Roberts Bay and Ida Bay Abandoned Mine Sites Geotechnical and Geophysical Assessment Final Report

Prepared for:

Public Works & Government Services Canada Environmental Services, Western Region 5th Floor, 10025 Jasper Avenue Edmonton, Alberta, T5J 1S6

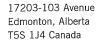
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April 2006

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Public Works and Government Services Canada Environmental Services 5th Floor, 10025 Jasper Avenue Edmonton, AB T5J 1S6

Attention:

Mr. Jared Buchko

Dear Sir:

Re: Roberts and Ida Bay Abandoned Mine Sites - Geotechnical and Geophysical

Assessment Final Report

Earth Tech Canada Inc. is please to submit five copies of our report presented the results of the geotechnical and geophysical assessment that was completed at the Roberts Bay and Ida Bay abandoned silver mines in Nunavut.

Thank you for the opportunity to be involved in this interesting project. If you have any questions, please contact the undersigned at 453-0710.

Very truly yours,

EARTH TECH (CANADA) INC.

Per:

Gordon Woollett, P.Eng.

She Wolk

Project Manager Environment Group

Encl.

ROBERTS BAY AND IDA BAY ABANDONED MINE SITES GEOTECHNICAL AND GEOPHYSICAL ASSESSMENT

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1.0 EXECUTIVE SUMMARY

In order to assist in the development of a remedial plan for the Roberts and Ida Bay Mine sites, Public Works Government Services Canada (PWGSC) was required to complete further assessments at the site. The assessments include the completion of a subsurface environmental (Phase III) assessment, a waste audit of hazardous and non-hazardous materials, the completion of a geotechnical investigation to identify potential borrow and landfill sites as well as the completion of a geophysical assessment to identify areas with buried debris.

In August 2005, on behalf of the Department of Indian Affairs and Northern Development (DIAND), PWGSC commissioned Earth Tech to complete the above assessments at the Roberts and Ida Bay Mine sites. In addition, PWGSC also commissioned AMEC to complete a geochemical assessment on the tailings and waste rock, an assessment of all mine related workings and to complete a remediation plan for the site. The fieldwork for this program was completed between August 15 and August 22, 2005. The scope of work for the geotechnical and geophysical assessment was to identify potential borrow sources, identify potential landfill sites as well as to identify areas with buried debris through the completion of a geophysical survey.

EBA completed the geophysical survey for the Roberts Bay site on August 17 and 18, 2005. This survey examined six areas suspected to contain buried debris. The results of the geophysical survey indicated that buried debris was not present at the Roberts Bay site. The geophysical survey was not completed at the Ida Bay site since there were no areas suspected to contain buried wastes.

During the site visit to both the Roberts Bay site and the Ida Bay site, four potential new landfill locations were identified and evaluated. In addition, the use of two previously developed areas at the site (the existing waste dump and the tailings pond) were considered. The potential landfill sites included the following:

- Northeast of fuel bladders
- East of garage
- Former camp area
- Below waste rock pile
- Existing dumpsite area
- Existing tailings pond

Various amount of borrow sources were identified around both the Roberts Bay and Ida Bay mine sites. Approximately 9,500 m³ of granular material was identified at the Roberts Bay site and 1,200 m³ of material was identified at the Ida Bay site. The following table presents a summary of the volumes of borrow material available at both mine sites.

Granular Borrow Area Summary

Borrow Area	Estimated Volume (m ³)	Distance to Site (m)	Material	Notes
1	300	200 m east of former camp	Fine to medium grained sand	South of former explosives storage area
2	2,520	South side of waste rock piles	64-74% sand, 26-33% gravel, 1% fines	50 m south of former garage. Water at 0.6 m
3	2,250	Approx 100 m south of former camp	Medium to coarse grained sand	Cobbles and boulders near shoulders of rock outcrops
4	1,370	40 m NE of fuel bladders	Well graded sand layer over gravel	80m northeast of Adit No. 1. Water at 0.76m depth
5	215	100 m north of Mill	Silty sand	Frost at 0.76 m
6	2,880	200 West of Tailings Pond	62% sand, 37% gravel, 1% fines	Deposited along a slope
Total	9,535		An additional granular source of estimated volume 5000 m ³ is located approximately 500 m to the west of the site along a south facing slope. This source is not included above due its distance from the site and the potential for damage to the tundra during hauling.	
Ida Bay	1,200	250 NW of adit	55% sand, 44% gravel, 1% fines	At former camp site

Of the landfill locations identified, the area east of the Garage and at the former Camp area are more favourable as they are well drained with stable foundations located above the seasonal water table. All the locations are centrally located and would entail minimal haul distance. The former camp area is somewhat larger in area and is also located in close proximity to Borrow Areas 2 and 3, as well as the former camp dumpsite which could be used for placement of inert wastes.

2.0 INTRODUCTION

The Department of Indian and Northern Development (DIAND), through the Northern Contaminated Sites Program (CSP) is responsible for the management of a number of contaminated properties in the northern territories that are no longer maintained by their original occupant. These contaminated sites originate from military, mining and oil and gas activities. The Roberts Bay Silver Mine and the Ida Bay Silver Mine are two abandoned mine sites that are included in the site assessment and remediation inventory.

Previous investigation activities have been completed at both the Roberts Bay and Ida Bay Mine Sites and the intent of this investigation is to build upon the information obtained from the previous programs. The main scope of work for the Earth Tech project was to conduct the contaminant and geotechnical assessments of the two sites as outlined in the Terms of Reference prepared by PWGSC-Environmental Services, Western Region. Earth Tech was one of four engineering consultants who collected data during the August 15 to August 22, 2005 field program at this site. This report specifically details the results of the Geotechnical and Geophysical Assessment and is one of three Earth Tech site project reports.

2.1 Scope of Work

2.1.1 Geotechnical Assessment

Since remedial activities at the Roberts Bay and Ida Bay sites are anticipated to consolidate a volume of both hazardous and non-hazardous waste that will require proper disposal, a field survey was required to identify future potential landfill, landfarm, and borrow areas at and near the investigated sites. This was required in order to allow for the development of a remedial plan for both the Roberts and Ida Bay Mine sites. The objectives of the geotechnical assessment included the following:

- Complete mapping of the surficial geology of the investigated sites, with the aid of testpits dug by shovel and hand auger holes, to provide vertical delineation of soil structure, subsurface water and depth to bedrock. Soil tespit/hand auger holes were logged visually to identify features such as ice content and lensing. In addition, where accessible, slope faces were exposed to observe in-situ soil stratigraphy.
- Obtain representative soil samples and submit for laboratory analysis of moisture content and grain size distribution. Handheld GPS equipment was used to provide descriptor locations as well as to help quantify potential borrow materials.
- Following completion of the field survey, an assessment was completed to determine the quantities of locally available borrow material and to determine candidate locations for on-site landfills (hazardous and non-hazardous waste). This also included an analysis of the approximate volumes of available material to be used for either landfill construction and/or capping. The scope of work does not include landfill design; however, preliminary concepts and options are discussed in the report.

2.1.2 Geophysical Assessment

Because of historical site activities for both the Roberts and Ida Bay Mine sites, and in order to complete the debris identification and quantification at the investigation locations, a survey of any potential buried waste was required. The information obtained from the geophysical assessment is to be included in the development of remediation options for each site. The objectives of the geophysical assessment included the following:

- Identify and map any buried debris in the area
- Define the limits of any known landfills.



The geophysical assessment was completed by EBA Engineering Ltd and is summarized in this report. It should be noted that it was decided after a site inspection that the geophysical investigation was not required at the Ida Bay site due to the low likelihood of buried debris at this site.

2.2 Previous Work

The following is a brief summary of the background reports that were available for review.

2.2.1 Vista Engineering Survey/Inspection

In 1986, Vista Engineering completed a survey/inspection of the Roberts Bay mine site. This inspection of the site produced a preliminary inventory of all abandoned waste materials including the quantities of potentially hazardous chemicals that were located in the remains of the buildings. Items of note that were observed at the site included drums of ore processing chemicals, floatation chemicals, lime, nitric acid, carbonate, lead acid batteries, lube oil, and 500 m of detonation cord. This inspection also indicated that the tailings pond was lined with polyethylene.

2.2.2 Preliminary Assessment of the Roberts Bay and Ida Bay Abandoned Mine Sites

Rescan Environmental Services Ltd. completed an assessment of both the Roberts and Ida Bay sites in 2003. The purpose of this assessment was to assess the stability of the mine workings, determine locations of waste rock piles and tailings areas, and determine the potential for acid rock drainage or metal leaching concerns.

