth values.

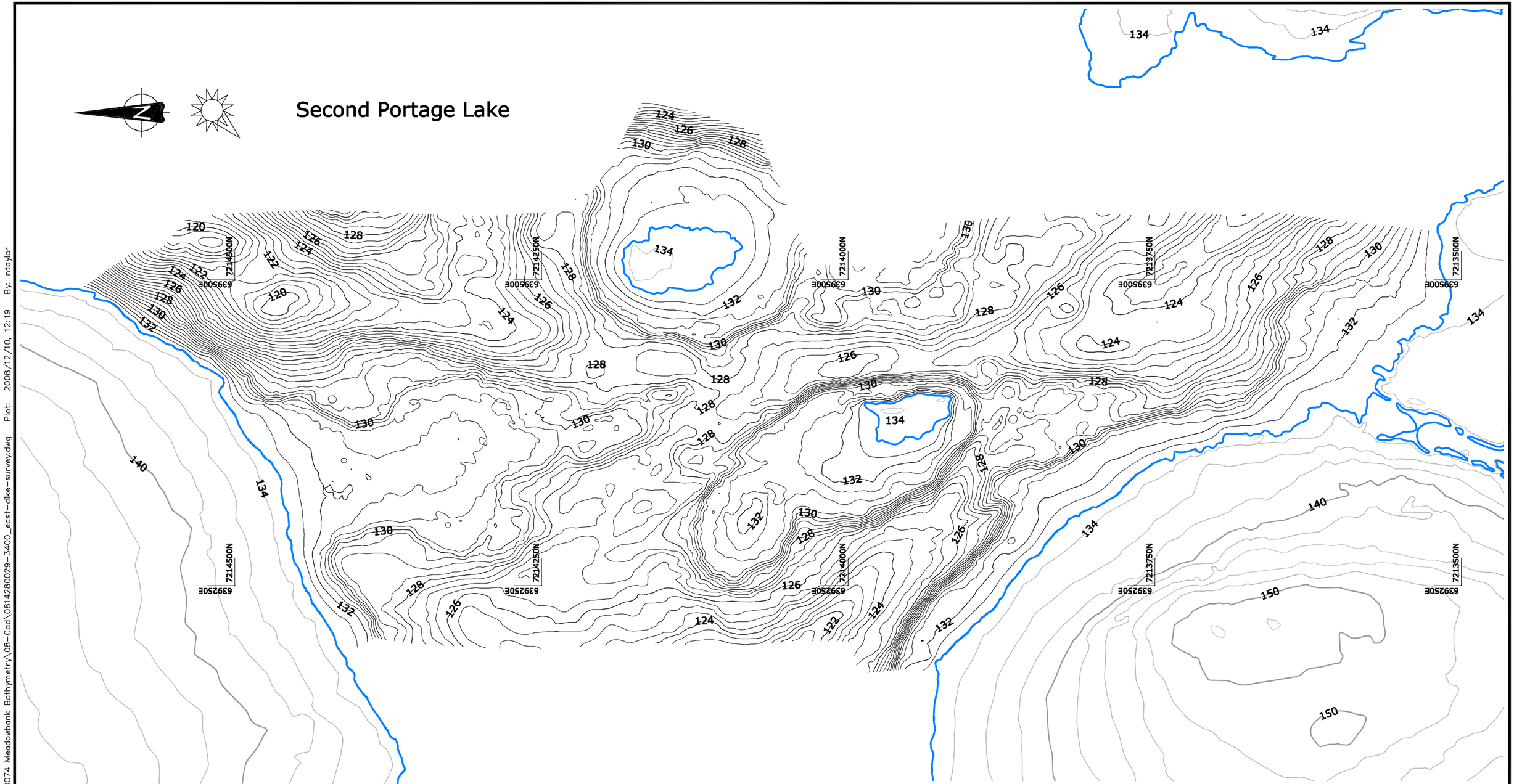
Positioning using the DGPS positioning system (recorded in WGS-84) is considered to be accurate to better than 1 m.

The accuracy of the resulting bathymetric maps is also dependent on the gridding process itself. Gridding involves interpolation, and this is most inaccurate where the data are sparse. Therefore, when using the bathymetric charts to determine depths, it is good practice to review the accompanying Trackline maps to identify where data exists and at what density.

5.0 CLOSURE

This report has been prepared based on the information obtained for the purposes outlined above. Should planned construction activities be modified or additional details become available, Golder Associates should be requested to review this report in light of this information, and provide revised and/or additional recommendations as appropriate.

O:\FINAL\2008\1428\08-1428-0029\DOC 784 RPT VER 0 FINAL\1212_08 APPENDIX III TEXT VER 0.DOC



PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

EAST DIKE AREA
CONTOURS

Golder Associates

PROJECT No.	08-1428-0029		FILE No.	...3400_east-dike-survey	
DESIGN			SCALE	1:3000	REV. –
CADD	NFT	20080723	Figure III-1		
CHECK					
REVIEW					

Drawing: O:\Active_2008\1419\07-1413-0074 Meadowbank Bathymetry\08-Cad\0814280029-3400_east-dike-survey.dwg Plot: 2008/12/10, 12:19 By: ntaylor

Second Portage Lake

639500E 7214000N

639250E 7214500N

639250E 7213750N

639250E 7213500N

Legend:

- Lake Bottom Contour, Major
- Lake Bottom Contour, Minor
- Lake Shore, Elev. 133.1m
- Land Topo Contour, Major
- Land Topo Contour, Minor
- Survey Trackline

Notes:

1. Horizontal datum: WGS-84, UTM Zone 14N
2. Elevations: Geodetic from AEM
3. Survey data acquired 2008-07 with 200 kHz sonar transducer and differential GPS
4. Bottom elevation information in this drawing is suitable for design purposes
5. Contours in areas not surveyed are interpolated from the survey and topographic data

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

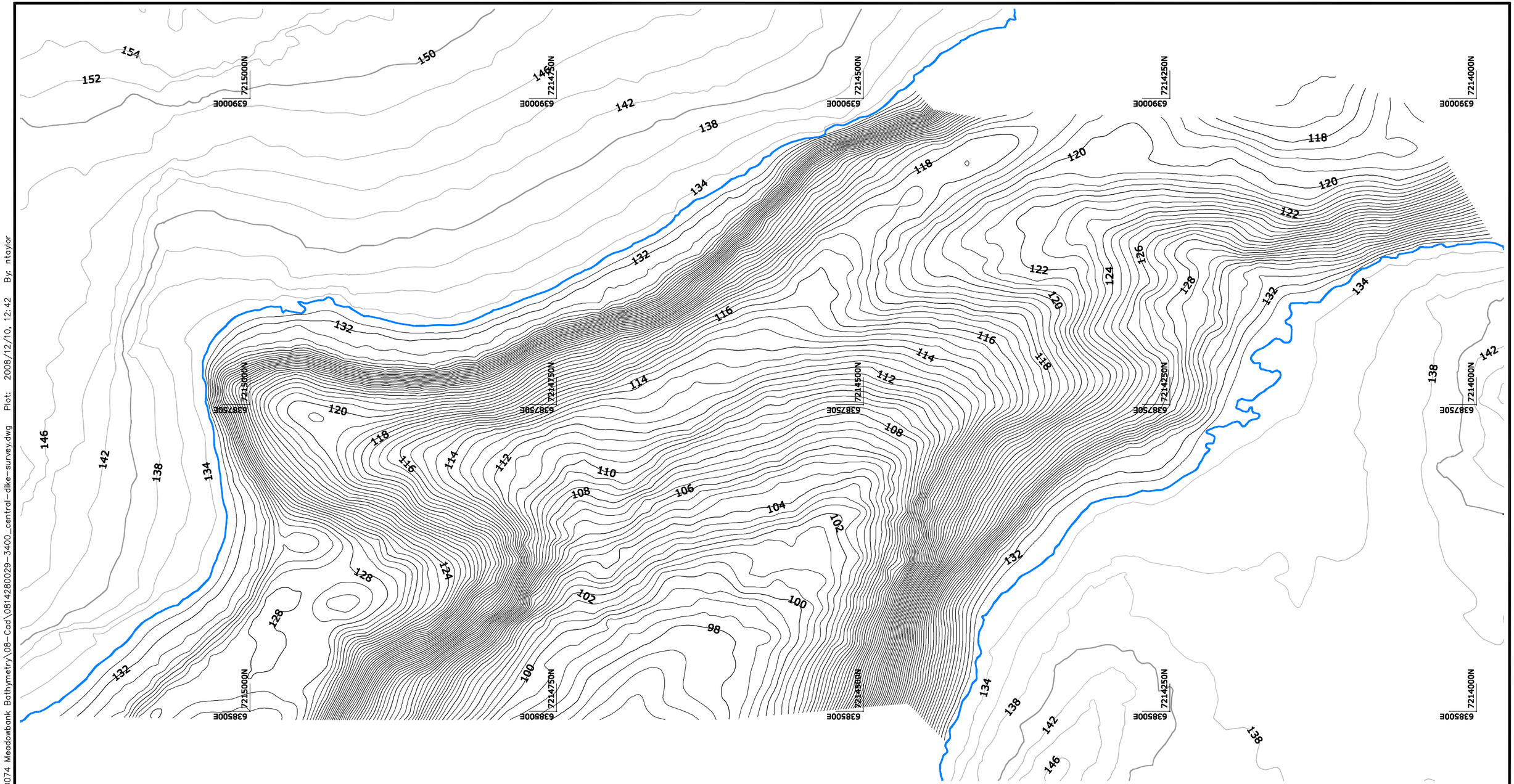
TITLE

EAST DIKE AREA
TRACK LINES

Golder Associates

PROJECT No.	08-1428-0029		FILE No.	...3400_east-dike-survey	
DESIGN			SCALE	1:3000	REV. –
CADD	NFT	20080723	Figure III-2		
CHECK					
REVIEW					

Drawing: O:\Active_2008\1419\07-1413-0074 Meadowbank Bathymetry\08-Cad\0814280029-3400_east-dike-survey.dwg Plot: 2008/12/10, 12:19 By: ntaylor



Second Portage Lake

Legend:

- Lake Bottom Contour, Major
- Lake Bottom Contour, Minor
- Lake Shore, Elev. 133.1m
- Land Topo Contour, Major
- Land Topo Contour, Minor

Notes:

1. Horizontal datum: WGS-84, UTM Zone 14N
2. Elevations: Geodetic from AEM
3. Survey data acquired 2008-09 with 200 kHz sonar transducer and differential GPS
4. Bottom elevation information in this drawing is suitable for design purposes

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

CENTRAL DIKE AREA CONTOURS

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ...3400_central-dike-survey	
DESIGN			SCALE 1:3000	REV. -
CADD	NFT	20081003	Figure III-3	
CHECK				
REVIEW				

Drawing: O:\Active_2008\1419\07-1413-0074 Meadowbank Bathymetry\08-Cad\0814280029-3400_central-dike-survey.dwg Plot: 2008/12/10, 12:42 By: ntaylor

Drawing: O:\Active_2008\1419\07-1413-0074 Meadowbank Bathymetry\08-Cad\0814280029-3400_central-dike-survey.dwg Plot: 2008/12/10, 12:42 By: ntaylor

Second Portage Lake

Legend:

- Lake Bottom Contour, Major
- Lake Bottom Contour, Minor
- Lake Shore, Elev. 133.1m
- Land Topo Contour, Major
- Land Topo Contour, Minor
- Survey Trackline

Notes:

1. Horizontal datum: WGS-84, UTM Zone 14N
2. Elevations: Geodetic from AEM
3. Survey data acquired 2008-09 with 200 kHz sonar transducer and differential GPS
4. Bottom elevation information in this drawing is suitable for design purposes
5. Contours in areas not surveyed are interpolated from the survey and topographic data

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

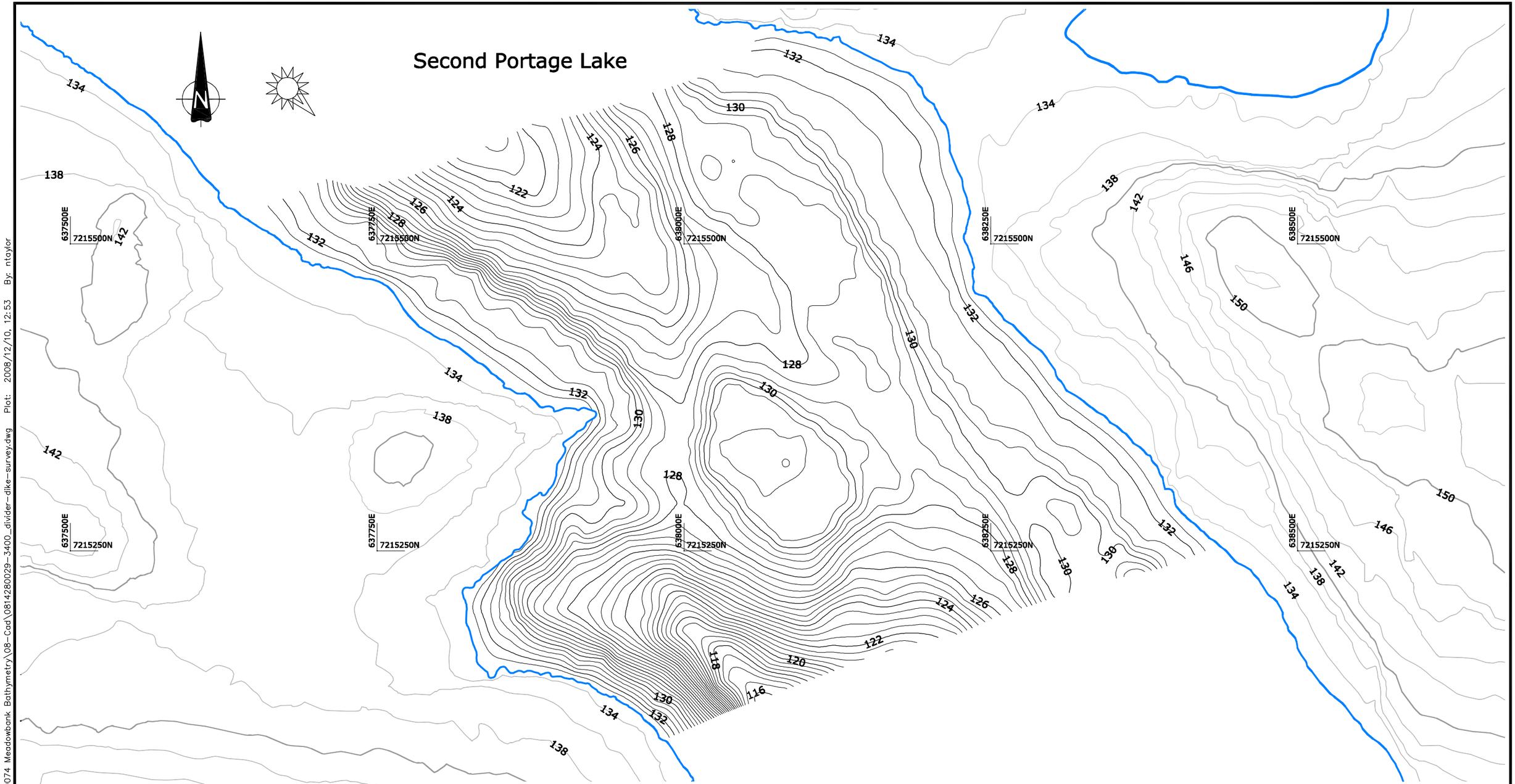
CENTRAL DIKE AREA TRACK LINES

Golder Associates

PROJECT No.	08-1428-0029		FILE No.	...3400_central-dike-survey	
DESIGN			SCALE	1:3000	REV. –
CADD	NFT	20081003	Figure III-4		
CHECK					
REVIEW					

Drawing: O:\Active_2008\1419\07-1413-0074 Meadowbank Bathymetry\08-Cad\0814280029-3400_divider-dike-survey.dwg Plot: 2008/12/10, 12:53 By: ntaylor

Second Portage Lake



Legend:

- Lake Bottom Contour, Major
- Lake Bottom Contour, Minor
- Lake Shore, Elev. 133.1m
- Land Topo Contour, Major
- Land Topo Contour, Minor

Notes:

1. Horizontal datum: WGS-84, UTM Zone 14N
2. Elevations: Geodetic from AEM
3. Survey data acquired 2008-09 with 200 kHz sonar transducer and differential GPS
4. Bottom elevation information in this drawing is suitable for design purposes

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

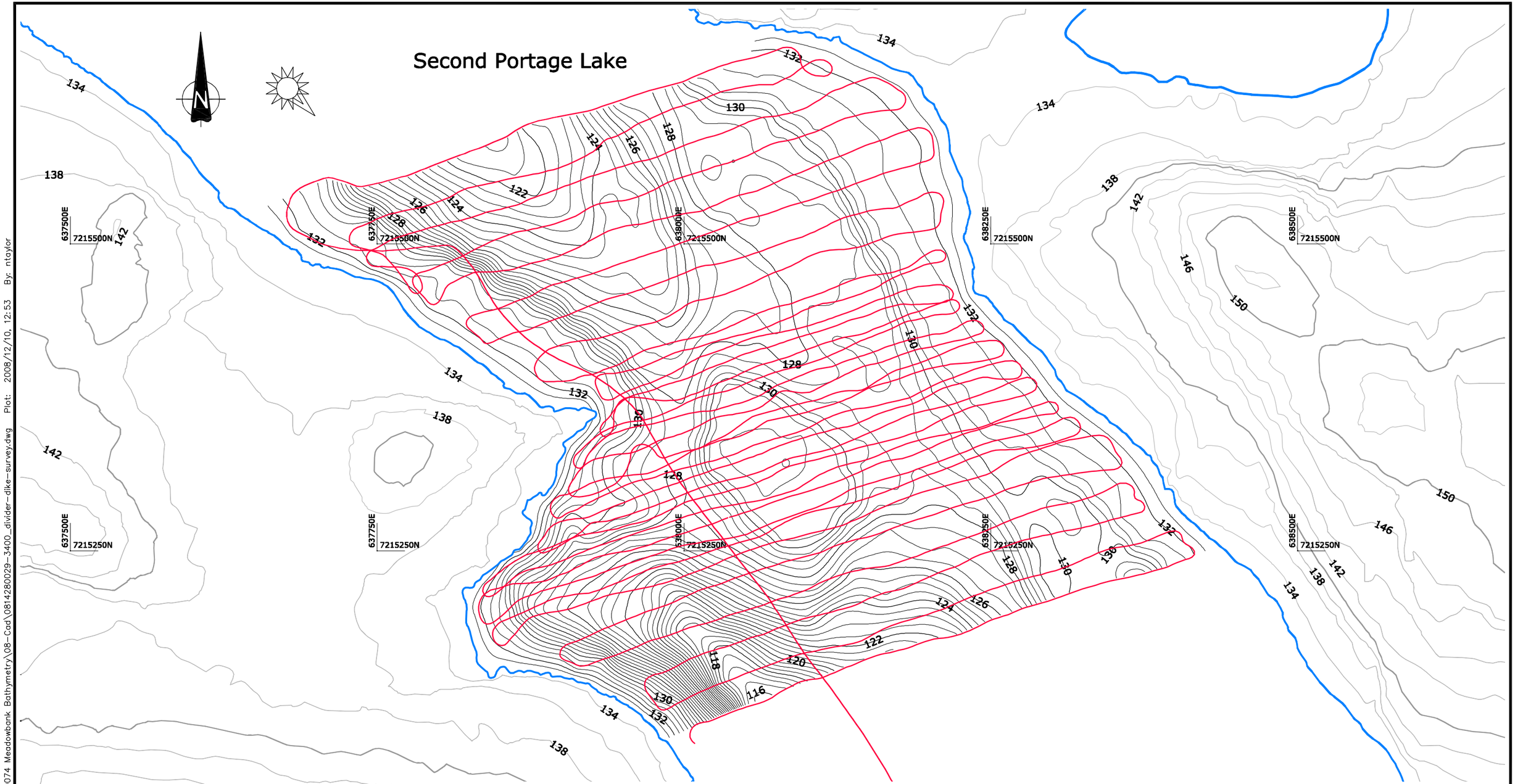
TITLE

DIVIDER DIKE AREA
CONTOURS

Golder Associates

PROJECT No.	08-1428-0029		FILE No.	...3400_divider-dike-survey	
DESIGN			SCALE	1:3000	REV. –
CADD	NFT	20081017	Figure III-5		
CHECK					
REVIEW					

Second Portage Lake



Legend:

- Lake Bottom Contour, Major
- Lake Bottom Contour, Minor
- Lake Shore, Elev. 133.1m
- Land Topo Contour, Major
- Land Topo Contour, Minor
- Survey Trackline

Notes:

1. Horizontal datum: WGS-84, UTM Zone 14N
2. Elevations: Geodetic from AEM
3. Survey data acquired 2008-09 with 200 kHz sonar transducer and differential GPS
4. Bottom elevation information in this drawing is suitable for design purposes
5. Contours in areas not surveyed are interpolated from the survey and topographic data

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

DIVIDER DIKE AREA
TRACK LINES

Golder Associates

PROJECT No.	08-1428-0029		FILE No.	...3400_divider-dike-survey	
DESIGN			SCALE	1:3000	REV. –
CADD	NFT	20081017	Figure III-6		
CHECK					
REVIEW					

Drawing: O:\Active_2008\1419\07-1413-0074 Meadowbank Bathymetry\08-Cad\0814280029-3400_divider-dike-survey.dwg Plot: 2008/12/10, 12:53 By: ntaylor

APPENDIX IV

SEISMIC HAZARD VALUES

Natural Resources Canada | Ressources naturelles Canada

Canada

Interpolate 2005 National Building Code of Canada seismic hazard values for your site

Enter your location details. Latitude and longitude values should be entered in decimal degree (DD.DDDD) or degree:minute:second (DD:MM:SS.S) format. If you have UTM coordinates, convert them to latitude and longitude using the Geodetic Survey Division's online GSRUG application.

For more information see seismic hazard in Canada

Latitude	Longitude
65:1:11.90	-96:4:7.1 longitudes in Canada should be entered as negative values
Number of closest points for interpolation	Parameter to display on map (values for all 5 parameters will be determined)
7 points	Sa (0.2)
Enter location place name	Type of structure
Meadowbank Gold Project	Dike
Company/Organization	Requestor's name and email
Golder Associates Ltd.	Ben Wickland name email (optional)
Calculate	

2005 National Building Code of Canada
interpolated seismic hazard values
Determined for a 2% in 50 year (0.000404 per annum) probability of exceedence. Values are for “firm ground” (NBCC 2005 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g for spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA). Only 2 significant figures are to be used. *These values have been interpolated Using Shepards method from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.*

Site Coordinates: **65.0199** °N **96.0686** °W
User File Reference: **Meadowbank Gold Project**
Requested by: **Ben Wickland, Golder Associates Ltd.**

National Building Code interpolated seismic hazard values
2%/50 years (0.000404 per annum) probability

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA	
0.116	**0.056**	**0.024**	**0.006**	**0.059**	g

Interpolated seismic hazard values at other probabilities
40%/50 years (0.01 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA	
0.015	0.008	0.003	0.001	0.007	g

10%/50 years (0.0021 per annum)

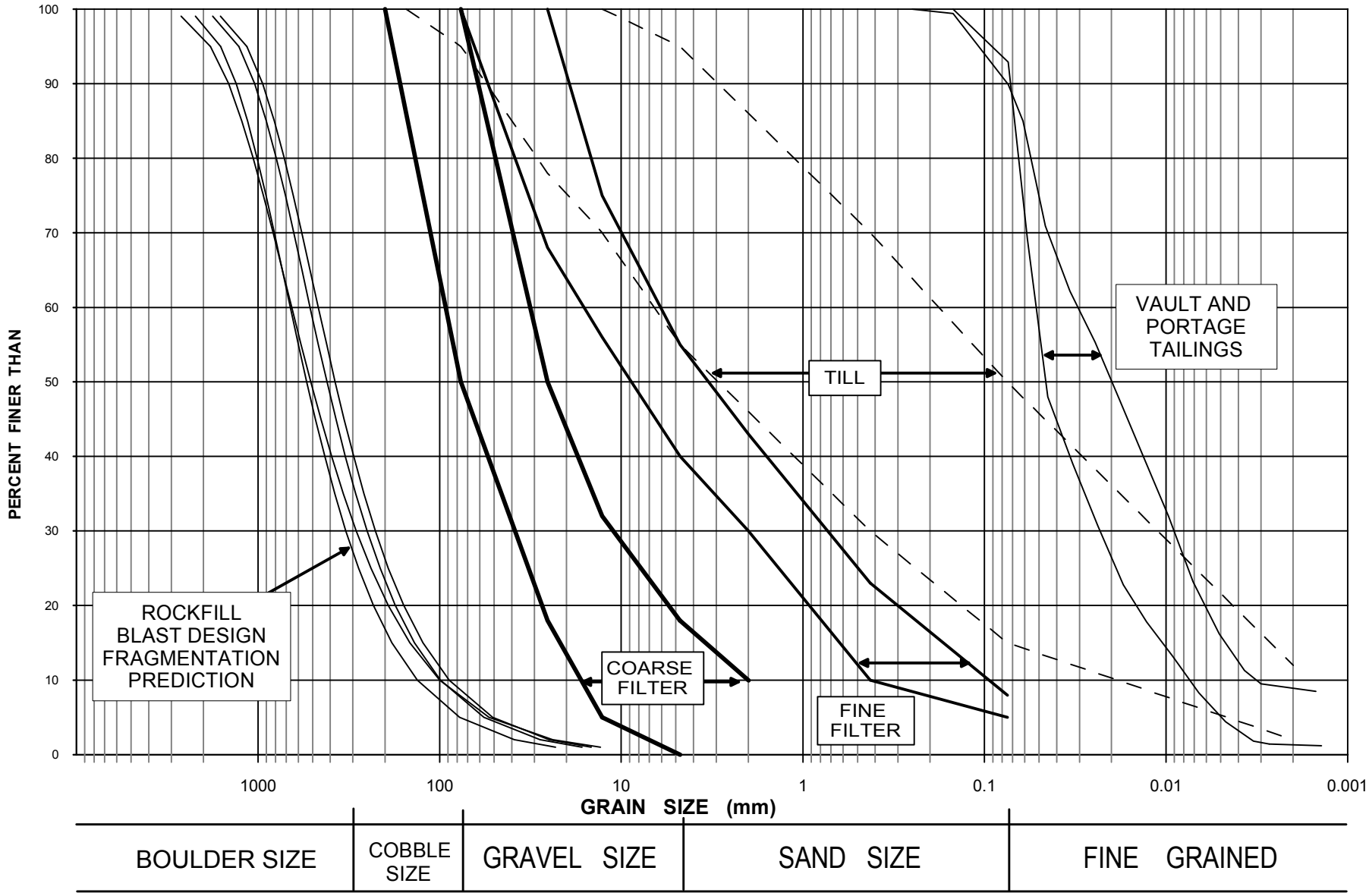
Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA	
0.044	0.024	0.010	0.003	0.021	g

5%/50 years (0.001 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA	
0.069	0.036	0.014	0.004	0.035	g

APPENDIX V

ANALYSIS RESULTS

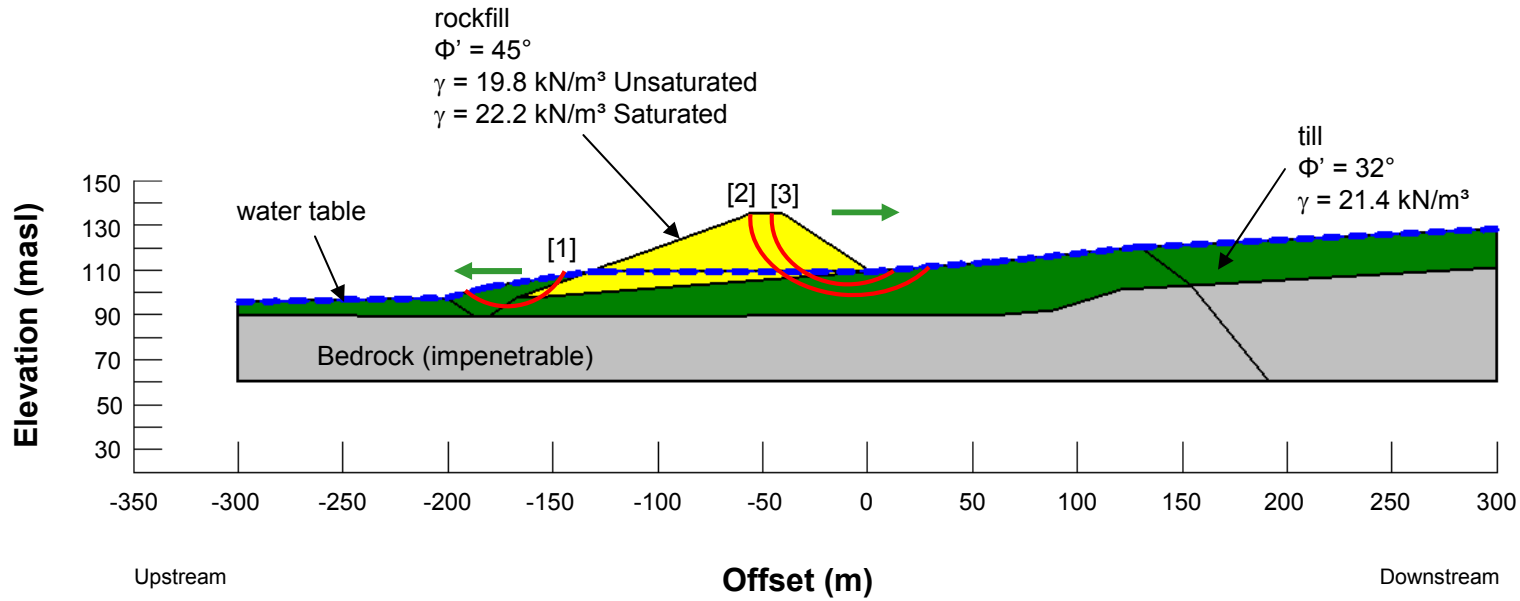


Project No. 08-1428-0029 **Drawn** BW **Reviewed** **Date** 09DEC08	Golder Associates	**TSF FILTER DESIGN GRADATIONS** **MEADOWBANK GOLD PROJECT, NUNAVUT**

Figure V-1

FoS for Drained Conditions
static (pseudostatic)

	Upstream Failure Mode	Downstream Failure Mode	
	Liner [1]	Liner [2]	Rockfill [3]
no pond	2.7 (2.3)	2.2 (2.0)	2.0 (1.8)
water ponded in rockfill	2.1 (1.8)	2.1 (1.9)	1.9 (1.7)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill Crest Elevation = 135 masl

Ponded water in rockfill Elevation = 109.5 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN CENTRAL DIKE
STABILITY ANALYSIS
STAGE 1 CONSTRUCTION

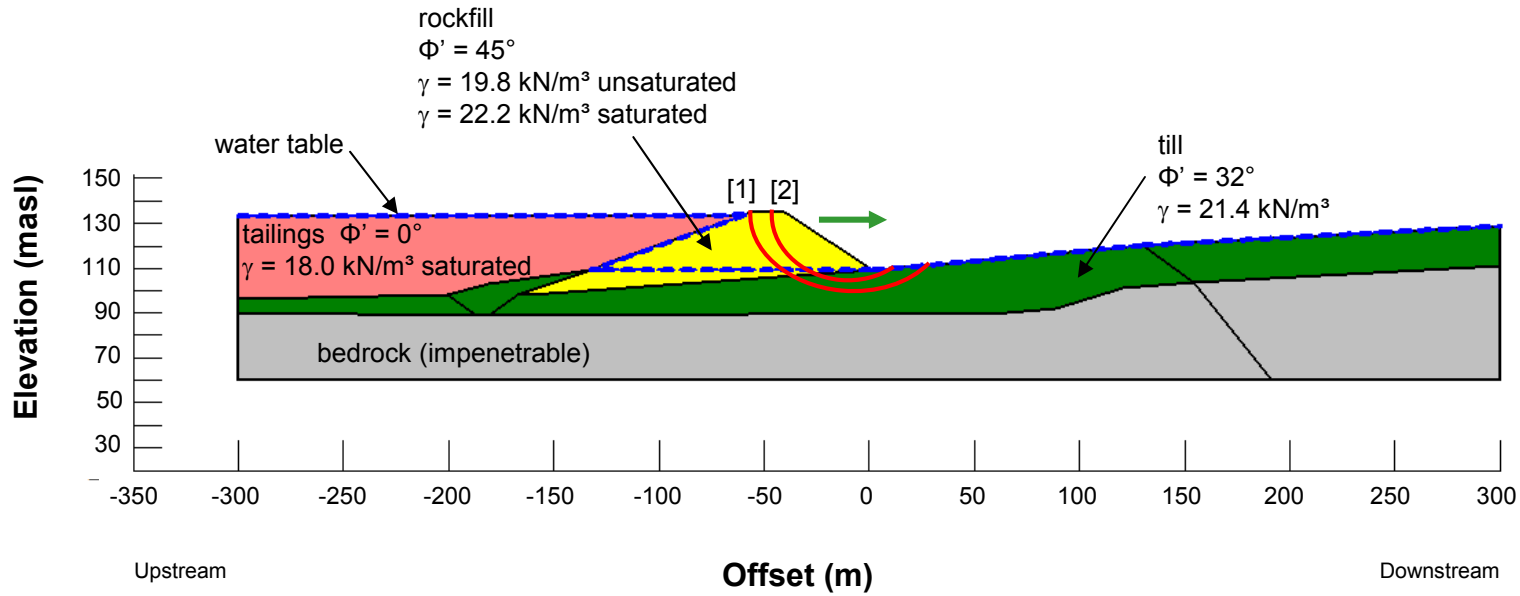
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-2

FoS for Drained Conditions
static (pseudostatic)

	Upstream Failure Mode	Downstream Failure Mode	
		Liner [1]	Rockfill [2]
no pond	>5	2.2 (2.0)	2.0 (1.8)
water ponded in rockfill	>5	2.1 (1.9)	1.9 (1.7)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 135 masl

Tailings Elevation = 133 masl

Ponded water in rockfill Elevation = 109.5 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN CENTRAL DIKE
STABILITY ANALYSIS
STAGE 1 OPERATION

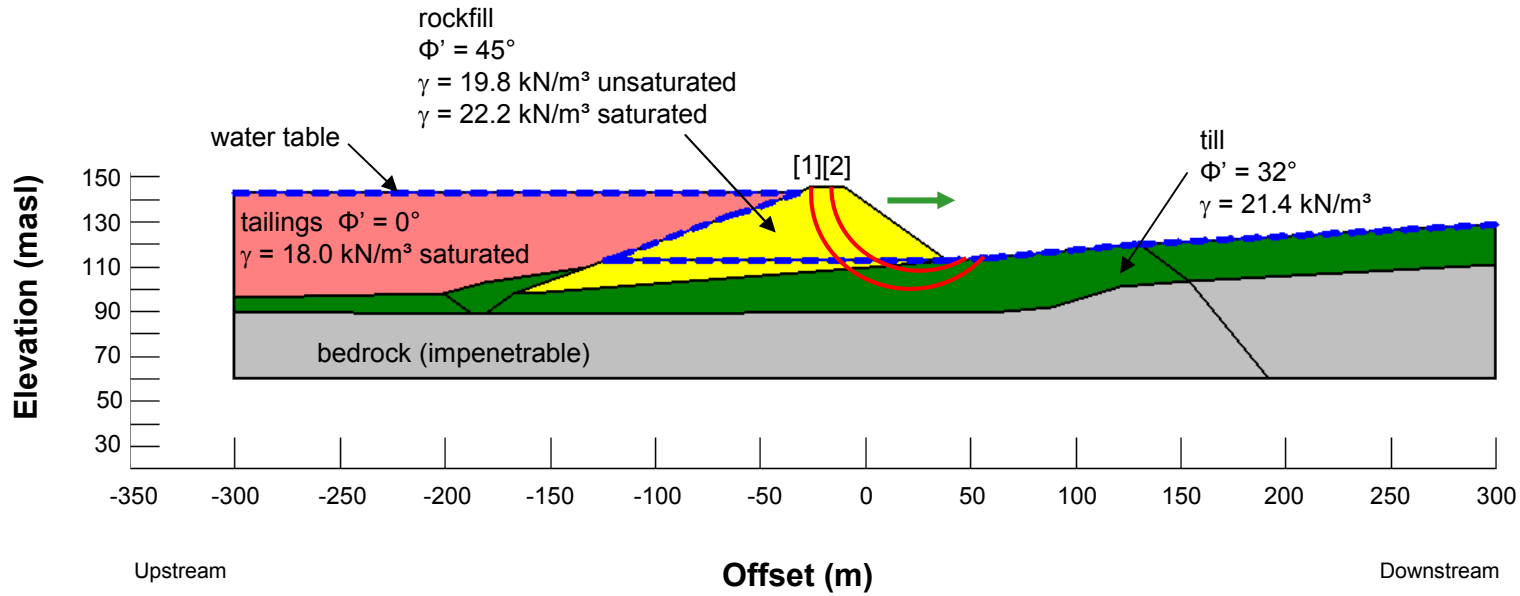
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-3

FoS for Drained Conditions
static (pseudostatic)

	Upstream Failure Mode	Downstream Failure Mode	
		Liner [1]	Rockfill [2]
no pond	>5	2.0 (1.9)	2.0 (1.8)
water ponded in rockfill	>5	2.0 (1.8)	1.9 (1.7)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 145 masl

Tailings Elevation = 143 masl

Ponded water in rockfill Elevation = 112.5 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN CENTRAL DIKE
STABILITY ANALYSIS
STAGE 2 OPERATION

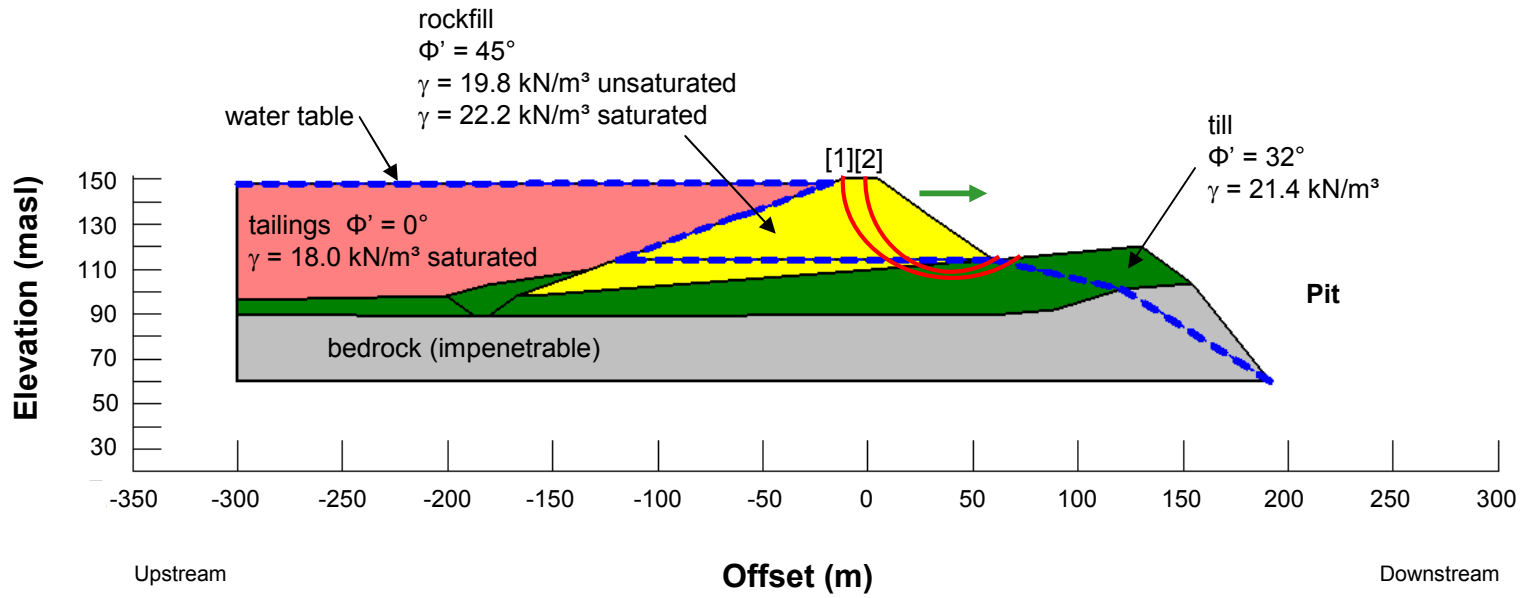
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-4

FoS for Drained Conditions
static (pseudostatic)

	Upstream Failure Mode	Downstream Failure Mode	
		Liner [1]	Rockfill [2]
no pond	>5	2.0 (1.9)	1.9 (1.8)
water ponded in rockfill	>5	2.0 (1.8)	1.8 (1.7)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 150 masl

Tailings Elevation = 148 masl

Ponded water in rockfill Elevation = 114 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

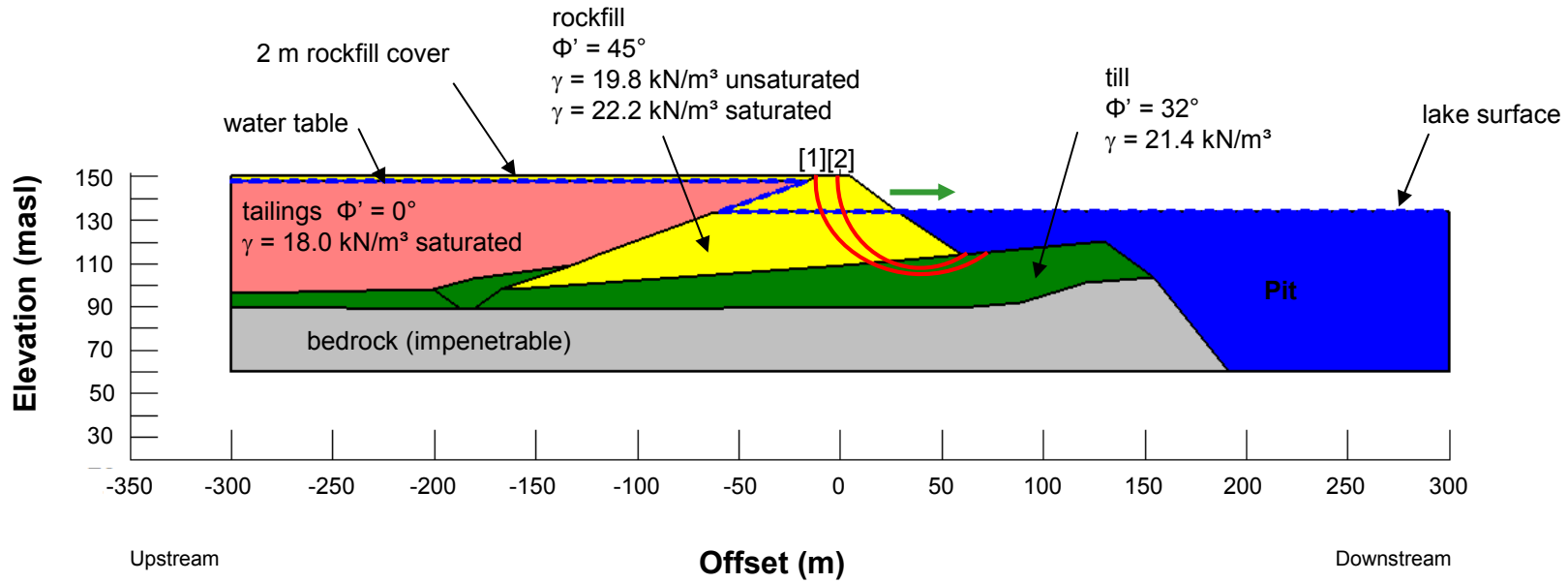
TSF DESIGN CENTRAL DIKE
STABILITY ANALYSIS
STAGE 3 OPERATION

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08	FIGURE V-5		
CHECK					
REVIEW					

FoS for Drained Conditions
static (pseudostatic)

Upstream Failure Mode	Downstream Failure Mode	
	Liner [1]	Rockfill [2]
>5	1.9 (1.5)	1.7 (1.7)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 150 masl

Tailings Elevation = 148 masl

Rockfill cover Elevation 150 masl

Ponded water in rockfill Elevation = 134.1 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN CENTRAL DIKE
STABILITY ANALYSIS
POST-CLOSURE

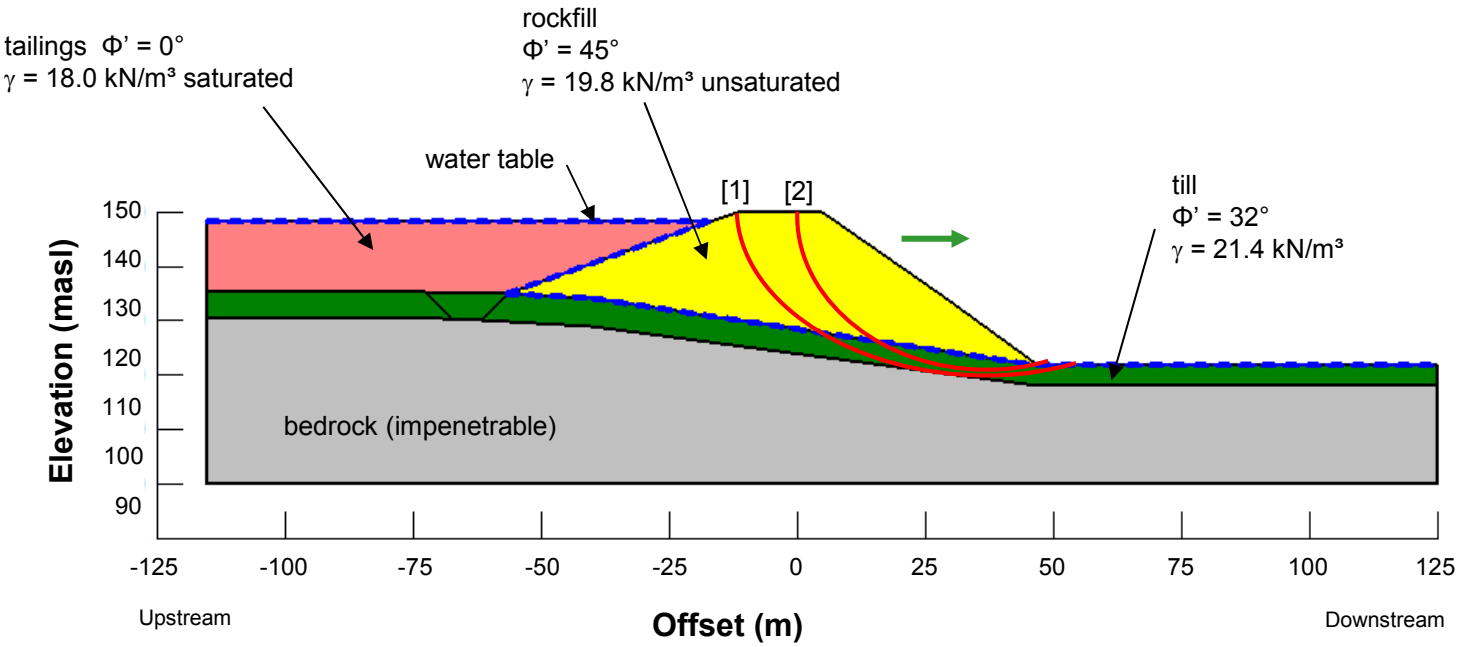
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-6

FoS for Drained Conditions
static (pseudostatic)

Downstream Failure Mode	
Liner [1]	Rockfill [2]
1.7 (1.5)	1.5 (1.4)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 150 masl

Tailings Elevation = 148 masl

Represents steepest downstream foundation slope.

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN CENTRAL DIKE STABILITY ANALYSIS STEEP FOUNDATION DURING OPERATIONS

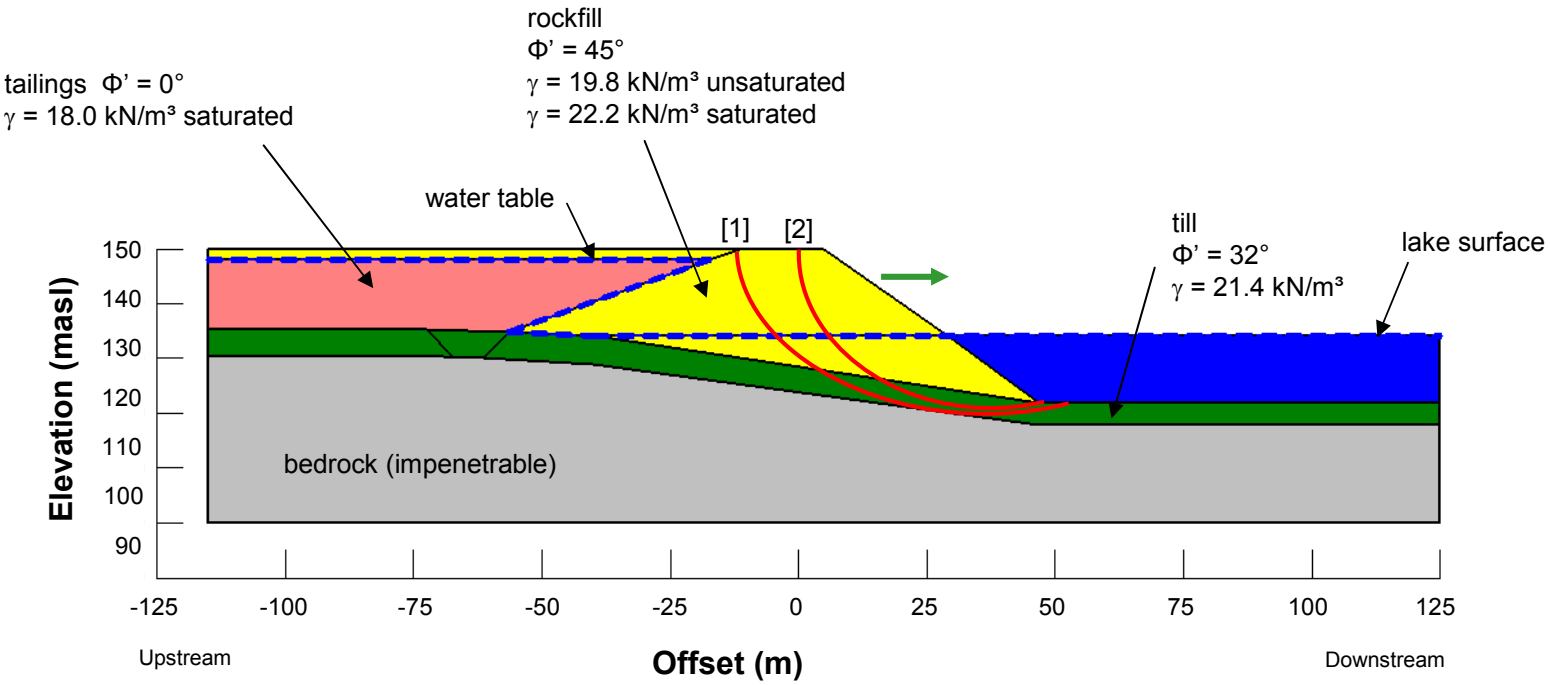
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	25NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-7

FoS for Drained Conditions
static (pseudostatic)

Downstream Failure Mode	
Liner [1]	Rockfill [2]
1.7 (1.5)	1.5 (1.4)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 150 masl

Tailings Elevation = 148 masl

Represents steepest downstream foundation slope.

Ponded water in rockfill Elevation = 134.1 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

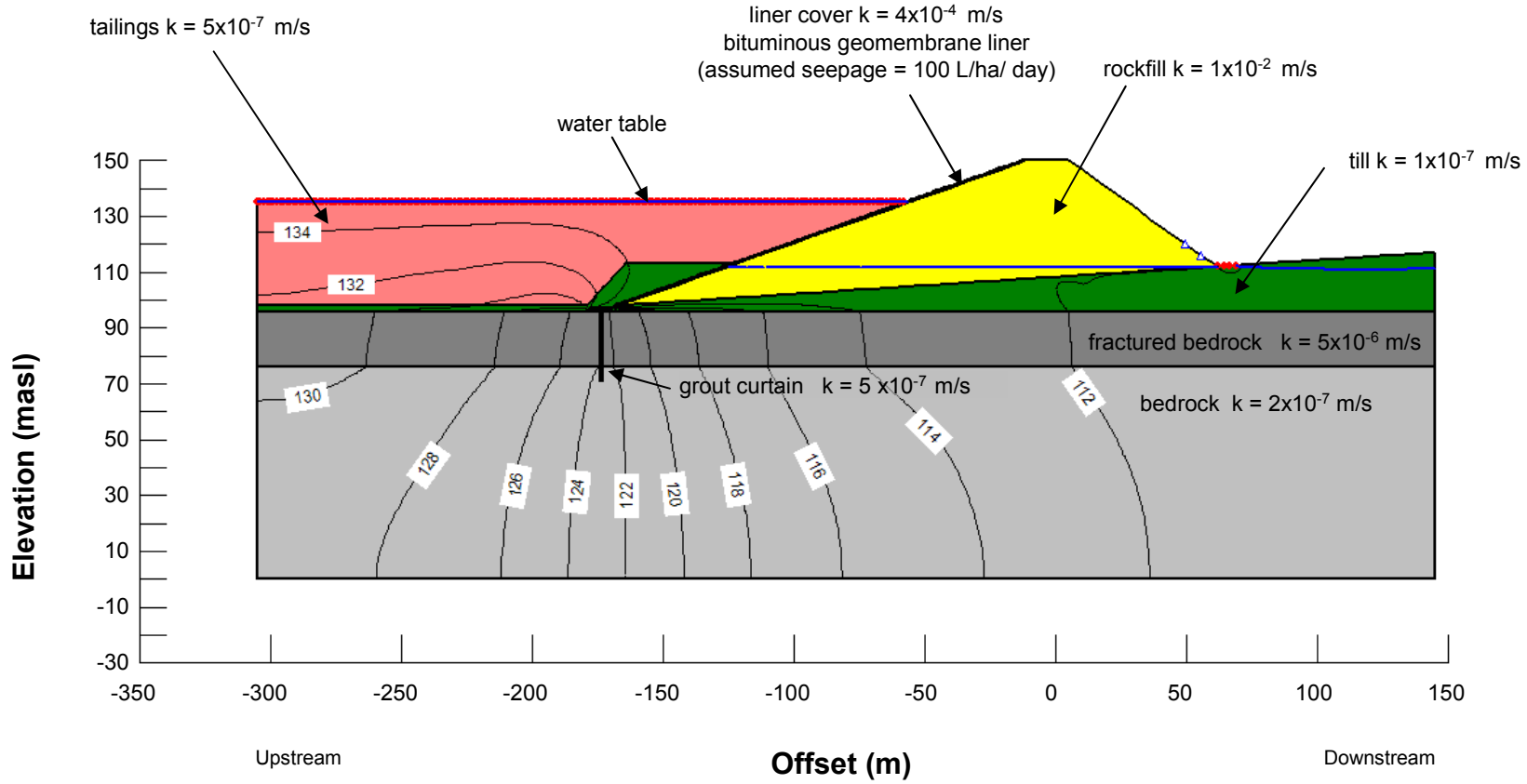
TITLE

TSF DESIGN CENTRAL DIKE
STABILITY ANALYSIS
STEEP FOUNDATION AT CLOSURE

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	25NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-8



Upstream Boundary:

Tailings Elevation = 135 masl

No beach

Total head contour interval = 2 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

Portage Pit not present

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

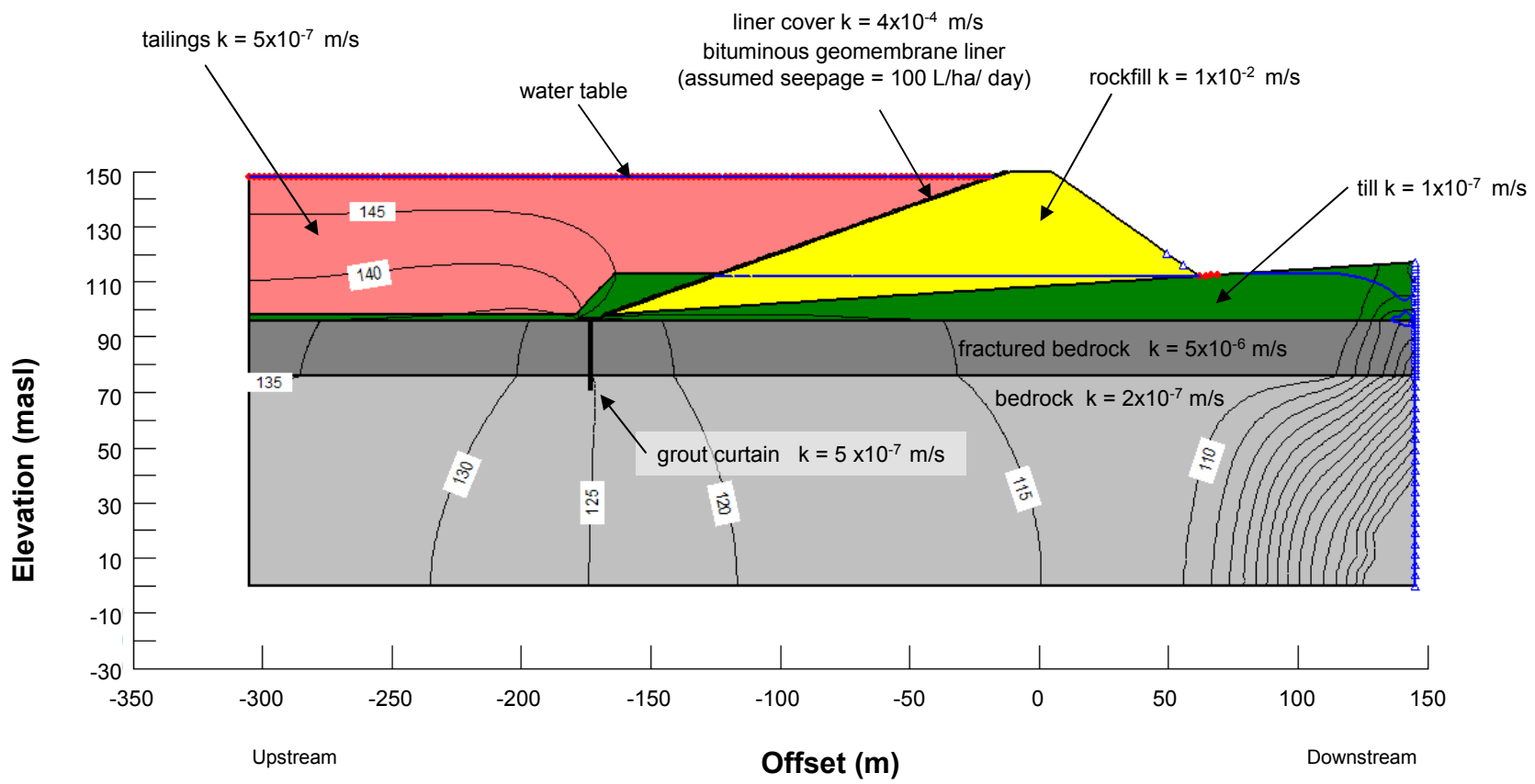
TITLE

TSF DESIGN CENTRAL DIKE SEEPAGE ANALYSIS NO BEACH NO PIT

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	20NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-9



Upstream Boundary:

Tailings Elevation = 148 masl

No beach

Total head contour interval = 5 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

Portage Pit Open

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

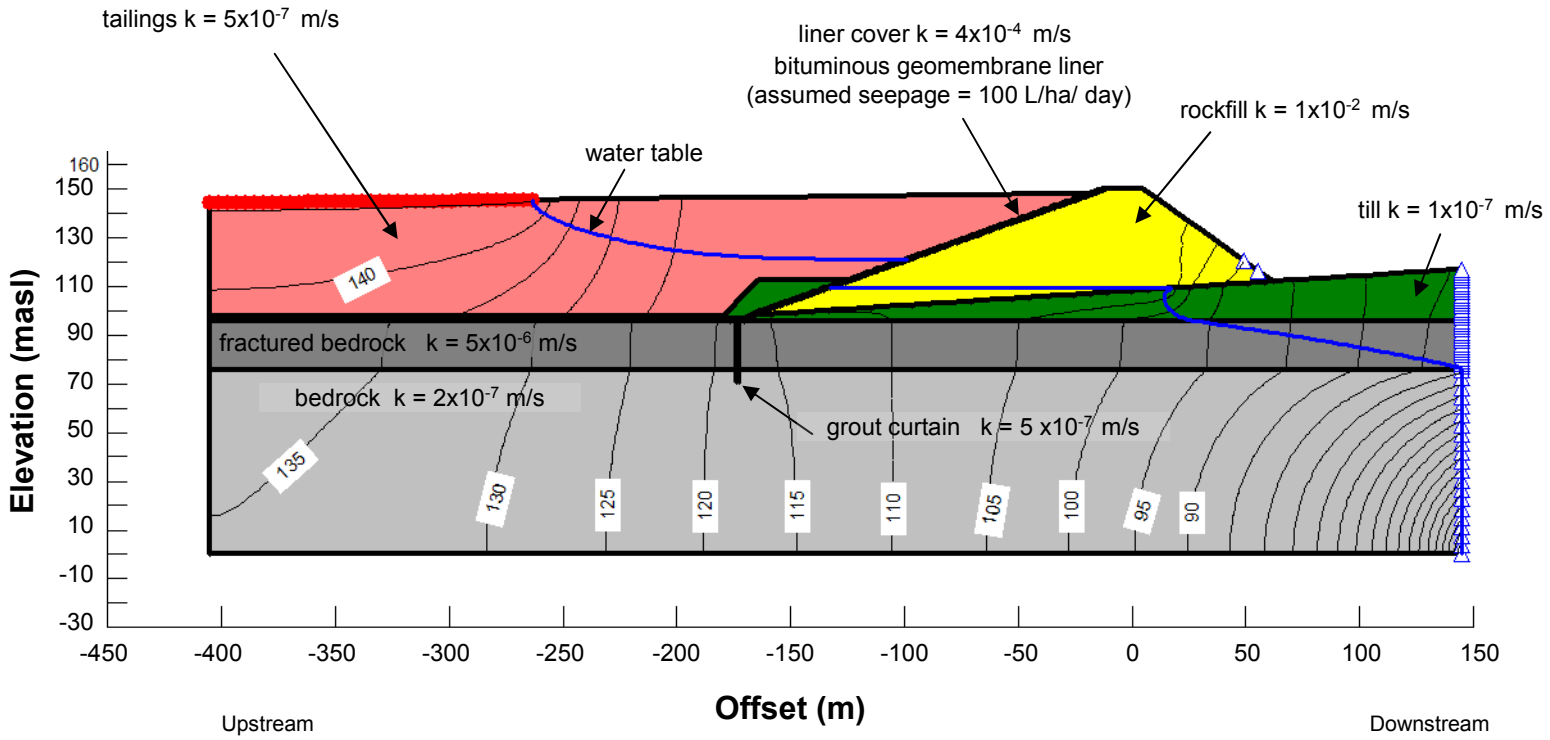
TITLE

TSF DESIGN CENTRAL DIKE SEEPAGE ANALYSIS NO BEACH

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	20NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-10



Upstream Boundary:

Tailings Elevation = 148 masl at dike face

250 m beach at 1% slope

Pond elevation = 145.5 masl

Total head contour interval = 5 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

Portage Pit open

PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

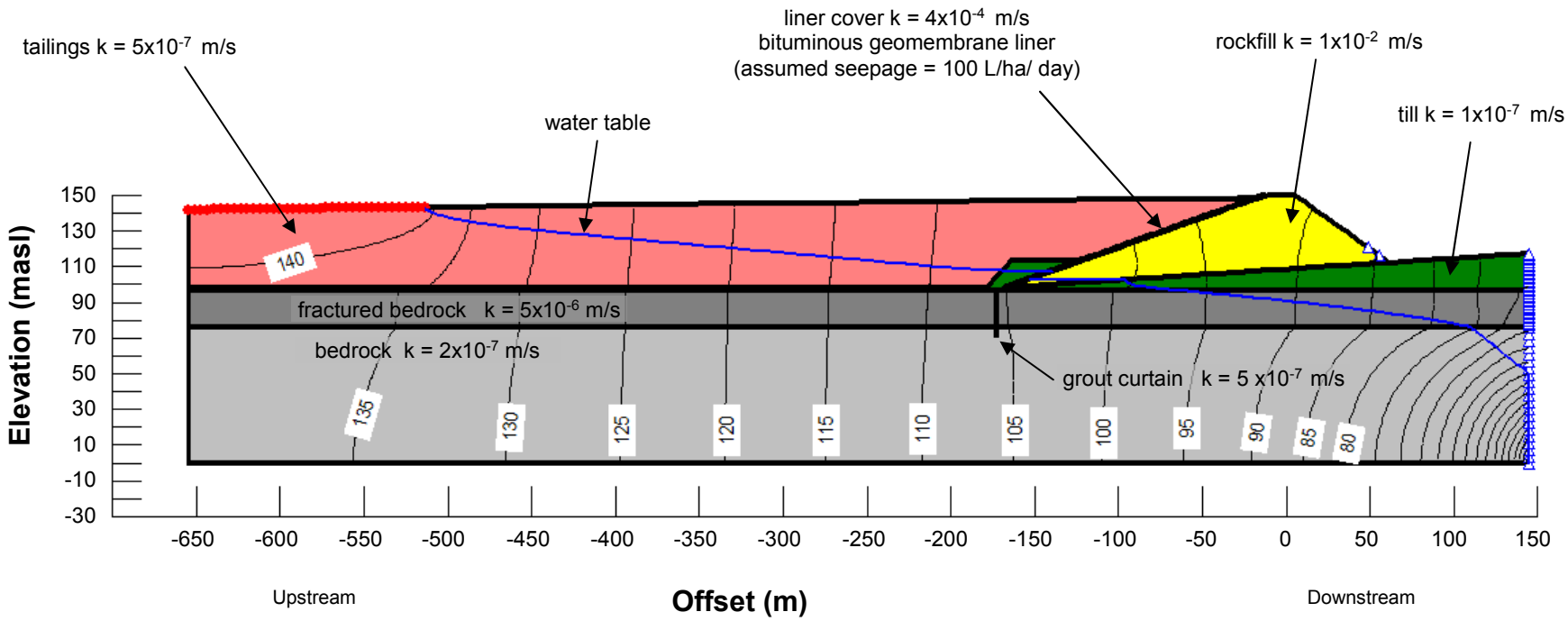
TSF DESIGN CENTRAL DIKE SEEPAGE ANALYSIS 250 m BEACH

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	20NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-11

REVISION DATE: 17DEC08 BY: BW FILE: O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix V Analysis Results



Upstream Boundary:

Tailings Elevation = 148 masl at dike face

500 m beach at 1% slope

Pond Elevation = 143 masl

Total head contour interval = 5 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

Portage Pit open

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

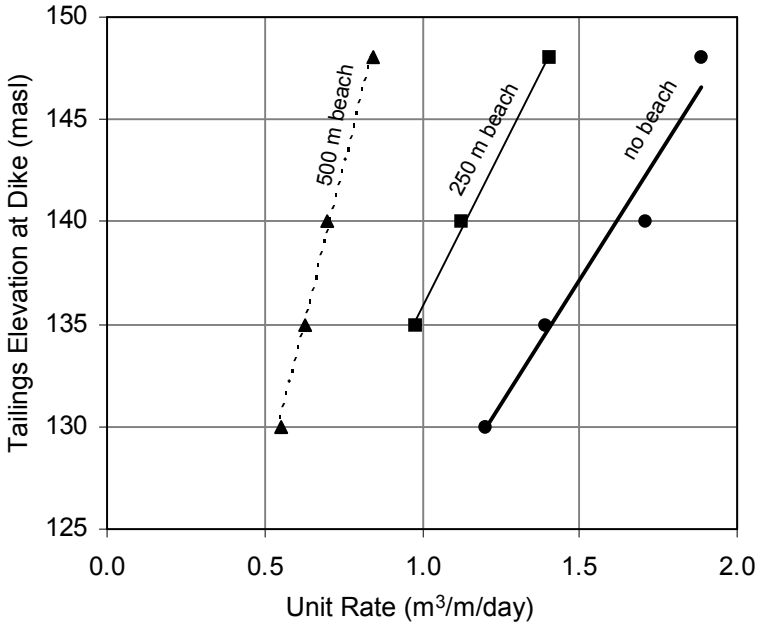
TITLE

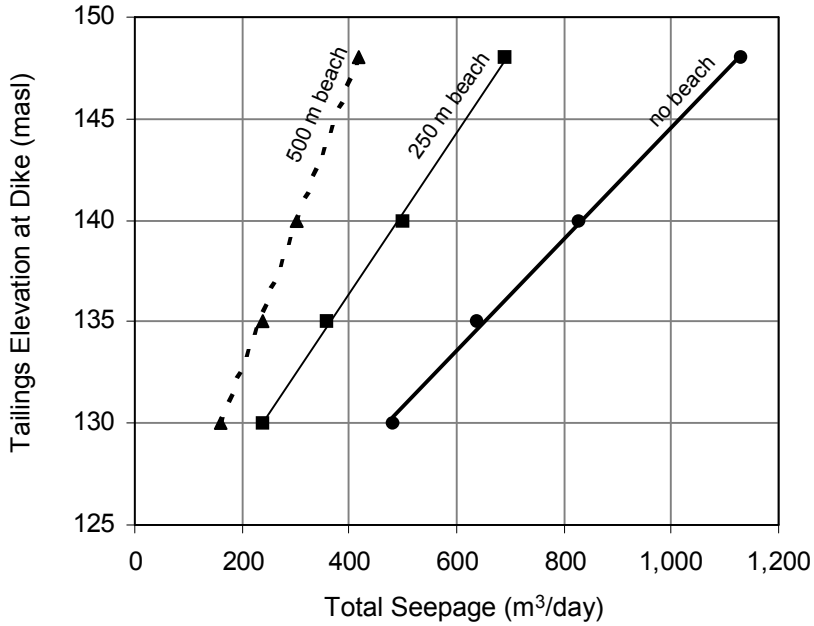
TSF DESIGN CENTRAL DIKE SEEPAGE ANALYSIS 500 m BEACH

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	20NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-12





Stage	Tailings El. (masl)	Beach Length (m)	Flow rate (m^3/day)
1	133	0	600
2	143	250	550
3	148	500	425

Seepage reports to toe of rockfill for beach length = 0 case.
Otherwise, seepage reports to pit.