2.2.2.1 Roberts Bay

This assessment concluded that there was no evidence of on-going acid rock drainage at the Roberts Bay site, however based on the analysis of a limited number of waste rock samples, this report indicated that there is a potential for some of the waste rock at this site to produce low pH leachate. In addition, this report concluded that arsenic leaching may be a potential problem in the future based on the lab testing conducted on tailings samples. This report recommended that all waste materials at the site be collected and landfilled, all mine openings be securely closed and that additional studies be completed to determine if there are any impacts from the tailings impoundment and waste rock piles.

2.2.2.2 Ida Bay

This report recommended that closure measures be developed and implemented for this site and that additional investigation be completed to confirm that there have been no impacts from acid drainage and metals leaching. Additional recommended activities included the collection and disposal of all waste materials and that all mine openings be securely closed.

2.2.3 Phase I/II Environmental Site Assessment Roberts Bay Mine and Ida Bay Deposit Nunavut

This report was prepared by Rescan Environmental Services in 2004 for Public Works Government Services Canada. This report restated the results from the 2003 report noted above and also included a Phase I/II ESA of both mine sites. The results from the Phase II ESA at the Roberts Bay site identified a total of 225 m³ of hydrocarbon impacted soils in the vicinity of the mill, garage and around the fuel storage area. Elevated metal concentrations in soils were also encountered however, it was reported that these values were similar to the metal concentrations found in the waste rock piles. This assessment also estimated 305 m³ of non-hazardous waste material at the site (wood, steel, miscellaneous metal products).

Hazardous materials were limited to barrels of fuel, oil, grease, compressed gas cylinders, lead acid batteries, one suspect electrical transformer and the unlabelled barrels located at the barrel storage area.

Based on the scope of investigative work completed at the Ida Bay site, no contaminated soil or water was identified and only 8 m³ of waste (non-hazardous) was identified at this site.

2.2.4 Screening Level Human Health Risk Assessment for the Roberts Bay and Ida Bay Mine Sites

This report was prepared by Senes Consultants Ltd. in 2004 for Indian and Northern Affairs Canada. The conclusions of this risk assessment were based on the information presented in the 2004 Phase I/II ESA of both sites prepared by Rescan Environmental Services. The screening level risk assessment included the following elements.

- Receptor characterization
- Exposure assessment
- Hazard assessment
- Risk characterization

This report summarized the screening level assessment for human health. The risk assessment was undertaken to determine whether there are contaminant levels present that may have an adverse effect on humans. The report concluded that on the basis of conservative assumptions, ingestion of arsenic is a concern at the site. In addition, physical hazards including the adits at both sites as well as general debris were identified as physical hazards.

3.0 SITE INFORMATION

3.1 Site Description

3.1.1 Roberts Bay

The Roberts Bay site is approximately 1 km north of the western end of Roberts Lake and approximately 1.5 km east of Melville Sound. For this investigation, Roberts Lake was used as a landing site by a float plane and access to the abandoned mine was achieved by following a road along a basaltic ridge that lead to the site approximately 1 km north and 100 m higher in elevation than Roberts Lake. A general area overview is presented in Figure 1 (Appendix A) and a detailed plan view of the Roberts Bay site is presented in Figure 2.

The area around the site is dominated by the presence of a number of ridges and outcrops to the east and north. Surrounding the site and located between the ridges are numerous low/wet muskeg areas and small lakes and ponds. The majority of the developed areas of the site drain to a prominent drainage course to the south towards Roberts Lake. Some areas of the site (i.e. areas west of the camp dump) drain to the west.

The developments on the site consist of an adit, shaft, covered raise, tailings pond, waste rock piles, remains of the mill, assay and garage, fuel storage compound, equipment storage area, barrel storage shed, camp and dump area. A small lake north east of the site was formerly used as a water source. Large amounts of waste rock have been used to level the operations areas of the site. The mill, assay and garage buildings were all constructed on waste rock pads. Field observations indicated the pad varies in thickness from 150 mm to several metres. The Mill and Assay buildings contain much of the original ore process equipment, while scattered around the site are various types of used equipment, debris, equipment parts and waste. The remains of an exploration camp are also located near the shore of Roberts Lake. A detailed plan view of the Ida Bay site is presented in Figure 3.

3.1.2 Ida Bay

The Ida Bay site is approximately 7 km north east of the Roberts Bay site and is located on the shore of a small bay facing Melville Sound. For this investigation, the Ida Bay site was accessed with ATV's following a faint trail from the Roberts Bay site and via helicopter.

The only developments at the former Ida Bay mine site are an open adit, a partially covered vent raise, rock piles and scattered debris located around the site. Waste rock at this site was observed adjacent to the ocean and below the high tide level.

3.2 Surficial Geology

The Phase I/II Environmental Site Assessment completed in February 2004 provides a detailed assessment of the surficial geology of the investigated sites. The Roberts Bay abandoned silver mine is found within the Hope Bay Volcanic Belt in the north of the Slave geological province and the rocks within the region are primarily Archean in age and within the Yellowknife Supergroup. The dominant soils in the region are Turbic and Static Cyrosols developed on discontinuous, thin, sandy moraine and level alluvial deposits. (Rescan Environmental Services 2004).

Low lying areas at the site are saturated and marshy and are underlain by clayey silt with permafrost at depths of 0.3 to 0.6 m. Elevated areas are typically underlain by a silty gravelly sand till which may be saturated if poorly drained with permafrost at approximately 0.6 m below grade. Occasional granular deposits are found in the vicinity of the site at surface and are typically a well graded sand and gravel with 1 to 2% silt/clay.

3.3 Hydrology

The Roberts Bay site is located on basaltic outcrops that lie approximately 100 m above the elevation of Roberts Lake (Rescan Environmental Services 2004). General overland drainage is directed towards the south end of the site and towards Roberts Lake. The flat areas surrounding the site are poorly drained and swampy with organics and peat thicknesses of approximately 0.3 m and tend to overlie permafrost affected silt. The Ida Bay site borders the shores of Melville Sound and overland drainage at the site drains directly into Melville Sound.

Both sites are found within the southern artic ecozone, where the summers are short and cool, while winters are long, cold and dark. The average annual temperatures for the study region (as measured in Cambridge Bay, Nunavut 125 km southwest of the Roberts Bay and Ida Bay Mine sites) is -14.4°C, with a daily mean temperature of -32.8°C in January and 8.4°C in July. The average annual precipitation at the Site is 138.8 mm (Cambridge Bay, Canadian Climate Normals, 1971-2000, Environment Canada). Permafrost is found throughout the region.

4.0 METHODOLOGY

The following is a summary of the geotechnical assessment protocols and methodologies which were used during the completion of this assessment program.

4.1 Geotechnical Assessment

The geotechnical assessment at the Roberts Bay and Ida Bay sites consisted of hand auger and shovel investigations, material sampling and a geotechnical testing program. Testpits and hand auger holes were advanced to refusal on permafrost or bedrock or to the depth limit of the hand auger/shovel.



Selected soil samples were retained in order to gain a representative assessment of the major soil units in the area. Samples were obtained near the surface, at water/soil interfaces and at any significant changes in soil stratigraphy. Representative soil samples were collected in laboratory-supplied bags and analyzed for moisture content, particle size and moisture content-density Proctor testing. All sample locations were marked with UV resistant stakes and pins in order to assist in any follow up remedial activity at the site. All investigation locations were recorded with a handheld GPS unit.

4.2 Geophysical Survey

EBA Engineering Consultants Ltd. of Edmonton, Alberta, under contract to Earth Tech completed the geophysical survey for the Roberts Bay site on August 17 and 18, 2005. Included below is an excerpt from the EBA report *Geophysical Investigation at Roberts Bay and IDA Bay October 2005* describing the methodology used for the geophysical survey. A copy of the full report is available in Appendix B.

"The Roberts Bay site was surveyed using Geometrics G-856 and G-858 magnetometer systems. The G-856 proton precession magnetometer was used as a base station to record diurnal variations in the background magnetic field strength for total magnetic field strength corrections during the course of the field program. The G-858 portable cesium magnetometer was used as a roving field gradiometer with two vertically orientated sensors separated by 1 metre to measure vertical total magnetic field strengths. The difference between the readings of the two sensors is a measure of the magnetic gradient at that location, which is proportional to near surface ferrous objects. Locations with high magnetic gradients will correspond to areas with large quantities of ferrous debris and therefore potential landfill or debris piles. The gradient is plotted as color contours on a grid system and provides a visual representation of the location and distribution of magnetic gradient anomalies. On the color contour map, a yellow background indicates a limited or nil response. High magnetic gradients are represented by either red at approximately +100 NanoTeslas per metre (nT/m), or blue at -100nT/m. There is no significance between a positive or negative anomaly, other than it provides an indication of the polarity and therefore direction of the magnetic gradient.