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

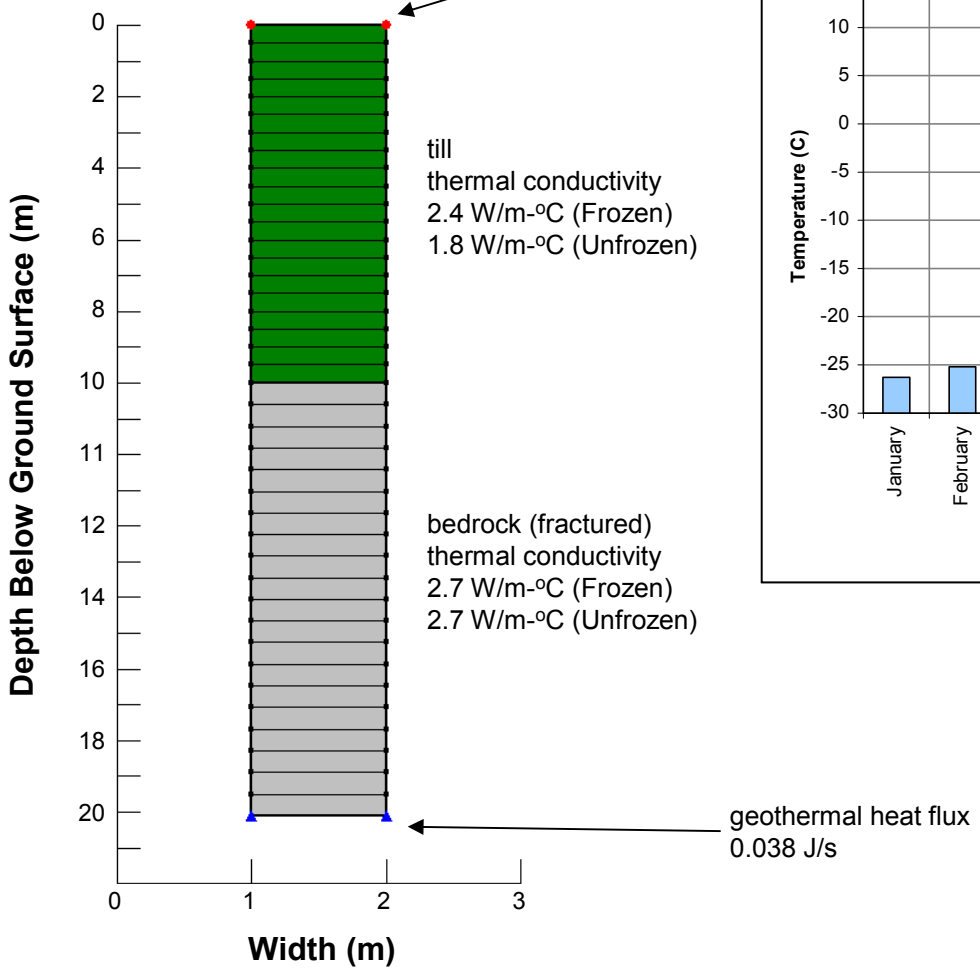
TSF DESIGN CENTRAL DIKE
SEEPAGE ANALYSIS
FLOW ESTIMATE

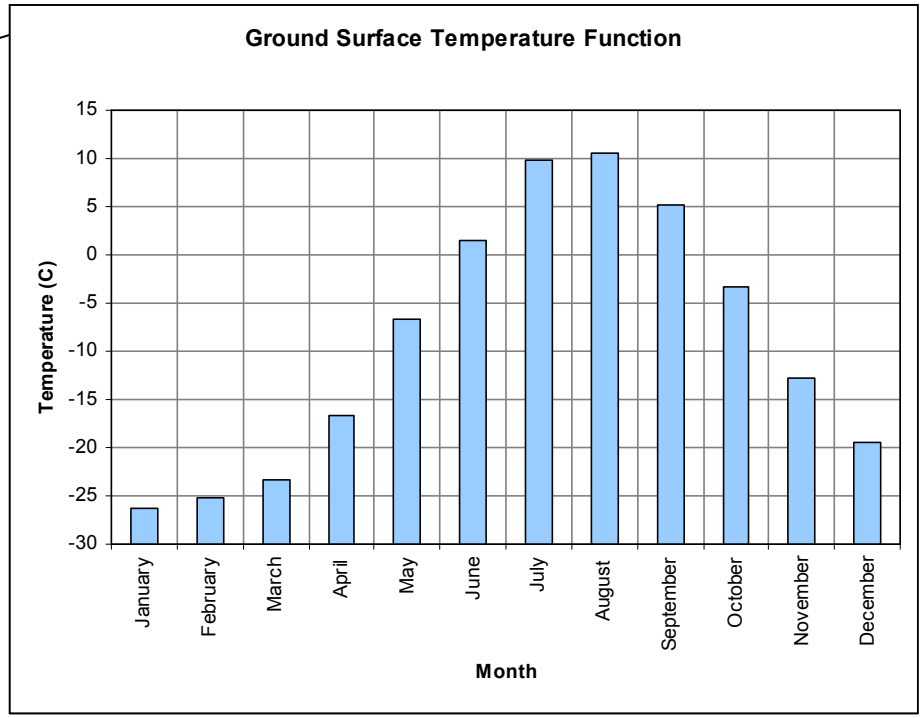
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	20NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-13

REVISION DATE: 17DEC08 BY: BW FILE: O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix V Analysis Results





PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

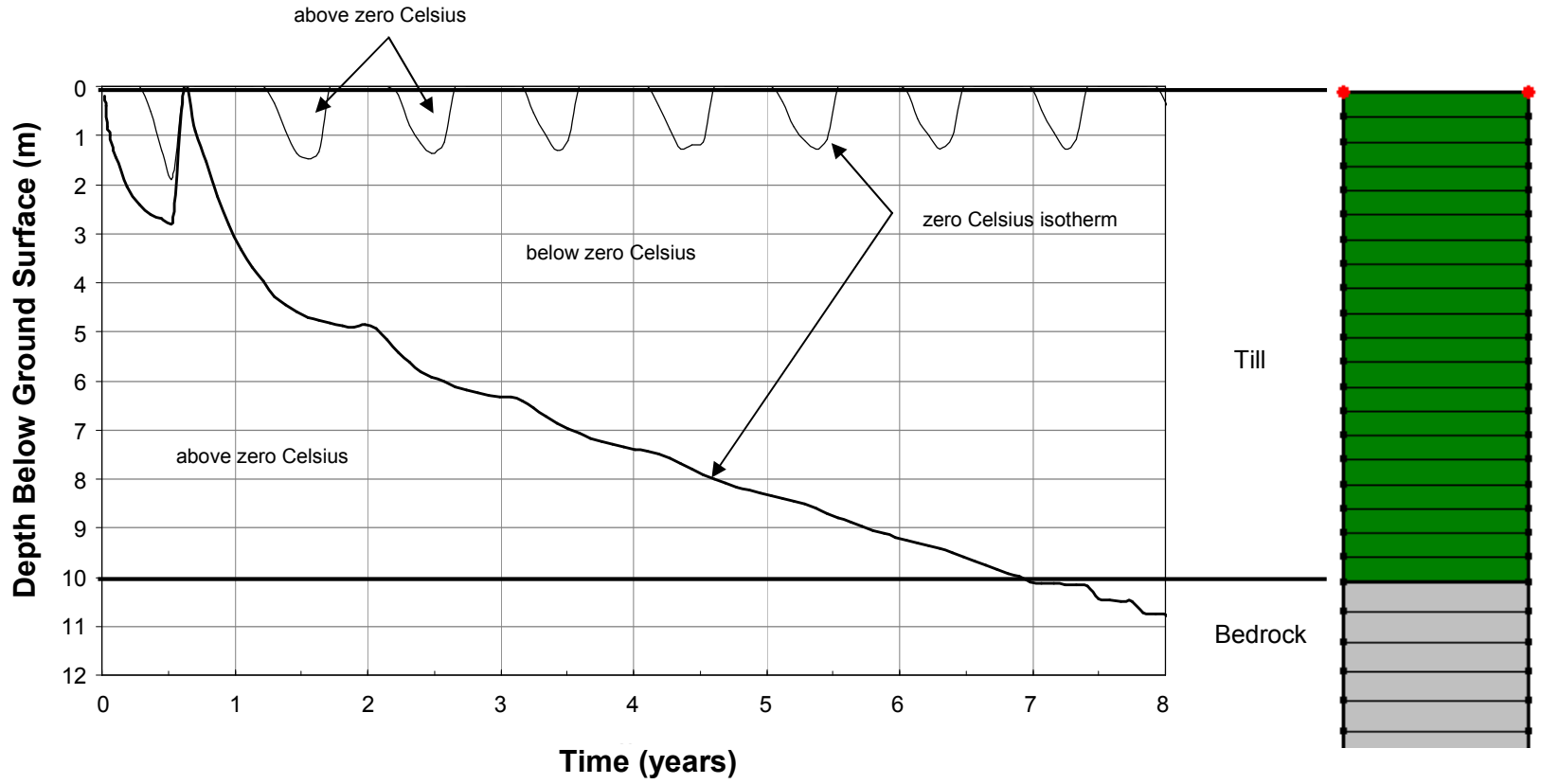
TSF DESIGN THERMAL ANALYSIS
LAKEBED SECTION

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	24NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-14

REVISION DATE: 17DEC08 BY: BW FILE: O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix V Analysis Results



PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

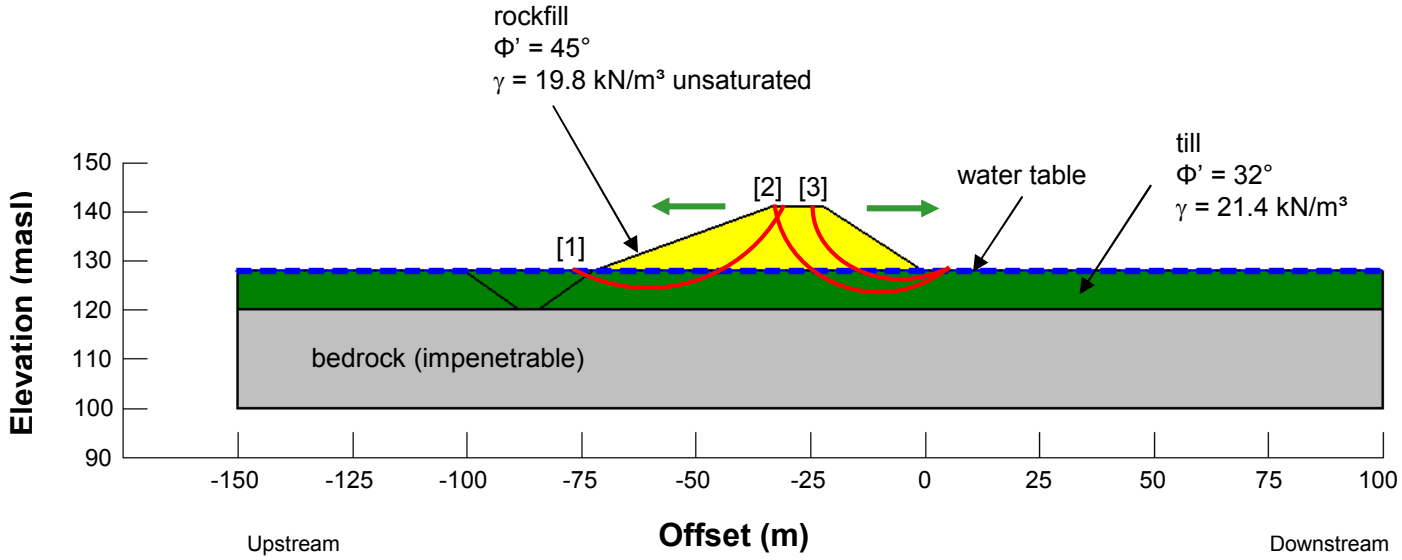
TSF DESIGN
THERMAL ANALYSIS RESULT
ZERO CELSIUS ISOTHERM

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----		
DESIGN	BW	24NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08	**FIGURE V-15**		
CHECK					
REVIEW					

FoS for Drained Conditions
static (pseudostatic)

Upstream Failure Mode	Downstream Failure Mode	
Liner [1]	Liner [2]	Rockfill [3]
2.5 (2.2)	2.2 (1.9)	2.1 (1.9)



Direction of failure

Schematic slip surface shown

Rockfill crest Elevation = 140 masl

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN DIVIDER DIKE
STABILITY ANALYSIS
STAGE 1 END OF CONSTRUCTION

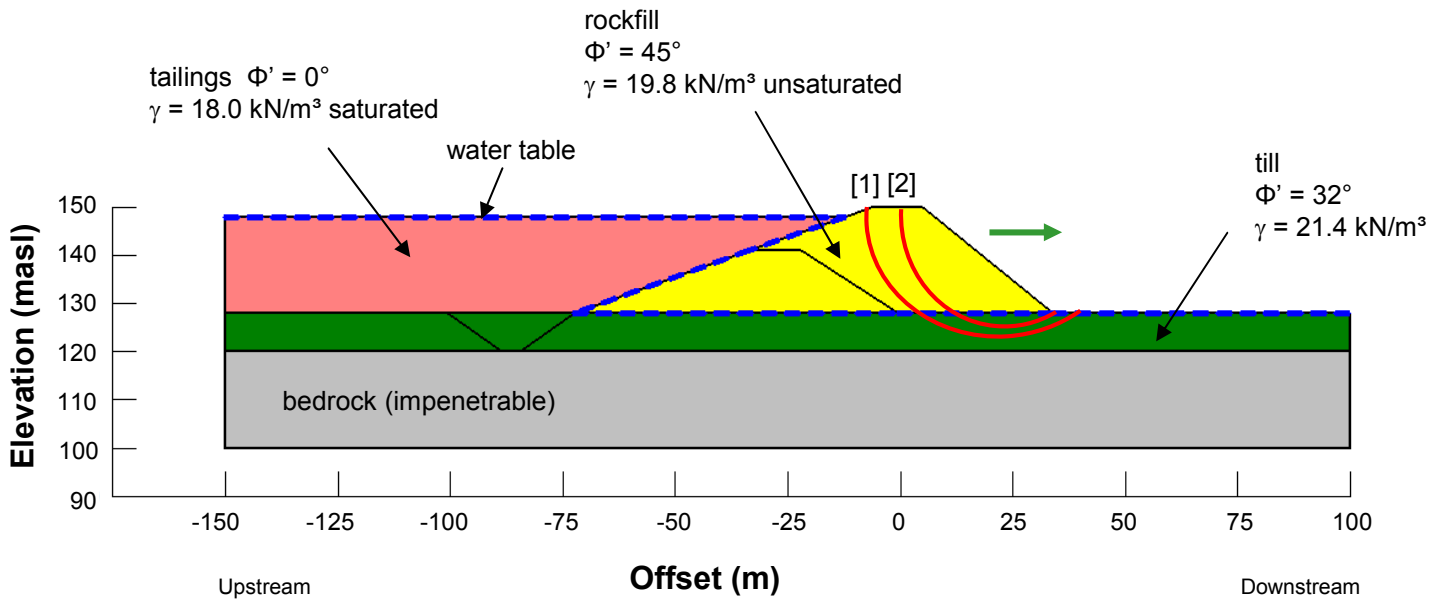
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-16

FoS for Drained Conditions

static (pseudostatic)	
Downstream Failure Mode	
Liner [1]	Rockfill [2]
1.7 (1.6)	1.6 (1.5)



Direction of failure

Schematic slip surface shown

Rockfill crest Elevation = 150 masl

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN DIVIDER DIKE
STABILITY ANALYSIS
STAGE 2 OPERATION

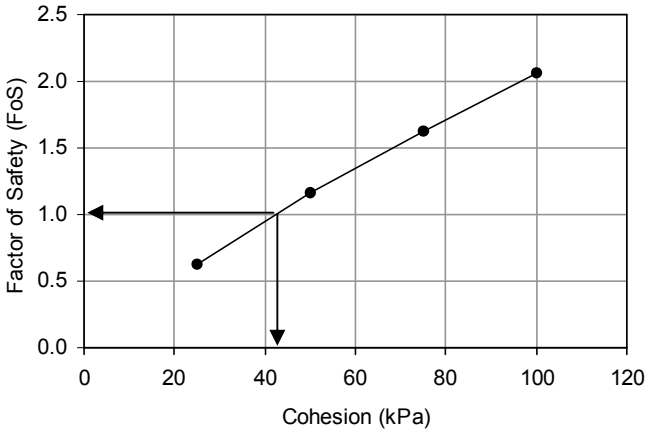
Golder Associates

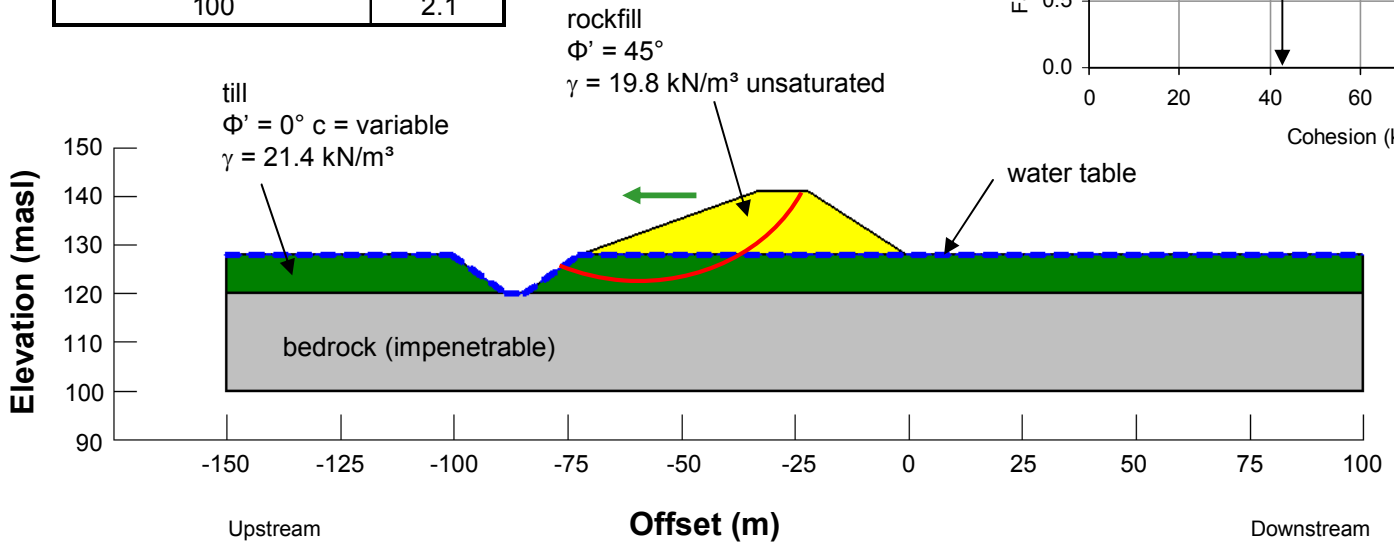
PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	25NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-17

FoS for Undrained Conditions
static

Till Cohesion (kPa)	FoS
25	0.6
50	1.2
75	1.6
100	2.1





Direction of failure

Schematic slip surface shown

Rockfill crest Elevation = 140 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN DIVIDER DIKE
STABILITY ANALYSIS
TRENCH CONSTRUCTION

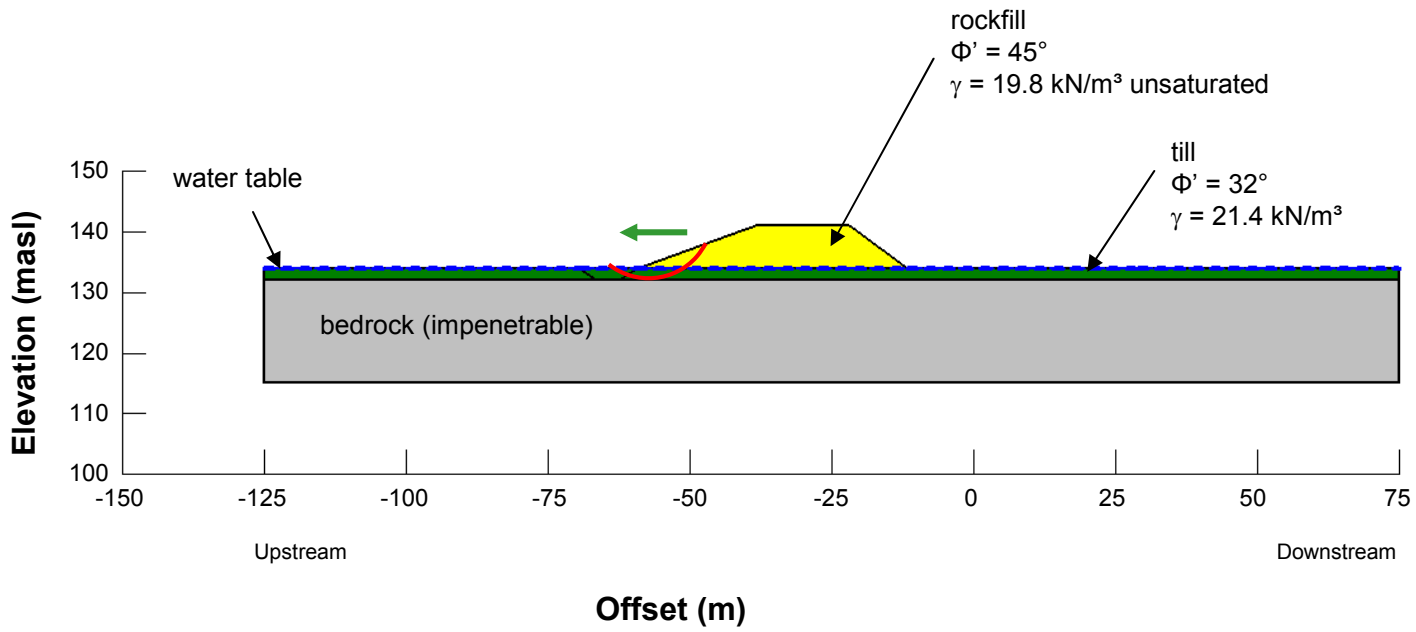
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	25NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-18

FoS for Drained Conditions
static (pseudostatic)

Upstream Failure Mode
2.4 (2.1)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 141 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN SADDLE DAM STABILITY ANALYSIS STAGE 1 CONSTRUCTION

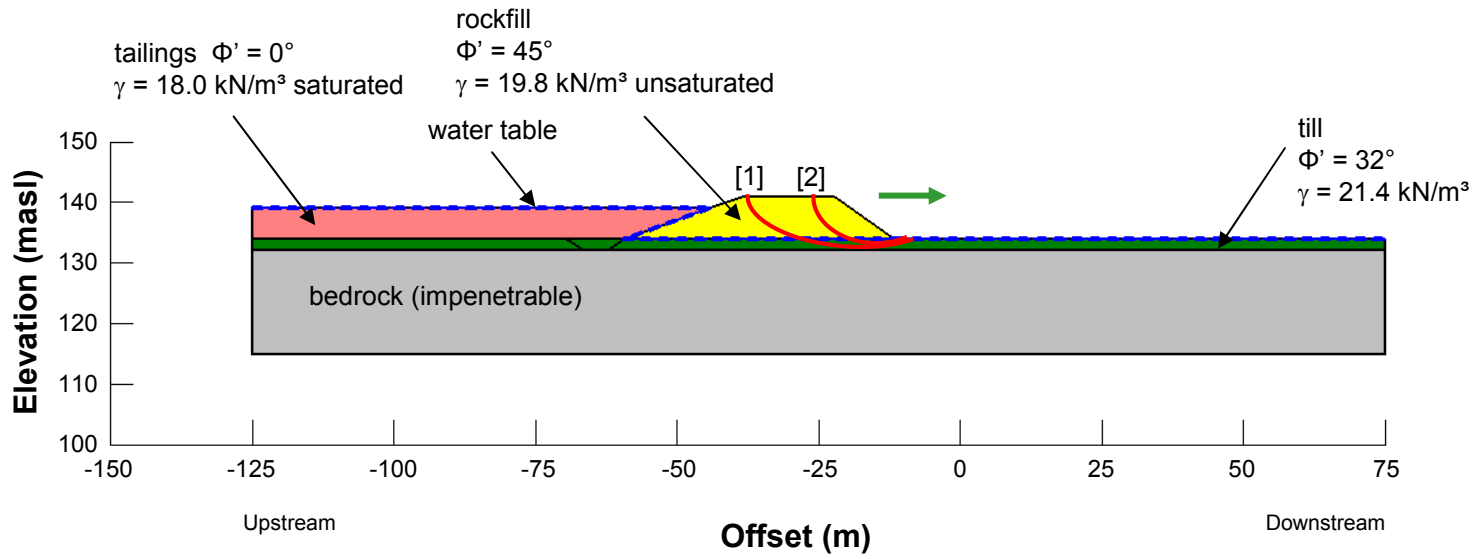
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	25NOV08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-19

FoS for Drained Conditions
static (pseudostatic)

Downstream Failure Mode	
Liner [1]	Rockfill [2]
3.1 (2.6)	2.1 (1.9)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 141 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN SADDLE DAM
STABILITY ANALYSIS
STAGE 1 OPERATION

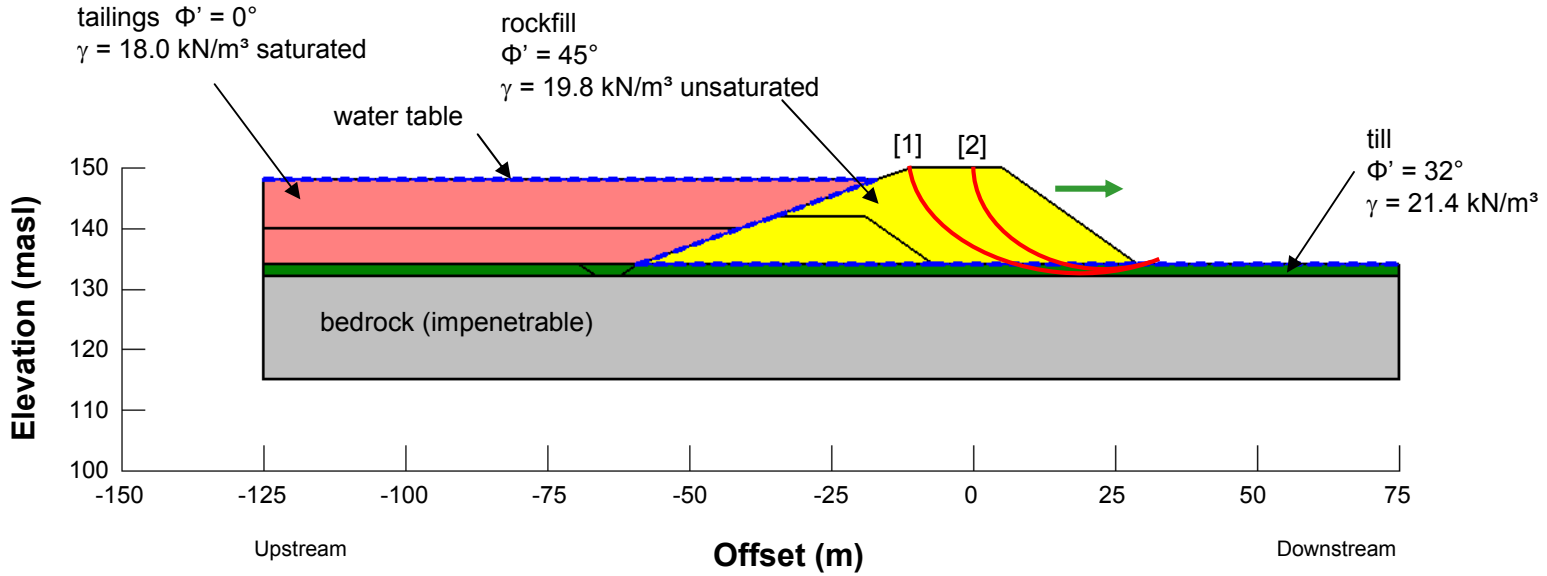
Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	25NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-20

FoS for Drained Conditions
static (pseudostatic)

Downstream Failure Mode	
Liner [1]	Rockfill [2]
2.3 (2.0)	1.8 (1.7)



Direction of failure

Schematic slip surface shown

Pseudostatic analyses assume horizontal seismic coefficient of 0.04 g = 2/3 x PGA

Rockfill crest Elevation = 150 masl

Tailings Elevation = 148 masl

PROJECT AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

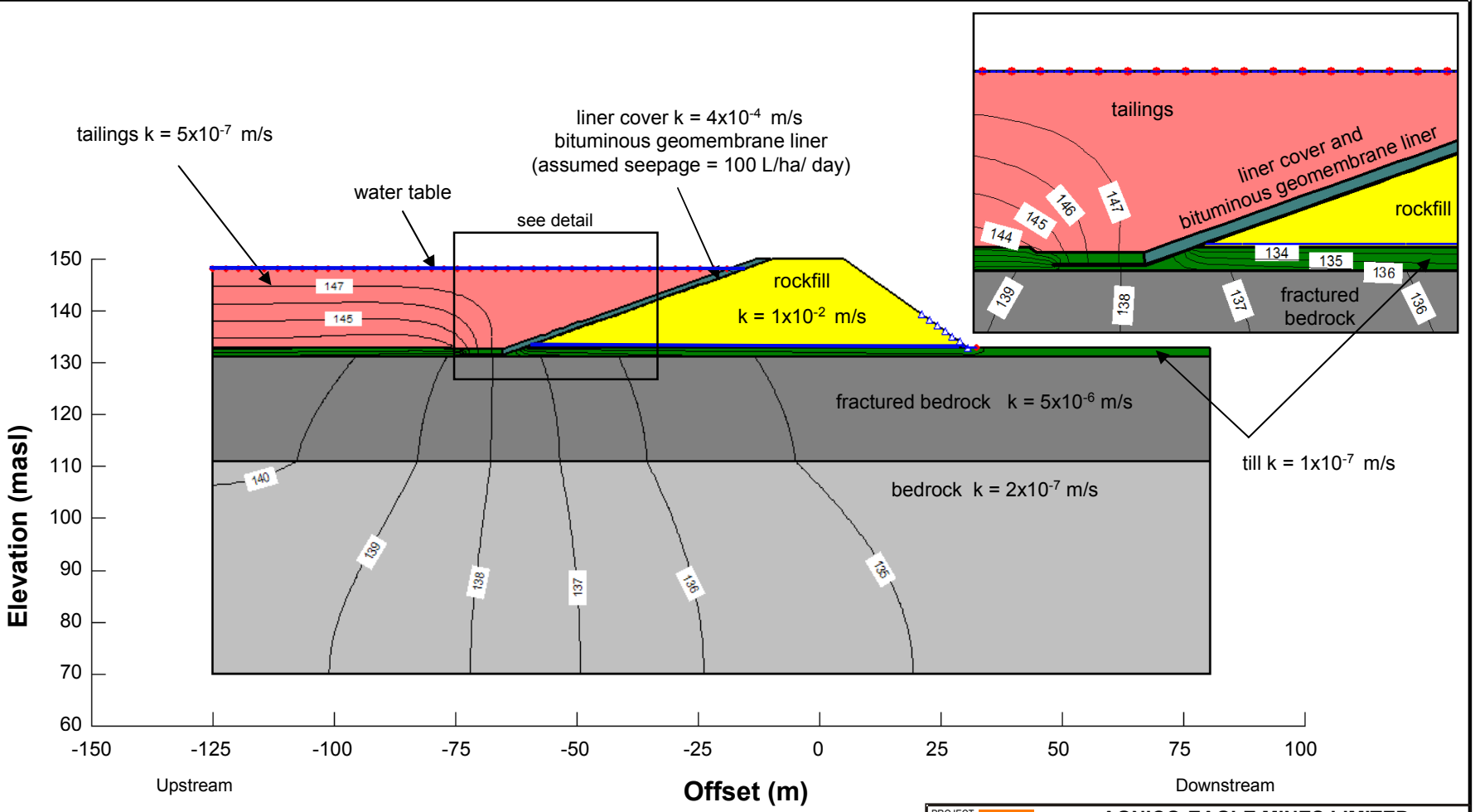
TSF DESIGN SADDLE DAM
STABILITY ANALYSIS
STAGE 2 OPERATION

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	25NOV08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-21

REVISION DATE: 17DEC08 BY: BW FILE: O:\Active_2008\1428\08-1428-0029 Meadowbank TSF Dike Design\3400 Reporting\Appendix V Analysis Results



Upstream Boundary:

Tailings Elevation = 148 masl

No beach

Total head contour interval = 1 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

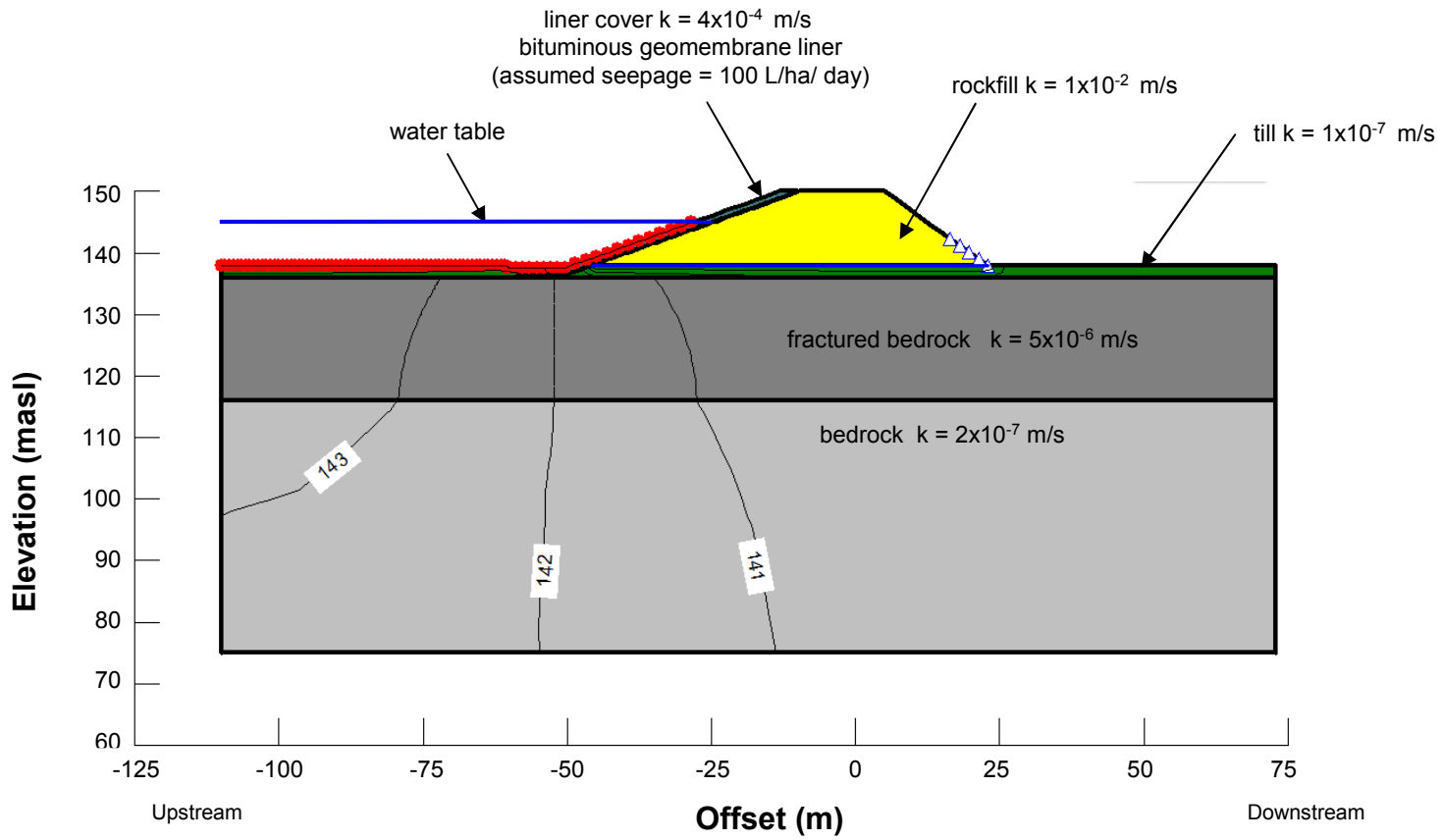
TITLE

TSF DESIGN SADDLE DAM SEEPAGE ANALYSIS NO BEACH

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	03DEC08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-22



Upstream Boundary:

Water pond Elevation = 145 masl

No tailings

Total head contour interval = 1 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

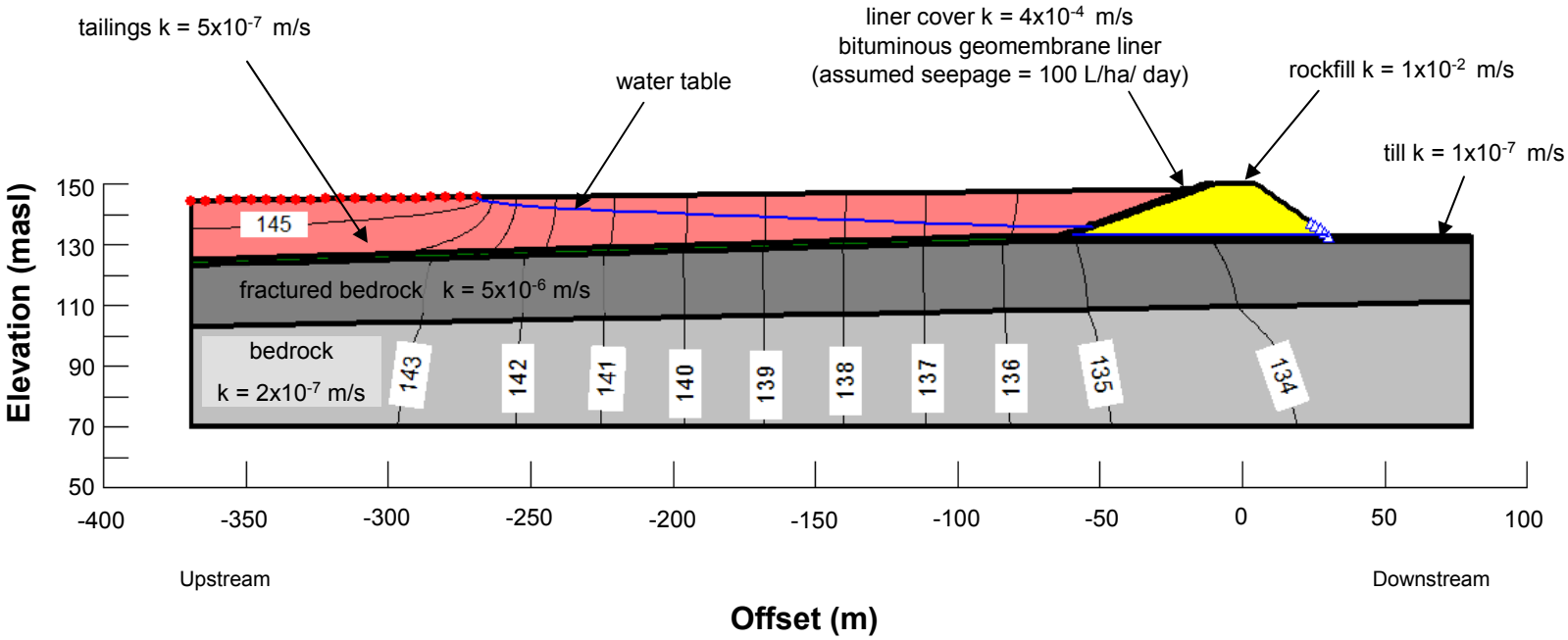
TITLE

TSF DESIGN SADDLE DAM SEEPAGE ANALYSIS POND NO TAILINGS

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	03DEC08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-23



Upstream Boundary:

Tailings Elevation = 148 masl at dike face

250 m beach at 1% slope

Pond Elevation = 145.5 masl

Total head contour interval = 5 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

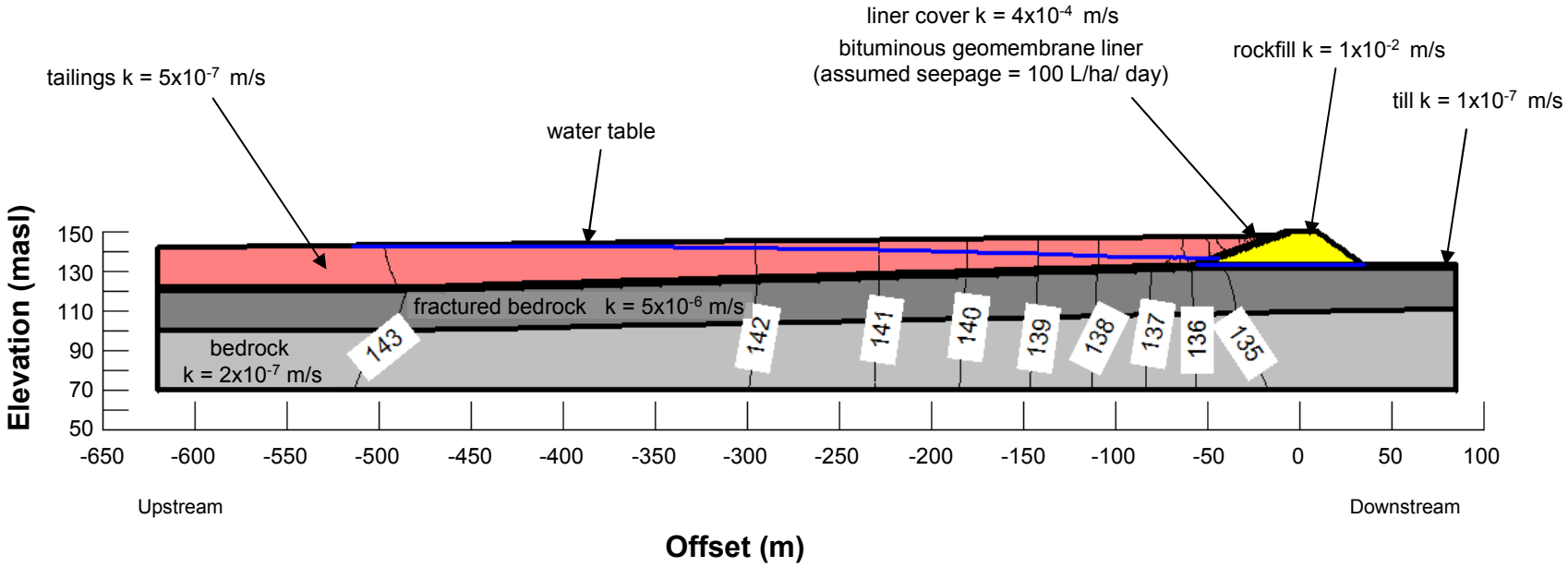
TITLE

TSF DESIGN SADDLE DAM SEEPAGE ANALYSIS 250 m BEACH

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---		
DESIGN	BW	03DEC08	SCALE NTS		REV. 0
CADD	BW	09DEC08			
CHECK					
REVIEW					

FIGURE V-24



Upstream Boundary:

Tailings Elevation = 148 masl at dike face

500 m beach at 1% slope

Pond Elevation = 143 masl

Total head contour interval = 1 m

Downstream Boundary:

Pressure = 0 kPa at downstream toe

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TSF DESIGN SADDLE DAM SEEPAGE ANALYSIS 500 m BEACH

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ---	
DESIGN	BW	03DEC08	SCALE NTS	REV. 0
CADD	BW	09DEC08		
CHECK				
REVIEW				

FIGURE V-25

APPENDIX VI

PRELIMINARY TAILINGS DEPOSITION PLAN

1.0 INTRODUCTION AND OBJECTIVES

A preliminary tailings deposition plan (TDP) is presented here for the Meadowbank Gold Project (Meadowbank) in Nunavut.

The main objective of this study is to determine the stage curve of the deposit in order to define the construction staging of the TSF Dikes.

2.0 AVAILABLE INFORMATION

The following information was used:

- Preliminary Tailings Deposition Planning Design Criteria, from Final Report Detailed Design of Central Dike Meadowbank Gold Project, Golder Associates Ltd. Doc. 420 Ver. 0, March 2007.

- Updated bathymetry based on 2008 bathymetry studies.

Dike alignments were used in this study will vary from final alignments. Variation in volumes introduced by minor changes to alignments is considered to be acceptable for a preliminary deposition plan.

3.0 DESCRIPTION OF THE FACILITIES AND OPERATION

The site is located in Nunavut Territory, north of Baker Lake (see site location map in Appendix XIII).

The Divider Dike divides the basin formed by dewatering of the northwest arm of Second Portage Lake into two cells (North and South), as indicated in Figure VI-1. Operations will be initiated in the northern area.

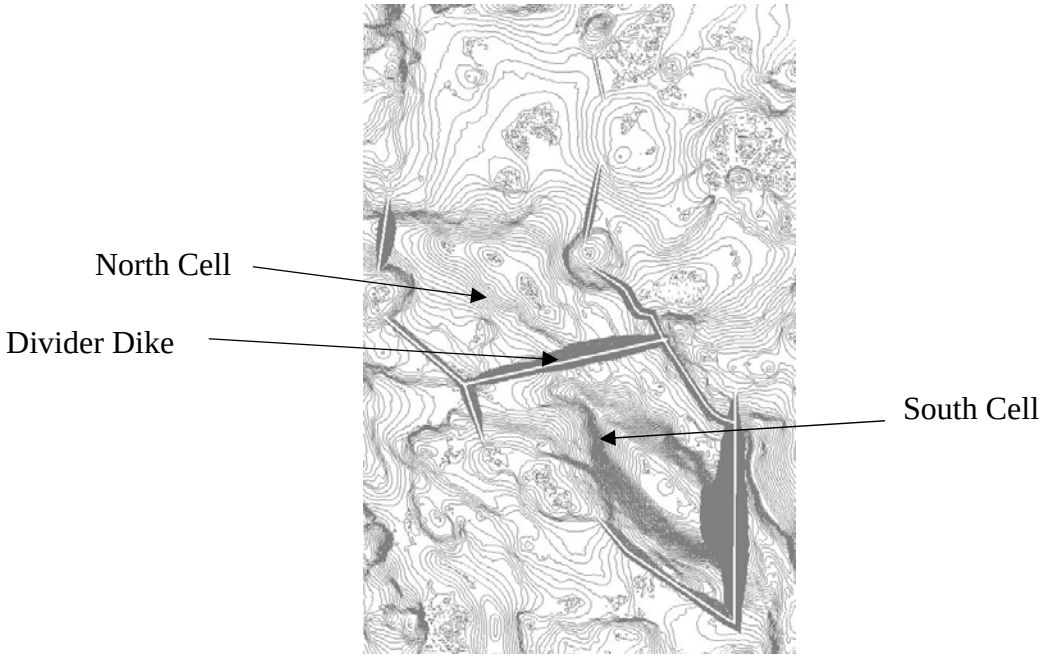


Figure VI-1: North and South Cells with Divider Dike

4.0 DESIGN CRITERIA AND PARAMETERS

The main design criteria and parameters to be used for the TMP are indicated in the | Table VI-1 below.

TABLE VI-1: Design criteria and parameters

Description	Unit	Value / Concept
Start of operation	-	**January 1st, 2010 – North Cell**
LOM	years	Approximately 9 to 10
Total required capacity	Mt	29.3
Supernatant pond volume	m^3	750,000
Supernatant pond location		Towards the adjacent area of the Divider Dike
Discharge lines		ON/OFF – No weather restrictions applicable to the present report.

Description	Unit	Value / Concept
Average settled tailings dry density	t/m^3	1.16 to 1.45 (average 1.31*)
Tailings production	tpd	8,500
Tailings ramp up		
Month 1	%	60
Month 2	%	70
Month 3	%	80
Month 4	%	100
Preliminary embankments elevation	m a.s.l.	150
Beach tailings slope	%	1
Subaqueous tailings slope	%	5
Ice bulking volume factor	%	20

* Average dry density assuming 20% bulking of tailings due to ice entrapment

5.0 GENERAL ASSUMPTIONS

This TDP has been conceptualized assuming the storage of the tailings into the north cell up to the maximum expected elevation and after that discharging the tailings into the south cell. The two storage areas have been considered, thus, separately. It was, moreover, intended to reach similar elevations in both areas.

Model was developed considering an adequate sequence of discharge for 1% slope, which defines the requirements for embankments (elevation) and ultimate footprint. It has to be noted that additional simulation using flatter slope should be done in the future in order to define the requirements to operate the supernatant pond (not included in this analysis).

The models have been run assuming a tailings dry density of 1.31 t/m^3, as agreed in the design criteria. Nevertheless, a total storage required tonnage of 29.3 Mt has been achieved, representing a lower tailings dry density. The models consider that the tailings are "discharged" at that density as they flow through the spigots. This assumption is acceptable considering the accuracy of the available data. Further studies, having additional tailings parameters, shall justify running a more accurate model, considering a

density for the flow discharging into the cells and a different one for the disposed tailings, with seasonal variations.

6.0 OPERATION PHILOSOPHY

The discharge points are located strategically in order to push the supernatant pond towards the barges location (for the reclaim water system) near the south abutments of the Divider Dike. Figure VI-2 shows the spigot locations, distributed as:

- Spigots 1 to 6: North Cell; and
- Spigots 7 to 17: South Cell

Based on the objectives of this study, it has been accepted that there is no restriction related to freezing conditions.

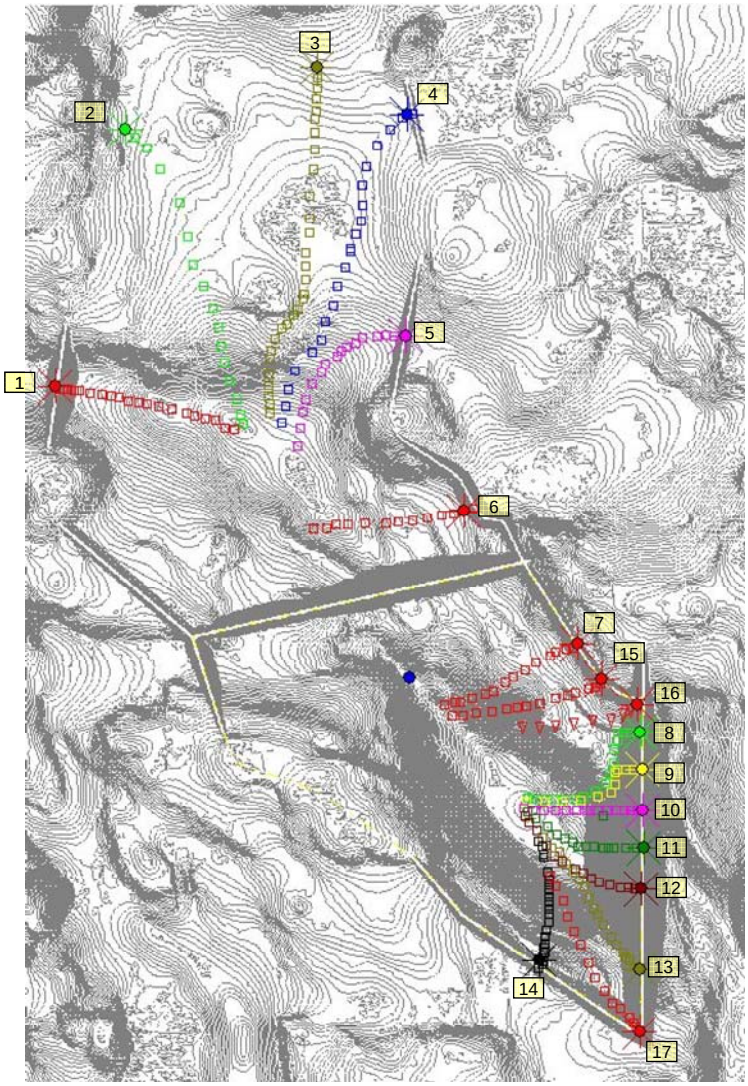


Figure VI-2: Discharge Locations

7.0 TAILINGS DEPOSITION PLAN

Stage elevations for the North and South Cells are listed in Table VI-2 and VI-3, and plotted in Figure VI-3 and Figure VI-4. Stage elevations and struck level storage volumes are listed in Table VI-4. The deposition sequence is illustrated in plan in Figures VI-5 to VI-10.

A combined stage curve including tailings production is included in Figure VI-11.

MEADOWBANK GOLD PROJECT - NUNAVUT
TAILINGS DEPOSITION PLAN
NORTHERN BASIN
STAGE CURVE

Tailings production:	8,500 tpd	Tailings average dry density:	1.31 t/m3
Tailings beach slope:	1.00 %	Supernatant pond:	0.75 Mm3
Tailings below water slope:	5.00 %	Delta "T":	30 days

Time				Tailings Production			Tailings Volume		Spigot Elevation						Pond Elev.	Pond Depth
Day #	Month	Year	Date	Ramp-up	Period	Cum.	Partial	Cum.	1	2	3	4	5	6		
(-)			(d/m/y)	%	(t)	(Mt)	(m3)	(Mm3)	(m a.s.l.)							(m)
0	0	0.00	1/1/10	60%	0	0.00	0	0.00	128.6	126.8	126.3	126.0	125.7	122.3	128.6	7.7
30	1	0.08	31/1/10	60%	153,000	0.15	116,794	0.12	131.0	129.2	128.8	128.7	128.4	126.9	129.1	8.2
60	2	0.16	2/3/10	70%	178,500	0.33	136,260	0.25	132.4	130.3	129.9	129.9	129.7	128.9	129.6	8.7
90	3	0.25	1/4/10	80%	204,000	0.54	155,725	0.41	133.5	131.2	130.9	130.9	130.7	130.3	130.2	9.3
120	4	0.33	1/5/10	100%	255,000	0.79	194,656	0.60	134.5	132.1	131.8	131.9	131.7	131.8	130.8	9.9
150	5	0.41	31/5/10	100%	255,000	1.05	194,656	0.80	135.2	132.9	132.6	132.8	132.6	133.0	131.4	10.5
180	6	0.49	30/6/10	100%	255,000	1.30	194,656	0.99	135.8	133.6	133.2	133.6	133.5	133.7	131.9	11.0
210	7	0.58	30/7/10	100%	255,000	1.56	194,656	1.19	136.3	134.2	133.8	134.3	134.2	134.4	132.5	11.2
240	8	0.66	29/8/10	100%	255,000	1.81	194,656	1.38	136.8	134.8	134.4	135.0	134.9	135.0	133.0	11.1
270	9	0.74	28/9/10	100%	255,000	2.07	194,656	1.58	137.3	135.4	135.0	135.6	135.6	135.5	133.4	11.2
300	10	0.82	28/10/10	100%	255,000	2.32	194,656	1.77	137.8	136.0	135.5	136.2	136.3	136.0	133.9	11.2
330	11	0.90	27/11/10	100%	255,000	2.58	194,656	1.97	138.2	136.5	136.0	136.9	137.0	136.6	134.4	11.2
360	12	0.99	27/12/10	100%	255,000	2.83	194,656	2.16	138.6	137.0	136.5	137.5	137.6	137.2	134.8	11.1
390	13	1.07	26/1/11	100%	255,000	3.09	194,656	2.36	138.9	137.5	136.9	138.0	138.2	137.7	135.2	11.0
420	14	1.15	25/2/11	100%	255,000	3.34	194,656	2.55	139.3	138.0	137.4	138.6	138.8	138.2	135.6	10.9
450	15	1.23	27/3/11	100%	255,000	3.60	194,656	2.74	139.6	138.5	137.8	139.2	139.4	138.6	136.1	10.8
480	16	1.32	26/4/11	100%	255,000	3.85	194,656	2.94	139.9	139.0	138.3	139.7	139.9	139.1	136.4	10.8
510	17	1.40	26/5/11	100%	255,000	4.11	194,656	3.13	140.3	139.5	138.8	140.2	140.4	139.5	136.8	10.8
540	18	1.48	25/6/11	100%	255,000	4.36	194,656	3.33	140.6	140.0	139.2	140.8	140.8	139.9	137.1	10.7
570	19	1.56	25/7/11	100%	255,000	4.62	194,656	3.52	141.0	140.5	139.7	141.4	141.3	140.2	137.5	10.7
600	20	1.64	24/8/11	100%	255,000	4.87	194,656	3.72	141.3	140.9	140.1	142.0	141.6	140.6	137.8	10.6
630	21	1.73	23/9/11	100%	255,000	5.13	194,656	3.91	141.6	141.4	140.6	142.6	142.0	141.0	138.1	10.5
660	22	1.81	23/10/11	100%	255,000	5.38	194,656	4.11	142.0	141.8	141.0	143.1	142.4	141.3	138.4	10.3
690	23	1.89	22/11/11	100%	255,000	5.64	194,656	4.30	142.3	142.2	141.4	143.6	142.8	141.7	138.7	10.1
720	24	1.97	22/12/11	100%	255,000	5.89	194,656	4.50	142.7	142.6	141.7	144.1	143.3	142.1	139.0	9.8
750	25	2.05	21/1/12	100%	255,000	6.15	194,656	4.69	143.0	143.0	142.1	144.5	143.6	142.4	139.3	9.7
780	26	2.14	20/2/12	100%	255,000	6.40	194,656	4.89	143.3	143.3	142.6	145.0	143.9	142.7	139.6	9.8
810	27	2.22	21/3/12	100%	255,000	6.66	194,656	5.08	143.6	143.6	143.1	145.4	144.1	143.0	139.9	9.9
840	28	2.30	20/4/12	100%	255,000	6.91	194,656	5.28	144.0	144.0	143.6	145.9	144.4	143.4	140.2	10.0
870	29	2.38	20/5/12	100%	255,000	7.17	194,656	5.47	144.2	144.3	144.0	146.3	144.7	143.7	140.4	9.8
900	30	2.47	19/6/12	100%	255,000	7.42	194,656	5.66	144.4	144.6	144.4	146.6	145.0	144.0	140.5	9.3
930	31	2.55	19/7/12	100%	255,000	7.68	194,656	5.86	144.6	145.0	144.8	147.0	145.3	144.4	140.6	8.9
960	32	2.63	18/8/12	100%	255,000	7.93	194,656	6.05	144.8	145.5	145.2	147.3	145.6	144.7	140.8	8.6
990	33	2.71	17/9/12	100%	255,000	8.19	194,656	6.25	145.0	146.4	145.6	147.5	145.9	144.9	141.0	8.5
1,020	34	2.79	17/10/12	100%	255,000	8.44	194,656	6.44	145.2	147.3	146.0	147.6	146.2	145.1	141.2	8.5
1,050	35	2.88	16/11/12	100%	255,000	8.70	194,656	6.64	145.4	148.2	146.4	147.8	146.6	145.4	141.4	8.4
1,080	36	2.96	16/12/12	100%	255,000	8.95	194,656	6.83	145.6	149.1	146.8	148.0	146.9	145.6	141.6	8.4
1,110	37	3.04	15/1/13	100%	255,000	9.21	194,656	7.03	145.9	149.6	147.1	148.2	147.1	145.9	141.8	8.4
1,140	38	3.12	14/2/13	100%	255,000	9.46	194,656	7.22	146.1	149.8	147.4	148.5	147.4	146.1	142.0	8.5
1,170	39	3.21	16/3/13	100%	255,000	9.72	194,656	7.42	146.4	149.9	147.6	148.7	147.6	146.4	142.2	8.7
1,200	40	3.29	15/4/13	100%	255,000	9.97	194,656	7.61	146.6	150.1	147.9	149.0	147.9	146.6	142.5	8.8
1,230	41	3.37	15/5/13	100%	255,000	10.23	194,656	7.81	146.9	150.2	148.1	149.2	148.1	146.9	142.7	8.9
1,260	42	3.45	14/6/13	100%	255,000	10.48	194,656	8.00	147.1	150.4	148.3	149.4	148.3	147.1	142.9	9.1

MEADOWBANK GOLD PROJECT - NUNAVUT
TAILINGS DEPOSITION PLAN
SOUTHERN BASIN
STAGE CURVE

Tailings production:	8.500 tpd	Tailings average dry density:	1,31 t/m3
Tailings beach slope:	1,00 %	Supernatant pond:	0,75 Mm3
Tailings below water slope:	5,00 %	Delta "T":	30 days

Time					Tailings Production			Tailings Volume		Spigot Elevation											Pond Elev.	Pond Depth
Day #	Month	Year	Year South	Date	Ramp-up	Period	Cum.	Partial	Cum.	7	8	9	10	11	12	13	14	15	16	17		
(-)				(d/m/y)	%	(t)	(Mt)	(m3)	(Mm3)	(m a.s.l.)												(m)
1.260	42	3,45		14-6-13	100%						95,3	95,3	95,6	96,9	96,7	96,8	96,6				105,0	11,2
1.290	43	3,53	0,08	14-7-13	100%	255.000	0,26	194.656	0,19		104,9	104,9	105,3	105,9	106,6	107,1	106,0				106,6	11,5
1.320	44	3,62	0,16	13-8-13	100%	255.000	0,51	194.656	0,39		107,1	107,2	107,5	108,2	108,8	109,4	108,3				107,9	12,4
1.350	45	3,70	0,25	12-9-13	100%	255.000	0,77	194.656	0,58		108,8	108,8	109,2	109,8	110,5	111,2	110,0				109,2	13,4
1.380	46	3,78	0,33	12-10-13	100%	255.000	1,02	194.656	0,78		110,3	110,4	110,7	111,4	112,1	112,8	111,5				110,4	14,6
1.410	47	3,86	0,41	11-11-13	100%	255.000	1,28	194.656	0,97		111,6	111,7	112,1	112,7	113,4	114,2	112,9				111,5	14,7
1.440	48	3,95	0,49	11-12-13	100%	255.000	1,53	194.656	1,17		112,9	113,1	113,4	114,0	114,8	115,5	114,2				112,7	14,9
1.470	49	4,03	0,58	10-1-14	100%	255.000	1,79	194.656	1,36		114,1	114,3	114,6	115,0	116,0	116,7	115,4				113,7	15,0
1.500	50	4,11	0,66	9-2-14	100%	255.000	2,04	194.656	1,56		115,3	115,4	115,8	115,9	117,1	117,9	116,6				114,7	15,1
1.530	51	4,19	0,74	11-3-14	100%	255.000	2,30	194.656	1,75		116,4	116,6	116,9	117,2	118,3	119,0	117,7				115,6	15,4
1.560	52	4,27	0,82	10-4-14	100%	255.000	2,55	194.656	1,95		117,4	117,6	118,0	118,4	119,3	120,1	118,8				116,5	15,3
1.590	53	4,36	0,90	10-5-14	100%	255.000	2,81	194.656	2,14		118,4	118,7	119,0	119,5	120,3	121,2	119,8				117,4	15,4
1.620	54	4,44	0,99	9-6-14	100%	255.000	3,06	194.656	2,34		119,4	119,7	120,0	120,6	121,3	122,2	120,8				118,2	15,3
1.650	55	4,52	1,07	9-7-14	100%	255.000	3,32	194.656	2,53		120,3	120,6	120,9	121,5	122,2	123,1	121,7				119,0	15,4
1.680	56	4,60	1,15	8-8-14	100%	255.000	3,57	194.656	2,73		121,2	121,5	121,8	122,4	123,2	124,1	122,6				119,8	15,5
1.710	57	4,68	1,23	7-9-14	100%	255.000	3,83	194.656	2,92		122,1	122,4	122,7	123,3	124,1	125,0	123,5				120,6	15,4
1.740	58	4,77	1,32	7-10-14	100%	255.000	4,08	194.656	3,11		123,0	123,2	123,6	124,2	124,9	125,9	124,3				121,3	15,4
1.770	59	4,85	1,40	6-11-14	100%	255.000	4,34	194.656	3,31		123,8	124,0	124,4	125,0	125,7	126,8	125,2				122,0	15,3
1.800	60	4,93	1,48	6-12-14	100%	255.000	4,59	194.656	3,50		124,6	124,8	125,2	125,8	126,5	127,7	126,0				122,7	15,2
1.830	61	5,01	1,56	5-1-15	100%	255.000	4,85	194.656	3,70		125,4	125,6	126,0	126,6	127,3	128,5	126,8				123,4	15,2
1.860	62	5,10	1,64	4-2-15	100%	255.000	5,10	194.656	3,89		126,1	126,3	126,7	127,3	128,1	129,3	127,5				124,0	15,1
1.890	63	5,18	1,73	6-3-15	100%	255.000	5,36	194.656	4,09		126,8	127,0	127,5	128,1	128,8	130,0	128,3				124,6	15,0
1.920	64	5,26	1,81	5-4-15	100%	255.000	5,61	194.656	4,28		127,4	127,7	128,2	128,8	129,5	130,8	129,0				125,2	14,9
1.950	65	5,34	1,89	5-5-15	100%	255.000	5,87	194.656	4,48		128,1	128,4	128,9	129,5	130,2	131,5	129,7				125,8	14,7
1.980	66	5,42	1,97	4-6-15	100%	255.000	6,12	194.656	4,67		128,7	129,0	129,6	130,2	130,9	132,2	130,4				126,4	14,6
2.010	67	5,51	2,05	4-7-15	100%	255.000	6,38	194.656	4,87		129,3	129,6	130,2	130,8	131,5	132,8	131,0				126,9	14,4
2.040	68	5,59	2,14	3-8-15	100%	255.000	6,63	194.656	5,06		129,9	130,3	130,8	131,4	132,1	133,5	131,6				127,4	14,2
2.070	69	5,67	2,22	2-9-15	100%	255.000	6,89	194.656	5,26		130,5	130,8	131,4	132,0	132,7	134,1	132,2				127,9	14,1
2.100	70	5,75	2,30	2-10-15	100%	255.000	7,14	194.656	5,45		131,1	131,4	132,0	132,6	133,3	134,7	132,8				128,4	13,9
2.130	71	5,84	2,38	1-11-15	100%	255.000	7,40	194.656	5,65		131,6	132,0	132,5	133,1	133,8	135,2	133,3				128,8	13,9
2.160	72	5,92	2,47	1-12-15	100%	255.000	7,65	194.656	5,84		132,2	132,5	133,1	133,6	134,4	135,8	133,8				129,3	13,8
2.190	73	6,00	2,55	31-12-15	100%	255.000	7,91	194.656	6,03		132,7	133,0	133,6	134,2	134,9	136,3	134,3				129,7	13,9
2.220	74	6,08	2,63	30-1-16	100%	255.000	8,16	194.656	6,23		133,2	133,5	134,1	134,6	135,3	136,7	134,8				130,0	14,2
2.250	75	6,16	2,71	29-2-16	100%	255.000	8,42	194.656	6,42		133,7	134,0	134,6	135,1	135,8	137,2	135,3				130,4	14,5
2.280	76	6,25	2,79	30-3-16	100%	255.000	8,67	194.656	6,62		134,2	134,5	135,0	135,6	136,3	137,7	135,7				130,8	14,5
2.310	77	6,33	2,88	29-4-16	100%	255.000	8,93	194.656	6,81		134,6	135,0	135,5	136,0	136,7	138,1	136,2				131,1	14,5
2.340	78	6,41	2,96	29-5-16	100%	255.000	9,18	194.656	7,01		135,1	135,4	135,9	136,5	137,2	138,6	136,6				131,5	14,5
2.370	79	6,49	3,04	28-6-16	100%	255.000	9,44	194.656	7,20		135,5	135,8	136,3	136,9	137,6	139,0	137,0				131,8	14,4
2.400	80	6,58	3,12	28-7-16	100%	255.000	9,69	194.656	7,40		135,9	136,3	136,8	137,3	138,0	139,4	137,4				132,1	14,4
2.430	81	6,66	3,21	27-8-16	100%	255.000	9,95	194.656	7,59		136,3	136,7	137,2	137,7	138,4	139,8	137,8				132,5	14,3
2.460	82	6,74	3,29	26-9-16	100%	255.000	10,20	194.656	7,79		136,8	137,1	137,6	138,1	138,8	140,2	138,2				132,8	14,2
2.490	83	6,82	3,37	26-10-16	100%	255.000	10,46	194.656	7,98		137,2	137,5	138,0	138,5	139,2	140,6	138,6				133,1	14,0
2.520	84	6,90	3,45	25-11-16	100%	255.000	10,71	194.656	8,18		137,5	137,9	138,4	138,9	139,6	141,0	139,0				133,4	14,0
2.550	85	6,99	3,53	25-12-16	100%	255.000	10,97	194.656	8,37		137,9	138,3	138,7	139,3	139,9	141,4	139,4				133,7	14,0

MEADOWBANK GOLD PROJECT - NUNAVUT
TAILINGS DEPOSITION PLAN
SOUTHERN BASIN
STAGE CURVE

Tailings production:	8.500 tpd	Tailings average dry density:	1,31 t/m3
Tailings beach slope:	1,00 %	Supernatant pond:	0,75 Mm3
Tailings below water slope:	5,00 %	Delta "T":	30 days

Time					Tailings Production			Tailings Volume		Spigot Elevation											Pond Elev.	Pond Depth
Day #	Month	Year	Year South	Date	Ramp-up	Period	Cum.	Partial	Cum.	7	8	9	10	11	12	13	14	15	16	17		
(-)				(d/m/y)	%	(t)	(Mt)	(m3)	(Mm3)	(m a.s.l.)												(m)
2.580	86	7,07	3,62	24-1-17	100%	255.000	11,22	194.656	8,56		138,3	138,6	139,1	139,7	140,3	141,7	139,8				134,0	14,0
2.610	87	7,15	3,70	23-2-17	100%	255.000	11,48	194.656	8,76		138,7	139,0	139,5	140,0	140,7	142,1	140,1				134,3	13,9
2.640	88	7,23	3,78	25-3-17	100%	255.000	11,73	194.656	8,95		139,1	139,4	139,9	140,4	141,0	142,5	140,5				134,6	13,7
2.670	89	7,32	3,86	24-4-17	100%	255.000	11,99	194.656	9,15		139,4	139,7	140,2	140,7	141,4	142,8	140,9				134,9	13,6
2.700	90	7,40	3,95	24-5-17	100%	255.000	12,24	194.656	9,34		139,8	140,1	140,6	141,1	141,8	143,2	141,2				135,2	13,5
2.730	91	7,48	4,03	23-6-17	100%	255.000	12,50	194.656	9,54		140,1	140,5	140,9	141,5	142,1	143,6	141,6				135,5	13,4
2.760	92	7,56	4,11	23-7-17	100%	255.000	12,75	194.656	9,73		140,5	140,8	141,3	141,8	142,5	143,9	141,9				135,8	13,3
2.790	93	7,64	4,19	22-8-17	100%	255.000	13,01	194.656	9,93		140,9	141,2	141,6	142,2	142,8	144,3	142,2				136,1	13,2
2.820	94	7,73	4,27	21-9-17	100%	255.000	13,26	194.656	10,12		141,2	141,5	142,0	142,5	143,1	144,6	142,6				136,3	13,2
2.850	95	7,81	4,36	21-10-17	100%	255.000	13,52	194.656	10,32		141,5	141,8	142,3	142,8	143,5	144,9	142,9				136,6	13,2
2.880	96	7,89	4,44	20-11-17	100%	255.000	13,77	194.656	10,51		141,9	142,2	142,6	143,2	143,8	145,3	143,2				136,9	13,2
2.910	97	7,97	4,52	20-12-17	100%	255.000	14,03	194.656	10,71		142,2	142,5	143,0	143,5	144,1	145,6	143,6				137,2	13,2
2.940	98	8,05	4,60	19-1-18	100%	255.000	14,28	194.656	10,90		142,6	142,9	143,3	143,8	144,5	145,9	143,9				137,4	13,2
2.970	99	8,14	4,68	18-2-18	100%	255.000	14,54	194.656	11,10		142,9	143,2	143,6	144,1	144,8	146,2	144,2				137,7	13,2
3.000	100	8,22	4,77	20-3-18	100%	255.000	14,79	194.656	11,29		143,2	143,5	144,0	144,5	145,1	146,5	144,5				138,0	13,2
3.030	101	8,30	4,85	19-4-18	100%	255.000	15,05	194.656	11,48		143,5	143,8	144,3	144,8	145,4	146,8	144,8				138,2	13,2
3.060	102	8,38	4,93	19-5-18	100%	255.000	15,30	194.656	11,68		143,9	144,1	144,6	145,1	145,7	147,2	145,1				138,5	13,2
3.090	103	8,47	5,01	18-6-18	100%	255.000	15,56	194.656	11,87		144,2	144,5	144,9	145,4	146,0	147,5	145,4				138,7	13,1
3.120	104	8,55	5,10	18-7-18	100%	255.000	15,81	194.656	12,07		144,5	144,8	145,2	145,7	146,3	147,8	145,7				139,0	13,1
3.150	105	8,63	5,18	17-8-18	100%	255.000	16,07	194.656	12,26		144,8	145,1	145,5	146,0	146,6	148,1	146,0				139,2	13,1
3.180	106	8,71	5,26	16-9-18	100%	255.000	16,32	194.656	12,46		145,1	145,4	145,8	146,3	146,9	148,3	146,3				139,5	13,1
3.210	107	8,79	5,34	16-10-18	100%	255.000	16,58	194.656	12,65		145,4	145,7	146,1	146,6	147,2	148,6	146,6				139,7	13,1
3.240	108	8,88	5,42	15-11-18	100%	255.000	16,83	194.656	12,85		145,7	146,0	146,4	146,9	147,5	148,9	146,9				140,0	13,1
3.270	109	8,96	5,51	15-12-18	100%	255.000	17,09	194.656	13,04		146,0	146,3	146,7	147,2	147,8	149,1	147,2				140,2	13,1
3.300	110	9,04	5,59	14-1-19	100%	255.000	17,34	194.656	13,24		146,4	146,7	147,1	147,6	148,2	149,1	147,5				140,5	13,0
3.330	111	9,12	5,67	13-2-19	100%	255.000	17,60	194.656	13,43		146,7	147,0	147,4	147,9	148,5	149,1	147,8				140,7	12,9
3.360	112	9,21	5,75	15-3-19	100%	255.000	17,85	194.656	13,63		147,0	147,3	147,7	148,2	148,8	149,1	148,1				141,0	12,9
3.390	113	9,29	5,84	14-4-19	100%	255.000	18,11	194.656	13,82		147,4	147,7	148,1	148,5	149,1	149,1	148,4				141,3	12,8
3.420	114	9,37	5,92	14-5-19	100%	255.000	18,36	194.656	14,02		147,6	147,8	148,2	148,6	149,2	149,1	148,5				141,6	12,4
3.450	115	9,45	6,00	13-6-19	100%	255.000	18,62	194.656	14,21		147,8	148,0	148,2	148,6	149,2	149,1	148,5				142,0	12,0
3.480	116	9,53	6,08	13-7-19	100%	255.000	18,87	194.656	14,40		148,0	148,1	148,3	148,6	149,2	149,1	148,5				142,4	11,7
3.510	117	9,62	6,16	12-8-19	100%	255.000	19,13	194.656	14,60		148,2	148,2	148,4	148,6	149,2	149,1	148,5				142,8	11,3
3.540	118	9,70	6,25	11-9-19	100%	255.000	19,38	194.656	14,79		148,4	148,4	148,4	148,6	149,2	149,1	148,5				143,2	10,9
3.570	119	9,78	6,33	11-10-19	100%	255.000	19,64	194.656	14,99	148,6	148,6	148,6	148,6	148,7	149,2	149,1	148,6	148,6	148,6	148,6	143,6	10,5
3.600	120	9,86	6,33	10-11-19	100%	255.000	19,89	194.656	15,18	149,1	149,1	149,1	149,1	149,1	149,4	149,3	149,1	149,1	149,1	149,1	144,0	10,4
3.630	121	9,95	6,33	10-12-19	100%	255.000	20,15	194.656	15,38	149,6	149,6	149,6	149,6	149,6	149,5	149,5	149,6	149,6	149,6	149,6	144,4	10,4

MEADOWBANK GOLD PROJECT - NUNAVUT
TAILINGS STORAGE FACILITY
STRUCK LEVEL STORAGE VOLUMES

Elevation (masl)	South Cell Volume (m^3)	North Cell Volume (m^3)	Total Volume (m^3)
96			
97	26890		26890
98	71192		71192
99	132247		132247
100	206994		206994
101	293238		293238
102	388407		388407
103	491931		491931
104	603234		603234
105	721971		721971
106	847856		847856
107	980719		980719
108	1120468		1120468
109	1267116		1267116
110	1420664		1420664
111	1581154		1581154
112	1748593		1748593
113	1923089		1923089
114	2104751		2104751
115	2293729		2293729
116	2490503		2490503
117	2695575		2695575
118	2909019		2909019
119	3130744		3130744
120	3360871		3360871
121	3599753		3599753
122	3847880		3847880
123	4106199	33835	4140034
124	4375668	96914	4472581
125	4657323	186692	4844016
126	4952440	305137	5257577
127	5263185	453132	5716317
128	5592474	630207	6222681
129	5946926	843646	6790572
130	6328577	1090641	7419217
131	6734250	1365513	8099762
132	7164408	1676237	8840644
133	7618592	2027673	9646265
134	8098145	2422997	10521142
135	8601959	2861123	11463081
136	9127032	3337505	12464537
137	9676084	3851707	13527791
138	10254711	4402802	14657513
139	10862539	4992872	15855410
140	11494203	5628429	17122632
141	12146527	6309924	18456451
142	12817744	7031356	19849099
143	13506716	7796669	21303384
144	14216201	8638963	22855164

MEADOWBANK GOLD PROJECT - NUNAVUT
TAILINGS STORAGE FACILITY
STRUCK LEVEL STORAGE VOLUMES

Elevation (masl)	South Cell Volume (m^3)	North Cell Volume (m^3)	Total Volume (m^3)
145	14944459	9581624	24526083
146	15687154	10630023	26317177
147	16446283	11778939	28225222
148	17224275	13022939	30247214
149	18023671	14358184	32381855
150	18896552	15792115	34688667

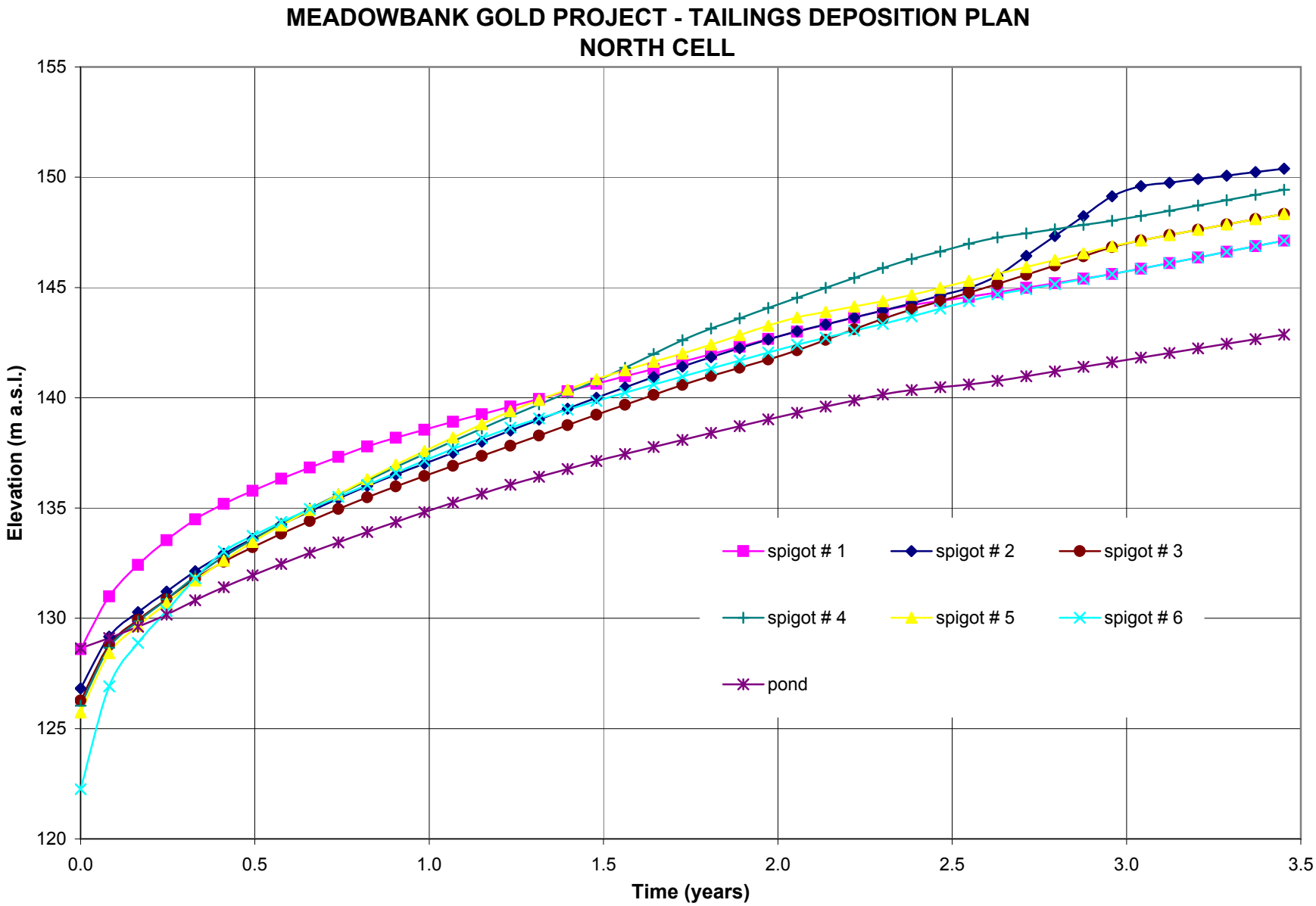


Figure VI-3: Northern Basin Stage Curve

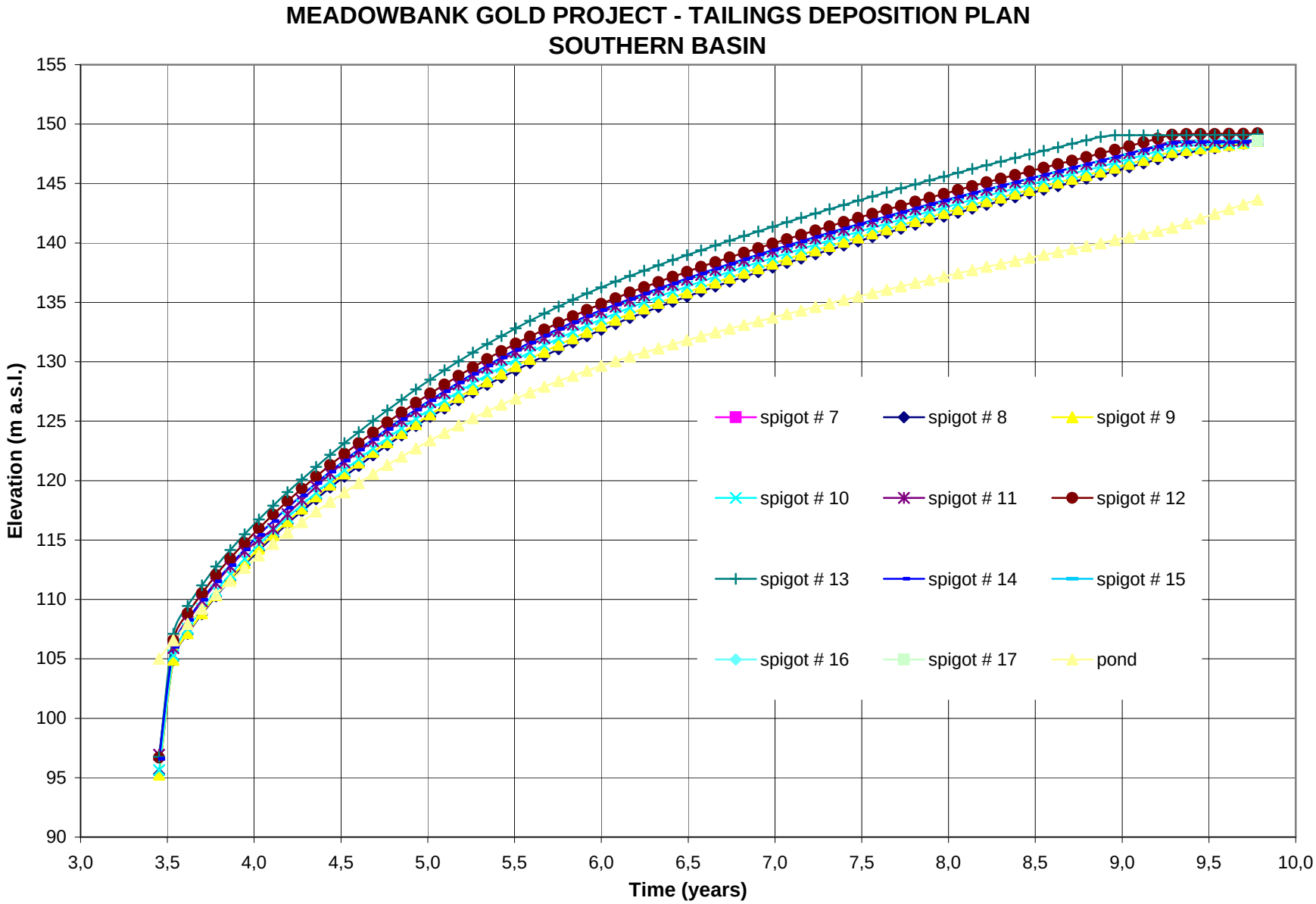
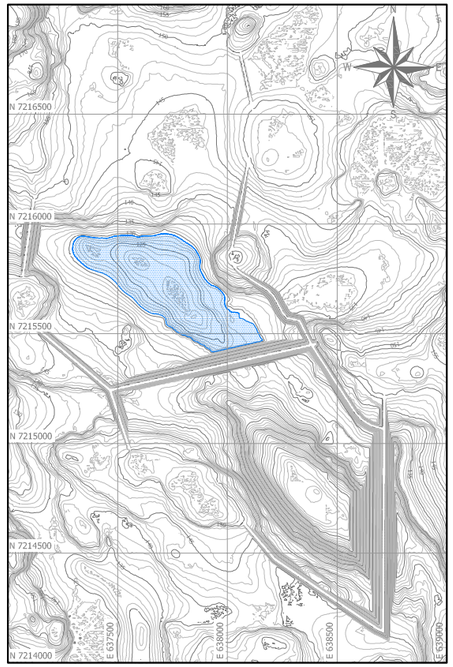


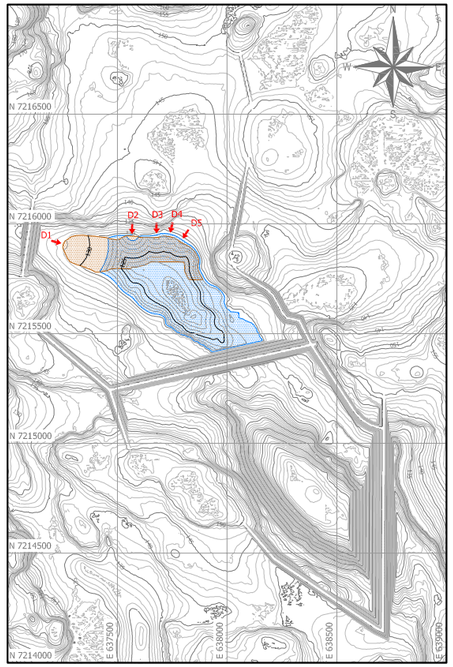
Figure VI-4: Southern Basin Stage Curve



INITIAL POND NORTHERN BASIN

SCALE 1:12500

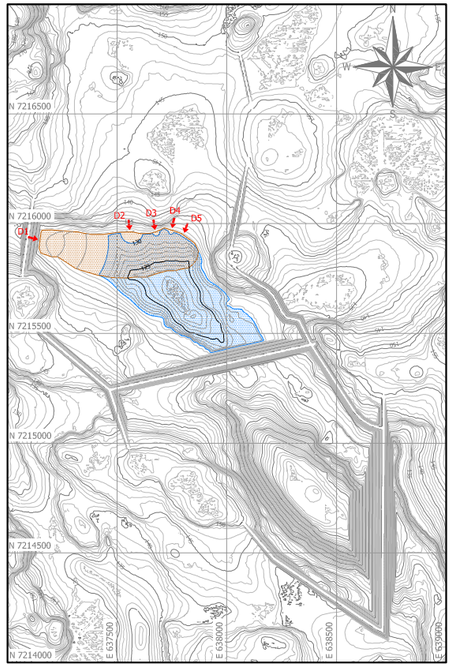
TIME	(months)	0,0
CUMULATIVE VOLUME	(Mm^3)	--
CUMULATIVE TONNAGE	(Mt)	--
POND ELEVATION	(m a.s.l.)	128,7
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	--
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	--



1,1 MONTHS

SCALE 1:12500

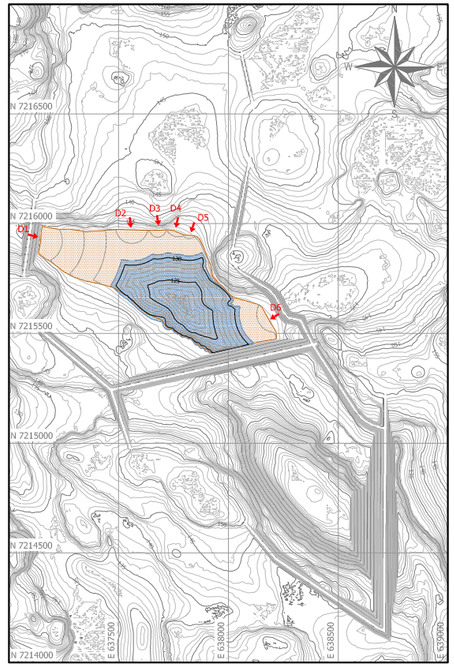
TIME	(months)	1,1
CUMULATIVE VOLUME	(Mm^3)	0,1
CUMULATIVE TONNAGE	(Mt)	0,2
POND ELEVATION	(m a.s.l.)	129,2
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	131,2
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	--



2,2 MONTHS

SCALE 1:12500

TIME	(months)	2,2
CUMULATIVE VOLUME	(Mm^3)	0,3
CUMULATIVE TONNAGE	(Mt)	0,4
POND ELEVATION	(m a.s.l.)	129,7
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	132,7
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	--



4,6 MONTHS

SCALE 1:12500

TIME	(months)	4,6
CUMULATIVE VOLUME	(Mm^3)	0,7
CUMULATIVE TONNAGE	(Mt)	1,0
POND ELEVATION	(m a.s.l.)	131,3
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	135,0
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	131,8

SIMBOLOGY:

- Supernatant Pond
- Deposited Tailings
- D# Main Active Spigots

Notes:

1. The dam alignments shown are indicative only. Detailed alignments will be defined in final design.
2. The dam footprint shown pertain to the estimated maximum crest elevations. The construction of the dams will be staged or deferred.
3. An average tailings dry density of 1,31 t/m^3 has been assumed. The estimated maximum required tailings tonnage is 29,3 Mt.
4. Supernatant pond volume: 0,75 Mm^3.
5. Tailings beach slope: 1%
6. Subaqueous tailings slope: 5%

250 125 0 125 250
Scale 1:12500

REFERENCIAS

PLANO	DESCRIPCION
-	-

REVISIONES

Nº	FECHA	DISEÑO	DIBUJO	J.P.	C.C.	D.P.	DESCRIPCION
.	.	.	.	.	.	.	.

CLIENTE	NOMBRE	FIRMA	FECHA
LIDER INGENIERIA	.		.
DIRECTOR DE PROYECTO	.		.
ADMINISTRADOR GRAL.	.		.

GOLDER ASSOCIATES S.A.	NOMBRE	FIRMA	FECHA
DISEÑO	M.S.		NOV. 2008
DIBUJO	P.B.		NOV. 2008
JEFE PROYECTO	M.M.		NOV. 2008
CONTROL DE CALIDAD	M.B.		NOV. 2008
DIRECTOR DE PROYECTO	M.B.		NOV. 2008

MEADOWBANK GOLD PROJECT

TITULO PROYECTO

CONCEPTUAL TAILINGS DEPOSITION PLAN
NORTHERN BASIN
SHEET 1 OF 3

Golder Associates

Figure VI-5

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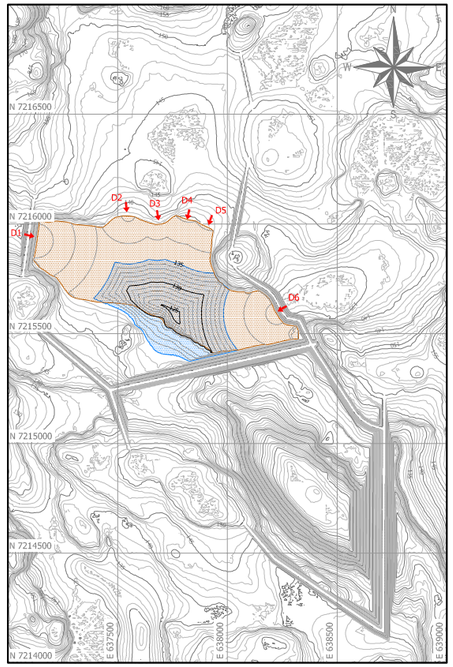
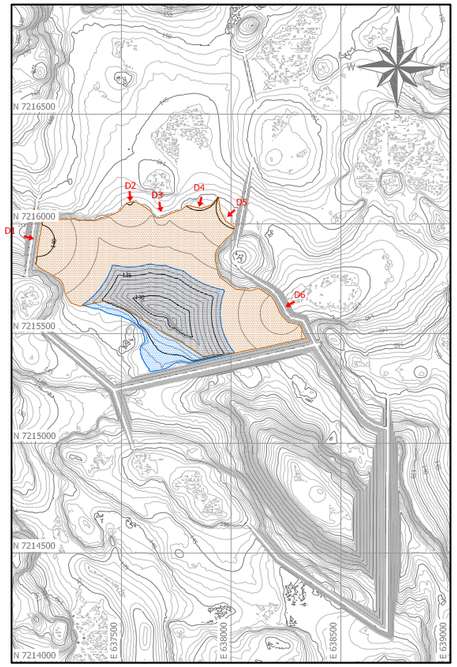


1,0 YEARS

SCALE 1:12500

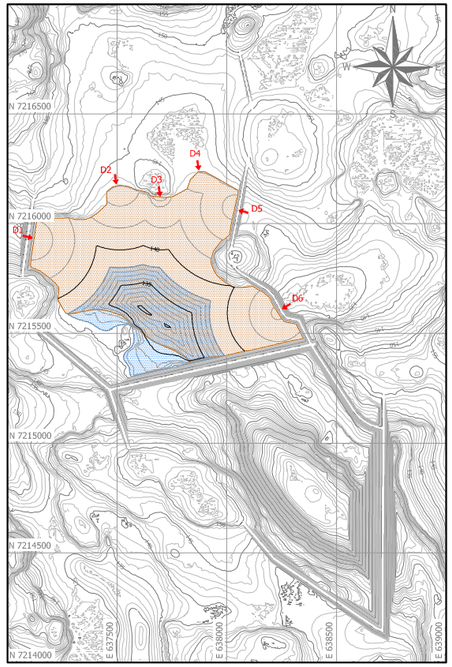
TIME	(years)	1,0
CUMULATIVE VOLUME	(Mm^3)	2,3
CUMULATIVE TONNAGE	(Mt)	3,0
POND ELEVATION	(m a.s.l.)	135,1
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	138,8
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	136,3



1,5 YEARS

SCALE 1:12500

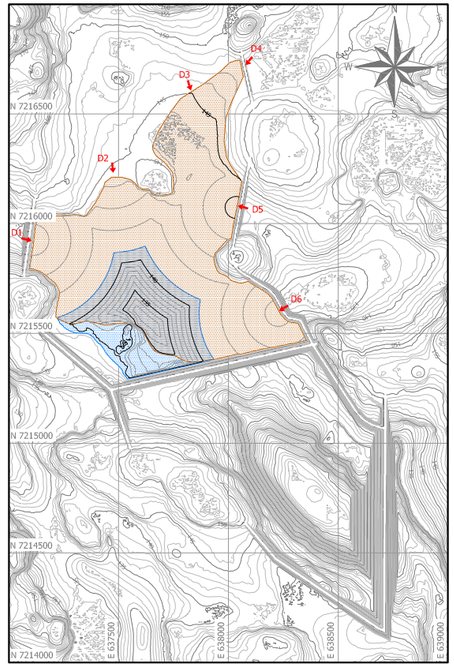
TIME	(years)	1,5
CUMULATIVE VOLUME	(Mm^3)	3,4
CUMULATIVE TONNAGE	(Mt)	4,4
POND ELEVATION	(m a.s.l.)	137,2
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	141,0
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	138,6



2,0 YEARS

SCALE 1:12500

TIME	(years)	2,0
CUMULATIVE VOLUME	(Mm^3)	4,6
CUMULATIVE TONNAGE	(Mt)	6,1
POND ELEVATION	(m a.s.l.)	139,2
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	144,4
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	140,8



2,6 YEARS

SCALE 1:12500

TIME	(years)	2,6
CUMULATIVE VOLUME	(Mm^3)	6,0
CUMULATIVE TONNAGE	(Mt)	7,8
POND ELEVATION	(m a.s.l.)	140,7
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	147,2
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	142,9

SIMBOLOGY:

- Supernatant Pond
- Deposited Tailings
- D# Main Active Spigots

Notes:

1. The dam alignments shown are indicative only. Detailed alignments will be defined in final design.
2. The dam footprint shown pertain to the estimated maximum crest elevations. The construction of the dams will be staged or deferred.
3. An average tailings dry density of 1,31 t/m^3 has been assumed. The estimated maximum required tailings tonnage is 29,3 Mt.
4. Supernatant pond volume: 0,75 Mm^3.
5. Tailings beach slope: 1%
6. Subaqueous tailings slope: 5%

250 125 0 125 250

Scale 1:12500

MEADOWBANK GOLD PROJECT

TITULO PROYECTO

CONCEPTUAL TAILINGS DEPOSITION PLAN
NORTHERN BASIN
SHEET 2 OF 3

Figure VI-6

REFERENCIAS		
PLANO	DESCRIPCION	
-	-	

REVISIONES							
Nº	FECHA	DISEÑO	DIBUJO	J.P.	C.C.	D.P.	DESCRIPCION
.	.	.	.	.	.	.	.

CLIENTE			
	NOMBRE	FIRMA	FECHA
LIDER INGENIERIA	.		.
DIRECTOR DE PROYECTO	.		.
ADMINISTRADOR GRAL.	.		.

GOLDER ASSOCIATES S.A.			
	NOMBRE	FIRMA	FECHA
DISEÑO	M.S.		NOV. 2008
DIBUJO	P.B.		NOV. 2008
JEFE PROYECTO	M.M.		NOV. 2008
CONTROL DE CALIDAD	M.B.		NOV. 2008
DIRECTOR DE PROYECTO	M.B.		NOV. 2008

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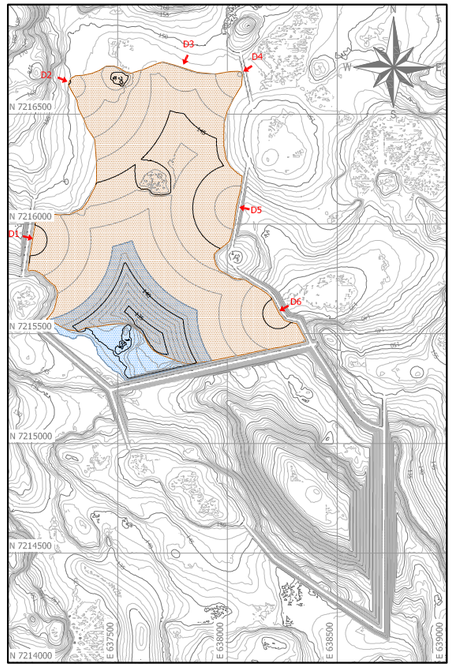
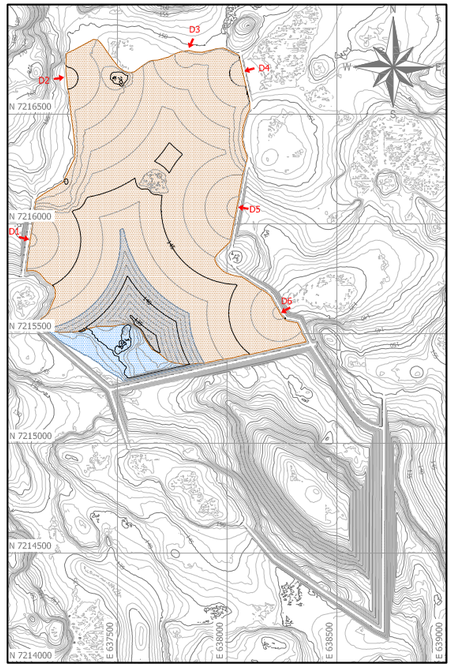


3,0 YEARS

SCALE 1:12500

TIME	(years)	3,0
CUMULATIVE VOLUME	(Mm^3)	6,9
CUMULATIVE TONNAGE	(Mt)	9,1
POND ELEVATION	(m a.s.l.)	141,7
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	149,5
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	144,3



3,5 YEARS

SCALE 1:12500

TIME	(years)	3,5
CUMULATIVE VOLUME	(Mm^3)	8,1
CUMULATIVE TONNAGE	(Mt)	10,7
POND ELEVATION	(m a.s.l.)	143,0
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	150,5
TAILINGS ELEVATION AGAINST SOUTHERN DAM	(m a.s.l.)	145,8

SIMBOLOGY:

- Supernatant Pond
- Deposited Tailings
- D# Main Active Spigots

Notes:

1. The dam alignments shown are indicative only. Detailed alignments will be defined in final design.
2. The dam footprint shown pertain to the estimated maximum crest elevations. The construction of the dams will be staged or deferred.
3. An average tailings dry density of 1,31 t/m^3 has been assumed. The estimated maximum required tailings tonnage is 29,3 Mt.
4. Supernatant pond volume: 0,75 Mm^3.
5. Tailings beach slope: 1%
6. Subaqueous tailings slope: 5%

250 125 0 125 250

Scale 1:12500

MEADOWBANK GOLD PROJECT

TITULO PROYECTO

CONCEPTUAL TAILINGS DEPOSITION PLAN
NORTHERN BASIN
SHEET 3 OF 3

Figure VI-7

REFERENCIAS		
PLANO	DESCRIPCION	
-	-	

REVISIONES								
Nº	FECHA	DISEÑO	DIBUJO	J.P.	C.C.	D.P.	DESCRIPCION	
.	.	.	.	.	.	.	.	

CLIENTE			
	NOMBRE	FIRMA	FECHA
LIDER INGENIERIA	.		.
DIRECTOR DE PROYECTO	.		.
ADMINISTRADOR GRAL.	.		.

GOLDER ASSOCIATES S.A.			
	NOMBRE	FIRMA	FECHA
DISEÑO	M.S.		NOV. 2008
DIBUJO	P.B.		NOV. 2008
JEFE PROYECTO	M.M.		NOV. 2008
CONTROL DE CALIDAD	M.B.		NOV. 2008
DIRECTOR DE PROYECTO	M.B.		NOV. 2008

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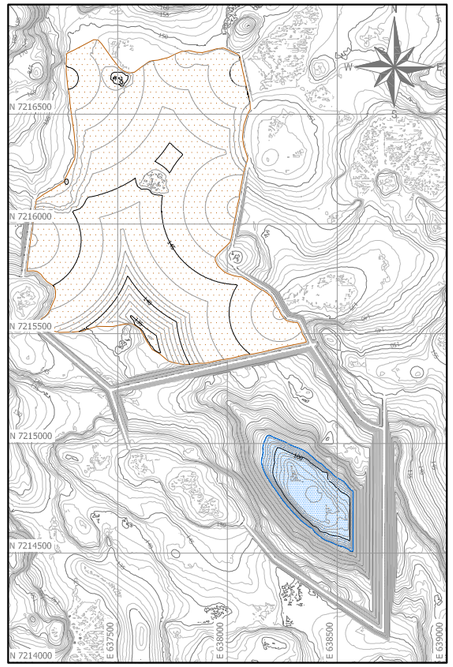
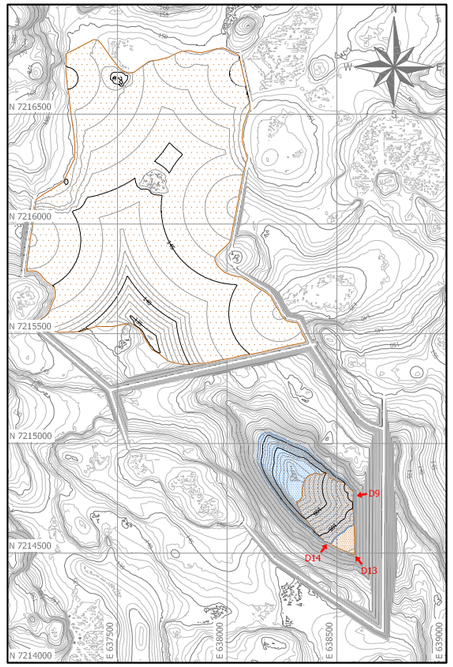


INITIAL POND SOUTHERN BASIN

SCALE 1:12500

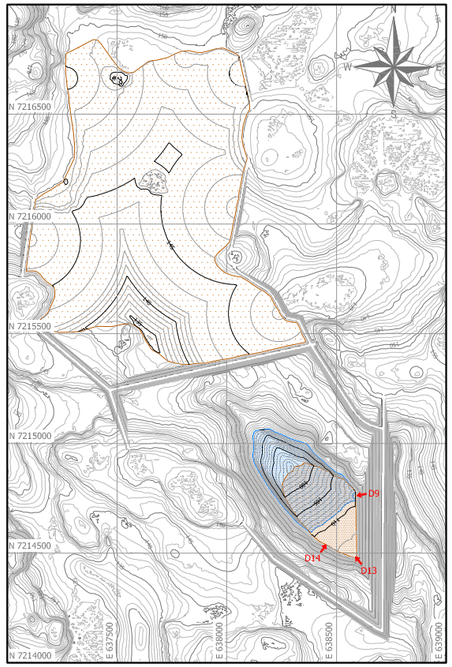
TIME	(years)	3,5
CUMULATIVE VOLUME	(Mm^3)	8,1
CUMULATIVE TONNAGE	(Mt)	10,7
POND ELEVATION	(m a.s.l.)	105,0
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	--
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	--



3,6 YEARS

SCALE 1:12500

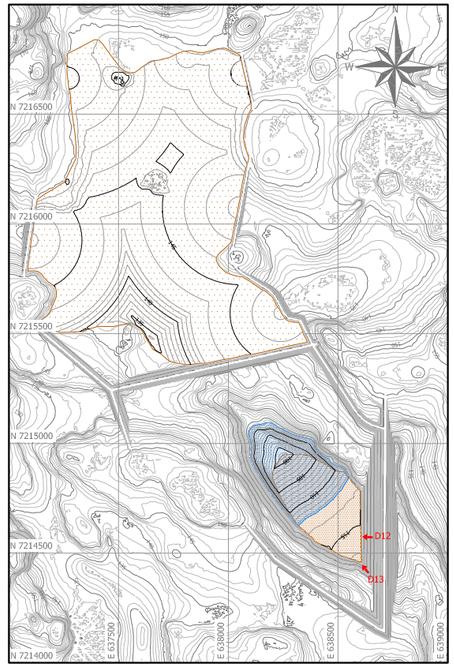
TIME	(years)	3,6
CUMULATIVE VOLUME	(Mm^3)	8,3
CUMULATIVE TONNAGE	(Mt)	10,8
POND ELEVATION	(m a.s.l.)	107,1
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	108,3
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	108,3



3,7 YEARS

SCALE 1:12500

TIME	(years)	3,7
CUMULATIVE VOLUME	(Mm^3)	8,7
CUMULATIVE TONNAGE	(Mt)	11,4
POND ELEVATION	(m a.s.l.)	109,7
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	111,9
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	111,9



4,0 YEARS

SCALE 1:12500

TIME	(years)	4,0
CUMULATIVE VOLUME	(Mm^3)	9,3
CUMULATIVE TONNAGE	(Mt)	12,2
POND ELEVATION	(m a.s.l.)	113,4
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	116,4
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	116,4

SIMBOLOGY:

- Supernatant Pond
- Deposited Tailings
- D# Main Active Spigots

Notes:

1. The dam allgnments shown are indicative only. Detailed allgnments will be defined in final design.
2. The dam footprinst shown pertain to the estimated maximum crest elevations. The construction of the dams will be staged or deferred.
3. An average tailings dry density of 1,31 t/m^3 has been assumed. The estimated maximum required tailings tonnage is 29,3 Mt.
4. Supernatant pond volume: 0,75 Mm^3.
5. Tailings beach slope: 1%
6. Subaqueous tallings slope: 5%
7. Indicated volumes, tonnages and times include the northern basin operation.

250 125 0 125 250
Scale 1:12500

REFERENCIAS

PLANO	DESCRIPCION
-	-

REVISIONES

Nº	FECHA	DISEÑO	DIBUJO	J.P.	C.C.	D.P.	DESCRIPCION
.	.	.	.	.	.	.	.

CLIENTE	NOMBRE	FIRMA	FECHA
LIDER INGENIERIA	.		.
DIRECTOR DE PROYECTO	.		.
ADMINISTRADOR GRAL.	.		.

GOLDER ASSOCIATES S.A.	NOMBRE	FIRMA	FECHA
DISEÑO	M.S.		NOV. 2008
DIBUJO	P.B.		NOV. 2008
JEFE PROYECTO	M.M.		NOV. 2008
CONTROL DE CALIDAD	M.B.		NOV. 2008
DIRECTOR DE PROYECTO	M.B.		NOV. 2008

MEADOWBANK GOLD PROJECT

TITULO PROYECTO

CONCEPTUAL TAILINGS DEPOSITION PLAN
SOUTHERN BASIN
SHEET 1 OF 3

Golder Associates

Figure VI-8

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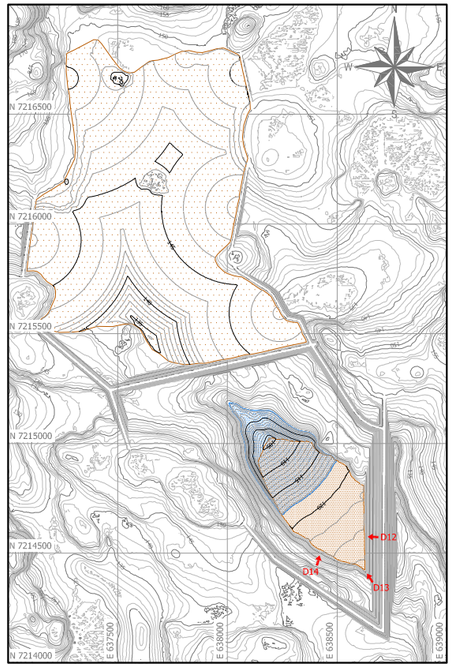
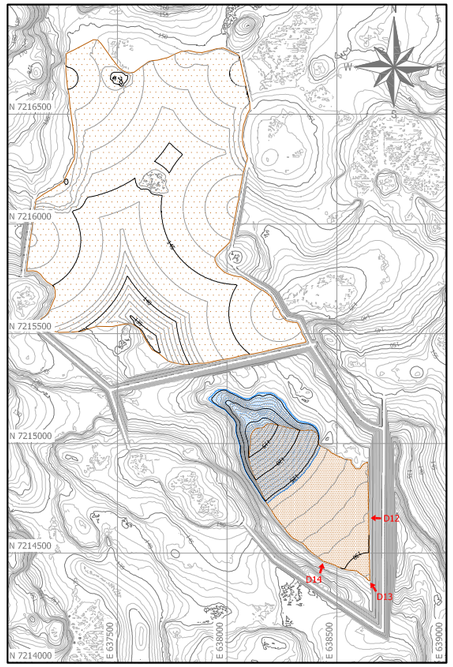


4,5 YEARS

SCALE 1:12500

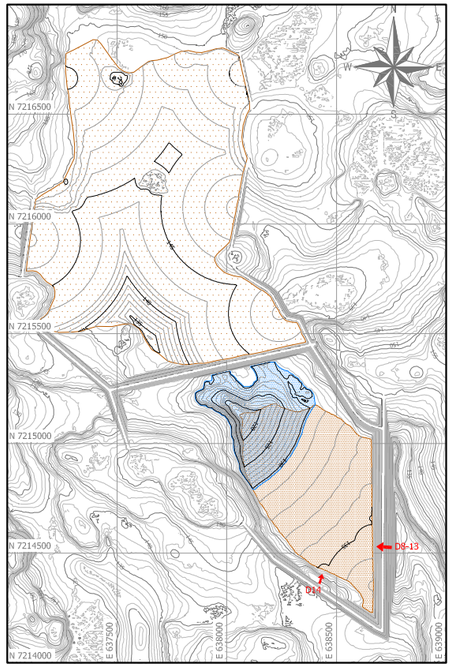
TIME	(years)	4,5
CUMULATIVE VOLUME	(Mm^3)	10,6
CUMULATIVE TONNAGE	(Mt)	13,9
POND ELEVATION	(m a.s.l.)	119,3
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	123,4
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	123,4



5,3 YEARS

SCALE 1:12500

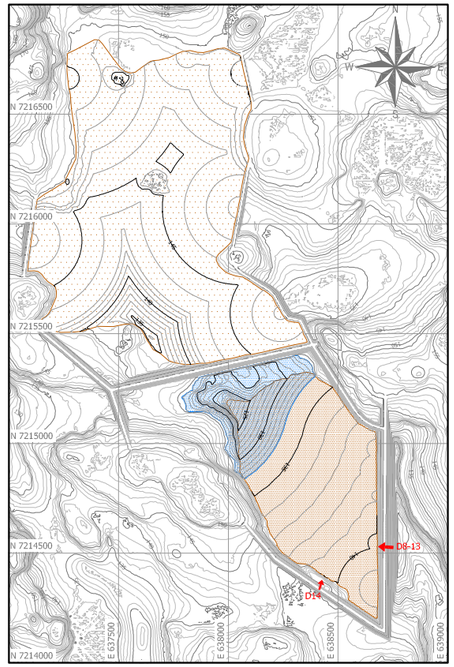
TIME	(years)	5,3
CUMULATIVE VOLUME	(Mm^3)	12,4
CUMULATIVE TONNAGE	(Mt)	16,2
POND ELEVATION	(m a.s.l.)	125,6
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	131,2
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	131,2



6,2 YEARS

SCALE 1:12500

TIME	(years)	6,2
CUMULATIVE VOLUME	(Mm^3)	14,4
CUMULATIVE TONNAGE	(Mt)	18,9
POND ELEVATION	(m a.s.l.)	130,4
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	137,2
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	137,2



7,1 YEARS

SCALE 1:12500

TIME	(years)	7,1
CUMULATIVE VOLUME	(Mm^3)	16,6
CUMULATIVE TONNAGE	(Mt)	21,8
POND ELEVATION	(m a.s.l.)	134,1
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	141,9
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	141,9

SIMBOLOGY:

- Supernatant Pond
- Deposited Tailings
- D# Main Active Spigots

Notes:

1. The dam allgnments shown are indicative only. Detailed allgnments will be defined in final design.
2. The dam footprinst shown pertain to the estimated maximum crest elevations. The construction of the dams will be staged or deferred.
3. An average tailings dry density of 1,31 t/m^3 has been assumed. The estimated maximum required tailings tonnage is 29,3 Mt.
4. Supernatant pond volume: 0,75 Mm^3.
5. Tailings beach slope: 1%
6. Subaqueous tallings slope: 5%
7. Indicated volumes, tonnages and times include the northern basin operation.

250 125 0 125 250
Scale 1:12500

MEADOWBANK GOLD PROJECT

TITULO PROYECTO

CONCEPTUAL TAILINGS DEPOSITION PLAN
SOUTHERN BASIN
SHEET 2 OF 3

Figure VI-9

REFERENCIAS

PLANO	DESCRIPCION
-	-

REVISIONES

Nº	FECHA	DISEÑO	DIBUJO	J.P.	C.C.	D.P.	DESCRIPCION
.	.	.	.	.	.	.	.

CLIENTE	NOMBRE	FIRMA	FECHA
LIDER INGENIERIA	.		.
DIRECTOR DE PROYECTO	.		.
ADMINISTRADOR GRAL.	.		.

GOLDER ASSOCIATES S.A.	NOMBRE	FIRMA	FECHA
DISEÑO	M.S.		NOV. 2008
DIBUJO	P.B.		NOV. 2008
JEFE PROYECTO	M.M.		NOV. 2008
CONTROL DE CALIDAD	M.B.		NOV. 2008
DIRECTOR DE PROYECTO	M.B.		NOV. 2008

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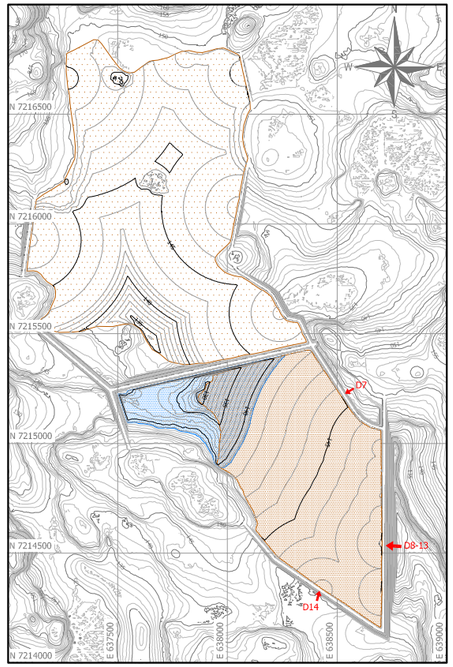
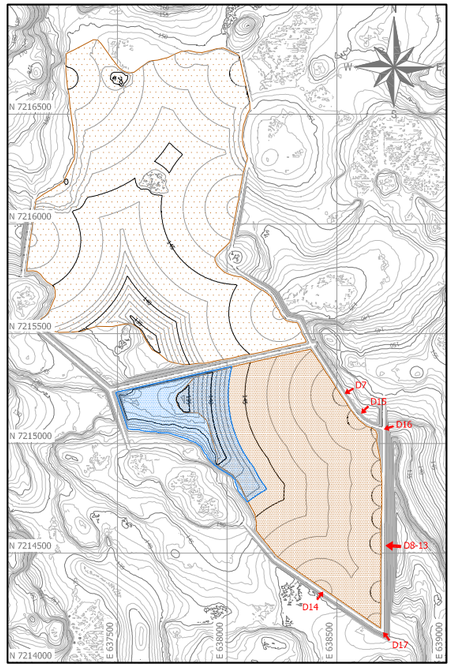


9,3 YEARS

SCALE 1:12500

TIME	(years)	9,3
CUMULATIVE VOLUME	(Mm^3)	21,9
CUMULATIVE TONNAGE	(Mt)	28,6
POND ELEVATION	(m a.s.l.)	141,3
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	149,2
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	149,2



9,7 YEARS

SCALE 1:12500

TIME	(years)	9,7
CUMULATIVE VOLUME	(Mm^3)	23,4
CUMULATIVE TONNAGE	(Mt)	30,6
POND ELEVATION	(m a.s.l.)	144,3
MAXIMUM TAILINGS DISCHARGE ELEVATION	(m a.s.l.)	149,5
TAILINGS ELEVATION AGAINST EASTERN DAM	(m a.s.l.)	149,5

SIMBOLOGY:

- Supernatant Pond
- Deposited Tailings
- D# Main Active Spigots

Notes:

1. The dam allgnments shown are indicative only. Detailed allgnments will be defined in final design.
2. The dam footprinst shown pertain to the estimated maximum crest elevations. The construction of the dams will be staged or deferred.
3. An average tailings dry density of 1,31 t/m^3 has been assumed. The estimated maximum required tailings tonnage is 29,3 Mt.
4. Supernatant pond volume: 0,75 Mm^3.
5. Tailings beach slope: 1%
6. Subaqueous tallings slope: 5%
7. Indicated volumes, tonnages and times include the northern basin operation.

250 125 0 125 250
Scale 1:12500

REFERENCIAS

PLANO	DESCRIPCION
-	-

REVISIONES

Nº	FECHA	DISEÑO	DIBUJO	J.P.	C.C.	D.P.	DESCRIPCION
.	.	.	.	.	.	.	.

CLIENTE	NOMBRE	FIRMA	FECHA
LIDER INGENIERIA	.		.
DIRECTOR DE PROYECTO	.		.
ADMINISTRADOR GRAL.	.		.

GOLDER ASSOCIATES S.A.	NOMBRE	FIRMA	FECHA
DISEÑO	M.S.		NOV. 2008
DIBUJO	P.B.		NOV. 2008
JEFE PROYECTO	M.M.		NOV. 2008
CONTROL DE CALIDAD	M.B.		NOV. 2008
DIRECTOR DE PROYECTO	M.B.		NOV. 2008

MEADOWBANK GOLD PROJECT

TITULO PROYECTO

CONCEPTUAL TAILINGS DEPOSITION PLAN
SOUTHERN BASIN
SHEET 3 OF 3

Golder Associates

Figure VI-10

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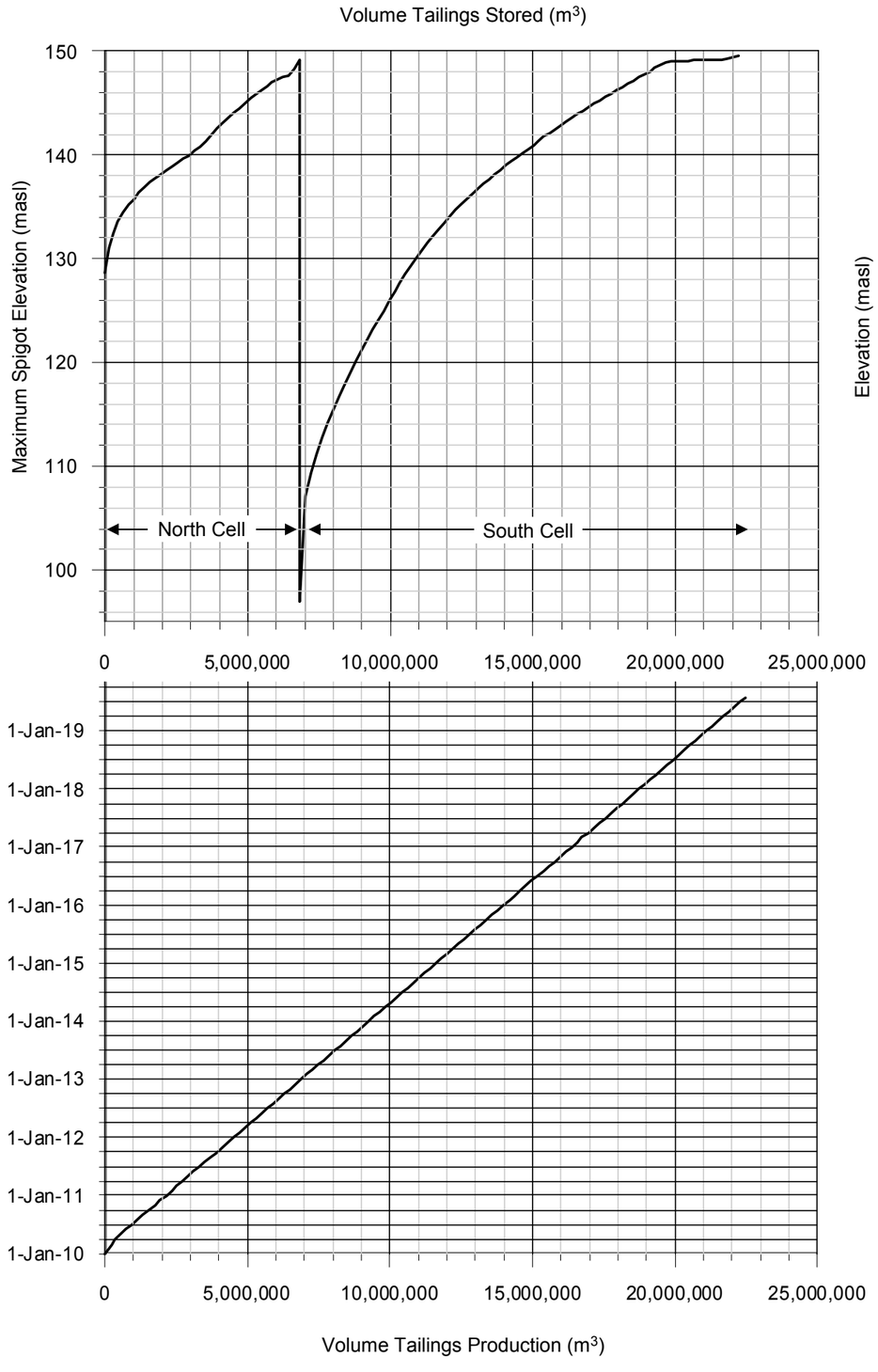

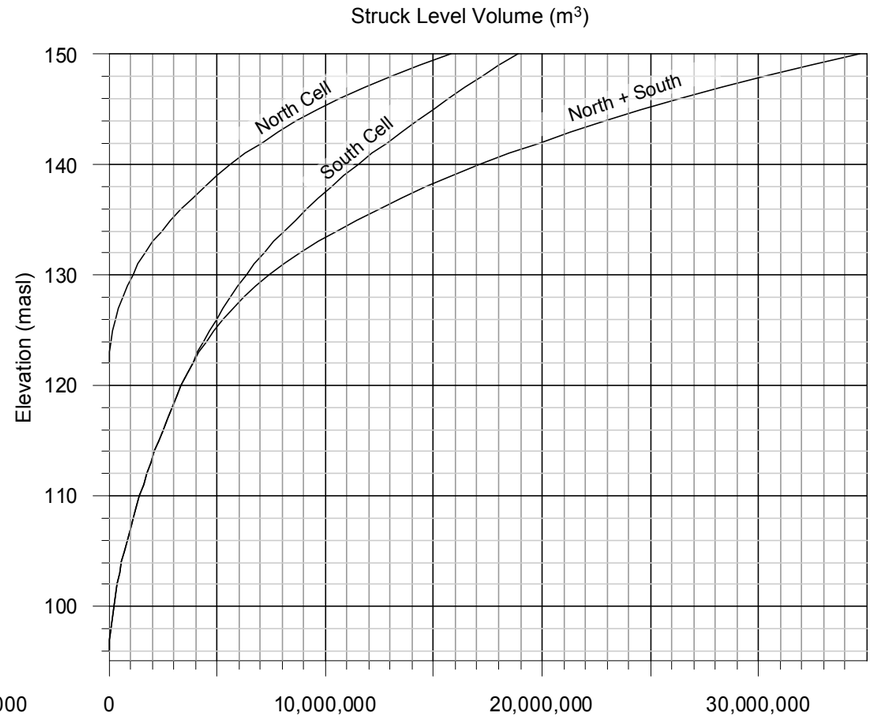

Tailings density of 1.31 t/m^3 including 20% for ice entrapment.

1% beach slope

60% capacity Month 1

70% capacity Month 2

80% capacity Month 3

then 8500 tpd

Volume tailings stored is based on data from preliminary tailings deposition plan for North and South Cell. Elevations based on maximum spigot elevation..

Combined deposition curve the North Cell is filled first, followed by the South Cell.

Freeboard requirements:

•Central Dike 2 m

•Saddle Dams 2 m

•Divider Dike 1 m

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS PRODUCTION AND STORAGE

Golder Associates

PROJECT No. 08-1428-0029			FILE No. ----	
DESIGN	BW	05DEC08	SCALE NTS	REV.
CADD	BW	11DEC08	**FIGURE VI-11**	
CHECK				
REVIEW				

REVISION DATE: 11DEC08 BY: BW FILE:O:\Active_2008\1428(08-1428-0029 Meadowbank TSF Dike Design\3100 Analysis &Data\Tailings Deposition Plan\Figure VI-11.ppt

APPENDIX VII

SPECIFICATIONS

PREPARED FOR:
AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

PREPARED BY:

ORIGINAL SIGNED

A	17DEC2008	ISSUED FOR REVIEW	JEK/BEW	
REV.	DATE	REASON FOR REVISION	BY	APP.

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Drilling and Grouting
Fill Placement
Liner Installation
Instrumentation

S1 ADMINISTRATION

S1.1 Scope

This Specification provides general administrative requirements for construction of dikes for the Tailings Storage Facility (TSF) at the Meadowbank Gold Project, Nunavut.

S1.2 General

Tailings generated from mining activities at the Meadowbank Gold Project site are stored in the basin formed by dewatering the northwest arm of Second Portage Lake.

The current Specifications are for construction of the TSF Dikes which are built around and across the dewatered northwest arm of Second Portage Lake.

The TSF Dikes are rockfill structures with an upstream liner anchored in a cut-off excavation through foundation soils to bedrock.

TSF Dike construction is staged relative to tailings deposition and water management requirements for the dewatered basin. Dikes and construction staging are shown in the Drawings that accompany these Specifications.

Dikes are constructed on-land, or “in the dry” following lake dewatering.

These Specifications are not for piping, barges, electrical, mechanical, structural or other works associated with tailings transport or water reclaim.

S1.2.1 General Site Conditions

The site is remote, and requires considerable logistic support for transport of materials to site. Climate is described in the accompanying design report and includes extreme cold weather conditions from October through May.

The current understanding of subsurface conditions is based on a limited number of boreholes and on interpretation of geophysical data. The presentation of subsurface conditions in the design report and Drawings are therefore subject to a large degree of interpretation. The Contractor is to make his own interpretation of geologic conditions.

S1.2.2 Definitions

The definitions used in the Specifications are given in Table 1-1.

TABLE 1-1: Definitions

Accuracy	Degree of approximation of a measurement to the true value of the quantity measured.
Approval	A written engineering or geotechnical opinion concerning the Work.
Coarse Filter	Material produced from processing of IV rock and meeting the Specifications.
Construction Manager (CM)	Owner's representative that oversees the project works and the Owner's interests. The primary point of contact for the Engineer and Contractor.
Contractor	A construction company contracted by the Owner to successfully carry out the Scope of Work described herein. For Work completed by mine employees, the Owner assumes responsibility for duties of the Contractor described in these Specifications.
EMP	Environmental Management Plan.
Engineer	Golder Associates Ltd. (Golder).
Field Laboratory	The area and facilities provided for QC and QA testing at the Meadowbank Gold Project Site.
Fine Filter	Material produced from processing of IV rock and meeting the Specifications.
Health and Safety	A planned set of activities and approach to ensure the health and safety of all persons involved in or affected by construction activities.
Ice-Rich Soil	Frozen soils that contain more than 10 percent visible ice and/or have a moisture content greater than 30%. Normally ice lenses are present.
Ice-Poor Soil	Frozen soils that contain less than 10 percent visible ice and have a moisture content less than 30%. No visible ice lensing.
Liner	Bituminous geomembrane meeting the Specifications.
Liner Manufacturer	Coletanche.
Meadowbank	The Meadowbank Gold Project site.
NPAG	Non-Potentially Acid Generating as defined by analytical test by the Owner.
Owner	Agnico-Eagle Mines Limited, Meadowbank Division (AEM)
PAG	Potentially Acid Generating as defined by analytical test by the Owner.

Quality Assurance (QA)	A planned system of inspection and testing that documents, to the satisfaction of the Owner, the Engineer, other stakeholders and regulators, that the Work complies with the Drawings and Specifications.
Quality Assurance Manager (QA Manager)	Engineer's representative that oversees QA activities.
Quality Control (QC)	A planned system of inspection, testing and documentation carried out by the Contractor during construction to ensure that the Work is being completed in a manner that will comply with the Drawings and Specifications.
Quality Control Manager (QC Manager)	Contractor's representative that oversees QC activities.
Reproducibility	Degree of approximation to the arithmetic average of each one of a series of similar measurements.
IV Rockfill	Intermediate volcanic mine aggregate material meeting the design Specification.
IF Rockfill	Iron formation mine aggregate material meeting the design Specification.
UM+Q Rockfill	Ultramafic and quartzite mine aggregate material meeting the design Specification.
Sensitivity	Minimum unit of pressure or deformation to be detected by a system of measurement.
Subcontractor	A construction company contracted by the Contractor to complete a portion of the Work.
Till	Unfrozen glacial deposit meeting the design Specification.
TSF	Tailings Storage Facility
TSF Dikes	Tailings Storage Facility Dikes, as shown on the Drawings.
Work	All activities associated with the construction of the TSF Dikes and appurtenances including instrumentation and seepage collection systems.
Work Completion Report (WCR)	Summary report prepared by the Contractor.
Contractor's Work Plan	Proposed construction equipment, procedures, schedules, QC plan, and Health and Safety plan for all components of Work to be completed by the Contractor and any Subcontractor the Contractor may employ to complete the Work.
Working Platform	The working platform is the surface of fill and/or excavated surface from which the Work is conducted.

S1.2.3 Standards and Regulations

Work shall conform to, but not be limited to the requirements of the standards, acts and regulations, listed in Table 1-2. Work included in this Specification shall conform to the applicable provisions of these publications, except as modified by the requirements specified herein or as indicated in the Drawings. Each publication shall be the most recent revision and addendum in effect at the time of construction.

TABLE 1-2: Standards and Regulations

AEM	March 2007 Safety Handbook
API Spec 13A	Specification for Drilling Fluid Materials
API RP 13B-1	Recommended Practice for Field Testing Water-Based Drilling Fluids
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTMC150	Standard Specification for Portland Cement
ASTMC185	Standard Test Method for Air Content of Hydraulic Cement Mortar
ASTM C191	Standard Test Methods for Time of Settling of Hydraulic Cement by Vicat Needle
ASTM C266	Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
ASTM C305	Standard Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
ASTM C349	Standard Test Method for Compressive Strength of Hydraulic-Cement Mortars (Using Portions of Prisms Broken in Flexure)
ASTM C494	Standard Specification for Chemical Admixtures for Concrete

ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C596	Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C845	Standard Specification for Expansive Hydraulic Cement
ASTM C940	Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C941	Standard Test Method for Water Retentivity of Grout Mixtures for Preplaced-Aggregate Concrete in the Laboratory
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C953	Standard Test Method for Time of Setting of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM 792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer Than No. 200 (75 µm) Sieve
ASTM 1204	Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D1633	Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders.
ASTM 1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D2113	Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation
ASTM D2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D4073	Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4354	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D4380	Standard Test Method for Density of Bentonitic Slurries
ASTM 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM 4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D5084	Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM 5147	Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
ASTM 5199	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
ASTM D5856	Standard Test Method for Measurement of Hydraulic Conductivity of Porous Material Using a Rigid-Wall, Compaction-Mould Permeameter
ASTM D6910	Standard Test Method for Marsh Funnel Viscosity of Clay Construction Slurries
ASTM D7056	Standard Test Method for Determining the Tensile Shear Strength of Pre-Fabricated Bituminous Geomembrane Seams
CSA A23.1/A23.2-04	Concrete Materials and Methods of Concrete Construction
CSA A3000-03	Cementitious Materials Compendium
CEBTP No 6327.7.390	Stress Relaxation with Time
DGS/VS4/No. 949	Potable Water Suitability
EN 495-2	Angle of Internal Friction
Mine Health and Safety Act, S.N.W.T. 1994, c25	
Mine Health and Safety Regulations, N.W.T. Reg. 125-95	

NFP 84350	Delamination
NFP 84507	Static Puncture Resistance
NFP 84523	Hydrostatic Puncture Resistance

AEM: Agnico-Eagle Mines Limited; API: American Petroleum Institute; ASTM: ASTM International; originally known as American Society for Testing and Materials; CEBTP: *Centre Expérimental de Recherches et D'Études du Bâtiment et des Travaux Public;* CSA : Canadian Standards Association; DGS: European Commission Research Directorate-General; EN: European Standard (European Committee for Standardization); GRI: Geosynthetic Research Institute; NFP : *Norme française (French Standard)*

S1.2.4 Alternative Standards

If the Contractor offers materials which conform to a standard other than that specified then the standard offered shall be equal to or superior, when tested, to the specified standard and full details of the differences between the standard offered and the standard specified shall be given.

S1.3 Execution

The TSF Dike construction package includes work to be carried out by the Contractor(s) and work to be carried out by Owner's mine employees.

S1.4 Scope of Work

The TSF Dikes include the Central Dike, Divider Dike, and a series of Saddle Dams and rockfill roads as shown on the Drawings. Table 1-3 includes a general description of construction tasks for TSF Dike construction. The tasks are not listed in order. A construction sequence shall be developed by the Construction Manager (CM).

TABLE 1-3: Scope of Work

Construction Task	Owner / Contractor Responsibility
Dewatering of the northwest area of Second Portage Lake	Owner
Foundation preparation	Owner
Placement, compaction and grading of rockfill embankment	Owner
Foundation Site Investigation	Owner
Placement and compaction of Coarse and Fine Filters or Liner Bedding	Contractor
Cut-off trench excavation	Contractor
Construction of Lean Concrete Mat (where required as shown on the Drawings)	Contractor
Grouting of bedrock foundation (where required as shown on the Drawings)	Contractor
Placement Liner, Liner Cover, and additional materials over the cover	Contractor
Installation of instrumentation within the dike and foundation	Contractor
Construction of seepage collection works	Owner

S1.5 Roles and Responsibilities

S1.5.1 General

Unless otherwise stipulated by project-specific addenda, the responsibility and authority of each party involved in the Work shall follow the lines set forth in the following sections and the applicable regulations and/or permit conditions for the following management structure.

S1.5.2 Owner

The Owner is Agnico-Eagle Mines Limited (AEM), Meadowbank Division. All references to the Owner in this document shall implicitly include the Construction Manager (CM), who is the Owner's representative designated specifically for the project by the Owner.

The Owner is responsible for:

- Submittals in Section 1.12;
- Responsibilities and tasks listed in the QC and QA Requirements Specification;
- inspection and maintenance of site, e.g. sumps, before any portion of the site is handed to the Contractor for the commencement of works;
- providing items as required in these Specifications and all incidentals needed to bring the Work to final completion, not including those to be supplied by the Contractor;
- obtaining all relevant permits;
- environmental management including prevention of pollution and other environmental problems related to TSF Dike construction activities;
- health and safety at the work site;
- providing reasonable access to the general open areas surrounding the work site for the Contractor and Subcontractors;
- traffic control on dike crest and in abutment areas;
- maintaining the Construction Schedule, including coordination and direction of the Work;
- co-ordinating communication for the project;
    - arranging Pre-Construction and Construction Meetings;
    - arranging Deficiency Resolution Meetings for resolving QC and QA issues;
        - preparing plans for corrective action for Work not in compliance with the Specifications;
- all survey for layout of the work, for QA, for documentation of as-built configurations, and for payment, with the exceptions of QC survey and as-built liner panel layout drawings;
- pre-processing of construction materials, including Coarse Filter, Fine Filter, Liner Cover and Till;
- supply of diesel, cement, concrete, rockfill materials, Bituminous Geomembrane Liner and associated materials, Till, Coarse Filter, Fine Filter, Liner Bedding, Liner Cover and waste disposal areas, sources of water;
- any blasting, including blast notification to the Contractor and Engineer or their representative;
- grading the site to the proper elevation as set forth in the project design;
- preparation of an as-built report at the completion of the project;

- For Work completed by mine employees, the Owner assumes responsibility for duties of the Contractor described in these Specifications; and
- For Work involving grouting, the Owner is responsible for:
    - Providing a disposal location for waste materials;
    - Delivery of all goods and materials for use on site;
    - Storing all goods and materials for grouting appropriately on site; and
    - Mine Operations' aspects related to efficiency of the Work.

S1.5.3 Contractor

The Contractor is responsible for:

- Submittals in Section 1.12;
- QC and QA responsibilities listed in the QA and QC Requirements Specification including survey and survey control required for QC;
- completion of the Work in compliance with the Drawings and Specifications, including any work performed by Subcontractors;
- health and safety of employees under the Contractor's supervision at the worksite, and for health and safety of Subcontractors employed by the Contractor;
- blast notification to the Contractors employees and Subcontractors;
- site preparation;
- protection of materials before and after placement;
- As-built survey and production of panel layout drawings for liner installation;
- Equipment to complete the work;
- compliance with requirements of the Mine Health and Safety Regulations (Nunavut);
- protection of the environment during construction; and
- inspection and maintenance of site, e.g. sumps, before any portion of the site is handed to the Owner after the completion of works, or a Subcontractor before their work is due to commence.
- For grouting work:
    - Provision of a technical expert to direct the work;
    - Successful completion of the scope of Work described in the Specification;
    - Supply of additives; and
    - Clean up as the work progresses on site.

The Contractor is responsible for Quality Control of his own work.

S1.5.4 Subcontractors

The Contractor is responsible for completion of the Work undertaken by any Subcontractors he may employ. The work must be completed in accordance with the intent of the design, as described in the design report, Drawings, and Specifications.

S1.5.5 Engineer

The Engineer is Golder Associates Ltd. (Golder), the dike design Engineer of Record. The Engineer is responsible for:

- Submittals listed in Section 1.12;
- QC and QA responsibilities listed in the QA and QC Requirements Specification;
- the design including the Drawings and Specifications;
- generation and approval of all design and/or Specification modifications and clarifications which pertain to the design; and
- design modifications and clarifications that may occur prior to and/or during construction.

The Engineer is represented on site by the QA Manager.

S1.5.6 Quality Assurance Manager

The Quality Assurance Manager (QA Manager) represents the Engineer on site and is responsible for:

- performing tasks outlined in QC and QA Requirements Specification, including observing, testing, inspecting, documenting, monitoring and reporting the relevant project activities;
- implementation of changes in Quality Control and QC aspects of the work including frequency of testing, monitoring, or additional testing to confirm conformance to the Specifications;
- preparing QA Weekly Reports outlining the progress of the Work and the result of testing carried out during the week;
- approving aspects of the Work as compliant with the Drawings and Specifications and the intent of the design; and
- blast notification to QA staff.

The QA Manager has the authority to stop work that is not in compliance with the design but does not have the authority to change methodology or to make any decisions related to the cost without prior approval of the Construction Manager.

S1.5.7 Quality Control Manager

The Quality Control Manager (QC Manager) represents the Contractor on site in matters related to QC. The QC Manager is responsible for checking the Work as construction proceeds with the purpose of aiding the Contractor to complete the Work in accordance to the Specifications, Drawings, and design report. The QC Manager is responsible for:

- performing tasks outlined in QC and QA Requirements Specification, which includes observing testing, inspecting, documenting, monitoring and reporting the relevant project activities;
- directing QC work and QC personnel;
- implement changes in Quality Control aspects of the work including frequency of testing, monitoring, or additional testing to confirm conformance to the Specifications; and
- preparation of Daily Summary Reports documenting the Work carried out each day, including QC testing results.

S1.6 Communications

The Construction Manager has the responsibility to organize communications through various meetings described in this Specification. Other meetings may be called as required by the CM.

All official communications shall be in writing, in English, with records of communications kept by both the Owner and the Engineer. Radio communications will be on the same channels as the mine and will be in English.

Official communications between the Engineer and the Contractor will be through the CM.

S1.6.1 Pre-Construction Meeting

Prior to the start of construction, the Owner, Engineer and Contractor shall meet to discuss:

- The design, Specifications and Drawings;
- Responsibilities of all parties as defined in the Specifications;
- Procedures for deficiency resolution, documentation and reporting;

- QC and QA procedures and responsibilities, including QC tasks documented in the Contractor's Work Plan, testing frequencies, testing methods and material acceptance/rejection criteria, reporting and documentation;
- Site conditions;
- Stockpile areas and areas to be used for temporary storage/stockpiling where applicable;
- Laboratory facilities with respect to volume of testing and requirements for QA and QC laboratory testing for each phase of construction;
- Construction quantities;
- Construction Schedule and Contractor's Work Plan;
- Each task of the Work with respect to overall Construction Schedule;
- Health and Safety, including the Site Health and Safety Plan and the Contractor's Health and Safety plan as included in the Contractor's Work Plan, including procedures for QA and QC activities, and procedures related to blasting and haul truck and heavy equipment traffic;
- Supply of materials, water, and waste disposal areas;
- The EMP; and
- To conduct site walk-over to discuss proposed construction sequence, start-up and inspect borrow areas, where applicable.

S1.6.2 Daily Health and Safety Meeting

Daily Health and Safety Meetings will be held on site including a site supervisors meeting and a TSF Dike Construction daily Health and Safety meeting. The CM will attend the site supervisors meeting and is responsible for relaying any relevant information, including blasting times and locations to the Contractor's staff and Engineering staff at the TSF Dike Construction daily Health and Safety meeting. The CM will be responsible for meeting minutes.

S1.6.3 Construction Meetings

Construction progress meeting shall occur monthly or more frequently as required, and be held and chaired by the CM and shall be attended by the QA Manager and the Contractor, or their representatives. Health and Safety concerns will be reviewed.

The CM is responsible for meeting minutes.

S1.6.4 Deficiency Resolution Meetings

If a construction problem or deficiency occurs, then a deficiency resolution meeting shall be held by the CM and the relevant construction work shall be suspended until a resolution is attained, A deficiency resolution document shall be filled out by the party that identified the deficiency and shall be provided to the various other parties (CM, QA Manager and QC Manager) prior to the deficiency resolution meeting.

The purpose of the meeting shall be to identify, isolate and resolve the problem or deficiency to achieve compliance with the Specifications and the intent of the design to the satisfaction of all parties to the extent possible. The deficiency resolution document will include method of resolution and will be signed by the CM and the QA Manager once the deficiency has been corrected. Documentation requirements for deficiencies are described in the QC and QA Requirements Specification.

The deficiency resolution meeting shall be attended by the CM, Contractor, QA Manager, and QC Managers or their representatives, either in person or by phone. If the conditions or circumstances require modification(s) to the design, then only the Engineer will make changes to the design.

The CM is responsible for meeting minutes and for distribution to all parties in attendance.

S1.7 Environment

An Environmental Management Plan (EMP) shall be prepared by the Owner and provided to the Contractor and Engineer prior to start of construction.

The Owner shall provide labour and equipment as required to contain and/or clean up any environmental spills.

The Contractor shall incorporate environmental considerations while developing and while implementing the Contractor's Work Plan. The EMP may discuss, but is not limited to the following:

- Spill Management;
- Animal protection;
- TSS or Turbidity Monitoring;
- Water Management; and
- Refuse Management.

An up-to-date EMP must be maintained to cover all work activities being conducted throughout the Work.

The Contractor will comply with the EMP and all standard procedures related to environmental issues.

Any spill or environmental concern shall be reported immediately to the CM.

S1.8 Health and Safety

The site is under regulation by the Mines Act and follows Mine Health and Safety Regulations of Nunavut.

The Owner is entirely responsible for the Health and Safety at the site, including the All Weather Private Access Road to Baker Lake. The Owner will provide a site orientation including regulations, Health and Safety, driving on the site and any procedures related to blasting, medical emergency, radio procedures, and incident reporting. The site orientation shall be completed by every person prior to the start of any Work at the site.

The Contractor is responsible for Health and Safety of the Contractor's employees and the Subcontractor's employees.

The Contractor and his Subcontractors shall incorporate Health and Safety considerations while developing and implementing their own work procedures.

The Contractor shall also comply with relevant Health and Safety regulations and AEM Health and Safety protocols and procedures (March 2007 Safety Handbook) or those in effect at the time of construction.

The Contractor shall observe the regulations, procedures and restriction for the ingress to the construction area.

The Contractor must submit as part of the Contractor's Work Plan, a Health and Safety plan covering all work activities being conducted for approval by the Owner. The plan must comply with AEM regulations and any additional health and safety requirements specifically related to the Contractor's work, and shall comply with the Mine Health and Safety Act and Regulations in effect in Nunavut Territory, including requirements for Supervisors. Following approval of the Health and Safety plan, the plan shall be implemented and modified as the need arises.

Any dangerous occurrence or reportable incident or Health and Safety concern shall be reported immediately to the CM.

S1.9 Cooperation

The Contractor and his Subcontractors shall cooperate with other parties to allow time and to provide safe work conditions to carry out any site visit required to check environmental or Health and Safety concerns, perform surveys or QA/QC activities. The Contractor and his Subcontractors shall provide labour and equipment as required to contain and/or clean up any environmental spills.

S1.10 Construction Facilities and Temporary Controls

Access to the site will be provided by the Owner. The Contractor will not have sole nor unrestricted access to the Work area and must be prepared to share and coordinate activities and access with others, through the CM. The Owner will provide staging areas, temporary facilities, haul roads or access roads.

S1.10.1 Power Supply

The Contractor is responsible for supply of any temporary power required for the Work by diesel powered generators. The Owner will supply diesel at no charge to the Contractor.

S1.10.2 Water Supply for Construction

Water for dust control, moisture conditioning material to be placed as fill, for grouting, and for maintaining in-place fill soils shall be obtained by the Contractor. The Contractor must supply all the pumps and tanks necessary. Water will be available at a location defined by the CM.

S1.10.3 Dust Control

During performance of the Work defined by the Specifications or any related operations, the Contractor shall control dust emissions.

S1.10.4 Surface Water Control

The Contractor is responsible for controlling surface water and protecting Work from damage caused by this water, as set out in the Care of Water Specification.

S1.10.5 Work Area

The Contractor shall:

- Store and dispense fuel, lubricating oils, and chemicals in such a manner to prevent or contain spills and prevent materials from entering local streams, lakes or groundwater according to applicable regulatory requirements.

- Maintain copies of Material Safety Data Sheets (MSDS) on file at the site for all hazardous materials. Copies of MSDS will be provided to the CM as the CM is responsible for the delivery and storage of goods on site, and made available to all workers.

- Avoid damaging instrumentation or instrumentation cables, such as for piezometers and thermistors, used at the site.

S1.10.6 Traffic Control

The Owner is responsible for traffic control.

AEM mine heavy equipment and haulage traffic has the right of way at all times with the exception of wild life and emergency vehicles.

The Owner shall provide a flag person or persons at intersections with limited visibility and heavy traffic.

S1.11 Mobilization and Demobilization

Mobilization comprises mobilizing to the mine all materials, supplies, equipment and tools required to carry out the Work. Demobilization includes transporting out of the mine all remaining materials, equipment, and tools, hauled on site to carry out the Work.

The Contractor is solely responsible for the planning and mobilization of materials in consultation with the Owner in accordance with the construction schedule. Subcontractors and their transportation equipment must comply with the same safety regulations as the Contractor.

It is required that all equipment that is to be used in the Work, pass a technical inspection by personnel employed by the Owner prior to transport to site.

Upon completion of the Work, any temporary structure built during the Work and/or any temporary construction that may have been installed during the Work shall be removed.

All regulations regarding mobilization towards and within the mine shall be followed.

S1.12 Submittals

Table 1-4 summarizes the submittals required prior to construction, during construction and post construction. These documents are in addition to those presented by the Contractor to the Owner at the tender stage.

TABLE 1-4: Submittals

Item	Submitted from	Submitted to	Required
Construction Schedule	Owner	Engineer, Contractor	30 days prior to start of construction and maintained during construction
Site Health and Safety Plan	Owner	Engineer, Contractor	90 days prior to start of construction and maintained during construction
EMP	Owner	Engineer, Contractor	90 days prior to start of construction and maintained during construction
Contractor's Work Plan	Contractor	Owner, Engineer	30 days prior to mobilization and maintained during construction
Daily Summary Report	Contractor	Owner, Engineer	Within 24 hours.
QC Weekly Summary Report	Contractor	Owner, Engineer	Weekly
Instrumentation Cabin Design	Contractor	Owner, Engineer	14 days prior to start of instrumentation installation
Work Completion Report (one for each Contract)	Contractor	Owner, Engineer	Within 30 days following completion of work
QA Weekly Report	Engineer	Owner	Weekly
As-built Report	Engineer	Owner	Within 45 days following receipt of all Work

Item	Submitted from	Submitted to	Required
			Completion Reports and As-built survey information

S1.12.1 Contractor's Work Plan

The Contractor's Work Plan shall include, but not be limited to:

- Proposed construction equipment, procedures, and schedules;
- Procedures for coordinating construction, maintenance and removal of working platforms, mixing pads, and haul roads;
- Equipment set-up and site use layout including storage areas, haul roads and work platform dimensions;
- Any updates or changes as necessary;
- List of equipment and specifications, service record for equipment;
- Material properties, sources, and (manufacturer's) certificates of quality;
- QC procedures, standards, testing frequencies;
- A detailed Health and Safety plan for each activity to be undertaken, including MSDS for all materials;
- Procedures and measures for control of drainage, spills, wastes, etc.; and
- Clean-up, spoils disposal.