The gradiometer data set was collected by walking parallel lines approximately 2.5 to 5 metres apart. Areas covered with substantial surface debris were avoided to prevent mapping out visible areas of debris, and to prevent possible sensor errors due to a high magnetic field gradients.

A real time differentially corrected GPS was used with the G-858 roving field unit to provide integrated sub-meter positioning accuracy. A Trimble AG132 GPS unit was used as the main GPS receiver collecting GPS positioning data and transmitting NMEA GPS strings to the G-858. Positions were recorded at one second intervals with the gradiometer data. The GPS data collected by the Trimble AG132 GPS receiver was corrected in real time by a GDGPS RTCM correction box that uses satellite relayed correction data from an MSAT satellite in geosynchronous orbit. The RTCM corrections were calculated using the GPS correction data generated by the Canadian GPS base station grid and location of the field roving unit.

The resulting accuracy of the system is less than 1 metre horizontally and 2 metres vertically. All geophysical survey lines are identified by small black cross-marks on the provided figures.



All positioning data has been reported in UTM coordinates using the NAD83 datum. The Roberts Bay site falls within Zone 13 with a central meridian of -105 degrees west."

5.0 RESULTS

The fieldwork for the geotechnical assessment for the Roberts Bay and Ida Bay sites was conducted between August 15 and August 22, 2005. The investigation included a total of 16 hand-augered testholes and testpits. Selected soil samples were retained and analyzed for moisture content, grain size distribution and moisture-density relationships. Detailed borehole logs for the investigation locations are included in Appendix B. The results of geotechnical testing and analysis are included in Appendix C. Investigation locations are presented in Figures 4 to 7, and Table 5.1 provides a summary of the testhole investigation results.

Table 5.1: Geotechnical Investigation Locations Results Summary

Location ID Completion Depth		Major Soil Description	Moisture Content
ET-1100	0.74m	Top layer: ORGANICS 0.15-0.30m: SAND, gravelly, trace silt/clay 0.51m-0.74m: SAND, gravelly, trace silt/clay	4.6% 5.1%
ET-1101	0.30m	Top layer: ORGANICS Clayey SILT, some sand, trace gravel	-
ET-1102	0.61m	Top layer: ORGANICS 0.20m-0.61m: SAND, some silt, trace clay and gravel	
ET-1103	0.97m	Top layer: ORGANICS Silty SAND, some gravel, trace clay	_
ET-1104 1.22m		Top layer: ORGANICS SILT, trace sand	_
ET-1105	0.76m	Top layer: ORĞANICS 0.31m-0.46m: SAND AND GRAVEL, trace silt/clay	3.7%
ET-1106	0.61m	Top layer: ORGANICS SAND, silty, trace gravel	_
ET-1107	1.37m	Top layer: ORGANICS 0.076m-0.23m: SAND, gravelly, some silt and clay	10.6%
ET-1108 0.18m		Top layer: ORGANICS SAND, trace gravel	-
ET-1109 0.41m		Top layer: MUSKEG SAND, silty, trace gravel and cobbles	-
ET-1110	ET-1110 0.33m Top layer: PEAT SILT		-
ET-1114	ET-1114 1.07m Top layer: ORGANICS 0.31m-0.61m: SAND AND GRAVEL, trace silt and clay		2.3%

		- Continued)		
Location ID	Completion Depth	Major Soil Description	Moisture Content	
ET-1115 0.30m		Top layer: ORGANICS SAND, silty, some gravel	_	
ET-1116 0.61m		Top layer: ORGANICS SAND, trace to some gravel	-	
ET-1117 0.30m		Top layer: ORGANICS SAND, some gravel and cobbles	-	
IDA 05 0.31 m 0.0 to 0.31 m SAND AND GRAVEL, trace silt and clay		3.7%		

Table 5.1: Geotechnical Investigation Locations Results Summary (Continued)

5.1 Geophysical Survey Results

EBA completed the geophysical survey for the Roberts Bay site on August 17 and 18, 2005. Excerpts from the EBA geophysical survey report *Geophysical Investigation at Roberts Bay and IDA Bay October 2005* are presented below. A copy of the full report is included in Appendix A.

All geophysical data collection took place approximately 1 km north of Roberts Lake in the direct vicinity of the mine site. A total of six data collection areas suspected to contain buried debris were investigated:

- 1. The Ida Bay Access Trail
- 2. The Ida Bay Access Trail
- 3. The Machine Shop Area
- 4. Camp Dump
- 5. The South Mill Access Road
- 6. The Mill Area
- 7. Waste Rock Pile 1

These locations were selected for investigation because they covered the majority of the areas impacted by the mining activities. These areas contained ferrous surface debris, and were suspected to have buried debris as well.

5.1.1 The Ida Bay Access Trail

Smaller surface debris was found to be scattered across the area; however buried debris is not suspected in this area.



5.1.2 The Machine Shop Area

The geophysical results of this area do not suggest the presence of buried debris; however, it is noted that some buried material may be present in small quantities beneath the larger concentration of surface debris.

5.1.3 Old Camp Dump

There exists the potential for a medium sized buried ferrous object, or a shallow rock with high ferromagnetic properties to be found within this area. If any buried debris is present, it will be contained to the area where the surface debris is located.

5.1.4 The South Mill Access Road

Buried debris is not suspected in this area.

5.1.5 The Mill Area

All ferrous material detected in the geophysical survey can be seen at the surface. Buried debris is not suspected at this location.

5.1.6 Waste Rock Pile 1

Buried debris is not suspected at this location.

6.0 POTENTIAL LANDFILL LOCATIONS

6.1 General

Based on the volumes of waste materials that have been left at the site, there will be a requirement to construct a non-hazardous landfill. Depending on the remedial options that are selected there may also be a requirement to construct a hazardous waste landfill as well. The size, relative design parameters and area chosen for construction of any landfill location will be dictated based on the volume and characteristics of the contaminated soil and debris to be landfilled. Details regarding the contaminated soils and waste debris are found in the accompanying reports prepared by Earth Tech and AMEC.

6.2 Landfill Siting Parameters

Due to the remoteness of the site, along with the unique environmental characteristics of the region, the selection of a suitable location for the disposal of the associated waste should consider a variety of factors, including the following:

6.2.1 General Siting Considerations

- General surface runoff through the area. Positioning of the landfill should consider areas where surface runoff is directed off the landfill surface to prevent any ponding and any associated infiltration. The general grade within the vicinity of the landfill should not be so steep that it promotes erosion of the associated landfill cover materials.
- Specific soil and foundation conditions. Because buried systems present more complex problems in northern areas, the positioning of the landfill should be situated within a region with ideal ground conditions that account for seasonal freezing and thaw cycles and that would allow for the permafrost itself to function as a containment system. This includes accounting for the prevention of movement caused by frost heave and the thaw settlement of the associated soils.
- Distance from natural water bodies and/or water courses. The landfill should be situated a minimum buffer distance from any nearby natural water bodies to minimize the potential impacts of any leachate generated within the landfill on those water bodies.
- Other notable considerations; including haul distances and size of the area available.

6.2.2 Specific Design Considerations

- Waste Characterization. Specific details regarding the contaminated soils and waste debris is found in the accompanying reports prepared by Earth Tech and AMEC. In general, the design of the landfill will be governed by the nature of the material that will be disposed of. For example, waste material to be disposed of in the landfill may consist of only non-hazardous debris and all PCB containing products will be recovered and hauled to an approved offsite location for disposal.
- Backfill Material. Difficulties are encountered with the handling, placement and compaction, settlements and instability with the use of high-moisture-content frozen and unfrozen cohesive soils. This is especially pronounced in northern and remote regions. As such, the backfill material to be used with the landfill operation should be frost stable. Additional material specifications that take into account these considerations in addressed in Section 6.0 Granular Borrow Materials.
- Landfill Construction: Given the remote northern location of the sites, earth materials in a frozen, freezing, thawing, thawed and unfrozen state may be encountered in the region. As such, the landfill should be constructed in such a manner to reduce constructability issues and to limit permafrost disturbance. The landfill should be constructed on grade to limit any extensive constructability issues and containment berms should enclose the landfill area. The debris should be placed in 0.5 m thick lifts and each lift covered with an associated non-frost susceptible intermediate fill layer. As a final step, the landfill should be capped to prevent moisture from moving in and out of the filled materials.

6.3 Potential Landfill Locations

During the site visit to both the Roberts Bay site and the Ida Bay site, four (4) potential new landfill locations were identified and evaluated. In addition, the use of two previously developed areas at the site (the existing waste dump and the tailings pond) were considered. The potential landfill locations are shown in Figure 5.1. The assessment of the potential landfill locations was completed in order to determine if landfilling of the identified waste is a viable option and to determine if there is an appropriate location with adequate space for the volume of waste requiring disposal. Details regarding their location and associated design considerations are described in detail below.