For placement of the Lean Concrete Mat:

- Submit details of procedures and equipment for hot and cold weather concreting;
- Submit a concrete placing schedule at least 10 days prior to the first scheduled pour; Update schedules as required during the project;
- Submit at least 30 days prior to concrete placement, a detailed description of the proposed equipment and procedure for placing, consolidating and finishing concrete;
- Submit details of proposed concrete curing procedures and protection to be provided; and
- Submit a detailed description of the proposed procedure and materials for repairing defects in the concrete at least 48 hours prior to undertaking this work.

Any updates to the Contractor's Work Plan will be submitted to the CM and the Engineer for review prior to introduction of any changes during the execution of the Work.

For drilling and grouting, the Contractor's Work Plan shall also include:

- Proposed drilling and grouting equipment, materials, procedures, and schedules;
- Schedule and sequence of operations including typical working hours, days and crew rotations; sequence of operations; and maintenance schedule;
- Coordinating the drilling, grouting, and maintenance of equipment;
- Equipment set-up and site use layout including storage areas, grout plants, and mobile shelters both for drill rigs and grouting equipment;
- Drill rod and bit diameter, rod length and number for total depth drillable;
- Equipment specifications including: drills, grout mixers, agitators, grout pumps, water pressure testing pumps, packers, hose lines, valves, pipe fittings, magnetic flow meters, pressure transducers, oil-filled pressure gauges, gauge savers, water heaters, and grout mix testing equipment;
- Procedure for installing casing and drilling grout holes in bedrock;
- Procedure for setting up and moving shelters and grout plants;
- Procedure for grouting operations including: packer inflation/deflation, grout pump control, and grout line circulation; and
- Material properties, sources, and (manufacturer's) certificates of quality for bentonite materials, concrete admixtures, and cement.

At any time during the works, the Engineer may request that the proposed sequence of works of schedule of grouting activities be updated and re-submitted within 48 hours of the request. Proposed revisions to the specified method of execution shall be subject to the approval of the Engineer.

S1.12.2 Work Completion Report

Immediately upon completion of the Work, the Contractor shall finalize the Work Completion Report (WCR) that shall provide as a minimum the following:

- Descriptive report;
- Original Construction Record;
- Copies of Meeting minutes, Field Change Notices (FCN), Site Instructions (SI), Request for information (RFI), and any other format of communication that has been part of the Work;
- Original protocols of field or lab tests, duly signed by both parties (Contractor and QA Manager);
- Any as-built survey information collected for foundation preparation, placement for each construction material, grouting records, and instrumentation installation layout in electronic AutoCAD and hard copy format (As-built survey is generally the responsibility of the Owner);

- Calculation sheets for actual quantities of work executed, duly signed by both parties (Contractor and CM);
- Liquidation of the Work; and
- Installation details of instrumentation in electronic and hard copy format.

The Work Completion Report for Bituminous Geomembrane Liner installation shall also include:

- As-built panel layout drawings, in AutoCAD and hardcopy formats;
- Roll deployment record;
- Seaming record;
- Repair record; and
- QC testing summary.

S1.13 Unit Measurement and Payment

Quantities for payment will be determined by the Owner's survey.

S1.14 Drawings

This Specification defines the requirements for performing the work as outlined on the most recent revision of the Drawings presented in Table 1-5. Should a discrepancy or omission be identified the party concerned shall request, in writing, clarification from the Engineer.

TABLE 1-5: List of Drawings

Number	Title	Revision
4100-00	DRAWING AND SPECIFICATION INDEX	A
4100-01	PROJECT SITE PLAN	A
4100-02	GENERAL LAYOUT PLAN	A
4100-03	BOREHOLE LOCATION PLAN	A
4100-04	STAGING PLAN AND ROCKFILL QUANTITIES	A
4100-05	CENTRAL DIKE STAGED LAYOUT PLAN	A
4100-06	CENTRAL DIKE PLAN SHOWING SOIL THICKNESS	A
4100-07	CENTRAL DIKE CONSTRUCTION SEQUENCE SECTIONS (1 OF 2)	A
4100-08	CENTRAL DIKE CONSTRUCTION SEQUENCE SECTIONS (2 OF 2)	A
4100-10	CENTRAL DIKE ROCKFILL PLAN AND PROFILE (1 OF 2)	A
4100-11	CENTRAL DIKE ROCKFILL PLAN AND PROFILE (2 OF 2)	A
4100-12	CENTRAL DIKE CROSS-SECTIONS	A
4100-13	CENTRAL DIKE EXCAVATION PLAN AND PROFILE	A
4100-14	CENTRAL DIKE CUT-OFF CENTRELINE PROFILE	A
4100-15	CENTRAL DIKE GROUTING PLAN AND LINER DETAILS	A
4100-16	CENTRAL DIKE INSTRUMENTATION LOCATION PLAN	A
4100-17	CENTRAL DIKE INSTRUMENTATION TYPICAL SECTIONS	A
4100-31	DIVIDER DIKE ROCKFILL PLAN AND PROFILE (1 OF 2)	A
4100-32	DIVIDER DIKE ROCKFILL PLAN AND PROFILE (2 OF 2)	A
4100-33	DIVIDER DIKE CONSTRUCTION SEQUENCE	A
4100-34	DIVIDER DIKE CROSS-SECTIONS AND QUANTITIES	A
4100-35	DIVIDER DIKE SADDLE DAM CONNECTION DETAIL	A
4100-50	SADDLE DAM LAYOUT PLAN AND QUANTITIES	A
4100-51	SADDLE DAM CONSTRUCTION SEQUENCE	A
4100-52	SADDLE DAM LINER DETAILS	A
4100-53	SADDLE DAM ROCKFILL PLAN AND PROFILE (1 OF 5)	A
4100-54	SADDLE DAM ROCKFILL PLAN AND PROFILE (2 OF 5)	A
4100-55	SADDLE DAM ROCKFILL PLAN AND PROFILE (3 OF 5)	A
4100-56	SADDLE DAM ROCKFILL PLAN AND PROFILE (4 OF 5)	A
4100-57	SADDLE DAM ROCKFILL PLAN AND PROFILE (5 OF 5)	A
4100-58	SADDLE DAM CROSS-SECTIONS	A
4100-59	SADDLE DAM INSTRUMENTATION PLAN AND SECTION	A
4100-70	ROCKFILL ROAD PLAN AND PROFILE (1 OF 2)	A
4100-71	ROCKFILL ROAD PLAN AND PROFILE (2 OF 2)	A
4100-72	ROCKFILL ROAD CROSS-SECTIONS AND QUANTIITES	A

DWG Nos. not used: 4100-09, 4100-18 to 4100-30, 4100-36 to 4100-49, 4100-60 to 4100-69

S2 CARE OF WATER

S2.1 Scope

This Specification describes care of water for the construction of TSF Dikes. Care of water consists of all work required to control water from any sources, including groundwater, surface water and precipitation, in order to complete the Work in accordance with the Drawings and Specifications, and in accordance with the EMP, the Site Health and Safety Plan, and all other environmental and Health and Safety controls established by the Owner.

Care of water shall include the following:

- Managing water before, during and after: excavating; preparing, and constructing foundation and abutments; placing dike fills; designated waste areas, use and construction of access roads, and stockpiles; constructing seepage collection works; and undertaking any other part of the Work.

- Dewatering foundations and associated working areas. The Contractor shall provide, operate and maintain any channels, flumes, drains, culverts, sumps, pumps and other drainage facilities and equipment necessary to divert water away from or to remove water from areas required to be used for construction of the Work and/or as required to meet environmental or safety requirements.

- Constructing and maintaining any embankments silt curtain, and other protective works required to divert water away from areas required for the Work, and where applicable, removing such structures upon completion of the Work.

- Diverting and controlling surface runoff occurring along the abutments at the edge of the crest and toe.

S2.2 General

Surface water shall be temporarily diverted and managed during construction of the Work. Any channel, ditch, dike or other facility required to divert surface water from any area required to complete the Work shall be constructed. All pumps, hoses, culverts and any other equipment required to dewater and maintain all parts of the construction site free from water shall be furnished, installed, maintained and operated.

The Contractor shall adequately operate and maintain temporary diversion and protective works and pumping stations. These shall also be readily accessible at all times.

The Contractor shall remove dikes and other temporary works promptly, when they are no longer required at the direction of the CM. Materials from such removal shall be hauled to disposal areas designated by the CM.

S2.3 Execution

The Work shall not commence until appropriate Care of Water measures have been designed, submitted to the QA Manager for review and approval by the Engineer and CM, and implemented.

Care of Water systems shall include, but not necessarily be limited to: embankments, trenches, ditches, and lined channels to divert or collect surface water runoff; pipes, drains and sumps to manager groundwater; and pumping systems.

S2.3.1 Dewatering Foundations

Excavations on land shall be dewatered in advance, to ensure that the Work is carried out in safe and dry conditions. Proposed methods for preventing and controlling seepage shall be submitted to the CM for approval as part of the Contractor's Work Plan.

S3 FOUNDATION PREPARATION

S3.1 Scope

This Specification provides the technical requirements for foundation preparation for the TSF Dikes, including:

- Stripping of dike footprints to provide suitable surface for Rockfill and Filter placement, including blasting for removal of ice rich soils;
- Preparation of bedrock surface for placement of Lean Concrete Mat;
- Excavation of cut-off trench, including blasting; and
- Preparation of surfaces for Liner placement.

S3.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the CM and following inspection, as-built survey and approval of pre-work conditions.

S3.3 General

Stripping and excavation shall be carried out in accordance with the Drawings and Specification, using ground support and water control measures required for safe and effective operation.

Temporary drainage and pumping systems shall be provided, operated and maintained as required to direct water away from the surface excavation areas as specified in the Care of Water Specification.

Foundation preparation is subject to inspection and approval by the Engineer.

S3.3.1 Waste Soil and Rock

Waste soil and rock includes soft soils, frozen material, organic materials and other rejected materials removed from the dike footprints.

Waste soil and rock shall be disposed of within the TSF and outside the dike footprints, or at areas designated by the CM.

Disposal materials shall not be piled higher than the crest of the Central Dike, Saddle Dams or Divider Dike.

Disposal materials shall not be spoiled as to adversely affect tailings deposition in the impoundment.

Waste materials shall not be deposited into any riverbed, lake, or other water channel and shall not be burned.

S3.3.2 Dimensional Tolerances

All excavations shall be completed to be within 300 mm horizontally and vertically of specified lines and grades unless otherwise specified by the Engineer.

S3.4 Examination

Prior to commencing construction, the Contractor shall thoroughly examine other Work upon which his Work is dependent and report any deficiencies discovered to the CM.

S3.5 Execution

The Contractor shall lay out each excavation subject to inspection by the Engineer, prior to commencing any excavation. The Contractor shall not initiate excavation of any part of the Work until the proposed methodology and construction sequence has been approved by the Engineer.

Surface excavation work may begin only after the necessary infiltration and runoff control measures have been completed in accordance with the Care of Water Specification, and the necessary equipment, elements and materials for protection of surface excavations are available at that site.

The Contractor shall allow for survey of foundation preparation limits and stockpiles.

S3.5.1 Dike Foundations

Foundation preparation shall be carried out within the footprint of the TSF Dikes, as indicated on the Drawings, and includes:

- Rough grading of the foundation surface by removing boulders protruding more than 150 mm above the ground and scalping tops of hummocks, to form a smooth surface;

- Removing of ice-rich soils;

- Removal of soft soils; and

- Removal of all dry, fibrous organic material and other unsuitable materials as directed by the Engineer.

S3.5.2 Lean Concrete Mat Foundation

Foundation preparation for the Lean Concrete Mat shall include cleanup of the bottom of the excavation, including brushing and sluicing, pressure washing of the exposed surface using a pressure washer capable of operating at 1400 kPa, and using air pressure equipment capable of producing 700 kPa air pressure through a 25 mm diameter nozzle, treating irregularities such as cracks, faults, fractures, weak bedrock zones, filling such areas with dental concrete or slush grout.

Treatment of irregularities may include using jackhammers, hydraulic breakers, air and water jets, hand-tools and brushes. Irregularities are defined as thin, fractured or crushed layers of rock, weathered contacts between different types of rock, in-filled seams, or similar features encountered during excavation, or weaknesses exposed during pressure washing. Such materials shall be excavated to a depth generally 3 times the width of the feature, and shall be replaced with shotcrete or dental concrete.

Pressure washing and compressed air jetting shall be carried out to prepare the rock surface such that it is clean and totally exposed with no remnants of soil, loose rock, or debris. Compressed air and pressure washing shall be carefully applied to the rock surface to remove all loose and disturbed material, but care shall be taken to ensure that high pressure air or water is not directed into joints such that blocks of competent bedrock are broken out.

Scaling and chiseling may be required as directed by the CM, using an excavator with rock breaker, jackhammer, or other equipment. Repeated scaling may be required. All broken and loosened rock material shall be removed.

All excavation shall be carried out using methods to avoid over break and preserve the foundation rock in sound condition, without shattering or splitting or opening up cracks or seams in the rock.

Bedrock foundation mapping of the cut-off trench shall be carried out by the Engineer prior to any bedrock treatment application.

All depressions or overhangs in which backfill materials cannot be properly compacted shall be filled with dental concrete or shotcrete, where:

"Dental Concrete" shall consist of the following:

.a Concrete materials and methods of construction shall be in accordance with CAN/CSA-A23.1 and CAN/CSA-A23.2 issued by the Canadian Standards Association. Cement shall be Portland Cement meeting CSA Type 10 unless otherwise approved by the Owner's Representative.

.b Dental Concrete shall have a minimum compressive strength of 10 MPa at 28 days. The consistency and workability of the concrete shall be adjusted to suit the size of cavity or fissure to be treated and to ensure that voids are completely filled.

"Shotcrete" shall consist of the following:

.a Dry-bagged premix material in which all ingredients, including mixing water, are mixed prior to their introduction into the shotcrete delivery system and compressed air is introduced to the material flow near the nozzle.

.b The Contractor is responsible for the mix design to ensure that the shotcrete has a minimum compressive strength of 10 MPa at 28 days.

.c Shotcrete shall comply with the requirements of ASTM Concrete Standards and Codes.

Dental concrete and shotcrete shall not be subjected to traffic until the material has fully set.

S3.5.3 Excavation

The excavation shall meet the minimum dimensions shown on the Drawings. Method of excavation and stability of the excavation shall be the responsibility of the Contractor, with method reviewed by the Engineer. The cut-off trench construction may require an open cut excavation through frozen foundation soils using drilling and blasting methods to establish a trench.

The downstream slope of the excavation must be flat enough to allow stable placement of Filters and liners, where required.

All necessary precautions shall be taken by the Contractor to obtain regular and stable excavation surfaces, which follow the boundary lines and grades shown on the Drawings.

Alternative methods such as mechanical cutting of rock surfaces and frozen ground are allowed.

S3.5.4 Liner Bedding

Liner bedding surfaces shall be smooth, firm, free of loose material, shall not contain protruding particles that may damage the liner, and at a slope that allows stable placement of the Liner. Liner bedding surfaces are subject to inspection and approval by the QA Manager.

The Contractor is responsible for preparation of the bedding surface, and for excavation of the anchor trenches. The Contractor must drain and dry the site when required. The Contractor shall not place any liner until the QA Manager has given written approval that the bedding surface has been prepared according to the Construction Drawings and Specifications.

The Contractor shall inspect the surface of the bedding material prior to placing the liner, to ensure that it is free of protrusions or surface irregularities that could cause stress in the liner.

S3.5.5 Blasting

All blasting will be by the Owner.

All operations in connection with transporting, storage and the use of explosives shall be subject to the rules and regulations of governing authorities. Blasting shall be performed by experienced and licensed personnel.

S3.5.5.1 Vibrations Control

Vibrations induced by blasting must not alter the natural state of rock beyond the excavation limits nor previously grouted rock, fills or already-placed concrete of any permanent structure. Therefore the maximum instantaneous explosive charge, as deduced from the following equation, shall be permanently monitored and not surpassed:

$$SD = D/(W)^{1/2}$$

Where:

SD = Scaled distance;
D = Blasting distance, in feet, to the nearest structure requiring protection; and
W = Maximum instantaneous charge, in pounds.

The SD relation will equal 50 when the blasting distance to the structure requiring protection is less than 50 m; when greater, the SD relation to deduce the maximum instantaneous charge will be 65.

S3.5.6 Work Areas

The Contractor shall inspect the work area with the CM and QA Manager prior to the trafficking of any heavy equipment.

Whenever working close to open excavations, the Contractor shall use appropriate methods and take necessary precautions to avoid damage or disturbance of the banks of the excavation. The Contractor shall take the necessary precautions to obtain regular and stable excavation surfaces. Any damage caused as a result of negligence by the Contractor shall be repaired at his expense and to the satisfaction of the CM.

Access to the work area will be controlled by the CM.

S3.6 Health and Safety

Health and Safety requirements are described in the Administration Specification.

The Contractor is responsible for the protection and safety of the Work, all Contractor personnel, all Subcontractor personnel, plant and materials in each working area. The Contractor shall implement any necessary installation or measures to ensure safety.

S3.7 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specification.

All prepared foundations and excavations are subject to inspection and must pass approval by the Engineer. The Contractor shall provide facilities and labour as required to assist sampling for QA.

S4 LEAN CONCRETE MAT

S4.1 Scope

This Specification covers the placement of a cast-in-place Lean Concrete Mat required for TSF Dike construction at locations shown on Drawings. The purpose of the Lean Concrete Mat is to provide an even surface on which to bond the Liner in the cut-off trench, and to facilitate grouting works.

The Contractor shall provide all products, equipment, machinery, labour, services and supervision required to carry out the work, including, but not limited to, the following:

- Formwork and design of formwork;
- Concrete construction joints;
- Concrete placement;
- Curing and protection;
- Finishing, encasements and concrete fill;
- Repair of surface defects in concrete;
- Casting of concrete items supplied by others; and
- Clean-up.

S4.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the CM and following inspection, as-built survey and approval of pre-work conditions.

S4.3 Site Conditions

The Contractor shall coordinate the location of all items to be built-in which are to be supplied by the Owner or other contractors. If required, the Contractor also shall coordinate his work with that of other contractors and the Owner's own forces working at the same location.

S4.4 Materials

Unless otherwise agreed, the Owner shall supply the concrete.

Cement: Type 10 (GU) Cement. Supply cement from one manufacturing source throughout the Contract to ensure consistent quality and compatibility with all concrete materials.

Admixtures: Obtain all admixtures from the same manufacturer to ensure compatibility between air-entraining agent, superplasticizer, and water-reducing agent. Conduct tests and trial mixes to verify that admixtures are compatible with all mix ingredients. Unless otherwise specified, provide liquid type admixtures.

Water: Supply, install, operate and maintain a satisfactory system for water supply for concrete manufacture. Use fresh, clean water, which is free from injurious amounts-of oil, silt, soluble chlorides, organic matter, acids, alkalis and other deleterious substances, and conforms to CSA A23.1. Submit details of the method by which the Contractor proposes to ensure a satisfactory and adequate supply of water for concrete curing. Provide a backup water supply system.

Fine Aggregates: Consisting of natural or crush rock or a combination conforming to all requirements of CSA-A23.1.

Coarse Aggregates: Consisting of natural gravel, crushed rock or a combination of both, conforming to requirements of CSAA23. 1.

Concrete Mix: Concrete shall meet the requirements of CSA A23.1 and the following criteria:

- 10 MPa compressive strength at 28 days;
- 6% +/- 1% air content;
- 20 mm maximum nominal aggregate size; and
- 100 mm +/- 30 mm slump.

The CM will provide access to aggregate source, stockpiles and batch plant for the purpose of materials sampling and inspection.

S4.5 Submittals

Submittal requirements to be included in the Contractor's Work Plan are described in the Administration Specification.

S4.6 Concrete Forms

Allow completed concrete forms to be inspected and approved at least 24 hours prior to ordering concrete.

S4.7 Execution

S4.7.1 Preparation

Prior to placing new concrete adjacent to or on existing work the Contractor shall:

- Remove all debris and foreign matter from the substrate;
- Pressure-wash the surfaces to be bonded with new concrete, and provide condition to all bonding surfaces;
- Remove all ponding water from the bedrock surface prior to concrete pour;
- Apply cement slurry bond coat per CSA A23.1 immediately before concrete placement. Do not allow slurry coat to dry; and
- Formwork placement required prior to concrete pour.

If form oil is used to coat forms, the Contractor shall ensure that oil is not present on concrete reinforcement.

S4.7.2 Concrete Placement

The Contractor shall strictly follow the requirements of CSA A23.1 for placing concrete.

Obtain written approval of Owner prior to placing concrete.

All concrete shall be placed as close as possible to its final position. All concrete shall be placed and mechanical vibrators utilized. Vibrators shall not be used to cause concrete to flow horizontally or on slopes. Prevent segregation, loss of ingredients, or damage by exposure to the elements.

Completely discharge and place concrete no later than 90 minutes after the cement has been mixed with the water. The time between batching and complete discharge is reduced to 60 minutes when the ambient air temperature exceeds 25 ^{o}C.

Where concrete is placed on a sloping surface, the Contractor shall commence placing at the lower end of the slope. Perform the placing of concrete as a continuous operation until the placement unit section is completed. Use a concrete placing rate which ensures that

each layer being placed is placed while the previous layer is soft or plastic so that the two layers can be made monolithic by penetration of the vibrators, and which prevents the formation of cold joints.

Use equipment for placing of such size, design, and condition so as to ensure an even supply of concrete at the point of delivery. Ensure that the equipment is equipped with the devices necessary to permit the prompt and complete discharge of concrete without segregation and with the required slump. In particular, if bottom-dump buckets are used, provide a positive means of regulating the amount and rate of concrete deposition in each dumping position. Concrete shall not be dropped from a height greater than 3.0 m. Where concrete is transported through a drop pipe in this manner, the concrete shall be fed into the pipe on surface in such a way as to prevent blockages or the pipe becoming full at any point.

The lean concrete pad must be minimum 800 mm thick, unless otherwise directed by the Engineer. Finished concrete surface shall be within 50 mm of design elevation.

S4.7.3 Cold Weather Concrete

Cold weather requirements in accordance with CSA A23.1 apply when the air temperature is at or below 5 ^{o}C, or is forecast to fall below 5 ^{o}C within 24 hours of placing.

When concrete is to be placed in cold weather, ensure that all materials and equipment needed for adequate protection and curing is on hand and ready for use before concrete placement is started. Obtain prior approval for the proposed enclosures, equipment and procedures for cold weather concreting.

Do not place concrete against any surface which has a temperature of less than 5 ^{o}C. Remove all snow and ice. Preheat such surfaces for 24 hours or as required to obtain surface temperatures of 5 ^{o}C minimum, whichever is longer, prior to placing concrete.

Design and construct heating and hoarding protection measures including heated enclosures, coverings, insulation, or a suitable combination of these methods in accordance with CSA A23.1.

Inspect heating and hoarding measures at least every 4 hours to ensure that enclosure, coverings and insulation are in place, there is adequate heater fuel, and the specified temperatures are being maintained.

Ensure that a sufficient number of adequately sized and properly vented heaters are provided. Do not place heaters at locations which may cause rapid drying of freshly placed concrete. Use fans to ensure that warm air is constantly circulated within the enclosure. Do not use tiger torches or other open flame burners as heaters. Provide an access strip of at least 1500 mm in width between the work and the nearest heater. Do not discharge the heater exhaust directly onto the work area.

S4.7.4 Concrete Finish

Concrete finishes shall be screened and floated to achieve a flat surface. No special finish is required.

S4.8 Curing and Protection

All concrete shall be properly cured in accordance with CSA A23.1. Ensure that all material and equipment required for curing and protection are on hand at the worksite prior to placing any concrete. Immediately after finishing, the concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical damage.

Continuously moist cure all concrete for a minimum duration of 7 consecutive days at a minimum temperature of 10 °C. Continuously moist cure concrete by covering with absorptive mat or fabric kept wet by using a system of perforated pipes, mechanical sprinklers, porous hoses, or by other methods which keep all surfaces continuously wet. For formed surfaces leave forms in position and keep such forms continuously wet.

The work area shall be maintained in a neat condition. All waste, deleterious and extraneous materials shall be removed as they accumulate.

S4.9 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specification.

The Contractor shall be responsible for ensuring that the Work is constructed in accordance with the Drawings and Specification, and concrete testing in accordance with CSA23.1/A23/2. Concrete testing shall be performed by technicians and lab certified to CSA A283 standards.

The Contractor shall furnish qualified personnel as necessary to obtain and handle samples on site or at the source of material.

The Contractor shall advise the Owner at least 24 hours in advance of concrete pouring operations to allow for required quality control tests and for assignment of personnel.

Obtain delivery tickets at the point of delivery as soon as a batch is delivered. Delivery ticket information for each batch of concrete from the batching plant shall include:

- Slip serial number and date;
- Specified 28 day strength;
- Type of cement and list of all admixtures;
- Time of loading or first mixing of cement, and water;
- Time the load arrived at the placement point;
- Time the discharge of load was started;
- Time the discharge of load was completed; and
- Concrete temperature during placing.

Ensure all necessary platforms; tools and equipment for obtaining samples are furnished. Temporarily cease batching for a short interval when directed to allow for sampling of the materials.

Compressive strength test cylinders shall be nominal 100 mm diameter by 200 mm. Plastic concrete for casting test cylinders shall be obtained at the point of concrete placement. Cylinders shall be cured for 24 hours, then stripped and placed in a bath or curing room.

One compressive strength test shall consist of testing minimum three cylinders of which one shall be tested at 7 days, and 2 shall be tested at 28 days. Not less than one strength test shall be made for each day in which concrete is placed or every 50 m^3, whichever is more testing.

Specified compressive strength shall be based on 28 day strengths for concrete. Test results shall be evaluated in accordance with CSA A23.1.

Slump tests in accordance with CSA A23.2-5C prior to placement until consistent results meeting the specified requirements are obtained, and whenever a strength test or air content test is taken. The sample shall be taken at the point of concrete placement.

The concrete temperature at placing shall be determined by placing a thermometer in the concrete after sampling at the point of concrete placement.

QA monitoring and testing will be carried out by the Engineer through his QA Representative, to satisfy himself and the Owner that the Work is being carried out in accordance with the Drawings and Specification. Results of QA testing will not be withheld from the Contractor.

S5 FILL PLACEMENT

S5.1 Scope

This Specification describes requirements for fill placement and compaction for construction of the TSF Dikes.

S5.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the CM and following inspection, as-built survey and approval of pre-work conditions.

S5.3 General

Fill placement shall be to the lines, grades and cross-sections shown on the Drawings and in accordance with the Specification.

Water control measures such as temporary drainage and pumping systems shall be operated and maintained as required to direct water away from the on-land fill placement areas as specified in the Care of Water Specification.

S5.3.1 Access

Access to the Work is the responsibility of the CM.

S5.3.2 Waste Materials

Waste soil and rock shall be disposed of within the Tailings Storage Facility and outside the footprint of the fill required for the dam, or at areas designated by the CM.

Disposal materials shall not be piled higher than the crest of the Central Dike or Saddle Dams or Divider Dike.

Disposal materials shall not be spoiled as to adversely affect tailings deposition in the impoundment.

Waste materials shall not be deposited into any riverbed, lake, or other water channel and shall not be burned.

S5.3.3 Borrow Sources

Borrow sources shall be tested prior to the start of construction and through construction as detailed in the QC and QA Requirements Specification.

S5.3.4 Rockfill Material

Rockfill material for construction of the TSF Dikes shall be NPAG, with the exception of the Divider Dike and rockfill roads that are founded on ground that drains into the TSF. Rockfill material placed on ground that drains into the TSF may also be constructed of NPAG and/or PAG material.

All rockfill materials will be supplied and classified by analytical test as PAG or NPAG by the Owner. The Owner is solely responsible for the classification, segregation and appropriate use of PAG and NPAG materials.

S5.3.5 Filter Material Handling

Filter materials shall be stockpiled in an area designated by the Owner. The storage area for the Filter materials shall be inspected by the QC Manager prior to storage. Handling, stockpiling and sampling of Filter materials shall be done to prevent segregation and contamination.

S5.3.6 Till

The Till borrow sources for use in TSF Dike construction shall be from the lakebed exposed on dewatering or other areas designated by the CM.

S5.4 Fill Materials

S5.4.1 IV Rockfill

IV Rockfill shall be run of mine material consisting of sound, hard, durable, well graded rock fragments free from ice, frozen chunks, organic matters, debris and other deleterious materials.

S5.4.2 IF Rockfill

IF Rockfill shall be run of mine material consisting of sound, hard, durable, well graded rock fragments free from ice, frozen chunks, organic matters, debris and other deleterious materials.

S5.4.3 UM+Q Rockfill

UM+Q Rockfill material shall be run of mine material consisting of sound, hard, durable, well graded rock fragments free from ice, frozen chunks, organic matters, debris and other deleterious materials.

S5.4.4 Coarse Filter

Coarse Filter shall be from IV Rockfill processed to meet the design Specification. Coarse Filter shall fall within the gradation limits in place on the dike, as shown in Table 5-1. Coarse Filter shall be free of clay, organic matters, debris, cinders, ash, refuse, snow, ice and other deleterious material, subject to the satisfaction of the Engineer.

TABLE 5-1: Coarse Filter Gradation Limits

Size (mm)	Percent Passing (%)
200	100
152	86-100
76	50-100
25	18-50
13	5-32
4.8	0-18
2	0-10

S5.4.5 Fine Filter

Fine Filter shall be crushed material from IV Rockfill and shall fall within the gradation limits in place on the dike as shown in Table 5-2. Fine Filter shall be free of organic material, debris, cinders, ash, refuse, snow, ice and, other deleterious material subject to the satisfaction of the Engineer.

TABLE 5-2: Fine Filter Gradation Limits

Grain Size (mm)	Percent Passing by Mass (%)
76	100
25	68-100
13	56-75
4.8	40-55
2	30-43
0.43	10-23
0.075	5-8

S5.4.6 Trench Backfill for Liner Bedding

Trench Backfill for Liner Bedding shall be Till or a mixture of Fine Filter and dry powdered bentonite. Specification for bentonite content will be finalized by the Engineer following testing of hydraulic conductivity for mixture design.

S5.4.7 Liner Cover

Liner Cover material shall have a maximum particle size of 75 mm. Liner Cover material shall be free of organic material, debris, cinders, ash, refuse, snow, ice and, other deleterious material and is subject to approval by the Engineer.

S5.4.8 Till

Till will be placed on the Liner Cover and as backfill in the cut-off trench.

Till shall be unfrozen silty sand and gravel. The material shall have a suitable moisture content to obtain sufficient compaction, as determined by the QA Manager.

Till shall be free of organic material, debris, cinders, ash, refuse, snow, ice and, other deleterious materials subject to approval of the Engineer.

Till gradation shall be visually inspected in the field and shall have a maximum particle size of 150 mm.

S5.5 Examination

Prior to commencing construction, the Contractor shall thoroughly examine other Work upon which his Work is dependent and report any deficiencies discovered to the CM.

S5.6 Survey and Initiation

Survey of the surface work areas shall be carried out by the Owner before the Work starts to establish the base plans for layout, as-built configuration, and quantity for payment.

The Owner is responsible for the layout of the Work. The Contractor is responsible for the correctness and exactness of his work.

S5.7 Execution

Foundation preparation is completed. No fill material is to be placed on prepared foundation surface without approval in writing from the Engineer.

Construction of the TSF Dikes and rockfills shall be to the lines, grades and cross-sections shown on the Drawings using only suitable materials approved prior to placement by the Engineer.

Equipment suitability, methods of working, rate of progress and quality of work shall be demonstrated during the initial stages of the Work. In the event that the work performance is unsatisfactory for either quality or schedule requirements, there shall be immediate implementation of such changes as are required to ensure the required quality and scheduled completion of the Work.

Accumulation of water, snow, ice or other deleterious material(s) shall be prevented on the surface of the fill or foundations.

Material placement shall cease when satisfactory work cannot be carried out due to rain, snow, unsatisfactory materials or any other unsatisfactory conditions.

During placement of materials, mixing of the materials from adjoining zones shall be prevented. Segregation during transportation, dumping and spreading of material shall be avoided so that the material placed meets the Specification.

S5.8 Dimensional Tolerances

All rockfill shall be completed to be within 0.3 m horizontally and vertically of specified lines and grades unless otherwise approved by the Engineer.

All Coarse Filter and Fine Filter material shall be greater than or equal to the minimum thickness as shown on the Drawings, unless otherwise approved by the Engineer.

Liner Cover shall be greater than or equal to the minimum thickness as shown on the Drawings, unless otherwise approved by the Engineer.

All Till material shall be completed to within 0.5 m horizontally and vertically of specified lines and grades unless otherwise approved by the Engineer.

S5.9 Fill Compaction

Each material lift shall be compacted before placement of the subsequent lift.

Compaction shall be carried out by rolling over large surfaces and by executing turns carefully to obtain uniform compaction. One passage of the roller over the entire area being compacted will constitute a pass and successive passes shall overlap the previous pass by at least 600 mm.

If the compaction of a lift or a portion of lift is insufficient due to either lack of overlapping or rolling, or to excessive lift thickness, or to excess or deficient moisture content, improve the condition of the fill in accordance with the requirements specified herein and re-compact the lift. If the additional work cannot provide satisfactory results, remove and waste such lift, or its portion, and provide new material.

If compaction of a material cannot be achieved due to the use of improper compaction equipment, immediately replace such equipment with equipment suitable for compaction of the material.

Compaction shall be suspended when weather conditions result in freezing or an increase in moisture content of the materials above the limits as directed by the Engineer.

Any fill material that has become saturated, softened, loosened or has undergone a reduction in density by precipitation, ponded water, construction traffic or frost action is to be treated or excavated and replaced with suitable material. The Engineer shall identify

areas from which material shall be removed. This work shall be performed to the satisfaction of the Engineer.

The compaction methodology and degree of compaction achieved in the field will be monitored by the Engineer. The Contractor shall cooperate with the CM and Engineer to conduct field trials and develop methodologies to achieve satisfactory degree of compaction for the Fill Materials.

Material in pockets and depressions in the foundation shall be compacted with jumping jacks and heavy plate tampers, or similar small size compaction equipment approved by the Engineer.

S5.9.1 Fine Filter

The maximum uncompacted lift thickness of Fine Filter shall be 400 mm for the measured perpendicular to the slope.

Compaction of the Fine Filter shall be carried out using a 10 tonne smooth drum vibratory roller compactor with a minimum 4 passes, subject to review of performance by the Engineer.

S5.9.2 Coarse Filter

The maximum uncompacted lift thickness of Coarse Filter shall be 600 mm measured perpendicular to the slope.

Compaction of the Coarse Filter shall be carried out using a 10 tonne smooth drum vibratory roller compactor with a minimum 4 passes.

S5.9.3 Rockfill

Compaction of Rockfill for the Central Dike and South Saddle Dam shall meet the following requirement:

a) The maximum un-compacted horizontal lift thickness shall be 1.0 m as shown on the Drawings;

b) Compaction of the rockfill shall be carried out using a 10 tonne smooth drum roller vibratory compactor with a minimum 6 passes; and

c) Nesting of oversize stones and be avoided such that no significant voids exist in this zone.

For the Divider Dike and rockfill roads:

- The maximum un-compacted horizontal lift thickness shall be 3.0 m as shown on the Drawings;

- Nesting of oversize stones and shall be avoided such that no significant voids exist in this zone; and

- Rockfill shall be nominally compacted using haulage and placement equipment. The compaction methodology and degree of compaction achieved in the field will be monitored by the Engineer. Modification to the maximum un-compacted horizontal lift thickness shall be at the discretion of the Engineer. Field trials shall be carried out to assess the material placement techniques and achieved placement densities to assess possible variation to the un-compacted lift thickness.

S5.10 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specification.

All foundation surfaces shall be inspected and are subject to approval by the QA Manager prior to fill placement. All fill surfaces shall be approved by the QA Manager prior to subsequent fill placement of different materials.

QA inspection shall be carried out by the QA Manager and/or personnel to confirm the QC results including whether the specified fill placement, construction grades and limits, Liner bedding surfaces and number of passes by the compactor, are being attained and construction materials are meeting the required Specifications.

The Owner shall provide facilities and labour as required to assist in conducting tests, surveys and sampling for QC and QA.

S6 BITUMINOUS GEOMEMBRANE LINER

S6.1 Work Sequence

The Work will only start upon receipt of approval to proceed from the CM and following inspection, as-built survey and approval of pre-work conditions.

S6.2 General

This Specification defines the technical requirements for installation of the Bituminous Geomembrane Liner for the TSF Dikes.

The Work covered by this Specification includes:

By Owner:

- Ordering the liner;
- Handling and transport of the liner to the mine site;
- Receiving and unloading rolls of the liner at the mine site; and
- Preparing a suitable temporary storage area for the rolls of the liner, and protecting the rolls from damage or environmental degradation while in temporary storage;

By Contractor:

- Transporting the rolls of the liner from the temporary storage area to the installation sites;
- Placing the liner in accordance with the Manufacturer's instructions and this technical Specification, to the lines, grades and dimensions shown on the Drawings, or as directed by the Engineer;
- Providing all materials, equipment and labour required to position and assemble the liner, as shown on the Drawings;
- Carrying out all the non-destructive and destructive tests required in the Specifications, employing industry standard techniques and equipment;

- Clean up of the site; and

- Preparation of pre-installation and as-built panel layout Drawings, in digital AutoCAD drawing format, as described in detail within this Specification.

S6.3 Manufacturer's Qualifications

The Manufacturer of the liner shall be Coletanche.

S6.4 Contractor's Qualifications

The Contractor shall arrange for a technical representative of the Manufacturer to be on site for the liner placement until the Manufacturer certifies that the Contractor's personnel are qualified to install and join the liner.

The Contractor installing the liner shall employ qualified personnel, experienced in deploying, welding, testing and patching Coletanche bituminous liner. Qualified personnel shall be certified annually by the liner Manufacturer with a non-transferable letter.

If new liner installation personnel are hired after the initial visit of the Manufacturer's representative, the Contractor shall arrange for the Manufacturer's representative to come to site to certify the new personnel. In addition, the Contractor shall arrange for a technical representative of the Manufacturer to visit the site regularly during the liner placement to review the liner installation procedures and QC testing.

S6.5 Sampling, Testing and Reporting

The Contractor shall cooperate with the Construction Manager and the QA Manager in providing the liner samples for QA testing, allowing access for QA review of the QC testing, and providing results of QC testing in a prompt manner.

The Contractor must provide laboratory equipment and facilities that are sufficient for the QC testing required within the Specifications. A representative of the Manufacturer shall review the laboratory testing procedures and facilities and certify that the equipment and testing procedures are correct.

S6.6 Bituminous Geomembrane Liner Supply

S6.6.1 Ordering the Liner

The Coletanche liner shall be ordered by the Owner from Soprema Inc.

S6.6.2 Supplier Requirements

The Supplier (Soprema) shall ensure that the Manufacturer has provided labels on each roll of the liner which shall include the following information:

- Name of manufacturer;
- Type of liner;
- Roll identification number and shipping weight;
- Thickness, length and width;
- Manufacturer's approved QC stamp, QC test results, and technician's signature;
- Location and type of any flaws; and
- Asqual certification.

Liner labels must be durable to be able to withstand shipping, unloading and temporary storage.

The Supplier shall provide a summary document of all the information listed above, including Manufacturer QC certificates to the Construction Manager. The QC certificates shall include results from all QC tests listed in Table 6-1.

TABLE 6-1: Required QC Testing of Liner in Manufacturer's Factory

Type of Test	Testing Standard [1]	Frequency of Testing	Specified Value
			ES3
Nominal Thickness	ASTM D5199	1 per 10 rolls	4.8 mm
Density	ASTM D792	1 per 10 rolls	1.240g/cm³
Static puncture	ASTM D4833	1 per 10 rolls	643 N (min)
Dimensional stability Longitudinal	ASTM 1204-02	1 per 10 rolls	-0.20% longitudinal (max)
Dimensional stability Transverse			-0.10% transverse (max)
Stress Relaxation with Time	CEBTP 6327.7.390	1 per 10 rolls	70% in 3 hours

Type of Test	Testing Standard [1]	Frequency of Testing	Specified Value
			ES3
Stress Cracking Susceptible	ASTM D1693	1 per 10 rolls	No
Coefficient of Thermal Expansion	ASTM D696	1 per 10 rolls	1×10^{-6} cm/cm/°C (max.)

Liner rolls delivered with defects such as holes, blisters, undispersed raw materials, or any signs of contamination by foreign matters, shall be rejected.

The Supplier shall warrant the liner material meets the requirements covered by these Specifications. The warranty shall provide for the total and complete replacement of any defective materials that may be identified at any time, upon written notification and demonstration by the Owner of the non-conformance of the liner material with these Specifications. The Supplier shall replace the defective liner within one month of notification of defect.

The Supplier must guarantee the liner material according to these Specifications for a period of five (5) years, starting from the date of delivery of the liner to site.

S6.7 Transportation and Handling

Transportation of the geomembrane liner is the responsibility of the Supplier and Owner. When the liner arrives at site, the Owner shall unload all the rolls at a temporary storage location where only one handling step is required to take each roll to its position for storage. The rolls must be handled in such a way to prevent damage to the liner.

All handling on-site from the temporary storage area to the work site is the responsibility of the Contractor.

At any time during delivery and/or upon arrival at site, the Owner must allow the QA Manager, or designated representative to be present when the liner is handled outside of the sea containers or off loaded from a transport vehicle. This requirement includes any off-site handling of the liner required for its transport to site.

All handling of the rolls shall be done using a beam or with a full length pin inserted in the liner's steel roll mandrel. ***The use of forklifts or other means is forbidden.***

S6.7.1 Mandrels

The Contractor is responsible to collect and store the steel roll mandrels from the Coletanche liner rolls and shall return them to the supplier. Mandrels not returned to the supplier shall be charged to the Contractor's account.

S6.8 Temporary Storage and Protection

Upon the arrival of the liner rolls on site the Owner shall:

- Prepare a suitable temporary storage area for the sea containers or the liner rolls in a secure location; and

- Prepare an 'As-Received' inventory of the rolls of the liner and materials, a copy of which must promptly be provided to the QA Manager.

The Owner shall be responsible for protection of the rolls and materials on site prior to the Contractor's retrieval of the rolls and materials.

The Contractor shall assume responsibility for the protection and handling of the rolls and materials following retrieval from the temporary storage area.

While in temporary storage, rolls shall be strapped so that no damage occurs to the outer wraps on each roll, and that straps do not damage adjacent rolls. Rolls shall be supported so that no penetrating stresses are induced in the liner, and the rolls cannot move. When storing for more than 4 months, rolls shall be supported by their mandrels.

Rolls shall be stacked no more than 3 rolls high, on a smooth, dry, clean, flat surface, and covered. Rolls shall be protected from heat sources, solvents, dirt, debris, rodents, and other conditions which could affect the performance of the materials. Manufacturer's labels shall be maintained intact. Labels shall be clearly visible and legible after rolls have been stored on site.

S6.9 Products

S6.9.1 Liner

The required liner material shall be Coletanche ES3 elastomeric bituminous geomembrane liner. The geomembrane liner must meet or exceed the characteristics indicated by the properties listed in Table 6-2.

TABLE 6-2: Properties of Coletanche ES3 Geomembrane

Material Property	Qualifier	Unit	ES3 Specified Value	Standard
Characteristics of Roll	Length Width	m m	65 5.1	- -
Unit Weight of Incorporated Non-Woven Geotextile	-	g/m^2	300	n/a
Thickness	nominal	mm	4.8	ASTM D5199
Density	typical	g/cm^3	1.240	ASTM D-792
Bitumen	-	n/a	Elastomeric bitumen	n/a
Tensile Stress at break				
Longitudinal	minimum	kN/m	32.4	ASTM D4595
Transverse	minimum	kN/m	25.7	ASTM D4595
Elongation at break				
Longitudinal	minimum	%	63	ASTM D4595
Transverse	minimum	%	77	ASTM D4595
Tensile Tear Resistance				
Longitudinal	minimum	N	1060	ASTM D4073
Transverse	minimum	N	916	ASTM D4073
Static puncture	minimum	N	643	ASTM 4833
Puncture by aggregates (20/40)	minimum	kN	25	NFP84507
Dimensional Stability				
Longitudinal	maximum	%	-0.20	ASTM D1204
Transverse	maximum	%	-0.10	ASTM D1204
Permeability	maximum	cm/sec	$1x10^{-12}$	-
Stress relaxation with time	-	% in 3 hours	70	CEBTP No. 6327.7.390
Stress cracking susceptible	-	-	No	ASTM D1693
Coefficient of Thermal Expansion	maximum	cm/cm/°C	1×10^{-6}	ASTM D696
Cold bending	minimum	°C	-25	ASTM D746

S6.9.2 Welding Primer Material

The primer material shall be Elastocol stick as manufactured by Soprema, or approved equivalent. The primer material shall be a blend of SBS (Styrene Butadiene Styrene) synthetic rubbers, fast-evaporating solvents and adhesive-enhancing additives. The primer material is required to prime surfaces such as concrete or metal in order to improve the adhesion of the Sopraflash Flam Stick. Characteristics of the required primer material are shown in Table 6-3.

TABLE 6-3: Properties of Elastocol Stick Primer Material

Property	Unit	Value
Specific gravity at 20°C	kg/l	0.79
Solids by weight	%	24
Viscosity, Brookfield	cP at 25 °C	200
Flash point (ASTM D-93)	°C	-18
Drying time	Minutes	15 to 60 depending on temperature and thickness

Elastocol stick primer can be applied with either a brush or roller at the manufacturer's recommended average coverage of about 0.5 litres/m^2.

S6.9.3 Sopraflash Flam Stick

A Sopraflash Flam Stick shall be joined to the lean concrete mat using the Elastocol stick primer material. The Sopraflash Flam Stick shall be a self-adhesive SBS modified bitumen membrane. Characteristics of the required Sopraflash Flam Stick are provided in Table 6-4.

TABLE 6-4: Properties of Sopraflash Flam Stick

Property	Standard	SOPRAFLASH System (Minimum Properties)
Base sheet dimensions (m)	-	15 x 1
Strain energy, MD/XD (kN/m)	CAN/CGSB-37.56-M 9th draft	8.4 / 8.3
Breaking strength, MD/XD (kN/m)	CAN/CGSB-37.56-M	18/16
Ultimate elongation, MD/XD (%)	9th draft	5 5/56
Tear resistance (N)	CAN/CGSB-37.56-M	120
Static puncture (N)	9th draft	380
Dimensional stability, MD/XD (%)	CAN/CGSB-37.56-M	0.1/0.4
Plastic flow (°C)	9th draft	105
Cold bending (°C) –initial –90 days at 70 °C	CAN/CGSB-37.56-M	-30 - 30

The design joint width is 0.5 m and the Sopraflash Flam Stick sheet may be cut in two 0.5 m width sheets.

S6.9.4 Mastic

The mastic used in the liner installation shall be Sopramastic as manufactured by Soprema or approved equivalent. The mastic shall be a solvent-based mastic containing SBS-modified bitumen, fibres and mineral fillers. Characteristics of the required material are shown in Table 6-5.

TABLE 6-5: Properties of Sopramastic

Property	Unit	Value
Specific gravity at 20 °C	kg/l	1.12
Application temperature	°C	-10 to 35
Solids by weight	%	83
Flash point (ASTM D-93)	C	25
Setting time	Hours	4 to 24 depending on temperature and thickness

S6.10 Liner Bedding and Cover Material

Surfaces for liner bedding shall meet the Foundation Preparation Specification for liner bedding.

Liner Cover material shall meet the Fill Placement Specification.

S6.11 Execution

S6.11.1 Liner Bedding Surface Preparation

The liner bedding and cover material shall be to the lines and grades as shown on the Drawings and in accordance with the Fill Placement Technical Specification. No liner shall be placed until the QA Manager has given written approval of the liner bedding surface.

Before beginning installation of the liner, a surface acceptance form, as prepared by the Contractor, must be signed by the liner installer first and then by the QA Manager. This acceptance may be segmented in order to cover only localized areas of the liner placement at any one time. No roll shall be installed before the QA Manager has signed the surface preparation acceptance form.

S6.11.2 Panel Layout Drawing

The Contractor shall provide the QA Manager with a proposed panel layout drawing, in digital AutoCAD drawing and hardcopy formats, at least one week prior to placing any liner. The panel layout drawing shall be based on the actual as-built surface on which the liner is to be placed and shall consider panel placement locations along the dam alignments.

The panel layout should minimize the number and length of required seams. In general, horizontal seams will not be allowed on the proposed panel layout for the sloping face portions of the liner installation. The Contractor shall not place any liner until the QA Manager has given written approval that the proposed panel layout is acceptable.

Following the installation, each panel must be clearly numbered by the Contractor. The location of material off of each roll must be noted on the as-built panel layout plan. This plan, once completed, will be submitted to the QA Manager for approval.

S6.11.3 Installation

The Contractor is responsible for the transportation of the rolls of the liner from the temporary storage area to the work site, installation of the liner, QC testing and document preparation.

The Contractor shall install the liner using personnel experienced in the deployment and welding of bituminous liners. The Contractor shall submit a list of proposed personnel to the Construction Manager and QA Manager for approval at least two weeks prior to the liner deployment, and specifically identify the experience of the personnel that will install the liner.

The Contractor shall arrange for a technical representative of the Manufacturer to be on site for the liner placement until the technical representative certifies that the Contractor's personnel are qualified to install and join the liner. The Contractor shall arrange for the technical representative to visit again if new liner installation personnel are hired at a later date. In addition, the Contractor shall arrange for a technical representative of the Manufacturer to make regular site visits during the liner installation to review the installation and QC testing procedures.

The Contractor shall install the liner in accordance with the Manufacturer's instructions, and these Specifications. The Contractor is responsible to prevent any damage that may be caused due to the liner cover placement or other construction activities.

In order to minimize mechanical damage to the liner during installation:

- Using brooms, maintain the liner surface free of stones;
- the equipment used shall not damage the liner;
- personnel working on or near the liner shall wear boots that will not damage the liners; and
- only all terrain vehicles (ATV) with low pressure tires may traffic on the uncovered surface of the liner.

Following the installation, each in-place liner panel shall be visually inspected by the Contractor in order to identify any damaged surfaces or abnormal appearance. Any defect must be repaired promptly by the Contractor. Additionally, the Contractor shall carry out required QC testing and sampling as specified in the QC/QA Specification.

The QA Manager will inspect and approve the liner installation only upon receiving all required QC documentation.

No covering or backfilling over the liner shall be carried out until the QA Manager has approved the liner installation in writing. The acceptance may be issued for completion of localized areas of the liner, prior to completing the entire liner installation, at the discretion of the QA Manager.

S6.11.4 Deployment of Rolls

The surface of the bedding material must be smoothed, free of protruding stones, clean, and dry. When deploying the rolls the Contractor shall ensure that the liner panels are properly aligned, with a minimum overlap of 200 mm. Chalk marks 200 mm from the panel edges shall be used to lay out the panels.

The Contractor shall ensure that sufficient ballast is placed to hold the liner in place, in the event of high winds. The ballast shall comprise sand-filled burlap sacks, or other means which will not cause damage to the liner.

S6.11.5 Flaws in Membrane

Flaws, which shall be repaired, shall not exceed one per 500 m^2, unless otherwise approved by the QA Manager. Edge flaws will only be accepted if they do not interfere with the seaming process. Defects such as holes, blisters, undispersed raw materials, or any signs of contamination by foreign matters, shall result in rejection of the roll.

S6.11.6 Torch Welding

The liner shall be welded using propane torches. The torch-welds must be performed according to these Specifications, and the instructions of the Manufacturer.

Liner panel ends and overlaps must be welded on a homogeneous and continuous basis, leaving a 6 to 10 mm bitumen bead along the seam.

Seams shall be aligned and welded so that a smooth surface is created with minimal wrinkles. The area in the immediate vicinity of the seam shall be free of moisture, dust, dirt, debris or any other foreign material. Seams shall be welded directly following deployment of the liner.

To the extent possible, welding of seams should be done from the bottom to the top of the slope. No horizontal welds shall be allowed on slopes of greater than 10% incline, except on small, localized patches required to repair defects. All seams shall be completed by a welding reviewer, who has not been a part of the welding team for that seam, completing visual checking and trowel testing of the entire seam length.

The Contractor shall note the following information for each weld performed:

- Weld identification number;
- Date and time of start and finish of welding;
- Corresponding roll identification numbers of welded sheets; and
- Welder's name and his certification number from Soprema.

A copy of this information shall be provided to the Construction Manager and QA Manager for approval.

S6.11.7 Installation Temperature

The ES3 liner may be installed in ambient air temperatures as low as -20 °C (or -30 °C including wind chill factor). The Contractor shall not install ES liner when the ambient air temperature is lower than -25°C (including wind chill factor) without prior written approval of the QA Manager.

S6.11.8 Quality Control

The Contractor shall provide on-site supervision, equipment and QC testing during the installation period, for inspection of the completed liner and seaming of the liner, as required to warrant the entire liner assembly. The Contractor shall maintain and clean all equipment on a regular basis to ensure that it is in good working order.

S6.11.9 Repairs

Seams and defective areas identified during the QC testing and inspections shall be repaired, and the areas re-inspected and re-tested until approved by the QA Manager.

S6.11.10 Attaching to Installed Liner

It will be necessary to attach the new liner to the existing TSF installed liner. This will require exposing and cleaning the existing liner by hand, and joining it to the new liner.

The connection between the new liner and the existing liner shall be made as indicated on the Drawings.

S6.11.11 Attaching to Lean Concrete Mat

It will be necessary to attach the ES3 bituminous liner to the Lean Concrete Mat in the base of the trench. This will require cleaning the surface of the Lean Concrete Mat and joining it to the surface using Elastocol Stick, Sopraflash Flam Stick and Sopramastic, all manufactured by Soprema Inc.

The connection between the ES3 and the concrete surface shall be made as indicated on the Drawings, and should be carried out according to the following general procedure.

1. The Lean Concrete Mat shall be cleaned of dirt and dried after grouting has been completed. Inspect the surface which must be straight, uniform and without obvious irregularities which might interfere with attaching it to the ES3. Report any problems with the concrete surface to the QA Manager.

2. Using a paint roller, apply Elastocol Stick primer to the cleaned and dry surface. Allow to dry the required time or until the surface feels dry to the touch.

3. Unroll and position the Sopraflash Flam stick until straight. Fold back the first few metres of the Sopraflash Flam Stick to peel the release paper back then position

it back down to stick the concrete surface.

4. Roll the top face of the Sopraflash Flam Stick with a steel roller to ensure a good bond to the concrete surface.

5. Finish seam of the Sopraflash Flam Stick to concrete liner with a bead of Sopramastic approximately 6mm wide on the downstream side and along the entire length of the seam to complete the connection. The bead of Sopramastic should be finished with a trowel as soon as possible after installation.

6. Once the Engineer has inspected and approved the Sopraflash Flam Stick and the Sopramastic that have been applied to the concrete surface, install Coletanche ES3 bituminous liner and weld to the top of the Sopraflash Flam Stick.

S6.12 Site Clean-up

The Contractor shall ensure that all excess or waste materials, debris, sand bags or any other extraneous materials are removed from the site whenever they are no longer required. Upon completion of work in any given area, the Contractor and the QA Manager shall examine that area to determine whether all waste and extraneous materials have been removed and that the area has been left in a satisfactory clean condition to allow placement of materials on top of the liner.

The polyethylene film and kraft paper which comes off the liner when it is installed must be collected and disposed of away from the construction works area following site procedures.

S6.13 Completion of Work

The installation of the liner shall be considered as totally complete when: all required deployment, field seaming, testing and repairs, and site clean-up have been completed by the Contractor; the Contractor has submitted all the required quality control documentation to the Owner; and the QA Manager is satisfied that the liner has been installed in accordance with the above Specifications. A Work Completion Report is required, as described in the Administration Specification.

S6.14 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specification.

The Contractor shall cooperate with the QA Manager, and extract QA field samples as requested by the QA Manager. The Contractor shall allow the QA Manager to oversee QC testing and inform the QA Manager of planned QC testing. The Contractor shall also give a minimum of 4 hours notice to the QA Manager when liner seams are ready for inspection when QC testing is complete. The liner shall not be covered before the QA Manager has performed tests and given written approval of material and seams.

S7 DRILLING AND GROUTING

S7.1 Scope

This Specification describes Drilling and Grouting for construction of the Central Dike. The Drilling and Grouting consists of all work required to seal fissures in the bedrock foundation and abutments by drilling and grouting holes from a working platform into bedrock foundations and abutments to provide a seepage cut-off.

Drilling and grouting shall include the following:

- All Works identified on the Drawings.

- Grouting the bedrock along the dike foundation. The scope includes: drilling grout holes, installing and removing casing, water testing grout holes and pressure injecting grout into grout holes for curtain grouting.

- Curtain grouting shall include the drilling of one or more rows of holes and injecting the specified grout mix into the holes to create a low-permeability curtain. In rock, curtain grouting shall use staged working in the holes and shall use the split-spaced closure method.

Climate conditions may require working in enclosed areas on panels of limited length. The Contractor is responsible for any required enclosures or shrouding required.

Limited data is available on bedrock condition along the dike alignment.

S7.1.1 Provisional Extent of Work

The spacing, depth, orientation and pattern of grout holes, grout mixes, quantity and type may be varied at the discretion of the Engineer as a result of conditions revealed as grouting progresses.

Water pressure testing shall be used to control the sequence of work. As such, water pressure testing will be carried out before, during and as the curtain is brought to completion.

S7.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the CM and following inspection, as-built survey and approval of pre-work conditions.

S7.3 General

S7.3.1 Responsibilities

Responsibilities are listed in the Administration Specification S1.

S7.3.2 Supervisory Staff Qualifications

The Contractor, his subcontractor or his consulting advisor shall have sufficient competent experienced personnel to drill and grout. The grouting operations manager shall have at least five (5) years experience of similar work. Drillers, grouting operators and grouting foremen shall have at least three (3) years experience in similar work.

S7.3.3 Weather Conditions

It is anticipated that the working conditions on site will be particularly challenging during winter conditions, with average temperatures ranging between -15 ^{o}C and -30 ^{o}C, and wind chill potentially taking ambient temperature down to -50 ^{o}C.

S7.3.4 Access

Access to the Work will be provided and coordinated by the CM.

S7.3.5 Storage Area

Storage areas for all goods and materials will be provided by the CM. Cement, superplasticizer, bentonite and other concrete admixtures shall be stored in a dry heated building and held at a temperature between 7 ^{o}C and 12 ^{o}C.

S7.3.6 Delivery and Storage of Goods

The CM shall be responsible for the correct addressing of all goods and materials for their use on site.

The CM shall take delivery of goods and materials for grouting and store them appropriately on site.

S7.3.7 Water Supply

The CM shall be responsible to provide a water source. The Contractor is responsible for pipes, pumps, storage tanks and equipment to heat the water supply.

S7.3.8 Electronic Monitoring

Grouting will be directed based on measured ground response to grout injection. Measured flow rate and pressure data shall be digitally recorded. Flow meters, pressure transducers and pressure gauges shall be supplied and operated by the Contractor as specified.

S7.3.9 Removal of Refuse

The Contractor shall clean up the work area as the Work progresses, removing debris from the Site to the designated disposal area daily. When the work is finished all buildings, tools, machinery, rubbish and waste materials shall be disposed of properly and the site shall be left in a neat and orderly condition.

S7.3.10 Waste Water

Waste water from grouting operations shall be directed to locations approved by the CM. The sizing and maintenance of any sumps or lagoons required to carry out the work shall be the responsibility of the Contractor.

S7.3.11 Electrical Power

The Contractor shall provide generators sufficient for the electrical power needs of the drilling and grouting operations. Diesel for the generator(s) will be supplied by the Owner at no cost to the Contractor.

S7.4 Submittals

Requirements for the Contractor's Work Plan for grouting activities are described in Administration Specification. Requirements for reporting are described in QC and QA Requirements Specification and the Administration Specification.

S7.5 Setting Out and Dimensional Control

S7.5.1 Hole Locations

The grouting centerlines and other key setting out information shall be provided by the Engineer following completion of the cut-off trench excavation and geologic mapping.

Set out primary grout holes shall be approved by the Engineer prior to drilling.

S7.5.2 Permanence of Markings

Holes for grouting, drainage, checking or exploration shall be tagged in a logical and sequential manner for proper identification.

Each tag shall be installed immediately on completion of drilling and shall have a distinctive color and number as approved by the Engineer.

S7.5.3 Grout Hole Tolerances

Grout holes shall be collared within 200 mm of nominal locations.

Out of tolerance holes shall be backfill grouted and re-drilled.

S7.6 Materials

S7.6.1 Cement

Cement shall be obtained from one manufacturing source throughout the period of work to ensure consistent quality and compatibility with all concrete materials.

Cement used in grouting shall be Type III high early strength Portland cement as per ASTM C150 or C595 (or HE Portland cement as per CSA A3000-03 Cementitious Materials Compendium). Cement shall be supplied in standard bags on pallets by the Owner.

Cement shall be less than 3 months old at the time of use in grout unless approved by the Engineer. Cement that has become partially hydrated during storage shall not be used in grout.

Heated storage for the cement is required to prevent the cement from freezing.

S7.6.2 Superplasticizer

Superplasticizer shall be a high-range water-reducing admixture used as a dispersion agent and shall comply with ASTM C494 Type F. Trials are required on site to verify satisfactory performance of specific superplasticizers with the cement used for grouting. Superplasticizer shall be:

Glenium 3030 NS supplied by:
BASF Admixtures Inc.
1800 Clark Boulevard, Brampton, Ontario
Tel: 800-387-5862

or similar, subject to satisfactory grout stability and viscosity being obtained as determined by the Engineer.

S7.6.3 Bentonite

Bentonite shall be finely ground (less than 200-mesh), premium grade sodium cation montmorillonite (Wyoming sodium bentonite) and shall meet all current API Standard 13A specifications. A suitable material is:

QUIK-GEL, supplied by
Baroid, Industrial Drilling Products
Houston, TX
Tel: 281-871-4612

S7.6.4 Viscosity Modifying Admixtures

Viscosity Modifying Admixtures (VMA's), if used shall be required to increase the viscosity and prevent washout of the injected grout. VMA's shall comply with ASTM C494. Trial mixes at site will be required to determine the actual mix proportions and requirements for use. The VMA shall be:

Rheomac UW450 supplied by:
BASF Admixtures Inc.
1800 Clark Boulevard, Brampton, Ontario
Tel: 800-387-5862

or similar, subject to satisfactory grout stability and viscosity being obtained as determined by the Engineer.

S7.6.5 Accelerators

Because of the anticipated cold (and possibly frozen) bedrock conditions, a non-chloride set time accelerator shall be required to ensure that the water does not freeze before the grout mix sets. The set time accelerator shall comply with ASTM C494 Type C and Type E. Trials are required on Site to verify satisfactory performance of specified accelerators with the cement and other admixtures used for grouting. Accelerator shall be:

Pozzutec 20+ supplied by:
BASF Admixtures Inc.
1800 Clark Boulevard, Brampton, Ontario
Tel: 800-387-5862

or similar, subject to satisfactory grout stability, viscosity and set times being obtained as determined by the Engineer.

S7.6.6 Other Admixtures or Modifiers

Other additives could be required, such as retarders, inert fillers, volcanic ash or expanders. Such materials shall be products of proven quality and shall be subjected to the same field trial requirements as other mixes.

Prior to mobilization, all other grout additives shall be proposed by submittal to the Engineer for approval.

Trial mixes at Site will be required to determine the actual mix proportions and requirements for use.

S7.6.7 Water

Water used in grout mix preparation shall be fresh, clean water from a local source which is free from injurious amounts of oil, silt, soluble chlorides, organic matter, acids, alkalis and other deleterious substances, and conforms to ASTM C1602. Water used for mixing shall be heated and held at temperature ranging between 7 ^{o}C and 12 ^{o}C.

S7.6.8 Materials Storage

Cement, superplasticizer, bentonite and other concrete admixtures shall be stored in heated, weather tight buildings or containers to provide protection from rain, dampness, and contamination and held at temperature ranging between 7 ^{o}C and 12 ^{o}C.

S7.7 Equipment

The following include minimum requirements anticipated to complete the Work. Alternative equipment proposed by the Contractor must be approved by the Engineer.

S7.7.1 Rock Drills

Drilling equipment shall be capable of installing/retrieving threaded steel casing through cut-off and overburden materials and a minimum 200 mm into bedrock, to a depth of 10 m. Steel casing may be replaced by PVC or other casing following completion of installation. In the absence of threaded casing, a casing jack shall be required on site for removal of installed casing.

Drilling equipment shall also be capable of drilling grout holes through the installed casing a further 50 m into bedrock. Grout holes in bedrock shall have a minimum internal diameter of 50 mm.

Drilling equipment shall be capable of installing/retrieving casing and drilling grout holes inclined vertically through to horizontally. All steel casing must be retrieved following the completion of grouting activities.

Water or foam flush shall be used as appropriate. Dry drilling (air flush) shall not be carried out.

S7.7.2 Water Heaters

Water heaters used to pre-heat mix water shall be of the West Coast Drilling Inc. propane water line heater variety or suitable alternative, as approved by the Engineer.

S7.7.3 Grout Mixers

Grout mixers shall be of the high-speed, high-shear (“colloidal”) type operating at a mixing speed of more than 1,500 rpm, capable of thoroughly mixing the water, cement, bentonite and superplasticizers into a stable colloidal suspension. The nominal required capacity is 200 L of grout per batch.

Grout mixers shall be equipped with bag-splitters so that grout is mixed using whole bags of cement. Grout mixers shall be equipped with water meters (with units in litres) for batching the mix water, and each grout plant shall have available five 500 mL and three

250 mL graduated cylinders for batching superplasticizers and one, 1,000 g maximum weight, electronic, digital scale with an accuracy of ± 0.1 g for batching bentonite.

Paddle mixers shall not be used.

S7.7.4 Grout Holding Tanks (Agitators)

Grout holding tanks shall be of about 500 L capacity and equipped with paddles rotating at about 100 revolutions per minute. The lowest paddle shall be set within about 50 mm of the base of the tank.

Holding tanks shall be provided with a 0.15 mm sieve to screen solids or hardened grout from being discharged into the holding tank by the grout return line.

S7.7.5 Grout Pumps

Grout pumps shall be of the variable speed, progressing cavity (Moyno or Mono) type with a maximum delivery pressure of 25 bar at a sustained flow rate of 20 L/min. The rotation speed of each progressive cavity pump shall be controlled by a dial-pot voltage regulator (*i.e.* rate of injection shall be controlled by the rotation speed of the pump, not by re-circulation lines and valves).

Piston pumps (even if fitted with pressure surge chambers) shall not be used for grout injection.

S7.7.6 Pumps for Water Pressure Testing

Water pressure testing pumps shall be capable of delivering a sustained flow rate of 200 L/min at a maximum pressure of 8 bars.

S7.7.7 Grout Pipes

Pipes and hoses used to circulate grout from holding tank to point of injection shall have a maximum internal diameter of 25 mm and shall be rated for a safe working pressure of at least 38 bar. There shall be no sudden reductions in pipe diameter that might cause grout blockages. Fittings and connections on grout pipes and hoses shall be rated to 38 bar safe working pressure and shall include safety chains (whip checks).

S7.7.8 Valves

Valves to be used in-line with the injection lines shall be of the diaphragm type.

Plug cock valves and ball valves shall only be used for fully-open/fully-closed functions.

S7.7.9 Single Packers

Provide single packers for pressure grouting.

Single packers shall be capable of isolating a part of a grout hole to enable only the lower portion of the hole to be pressure grouted.

Single packers shall be sized based on the choice of grout hole diameter and method of drilling.

In general pneumatic packers shall be used for down hole work. Mechanical packers shall be used for grout injection at the top of the hole during consolidation grouting.

The maximum allowable leakage of grout past the packer shall be 0.1 L/min at a grout pressure of 25 bars at ground surface.

S7.7.10 Double Packers

Double packers shall be provided for water tests. Double packers shall be capable of isolating a 2 m long portion of the grout hole and allowing water to be pumped into that isolated portion. The supply of water to the injection point shall not be subject to significant head loss below the hole collar.

Double packers shall be sized based on the choice of grout hole diameter and method of drilling. Double packers shall be actuated by compressed nitrogen and the required compressed gas supplies, lines, regulators and pressure gauges shall be supplied. When sealing a portion of grout hole the actuation pressure shall be at least 10 bars greater than the pressure used in the water test.

S7.7.11 Pressure Transducers

Pressure transducers shall be of 30 bar maximum pressure and of the 4-20 mA type. Transducers shall have an accuracy of better than 1% FSD (Full Scale Deflection). Pressure transducers shall be mounted on the grout line tee at the hole collar, and shall be

protected from the grout using an in-line gauge saver. Only one hole shall be monitored with each pressure transducer.

S7.7.12 Pressure Gauges

Bourdon-type pressure gauges shall be provided at each grout pump discharge and at each hole collar. Gauges shall be protected from grout using gauge savers independent of those used for the pressure transducers. Gauges shall have a minimum face diameter of 75 mm and shall be available with a 30 bar maximum pressure range.

S7.7.13 Flow Meters

Flow meters shall be of the electromagnetic type. Flow meters shall have a full scale capacity of 100 L/min and shall be capable of resolving flows as low as 0.3 L/min with an accuracy of ± 0.1 L/min. The flow meters shall provide an electronic signal of the 4-20 mA type.

S7.7.14 Calibration Checks

Pressure transducers and pressure gauges and flow meters shall be calibrated in the frequency specified in QC and QA Requirements Specifications.

Pressure transducers, pressure gauges and flow meters shall be re-calibrated if deviations are greater than ± 5%.

S7.7.15 Recording Equipment

The output of the pressure transducer (pressure) and flow meters (flow rate, total injected volume) shall be recorded and displayed on a data acquisition system, with the display visible close to the hole collar and adjacent to the pressure control valve. Graphical output capabilities shall be the same as those presented in this Specification.

Data acquisition systems shall record time, pressure, and flow rate for each grout stage at one second intervals and these records shall be provided to the Engineer as comma separated (“csv”) files readable by a personal computer within 12 hours of completion of the shift.

Data acquisition systems shall also provide a RS232 output of pressure and flow rate to enable the Engineer to carry out real-time analysis of ground response to grout, if required, by connecting a laptop computer to the data acquisition system.

S7.7.16 Power Supplies and Electrical Protection

Data acquisition systems shall be powered by uninterruptible power supplies with surge and spike suppression.

Flow meters and pressure transducers shall be protected from electrical power surges and voltage spikes.

S7.7.17 Shelters

During periods of cold weather, the Contractor shall provide an enclosed, heated working area (Quonset Hut) of sufficient size to carry out the specified works on a panel-by-panel basis. Each panel will be a minimum of 50 m in length.

When not located within a Quonset Hut, temporary portable shelters shall be provided by the Contractor to protect data acquisition systems from rain, sun, snow, wind and freezing temperatures. Typical enclosures are shown on the following figure for reference.

S7.7.18 Radios

Sufficient handheld radios shall be provided by the Contractor so that grouting operators can communicate with the grout mixing station and with the grouting operations supervisor.

S7.7.19 Equipment Reliability

It is essential that grouting of a hole or stage of a hole shall continue smoothly until refusal of grout occurs. If grouting is interrupted through equipment breakdown or other delays, grouting of that hole and stage shall be terminated, and all operations carried out in connection with that hole or stage as applicable shall not be measured for payment.

S7.7.20 Other Equipment

Hoses, pipes, wrenches, valves and all other equipment and small tools necessary for the drilling and grouting shall be provided by the Contractor.

S7.7.21 Spares

At all times, sufficient spares shall be provided so that all equipment can be readily kept in full working order.

In particular, a sufficient number of packers, grout mixers, agitators, grout pumps, magnetic flow meters, pressure transducers, pressure gauges, water heaters, hoses, valves, pipe fittings and grout mix testing equipment shall be available, ready for immediate use, to produce grout at rates required by the hole or holes being grouted and without interruption due to mixer breakdown.

S7.7.22 Water Pressure Testing Equipment

Water pressure testing shall be carried out using equipment dedicated to water testing and independent of the grouting operations.

The pump for water pressure testing and monitoring equipment shall be as specified.

S7.7.23 Grouting Testing Equipment

Equipment requirements for testing grout are listed in the QC and QA Requirements Specification.

S7.8 Grouting of Rock

Alternative methodology for grouting may be proposed by the Contractor as part of the Contractor's Work Plan but is subject to review and approval by the Engineer. The following methodology is otherwise specified.

S7.8.1 Methodology

Grouting of rock foundations will comprise of drilling and grouting of the curtain using the split-spaced closure method. Primary hole spacing shall be 6 m or as approved by the Engineer.

Bedrock grouting will generally be upstage with packer, unless ground conditions require downstage working. Stages shall be 5 m length unless approved by the Engineer.

Grouting activities and closure will be carried out panel-by-panel, with closure in one panel being achieved before work is initiated in the next.

S7.8.2 Performance Criterion

The cut-off shall have a target hydraulic conductivity of 4 Lugeons (1 Lugeons $=1x10^{-7}$ m/s) with no single test greater than 7 Lugeons as determined by water pressure testing in boreholes drilled into the installed grout curtain.

S7.8.3 Bedrock Drilling

Holes shall be drilled at locations shown on the Drawings, or as directed by the Engineer.

S7.8.4 Restriction on Drilling

Holes may not be drilled within 6 m of a grouted hole until at least 8 hours has elapsed after completion of grouting of that hole. If frequent communication between holes occurs, the minimum working distance requirements may be increased by the Engineer.

All primary holes can be drilled as most convenient. No secondary hole shall be drilled until its adjacent primary holes have been grouted.

S7.8.5 Protection and Cleaning of Drill Holes

Thoroughly wash all holes immediately before grouting the hole to remove cuttings, sediments, sludge and other loose material. Wash by injection of water at the bottom of the hole for five minutes or until return water is clear.

Protect cleaned holes from becoming clogged or obstructed using standpipes, rubber stoppers or similar means, until the holes are completely grouted. Drill holes shall be re-cleaned if clogging or obstruction occurs.

Grout hole casing shall be protected against damage prior to grouting.

S7.8.6 Removal of Water from Grout Holes

An air compressor and airline of sufficient capacity to be capable of blowing water or unset grout out of grout holes by the airlift technique shall be available on site. Water or unset grout shall be blown out of grout holes.

Drill holes shall be re-drilled if ice build-up occurs.