6.3.1 Potential Landfill Location A – Northeast of Fuel Bladders

Potential Landfill Location A is situated immediately northeast of the fuel bladders and is located between a large rock outcrop to the east and a waste rock area to the west. There are two small ponds to the immediate west of this area which could be filled if this location is to be developed. A potential surface area of 1371 m² is identified as being available for landfilling operations in this area. This area is illustrated in Photo 1 and in Figure 6.

This area was also identified as a borrow area (Borrow Area 4) and is very close to the source waste areas at the site. The water table is approximately 0.7 m below grade in this area and if the granular material was removed, suitable foundation material would have to be placed.

6.3.2 Potential Landfill Location B – East of Garage

Potential Landfill Location B is situated directly south of Adit No. 1 and directly east of Building No. 3 (the former garage). The identified area is located on a built-up waste rock pad and encompasses a total surface area of approximately 900 m². This area is illustrated in Photo 2 and in Figure 6.

The waste rock pad thickness varies from approximately 0.3 m at the north edge to more than 2 m at the south edge of the designated area. Some debris, barrels, the remains of the garage frame, and miscellaneous equipment would have to be cleared out of the vicinity to allow placement of waste. As Adit No. 1 is immediately north of the area, any closure or remedial plans for the adit would have to be considered in the layout of a landfill cell at this location. The site is centrally located and would require limited hauling of waste materials. In addition, the waste rock foundation is frost stable and would not require clearing of organics.

6.3.3 Potential Landfill Location C – Camp Area

Potential Landfill Location C is located on a relatively level rock outcrop area where the mine site camp was formerly located. This site is in close proximity to the waste source areas, thereby minimizing haul distances. It is well drained with a stable foundation free of frost susceptible materials. It is also located in close proximity to Borrow Area 3 immediately to the south. The total estimated potential surface area available for the construction of the landfill is approximately at 1,500 m². This area is illustrated in Figures 2 and 5 as well as in Photo 3.



6.3.4 Potential Landfill Location D – Below Waste Rock Pile

Location D is immediately south of the waste rock pile as illustrated in Figure 5 and Photo 4. The water table was found to be approximately 0.5 m below the surface of this well graded gravelly sand deposit. Bedrock was noted at a depth of 0.75 m. This area is centrally located, implying minimal haul distances. Waste and fill could be placed against the waste rock face to the north and the rock outcrop to the east, thereby reducing the volume of granular material required for containment berms.

6.3.5 Potential Alternative Option A - Existing Dumpsite Area

The existing dumpsite is located directly west of the old campsite area. This small dump consists of a waste rock berm approximately 20 m long, 10 m wide, and 1.5 to 2 m deep. Waste materials observed in the dump included rusted tin cans, glass bottles, and burned wastes. The surface area of the dumpsite is approximately 300 m². This area is visible in Photo 4 and Figure 5 and could be used for disposal of inert materials placed between lifts of non frost-susceptible granular material.

6.3.6 Potential Alternative Option B - Existing Tailings Pond

The tailings pond is located near the site Mill and Assay buildings. Based on a survey/inspection completed in 1986 by Vista Engineering, it was indicated that the tailings pond was lined with polyethylene. The tailings pond covers an area of approximately 600 m². It is visible in Photo 4 and Figures 2, 5, and 6. The tailings pond is centrally located, thereby minimizing haul distances.

Placement of both inert and contaminated waste in the tailings pond has the advantage of encapsulating the highly impacted tailings at the same time. The encapsulation design would have to allow for freezeback of the waste, an erosion-resistant cover and improvements to the existing sideslopes with an engineered embankments likely built with waste rock. The geometry of the landfill area would be a function of the volume of waste requiring disposal.

6.4 Summary of the Identified Potential Landfill Locations

Of the four potential landfill locations identified, Locations B and C are more favourable as they are well drained with stable foundations located above the seasonal water table. All the locations are centrally located and would entail minimal haul distance. Location C is somewhat larger in area and is also located in close proximity to Borrow Areas 2 and 3, as well as the former camp dumpsite which could be used for placement of inert wastes.

7.0 GRANULAR BORROW MATERIAL

7.1 Granular Borrow Material

During the site work at Roberts Bay potential granular borrow areas were identified and evaluated. Proposed borrow locations for the main Roberts Bay site are illustrated in Figure 2. Granular borrow material will be required for the construction of a new landfill disposal site, the backfilling of remediated areas and for the construction of any site access roads. The assessment of granular borrow areas was completed in order to identify borrow material sources and to determine if sufficient material is available for the proposed remediation options.

7.2 Granular Borrow Areas and Volumes

7.2.1 Roberts Bay Borrow Areas

A total of six (6) potential borrow sources were identified at the main Roberts Bay site. Details regarding the locations of the granular borrow areas and their characteristics are described below.

7.2.1.1 Borrow Area 1 – East of the Former Campsite Area

Borrow Area 1 is located approximately 200 m east of the former campsite area and consists of approximately 300 m³ of fine to medium grained sand with a confirmed thickness of 0.6 m. The area is accessible from the north by the path to the former explosives storage area, with the borrow area located approximately 100 m past the storage area. The location of Borrow Area 1 is illustrated in Figure 5.

7.2.1.2 Borrow Area 2 – South of Waste Rock Pile

Borrow Area 2 is situated to the south of the waste rock pick pile and the former garage and is bounded on the east by a rock outcrop. This area is illustrated in Figure 5. Several ET investigation locations were completed in Borrow Area 2 (ET-1100 and ET-1108 and ET-1109). In general, the borrow area consists of a fine to medium grained sand with gravel and trace silt/clay. Based on an area of approximately 3,590 m² and a thickness of 0.7 m above the seasonal water table, 2,520 m³ of granular material is available for borrow.

7.2.1.3 Borrow Area 3 - South of Camp Site

Borrow Area 3 is located approximately 60m south of the old camp site area at the main Roberts Bay site and is illustrated in Figure 4. ET specific investigation locations related to Borrow Area 3 included testpit ET-1102 and hand auger testhole ET-1117. Several additional confirmatory hand auger holes were advanced in this area to confirm the material type. The borrow area materials consist of medium to coarse sand with gravels and cobbles and are covered by a thin organics layer. Cobbles and boulders are more numerous along the shoulders of the rock outcrops. Based on an area of approximately 3,750 m² extending down to a confirmed depth of 0.6 m, a volume of approximately 2,250 m³ is available for granular borrow. Note that this is a conservative estimate as the thickness of available granular material is likely greater than 0.6 m. Furthermore, additional sand and gravel is likely available along the shoulders of the outcrops if the cobbles and boulders can be sorted out during excavation. The



material becomes finer to the east as it becomes closer to the muskeg/swamp area. At testpit location ET-1102, subsurface materials consisted of fine sand containing silts and gravels.

7.2.1.4 Borrow Area 4 - Northeast of Fuel Bladders

Borrow Area 4 is in the same location as Potential Landfill Location A (northeast of the fuel bladders). Testpits ET-1105 and ET-1106 were completed in order to obtain an assessment of the general soil characteristics of the borrow area. In general, the materials consisted of approximately 0.3 m of well graded sand overlying sandy gravel with trace silt/clay. There is a 0.10 m thick layer of organics overlying the granular material. The area of the granular deposit is approximately 1,370 m² and is estimated to have a thickness of approximately 1.0 m. The estimated available volume is 1,370 m³. The seasonal water table was present at a depth of approximately 0.76 m.

7.2.1.5 Borrow Area 5 – North of the Former Mill Building

Borrow Area 5 is located approximately 100 m north of the former mill building. It is a small deposit consisting of silty sand, trace gravel and is approximately 265 m² with an estimated available volume of 215 m³ above the frost line at 0.76 m. Due to the silt content of the material it is frost susceptible and is not free draining, however, it could be used as general fill. This area is illustrated in Figure 6.

7.2.1.6 Borrow Area 6 – West of the Tailings Pond

Borrow Area 6 is located approximately 200 m west of the tailings pond and is illustrated in Figure 7. Several testpits were advanced in Borrow Area 4 (ET-1114 and ET-1115 and ET-1116). In general, the borrow area consists of a well graded sand and gravel with trace silt/clay overlain by 0.1 m thick organic layer. Based on the site investigation data, an area of approximately 2,665 m² and a confirmed thickness of 1.08 m, the estimated quantity of available borrow material is 2,880 m³. Note however, that the deposit may be thicker than 1.1 m and additional material may be available. This deposit is located relatively far away from the mine site as compared to the other deposits, however is still within economical haul distance. The deposit is located on a slope between two rock outcrops and may be difficult to access for trucks due to the grade.