S7.8.7 Upstage Working

Upstage working shall comprise drilling the grout hole to full depth, washing and cleaning the hole, setting the packer at the top of the lowest stage, then grouting that stage. Provided that the target injection pressure is attained with grout refusal, grouting may continue by moving the packer to the next stage above after 10 minutes has elapsed and continuing to inject grout.

If the target pressure is not attained or, if the final grout flow rate when the volume limit of 1,500 L is reached is greater than 5 L per minute, then work shall stop on that hole until 6 hours have elapsed.

S7.8.8 Downstage Working

Downstage working shall comprise drilling the depth of a grout stage, washing and cleaning the hole, seating the packer at surface, injecting the grout, removing the packer, and washing the hole, completing these six operations before commencing the next stage.

Work shall commence in the stage nearest the surface and shall proceed down the hole until the final depth is reached.

At least 8 hours shall elapse between completing a stage and commencement of work on the next deeper stage.

After completion of the final stage, the hole shall not be washed and instead backfilled with grout.

S7.8.9 Split Spacing

The process of progressively closing a grout curtain by locating, drilling and grouting holes approximately at the midpoint between two other holes previously drilled and grouted. The spacing of the holes drilled and grouted may vary considerably from station to station, depending on conditions encountered.

S7.8.10 Closure Sequencing

Higher sequence holes shall not be started until both the adjacent prior holes have been completed. For example, a secondary hole shall not be drilled until grouting has been completed on both the adjacent primary holes.

S7.8.11 Panel-by-panel Sequencing

Depending on weather conditions or as approved by the Engineer, grouting activities and closure will be carried out panel-by-panel, with closure in one panel being achieved before work is initiated in the next.

Each panel will be a minimum of 50 m length, and shall overlap the previous panel by a minimum of 6 m.

S7.8.12 Water Pressure Testing

A water pressure test consists of measuring the rate at which water is accepted by bedrock for five periods of five minutes each.

Water pressure tests shall be carried out on 5 m long stages of cleaned grout holes. Generally, water pressure tests will be carried out in selected holes prior to grouting and in secondary holes to determine the adequacy of the grout curtain. Water pressure tests will be carried out independent of grouting operations.

The location and number of water pressure tests shall be determined by the Engineer. No such test shall be performed adjacent to a borehole grouted less than 8 hours previously.

S7.8.13 Grout Mix

The following grout mixes are proposed to initiate the grouting program:

Casing Grout

Water	200 L
Cement	100 kgs
Bentonite	7.5%
Superplasticizer	0 mL
7-day UCS value	~ 1 MPa

Mix A

Water	70 L
Cement	100 kg
Bentonite	0.0 kg
Superplasticizer	400 mL (0.9%)
Marsh Cone	30 seconds (nominal)

Mix B

Water	70 L
Cement	100 kg
Bentonite	0.0 kg
Superplasticizer	0 mL
Marsh Cone	35 seconds (nominal)

Mix C

Water	70 L
Cement	100 kg
Bentonite	0.6%
Superplasticizer	0 mL
Marsh Cone	45 seconds (nominal)

Mix D

Water	70 L
Cement	100 kg
Bentonite	1.2%
Superplasticizer	0 mL
Marsh Cone	60 seconds (nominal)

The above quantities shall be adjusted to match the cement weight such that the mix comprises a unit number of bags of cement.

Mixing shall be carried out by first introducing the water into the mixer followed by the superplasticizer and the dry bentonite. The water bentonite mixture shall be thoroughly mixed for three minutes before the cement is added. Mixing shall then continue for sufficient time to give stable, uniform slurry.

Grout shall be continuously agitated during pumping and grouting.

S7.8.14 Trial Mixes

The grout mixes given are provisional mixes. Trials shall be carried out using the mixers and a standard batch size to verify that the mix gives the required grout quality. The Contractor may change the mix, if required, to obtain the specified grout viscosity and bleed parameters.

All grout shall have less than 5% bleed (bleed shall be measured over a two-hour period and shall comprise the decantation of clear water at the top of a 500 mL grout cylinder).

S7.8.15 Modifying Grout During Injection

The grout mix may be modified as grouting of a hole progresses depending on ground response at the discretion of the Contractor. Mix A shall generally be used.

Modifications will most likely occur if high take zones are encountered and will likely comprise first the omission of the superplasticizer from the grout mix (to achieve an approximately 35 second Marsh cone grout), followed by an increase in bentonite content using the previously established standard mixes.

Possible modified mixes shall be batched and tested prior to the start of grouting and approved by the Engineer.

S7.8.16 Grout Injection

The rate of injection shall be controlled by the rotation speed of the pump (*i.e.* using a dial-pot voltage regulator to vary or control the rotational speed of the positive displacement helical screw).

Pumping of the grout mix shall be at a steady flow rate of no more than 2 L/min/m, which results in a gradual pressure increase as the mix penetrates into rock discontinuities.

Grout shall be injected at the pressures and mix proportions as specified.

Grouting shall take place continuously until grout refusal occurs or the instructed volume limit of 1,500 L for that stage is reached.

Grout refusal for a given stage shall be a flow rate of less than 2.5 L/min per 5 m stage and measured over a 10 minute period (or 0.5 L/min/m for 10 minutes) at the target pressures for the stage.

Any sudden loss of pressure or a sudden increase in grout take shall be immediately reported to the Engineer.

S7.8.17 Pressure Control

Grout injection shall be carried out by pressure control.

Grout shall be injected at a gradually increasing flow rate to a maximum of 10 L/min per 5 m stage or less until the target pressure is reached, at which time the flow rate shall be progressively reduced to maintain the target pressure with continued grout injection until refusal, as defined above.

Injection pressures shall be measured adjacent to the hole collar.

Initial specified target pressures at the mid-point of a stage are calculated as 0.2 bar per metre measured vertically from the working platform to the top of bedrock, plus 0.5 bar per meter from the bedrock surface. The minimum pressure required at mid-stage is 1 bar above the hydrostatic head from the water level, and the maximum is 25 bar.

Target pressures shall be evaluated based on the results of the water pressure tests and the ground response to grout and the target pressures shall be modified to suit the ground conditions.

S7.8.18 Grout Volume Limit

The maximum volume of grout injected per 5 m stage shall be 1,500 L unless otherwise approved by the Engineer.

If the target pressure is not attained, or if the final grout flow rate when the volume limit of 1,500 L is reached is greater than 2.5 L/min, then:

- work shall stop on that hole;
- a period of 6 hours allowed to elapsed; and

- the same stage should then be re-injected.

S7.8.19 Additional Grout Holes

Secondary and higher order grout holes shall be required on either side of an existing grout hole if the grout take of any one stage in that hole is higher than 200 L/m. Additional grout holes shall be completed to a depth of one stage beyond the noted high take.

S7.8.20 Communication Between Grout Holes

Grouting of any hole resulting in connection to an un-grouted hole shall be immediately reported to the Engineer. Multi-point injection shall then proceed in the connected holes.

S7.9 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specification.

The Contractor is responsible for QC of his Work. The QA Manager will continuously observe all grouting activities.

The Owner shall provide facilities and labour as required, if available, to assist in conducting tests and sampling for QC and QA.

S8 INSTRUMENTATION

S8.1 Scope

This Specification describes the requirements for installation of instrumentation for the TSF Dikes. The requirements include equipment and application software for the data acquisition, transmission and processing system.

All instrumentation will be supplied by the Contractor. The main items include installation of:

- vibrating wire piezometers, specifically "Model 4500MLP Piezometer" by Geokon, or equivalent;
- multiple bead thermistor strings;
- survey prisms along crest of the dike;
- survey control monuments; and
- prefabricated cabins for housing instrumentation terminals and data acquisition equipment.

The Contractor has the option of supplying alternate piezometers and readout instruments, subject to approval by Engineer prior to mobilization of equipment to site.

The work shall include the installation and testing of instrumentation, including all labour, materials and equipment to complete the design as shown on the Drawings. The Contractor will be responsible for protection of all instruments, leads, and connectors from damage and displacement during progress of the work, and shall provide markers and barricades as necessary.

S8.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the CM and following inspection, as-built survey and approval of pre-work conditions.

S8.3 General

S8.3.1 Location and Installation Procedures for Instrumentation

The locations for the dike instrumentation are shown on the Drawings. Installation procedures are provided in this Specification. The location of all instruments and

installation will be subject to approval by the QA Manager. Installation of the instruments shall be carried out in accordance with the Drawings, Specifications and the instructions of the equipment manufacturer. The Contractor shall be responsible for proper installation, testing, protection, and maintenance of instrumentation during construction.

Readings of each instrument shall be taken to verify correct functioning, and an initial set of readings shall be taken immediately after installation. Fill shall not be placed over the instruments or leads until the instruments have been tested and initial readings have been taken.

All cable conduits shall be marked with identification tags at intervals of 15 m, or closer if required. In addition, each instrument shall be marked with the identification given to it on the Drawings. Cable conduits shall be installed in maximum practicable lengths to minimize joints. Any necessary cutting, splicing and coupling shall be performed in accordance with the recommendations of the manufacturer.

Open ends of all incomplete lines of tubing, conduits and casing shall be sealed to keep the inside of tubes, conduits and casings free from foreign matter.

No traffic or equipment shall pass over any part of any instrument, leads or connections until at least 600 mm thickness of compacted material cover has been installed. The Contractor shall be responsible for protection of all instruments, leads and connections from damage and displacement during the progress of the Work, and shall provide markers and barricades as necessary.

S8.3.2 Electrical Protection and Safety

New and existing instrumentation shall be connected to the data acquisition system and it shall be confirmed that the system provides the following minimum protection for all electrical equipment:

- Over-voltage peak suppressor;
- Alternating current filter to eliminate interference; and
- Grounding system for lightning protection.

S8.3.3 Cabins and Accessories

All cabins, supports and accessories necessary for installation and protection of instruments shall be supplied by the Contractor.

All cabin and support structures shall be protected from corrosion and shall be finished and painted.

S8.3.4 Voltage and Electrical Frequency

Facilities requiring permanent electrical power, including battery chargers, shall be configured to operate at 110 V alternating current at 60 Hz.

S8.4 Equipment and Installation

All equipment shall be provided by the Contractor to install, operate and maintain the instrumentation. The instrumentation shall be protected with end caps and protective casing. All grouting equipment shall be provided by the Contractor including but not limited to tremie lines, grout pump and grout mix.

Method of installation will be submitted with the Contractor's Work Plan for review and approval by the Engineer.

S8.4.1 Grout Mix

The vibrating wire piezometers, inclinometers and thermistors in bedrock shall be installed using the following grout mix:

- Water 660 L;
- Cement 100 kg; and
- Bentonite 40 kg.

The above quantities shall be adjusted to match the cement weight such that the mix comprises a unit number of bags of cement.

Mixing shall be carried out by first introducing the water into the mixer followed by the cement. The water cement mixture shall be thoroughly mixed before the bentonite is added. Mixing shall continue until a stable, uniform slurry is achieved.

Grout shall be continuously agitated during pumping and grouting.

S8.4.2 Geokon Multi-Level Vibrating Wire Piezometers (MLP)

S8.4.2.1 General

Vibrating wire piezometers shall include all equipment, leads, connection boxes, tubes, fluids, cement-bentonite grout, grout pump, grout tremie pipe, conduits and accessories necessary for installation and operation. The piezometer, leads and connection boxes shall be provided by Geokon Inc and the piezometer shall be specifically "Model 4500MLP Piezometer" (MLP) by Geokon, or equivalent. Data reading shall be carried out manually during construction of the Work and automatically thereafter.

Each MLP shall be capable of measuring water pressure over a range between 0 and 1000 kPa, with a resolution of 0.025%, and accuracy of 0.1% over its entire range.

The spring loaded mechanism of the MLP shall be suitable for a nominal borehole size of 100 mm.

The connector boxes shall have capacity for simultaneous installation of all leads from the piezometers shown on the Drawings.

S8.4.2.2 Installation

MLP shall be installed according to the manufacturer's instructions, within the dike fill and foundation at elevations shown on the Drawings or as directed by the Engineer. Prior to installation, the piezometer shall be immersed in de-aired water in accordance with the manufacturer's instructions.

For vertical installations, a 100 mm diameter borehole shall be drilled at the location and to the elevations shown on the Drawings. The MLP shall be placed in the hole to the elevation shown on the Drawings. After the spring has been triggered the hole shall be grouted with cement-bentonite.

Leads from the instruments to the connector boxes shall be routed through PVC conduits installed into trenches, as shown on the Drawings or as required by the Engineer. The PVC conduit shall be protected from impact and damage during construction by hand-tamped sand backfill.

Installation of the piezometers shall be completed by connecting the leads to the connector boxes within the instrumentation cabin.

No geotextile will be used.

S8.4.3 Survey Monuments and Prisms

S8.4.3.1 General

Survey prisms shall be installed on the crest of the dike, as shown on the Drawings. Each prism mount shall be equipped with a pin or point, to facilitate reading by total station equipment. Readings shall be taken manually during construction.

Survey control monuments shall be installed at locations specified on the Drawings. Survey control monuments shall be Type D monuments detailed in US Army Corps of Engineers EM1110-1-1002 Engineering and Design Survey Markers and Monumentation.

S8.4.4 Themistor Strings

S8.4.4.1 General

Thermistor strings shall include all equipment, leads, connector boxes, conduits and accessories necessary for installation and operation. Data collection shall be carried out manually during construction of the Work and automatically thereafter. Each thermistor string shall have the following:

- Length as shown on Drawings;
- Nodes located on each thermistor string as shown on Drawings;
- Heavy duty, direct burial rated 22 gauge, water-blocked instrumentation cable;
- Rated for a temperature range of at least -50°C to 50°C; and
- Accurate to within 0.2°C.

The connector boxes shall have capacity for simultaneous installation of all thermistor leads shown on the Drawings.

S8.4.4.2 Installation

Themistor strings shall be installed according to the manufacturer's instructions, within the dike fill and foundation at locations and elevations shown on the Drawings.

Leads from the instruments to the connector boxes shall be routed through PVC conduits installed into trenches, as shown on the Drawings. The PVC conduit shall be protected from impact during construction by hand-tamped sand backfill.

The installation of the thermistor string shall be completed by connecting the lead to the connector boxes within the instrumentation cabin.

S8.4.5 Instrumentation Cabins

The instrumentation cabin shall be installed at instrumentation station locations shown in the Drawings. Such cabins shall be suitable for relocation.

Two weeks prior to installation, the details of the proposed cabins shall be submitted by the Contractor to the QA Manager.

S8.4.6 Data Acquisition and Processing Equipment

S8.4.6.1 Scope

The data acquisition system and processing system for the instrumentation shall be supplied. The personnel selected by the CM to handle and operate the equipment and software shall be trained for operations and maintenance.

S8.4.6.2 Functional Requirements

The equipment must allow:

- Acquisition, verification, processing and display of the data obtained from the geotechnical instruments; and

- Sequential data recording complete with date and time, to allow retrieval of all data from any time.

S8.4.6.3 Data Acquisition and Storage Unit

The data acquisition and storage unit will receive data from the geotechnical instrumentation at time intervals selected by the operator. The unit shall be installed within the instrumentation cabin. Data shall be stored for subsequent transfer to a computer for processing. Data shall be recorded with corresponding legend, date and time.

S8.4.6.4 Computer Equipment and Software

A PC notebook computer system and a colour printer complete with system software and specialized software used for data transfer, evaluation, storing, processing and display shall be provided.

S8.5 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specification.

Copies of instrument calibration test sheets provided by the manufacturer will be provided to the Owner and the Engineer.

Testing of each instrument will be undertaken by the Contractor immediately prior to and following installation. Readings will be recorded and submitted in the Daily Summary Report.

QA inspection shall be carried out by the QA Manager and/or personnel as required to confirm the QC results including whether the specified location and construction materials meet the Specifications and Drawings.

The Owner shall provide facilities and labour as required to assist in conducting tests and sampling for QC and QA.

S9 QC AND QA REQUIREMENTS

S9.1 Scope

This Specification defines the requirements for the QC and Quality Control for the construction of the TSF Dikes.

The Specification includes:

- Equipment list for the field laboratory;
- Minimum QC site inspections and testing requirements;
- Minimum QA site inspections and testing requirements;
- Documentation requirements for QC and QA activities;
- Checklists for QC/QA of the major construction activities; and
- Corrective action procedures for non-conforming materials.

S9.2 Site Inspection and Testing

The tasks of the Contractor, CM, and the QC and QA Managers for construction activities are listed in Table 9-1.

TABLE 9-1: Construction Activities and QC/QA Responsibilities

Activities	Tasks		
	Contractor/QC Manager	**QA Manager**	**CM**
Survey	• Survey as required for QC of the Work; and • Provide protection of the survey stakes.	• Review survey lines and chainage and layout; • Review survey data provided by Owner and Contractor; • Determine need for adjustments in field; • Approve quantities; and • Approve layout for fill placement, grout holes.	• Survey for pre-construction condition; lay-out of the Work; as-built reporting; and quantities for payment.
Borrow Source Materials Sources and Storage	• Ensure materials meet Specifications; • Surface water management; and • Control material segregation.	• Perform QA testing including gradations, moisture content; • Perform visual inspection of materials; • Approve suitability of borrow material and storage area for construction; • Approve quantities; and • Documentation including photographic records.	
On Land Foundation Preparation and Excavations	• Specify removal methods for unsuitable materials; • Surface water management; • Prepare sumps, pumps and lines for dewatering; • Report unusual conditions; • Survey lines conform with Drawings; • Plan excavation and waste material disposal; • Provide excavation records; • All in-situ material loosened from excavation removed from cut-off trench. • Excavation stability	• Review proposed waste storage areas; • Check surficial features to determine ground ice conditions; • Observe foundation preparation; • Documentation including photographic records; • Review survey lines and locations; • Review proposed excavation methods and blasting methods/pattern; • Observe foundation excavation; • Inspect trench and prepared foundation area prior to fill placement; • Map bedrock; • Report problems; • Review as-built survey report;	• Identify storage areas for waste materials.

Activities	Tasks		
	Contractor/QC Manager	**QA Manager**	**CM**
Dike and Dam Fill Placement	Ensure placement and extent as per Drawings; • Confirm topography, • Plan material storage and waste material disposal; • Ensure fill materials conform with Specifications; • Report any unusual conditions; • Survey extent of any unusual conditions; • Surface water management; and • Perform as-built survey.	• Review survey lines and locations; • Inspect excavation and prepared foundation area prior to fill placement; • Inspection of liner bedding surfaces; • Inspect fill surfaces prior to subsequent fill placement; • Perform QA/QC testing including gradations of placed material, moisture content; • Observe fill placement, • Inspection of excavation, • Inspect fill quality and extents; • Approval of suitability of fill materials prior to placement; • Report problems; • Review as-built survey report and approve quantities; and • Documentation including photographic records.	QC of fill gradations at crusher;
Foundation Preparation	• Specify removal methods for unsuitable materials; • Provide survey of exposed lake bed surface; and • Report unusual conditions.	• Review and approve survey data for exposed lake bottom; • Confirm and approve bedrock surface by visual inspection and mapping. • Documentation including photographic records.	• Identify storage areas for waste materials.
Liner Installation	• Ensure placement and extent as per Drawings; • Perform QC testing and provide results; • Report any unusual conditions or problems and provide resolutions; • Provide liner panel layout plan. • Inspect liner bedding material conforms to Specification and suitable for liner placement.	• Perform QA testing. • Inspect liner trench excavation and prepared foundation area prior to fill placement; • Report problems; • Review as-built survey report and approve quantities; and • Documentation including photographic records.	
Lean Concrete Mat	• Ensure placement and extent as per Drawings; • Perform QC testing and provide results; and • Report any unusual conditions or problems and provide resolutions.	• Perform QA sampling and testing • Inspect formwork. • Report problems; • Review as-built survey report and approve quantities; and • Documentation including	

Activities	Tasks		
	Contractor/QC Manager	**QA Manager**	**CM**
		photographic records.	
Drilling and Grouting	• Plan material storage and waste material disposal; • Ensure grouting equipment and materials conform with Specifications; • Perform QC testing • Provide real-time pressure, injection rates and volume records for grouting process; • Report any unusual conditions;	• Review survey lines and locations; • Perform QA testing; • Inspect grouting equipment and materials; • Monitor injection process including real-time pressures, injection rates and volume; • Report problems; • Review as-built survey report; and • Documentation including photographic records.	
Instrumentation Installation	• Provide instrumentation, supporting equipment, software, operating manuals, and demonstration to mine staff; • Provide instrumentation casings; • Provide energy sources for applicable instrumentation; • Report any unusual conditions; • Perform QC testing	• Review survey lines and locations; • Perform QA testing; • Inspect instrumentation, supporting equipment and software; • Report problems; • Review as-built survey report; and • Documentation including photographic records.	
Final Site Clean Up			• Inspection.

S9.2.1 Field Laboratory

The Owner shall provide a proper facility/location for performing the required testing in addition to suitable testing equipment, maintained in good repair, properly calibrated at all times.

The following should be provided in the field laboratory as a minimum:

- ASTM Gradation Sieves and shaker;
- Hydrometer and Hydrometer jar -2;
- Oven for moisture content and density;
- Running water and appropriate waste water;
- Aluminum moisture boxes- 4;
- Stainless steel mixing bowls – 3 large round and 3 large rectangular;
- Scale for density and moisture content;
- Sample splitter – 1 large and 1 standard;
- Split Standard Proctor mold with hammer and straight edge;

- Tool set including screwdrivers, chisels, hammers, etc;
- Brush, soft bristle;
- Wash bottle;
- Mortars and pestles – 2;
- Round bottom scoops – 1 large and 1 small;
- Timers – 2 – 1s resolution to 24 hours, electronic;
- Mechanical analysis stirrer for hydrometer testing;
- Concrete cylinder casings for grout strength testing (50 mm dia. x 100 mm height);
- Concrete curing room;
- Concrete testing equipment for slump, air content, and for crushing of cylinders;
- 10 L Sample buckets and lids;
- Crates for shipping samples;
- Grout mix test equipment;
    - Marsh funnel and cup – 1 set per grout plant;
    - Mud balance – 1 per grout pant;
    - Thermometer- 2 per grout plant, graded in Celsius;
    - 500 mL - Graduated cylinders - 5 per grout plant;
    - 250 mL – Graduated cylinders – 3 per grout plant;
    - Pilcon hand vane – 1 per grout plant;
    - Stopwatch – 2 per grout plant;
    - Electronic, digital scale – 1,000 g max. weight, accuracy ± 0.1 - 1 per grout plant;
- pH tape – 1 set;
- Slump cone and rod – 1 set;
- Sand Cone and/or nuclear densometer; and
- Rigid walled compaction mould permeameter.

In addition the Owner shall provide calibration certificates to the QC Manager.

S9.2.2 Minimum Field Testing and Frequency for QA/QC

The quality assurance and quality control minimum testing requirements and frequency are listed in Table 9-2. At a minimum, all the required testing to document the construction quality shall be performed.

Characterization of different rock types, segregation, and placement during construction with respect to geochemistry is the responsibility of the Owner.

TABLE 9-2: QC/QA Activity with Testing and Frequency

		Quality Control (QC)				Quality Assurance (QA)	
Work	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**	**Requirement**	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**
Care of Water	Owner	Visual Observation	Continuously		QA Manager	Visual Observation	Continuously
Borrow Material Storage	Owner	Visual Observation	Continuously		QA Manager	Visual Observation	Continuously
Foundation Preparation and Excavation							
On-land location and extents	Owner and Contractor	Survey for QC	Before and after foundation preparation, excavation.		Owner	Survey for QA	As-built, following the work.
Foundation Preparation Inspection	Owner and Contractor	Visual Observation	Continuously		QA Manager	Visual Observation	Continuously
Fill Placement and Compaction							
Central Dike and Saddle Dam							
Rockfill	Owner	Visual Gradation	Continuously		QA Manager	Visual Gradation	Continuously
		Rock Fill Placement - Visual Inspection	Continuously	max. 1.0 m loose lift thickness	QA Manager	Visual Inspection	Continuously
		Rock Fill Compaction - Visual Inspection	Continuously	6 passes w/ 10 t smooth drum vibratory roller	QA Manager	Visual Inspection, count compaction passes.	Continuously
Coarse Filter	Owner	Gradation (stockpile and as placed)	1 every 5,000 m^3		QA Manager	Gradation (stockpile and as placed)	1 every 5 QC test
	Owner	Coarse Filter Placement - Visual Inspection	Continuously	max. 0.6 m loose lift thickness	QA Manager	Visual Inspection	Continuously
	Owner	Coarse Filter Compaction - Visual Inspection	Continuously	4 passes w/ 10 t smooth drum vibratory roller	QA Manager	Visual Inspection, count compaction passes.	Continuously
Fine Filter	Owner	Gradation (stockpile and as placed)	1 every 1,000 m^3		QA Manager	Gradation (stockpile and as placed)	1 every 5 QC test
	Owner	Moisture Content	1 every 1,000 m^3		QA Manager	Moisture Content	1 every 5 QC test
	Owner	Fine Filter Placement - Visual Inspection	Continuously	max. 0.4 m loose lift thickness	QA Manager	Visual Inspection	Continuously
		Fine Filter Compaction - Visual Inspection	Continuously	4 passes w/ 10 t smooth drum vibratory roller	QA Manager	Visual Inspection, count compaction passes.	Continuously
Till	Owner	Till Placement - Visual Inspection	Continuously	max 3.0 m loose lift thickness	QA Manager	Visual Inspection	Continuously

		Quality Control (QC)				Quality Assurance (QA)	
Work	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**	**Requirement**	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**
Divider Dike and Rockfill Road							
Rockfill	Owner	Visual Gradation	Continuously		QA Manager	Visual Gradation	Continuously
	Owner	Rock Fill Placement - Visual Inspection	Continuously	max. 3.0 m loose lift thickness	QA Manager	Visual Inspection	Continuously
	Owner	Rock Fill Compaction - Visual Inspection	Continuously	Nominally compacted with haulage and placement equipment	QA Manager	Visual Inspection	Continuously
Coarse Filter / Liner Bedding	Owner	Gradation (stockpile and as placed)	1 every 5,000 m^3		QA Manager	Gradation (stockpile and as placed)	1 every 5 QC test
	Owner	Coarse Filter Placement - Visual Inspection	Continuously	max. 0.6 m loose lift thickness	QA Manager	Visual Inspection	Continuously
	Owner	Coarse Filter Compaction - Visual Inspection	Continuously	4 passes w/ 10 t smooth drum vibratory roller	QA Manager	Visual Inspection, count compaction passes.	Continuously
Lean Concrete Mat							
Platform Construction	Contractor	Visual inspection of formwork and placement	Continuously		Owner	Visual inspection of formwork and placement	Continuously
	Contractor	Concrete testing (slump, concrete temperature air content, sampling for comp. strength)	1 per shift or 1 every 50 m^3, which ever is greater	per design mix	Owner	Concrete testing (slump, concrete temperature air content, sampling for comp. strength)	1 every 5 QC test
Bituminous Geomembrane Liner Installation					**NOTE: Contractor will extract samples for QA Testing at the request of the QA Manager**		
Liner and Seaming	Contractor	Visual inspection of seams - in situ	Continuously		QA Manager	Visual inspection of seams	Continuously
	Contractor	Tensile Shear Strength of seams - Sample extraction	1 per 1,000m seam length	15kN/m (min.) ASTM D7056	QA Manager	Oversee Tensile Shear Strength of seams	1 every 5 QC Test
	Contractor	Vacuum Box Testing - In situ	1 per 30 m of seam length or 1 per shift of liner placement	No defects permitted	QA Manager	Oversee Vacuum Box Testing	1 every 10 QC Test
	Contractor	Ultrasonic Testing of Seams - In situ	1 per 300 m of seam length	No defects permitted	QA Manager	Ultrasonic Testing of Seams	Monitor 1 every 5 QC Test
				4.5 mm (min) ASTM D5199	QA Manager	Liner Thickness	1 per 1,000 m seam length
				1.240 g/cm^3 ASTM D792	QA Manager	Liner Density	1 per 1,000 m seam length

		Quality Control (QC)				Quality Assurance (QA)	
Work	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**	**Requirement**	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**
				32.4 kN/m longitudinal 25.7 kN/m transverse ASTM D4595	QA Manager	Tensile Shear Strength of Bituminous Liner	1 per 2,000 m seam length
Liner Bedding material	Contractor	Liner Bedding surface -Visual inspection	Continuously		QA Manager	Visual Inspection	Continuously
Liner Cover material	Owner	Gradation (as placed) and continuous visual	1 every 5,000 m^3		QA Manager	Gradation (stockpile and as placed)	1 every 5 QC test
	Owner	Liner cover material compaction-Visual Inspection	Continuously	Nominally compacted with haulage and placement equipment	QA Manager	Visual Inspection, count compaction passes.	Continuously
Placement extent	Owner	Visual Inspection and Survey	Continuously		QA Manager	Visual Inspection	Continuously
Instrumentation							
	Contractor	Pre And Post Installation Testing	Every Instrument		QA Manager	Visual Observation during Installation	Every Installation
Drilling and Grouting							
Location and Extents	Contractor	Grout Hole Collar Survey	Each Hole		QA Manager	Visual inspection and manual measurement.	1 every 10 holes
Equipment Calibration	Contractor	Calibration Checks (pressure transducer and gauges)	1 per week against a reference pressure gauge		QA Manager	Calibration Checks (pressure transducer and gauges)	1 every 5 QC tests
	Contractor	Calibration Checks (flow meters)	1 per week against a known volume container.		QA Manager	Calibration Checks (flow meters)	1 every 5 QC tests
Grout Mix	Contractor	Marsh Funnel	1 at the initiation of injection of every stage, and thereafter, at every change of mix.		QA Manager	Marsh Funnel	1 every shift, per grout plant carrying out injection grouting (day shift and night shift)
	Contractor	Vane Shear	1 at the initiation of injection of every stage, and thereafter, at every change of mix.		QA Manager	Vane Shear	1 every shift, per grout plant carrying out injection grouting (day shift and night shift)
	Contractor	Mud Balance	1 at the initiation of injection of every stage, and thereafter, at every change of mix.		QA Manager	Mud Balance	1 every shift, per grout plant carrying out injection grouting (day shift and night shift)

		Quality Control (QC)				Quality Assurance (QA)	
Work	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**	**Requirement**	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**
	Contractor	Bleed	1 at the initiation of injection of every stage, and thereafter, at every change of mix.		QA Manager	Bleed	1 every shift, per grout plant carrying out injection grouting (day shift and night shift)
Grout Mix	Contractor	Mix Water and Grout Mix Temperature	1 at the initiation of injection of every stage, and thereafter, at every change of mix.		QA Manager	Mix Water and Grout Mix Temperature	1 every shift, per grout plant carrying out injection grouting (day shift and night shift).
	Contractor	Strength Testing	2 sets of 6 cylinders per grout mix used per week.		QA Manager	Strength Testing	1 every 5 QC tests
Grout Injection and Water Pressure Testing	Contractor	Real Time Data Acquisition	Continuous		QA Manager	Visual Monitoring	Continuously

QC Note:

1) Rockfill maximum particle size to be visually controlled during fill placement. Samples will not be taken.

2) Filter material as placed.

3) Testing shall comply with the Standards listed in Table 1-2. Gradation shall comply with the limits provided in Specification S5 Fill Placement. Grout testing results shall comply with the Drilling and Grouting Specification.

Increased testing frequencies shall be instituted if observations of normal testing frequency results indicate potential problems. Additional testing may be warranted when:

- The material repeatedly fails to meet Specifications;
- The degree of compaction is doubtful;
- The materials appear to differ from those specified;
- Less than the required number of compaction equipment passes are made;
- The material moisture contents differ from those specified;
- The lift thicknesses differ from those specified; or
- Adverse weather conditions occur.

S9.2.3 Deficient Work or Materials

The extent and nature of deficient work or materials shall be determined through additional tests, observations, review of records and test results or other means that are deemed appropriate. The identifier of the deficient work and materials shall fill out a deficiency resolution document. The CM shall hold a deficiency resolution meeting. After the extent and nature of the deficiency has been ascertained, the CM shall institute corrective actions required to meet the Specifications and Drawings. Areas that have been reworked shall be further retested. All retests must verify that the entire defective area has been corrected prior to additional work being performed in that area.

S9.3 Documentation

The QA Manager shall document all testing and that all QA requirements have been addressed and satisfied. Further, the QC Manager shall provide field reports; data sheets and checklists to substantiate that requisite monitoring tasks have been implemented. The QC and QA Managers shall maintain a job site file of plans, Specifications, checklists, test procedures, daily and weekly reports, logs and other project relevant documents.

S9.3.1 Daily Summary Report

Daily record keeping by the QC Manager shall at a minimum include:

- Date, project name and location;
- Parties on-site participating in meetings and discussions;
- Daily summary, reporting meetings and/or discussions with the CM summarizing QC daily activities;
- Daily Construction activities;

- Daily weather observations including precipitation and temperature;
- Compaction equipment (type and weight) and typical number of passes;
- Equipment used to place and spread materials;
- Daily field test results data sheets;
- Laboratory test results data sheets;
- Equipment calibration or recalibration forms as applicable; and
- Design and Specification modification/clarification documentation.

For Bituminous Geomembrane Liner installation, the Contractor shall prepare and submit the following liner QC documentation, in electronic and hardcopy formats in the Daily Summary Report:

- Summary of work completed;
- list of equipment working on project;
- number of personnel in each trade;
- results of QC field and laboratory testing and test data sheets;
- repair records (including documenting the location of all repairs on layout plan);
- description of incidents and problems, and steps to solve them and prevent re-occurrence; and
- additional information for cold weather seaming (defined as temperatures below 0°C, including wind chill), which includes:
    - Ambient air temperature measured 1 m above the liner;
    - Method of removing frost from area to be seamed, as well as drying and cleaning of surface;
    - Condition of subgrade beneath seamed area;
    - Identification of seaming system used, including preheat, seaming rate and use of enclosure; and
    - Unusual conditions with respect to personnel, equipment, sampling and testing attributes to cold weather.

For Grouting activities, the following records shall be maintained on completion of each shift and submitted on a daily basis to the Engineer by the Contractor:

- Drill hole number, length drilled, size and orientation, drills used, and observations on location, estimated quantity of water inflow intercepted, drilling action and zones of hole instability or voids.

- Orientation survey results for drilled curtain grout holes to be included with Contractor’s daily summary report.

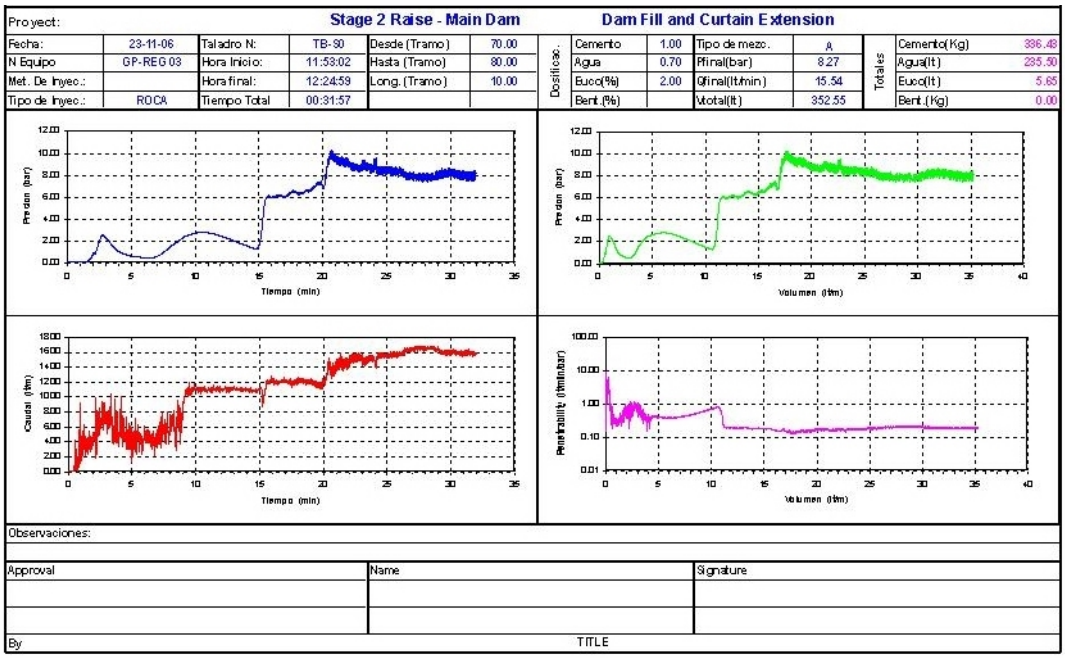
- Grouting records, including quantity, mix, location and injection pressures of all grout placements.

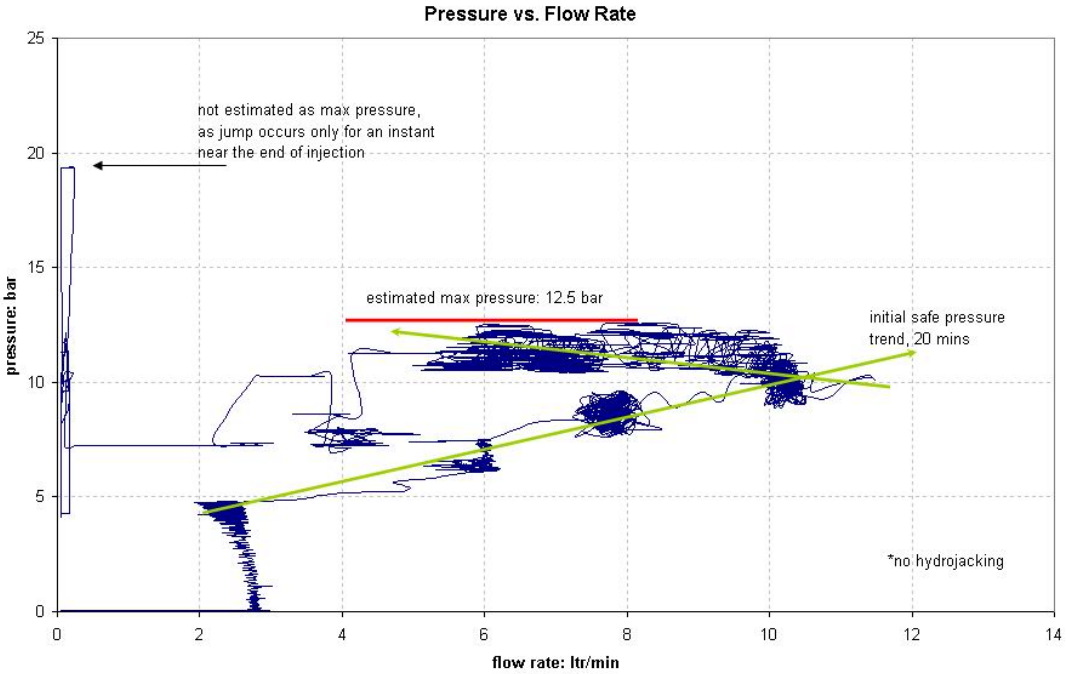
- Results for all grout tests, including details of shift, hole, stage and mix designation for each test. Forms to be used for reporting test results shall be approved by the Engineer prior to the beginning of field activities.

- Water test and grout injection data comprising record time, pressure, and flow rate for each stage at one second intervals shall be provided to the Engineer as comma separated ("csv") files readable by a laptop computer within 12 hours of completion of the shift.

- Digital records (time, flow rate and pressure at 1 second intervals) of each water pressure test or grout injection.

- Graphical records per stage of ground response during grout injection, including one plot showing pressure vs. time, volume vs. time, pressure vs. volume, and penetrability vs. volume, and another plot showing just pressure vs. flow rate as shown on the attached screen dumps below:





S9.3.2 QA Weekly Summary Report

The QA Weekly Reports are prepared by the QA Manager and summarize the activities for the week and, where applicable, will include:

- Date, project name and location;
- Parties on-site participating in meetings and discussions;
- Summary of meetings and discussions attended;
- Identification of borrow source and the associated optimum moisture content/maximum dry density;
- Documentation of all observations of construction and QA/QC activities/test results with diagrams showing locations of field tests and locations of sampling for laboratory testing;
- Methods used to correct construction deficiencies;
- Summary of construction progress and work completed;
- Summary of QA/QC activities and test results, including an indication of passing and failing tests; and
- Summary of problems and their resolutions.

S9.3.3 Construction Deficiency Resolution Forms

Construction problem and resolution documents shall reference specific observations and test result data forms. These documents shall include the following information:

- A detailed description of the problem, non-conformance or deficiency;
- A location identified by co-ordinates and probable cause for the problem;
- Detailed description of how and when the problem was identified;
- Detailed description of how the problem, non-conformance or deficiency was solved or corrected;
- Reference to results of any retests performed; and
- Detailed description of measures implemented to prevent recurrence of the problem.

These documents shall be incorporated as part of the Daily Summary Report. Any modifications or to the Drawings or Specifications shall be by the Engineer. Any resulting modification or clarification to procedures used to complete the Work shall be approved by the CM.

S9.3.4 Site Checklists

QC checklist forms shall be used for documenting the construction activities. The QC checklist shall be signed by the CM and the QC Manager. The checklists shall include the following information:

- Date;
- Shift inspected;
- Tests performed;
- Location inspected with chainage;
- Fill material;
- As-built survey conducted;
- Dewatering measures provided;
- Remarks; and
- Deviations and rectifications.

The following examples are attached:

- TSF Dike construction checklist – Foundation Preparation and Excavation;
- TSF Dike construction checklist – Fill Placement;
- TSF Dike construction checklist – Drilling and Grouting;

- TSF Dike construction checklist – Liner Installation
- TSF Dike construction checklist – Instrumentation.

Foundation Preparation and Excavation

DIKE :_____ TSF DIKE CONSTRUCTION CHECKLIST - FOUNDATION PREPARATION and EXCAVATION

From Sta. Offset	SHIFT: NIGHT :☐ DAY :☐	DATE :	SHEET OF
To Sta. Offset	LOCATION: :		
EQUIPMENT:			

DESCRIPTION

NO.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY ENGINEER
1.	Survey lines and layout checked to ensure the locations conform with the Drawings		
2.	Storage areas planned for disposal of removed materials		
3.	Occurrence of snow and ice removal method in place		
4.	Occurrence of boulders and removal method in place		
5.	Occurrence of hummocks and scalping method in place		
6.	Occurrence of surface and ground water and its impact mitigation in place		
7.	Presence of other unsuitable materials and removal method in place		
8.	Soil frozen or thawed and measures taken		
9.	Blasting requirement to remove unsuitable material and safety measure checked		
10.	Adjustment made to suit design in field		
11.	Final walkover inspection before re-sloping or fill placement		
12.	“As-excavated” survey conducted		
13.	Bedrock Mapping		

REMARKS :

DEVIATIONS : (Attach list if necessary)

DATE OF RECTIFICATION :

SURVEY VERIFICATION	ACCEPTED BY QA Manager :	ACCEPTED BY OWNER :
NAME: _____	NAME: _____	NAME: _____
SIGNATURE : _____	SIGNATURE : _____	SIGNATURE : _____
DATE _____	DATE _____	DATE _____

Fill Placement

DIKE: _____ TSF DIKE CONSTRUCTION CHECKLIST- FILL PLACEMENT

From Sta. Offset	SHIFT: NIGHT : ☐ DAY : ☐	DATE :	SHEET OF
To Sta. Offset	LOCATION:		
EQUIPMENT :			

DESCRIPTION :

NO.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY ENGINEER
1.	Survey lines and layout conform with the Drawings		
2.	Fill materials stockpiled meet the Specification requirements		
3.	Dewatering measure provided		
4.	Required soil tests performed		
5.	Required visual inspection of stockpiled materials performed		
6.	Required visual inspection of placed materials performed		
7.	Snow and loose materials removed from the surface		
8.	Weather condition meets the requirements during fill placement and compaction		
9.	Fill materials contain no frozen chunks		
10.	Adequate control of segregation of fill materials		
11.	No snow or ice trapped during placement		
12	Compaction completed as per Specifications		
13.	Final trench inspection performed before backfill		
14.	As-built survey conducted		

REMARKS :

DEVIATIONS : (Attach list if necessary)

DATE OF RECTIFICATION :

SURVEY VERIFICATION	ACCEPTED BY QA Manager :	ACCEPTED BY OWNER :
NAME: _____	NAME: _____	NAME: _____
SIGNATURE : _____	SIGNATURE : _____	SIGNATURE : _____
DATE _____	DATE _____	DATE _____

Drilling and Grouting

DIKE: _____ TSF DIKE CONSTRUCTION CHECKLIST- DRILLING AND GROUTING

From Sta. Offset	SHIFT: NIGHT :☐ DAY :☐	DATE :	SHEET OF
To Sta. Offset	LOCATION:		
EQUIPMENT :			
DESCRIPTION :			

NO.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY ENGINEER
1.	Survey lines and layout conform with the Drawings		
2.	Dewatering measures provided for surface and groundwater		
3.	Required grouting tests performed		
4.	As-built survey conducted		

REMARKS :

DEVIATIONS : (Attach list if necessary)

DATE OF RECTIFICATION :

SURVEY VERIFICATION	ACCEPTED BY QA Manager :	ACCEPTED BY OWNER :
NAME: _____	NAME: _____	NAME: _____
SIGNATURE : _____	SIGNATURE : _____	SIGNATURE : _____
DATE _____	DATE _____	DATE _____

Liner Installation

DIKE: _____ TSF DIKE CONSTRUCTION CHECKLIST - LINER INSTALLATION

From Sta. Offset	SHIFT: NIGHT : ☐ DAY : ☐	DATE :	SHEET OF
To Sta. Offset	LOCATION:		
EQUIPMENT :			

DESCRIPTION :

NO.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY ENGINEER
1.	Liner material received has Manufacturer's certification and meets the specification		
2.	Visual inspection of liner performed to determine physical damages during handling		
3	Deficiencies reported before installation		
4	Final bedding surface condition meets the Specification		
5	Visual inspection during liner installation performed		
6	Weather conditions meet the requirements during installation		
7	Welding carried out in accordance with manufacturer's specification		
8	Liner (routine destructive and non-destructive) testing and sampling performed as required		
9	Floor and upstream wall surfaces of anchor trench are smooth		
10	Damages during installation repaired in accordance with Specification		
11	Site cleaned up		
12	As-built survey conducted and approved		
13	Check for: overheating of seams and loss of bitumen, risibility by trowel test, holes, folding, wrinkling, visible lumps or protrusions		

REMARKS :

DEVIATIONS : (Attach list if necessary)

DATE OF RECTIFICATION :

SURVEY VERIFICATION	ACCEPTED BY QA Manager :	ACCEPTED BY OWNER :
NAME: _____	NAME: _____	NAME: _____
SIGNATURE : _____	SIGNATURE : _____	SIGNATURE : _____
DATE _____	DATE _____	DATE _____

Instrumentation

DIKE: _____ TSF DIKE CONSTRUCTION CHECKLIST- INSTRUMENTATION

From Sta. Offset		SHIFT: NIGHT : ☐ DAY : ☐	DATE :	SHEET OF
To Sta. Offset		LOCATION:		
EQUIPMENT :				
DESCRIPTION :				
NO.	ITEMS TO BE INSPECTED		INSPECTED BY CONSTRUCTION MANAGER	INSPECTED BY QA MANAGER
1.	Survey lines and layout conform with the Drawings			
2.	Instrumentation equipment and methods acceptable			
3.	Instrumentation details provided in as built			
4.	As-built survey conducted			
REMARKS :				
DEVIATIONS : (Attach list if necessary) DATE OF RECTIFICATION :				

SURVEY VERIFICATION	ACCEPTED BY QA Manager :	ACCEPTED BY OWNER :
NAME: _____	NAME: _____	NAME: _____
SIGNATURE : _____	SIGNATURE : _____	SIGNATURE : _____
DATE _____	DATE _____	DATE _____

APPENDIX VIII

DRAWINGS

AGNICO-EAGLE MINES LIMITED

MEADOWBANK GOLD PROJECT

TAILINGS STORAGE FACILITY

DRAWING INDEX		
DWG NO.	TITLE	REVISION
4100-00	DRAWING AND SPECIFICATION INDEX	A
4100-01	PROJECT SITE PLAN	A
4100-02	GENERAL LAYOUT PLAN	A
4100-03	BOREHOLE LOCATION PLAN	A
4100-04	STAGING PLAN AND ROCKFILL QUANTITIES	A
4100-05	CENTRAL DIKE STAGED LAYOUT PLAN	A
4100-06	CENTRAL DIKE PLAN SHOWING SOIL THICKNESS	A
4100-07	CENTRAL DIKE CONSTRUCTION SEQUENCE SECTIONS (1 OF 2)	A
4100-08	CENTRAL DIKE CONSTRUCTION SEQUENCE SECTIONS (2 OF 2)	A
4100-10	CENTRAL DIKE ROCKFILL PLAN AND PROFILE (1 OF 2)	A
4100-11	CENTRAL DIKE ROCKFILL PLAN AND PROFILE (2 OF 2)	A
4100-12	CENTRAL DIKE CROSS-SECTIONS	A
4100-13	CENTRAL DIKE EXCAVATION PLAN AND PROFILE	A
4100-14	CENTRAL DIKE CUT-OFF CENTRELINE PROFILE	A
4100-15	CENTRAL DIKE GROUTING PLAN AND LINER DETAILS	A
4100-16	CENTRAL DIKE INSTRUMENTATION LOCATION PLAN	A
4100-17	CENTRAL DIKE INSTRUMENTATION TYPICAL SECTIONS	A
4100-31	DIVIDER DIKE ROCKFILL PLAN AND PROFILE (1 OF 2)	A
4100-32	DIVIDER DIKE ROCKFILL PLAN AND PROFILE (2 OF 2)	A
4100-33	DIVIDER DIKE CONSTRUCTION SEQUENCE	A
4100-34	DIVIDER DIKE CROSS-SECTIONS AND QUANTITIES	A
4100-35	DIVIDER DIKE SADDLE DAM CONNECTION DETAIL	A
4100-50	SADDLE DAM LAYOUT PLAN AND QUANTITIES	A
4100-51	SADDLE DAM CONSTRUCTION SEQUENCE	A
4100-52	SADDLE DAM LINER DETAILS	A
4100-53	SADDLE DAM ROCKFILL PLAN AND PROFILE (1 OF 5)	A
4100-54	SADDLE DAM ROCKFILL PLAN AND PROFILE (2 OF 5)	A
4100-55	SADDLE DAM ROCKFILL PLAN AND PROFILE (3 OF 5)	A
4100-56	SADDLE DAM ROCKFILL PLAN AND PROFILE (4 OF 5)	A
4100-57	SADDLE DAM ROCKFILL PLAN AND PROFILE (5 OF 5)	A
4100-58	SADDLE DAM CROSS-SECTIONS	A
4100-59	SADDLE DAM INSTRUMENTATION PLAN AND SECTION	A
4100-70	ROCKFILL ROAD PLAN AND PROFILE (1 OF 2)	A
4100-71	ROCKFILL ROAD PLAN AND PROFILE (2 OF 2)	A
4100-72	ROCKFILL ROAD CROSS-SECTIONS AND QUANTITIES	A

UNUSED DWG. NOS. 4100-09, 4100-18 TO 4100-30, 4100-36 TO 4100-49, 4100-60 TO 4100-69

KEY PLAN

LIST OF SPECIFICATIONS		
SPECIFICATION No.	TITLE	REVISION
4100-S1	ADMINISTRATION	A
4100-S2	CARE OF WATER	A
4100-S3	FOUNDATION PREPARATION	A
4100-S4	LEAN CONCRETE MAT	A
4100-S5	FILL PLACEMENT	A
4100-S6	BITUMINOUS GEOMEMBRANE LINER	A
4100-S7	DRILLING AND GROUTING	A
4100-S8	INSTRUMENTATION	A
4100-S9	QC AND QA REQUIREMENTS	A

NOT FOR CONSTRUCTION

REVISION DATE: 08/12/17 12:24PM By: ASalvador CADD FILE: N:\Bur-Graphics\Projects\2008\1428_08-1428-0029\Drafting\3200\Tank-1000\4100\0814280029-4100-00.dwg

REVISION DESCRIPTION							
REV	DATE	DES			CADD	CHK	RVW
A	17DEC08	JEK	ISSUED FOR REVIEW		AS		
REFERENCES							
4000-00	MEADOWBANK GOLD PROJECT LOCATION MAP AND DRAWING INDEX						
DRAWING NO.							

STAMP

ORIGINAL SIGNED

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
DRAWING AND SPECIFICATION INDEX

Golder Associates

PROJECT No.		08-1428-0029	FILE No.		
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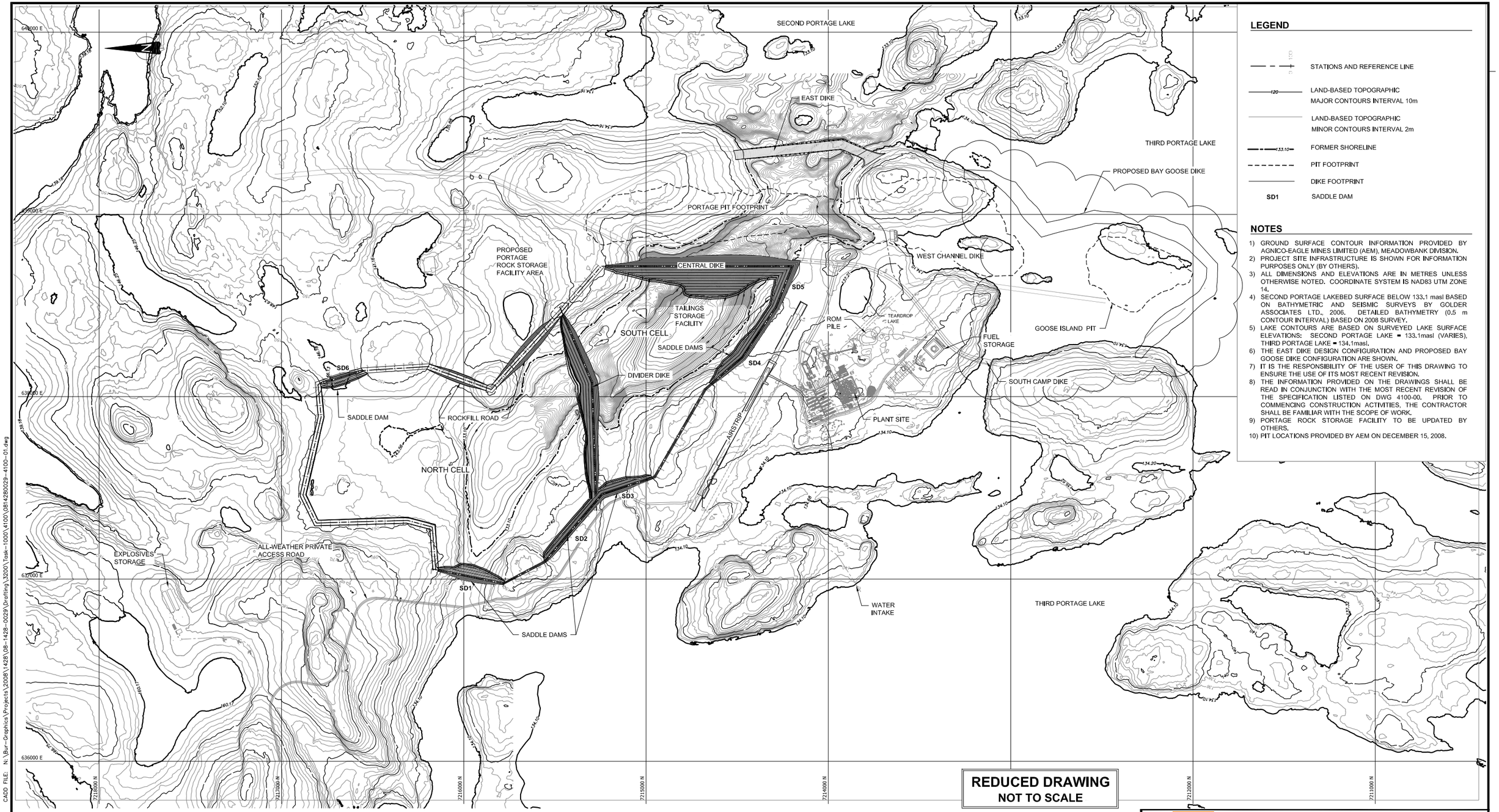
CADD	AS	02DEC08	4100-00		
CHECK					
REVIEW					



LEGEND

- STATIONS AND REFERENCE LINE
- LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- FORMER SHORELINE
- PIT FOOTPRINT
- DIKE FOOTPRINT
- SD1 SADDLE DAM

NOTES

1) GROUND SURFACE CONTOUR INFORMATION PROVIDED BY AGNICO-EAGLE MINES LIMITED (AEM), MEADOWBANK DIVISION.
2) PROJECT SITE INFRASTRUCTURE IS SHOWN FOR INFORMATION PURPOSES ONLY (BY OTHERS).
3) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS NAD83 UTM ZONE 14.
4) SECOND PORTAGE LAKEBED SURFACE BELOW 133.1 masl BASED ON BATHYMETRIC AND SEISMIC SURVEYS BY GOLDER ASSOCIATES LTD., 2006. DETAILED BATHYMETRY (0.5 m CONTOUR INTERVAL) BASED ON 2008 SURVEY.
5) LAKE CONTOURS ARE BASED ON SURVEYED LAKE SURFACE ELEVATIONS: SECOND PORTAGE LAKE = 133.1masl (VARIES), THIRD PORTAGE LAKE = 134.1masl.
6) THE EAST DIKE DESIGN CONFIGURATION AND PROPOSED BAY GOOSE DIKE CONFIGURATION ARE SHOWN.
7) IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
8) THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATION LISTED ON DWG 4100-00. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
9) PORTAGE ROCK STORAGE FACILITY TO BE UPDATED BY OTHERS.
10) PIT LOCATIONS PROVIDED BY AEM ON DECEMBER 15, 2008.

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY PROJECT SITE PLAN

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
0	17DEC08	JEK	ISSUED FOR REVIEW	AS		

4000-01 — DRAWING NO.
CENTRAL DIKE OVERALL SITE PLAN — REFERENCES

STAMP

ORIGINAL SIGNED

Golder Associates

PROJECT No.		08-1428-0029	FILE No.		0814280029-4100-01
DESIGN	JEK	20NOV08	SCALE	AS SHOWN	REV. A
CADD	AS	01DEC08	4100-01		
CHECK					
REVIEW					

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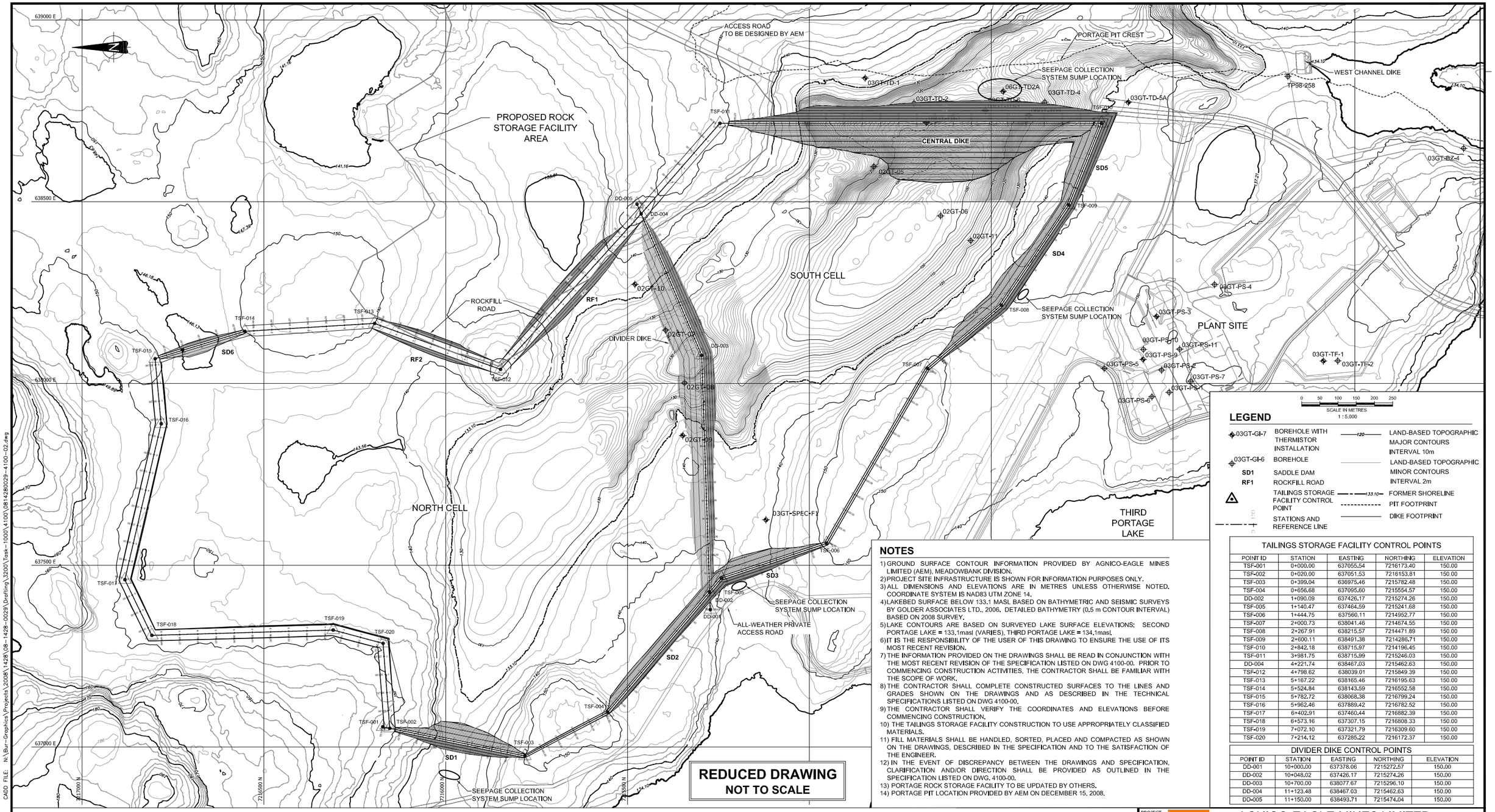
REVISION DATE: 08/12/17 12:25PM By: ASalvador



NOTES

1) GROUND SURFACE CONTOUR INFORMATION PROVIDED BY AGNICO-EAGLE MINES LIMITED (AEM), MEADOWBANK DIVISION.
2) PROJECT SITE INFRASTRUCTURE IS SHOWN FOR INFORMATION PURPOSES ONLY.
3) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS NAD83 UTM ZONE 14.
4) LAKEBED SURFACE BELOW 133.1 MASL BASED ON BATHYMETRIC AND SEISMIC SURVEYS BY GOLDER ASSOCIATES LTD., 2006. DETAILED BATHYMETRY (0.5 m CONTOUR INTERVAL) BASED ON 2008 SURVEY.
5) LAKE CONTOURS ARE BASED ON SURVEYED LAKE SURFACE ELEVATIONS: SECOND PORTAGE LAKE = 133.1masl (VARIES), THIRD PORTAGE LAKE = 134.1masl.
6) IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
7) THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATION LISTED ON DWG 4100-00. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
8) THE CONTRACTOR SHALL COMPLETE CONSTRUCTED SURFACES TO THE LINES AND GRADES SHOWN ON THE DRAWINGS AND AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS LISTED ON DWG 4100-00.
9) THE CONTRACTOR SHALL VERIFY THE COORDINATES AND ELEVATIONS BEFORE COMMENCING CONSTRUCTION.
10) THE TAILINGS STORAGE FACILITY CONSTRUCTION TO USE APPROPRIATELY CLASSIFIED MATERIALS.
11) FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATION AND TO THE SATISFACTION OF THE ENGINEER.
12) IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND SPECIFICATION, CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATION LISTED ON DWG. 4100-00.
13) PORTAGE ROCK STORAGE FACILITY TO BE UPDATED BY OTHERS.
14) PORTAGE PIT LOCATION PROVIDED BY AEM ON DECEMBER 15, 2008.

TAILINGS STORAGE FACILITY CONTROL POINTS

POINT ID	STATION	EASTING	NORTHING	ELEVATION
TSF-001	0+000.00	637055.54	7216173.40	150.00
TSF-002	0+020.00	637051.53	7216153.81	150.00
TSF-003	0+399.04	636975.46	7215782.48	150.00
TSF-004	0+656.68	637095.60	7215554.57	150.00
DD-002	1+090.09	637426.17	7215274.26	150.00
TSF-005	1+140.47	637464.59	7215241.68	150.00
TSF-006	1+444.75	637560.11	7214952.77	150.00
TSF-007	2+000.73	638041.46	7214674.55	150.00
TSF-008	2+267.91	638215.57	7214471.89	150.00
TSF-009	2+600.11	638491.38	7214286.71	150.00
TSF-010	2+842.18	638715.97	7214196.45	150.00
TSF-011	3+981.75	638715.89	7215246.03	150.00
DD-004	4+221.74	638467.03	7215462.63	150.00
TSF-012	4+798.62	638039.01	7215849.39	150.00
TSF-013	5+167.22	638165.46	7216195.63	150.00
TSF-014	5+524.84	638143.59	7216552.58	150.00
TSF-015	5+782.72	638068.38	7216799.24	150.00
TSF-016	5+962.46	637889.42	7216782.52	150.00
TSF-017	6+402.91	637460.44	7216882.39	150.00
TSF-018	6+573.16	637307.15	7216808.33	150.00
TSF-019	7+072.10	637321.79	7216309.60	150.00
TSF-020	7+214.12	637285.22	7216172.37	150.00

DIVIDER DIKE CONTROL POINTS

POINT ID	STATION	EASTING	NORTHING	ELEVATION
DD-001	10+000.00	637378.06	7215272.57	150.00
DD-002	10+048.02	637426.17	7215274.26	150.00
DD-003	10+700.00	638077.67	7215296.10	150.00
DD-004	11+123.48	638467.03	7215462.63	150.00
DD-005	11+150.00	638493.71	7215474.04	150.00

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	17DEC08	JEK	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP

ORIGINAL SIGNED

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
GENERAL LAYOUT PLAN

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.
DESIGN	JEK	20NOV08	SCALE AS SHOWN REV. A
CADD	JK	20NOV08	4100-02
CHECK			
REVIEW			

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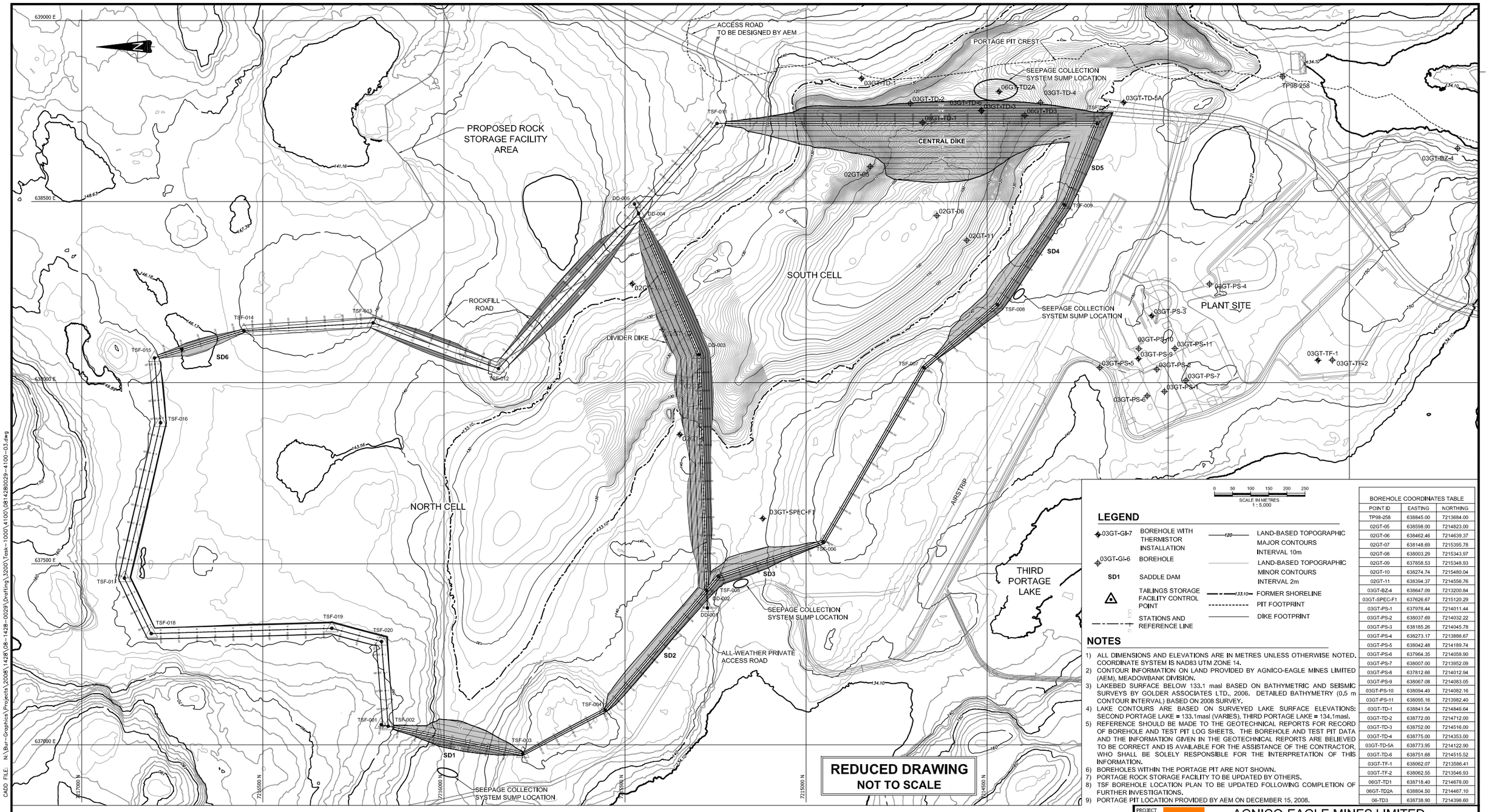

0 50 100 150 200 250
SCALE IN METRES
1 : 5,000

LEGEND

- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- SD1 — SADDLE DAM
- TAILINGS STORAGE FACILITY CONTROL POINT
- STATIONS AND REFERENCE LINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- 133.10 — FORMER SHORELINE
- PIT FOOTPRINT
- DIKE FOOTPRINT

NOTES

1) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS NAD83 UTM ZONE 14.
2) CONTOUR INFORMATION ON LAND PROVIDED BY AGNICO-EAGLE MINES LIMITED (AEM), MEADOWBANK DIVISION.
3) LAKEBED SURFACE BELOW 133.1 masl BASED ON BATHYMETRIC AND SEISMIC SURVEYS BY GOLDER ASSOCIATES LTD., 2006. DETAILED BATHYMETRY (0.5 m CONTOUR INTERVAL) BASED ON 2008 SURVEY.
4) LAKE CONTOURS ARE BASED ON SURVEYED LAKE SURFACE ELEVATIONS: SECOND PORTAGE LAKE = 133.1masl (VARIES), THIRD PORTAGE LAKE = 134.1masl.
5) REFERENCE SHOULD BE MADE TO THE GEOTECHNICAL REPORTS FOR RECORD OF BOREHOLE AND TEST PIT LOG SHEETS. THE BOREHOLE AND TEST PIT DATA AND THE INFORMATION GIVEN IN THE GEOTECHNICAL REPORTS ARE BELIEVED TO BE CORRECT AND IS AVAILABLE FOR THE ASSISTANCE OF THE CONTRACTOR, WHO SHALL BE SOLELY RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION.
6) BOREHOLES WITHIN THE PORTAGE PIT ARE NOT SHOWN.
7) PORTAGE ROCK STORAGE FACILITY TO BE UPDATED BY OTHERS.
8) TSF BOREHOLE LOCATION PLAN TO BE UPDATED FOLLOWING COMPLETION OF FURTHER INVESTIGATIONS.
9) PORTAGE PIT LOCATION PROVIDED BY AEM ON DECEMBER 15, 2008.