Note that an additional granular deposit is located approximately 500 m to the west of the site. It consists of a sand and gravel outwash deposit and is estimated to contain 5,000 m³ of sand and gravel material. It is deposited along a south facing slope and due to it's relatively long distance from the site is considered a less promising source, although it is the largest single source identified during site investigations.

7.2.2 Ida Bay Borrow Areas

A granular deposit of approximately 1,200 m³ volume was identified approximately 250 m northeast of the Ida Bay adit and is immediately adjacent to the former camp area. The deposit consists of sand and gravel with 1.1% fines and has a confirmed thickness of 1 m. The location is illustrated in Figure 3 and is accessible from the adit area.



7.3 Summary of Granular Borrow Resources

The various granular borrow sources identified during site activities are summarized in Table 7.1 below.

Table 7.1: Granular Borrow Area Summary

Borrow Area	Estimated Volume (m ³)	Distance to Site (m)	Material	Notes
1	300	200 m east of former camp	Fine to medium grained sand	South of former explosives storage area
2	2,520	South side of waste rock piles	64-74% sand, 26-33% gravel, 1% fines	50 m south of former garage. Water at 0.6 m
3	2,250	Approx 100 m south of former camp	Medium to coarse grained sand	Cobbles and boulders near shoulders of rock outcrops
4	1,370	40 m NE of fuel bladders	Well graded sand layer over gravel	80m northeast of Adit No. 1. Water at 0.76m depth
5	215	100 m north of Mill	Silty sand	Frost at 0.76 m
6	2,880	200 West of Tailings Pond	62% sand, 37% gravel, 1% fines	Deposited along a slope
Total	9,535		An additional granular source of estimated volume 5000 m ³ is located approximately 500 m to the west of the site along a south facing slope. This source is not included above due its distance from the site and the potential for damage to the tundra during hauling.	
Ida Bay	1,200	250 NW of adit	55% sand, 44% gravel, 1% fines	At former camp site

8.0 WORKS CITED

Rescan Environmental Services and PWGSC, Phase I/II Environmental Site Assessment, Roberts Bay Silver Mine and Ida Bay Silver Deposit, Nunavut, February 2004, Prepared for INAC

Environment Canada. 2002. Canadian Climate Normals, 1971-2000, Prairie Provinces.

S PHOTOGRAPHS



APPENDIX A FIGURES



ROBERTS BAY AND IDA BAY MINE SITE OVERVIEW NOT TO SCALE

GENERAL AREA OVERVIEW
NOT TO SCALE

Date: October 07, 2005



LEGEND:



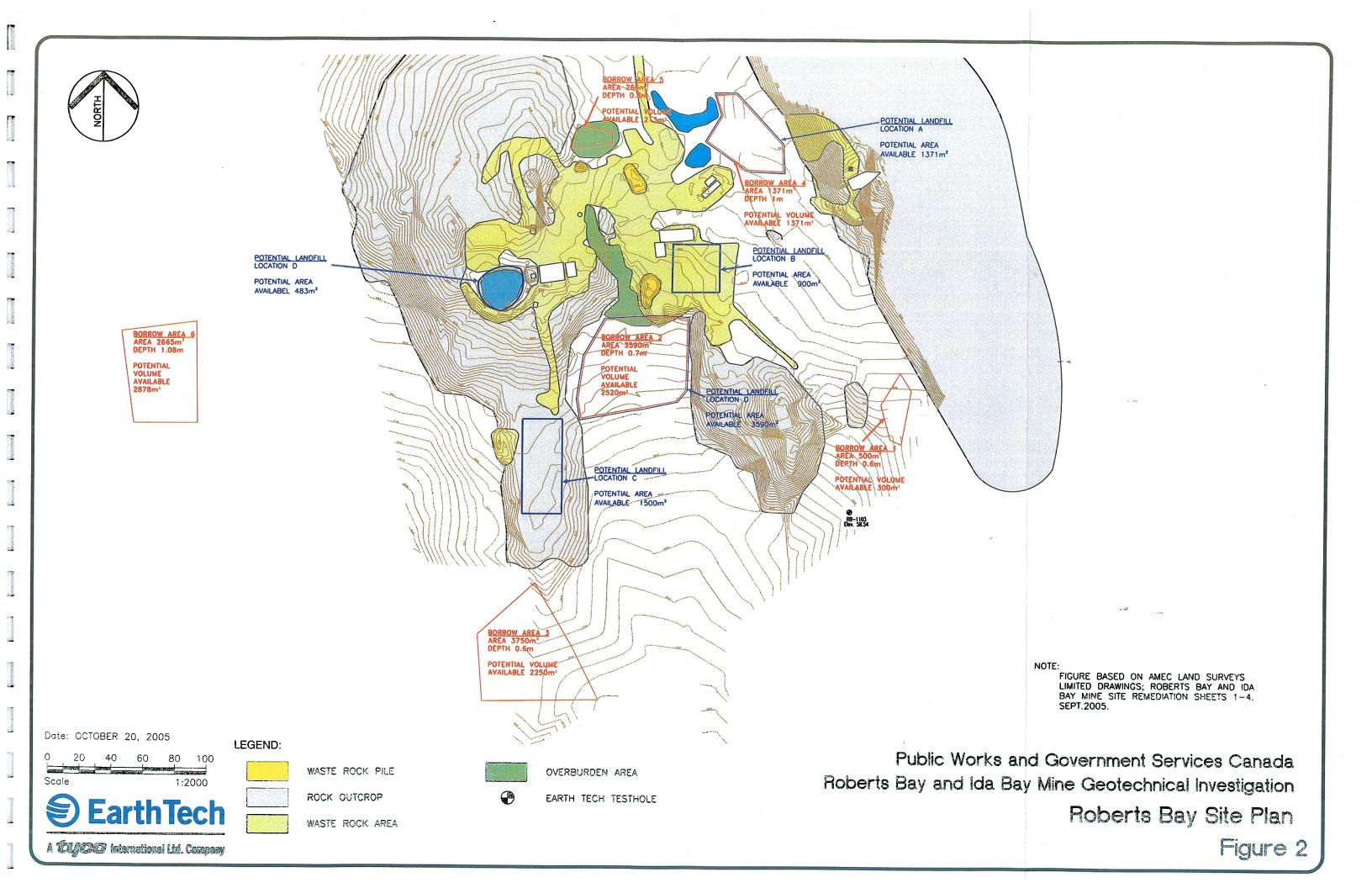


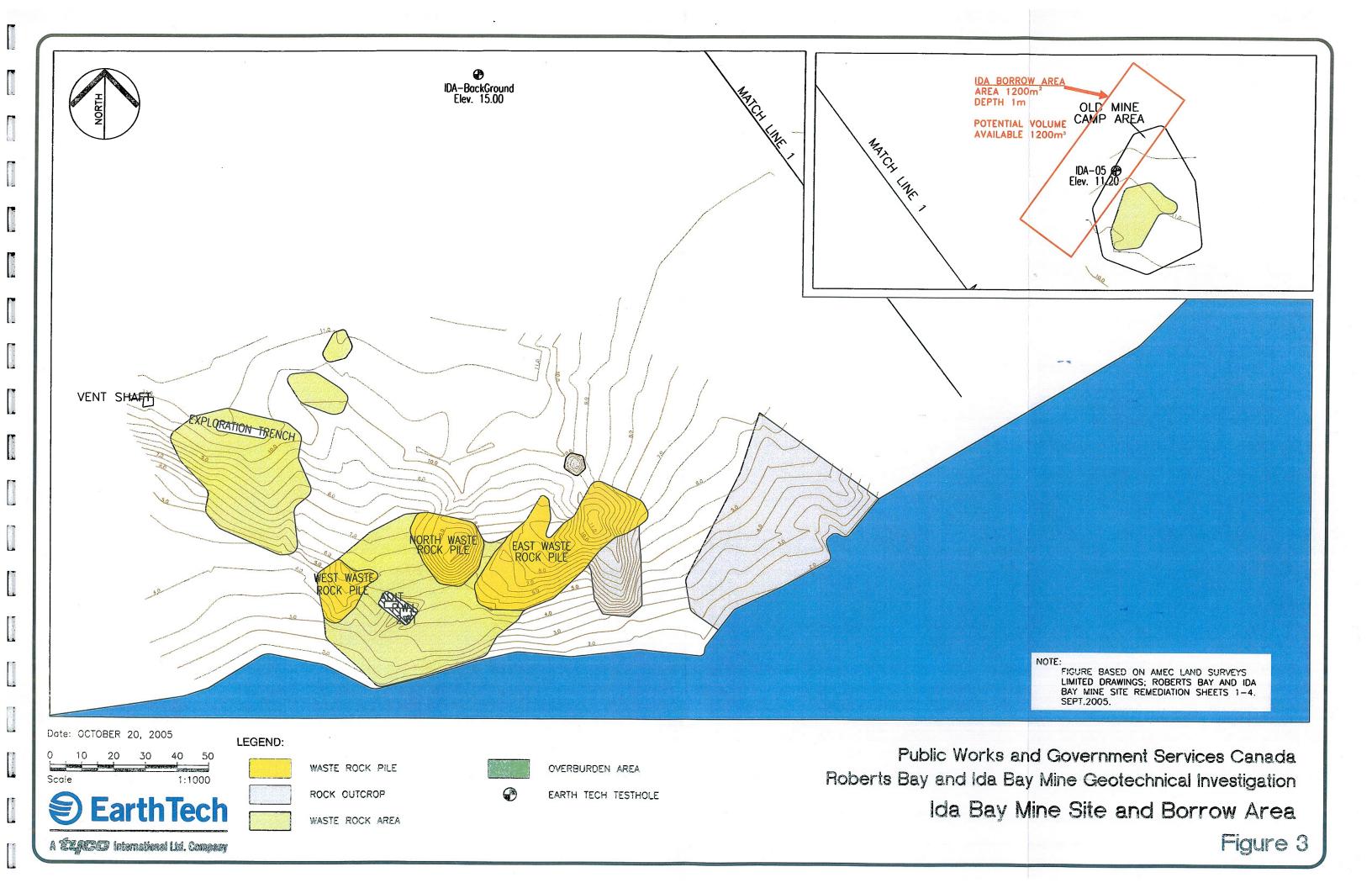
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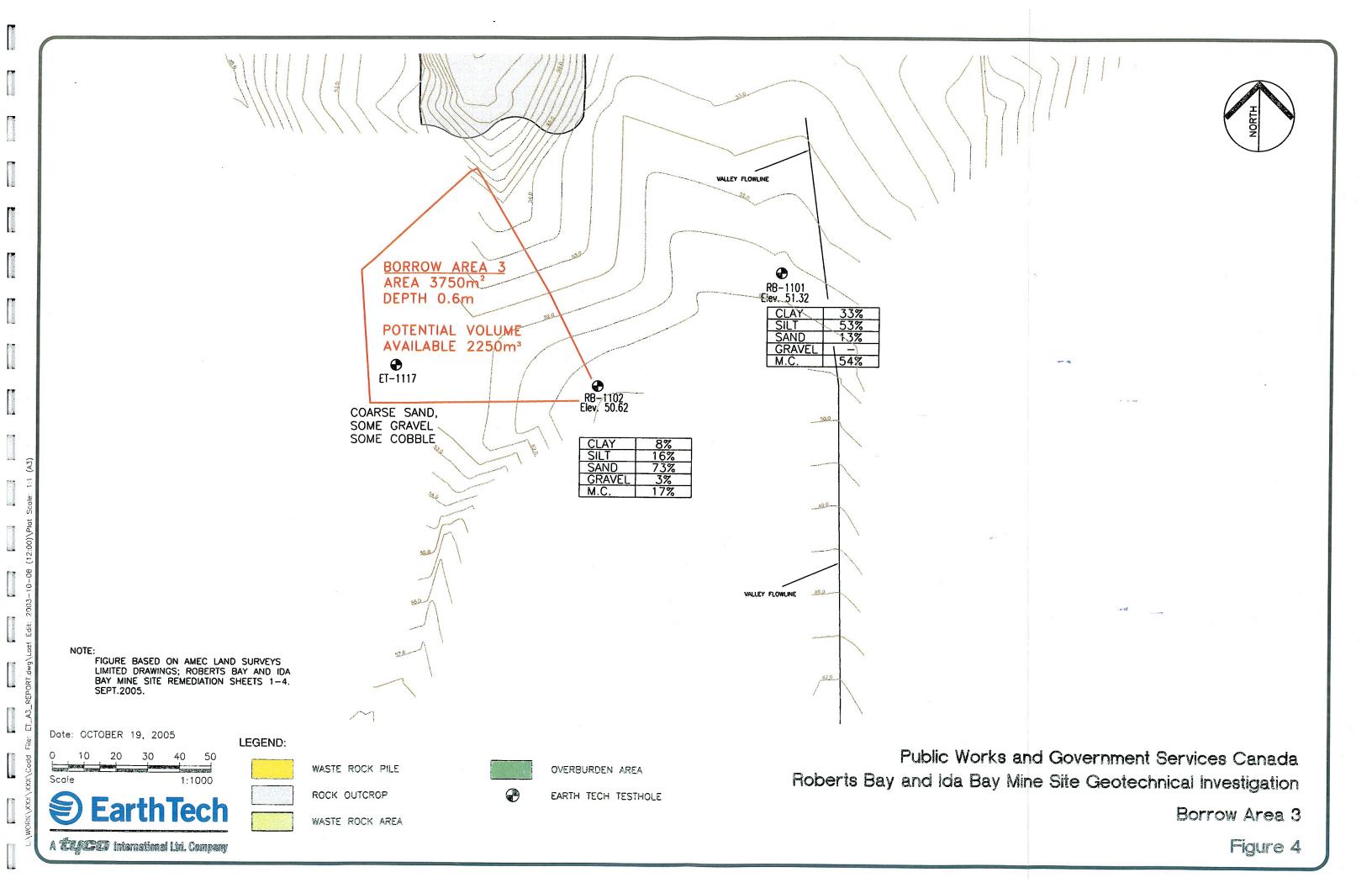
FIGURE BASED ON AMEC LAND SURVEYS LIMITED DRAWINGS; ROBERTS BAY AND IDA BAY MINE SITE REMEDIATION SHEETS 1-4. SEPT.2005.

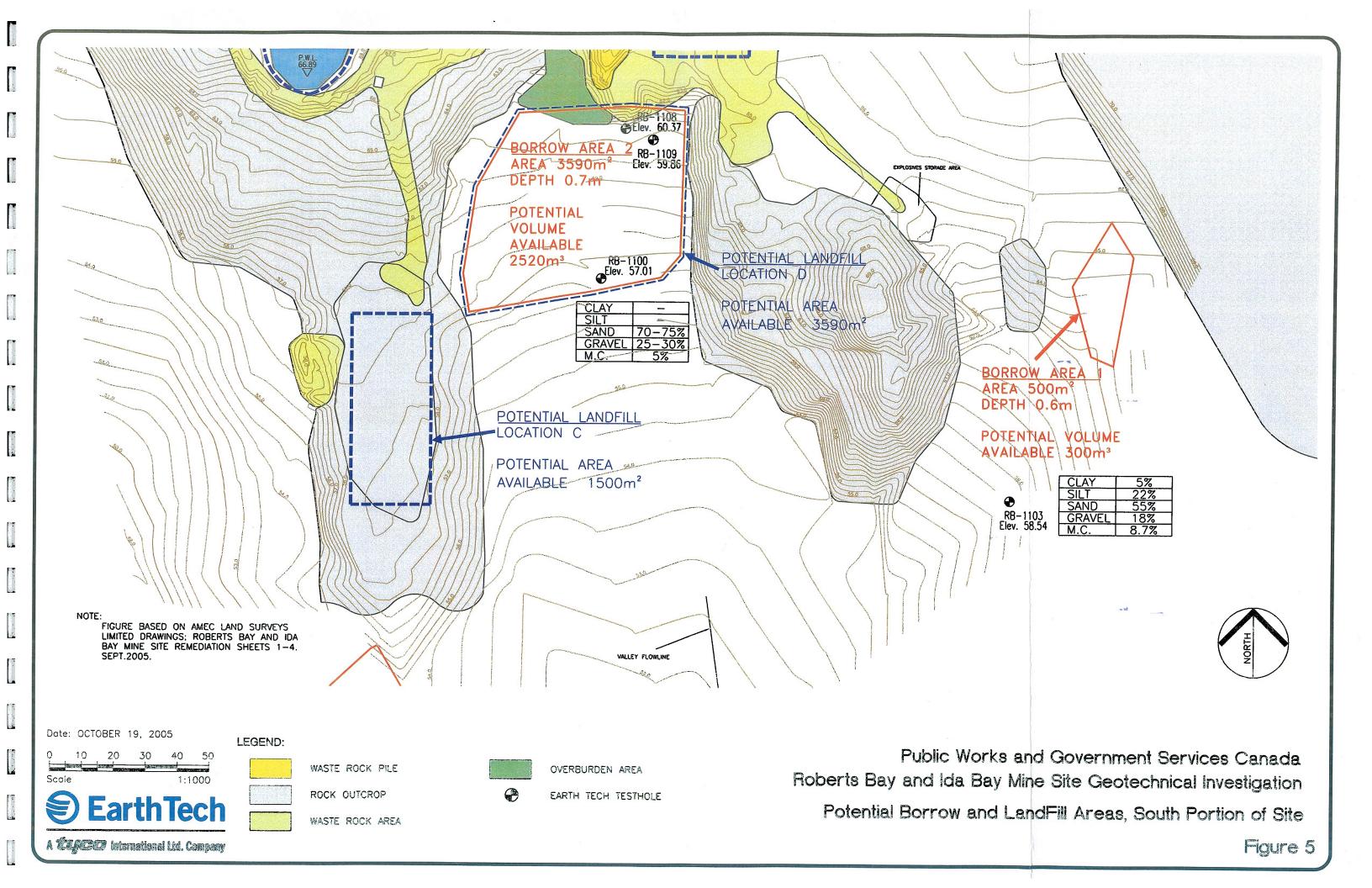
Public Works and Government Services Canada Roberts Bay and Ida Bay Geotechnical Investigation Location Plan