BOREHOLE COORDINATES TABLE

POINT ID	EASTING	NORTHING
TP98-258	638845.00	7213684.00
02GT-05	638598.00	7214823.00
02GT-06	638462.46	7214639.37
02GT-07	638148.69	7215395.78
02GT-08	638003.29	7215343.97
02GT-09	637858.53	7215348.93
02GT-10	638274.74	7215480.04
02GT-11	638394.37	7214556.76
03GT-BZ-4	638647.09	7213200.84
03GT-SPEC-F1	637626.67	7215120.29
03GT-PS-1	637976.44	7214011.44
03GT-PS-2	638037.69	7214032.22
03GT-PS-3	638185.26	7214045.78
03GT-PS-4	638273.17	7213886.67
03GT-PS-5	638042.48	7214189.74
03GT-PS-6	637964.35	7214058.90
03GT-PS-7	638007.00	7213952.09
03GT-PS-8	637812.66	7214012.94
03GT-PS-9	638067.08	7214083.05
03GT-PS-10	638094.49	7214082.16
03GT-PS-11	638095.16	7213982.40
03GT-TD-1	638841.54	7214846.64
03GT-TD-2	638772.00	7214712.00
03GT-TD-3	638752.00	7214516.00
03GT-TD-4	638775.00	7214353.00
03GT-TD-5A	638773.95	7214122.90
03GT-TD-6	638751.68	7214515.52
03GT-TF-1	638062.07	7213586.41
03GT-TF-2	638062.55	7213546.93
06GT-TD1	638718.40	7214678.00
06GT-TD2A	638804.50	7214467.10
06-TD3	638738.90	7214396.60

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	AS		

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PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY BOREHOLE LOCATION PLAN

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	AS	24NOV08			
CHECK			4100-03		
REVIEW					

4000-02 — DRAWING NO.
BOREHOLE LOCATIONS PLAN — REFERENCES

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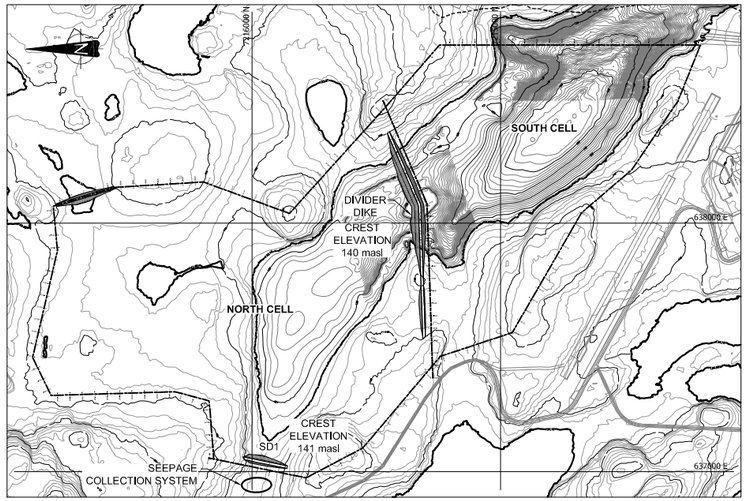

1 - **NORTH CELL STAGE 1**
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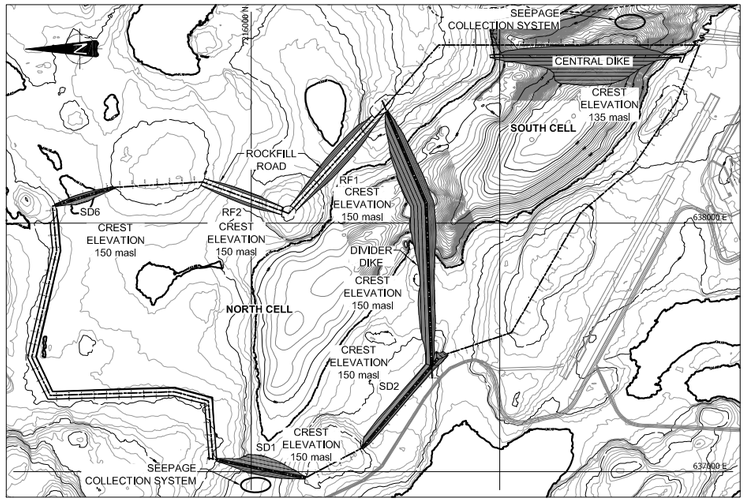
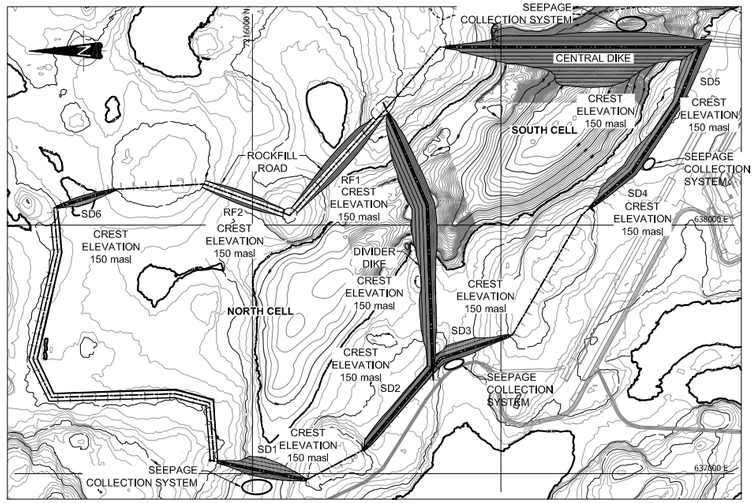
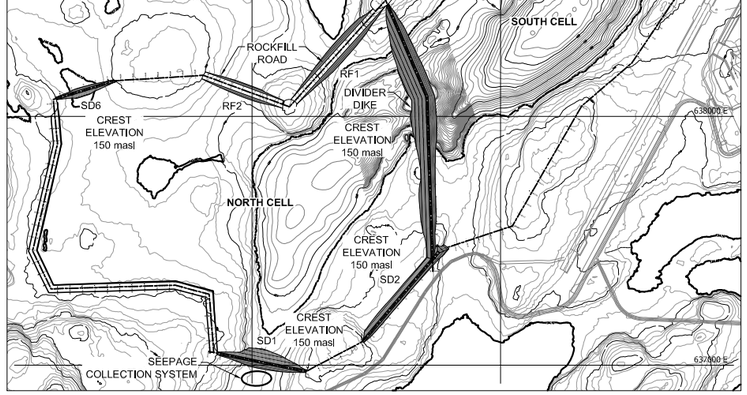


3 - **SOUTH CELL STAGE 1**
(SCALE 1:12,500)



5 - **SOUTH CELL STAGE 3**
(SCALE 1:12,500)



2 - **NORTH CELL STAGE 2**
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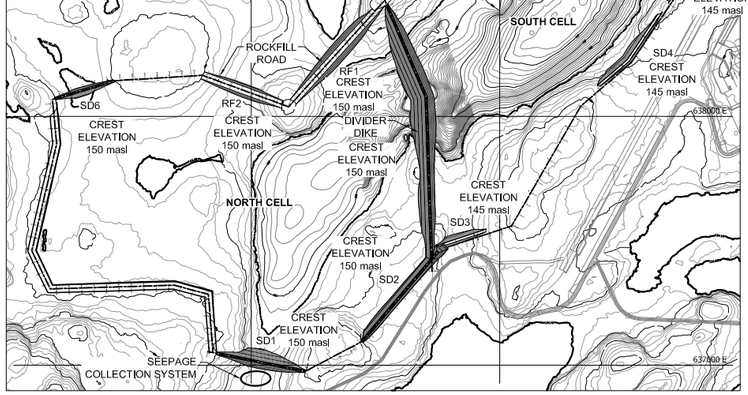

4 - **SOUTH CELL STAGE 2**
(SCALE 1:12,500)

LEGEND

RF1	ROCKFILL ROAD	STATIONS AND REFERENCE LINE
SD2	SADDLE DAM	LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
		LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
		133.10 FORMER SHORELINE
		PIT FOOTPRINT

NOTES

1) LOCATIONS REQUIRING SEEPAGE COLLECTION SYSTEM SHOWN.
2) ROCKFILL QUANTITIES ARE FOR DIKE AND DAM ROCKFILL EMBANKMENT SHELLS ONLY AND ARE NEAT IN PLACE GEOMETRY NOT INCLUDING FOUNDATION PREPARATION.
3) QUANTITIES FOR FILTERS, LINER AND BEDDING AND COVER MATERIAL FOR THE CENTRAL DIKE, DIVIDER DIKE AND SADDLE DAMS ARE SHOWN ON DWG 4100-05, 4100-34, 4100-50, RESPECTIVELY.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

0 12.5 25 37.5 50 62.5
SCALE IN METRES
1 : 12,500

TAILINGS STORAGE FACILITY QUANTITIES

CELL	SEQUENCE	ELEVATION (masl)	STRUCTURE	STRUCTURE CUMULATIVE VOLUME OF ROCKFILL (m^3)
NORTH CELL	STAGE 1	141	SD1	16,600
		140	DIVIDER DIKE	143,400
	STAGE 2	150	SD1	109,700
		150	SD2	72,000
		150	DIVIDER DIKE	688,370
		150	RF1	239,000
		150	RF2	73,000
		150	SD6	17,000
SOUTH CELL	STAGE 1	135	CENTRAL DIKE	971,100
	STAGE 2	145	SD3	24,500
		145	SD4	37,100
		145	SD5	41,700
		145	CENTRAL DIKE	1,932,100
	STAGE 3	150	SD3	68,800
		150	SD4	111,000
		150	SD5	122,000
		150	CENTRAL DIKE	2,551,100

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

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REVISION DATE: 08/12/17 11:04AM By: ASalvador

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP

ORIGINAL SIGNED

PROJECT

AEM

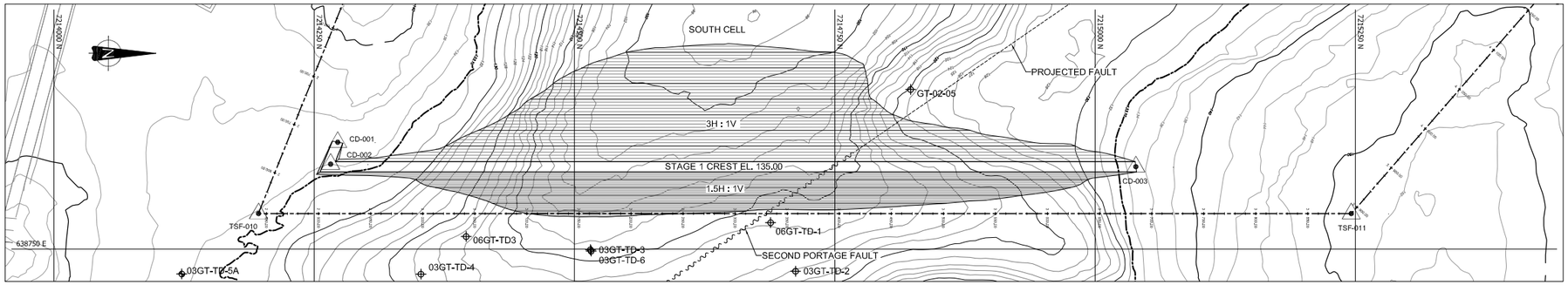
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
STAGING PLAN AND ROCKFILL QUANTITIES

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	24NOV08	4100-04		
CHECK					
REVIEW					



1 - **STAGE 1 PLAN**
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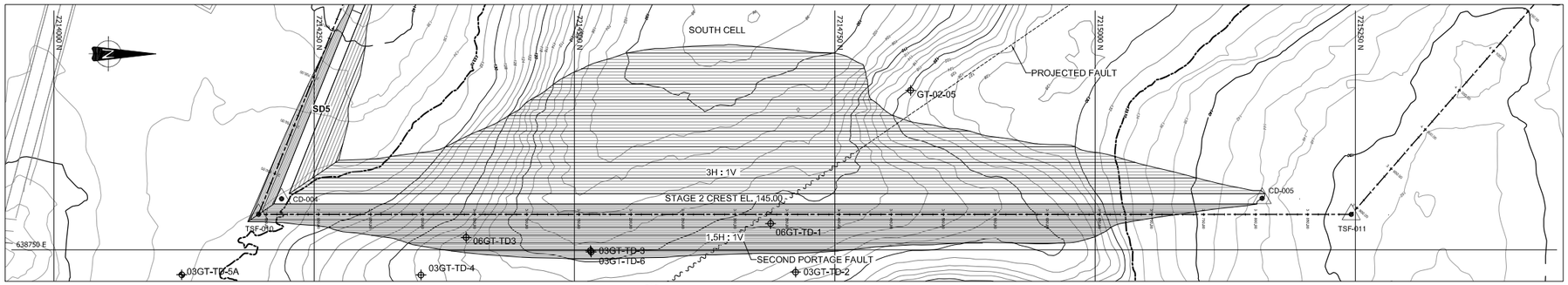

2 - **STAGE 2 PLAN**
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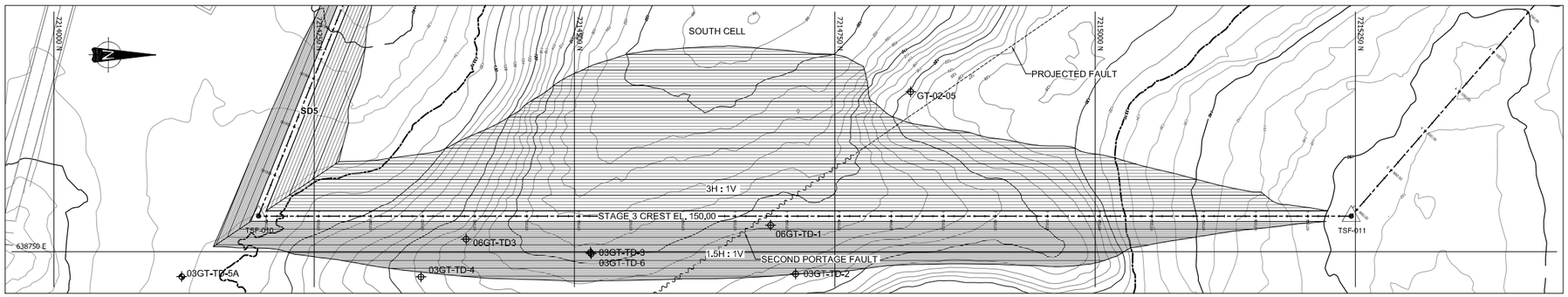

3 - **STAGE 3 PLAN**
(SCALE 1:2,500)

LEGEND

- TSF-010 — TAILINGS STORAGE FACILITY CONTROL POINT
- CD-001 — CENTRAL DIKE STAGE CONTROL POINT
- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- SD5 — SADDLE DAM
- 0 100 — STATIONS AND REFERENCE LINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- 133.10 — FORMER SHORELINE
- PIT FOOTPRINT

NOTES

1) THE INFORMATION PRESENTED ON THIS DRAWING IS INTENDED TO CONVEY STAGE 1 AND STAGE 2 CENTRAL DIKE RELATIVE TO THE PROPOSED STAGE 3 CENTRAL DIKE.
2) REFER TO DWG. 4100-10 AND 4100-11 FOR THE STAGE 1, STAGE 2 AND STAGE 3 CENTRAL DIKE CONTROL POINTS.
3) ROCKFILL EMBANKMENT SHOWN. TRENCH EXCAVATION, FILTERS AND FOUNDATION PREPARATION OMITTED.
4) ESTIMATED QUANTITIES FOR LINER DO NOT INCLUDE ANY OVERLAP.
5) THE ESTIMATED QUANTITY FOR TRENCH EXCAVATION IS BASED ON ASSUMED BEDROCK DEPTHS.
6) REFERENCE SHOULD BE MADE TO THE GEOTECHNICAL REPORTS FOR RECORD OF BOREHOLE AND TEST PIT LOG SHEETS. THE BOREHOLE AND TEST PIT DATA AND THE INFORMATION GIVEN IN THE GEOTECHNICAL REPORTS ARE BELIEVED TO BE CORRECT AND IS AVAILABLE FOR THE ASSISTANCE OF THE CONTRACTOR, WHO SHALL BE SOLELY RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION.
7) ACTUAL LIMITS OF FOUNDATION PREPARATION TO BE DETERMINED BASED ON CONDITIONS ENCOUNTERED IN THE FIELD AND AS DIRECTED BY THE ENGINEER.
8) THE PREPARED FOUNDATION SURFACE SHALL BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO PLACEMENT OF FILL MATERIALS.
9) ROCKFILL FOR CENTRAL DIKE WILL BE NPAG. UM+Q ROCKFILL WILL NOT BE USED FOR CENTRAL DIKE BELOW 134.1 masl.
10) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

ESTIMATED MATERIAL QUANTITY

STRUCTURE	DAM	STAGE	CREST ELEVATION	ROCKFILL VOLUME	FINE FILTER VOLUME	COARSE FILTER VOLUME	LINER AREA	LINER COVER VOLUME	TRENCH EXCAVATION VOLUME	FOUNDATION PREPARATION AREA
			(masl)	m³	m³	m³	m²	m³	m³	m²
SOUTH CELL	CENTRAL DIKE	STAGE 1	135	971,100	46,400	46,100	53,800	23,000	42,700	86,800
		STAGE 2	145	961,000	28,200	28,200	30,200	14,100	8,760	43,800
		STAGE 3	150	619,000	15,500	15,500	15,800	7,760	451	23,500
		TOTAL		2,551,100	90,100	89,800	99,800	44,860	51,911	154,100

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

0 25 50 75 100 125
SCALE IN METRES
1 : 2,500

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP

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PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
CENTRAL DIKE STAGED LAYOUT PLAN

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	01DEC08	SCALE	AS SHOWN	REV. A
CADD	JK	02DEC08	4100-05		
CHECK					
REVIEW					

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By: ASalvador
REVISION DATE: 08/12/17 11:28AM

PORTAGE PIT

SOUTH CELL

PROPOSED ROAD
TO BE DESIGNED BY AEM

PORTAGE PIT CREST

BAY FAULT

SECOND PORTAGE FAULT

SECOND PORTAGE FAULT
(PROJECTED)

CENTRAL DIKE FOOTPRINT

SD4 FOOTPRINT

SD5 FOOTPRINT

03GT-TD-1
06GT-TD2A
03GT-TD-2
03GT-TD-4
03GT-TD-5A
03GT-TD-6
03GT-TD-3
06GT-TD3
06GT-TD-1
02GT-05
02GT-06
02GT-11
03GT-PS-4
03GT-PS-3

TSF-011
TSF-010
TSF-009
TSF-008

639000 E
638800 E
638600 E
638400 E
638200 E

7215200 N
7215000 N
7214800 N
7214600 N
7214400 N
7214200 N
7214000 N
7213800 N

SCALE IN METRES
0 20 40 60 80 100
1 : 2,000

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

TAILINGS STORAGE FACILITY CONTROL POINTS

POINT ID	STATION	EASTING	NORTHING	ELEVATION
TSF-001	0+000.00	637055.54	7216173.40	150.00
TSF-002	0+020.00	637051.53	7216153.81	150.00
TSF-003	0+399.04	636975.46	7215782.48	150.00
TSF-004	0+656.68	637095.60	7215554.57	150.00
DD-002	1+090.09	637426.17	7215274.26	150.00
TSF-005	1+140.47	637464.59	7215241.68	150.00
TSF-006	1+444.75	637560.11	7214952.77	150.00
TSF-007	2+000.73	638041.46	7214674.55	150.00
TSF-008	**2+267.91**	**638215.57**	**7214471.89**	**150.00**
TSF-009	**2+600.11**	**638491.38**	**7214286.71**	**150.00**
TSF-010	**2+842.18**	**638715.97**	**7214196.45**	**150.00**
TSF-011	**3+981.75**	**638715.99**	**7215246.03**	**150.00**
DD-004	4+221.74	638467.03	7215462.63	150.00
TSF-012	4+798.62	638039.01	7215849.39	150.00
TSF-013	5+167.22	638165.46	7216195.63	150.00
TSF-014	5+524.84	638143.59	7216552.58	150.00
TSF-015	5+782.72	638068.38	7216799.24	150.00
TSF-016	5+962.46	637889.42	7216782.52	150.00
TSF-017	6+402.91	637460.44	7216882.39	150.00
TSF-018	6+573.16	637307.15	7216808.33	150.00
TSF-019	7+072.10	637321.79	7216309.60	150.00
TSF-020	7+214.12	637285.22	7216172.37	150.00

DIVIDER DIKE CONTROL POINTS

POINT ID	STATION	EASTING	NORTHING	ELEVATION
DD-001	10+000.00	637378.06	7215272.57	150.00
DD-002	10+048.02	637426.17	7215274.26	150.00
DD-003	10+700.00	638077.67	7215296.10	150.00
DD-004	11+123.48	638467.03	7215462.63	150.00
DD-005	11+150.00	638493.71	7215474.04	150.00

LEGEND

- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- SD1 — SADDLE DAM
- TAILINGS STORAGE FACILITY CONTROL POINT
- 0 + 100 — STATIONS AND REFERENCE LINE
- 12 — SOIL THICKNESS
- 433.10m — FORMER SHORELINE
- PIT FOOTPRINT
- DIKE FOOTPRINT

NOTES

1) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS NAD83 UTM ZONE 14.
2) REFERENCE SHOULD BE MADE TO THE GEOTECHNICAL REPORTS FOR RECORD OF BOREHOLE AND TEST PIT LOG SHEETS. THE BOREHOLE AND TEST PIT DATA AND THE INFORMATION GIVEN IN THE GEOTECHNICAL REPORTS ARE BELIEVED TO BE CORRECT AND IS AVAILABLE FOR THE ASSISTANCE OF THE CONTRACTOR, WHO SHALL BE SOLELY RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION.
3) SOIL THICKNESS SHOWN BASED ON INTERPRETATION OF GEOPHYSICAL DATA, BATHYMETRIC AND SEISMIC SURVEYS BY GOLDER ASSOCIATES LTD., 2006. CONDITIONS TO BE CONFIRMED BY THE CONTRACTOR FOLLOWING DEWATERING.
4) FURTHER INVESTIGATIONS ARE REQUIRED.
5) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
0	17DEC08	JEK	ISSUED FOR REVIEW	AS		

4000-05 — DRAWING NO.
CENTRAL DIKE, PROPOSED DIKE FOOTPRINT SHOWING SOIL THICKNESS — REFERENCES

STAMP

ORIGINAL SIGNED

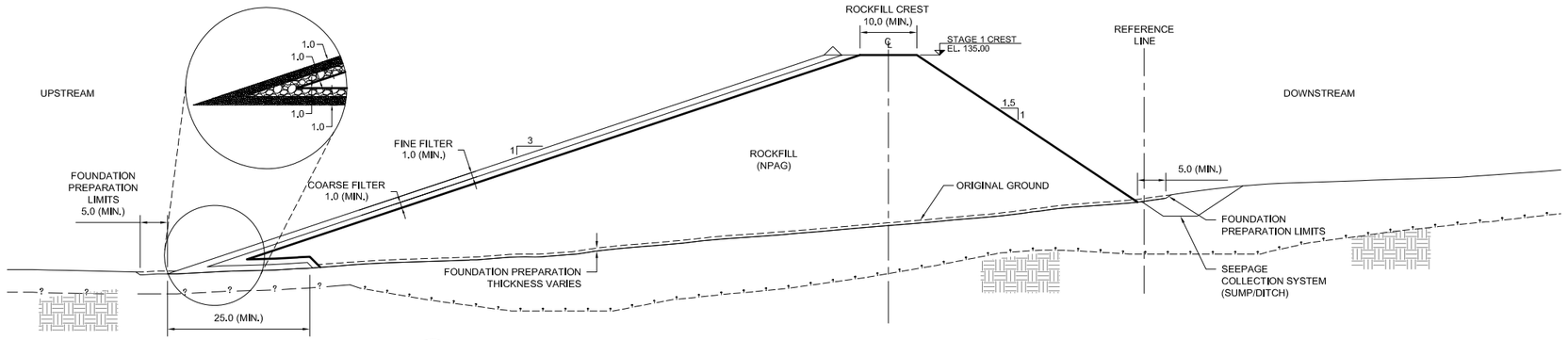
PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
CENTRAL DIKE PLAN
SHOWING SOIL THICKNESS

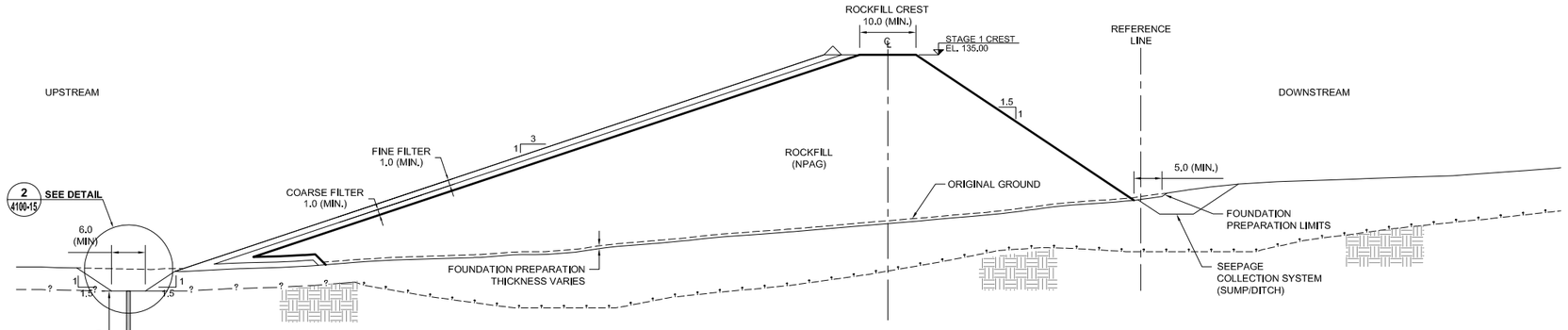
Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	JEK	20NOV08	SCALE	AS SHOWN	REV. A
CADD	AS	25NOV08	4100-06		
CHECK					
REVIEW					

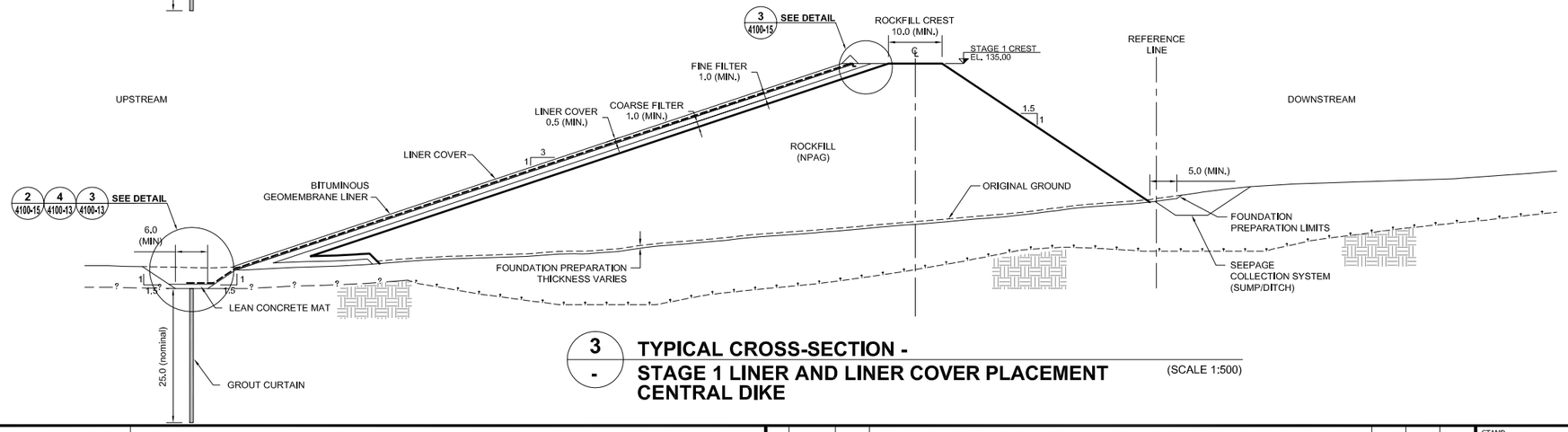
Drawing File: N:\Bur--Graphics\Projects\2008\1428-08--1428--0029\Drafting\3200\Task--1000\41100\08142800329--4100--06.dwg December 17, 2008 12:32:36 PM By: MSalvador



1 - TYPICAL CROSS-SECTION - STAGE 1 FOUNDATION PREPARATION, ROCKFILL AND FILTER PLACEMENT CENTRAL DIKE (SCALE 1:500)



2 - TYPICAL CROSS-SECTION - STAGE 1 TRENCH EXCAVATION CENTRAL DIKE (SCALE 1:500)



3 - TYPICAL CROSS-SECTION - STAGE 1 LINER AND LINER COVER PLACEMENT CENTRAL DIKE (SCALE 1:500)

LEGEND

- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- EXISTING GROUND
- ASSUMED BEDROCK

NOTES

1) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
2) EXTENT OF GROUTING TO BE DETERMINED IN THE FIELD BASED ON GROUND CONDITIONS AS MEASURED BY WATER PRESSURE TEST IN BOREHOLE.
3) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED IN THE FIELD TO SUIT SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
4) ACTUAL LIMITS OF FOUNDATION PREPARATION TO BE DETERMINED BASED ON CONDITIONS ENCOUNTERED IN THE FIELD AND AS DIRECTED BY THE ENGINEER.
5) THE PREPARED FOUNDATION SURFACES SHALL BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO PLACEMENT OF FILL MATERIALS.
6) SEE BITUMINOUS GEOMEMBRANE LINER PLACEMENT AND FOUNDATION PREPARATION SPECIFICATIONS LISTED ON DWG 4100-00.
7) SEE DRILLING AND GROUTING SPECIFICATION AND GROUTING DETAIL REFERENCED ON DWG. 4100-00.
8) STAGE 1 AND STAGE 2 ROCKFILL CREST ARE OFFSET FROM THE CENTRAL DIKE REFERENCE LINE.
9) SEEPAGE COLLECTION SUMP LOCATION AND CONFIGURATION TO BE DETERMINED IN FIELD AFTER COMPLETION OF FOUNDATION PREPARATION.
10) ADDITIONAL FILL IS REQUIRED OVER LINER COVER BELOW ELEVATION 114 masl (NOT SHOWN) TO BE DESIGNED BASED ON AS-BUILT CONFIGURATION OF SEEPAGE COLLECTION SYSTEM TO PREVENT UPLIFT OF LINER DUE TO WATER PONDED IN ROCKFILL.
11) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
12) DIMENSIONS OF ADDITIONAL TRAFFIC SAFETY BERMS TO FOLLOW MINE HEALTH AND SAFETY REGULATIONS.

0 5 10 15 20 25
SCALE IN METRES
1 : 500

REDUCED DRAWING NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
0	17DEEC08	BW	ISSUED FOR REVIEW	JK		

STAMP: ORIGINAL SIGNED

DRAWING NO. 4000-07 — CENTRAL DIKE CONSTRUCTION STAGING OVERVIEW
REFERENCES

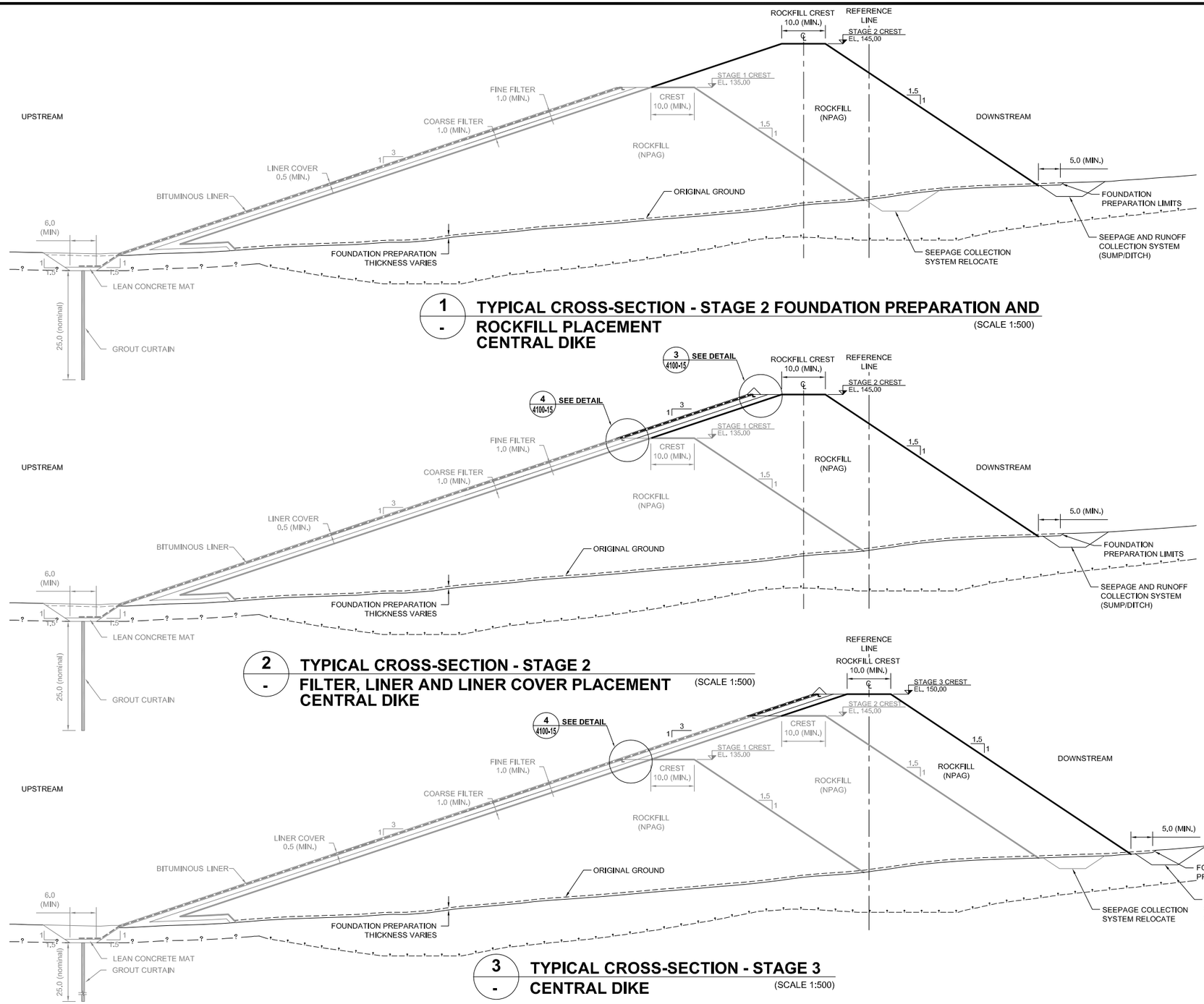
PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: TAILINGS STORAGE FACILITY
CENTRAL DIKE
CONSTRUCTION SEQUENCE SECTIONS (1 OF 2)

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	01DEC08	SCALE	AS SHOWN	REV. A
CADD	DCB/JK	01DEC08			
CHECK			4100-07		
REVIEW					

REVISION DATE: 08/12/17 11:31AM By: ASalvador CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\0814280029-4100-07.dwg



1 - TYPICAL CROSS-SECTION - STAGE 2 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT CENTRAL DIKE (SCALE 1:500)

2 - TYPICAL CROSS-SECTION - STAGE 2 FILTER, LINER AND LINER COVER PLACEMENT CENTRAL DIKE (SCALE 1:500)

3 - TYPICAL CROSS-SECTION - STAGE 3 CENTRAL DIKE (SCALE 1:500)

LEGEND

- STAGE 2 AND STAGE 3 ROCKFILL LIMIT
- STAGE 1 AND 2 ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- EXISTING GROUND
- ASSUMED BEDROCK

NOTES

1) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
2) EXTENT OF GROUTING TO BE DETERMINED IN THE FIELD BASED ON GROUND CONDITIONS AS MEASURED BY WATER PRESSURE TEST IN BOREHOLE.
3) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED IN THE FIELD TO SUIT SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
4) ACTUAL LIMITS OF FOUNDATION PREPARATION TO BE DETERMINED BASED ON CONDITIONS ENCOUNTERED IN THE FIELD AND AS DIRECTED BY THE ENGINEER.
5) THE PREPARED FOUNDATION SURFACES SHALL BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO PLACEMENT OF FILL MATERIALS.
6) SEE BITUMINOUS GEOMEMBRANE LINER PLACEMENT AND FOUNDATION PREPARATION SPECIFICATION LISTED ON DWG 4100-00.
7) SEE DRILLING AND GROUTING SPECIFICATION AND GROUTING DETAIL REFERENCED ON DWG. 4100-00.
8) STAGE 1 AND STAGE 2 ROCKFILL CREST ARE OFFSET FROM THE CENTRAL DIKE REFERENCE LINE.
9) SEEPAGE COLLECTION SUMP LOCATION AND CONFIGURATION TO BE DETERMINED IN FIELD AFTER COMPLETION OF FOUNDATION PREPARATION.
10) ADDITIONAL FILL IS REQUIRED OVER LINER COVER BELOW ELEVATION 114 masl (NOT SHOWN) TO BE DESIGNED BASED ON AS-BUILT CONFIGURATION OF SEEPAGE COLLECTION SYSTEM TO PREVENT UPLIFT OF LINER DUE TO WATER PONDED IN ROCKFILL.
11) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
12) DIMENSIONS OF ADDITIONAL TRAFFIC SAFETY BERMS TO FOLLOW MINE HEALTH AND SAFETY REGULATIONS.

0 5 10 15 20 25
SCALE IN METRES
1 : 500

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

4000-07 — CENTRAL DIKE CONSTRUCTION STAGING OVERVIEW
DRAWING NO. — REFERENCES

STAMP: ORIGINAL SIGNED

PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: **TAILINGS STORAGE FACILITY**
CENTRAL DIKE
CONSTRUCTION SEQUENCE SECTIONS (2 OF 2)

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
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CADD	DCB/JK	01DEC08			
CHECK			4100-08		
REVIEW					

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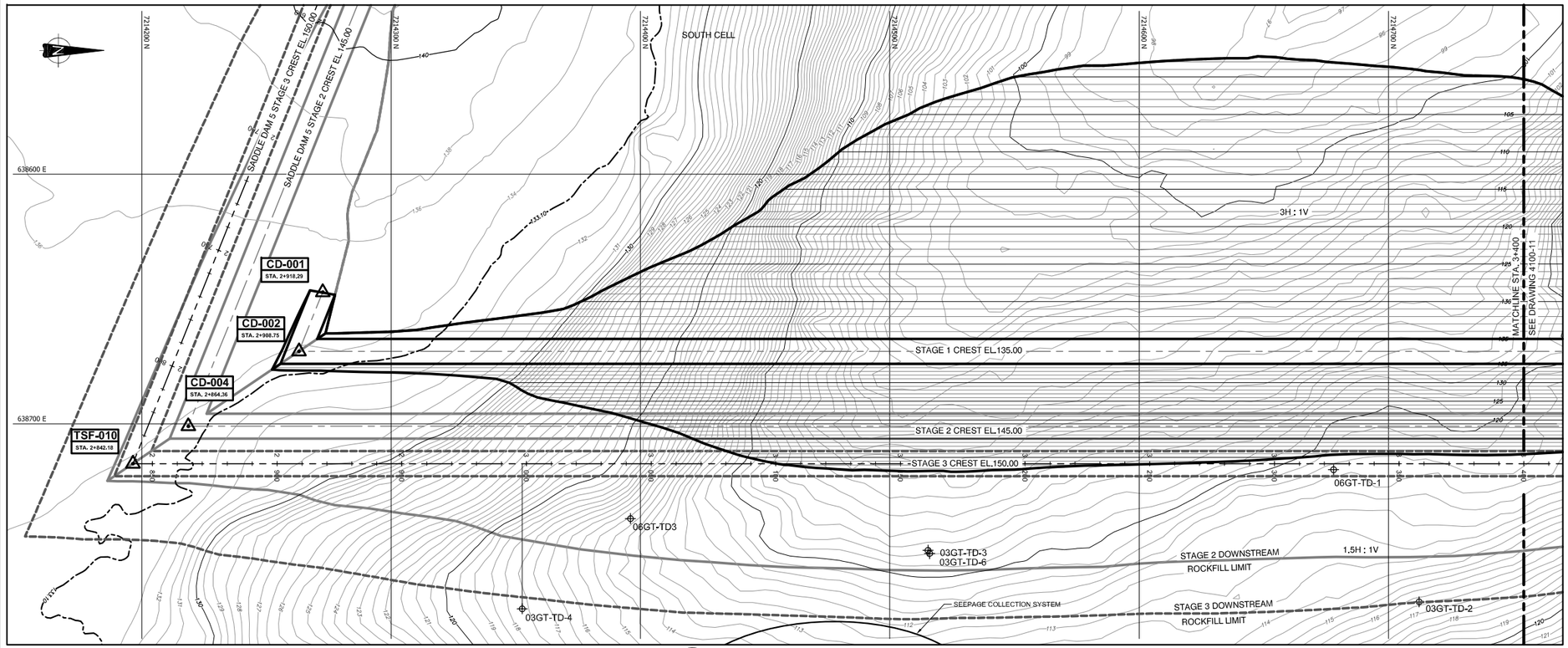
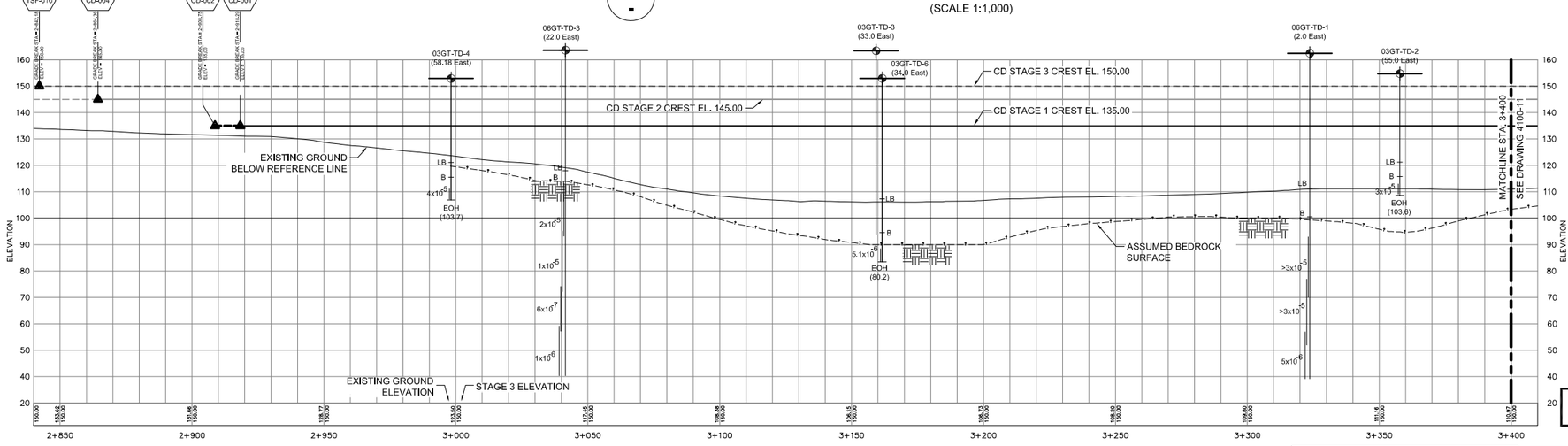


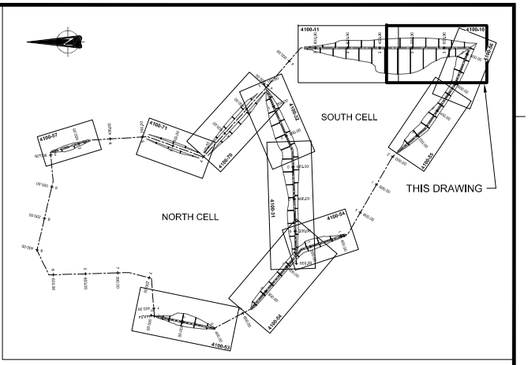
1 - CENTRAL DIKE PLAN STA. 2+840 to 3+400

(SCALE 1:1,000)



2 - CENTRAL DIKE PROFILE STA. 2+840 to 3+400

(SCALE 1:1,000)



KEY PLAN

NOT TO SCALE

0 10 20 30 40 50

SCALE IN METRES
1 : 1,000

LEGEND

- 03GT-GI-6 — BOREHOLE
- TSF-010 STA. 2+842.18 — CONTROL POINT
- 2+850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 1
- STAGE 2
- STAGE 3
- FORMER SHORELINE
- LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- BOREHOLE COLLAR ELEVATION ADJUSTED FOR CLARITY.
- 2x10 -5 — HYDRAULIC CONDUCTIVITY TEST INTERVAL WITH RESULTS IN m/s
- 03GT-SE-2 (150m North) — -BOREHOLE NAME -(OFFSET PERPENDICULAR TO REFERENCE LINE)
- LB — LAKEBED
- EOH — END OF HOLE
- B — BEDROCK
- G — GROUND SURFACE
- ASSUMED BEDROCK SURFACE

NOTES

1) STAGE 1 AND STAGE 2 ROCKFILL CREST ARE OFFSET FROM THE CENTRAL DIKE REFERENCE LINE.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING LAKEBED AND BEDROCK ELEVATION IS CONSIDERED APPROXIMATE.
3) ROCKFILL FOR CENTRAL DIKE WILL BE NPAG, UM+Q ROCKFILL WILL NOT BE USED FOR CENTRAL DIKE BELOW 134.1 masl.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

CENTRAL DIKE CONTROL POINTS

	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
STAGE 1	**CD-001**	**2+918.29**	**-68.74**	**7214272.57**	**638647.23**	**135.00**
	CD-002	**2+908.75**	**-45.00**	**7214263.03**	**638670.97**	**135.00**
	CD-003	3+685.00	-15.00	7215039.28	638670.98	135.00
STAGE 2	**CD-004**	2+864.36	**-15.00**	**7214218.64**	**638700.97**	**145.00**
	CD-005	3+810.00	-45.00	7215164.28	638700.98	145.00
STAGE 3	**TSF-010**	**2+842.18**	**0**	**7214196.45**	**638715.97**	**150.00**
	TSF-011	3+981.75	0	7215246.03	638715.99	150.00

DATA IN **BOLD** PRESENTED ON THIS DRAWING

NOT FOR CONSTRUCTION

REDUCED DRAWING
NOT TO SCALE

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
CENTRAL DIKE ROCKFILL
PLAN AND PROFILE (1 OF 2)

DRAWING NO.	REFERENCES
4000-12	STAGE 1 PLAN
4000-14	STAGE 2 PLAN
4000-16	STAGE 3 PLAN

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

STAMP

ORIGINAL SIGNED

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	10NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	21NOV08	4100-10		
CHECK					
REVIEW					

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By: jkownocki

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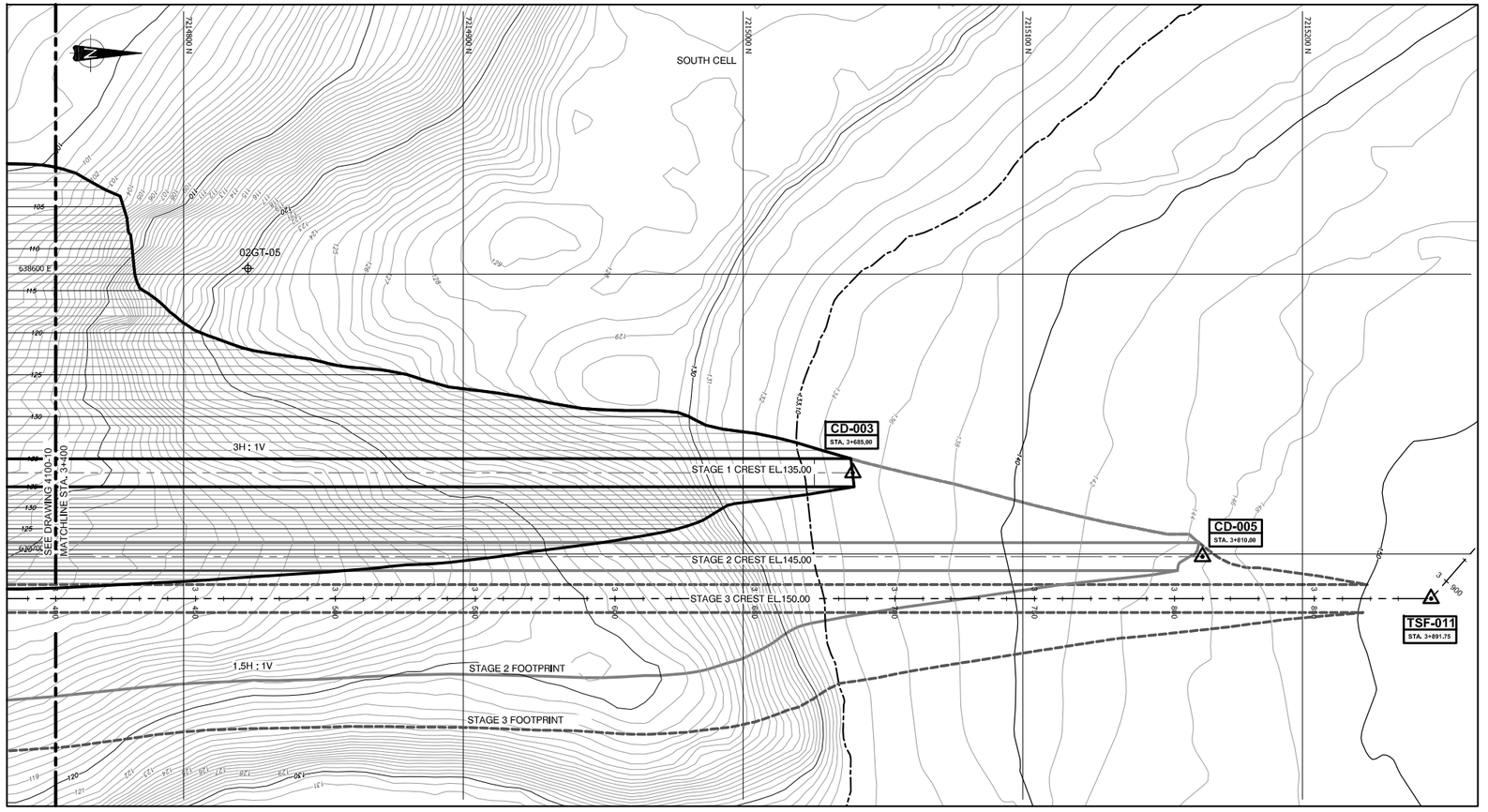
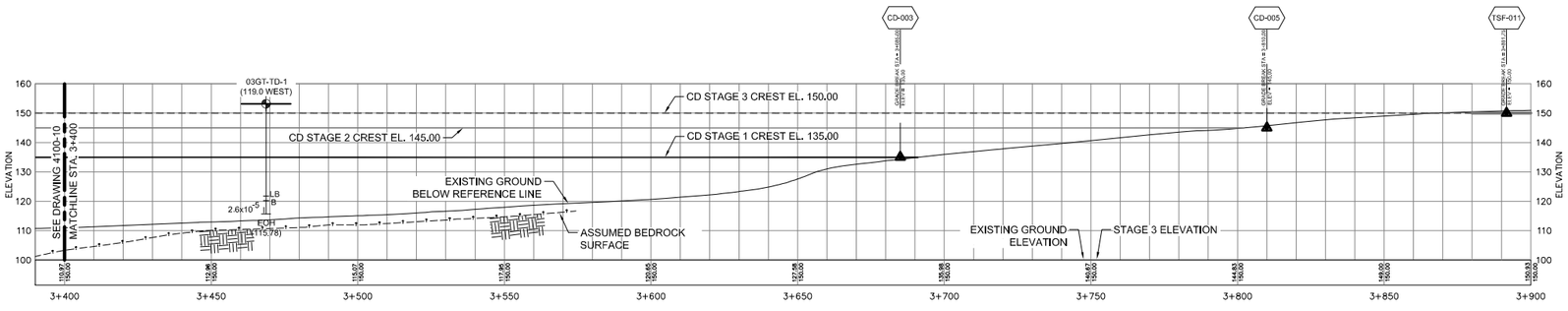


1 - CENTRAL DIKE PLAN STA. 3+400 to 3+900

(SCALE 1:1,000)

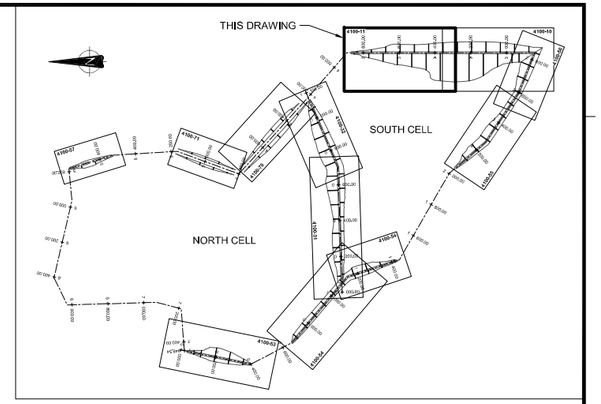


2 - CENTRAL DIKE PROFILE STA. 3+400 to 3+900

(SCALE 1:1,000)

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION



KEY PLAN

NOT TO SCALE

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SCALE IN METRES
1 : 1,000

LEGEND

- 03GT-GI-6 — BOREHOLE
- TSF-010 STA. 2+842.18 — CONTROL POINT
- 2+850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 1
- STAGE 2
- STAGE 3
- 133.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- BOREHOLE COLLAR ELEVATION ADJUSTED FOR CLARITY.
- 2x10 -5 — HYDRAULIC CONDUCTIVITY TEST INTERVAL WITH RESULTS IN m/s
- 03GT-SE-2 (150m North) — -BOREHOLE NAME -(OFFSET PERPENDICULAR TO REFERENCE LINE)
- LB — LAKEBED
- EOH — END OF HOLE
- B — BEDROCK
- ASSUMED BEDROCK SURFACE

NOTES

1) STAGE 1 AND STAGE 2 ROCKFILL CREST ARE OFFSET FROM THE CENTRAL DIKE REFERENCE LINE.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING LAKEBED AND BEDROCK ELEVATION IS CONSIDERED APPROXIMATE.
3) ROCKFILL FOR CENTRAL DIKE WILL BE NPAG. UM+Q ROCKFILL WILL NOT BE USED FOR CENTRAL DIKE BELOW 134.1 masl.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

CENTRAL DIKE CONTROL POINTS

	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
STAGE 1	CD-001	2+918.29	-68.74	7214272.57	638647.23	135.00
	CD-002	2+908.75	-45.00	7214263.03	638670.97	135.00
	CD-003	**3+685.00**	**-15.00**	**7215039.28**	**638670.98**	**135.00**
STAGE 2	CD-004	2+864.36	-15.00	7214218.64	638700.97	145.00
	CD-005	**3+810.00**	**-45.00**	**7215164.28**	**638700.98**	**145.00**
STAGE 3	TSF-010	2+842.18	0	7214196.45	638715.97	150.00
	TSF-011	**3+981.75**	**0**	**7215246.03**	**638715.99**	**150.00**

DATA IN **BOLD** PRESENTED ON THIS DRAWING

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
CENTRAL DIKE ROCKFILL
PLAN AND PROFILE (2 OF 2)

REFERENCES	DRAWING NO.
STAGE 1 PLAN	4000-12
STAGE 2 PLAN	4000-14
STAGE 3 PLAN	4000-16

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

STAMP

ORIGINAL SIGNED

Golder Associates

PROJECT No. 08-1428-0029/3200			FILE No.
DESIGN	BW	10NOV08	SCALE AS SHOWN REV. A
CADD	JK	01DEC08	4100-11
CHECK			
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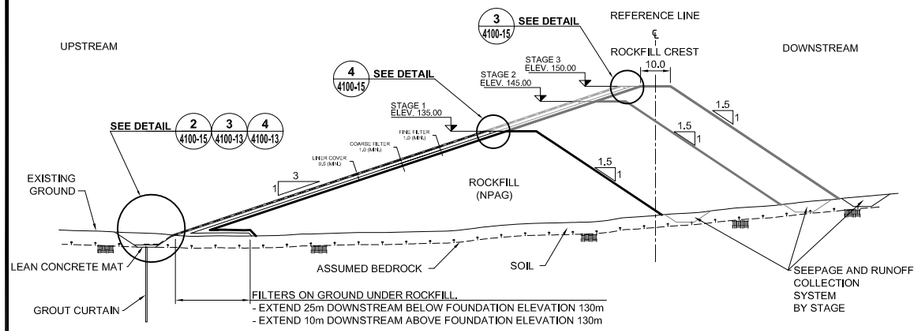
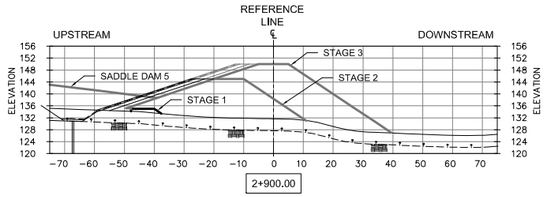
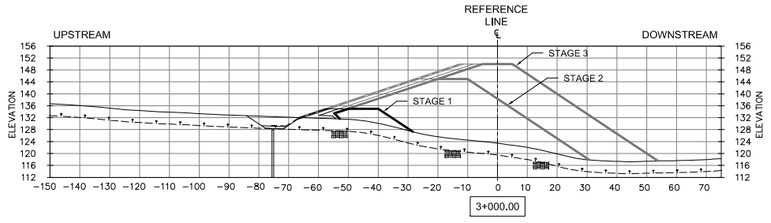
REVISION DATE: 08/12/17 09:40AM By: jkowacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800229-4100-11.dwg

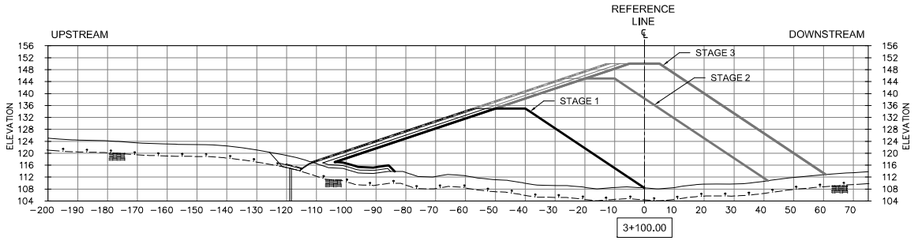


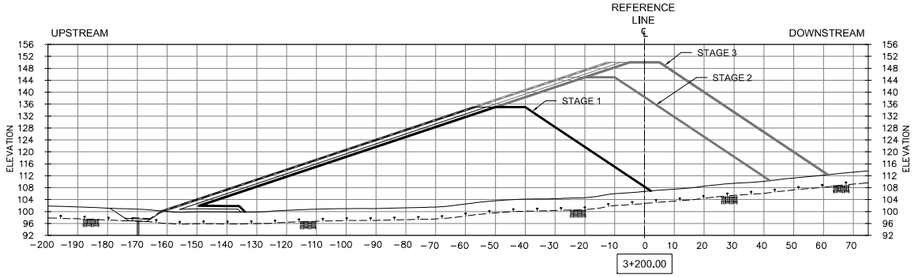
1 - TYPICAL SECTION - CENTRAL DIKE ROCK FILL

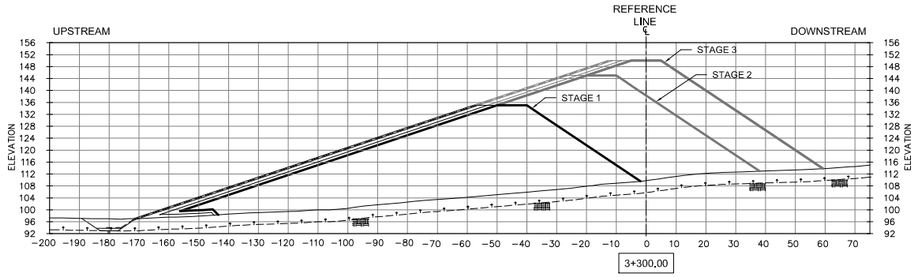
SCALE 1:1000

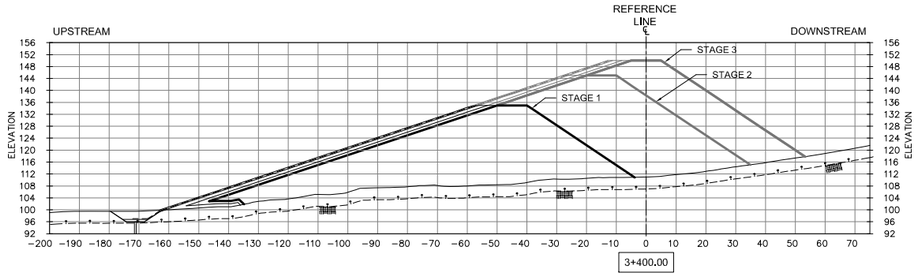


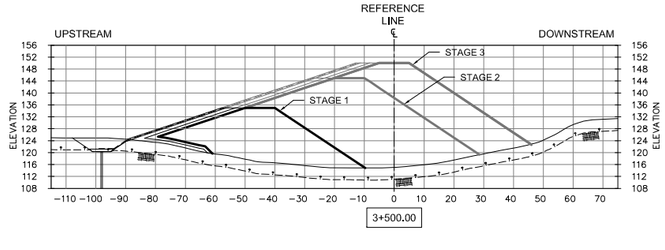


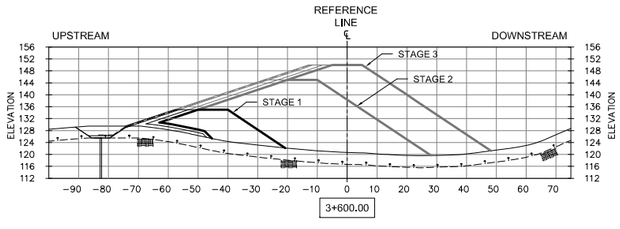


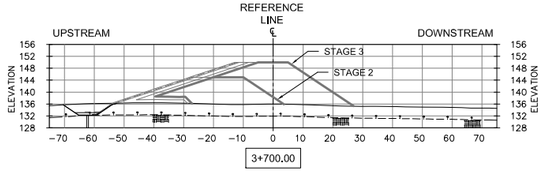


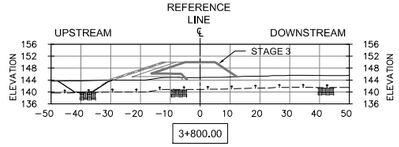


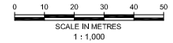












LEGEND

- STAGE 1 ROCKFILL LIMIT
- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- EXISTING GROUND
- ASSUMED BEDROCK

NOTES

1) THIS DRAWING PROVIDES CROSS-SECTION INFORMATION FOR THE CENTRAL DIKE. STAGE 1, STAGE 2 AND STAGE 3 CENTRAL DIKE CONSTRUCTION. REFER TO THE CONTROL POINT DETAILS PRESENTED ON DWG. 4100-10 to 4100-11.
2) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
3) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED IN THE FIELD TO SUIT SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION AS DIRECTED BY THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
4) EXTENT OF GROUTING TO BE DETERMINED IN THE FIELD BASED ON GROUND CONDITIONS AS MEASURED BY WATER PRESSURE TESTS IN BOREHOLES.
5) LIMITS OF FOUNDATION PREPARATION AND LINER COVER NOT SHOWN FOR CLARITY; REFER TO DWG. 4100-06 AND 4100-07.
6) FILTER ON LAKEBED EXTENDED DOWNSTREAM BY: 25m BELOW ELEVATION 130m, 10m ABOVE ELEVATION 130 m.
7) ADDITIONAL FILL IS REQUIRED OVER LINER COVER BELOW ELEVATION 114 masl (NOT SHOWN) TO BE DESIGNED BASED ON AS-BUILT CONFIGURATION OF SEEPAGE COLLECTION SYSTEM TO PREVENT UPLIFT OF LINER DUE TO WATER PONDED IN ROCKFILL.
8) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

DRAWING NO.	REFERENCES
4000-13	STAGE 1 SECTIONS
4000-15	STAGE 2 SECTIONS
4000-17	STAGE 3 SECTIONS

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

STAMP

ORIGINAL SIGNED

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
CENTRAL DIKE
CROSS-SECTIONS

Golder Associates

PROJECT No.	08-1428-0029/3200			FILE No.	
DESIGN	BW	21NOV08		SCALE	AS SHOWN	REV.	A
CADD	JK	01DEC08			
CHECK				4100-12	
REVIEW					

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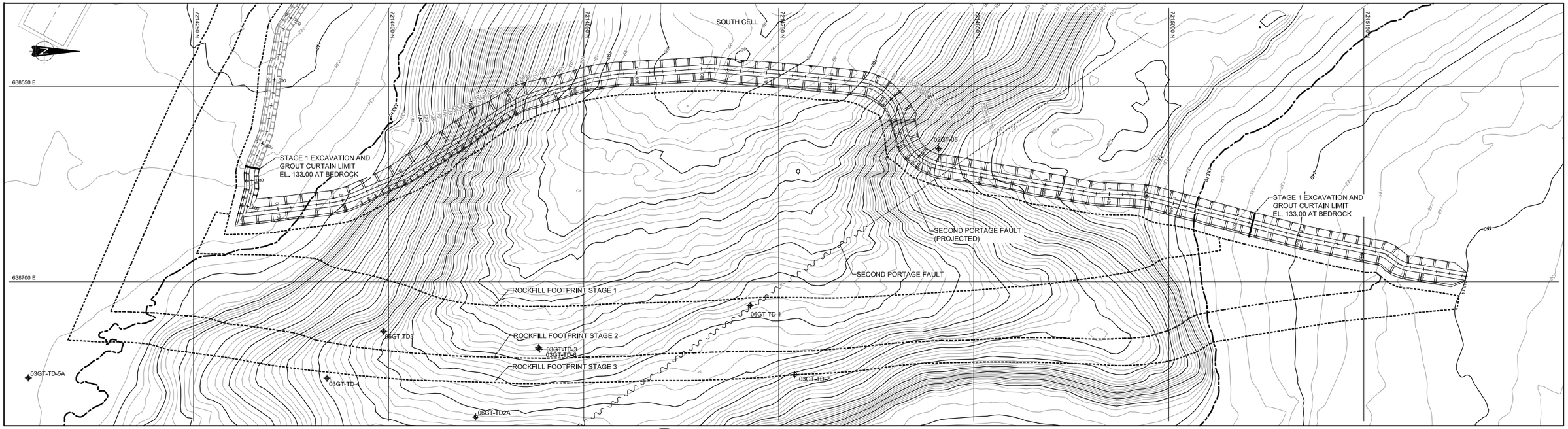
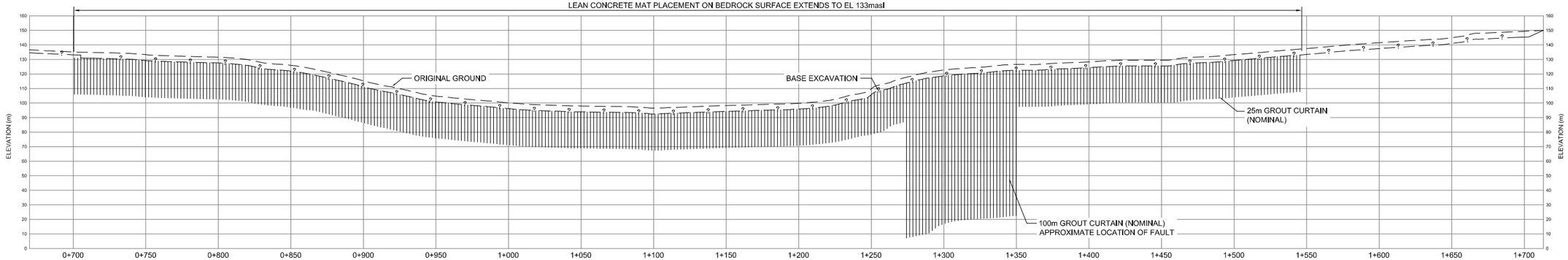
By: jkownacki
REVISION DATE: 08/12/17 12:27PM



1 - TRENCH PLAN

(SCALE 1:1,500)

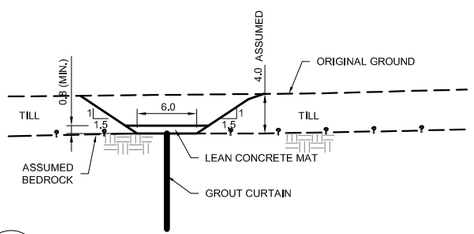


NOTES

1. SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
2. EXTENT OF GROUTING TO BE DETERMINED IN THE FIELD BASED ON GROUND CONDITIONS AS MEASURED BY WATER PRESSURE TEST IN BOREHOLES.
3. CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED IN THE FIELD TO SUIT SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION AS DIRECTED BY THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
4. SEEPAGE COLLECTION SUMP LOCATION AND CONFIGURATION TO BE DETERMINED IN FIELD AFTER COMPLETION OF FOUNDATION PREPARATION.
5. SEE GROUTING PATTERN ON DWG. 4100-15 AND SPECIFICATIONS FOR DRILLING AND GROUTING AND BITUMINOUS GEOMEMBRANE LINER AND FOUNDATION PREPARATION.
6. FURTHER INVESTIGATIONS ARE REQUIRED.
7. REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

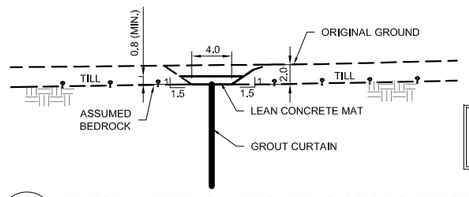
LEGEND

- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- STATIONS AND REFERENCE LINE
- EXISTING GROUND (PROFILE)
- LAND-BASED TOPOGRAPHIC
- 120 — MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC
- MINOR CONTOURS INTERVAL 2m
- ASSUMED BEDROCK (PROFILE)
- 133.10 — FORMER SHORELINE
- DIKE ROCKFILL FOOTPRINT



3 - TYPICAL TRENCH CROSS SECTION

CENTRAL DIKE (SCALE 1:300)



4 - TYPICAL TRENCH GROUTING CROSS SECTION

SADDLE DAM (SCALE 1:300)

2 - PROFILE THROUGH BASE OF EXCAVATION ALONG TRENCH CENTRELINE

(SCALE 1:1,500)

NOT FOR CONSTRUCTION

REDUCED DRAWING NOT TO SCALE

0 3 6 9 12 15 — SCALE IN METRES 1 : 300

0 15 30 45 60 75 — SCALE IN METRES 1 : 1,500

REVISION DATE:	By:	CADD FILE:
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REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO.	REFERENCES
4000-08	EXCAVATION PLAN STAGE 1
4000-09	CENTRAL DIKE EXCAVATION PLAN STAGE 2 AND 3

STAMP

ORIGINAL SIGNED

PROJECT

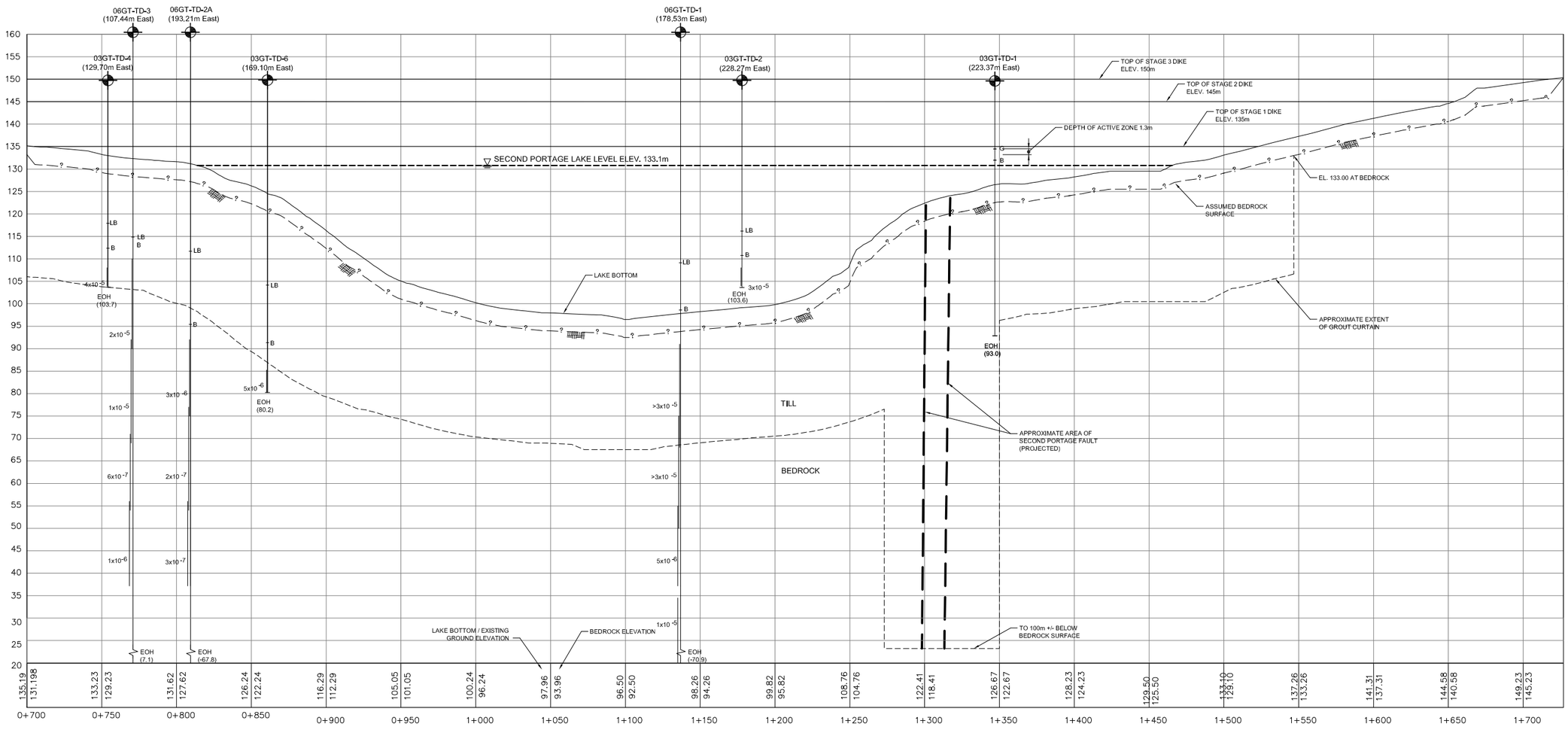
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY CENTRAL DIKE EXCAVATION PLAN AND PROFILE

Golder Associates

PROJECT No. 08-1428-0029/3200			FILE No.
DESIGN	BW	01DEC08	SCALE AS SHOWN REV. A
CADD	JK	02DEC08	4100-13
CHECK			
REVIEW			



LEGEND:

$2x10^{-5}$ HYDRAULIC CONDUCTIVITY TEST INTERVAL WITH RESULTS IN m/s

03GT-SE-2 (150m East) -BOREHOLE NAME -(OFFSET PERPENDICULAR THROUGH REFERENCE LINE)

BOREHOLE ELEVATION ADJUSTED FOR CLARITY.