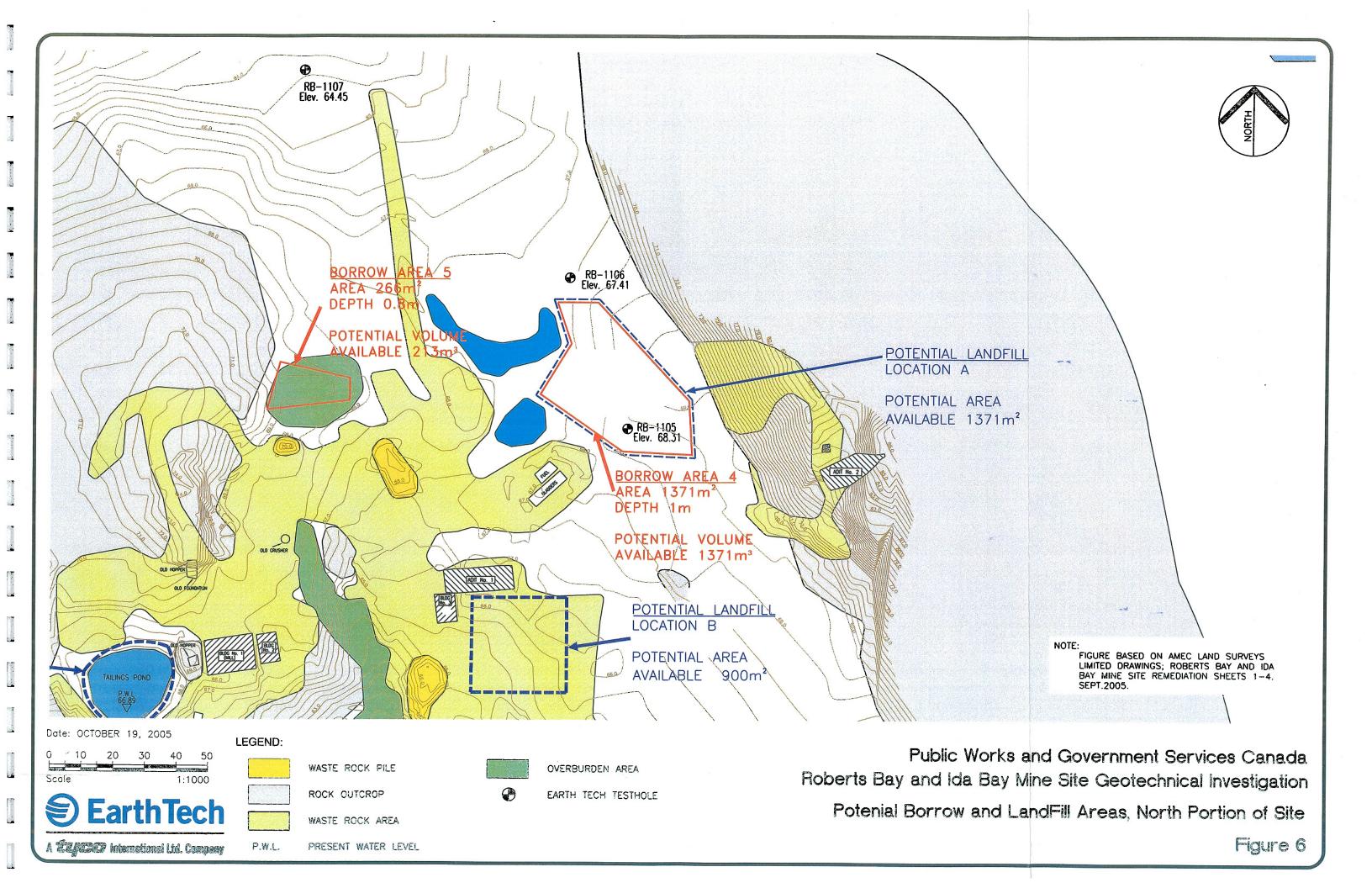
Figure 1













POTENTIAL LANDFILL LOCATION D

POTENTIAL AREA AVAILABEL 483m²

CLAY	_
SILT SAND	
SAND	62%
GRAVEL	38%
M.C.	

BORROW AREA 6 AREA 2665m² DEPTH 1.08m POTENTIAL VOLUME AVAILABLE 2878m³ ET-1116

ET-1114 ET-1115

.

FIGURE BASED ON AMEC LAND SURVEYS LIMITED DRAWINGS; ROBERTS BAY AND IDA BAY MINE SITE REMEDIATION SHEETS 1-4. SEPT.2005.

Date: OCTOBER 19, 2005

A TOURS International Ltd. Company

LEGEND:

WASTE ROCK PILE

ROCK OUTCROP

WASTE ROCK AREA

P.W.L. PRESENT WATER LEVEL



EARTH TECH TESTHOLE

Public Works and Government Services Canada Roberts Bay and Ida Bay Mine Site Geotechnical Investigation

Borrow Area 6

Figure 7

APPENDIX B SITE PHOTOGRAPHS



Photo 1: Potential Landfill Location A looking West



Photo 2: Potential Landfill Location B, Center Left, on Waste Rock Pad

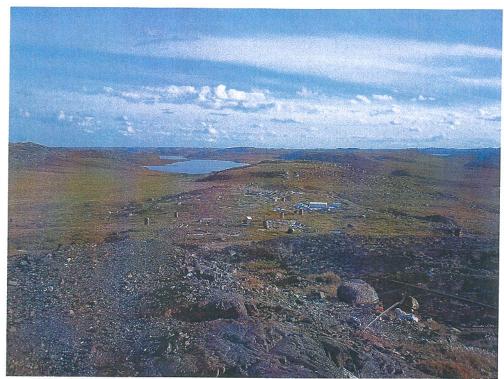


Photo 3: Potential Landfill Location C, Old Campsite in Center of Photo

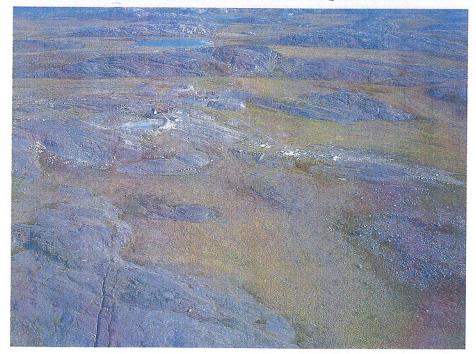


Photo 4: Potential Landfill Location D, looking East

Site is south of waste rock pile and east of old campsite. Note tailings pond at center-left and camp dumpsite just below old campsite.