LB LAKEBED

EOH END OF HOLE

B BEDROCK

G GROUND SURFACE

NOTES

1) SECOND PORTAGE FAULT LOCATION APPROXIMATE ONLY.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING LAKEBED SURFACE AND BEDROCK ARE CONSIDERED APPROXIMATE.
3) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
4) EXTENT OF GROUTING TO BE DETERMINED IN THE FIELD BASED ON GROUND CONDITIONS AS MEASURED BY WATER PRESSURE TEST IN BOREHOLES.
5) GROUT CURTAIN EXTENDED TO 133 masl AT BEDROCK SURFACE.
6) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
7) DWG. 4100-14 TO BE UPDATED WITH RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

1
4100-13

LONGITUDINAL SECTION - ALONG TRENCH CENTRELINE

VERTICAL EXAGGERATION = 3X

REDUCED DRAWING
NOT TO SCALE

0 5 10 15 20 25
SCALE IN METRES
1 : 500

0 15 30 45 60 75
SCALE IN METRES
1 : 1,500

NOT FOR CONSTRUCTION

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
CENTRAL DIKE
CUT-OFF CENTRELINE PROFILE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	AS		

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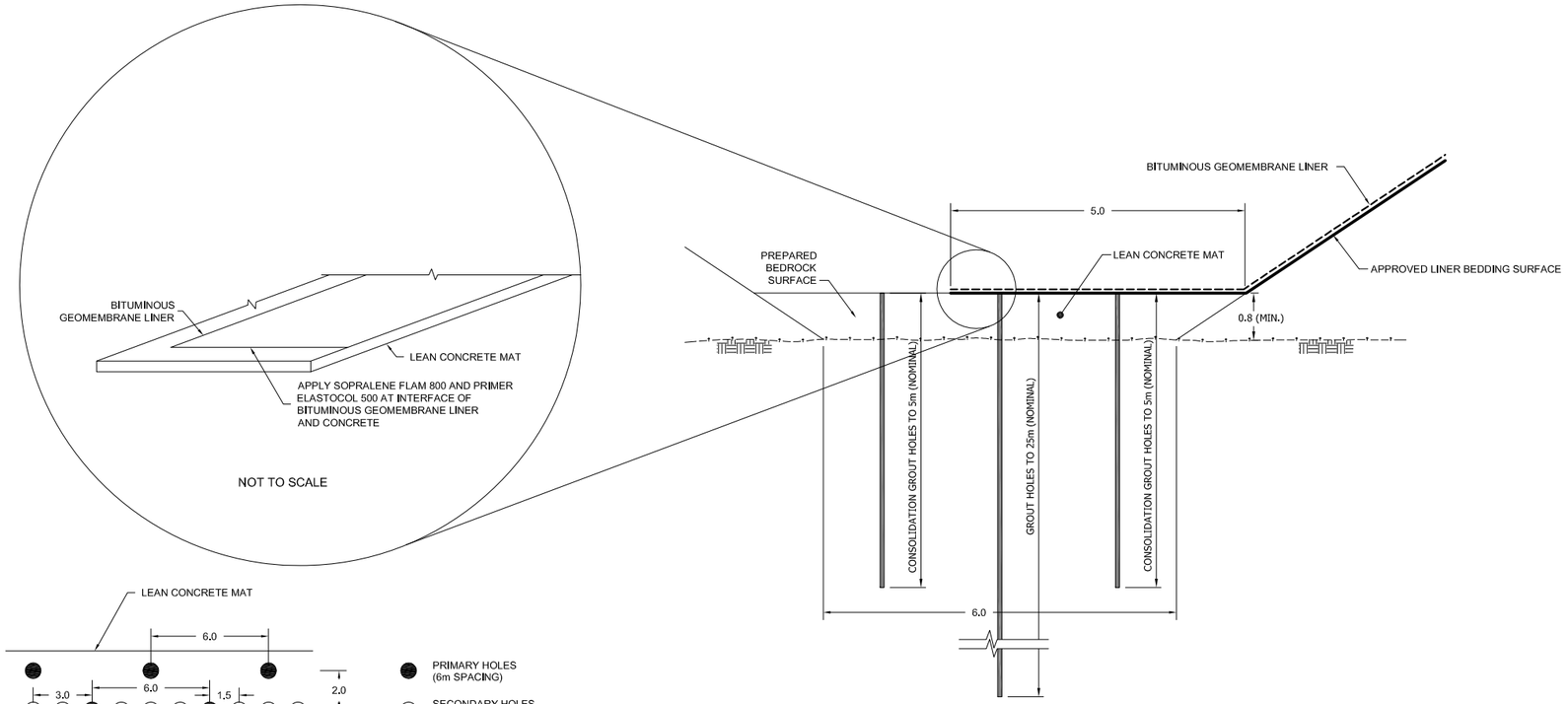
ORIGINAL SIGNED

4000-03 DRAWING NO.
CENTRAL DIKE GEOLOGICAL SECTION ALONG DIKE ALIGNMENT REFERENCES

Golder Associates

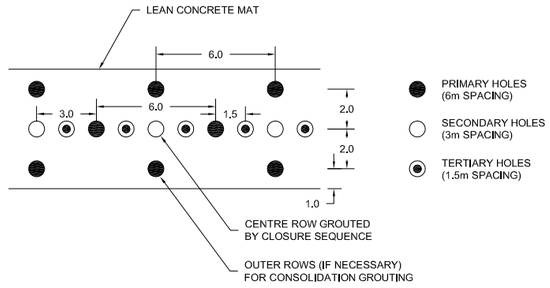
PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	10JAN07	SCALE	AS SHOWN	REV. A
CADD	AS	25NOV08	4100-14		
CHECK					
REVIEW					

REVISION DATE: 08/12/17 04:00PM By: jkowacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\0814280029-4100-14.dwg



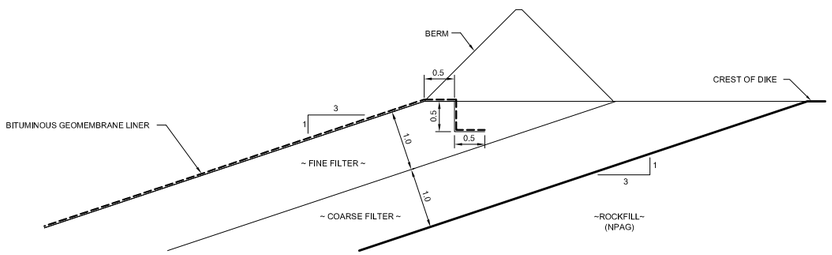
2 - DETAIL - BITUMINOUS GEOMEMBRANE LINER IN CUT-OFF TRENCH

(SCALE 1:50)



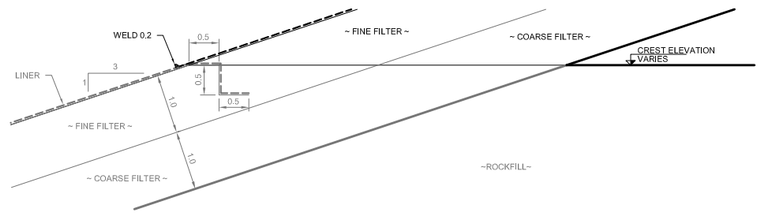
1 - DETAIL - GROUTING SEQUENCE

(SCALE 1:150)



3 - DETAIL - BITUMINOUS GEOMEMBRANE LINER AT CREST CENTRAL DIKE

(SCALE 1:50)



4 - DETAIL - LINER RAISE CENTRAL DIKE

(SCALE 1:50)

0 1.5 3 4.5 6 7.5
SCALE IN METRES
1 : 150

0 0.5 1.0 1.5 2.0 2.5
SCALE IN METRES
1 : 50

NOTES

1) REFER TO SPECIFICATIONS LISTED ON DWG. 4100-00 FOR a) LEAN CONCRETE MAT, b) FOUNDATION PREPARATION, c) BITUMINOUS GEOMEMBRANE LINER AND d) DRILLING AND GROUTING FOR ADDITIONAL INFORMATION.
2) MINIMUM THICKNESS OF LEAN CONCRETE MAT 800 mm UNLESS OTHERWISE DIRECTED BY THE ENGINEER BASED ON GROUTING WORK PLAN.
3) LINER TO BE EXPOSED BY HAND.
4) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

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REVISION DATE: 08/12/17 11:34AM By: ASalvador

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

4000-10 — DRAWING NO.
CENTRAL DIKE GROUTING PLAN AND LINER DETAILS — REFERENCES

STAMP

ORIGINAL SIGNED

PROJECT

AEM

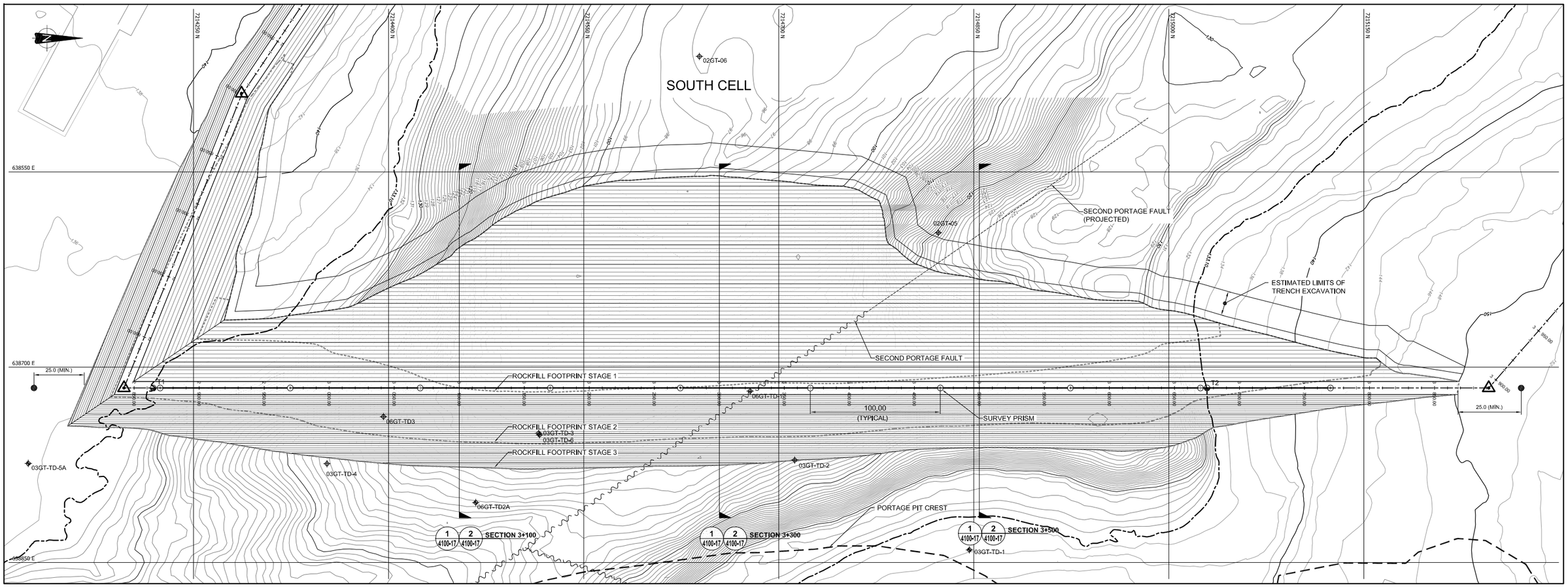
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
CENTRAL DIKE
GROUTING PLAN AND LINER DETAILS

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	28NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	01DEC08			
CHECK			4100-15		
REVIEW					



1 PLAN
(SCALE 1:1,500)

LEGEND

- TSF — CONTROL POINT
- T1 — THERMISTOR
- STAGE 1 SURVEY CONTROL MONUMENT
- SURVEY PRISM
- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- STATIONS AND REFERENCE LINE (100 / 0)
- EXISTING GROUND
- LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m (120)
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- FORMER SHORELINE (133.10)
- PIT FOOTPRINT
- DIKE FOOTPRINT

NOTES

1) SURVEY PRISMS TO BE INSTALLED AT 100 m SPACING ALONG DIKE CREST FOR EACH STAGE.
2) A SURVEY CONTROL MONUMENT SHALL BE INSTALLED AT EACH ABUTMENT AT A MINIMUM 25m FROM THE CENTRAL DIKE.
3) SEE TYPICAL CROSS-SECTION ON DRAWING 4100-17 FOR DETAILS. THERMISTOR BEAD SPACING TO FOLLOW T4 ON 4100-17
4) LENGTH OF LEADS AND READ LOCATIONS WILL DEPEND ON AS-BUILT CONFIGURATION AND ON CONDITIONS ENCOUNTERED IN THE FIELD.
5) INSTRUMENTATION INSTALLATION SHALL BE IN ACCORDANCE WITH INSTRUMENTATION SPECIFICATION LISTED ON DWG. 4100-00.
6) SEISMOGRAPH MONITORING LOCATION TO BE LOCATED AT MAXIMUM AS-BUILT DIKE HEIGHT AT DOWNSTREAM TOE AND DOWNSTREAM CREST.
7) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REDUCED DRAWING
NOT TO SCALE

0 15 30 45 60 75
SCALE IN METRES
1 : 1,500

NOT FOR CONSTRUCTION

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
CENTRAL DIKE INSTRUMENTATION
LOCATION PLAN

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	AS		

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4000-24 — DRAWING NO.
CENTRAL DIKE INSTRUMENTATION PLAN LOCATIONS — REFERENCES

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	01DEC08	SCALE	AS SHOWN	REV. A
CADD	AS	02DEC08			
CHECK			4100-16		
REVIEW					

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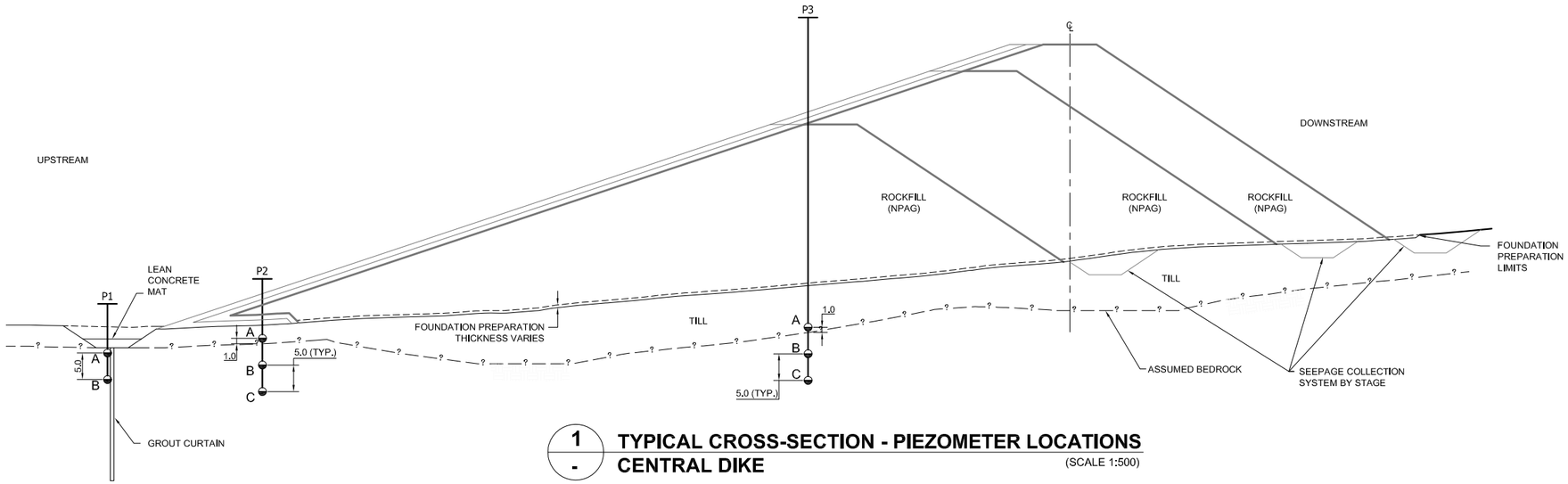
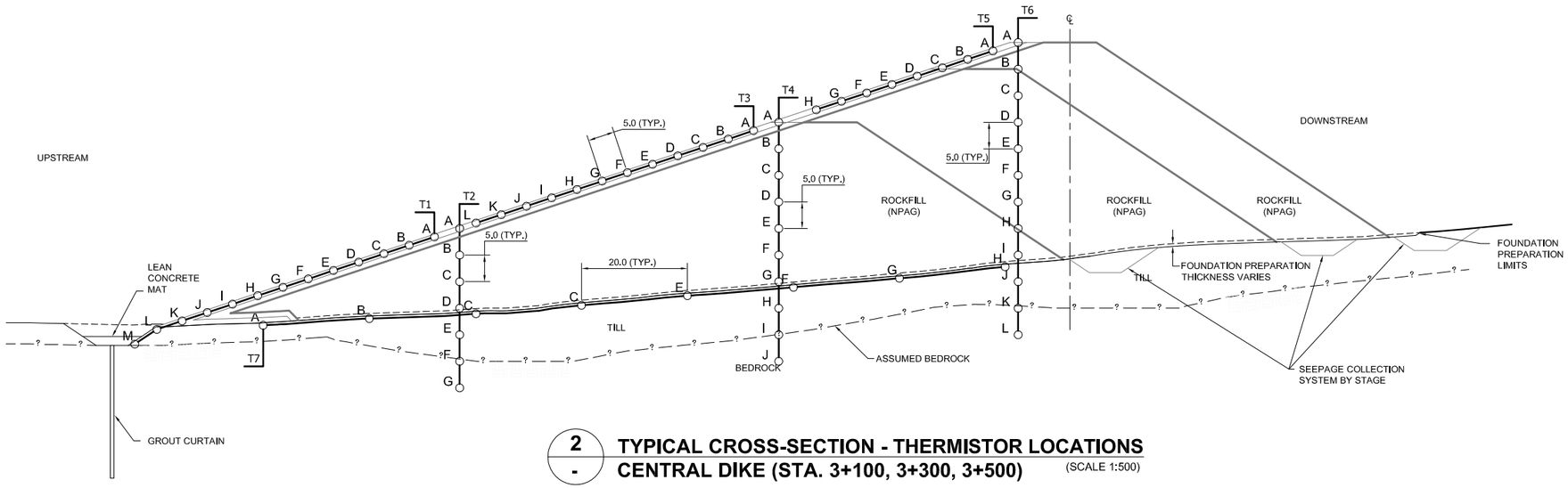
By: jkowacki
REVISION DATE: 08/12/17 12:20PM



1 / - TYPICAL CROSS-SECTION - PIEZOMETER LOCATIONS
CENTRAL DIKE (SCALE 1:500)



2 / - TYPICAL CROSS-SECTION - THERMISTOR LOCATIONS
CENTRAL DIKE (STA. 3+100, 3+300, 3+500) (SCALE 1:500)

LEGEND

- PI — PIEZOMETER
- TI — THERMISTOR
- ROCKFILL LIMIT
- ASSUMED BEDROCK

NOTES

1) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
2) INSTRUMENTATION INSTALLATION SHALL BE IN ACCORDANCE WITH INSTRUMENTATION SPECIFICATION LISTED ON DWG. 4100-00.
3) SURVEY PRISMS TO BE INSTALLED AT 100 m SPACING ALONG DIKE CREST FOR EACH STAGE.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
5) DWG. 4100-17 TO BE UPDATED WITH RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

0 5 10 15 20 25
SCALE IN METRES
1 : 500

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REVISION DATE: 08/12/17 04:03PM By: jkownacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800229-4100-17.dwg

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

4000-25 — DRAWING NO.
CENTRAL DIKE INSTRUMENTATION TYPICAL SECTION — REFERENCES

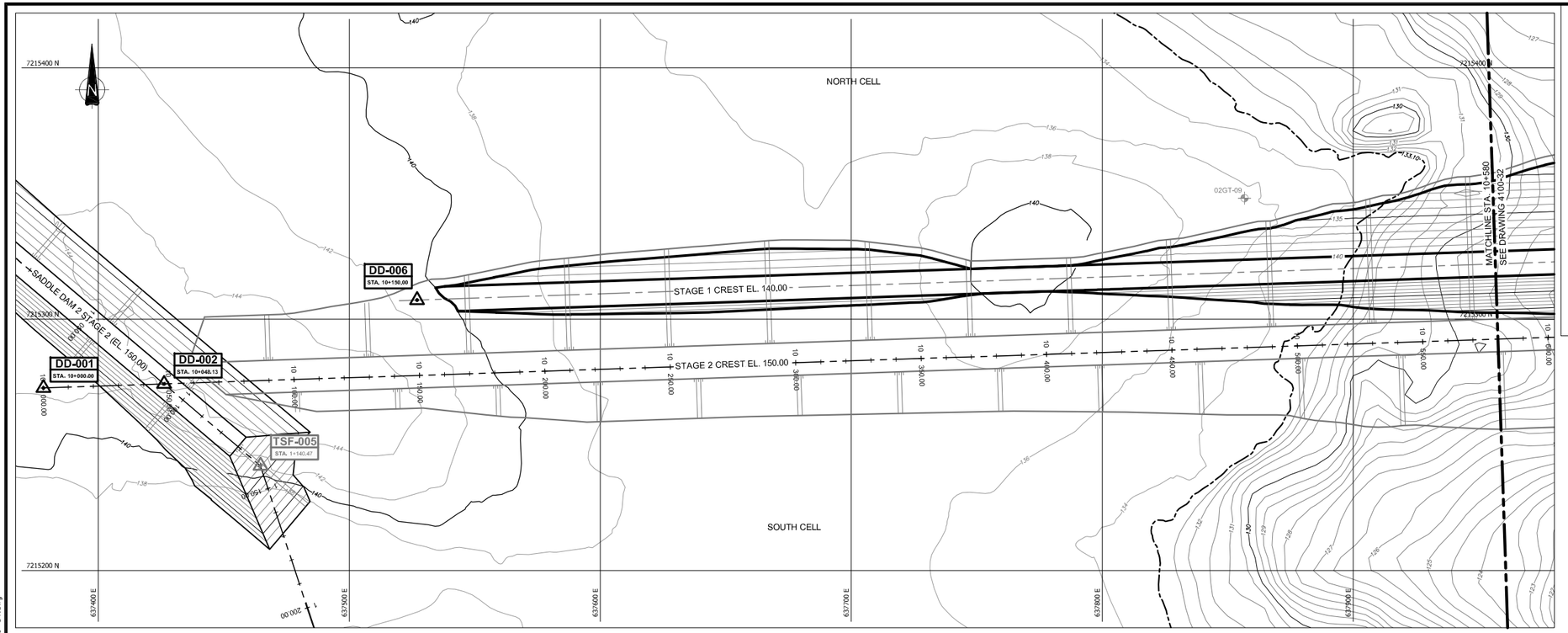
STAMP: ORIGINAL SIGNED

PROJECT: AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
CENTRAL DIKE
INSTRUMENTATION TYPICAL SECTIONS

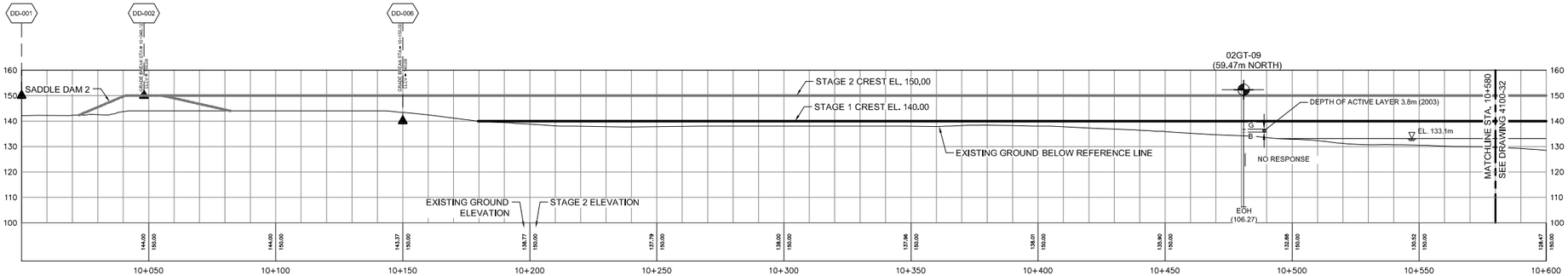
Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	01DEC08	SCALE	AS SHOWN	REV. A
CADD	JK	02DEC08			
CHECK			4100-17		
REVIEW					



1 - DIVIDER DIKE PLAN STA. 10+000 to 10+580

(SCALE 1:1,000)

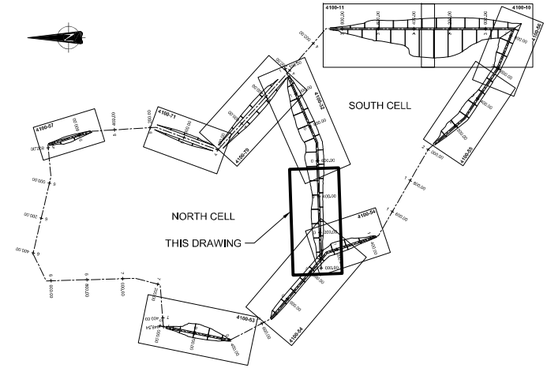


2 - DIVIDER DIKE PROFILE STA. 10+000 to 10+580

(SCALE 1:1,000)

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION



KEY PLAN

NOT TO SCALE

0 10 20 30 40 50
SCALE IN METRES
1: 1,000

NOTES

1) STAGE 1 ROCKFILL CREST IS OFFSET FROM DIVIDER DIKE REFERENCE LINE.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING LAKEBED AND BEDROCK ELEVATION IS CONSIDERED APPROXIMATE.
3) ROCKFILL FOR THE DIVIDER DIKE SHALL BE PAG OR NPAG.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
5) DWG. 4100-31 TO BE UPDATED WITH RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

LEGEND

- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- BOREHOLE COLLAR ELEVATION ADJUSTED FOR CLARITY.
- TSF-001 STA. 0+000.00 — CONTROL POINT
- 2x10 -5 — HYDRAULIC CONDUCTIVITY TEST INTERVAL WITH RESULTS IN m/s
- 0 100 — STATIONS AND REFERENCE LINE
- 03GT-SE-2 (150m North) — BOREHOLE NAME -(OFFSET PERPENDICULAR TO REFERENCE LINE)
- EXISTING GROUND
- STAGE 1
- STAGE 2
- 133.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- BELOW 133.1 LAKEBED MINOR CONTOURS INTERVAL 0,5m
- LB — LAKEBED
- EOH — END OF HOLE
- B — BEDROCK
- G — GROUND SURFACE

TAILINGS STORAGE FACILITY CONTROL POINTS

	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
STAGE 2	TSF-005	1+140.47	0	7215241.68	637464.59	150.00

DIVIDER DIKE CONTROL POINTS

	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
STAGE 1	**DD-006**	**10+150.00**	**-30**	**7215307.66**	**637526.97**	**140.00**
	DD-007	10+695.48	-30	7215325.93	638072.14	140.00
	DD-008	11+030.00	-30	7215453.34	638369.21	140.00
STAGE 2	**DD-001**	**10+000.00**	**0**	**7215272.65**	**637378.06**	**150.00**
	DD-002	**10+048.13**	**0**	**7215274.26**	**637426.17**	**150.00**
	DD-003	10+700.00	0	7215296.10	638077.67	150.00
	DD-004	11+123.48	0	7215462.63	638467.03	150.00
	DD-005	11+150.00	0	7215474.04	638493.71	150.00

DATA IN **BOLD** PRESENTED ON THIS DRAWING

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
DIVIDER DIKE ROCKFILL
PLAN AND PROFILE (1 of 2)

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP
ORIGINAL SIGNED

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	10NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	21NOV08	4100-31		
CHECK					
REVIEW					

REVISION DATE: 08/12/17 01:37PM By: jkownacki
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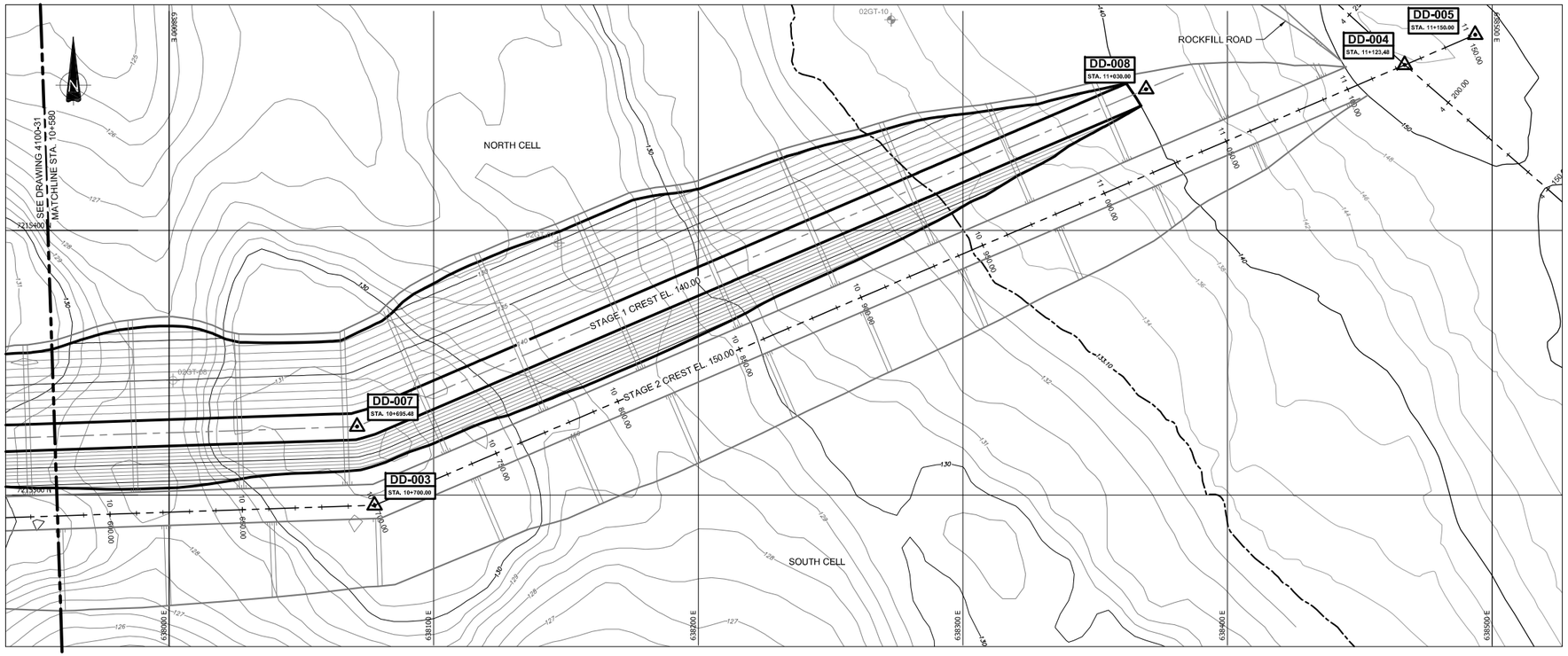
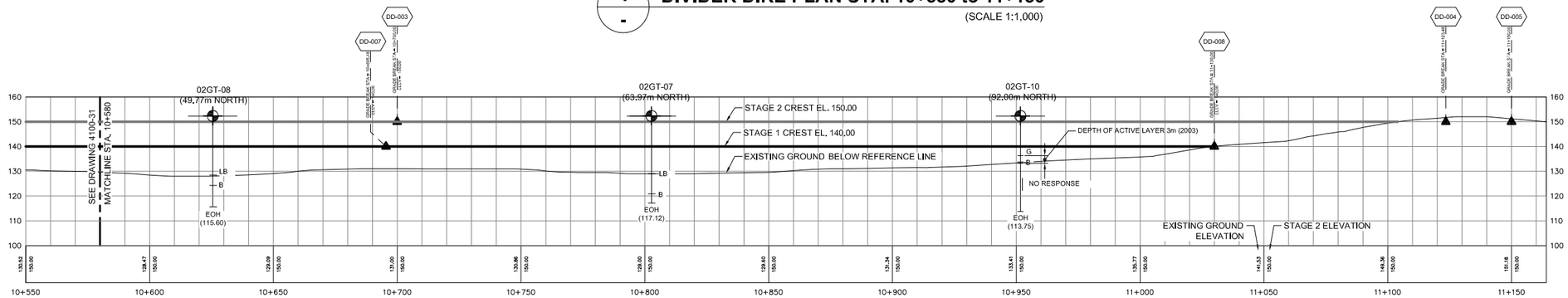


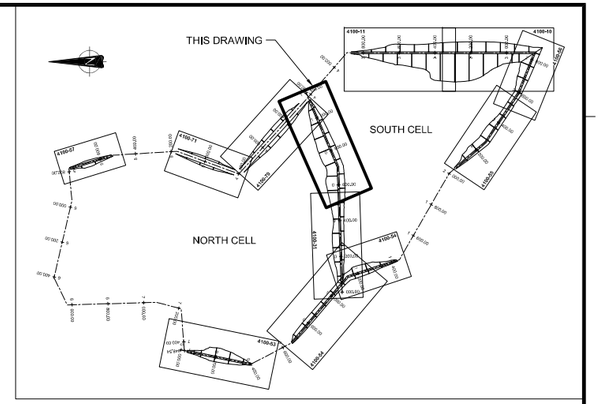
1 DIVIDER DIKE PLAN STA. 10+580 to 11+150

(SCALE 1:1,000)



2 DIVIDER DIKE PROFILE STA. 10+580 to 11+150

(SCALE 1:1,000)



KEY PLAN

NOT TO SCALE

SCALE IN METRES
1 : 1,000

NOTES

1) STAGE 1 ROCKFILL CREST IS OFFSET FROM DIVIDER DIKE REFERENCE LINE.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING LAKEBED AND BEDROCK ELEVATION IS CONSIDERED APPROXIMATE.
3) ROCKFILL FOR THE DIVIDER DIKE SHALL BE PAG OR NPAG.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
5) DWG. 4100-32 TO BE UPDATED WITH RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

LEGEND

- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- BOREHOLE COLLAR ELEVATION ADJUSTED FOR CLARITY.
- TSF-001 STA. 0+000.00 — CONTROL POINT
- 0 100 — STATIONS AND REFERENCE LINE
- 2x10 -5 — HYDRAULIC CONDUCTIVITY TEST INTERVAL WITH RESULTS IN m/s
- 03GT-SE-2 (150m North) — -BOREHOLE NAME -(OFFSET PERPENDICULAR TO REFERENCE LINE)
- EXISTING GROUND
- STAGE 1
- STAGE 2
- 133.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- BELOW 133.1 LAKEBED MINOR CONTOURS INTERVAL 0.5m
- LB — LAKEBED
- EOH — END OF HOLE
- B — BEDROCK
- G — GROUND SURFACE

DIVIDER DIKE CONTROL POINTS

	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
STAGE 1	DD-006	10+150.00	-30	7215307.66	637526.97	140.00
	DD-007	**10+695.48**	**-30**	**7215325.93**	**638072.14**	**140.00**
	DD-008	**11+030.00**	**-30**	**7215453.34**	**638369.21**	**140.00**
STAGE 2	DD-001	10+000.00	0	7215272.65	637378.06	150.00
	DD-002	10+048.13	0	7215274.26	637426.17	150.00
	DD-003	**10+700.00**	**0**	**7215296.10**	**638077.67**	**150.00**
	DD-004	**11+123.48**	**0**	**7215462.63**	**638467.03**	**150.00**
	DD-005	**11+150.00**	**0**	**7215474.04**	**638493.71**	**150.00**

DATA IN **BOLD** PRESENTED ON THIS DRAWING

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
DIVIDER DIKE ROCKFILL
PLAN AND PROFILE (2 of 2)

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

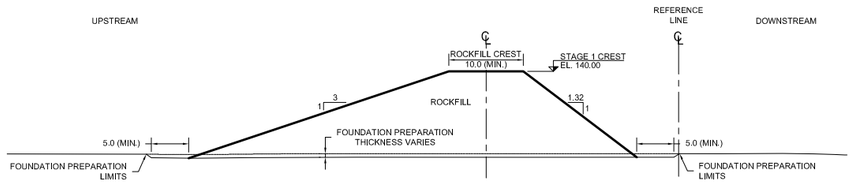
STAMP

ORIGINAL SIGNED

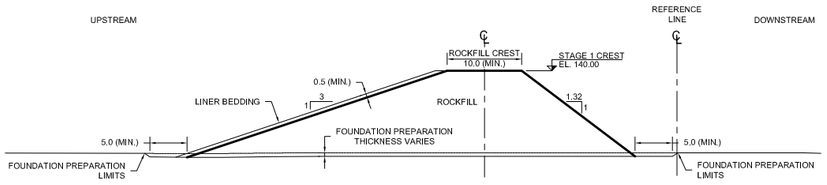
Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	10NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	21NOV08	4100-32		
CHECK					
REVIEW					

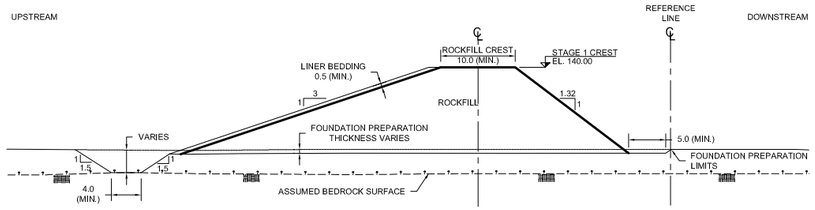
REVISION DATE: 08/12/17 01:38PM By: jkownacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800029-4100-32.dwg



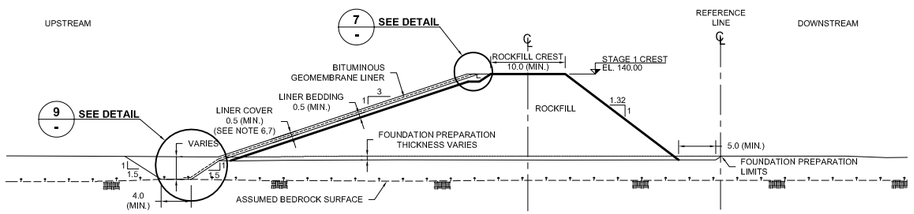
1 - TYPICAL CROSS-SECTION - STAGE 1 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



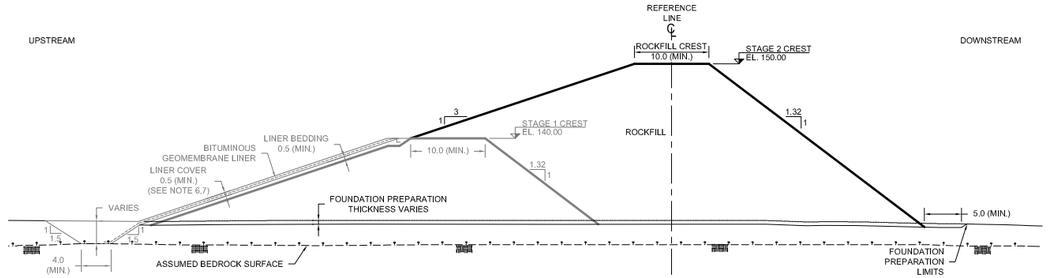
2 - TYPICAL CROSS-SECTION - STAGE 1 LINER BEDDING DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



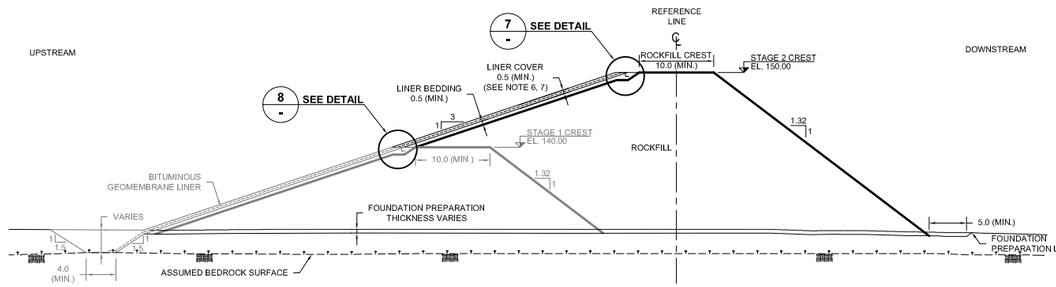
3 - TYPICAL CROSS-SECTION - STAGE 1 TRENCH EXCAVATION DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



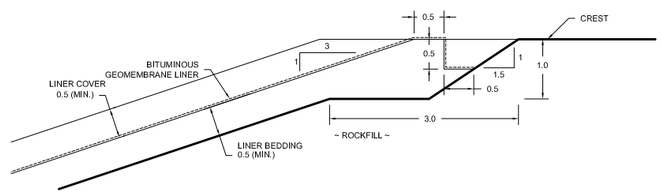
4 - TYPICAL CROSS-SECTION - STAGE 1 LINER AND LINER COVER PLACEMENT DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



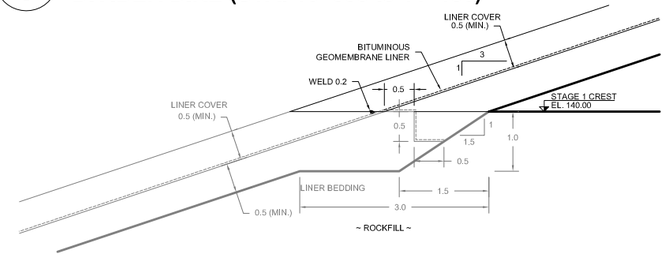
5 - TYPICAL CROSS-SECTION - STAGE 2 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:400)



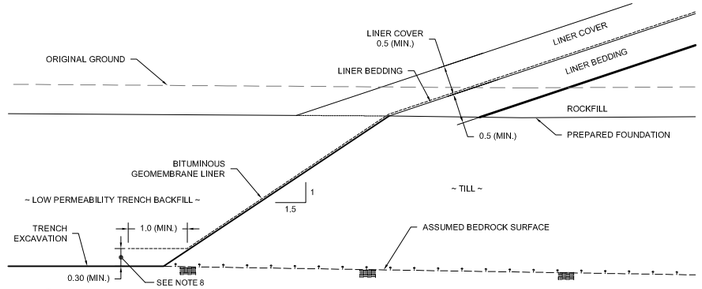
6 - TYPICAL CROSS-SECTION - STAGE 2 LINER PLACEMENT AND LINER COVER DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:400)



7 - DETAIL - BITUMINOUS GEOMEMBRANE LINER AT CREST DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:50)



8 - DETAIL - LINER RAISE DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:50)



9 - DETAIL - LINER TIE IN WITH TRENCH EXCAVATION DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:50)

0 4 8 12 16 20
SCALE IN METRES
1 : 400

0 0.5 1.0 1.5 2.0 2.5
SCALE IN METRES
1 : 50

LEGEND

- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- ASSUMED BEDROCK

NOTES

1) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD AFTER DEWATERING.
2) ACTUAL LIMITS OF FOUNDATION PREPARATION TO BE DETERMINED BASED ON CONDITIONS ENCOUNTERED IN THE FIELD AND AS DIRECTED BY THE ENGINEER.
3) THE PREPARED FOUNDATION SURFACES SHALL BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO PLACEMENT OF FILL MATERIALS.
4) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED BASED ON SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
5) TRENCH BACKFILL MATERIAL SUBJECT TO APPROVAL BY THE ENGINEER.
6) SEE LINER PLACEMENT, FILL PLACEMENT AND FOUNDATION PREPARATION SPECIFICATIONS LISTED ON DWG. 4100-00.
7) ADDITIONAL 2.0 m OF MATERIAL TO BE PLACED OVER LINER COVER ON DIVIDER DIKE (NOT SHOWN).
8) LINER BEDDING ON APPROVED SURFACE IN BASE OF TRENCH. MATERIAL PLACED BETWEEN BEDROCK AND LINER SUBJECT TO APPROVAL BY ENGINEER.
9) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
10) FURTHER GEOTECHNICAL INVESTIGATION REQUIRED.

REDUCED DRAWING NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. 4000-19 — REFERENCES — CONSTRUCTION STAGING OVERVIEW - STORMWATER DIKE

STAMP: ORIGINAL SIGNED

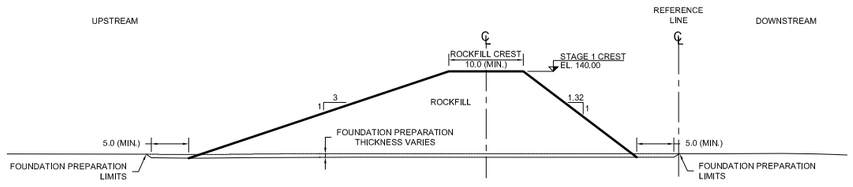
PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: TAILINGS STORAGE FACILITY
DIVIDER DIKE
CONSTRUCTION SEQUENCE

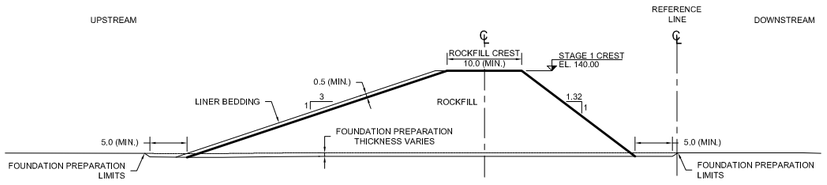
Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	14NOV08	SCALE	AS SHOWN	REV. A
CADD	DCB/JK	21NOV08	4100-33		
CHECK					
REVIEW					

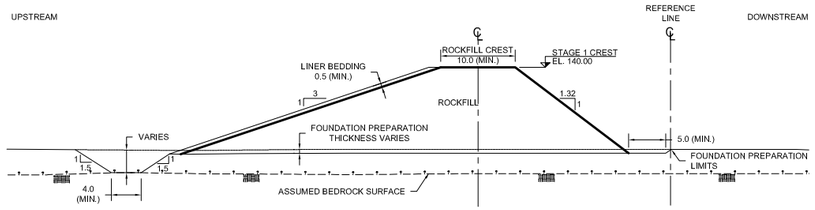
REVISION DATE: 08/12/17 01:39PM By: jkownacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800229-4100-33.dwg



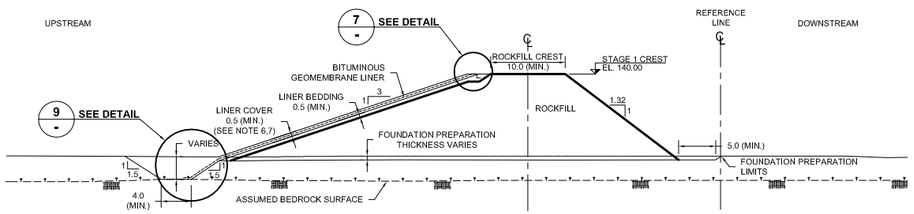
1 - TYPICAL CROSS-SECTION - STAGE 1 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



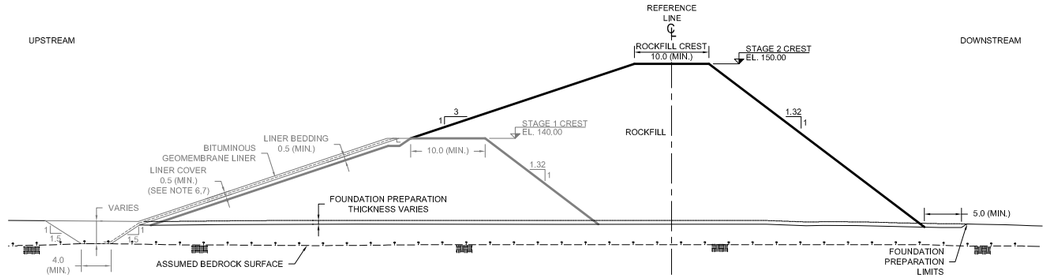
2 - TYPICAL CROSS-SECTION - STAGE 1 LINER BEDDING DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



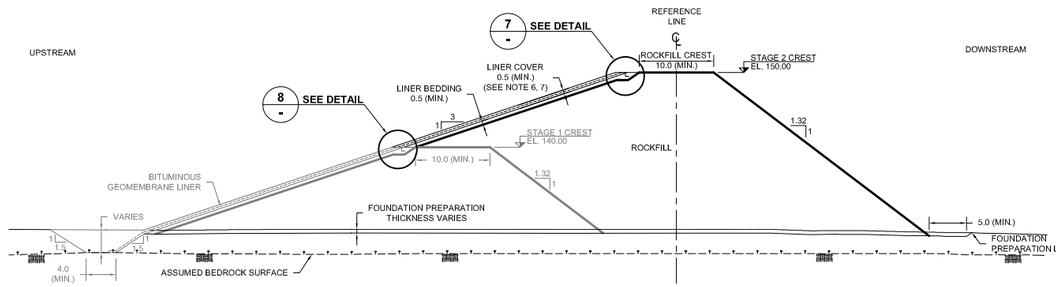
3 - TYPICAL CROSS-SECTION - STAGE 1 TRENCH EXCAVATION DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



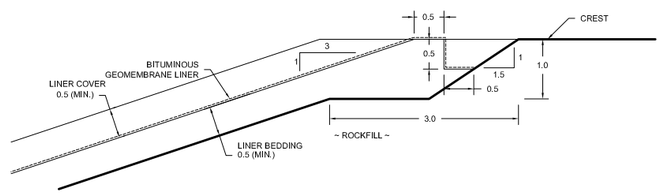
4 - TYPICAL CROSS-SECTION - STAGE 1 LINER AND LINER COVER PLACEMENT DIVIDER DIKE (STA. 10+150 to 11+030) (SCALE 1:400)



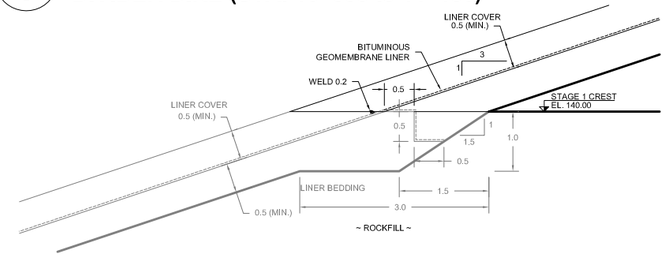
5 - TYPICAL CROSS-SECTION - STAGE 2 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:400)



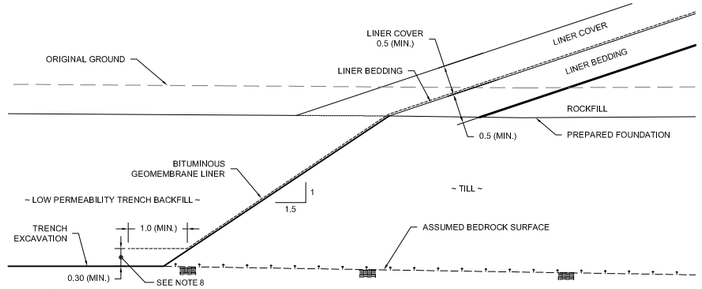
6 - TYPICAL CROSS-SECTION - STAGE 2 LINER PLACEMENT AND LINER COVER DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:400)



7 - DETAIL - BITUMINOUS GEOMEMBRANE LINER AT CREST DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:50)



8 - DETAIL - LINER RAISE DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:50)



9 - DETAIL - LINER TIE IN WITH TRENCH EXCAVATION DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1:50)

0 4 8 12 16 20
SCALE IN METRES
1 : 400

0 0.5 1.0 1.5 2.0 2.5
SCALE IN METRES
1 : 50

LEGEND

- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- ASSUMED BEDROCK

NOTES

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1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. 4000-19 — REFERENCES — CONSTRUCTION STAGING OVERVIEW - STORMWATER DIKE

STAMP: ORIGINAL SIGNED

PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: TAILINGS STORAGE FACILITY
DIVIDER DIKE
CONSTRUCTION SEQUENCE

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
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CADD	DCB/JK	21NOV08	4100-33		
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REVIEW					

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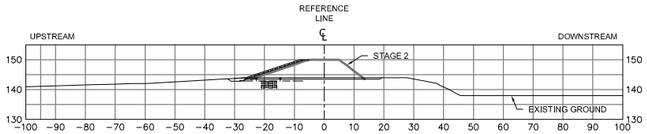

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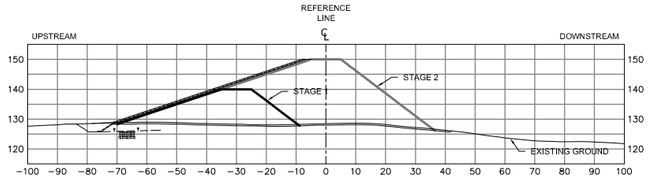

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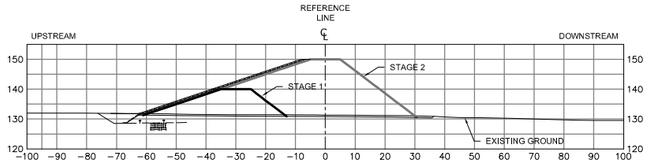

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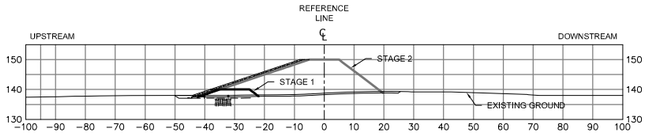

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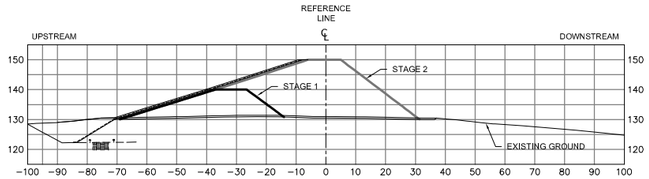

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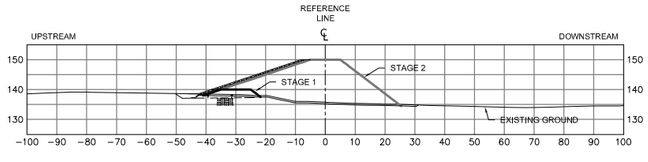
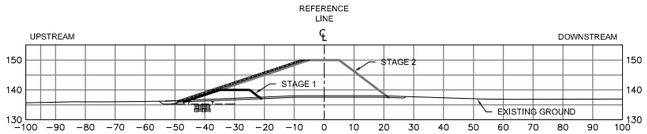


11+000



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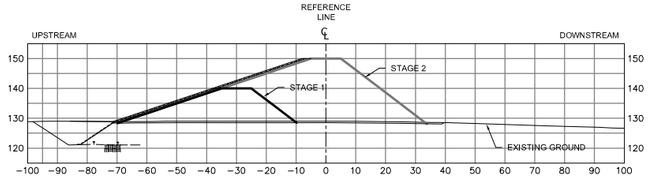

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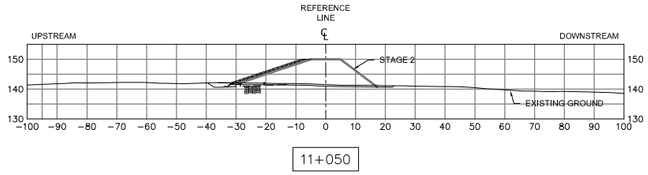

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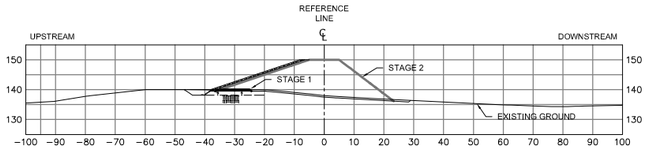

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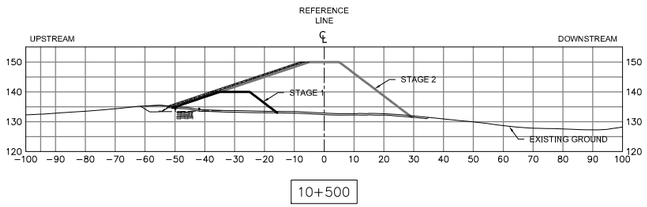

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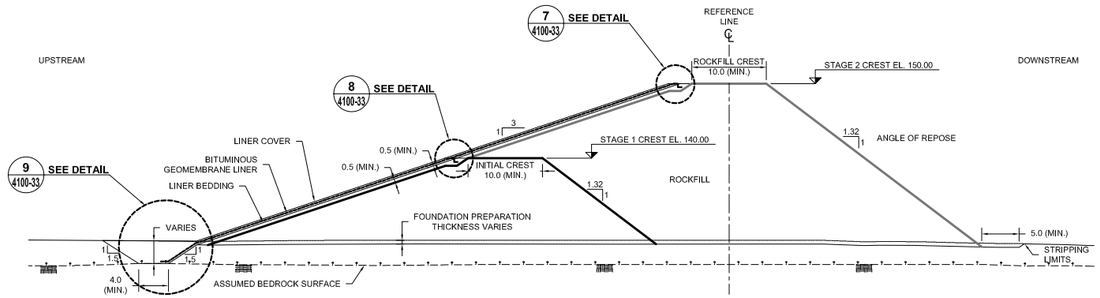

1 . TYPICAL CROSS-SECTION - STRIPPING AND ROCKFILL PLACEMENT DIVIDER DIKE (STA. 10+000 to 11+150) (SCALE 1 : 400)

ESTIMATED MATERIAL QUANTITY

CELL	STRUCTURE	STAGE	CREST ELEVATION	ROCKFILL VOLUME	COARSE FILTER VOLUME	LINER AREA	LINER COVER VOLUME	TRENCH EXCAVATION VOLUME	FOUNDATION PREPARATION AREA
			(masl)	m³	m³	m²	m³	m³	m²
NORTH CELL	DIVIDER DIKE	STAGE 1	140	143,400	8,460	23,600	10,100	27,400	38,900
		STAGE 2	150	544,600	13,940	28,800	14,100	1,100	47,500
		TOTAL		688,000	22,400	52,400	24,200	28,500	86,400

NOT FOR CONSTRUCTION

REDUCED DRAWING
NOT TO SCALE

0 4 8 12 16 20
SCALE IN METRES
1 : 400

0 10 20 30 40 50
SCALE IN METRES
1 : 1,000

LEGEND

- STAGE 1 ROCKFILL LIMIT
- STAGE 2 ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- EXISTING GROUND
- ASSUMED BEDROCK

NOTES

1) THIS DRAWING PROVIDES CROSS-SECTION INFORMATION FOR THE DIVIDER DIKE. STAGE 1 AND STAGE 2 DIKE CONSTRUCTION CONTROL POINT DETAILS PRESENTED ON DWG. 4100-31 AND 4100-32.
2) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATION AND TO BE CONFIRMED IN FIELD AFTER DEWATERING.
3) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED BASED ON SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION AS DIRECTED BY THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
4) TRENCH BACKFILL MATERIAL SUBJECT TO APPROVAL BY THE ENGINEER.
5) SEE FILL PLACEMENT, LINER PLACEMENT AND FOUNDATION PREPARATION SPECIFICATIONS LISTED ON DWG. 4100-00.
6) LINER BEDDING ON APPROVED SURFACE IN BASE OF TRENCH. MATERIAL PLACED BETWEEN BEDROCK AND LINER SUBJECT TO APPROVAL BY ENGINEER.
7) ADDITIONAL 2.0 m OF MATERIAL TO BE PLACED OVER LINER COVER ON DIVIDER DIKE (NOT SHOWN).
8) FURTHER GEOTECHNICAL INVESTIGATION REQUIRED.
9) LINER AREA DOES NOT INCLUDE WASTE OR OVERLAP AT SEAMS.
10) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP

ORIGINAL SIGNED

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
DIVIDER DIKE CROSS-SECTIONS AND QUANTITIES

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.	
DESIGN	BW	12NOV08	SCALE	AS SHOWN
CADD	JK	20NOV08	REV.	A
CHECK			4100-34	
REVIEW				

REVISION DATE: 08/12/17 10:58AM By: ASalvador
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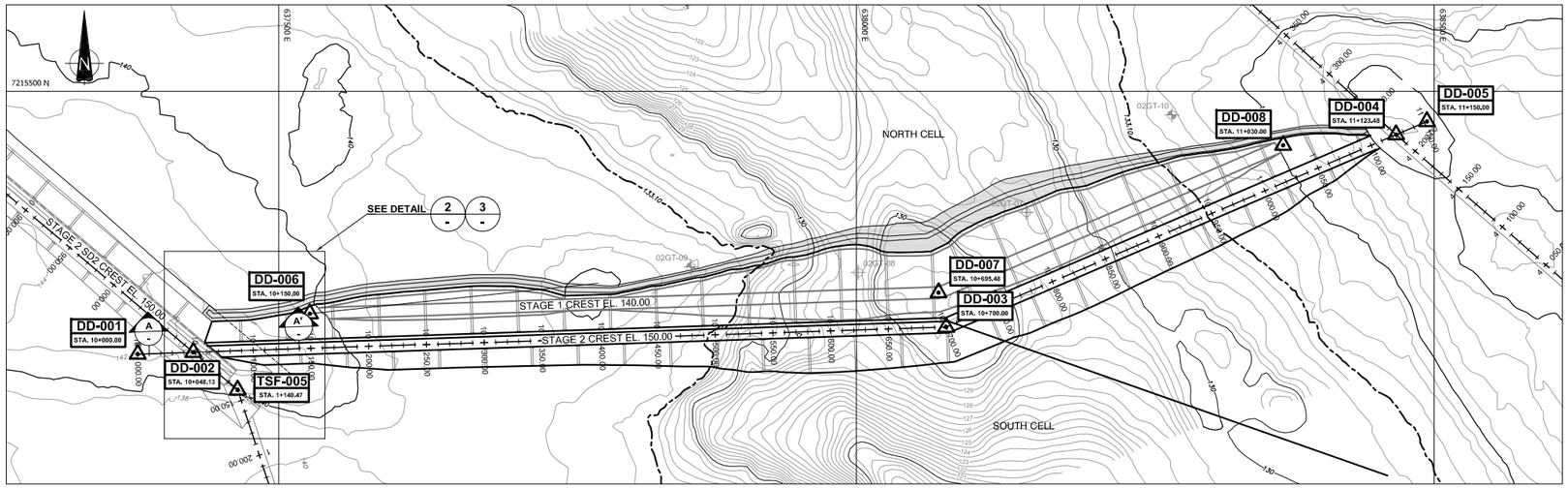
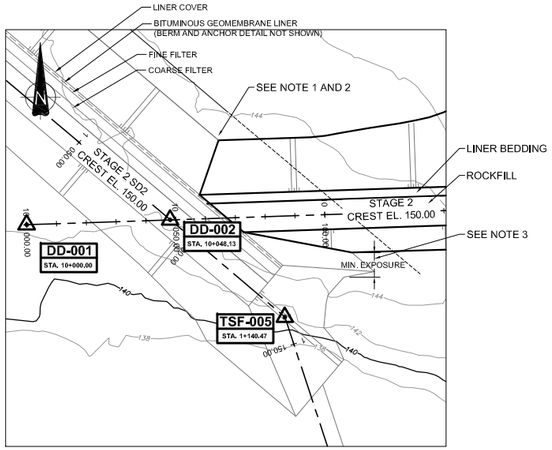


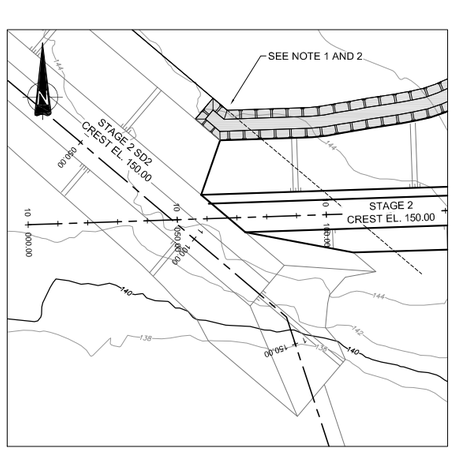
1 - DIVIDER DIKE AND SADDLE DAM 2 CONNECTION

(SCALE 1:2,500)



2 - DIVIDER DIKE FILL PLACEMENT

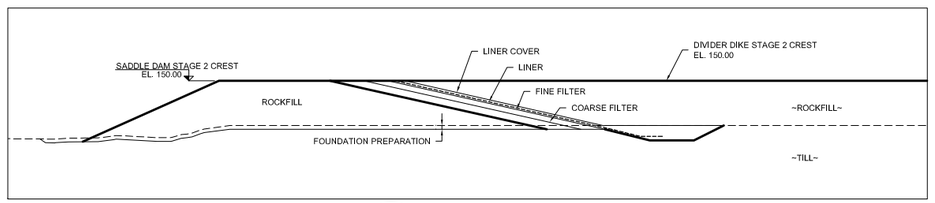
(SCALE 1:1,000)



3 - DIVIDER DIKE TRENCH TIE-IN

(SCALE 1:1,000)

DIVIDER DIKE CONTROL POINTS						
	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
STAGE 1	DD-006	10+150.00	-30	7215307.66	637526.97	140.00
	DD-007	10+695.48	-30	7215325.93	638072.14	140.00
	DD-008	11+030.00	-30	7215453.34	638369.21	140.00
STAGE 2	DD-001	10+000.00	0	7215272.65	637378.06	150.00
	DD-002	10+048.13	0	7215274.26	637426.17	150.00
	DD-003	10+700.00	0	7215296.10	638077.67	150.00
	DD-004	11+123.48	0	7215462.63	638467.03	150.00
	DD-005	11+150.00	0	7215474.04	638493.71	150.00



A - SECTION A-A'

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0 10 20 30 40 50 SCALE IN METRES 1 : 1,000

0 4 8 12 16 20 SCALE IN METRES 1 : 400

LEGEND

- DD-001 STA. 10+000.00 — CONTROL POINT
- 100 / 10 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- BOREHOLES
- BOREHOLES WITH THERMISTOR
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- 3,3,10 — FORMER SHORELINE
- BITUMINOUS GEOMEMBRANE LINER
- DIVIDER DIKE TRENCH

NOTES

1) DIVIDER DIKE STAGE 2 TO BE BUILT AFTER SADDLE DAM 2 (SD2) CONSTRUCTION INCLUDING LINER AND COVER INSTALLATION.
2) EXPOSURE OF SD2 LINER TO BE DONE BY HAND.
3) LINER OF SD2 WILL EXTEND A MINIMUM OF 5m BEYOND THE DIVIDER DIKE TO ALLOW TIE IN WITH SD3.
4) SEAMS IN THE LINER AT THE JOIN SHALL RUN DOWN THE SLOPE, NOT ACROSS THE SLOPE.
5) ROCKFILL FOR THE DIVIDER DIKE WILL BE PAG OR NPAG.
6) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REDUCED DRAWING NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
0	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP: ORIGINAL SIGNED

PROJECT: AEM — AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: TAILINGS STORAGE FACILITY
DIVIDER DIKE
SADDLE DAM CONNECTION DETAIL

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	01DEC08	SCALE	AS SHOWN	REV. A
CADD	DCB/JK	05DEC08	4100-35		
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REVIEW					

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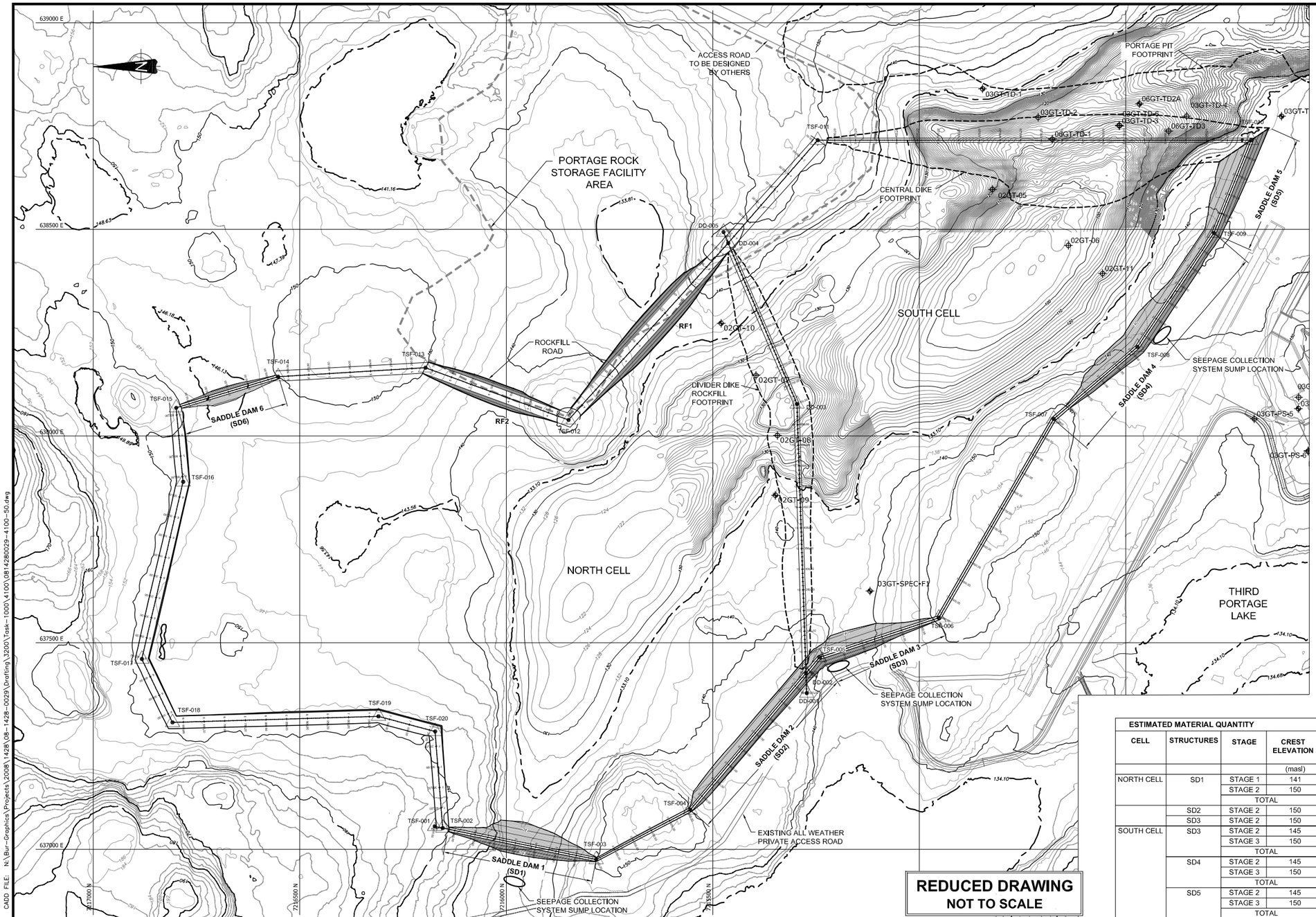

LEGEND

- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- LAKEBED TOPOGRAPHIC CONTOURS AS SHOWN
- 133.10 — FORMER SHORELINE
- DIKE/PIT FOOTPRINT
- 03GT-GI-7 BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 BOREHOLE

LEGEND

1) ESTIMATED QUANTITIES FOR LINER DOES NOT INCLUDE ANY OVERLAP.
2) THE ROCKFILL FOOTPRINT FOR THE SADDLE DAMS DOES NOT INCLUDE ANY FOUNDATION PREPARATION. THE ESTIMATED QUANTITY FOR TRENCH EXCAVATION IS BASED ON ASSUMED BEDROCK DEPTHS.
3) REFERENCE SHOULD BE MADE TO THE GEOTECHNICAL REPORTS FOR RECORD OF BOREHOLE AND TEST PIT LOG SHEETS. THE BOREHOLE AND TEST PIT DATA AND THE INFORMATION GIVEN IN THE GEOTECHNICAL REPORTS ARE BELIEVED TO BE CORRECT AND IS AVAILABLE FOR THE ASSISTANCE OF THE CONTRACTOR, WHO SHALL BE SOLELY RESPONSIBLE FOR THE INTERPRETATION OF THIS INFORMATION.
4) SEEPAGE COLLECTION SYSTEM SHOWN FOR INFORMATION PURPOSES ONLY. SEQUENCE CONSTRUCTION AND DETAILED DESIGN TO BE ADDRESSED UNDER SEPARATE COVER.
5) REFER TO DWG. 4100-53 TO 4100-57 FOR STAGE 1, STAGE 2 AND STAGE 3 SADDLE DAM CONTROL POINTS.
6) ROCKFILL FOR SADDLE DAMS WILL BE NPAG.
7) SADDLE DAM ROCKFILL SHOWN ON PLAN. DIVIDER DIKE AND CENTRAL DIKE FOOTPRINTS ARE FOR ROCKFILL ONLY.
8) PORTAGE ROCK STORAGE FACILITY TO BE UPDATED BY OTHERS.
9) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

TAILINGS STORAGE FACILITY CONTROL POINTS

POINT ID	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION (masl)
TSF-001	0+000.00	0	7216173.40	637055.54	150.00
TSF-002	0+020.00	0	7216153.81	637051.53	150.00
TSF-003	0+399.04	0	7215782.48	636975.46	150.00
TSF-004	0+656.68	0	7215554.57	637095.60	150.00
DD-002	1+090.09	0	7215274.26	637426.17	150.00
TSF-005	1+140.47	0	7215241.68	637464.59	150.00
TSF-006	1+444.75	0	7214952.77	637560.11	150.00
TSF-007	2+000.73	0	7214674.55	638041.46	150.00
TSF-008	2+267.91	0	7214471.89	638215.57	150.00
TSF-009	2+600.11	0	7214286.71	638491.38	150.00
TSF-010	2+842.18	0	7214196.45	638715.97	150.00
TSF-011	3+981.75	0	7215246.03	638715.99	150.00
DD-004	4+221.74	0	7215462.63	638467.03	150.00
TSF-012	4+798.82	0	7215849.39	638039.01	150.00
TSF-013	5+167.22	0	7216195.63	638165.46	150.00
TSF-014	5+524.84	0	7216552.58	638143.59	150.00
TSF-015	5+782.72	0	7216799.24	638068.38	150.00
TSF-016	5+962.46	0	7216782.52	637889.42	150.00
TSF-017	6+402.91	0	7216882.39	637460.44	150.00
TSF-018	6+573.16	0	7216808.33	637307.15	150.00
TSF-019	7+072.10	0	7216309.60	637321.79	150.00
TSF-020	7+214.12	0	7216172.37	637285.22	150.00

DIVIDER DIKE CONTROL POINTS

POINT ID	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION (masl)
DD-001	10+000.00	0	7215272.57	637378.06	150.00
DD-002	10+048.02	0	7215274.26	637426.17	150.00
DD-003	10+700.00	0	7215296.10	638077.67	150.00
DD-004	11+123.48	0	7215462.63	638467.03	150.00
DD-005	11+150.00	0	7215474.04	638493.71	150.00

ESTIMATED MATERIAL QUANTITY

CELL	STRUCTURES	STAGE	CREST ELEVATION	ROCKFILL VOLUME	FINE FILTER VOLUME	COARSE FILTER VOLUME	LINER AREA	LINER COVER VOLUME	TRENCH EXCAVATION VOLUME	FOUNDATION PREPARATION AREA
			(masl)	m^3	m^3	m^3	m^2	m^3	m^3	m^2
NORTH CELL	SD1	STAGE 1	141	16,600	1,960	2,080	3,050	1,340	1,930	8,780
		STAGE 2	150	93,100	7,580	7,640	8,920	3,530	2,570	15,900
		TOTAL		109,700	9,540	7,720	11,970	4,500	4,500	24,680
	SD2	STAGE 2	150	72,000	9,170	9,270	3,050	4,660	5,800	28,500
	SD3	STAGE 2	150	12,300	2,040	2,000	3,340	991	2,960	10,490
SOUTH CELL	SD3	STAGE 2	145	24,500	2,774	2,760	4,230	1,380	2,490	10,000
		STAGE 3	150	44,300	4,074	4,070	4,510	2,030	1,550	8,310
		TOTAL		68,800	6,848	6,830	8,740	3,410	4,040	18,310
	SD4	STAGE 2	145	37,100	6,100	6,270	8,620	3,140	3,560	19,000
		STAGE 3	150	73,900	6,350	6,390	7,080	3,190	1,130	12,500
		TOTAL		111,000	12,450	12,660	15,700	6,330	4,690	31,500
	SD5	STAGE 2	145	41,700	2,922	2,890	2,300	1,450	1,910	13,300
		STAGE 3	150	80,300	1,753	4,560	6,910	2,280	659	9,190
		TOTAL		122,000	4,675	7,450	9,210	3,730	2,569	22,490

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

ORIGINAL SIGNED

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
4000-18	STORMWATER DIKE AND SADDLE DAM LAYOUT					
DRAWING NO.	REFERENCES					
1	17DEC08	JEK	ISSUED FOR REVIEW	AS		

STAMP

PROJECT
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
SADDLE DAM
LAYOUT PLAN AND QUANTITIES

Golder Associates

PROJECT No.	08-1428-0029/3200	FILE No.	
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CADD	AS 24NOV08	REV.	A
CHECK		4100-50	
REVIEW			

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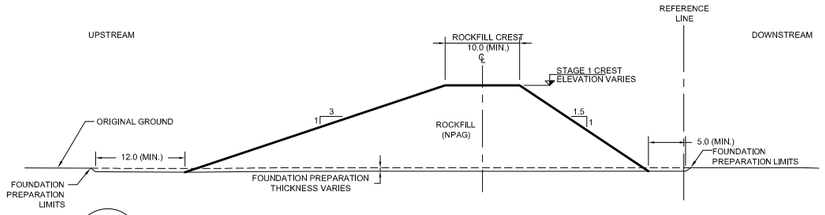

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STAGE 1 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT SADDLE DAMS
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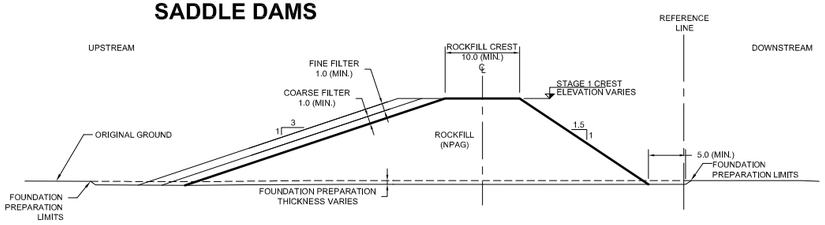

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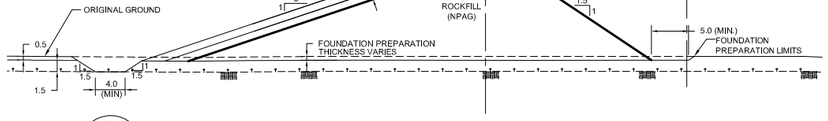
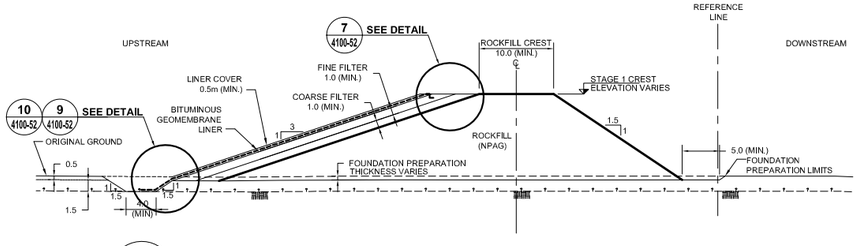
STAGE 1 FILTER PLACEMENT SADDLE DAMS
(SCALE 1:400)



3 - TYPICAL CROSS-SECTION
STAGE 1 TRENCH EXCAVATION SADDLE DAMS
(SCALE 1:400)



4 - TYPICAL CROSS-SECTION
STAGE 1 LINER AND LINER COVER PLACEMENT SADDLE DAMS
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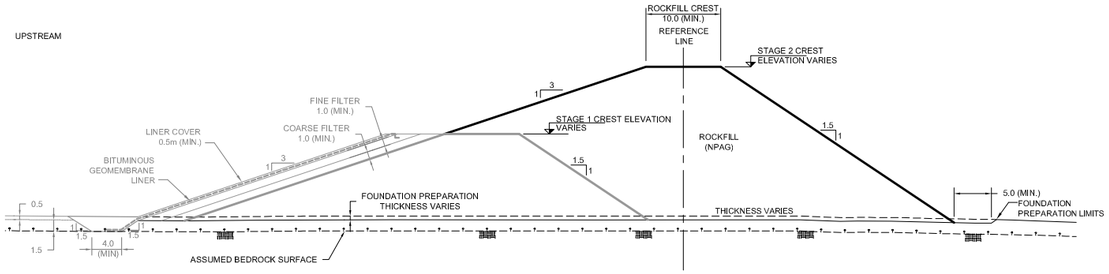
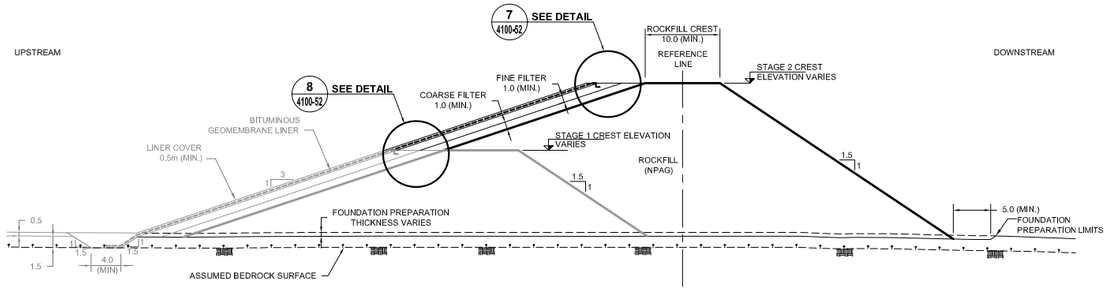


5 - TYPICAL CROSS-SECTION
STAGE 2 FOUNDATION PREPARATION AND ROCKFILL PLACEMENT SADDLE DAMS
(SCALE 1:400)



6 - TYPICAL CROSS-SECTION
STAGE 2 LINER AND LINER COVER PLACEMENT SADDLE DAMS
(SCALE 1:400)

LEGEND

- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- ASSUMED BEDROCK

NOTES

1) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION ON LIMITED INVESTIGATION INFORMATION. CONTRACTOR TO CONFIRM IN FIELD.
2) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED IN THE FIELD TO SUIT SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
3) TRENCH BACKFILL MATERIAL SUBJECT TO APPROVAL BY THE ENGINEER.
4) ACTUAL LIMITS OF FOUNDATION PREPARATION TO BE DETERMINED BASED ON CONDITIONS ENCOUNTERED IN THE FIELD AND AS DIRECTED BY THE ENGINEER.
5) THE PREPARED FOUNDATION SURFACES SHALL BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO PLACEMENT OF FILL MATERIALS.
6) SEE BITUMINOUS GEOMEMBRANE LINER, FILL PLACEMENT AND FOUNDATION PREPARATION SPECIFICATION LISTED ON DWG 4100-00.
7) STAGE 1 ROCKFILL CREST IS OFFSET FROM THE TSF REFERENCE LINE.
8) EXPOSURE OF LINER TO BE DONE BY HAND.
9) ADDITIONAL 2.0m OF ROCKFILL (ANY TYPE) OR TILL MATERIAL TO BE PLACED ON THE LINER COVER AT SADDLE DAM 3 (SD3) DURING STAGE 2 SOUTH CELL CONSTRUCTION.
10) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REDUCED DRAWING
NOT TO SCALE

0 4 8 12 16 20
SCALE IN METRES
1 : 400

NOT FOR CONSTRUCTION

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REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO.	REFERENCES
4000-20	CONSTRUCTION STAGING OVERVIEW SADDLE DAM

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ORIGINAL SIGNED

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
SADDLE DAM CONSTRUCTION SEQUENCE

Golder Associates

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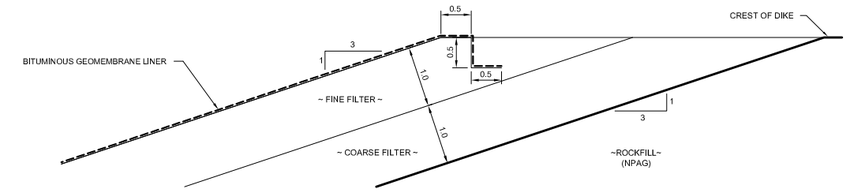
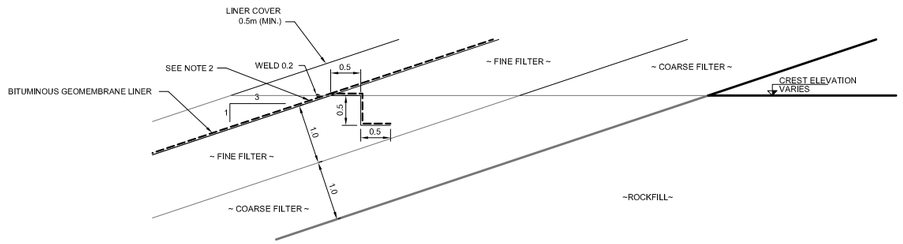
REVIEW				



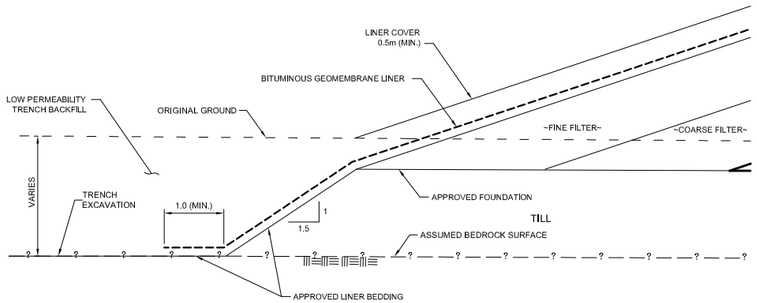
7 - DETAIL - BITUMINOUS GEOMEMBRANE LINER ANCHOR TRENCH DETAIL SADDLE DAMS

(SCALE 1:50)



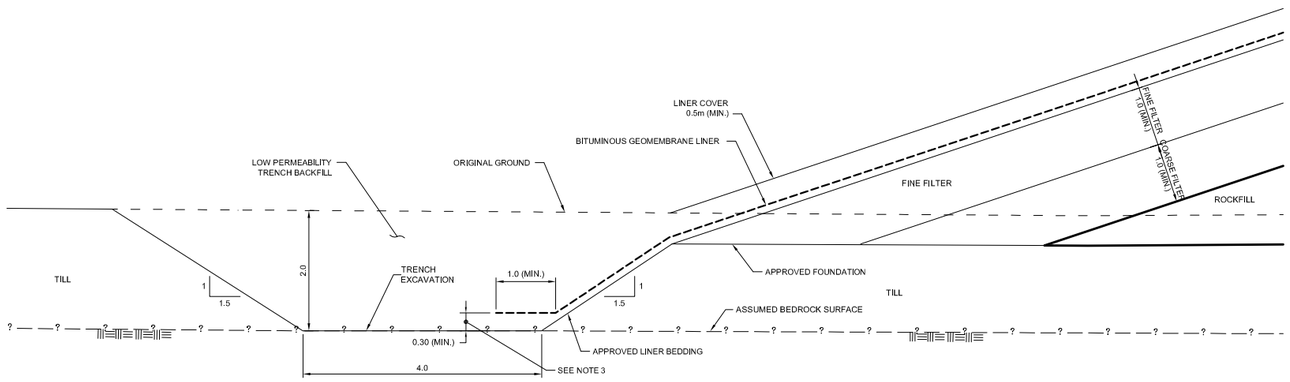
8 - DETAIL - LINER RAISE DETAIL SADDLE DAMS

(SCALE 1:50)



9 - DETAIL - LINER TIE IN TO BEDROCK SADDLE DAMS

(SCALE 1:50)



10 - DETAIL - LINER TIE IN TO CUT-OFF TRENCH SADDLE DAMS

(SCALE 1:50)

LEGEND

- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- EXISTING GROUND
- ASSUMED BEDROCK

NOTES

1) ADDITIONAL 2.0m OF ROCKFILL (ANY TYPE) OR TILL MATERIAL TO BE PLACED ON THE LINER COVER AT SADDLE DAM 3 (SD3) DURING STAGE 2 SOUTH CELL CONSTRUCTION.
2) EXPOSURE OF LINER TO BE DONE BY HAND.
3) LINER BEDDING ON APPROVED SURFACE IN BASE OF TRENCH. MATERIAL PLACED BETWEEN BEDROCK AND LINER SUBJECT TO APPROVAL BY ENGINEER.
4) CONFIGURATION OF CUT-OFF TRENCH TO BE ADJUSTED IN THE FIELD TO SUIT SOIL CONDITIONS ENCOUNTERED IN THE EXCAVATION AS DIRECTED BY THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR TRENCH EXCAVATION AND TRENCH STABILITY.
5) TRENCH BACKFILL MATERIAL SUBJECT TO APPROVAL BY THE ENGINEER.
6) SEE LINER PLACEMENT, FILL PLACEMENT AND FOUNDATION PREPARATION SPECIFICATION LISTED ON DWG 4100-00.
7) REFER TO DWGS. 4100-02 FOR ADDITIONAL NOTES.

REDUCED DRAWING
NOT TO SCALE

0 0.5 1.0 1.5 2.0 2.5
SCALE IN METRES
1 : 50

NOT FOR CONSTRUCTION

REVISION DATE:	CADD FILE:	By:
08/12/17 12:16PM	N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800029-4100-52.dwg	ASalvador

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP

ORIGINAL SIGNED

PROJECT

AEM

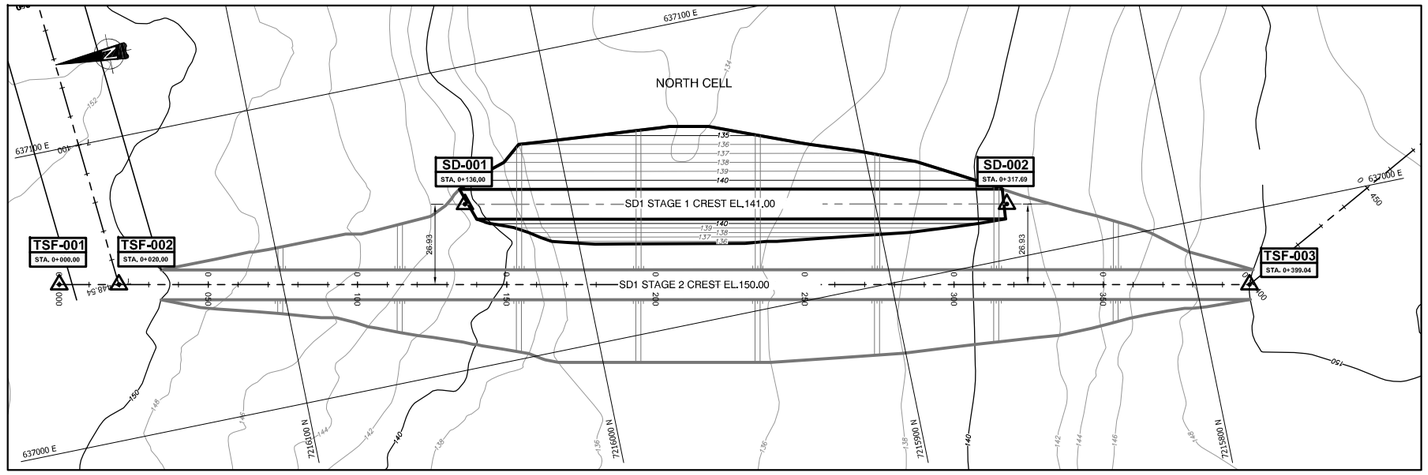
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
SADDLE DAM
LINER DETAILS

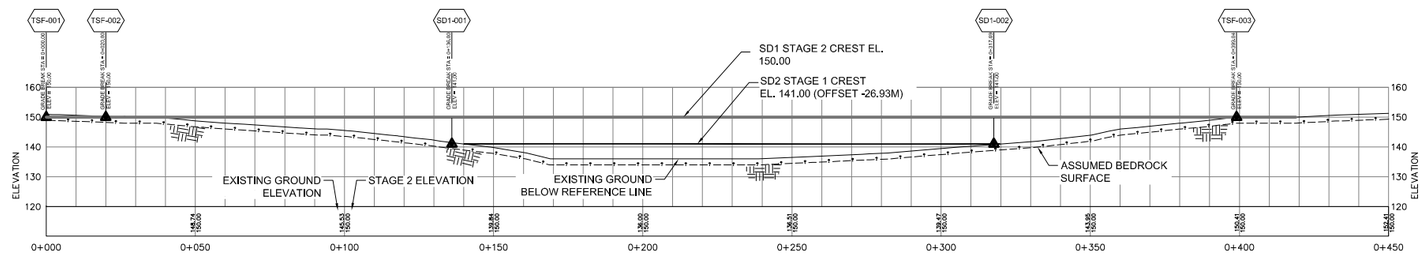
Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	DCB/JK	20NOV08			
CHECK			4100-52		
REVIEW					



1 - SADDLE DAM 1 PLAN STA. 0+000 to 0+450

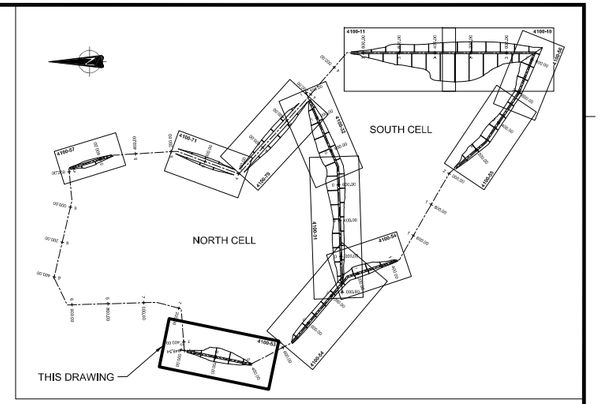
(SCALE 1:1,000)



2 - SADDLE DAM 1 PROFILE STA. 0+000 to 0+450

(SCALE 1:1,000)

SADDLE DAM 1 CONTROL POINTS							
CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
NORTH CELL	STAGE 1	SD1-001	0+136.00	26.93	7216034.67	637054.58	141.00
		SD1-002	0+317.69	26.93	7215856.74	637018.20	141.00
	STAGE 2	TSF-001	0+000.00	0	7216173.40	637055.54	150.00
		TSF-002	0+020.00	0	7216153.81	637051.53	150.00
		TSF-003	0+399.04	0	7215782.48	636975.46	150.00



KEY PLAN

NOT TO SCALE

0 10 20 30 40 50

SCALE IN METRES

1 : 1,000

LEGEND

- TSF-010 / STA. 2+842.18 — CONTROL POINT
- 2 + 850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 1
- STAGE 2
- ASSUMED BEDROCK SURFACE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m

NOTE

1. CENTRELINE OF ROCKFILL CREST FOR INITIAL STAGES IS OFFSET FROM THE TSF REFERENCE LINE.
2. GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE ARE CONSIDERED APPROXIMATE.
3. ROCKFILL FOR THE SADDLE DAMS SHALL BE NPAG.
4. REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

STAMP

ORIGINAL SIGNED

PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
SADDLE DAM
ROCKFILL PLAN AND PROFILE (1 of 5)

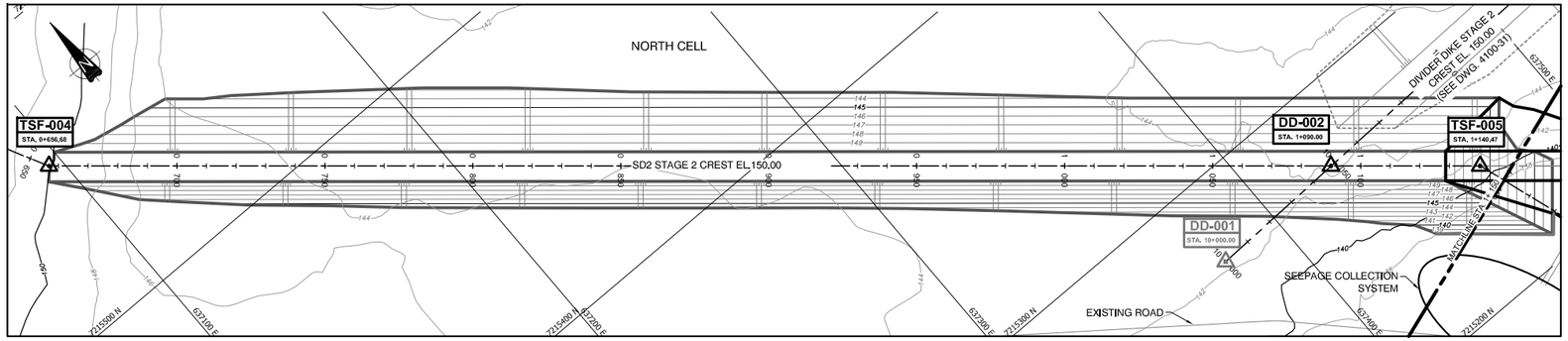
Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.
DESIGN	JEK/BW	20NOV08	SCALE AS SHOWN / REV. A
CADD	JK	20NOV08	4100-53
CHECK			
REVIEW			

4000-21 — DRAWING NO.

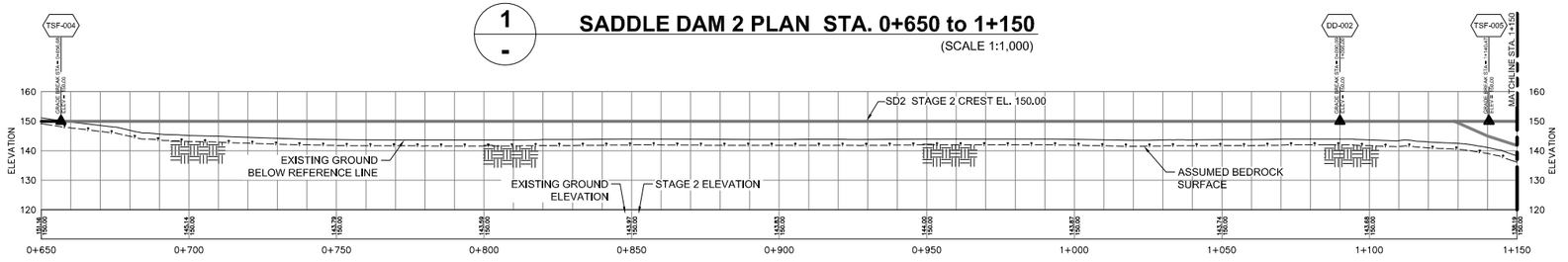
ROCKFILL PLACEMENT PLAN — REFERENCES

REVISION DATE: 08/12/15 01:16PM By: jkowacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800029-4100-53.dwg



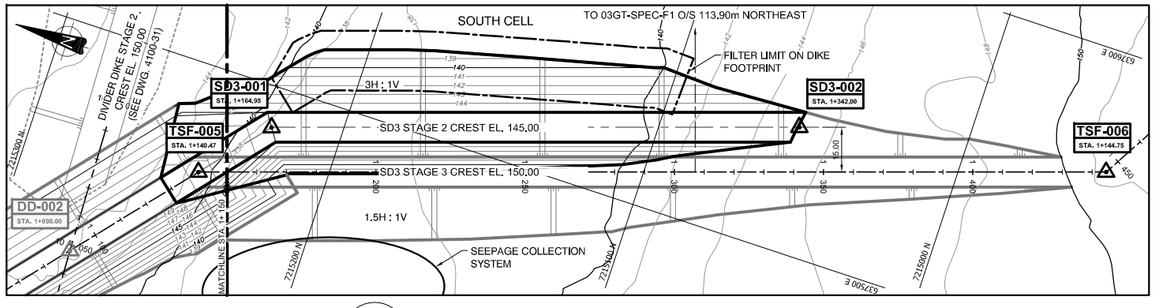
1 - SADDLE DAM 2 PLAN STA. 0+650 to 1+150

(SCALE 1:1,000)



2 - SADDLE DAM 2 PROFILE STA. 0+650 to 1+150

(SCALE 1:1,000)



3 - SADDLE DAM 3 PLAN STA. 1+150 to 1+450

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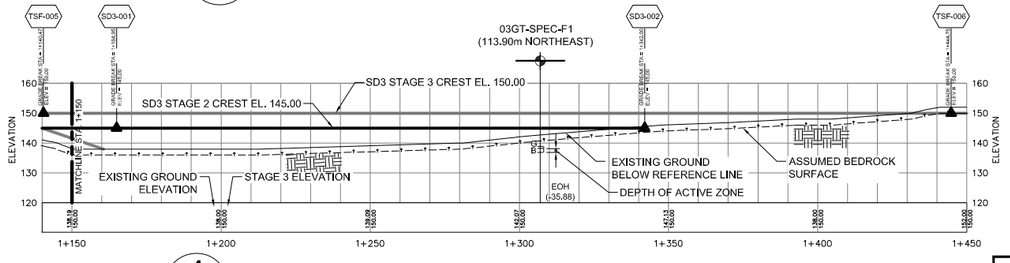
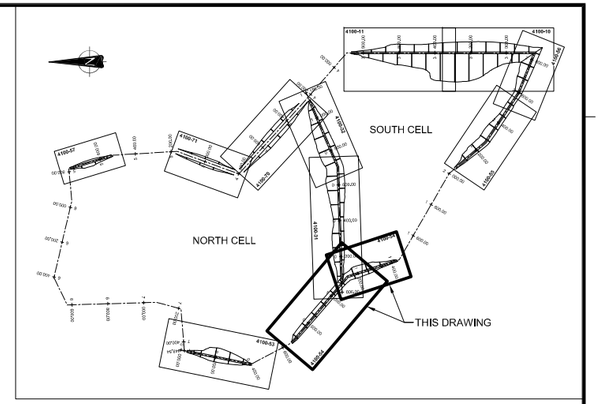


4 - SADDLE DAM 3 PROFILE STA. 1+150 to 1+450

(SCALE 1:1,000)



KEY PLAN

NOT TO SCALE

0 10 20 30 40 50
SCALE IN METRES
1 : 1,000

LEGEND

- TSF-010 STA. 2+842.18 — CONTROL POINT
- 2+850 — STATIONS AND REFERENCE LINE
- BOREHOLES
- EXISTING GROUND
- STAGE 2
- STAGE 3
- FILTER LIMIT ON DIKE FOOTPRINT
- ASSUMED BEDROCK SURFACE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- BOREHOLE COLLAR ELEVATION ADJUSTED FOR CLARITY.

NOTES

1. CENTRELINE OF ROCKFILL CREST FOR INITIAL STAGES IS OFFSET FROM THE TSF REFERENCE LINE.
2. GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE ARE CONSIDERED APPROXIMATE.
3. ROCKFILL FOR THE SADDLE DAMS SHALL BE NPAG.
4. REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.
5. FOR SADDLE DAM 3 (SD3) FILTER ON LAKEBED EXTENDED DOWNSTREAM BY: 10m BELOW ELEVATION 141m.

SADDLE DAM 2 AND 3 CONTROL POINTS

CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
NORTH CELL	STAGE 2	TSF-004	0+656.68	0	7215554.57	637095.60	150.00
		DD-002	10+090.00	0	7215274.26	637426.17	150.00
		TSF-005	1+140.47	0	7215241.68	637464.59	150.00
SOUTH CELL	STAGE 2	SD3-001	1+164.95	15.00	7216034.67	637054.58	145.00
		SD3-002	1+342.00	15.00	7215856.74	637018.20	145.00
	STAGE 3	TSF-005	1+140.47	0	7215241.68	637464.59	150.00
		TSF-006	1+444.75	0	7214952.77	637560.11	150.00

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

STAMP

ORIGINAL SIGNED

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
SADDLE DAM
ROCKFILL PLAN AND PROFILE (2 OF 5)

Golder Associates

PROJECT No.	08-1428-0029/3200	FILE No.	
DESIGN	BW 20NOV08	SCALE	AS SHOWN REV. A
CADD	JK 20NOV08		
CHECK			4100-54
REVIEW			

4000-21 — DRAWING NO.
ROCKFILL PLACEMENT PLAN — REFERENCES

REVISION DATE: 08/12/17 11:17AM By: jkownacki
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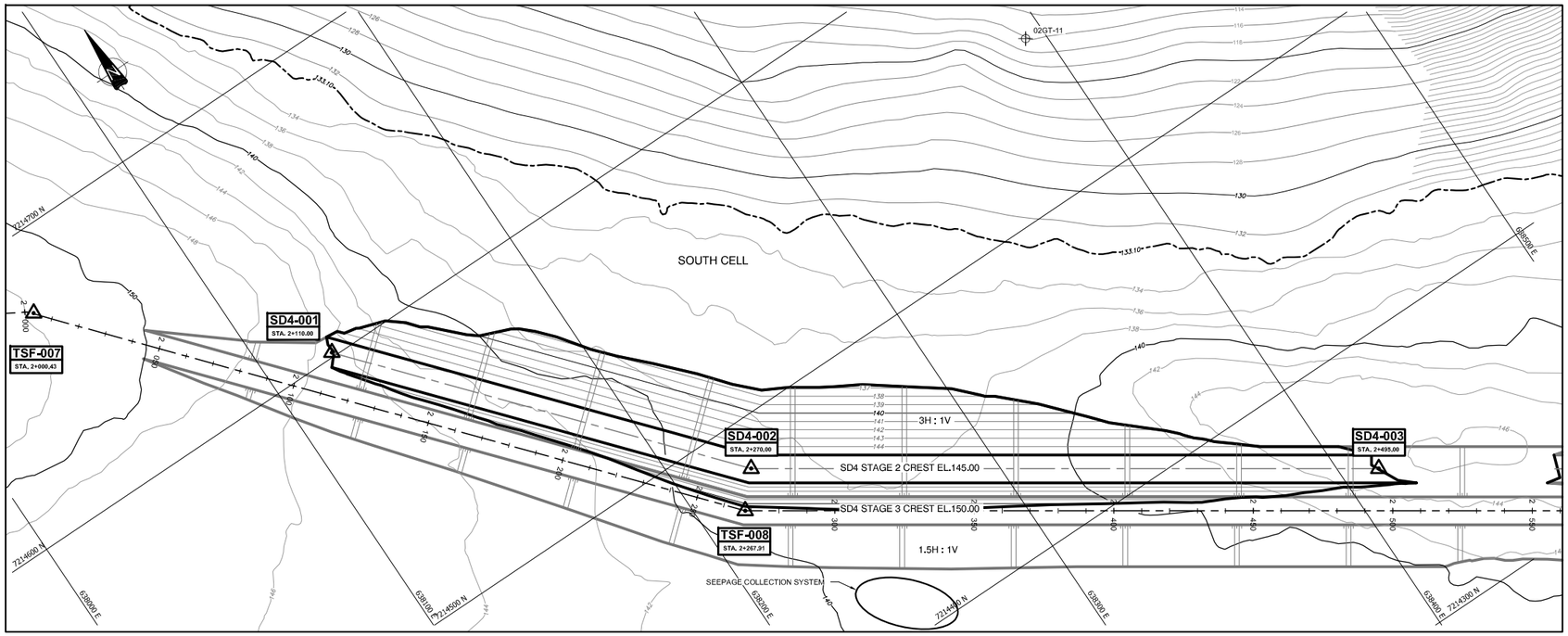
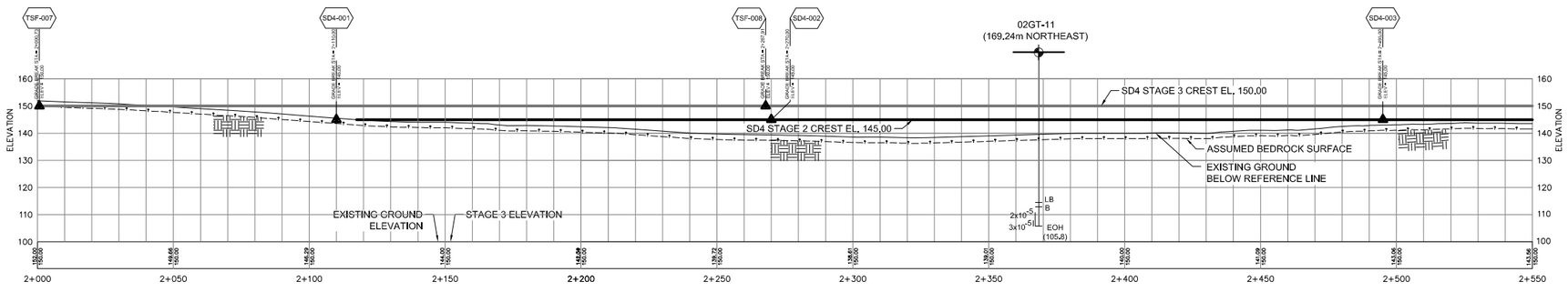


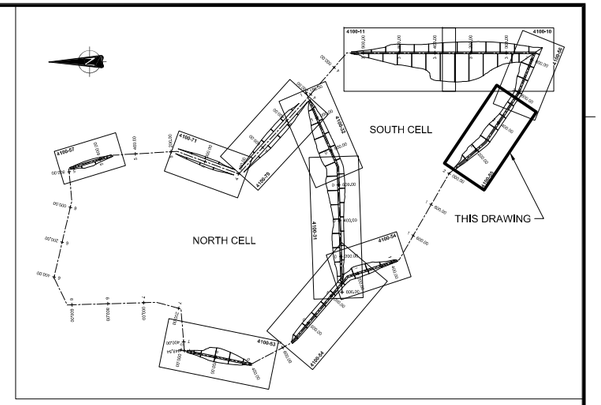
1 / - SADDLE DAM 4 PLAN STA. 2+000 to 2+550

(SCALE 1:1,000)



2 / - SADDLE DAM 4 PROFILE STA. 2+000 to 2+550

(SCALE 1:1,000)



KEY PLAN

NOT TO SCALE

SCALE IN METRES
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1 : 1,000

LEGEND

- TSF-010 STA. 2+842.18 — CONTROL POINT
- 2+850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- BOREHOLES
- STAGE 2
- STAGE 3
- ASSUMED BEDROCK SURFACE
- 33.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- BOREHOLE COLLAR ELEVATION ADJUSTED FOR CLARITY.
- 2x10 -5 — HYDRAULIC CONDUCTIVITY TEST INTERVAL WITH RESULTS IN m/s
- 03GT-SE-2 (150m North) — -BOREHOLE NAME -(OFFSET PERPENDICULAR TO REFERENCE LINE)
- LB — LAKEBED
- EOH — END OF HOLE
- B — BEDROCK
- G — GROUND SURFACE

NOTE

1) CENTRELINE OF ROCKFILL CREST FOR INITIAL STAGES IS OFFSET FROM THE TSF REFERENCE LINE.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE ARE CONSIDERED APPROXIMATE.
3) ROCKFILL FOR THE SADDLE DAMS SHALL BE NPAG.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

SADDLE DAM CONTROL POINTS

CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
SOUTH CELL	STAGE 2	SD4-001	2+110.00	15.00	7214601.53	638124.15	145.00
		SD4-002	2+270.00	15.00	7214483.27	638225.76	145.00
		SD4-003	2+495.00	15.00	7214358.45	638411.59	145.00
	STAGE 3	TSF-007	2+000.73	0	7214674.55	638041.46	150.00
		TSF-008	2+267.91	0	7214357.86	638212.54	150.00

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	AS	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW				

STAMP

ORIGINAL SIGNED

4000-21 — DRAWING NO.
ROCKFILL PLACEMENT PLAN — REFERENCES

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
SADDLE DAM
ROCKFILL PLAN AND PROFILE (3 OF 5)

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	AS	20NOV08	4100-55		
CHECK					
REVIEW					

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By: jkownacki
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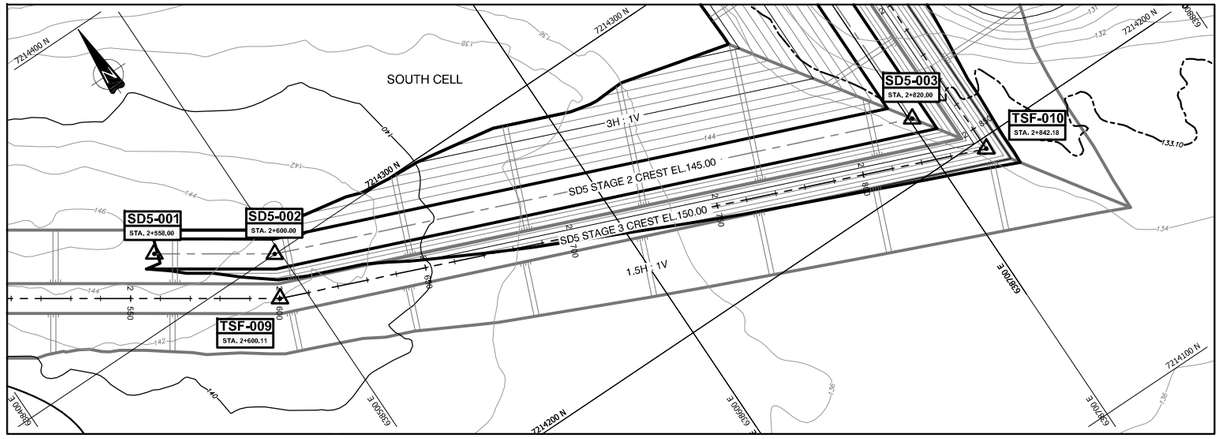
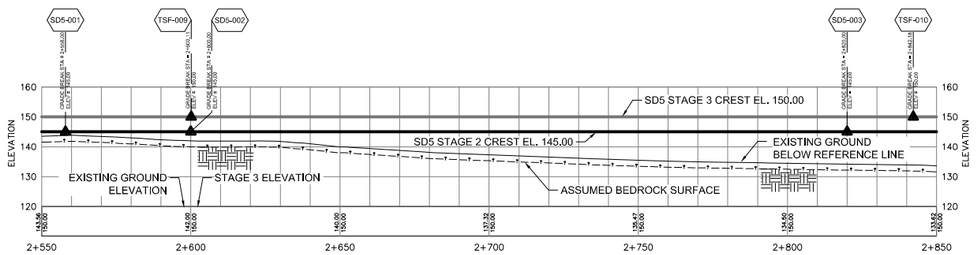
REVISION



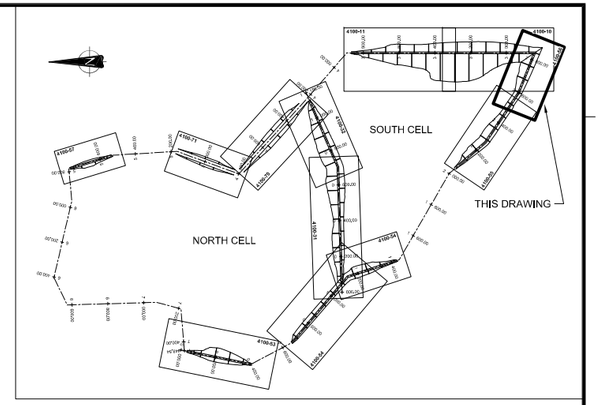
1 - SADDLE DAM 5 PLAN STA. 2+550 to 2+842

(SCALE 1:1,000)



2 - SADDLE DAM 5 PROFILE STA. 2+550 to 2+842

(SCALE 1:1,000)



KEY PLAN

NOT TO SCALE

0 10 20 30 40 50

SCALE IN METRES
1 : 1,000

LEGEND

- TSF-010 STA. 2+842.18 — CONTROL POINT
- 2 850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 2
- STAGE 3
- ASSUMED BEDROCK SURFACE
- 133.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m

NOTES

1) CENTRELINE OF ROCKFILL CREST FOR INITIAL STAGES IS OFFSET FROM THE TSF REFERENCE LINE.
2) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE ARE CONSIDERED APPROXIMATE.
3) ROCKFILL FOR THE SADDLE DAMS SHALL BE NPAG.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

SADDLE DAM SETOUT POINTS

CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
SOUTH CELL	STAGE 2	SD5-001	2+558.00	15.00	7214322.64	638464.78	145.00
		SD5-002	2+600.00	15.00	7214483.27	638225.76	145.00
		SD5-003	2+820.00	15.00	7214358.45	638411.59	145.00
	STAGE 3	TSF-009	2+600.11	0	7214286.71	638491.38	150.00
		TSF-010	2+842.18	0	7214196.45	638715.97	150.00

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
4000-21	ROCKFILL PLACEMENT PLAN	1	17DEC08 BW ISSUED FOR REVIEW	AS		
DRAWING NO.	REFERENCES					

STAMP

ORIGINAL SIGNED

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

TAILINGS STORAGE FACILITY
SADDLE DAM
ROCKFILL PLAN AND PROFILE (4 OF 5)

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
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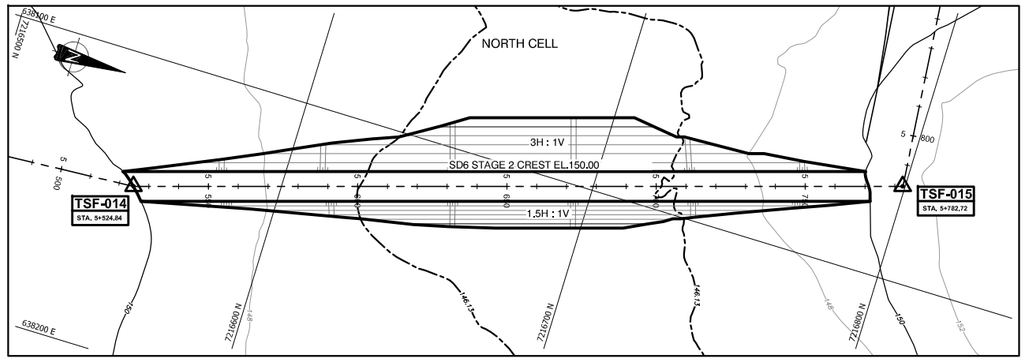
CHECK					
REVIEW					

REVISION DATE: 08/12/17 12:12PM By: jkownocki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800029-4100-56.dwg



1 - SADDLE DAM 6 PLAN STA. 5+500 to 5+800
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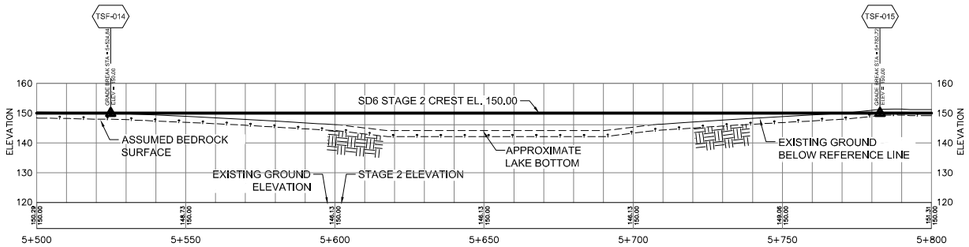
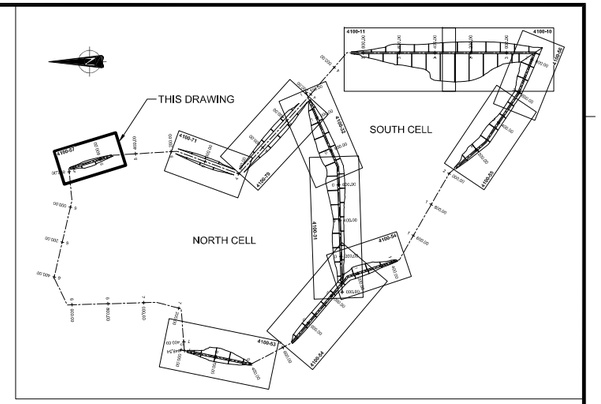


2 - SADDLE DAM 6 PROFILE STA. 5+500 to 5+800
(SCALE 1:1,000)



KEY PLAN
NOT TO SCALE

0 10 20 30 40 50
SCALE IN METRES
1 : 1,000

LEGEND

- TSF-010 / STA. 2+842.18 — CONTROL POINT
- 2 + 850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 2
- ASSUMED BEDROCK SURFACE
- 133.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m

NOTES

1) GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE ARE CONSIDERED APPROXIMATE.
2) ROCKFILL FOR THE SADDLE DAMS SHALL BE NPAG.
3) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES

SADDLE DAM 6 CONTROL POINTS

CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
NORT CELL	STAGE 2	TSF-014	5+524.84	0	7216552.58	638143.59	150.00
		TSF-015	5+782.72	0	7216799.24	638068.38	150.00

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
4000-21	ROCKFILL PLACEMENT PLAN					
DRAWING NO.	REFERENCES					
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

STAMP

ORIGINAL SIGNED

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

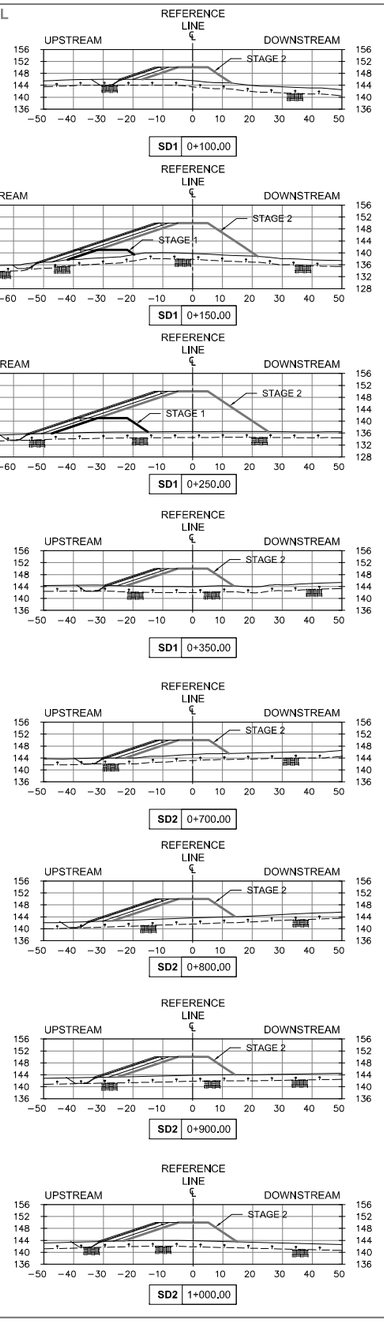
TITLE
TAILINGS STORAGE FACILITY
SADDLE DAM
ROCKFILL PLAN AND PROFILE (5 OF 5)

Golder Associates

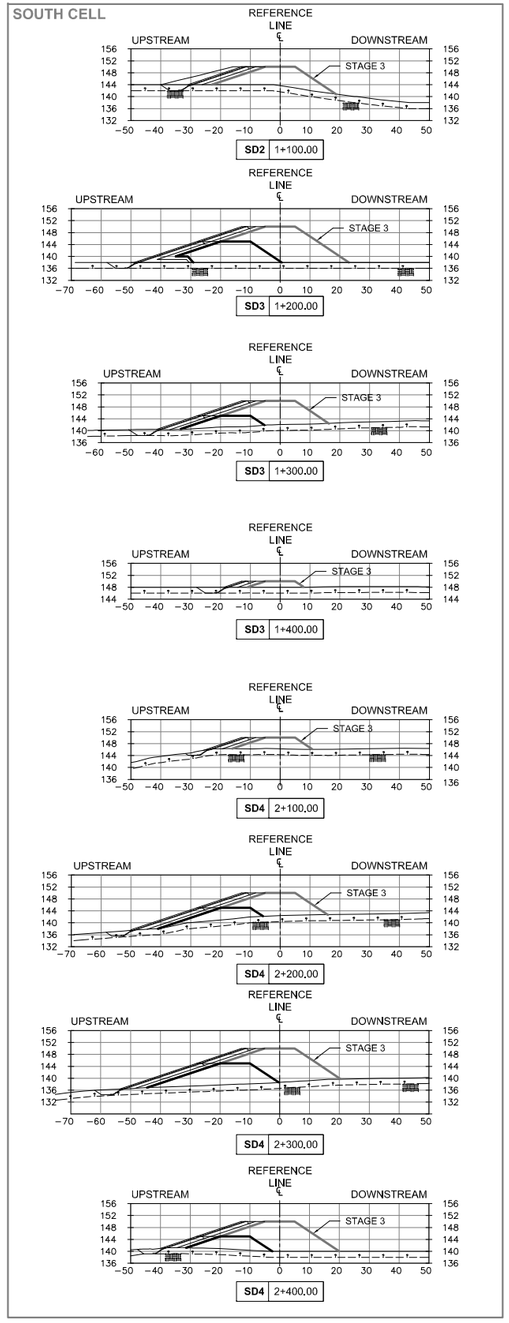
PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	20NOV08	4100-57		
CHECK					
REVIEW					

REVISION DATE: 08/12/17 12:14PM By: jkowanacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\0814280029-4100-57.dwg

NORTH CELL



SOUTH CELL



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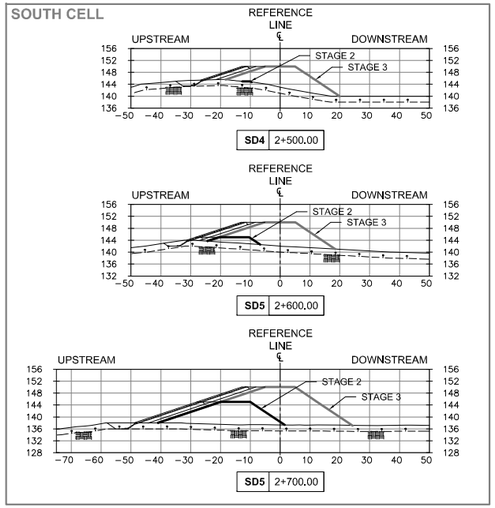
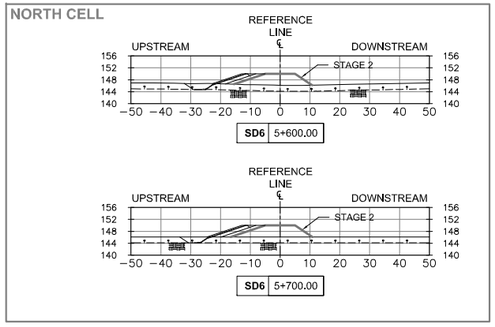


NORTH CELL

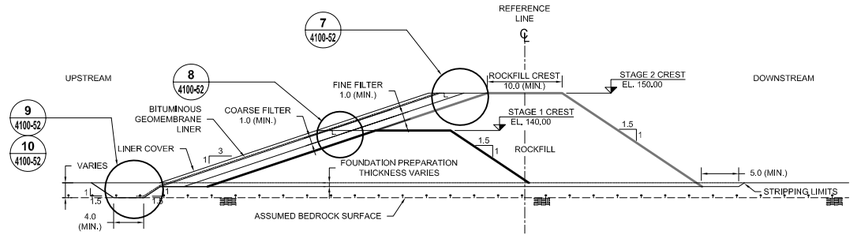


LEGEND

- STAGE 1 ROCKFILL LIMIT
- ROCKFILL LIMIT
- BITUMINOUS GEOMEMBRANE LINER
- EXISTING GROUND
- ASSUMED BEDROCK

NOTES

1. THIS DRAWING PROVIDES CROSS-SECTION INFORMATION FOR THE SADDLE DAMS. STAGE 1, STAGE 2 AND STAGE 3 SADDLE DAM SHOULD BE REFERRED TO THE SADDLE DAM CONTROL POINT DETAILS PRESENTED ON DWG. 4100-53 to 4100-57.
2. SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD.
3. LIMITS OF FOUNDATION PREPARATION AND LINER COVER NOT SHOWN; REFER TO DWG. 4100-51 AND 4100-52 FOR DETAILS.
4. ADDITIONAL 2.0m OF ROCKFILL (ANY TYPE) OR TILL MATERIAL TO BE PLACED ON THE LINER COVER AT SADDLE DAM 3 (SD3) DURING STAGE 2 SOUTH CELL CONSTRUCTION.
5. FOR SADDLE DAM 3 (SD3) FILTER ON LAKEBED EXTENDED DOWNSTREAM BY: 10m BELOW ELEVATION 141m.
6. REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.



1 - TYPICAL CROSS-SECTION - STRIPPING AND ROCKFILL PLACEMENT SADDLE DAM (SCALE 1 : 400)

REDUCED DRAWING NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP: ORIGINAL SIGNED

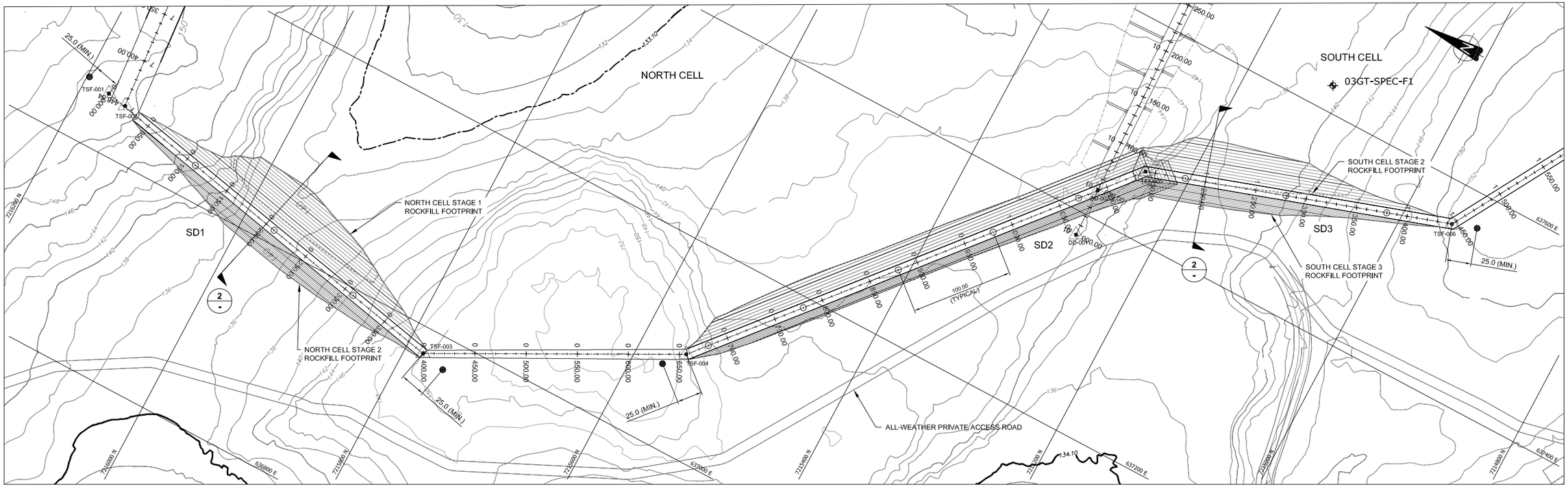
PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: **TAILINGS STORAGE FACILITY SADDLE DAM CROSS-SECTIONS**

Golder Associates

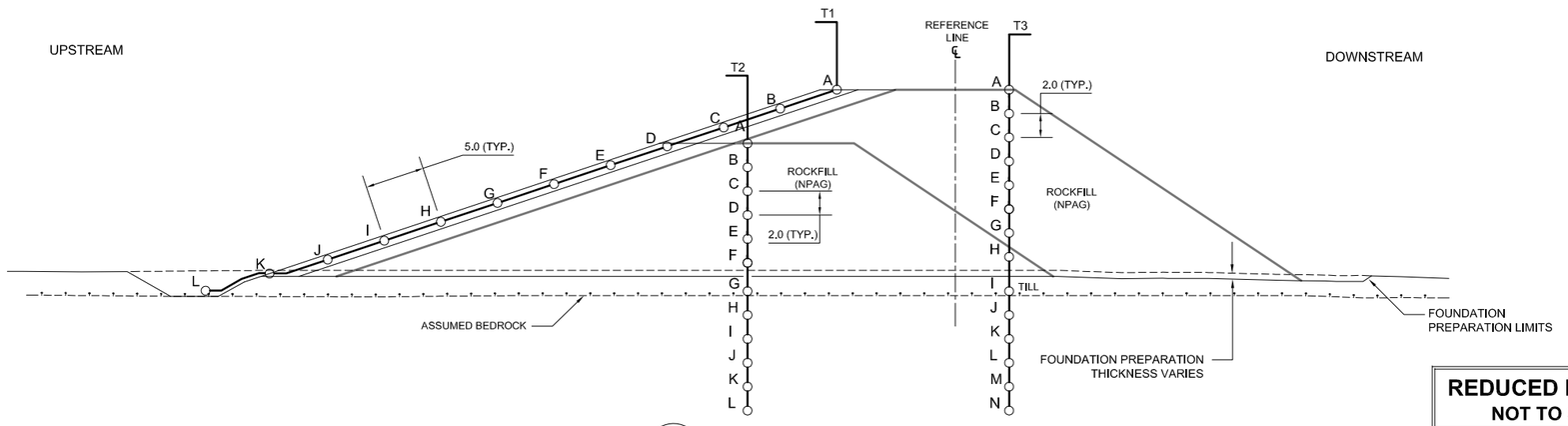
PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	21NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	01DEC08	4100-58		
CHECK					
REVIEW					

CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800029-4100-58.dwg
REVISION DATE: 08/12/17 12:15PM By: jkownacki



1 - PLAN SADDLE DAM

(SCALE 1 : 2,000)



2 - TYPICAL CROSS-SECTION - THERMISTOR LOCATIONS SADDLE DAM

(SCALE 1 : 250)

REDUCED DRAWING NOT TO SCALE

NOT FOR CONSTRUCTION

LEGEND

- TSF — CONTROL POINT
- T1 — THERMISTOR
- STAGE 1 SURVEY CONTROL MONUMENT
- SURVEY PRISM
- 03GT-GI-7 — BOREHOLE WITH THERMISTOR INSTALLATION
- 03GT-GI-6 — BOREHOLE
- STATIONS AND REFERENCE LINE
- LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
- FORMER SHORELINE
- DIKE FOOTPRINT

NOTES

1) SURVEY PRISMS TO BE INSTALLED AT 100 m SPACING ALONG DIKE CREST FOR EACH STAGE.

2) SURVEY CONTROL MONUMENTS SHALL BE INSTALLED AT EACH ABUTMENT AT A MINIMUM 25m FROM THE SADDLE DAM.

3) LENGTH OF LEADS AND READ LOCATIONS WILL DEPEND ON AS-BUILT CONFIGURATION AND ON CONDITIONS ENCOUNTERED IN THE FIELD.

4) INSTRUMENTATION INSTALLATION SHALL BE IN ACCORDANCE WITH INSTRUMENTATION SPECIFICATION LISTED ON DWG. 4100-00.

5) SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF LIMITED INVESTIGATIONS AND TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD.

6) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

REVISION DATE:	CADD FILE:	By:
06/12/17 03:23PM	N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800 29-4100-59.dwg	jkownacki

DRAWING NO.	REFERENCES

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	AS		

STAMP

ORIGINAL SIGNED

PROJECT

AEM

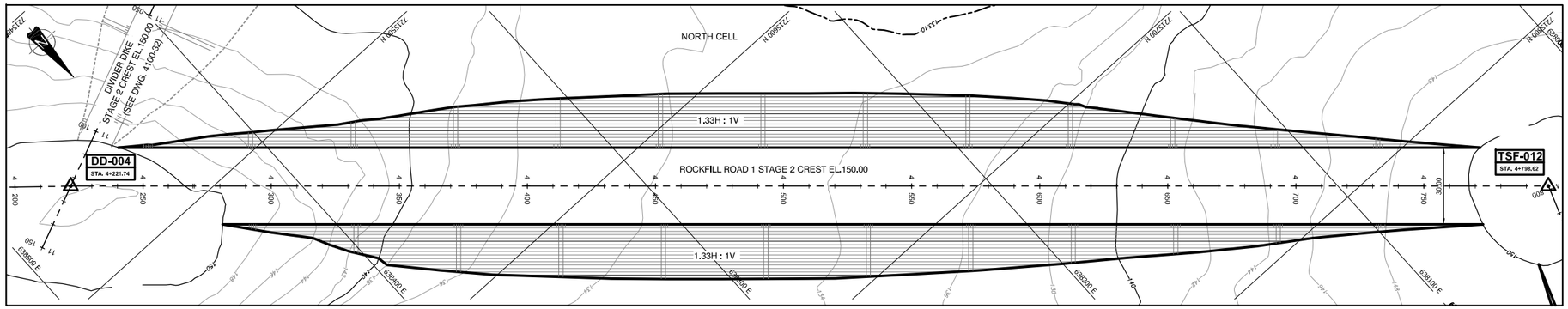
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE

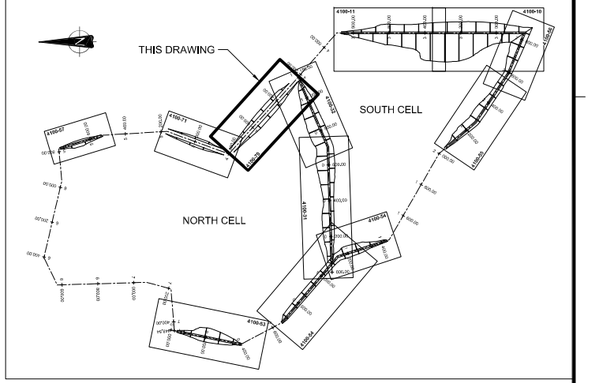
TAILINGS STORAGE FACILITY SADDLE DAM INSTRUMENTATION PLAN AND SECTION

Golder Associates

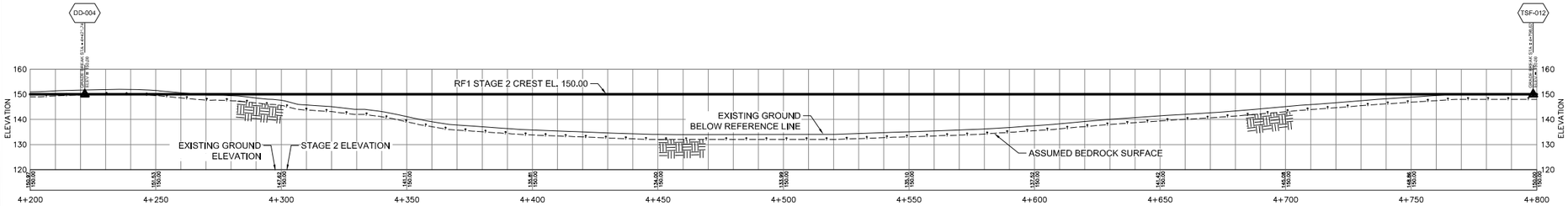
PROJECT No.	08-1428-0029/3200		FILE No.	
DESIGN	BW	10DEC08	SCALE	AS SHOWN
CADD	AS	11DEC08	REV.	A
CHECK			4100-59	
REVIEW				



1 - **ROCKFILL ROAD 1 PLAN STA. 4+200 to 4+800**
(SCALE 1:1,000)



KEY PLAN
NOT TO SCALE



2 - **ROCKFILL ROAD 1 PROFILE STA. 4+200 to 4+800**
(SCALE 1:1,000)

0 10 20 30 40 50
SCALE IN METRES
1 : 1,000

LEGEND

- TSF-010 / STA. 2+842.18 — CONTROL POINT
- 2 + 850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 2
- ASSUMED BEDROCK SURFACE
- 133.10 — FORMER SHORELINE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m

NOTES

1) ROCKFILL ROADS MAY BE PAG OR NPAG MATERIAL.
2) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

ROCKFILL ROAD 1 CONTROL POINTS

CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
NORTH CELL	STAGE 2	**DD-004**	**4+221.74**	**0**	**7215462.63**	**638467.03**	**150.00**
		TSF-012	**4+798.62**	**0**	**7215849.39**	**638039.01**	**150.00**

DATA IN **BOLD** PRESENTED ON THIS DRAWING

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	AS		

4000-21 — DRAWING NO.
ROCKFILL PLACEMENT PLAN — REFERENCES

STAMP: ORIGINAL SIGNED

PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE: **TAILINGS STORAGE FACILITY**
ROCKFILL ROAD
PLAN AND PROFILE (1 OF 2)

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	AS	24NOV08	4100-70		
CHECK					
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REVISION DATE: 08/12/16 05:11PM By: jkownacki
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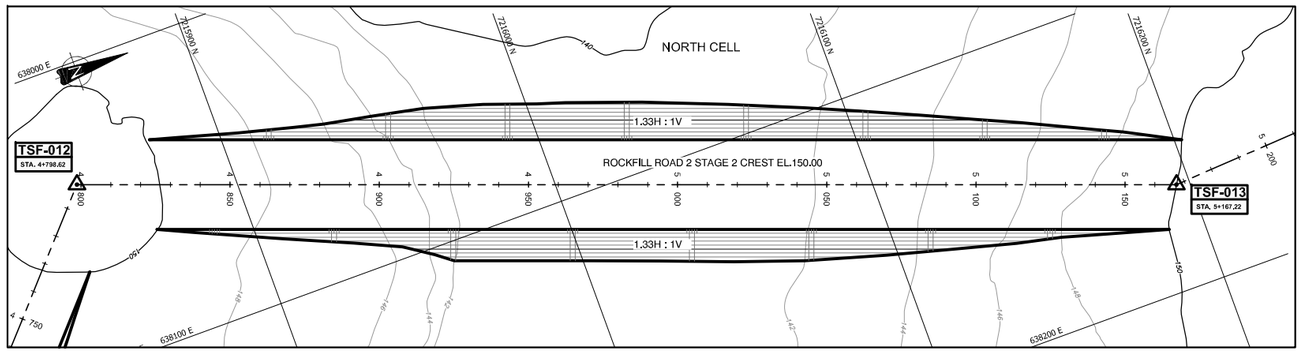

1 - ROCKFILL ROAD 2 PLAN STA. 4+800 TO 5+200
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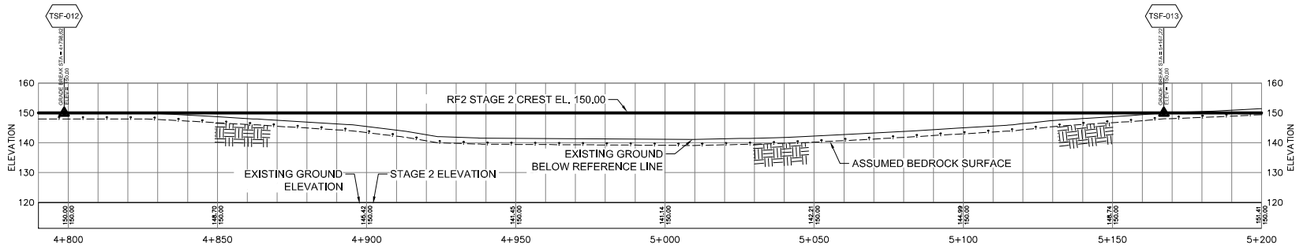

2 - ROCKFILL ROAD 2 PROFILE STA. 4+800 TO 5+200
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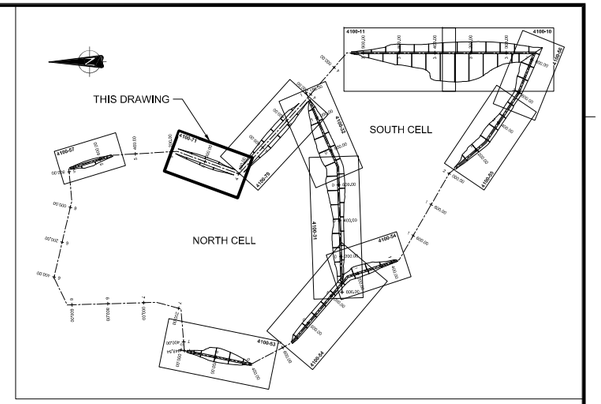

KEY PLAN
NOT TO SCALE

0 10 20 30 40 50
SCALE IN METRES
1 : 1,000

LEGEND

- TSF-010 STA. 2+842.18 — CONTROL POINT
- 2 + 850 — STATIONS AND REFERENCE LINE
- EXISTING GROUND
- STAGE 2
- ASSUMED BEDROCK SURFACE
- 120 — LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
- LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m

NOTES

1) ROCKFILL ROADS MAY BE PAG OR NPAG MATERIAL.
2) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

ROCKFILL ROAD 2 CONTROL POINTS

CELL	SEQUENCE	POINT NAME	STATION	OFFSET FROM REFERENCE LINE (m)	NORTHING	EASTING	ELEVATION
NORTH CELL	STAGE 2	TSF-012	4+798.62	0	7215849.39	638039.01	150.00
		TSF-013	5+167.22	0	7216195.63	638165.46	150.00

DATA IN **BOLD** PRESENTED ON THIS DRAWING

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

PROJECT
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
ROCKFILL ROAD
PLAN AND PROFILE (2 OF 2)

STAMP
ORIGINAL SIGNED

Golder Associates

PROJECT No.	08-1428-0029/3200
FILE No.	
DESIGN	BW 20NOV08
SCALE	AS SHOWN
REV.	A
CADD	AS 24NOV08
CHECK	
REVIEW	

4100-71

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	17DEC08	BW	ISSUED FOR REVIEW	AS		

4000-21 — DRAWING NO.
ROCKFILL PLACEMENT PLAN — REFERENCES

REVISION DATE: 08/12/16 01:21PM By: jkownocki
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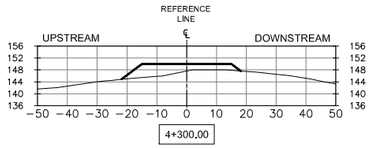

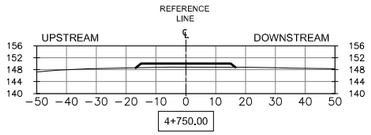

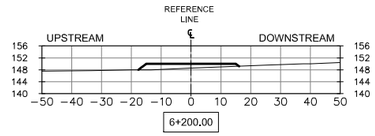

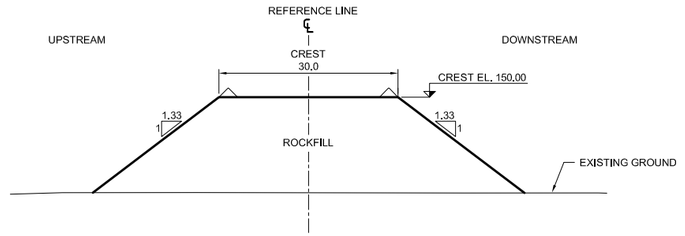

TYPICAL SECTION - ROCKFILL ROAD
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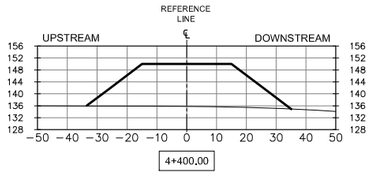

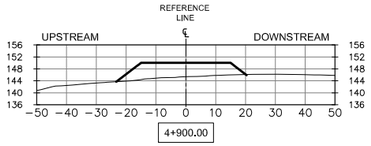

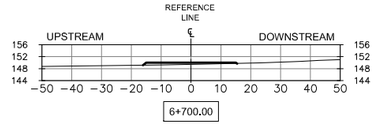

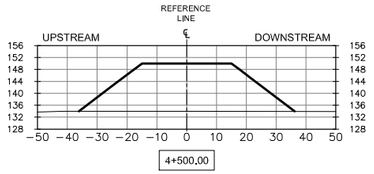

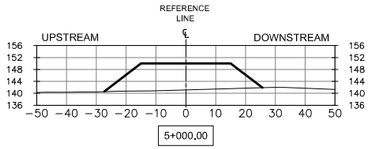

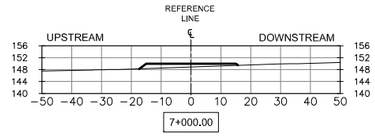

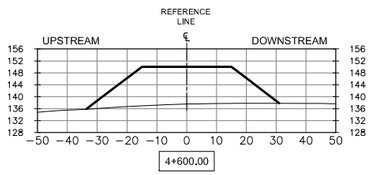

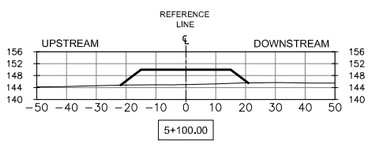

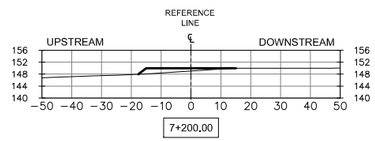

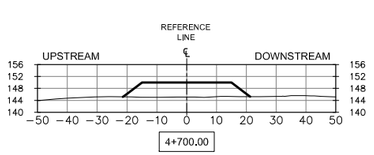

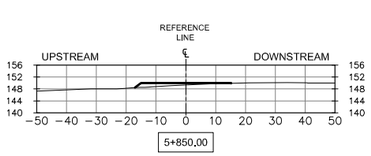

LEGEND

- ROCKFILL LIMIT
- EXISTING GROUND

NOTES

1) THIS DRAWING PROVIDES CROSS-SECTION INFORMATION FOR THE ROCK FILL ROAD. REFER TO THE CONTROL POINT DETAILS ON DWG. 4100-70 AND 4100-71
2) ROCKFILL ROADS MAY BE PAG OR NPAG MATERIAL.
3) DIMENSIONS OF ADDITIONAL TRAFFIC SAFETY BERMS TO FOLLOW MINE HEALTH AND SAFETY REGULATIONS.
4) REFER TO DWG. 4100-02 FOR ADDITIONAL NOTES.

ESTIMATED MATERIAL QUANTITY				
CELL	STRUCTURE	STAGE	CREST ELEVATION	ROCKFILL VOLUME
			masl	m³
NORTH CELL	RF1	STAGE 2	150	239,000
	RF2	STAGE 2	150	73,000

REDUCED DRAWING
NOT TO SCALE

NOT FOR CONSTRUCTION

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RWV
1	17DEC08	BW	ISSUED FOR REVIEW	JK		

DRAWING NO. | REFERENCES

STAMP

ORIGINAL SIGNED

PROJECT
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
TAILINGS STORAGE FACILITY
ROCKFILL ROAD
CROSS-SECTIONS AND QUANTITIES

Golder Associates

PROJECT No.	08-1428-0029/3200		FILE No.		
DESIGN	BW	20NOV08	SCALE	AS SHOWN	REV. A
CADD	JK	01DEC08	4100-72		
CHECK					
REVIEW					

REVISION DATE: 08/12/17 01:53PM By: jkownacki CADD FILE: N:\Bur-Graphics\Projects\2008\1428\08-1428-0029\Drafting\3200\Task-1000\4100\08142800029-4100-72.dwg