Photo 5: Borrow Area 1 in foreground, looking South

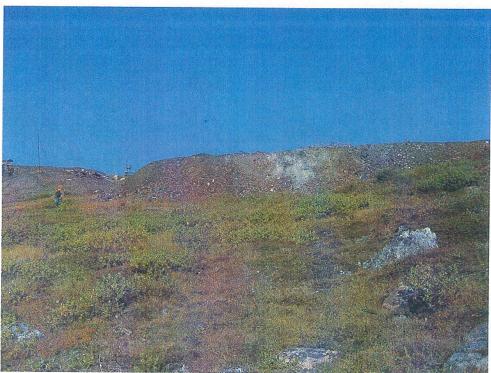


Photo 6: Borrow Area 2, looking North



Photo 7: Borrow Area 2, Testpit ET-1100



Photo 8: Borrow Area 3, looking South



Photo 9: Borrow Area 4, looking West

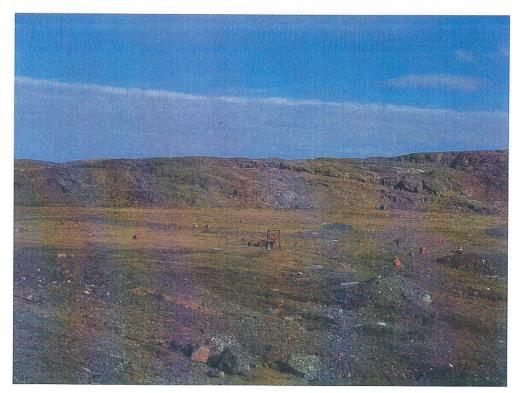


Photo 10: Borrow Area 5, Center, immediately West of hopper, looking East



Photo 11: Borrow Area 6, looking Southeast

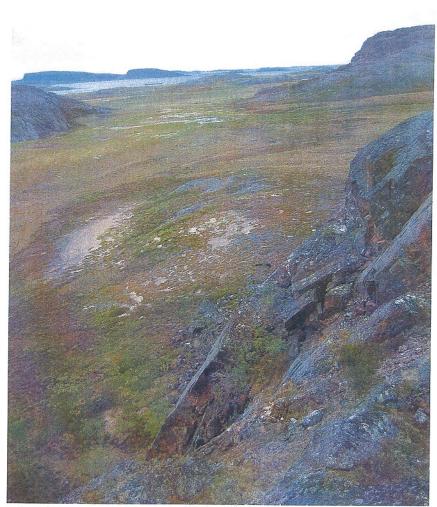
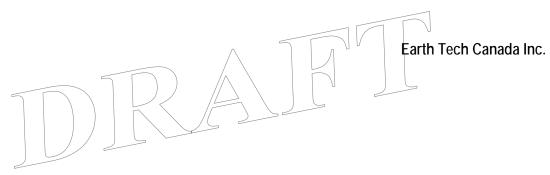


Photo 12: Additional Borrow Area located 500 m west of site, looking Northwest

APPENDIX C EBA GEOPHYSICAL REPORT



ENVIRONMENTAL PHASE III SITE ASSESSMENTS AND WASTE AUDIT GEOPHYSICAL INVESTIGATION AT ROBERTS BAY AND IDA BAY ROBERTS BAY AND IDA BAY, NUNAVUT

1940010

October 2005

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1.0 INTRODUCTION

1.1 GENERAL

The abandoned Roberts Bay Silver Mine is on the list of 97 priority contaminated sites funded under the Federal Contaminated Sites Action Plan in 2005-2006. The mine began operation in 1973 and was closed in 1975, although exploration continued throughout the 1990's. The Roberts Bay site includes an exploration camp located on the shores of Roberts Lake; and the Mine Camp, Mill and Garage, located 1 km north of the lake. The Ida Bay Silver Deposit is located another 7 km north of the Roberts Bay camp on the shores of Melville Sound.

Hydrocarbon contaminated soils were identified in 2003 during a site investigation. Waste rock piles, metal framework and scattered debris remain at the Roberts Bay and Ida Bay sites.

EBA Engineering Consultants Ltd. (EBA) partnered with Earth Tech Canada to provide geophysical investigation services at the Roberts Bay and Ida Bay sites. The objective was to identify and map buried debris areas, and define the limits of any known landfills. The investigation contract was administered by the Public Works & Government Services of Canada (PWGSC) on behalf of Indian and Northern Affairs Canada (INAC).

1.2 SITE VISIT

The Roberts Bay and Ida Bay Silver Mines are approximately 125 km southwest of Cambridge Bay at 68°10'45" latitude and 106°33'29" longitude. A location map is provided in Figure 1. The geophysical investigation at Roberts Bay was carried out between August 17 and August 18, 2005, by Mr. Brad Anshelm of EBA's Edmonton office. On August 19, Mr. Anshelm assisted the Earth Tech environmental sampling program. It was decided on site by Earth Tech and PWGSC that the geophysical investigation was not needed at the Ida Bay site. The rationale for this was that remediation work was already planned for the waste rock at the Ida Bay site. Therefore, any metallic debris would be identified and removed as part of the process.

All geophysical data collection took place 1 km north of Roberts Lake in the vicinity of the mine site. A total of six data collection areas suspected to contain buried debris were investigated:

- The Ida Bay Access Trail;
- The Machine Shop Area;
- The Old Camp;
- The South Mill Access Road;
- The Mill Area; and



Waste Rock Pile 1.

These locations were selected for investigation because they covered the majority of previous mining activities. These areas contained ferrous surface debris, and were suspected to have buried debris as well.

1.3 PREVIOUS WORK

The Roberts Bay site was visited in August 2003 to collect water, soil and hazardous material samples from the site. Existing landfills and locations of other buried debris had not been assessed prior to the geophysical investigation undertaken by EBA in 2005.

2.0 METHODOLOGY

The six areas at the Roberts Bay site were surveyed using Geometrics G-856 and G-858 magnetometer systems.

The G-856 proton precession magnetometer was used as a base station to record diurnal variations in the background magnetic field strengths for total magnetic field strength corrections during the course of the field program.

The G-858 portable cesium magnetometer was used as a roving field gradiometer with two vertically orientated sensors separated by 1 meter to measure vertical total magnetic field strengths. The difference between the readings of the two sensors is a measure of the magnetic gradient at that location, which is proportional to near surface ferrous objects. Locations with high magnetic gradients will correspond to areas with large quantities of ferrous debris and therefore potential landfill or debris piles. The gradient is plotted as color contours on a grid system and provides a visual representation of the location and distribution of magnetic gradient anomalies. On the color contour map, a yellow background indicates a limited or nil response. High magnetic gradients are represented by either red at approximately +100 NanoTeslas per meter (nT/m), or blue at -100 nT/m. There is no significance between a positive or negative anomaly, other than it provides an indication of the polarity and therefore direction of the magnetic gradient.

The gradiometer data set was collected by walking parallel lines approximately 2.5 to 5 meters apart. Areas covered with substantial surface debris were avoided to prevent mapping out visible areas of debris, and prevent possible sensor errors due to a high magnetic field gradients.

A real time differentially corrected GPS was used with the G-858 roving field unit to provide integrated sub-meter positioning accuracy. A Trimble AG132 GPS unit was used as the main GPS receiver collecting GPS positioning data and transmitting NMEA GPS strings to the G-858. Positions were recorded at one second intervals with the gradiometer data. The GPS data collected by the Trimble AG132 GPS receiver was corrected in real time by a CDGPS RTCM correction box that uses satellite relayed correction data from an MSAT satellite in geo-synchronous orbit. The RTCM corrections were calculated using the



GPS correction data generated by the Canadian GPS base station grid and location of the field roving unit.

The resulting accuracy of the system is less than 1 meter horizontally and 2 meters vertically. All geophysical survey lines are identified by small black cross-marks on the attached figures.

All positioning data has been reported in UTM coordinates using the NAD83 datum. The Roberts Bay site falls within Zone 13 with a central meridian of -105 degrees west.

3.0 RESULTS

A total of six locations were investigated at Roberts Bay Site. The overall plan map showing the relative location of all surveyed sites is shown in Figure 1. Within each area, anomalous lobes are identified where gradiometer readings were significant. The larger lobes are indicative of either larger objects, or several objects situated in the same area. Smaller anomalies are the result of individual, compact ferrous surface debris and are not labeled.

Along with the gradient contours, separate top and bottom sensor contours of diurnally corrected total magnetic field strength are also plotted. The total magnetic field strength is useful in providing a sense of where the greatest concentration of ferrous debris and potentially buried material are situated. Results for each area are discussed in following subsection.

It should be noted that the geophysical survey lines do not always parallel topographic contour lines. The geophysical survey lines were placed to provide adequate coverage over the areas surveyed, but on occasion, would be required to deviate around large debris piles or topographic features such as cliffs or lakes. An example of this is seen in Figure 4(a,b,c) where a survey line was run over the top of the waste rock pile to avoid walking through a debris pile (Lobe I). The placement of all geophysical survey areas has been checked using several different methods and are believed to fall within the level of accuracy discussed in the previous Section.

3.1 IDA BAY ACCESS TRAIL

This area is located on the northern section of the mine site and is the start of the trail to the Ida Bay Mine site (Photo 1). The area has the highest surface elevation of all six survey areas. In Figures 3 (a,b,c), Lobe A is located at the storage pad on the southern portion of the surveyed area. Lobe A consists of a large iron beam and two fuel drums.

Smaller surface debris is scattered across the area; buried debris is not suspected in this area.

3.2 MACHINE SHOP AREA

The Machine Shop area is located south of the Mine vestibule and Machine Shop (Photos 2 and 3). The surveyed area and geophysical results are presented in Figures 4 (a,b,c). The area is scattered with ferrous surface debris, concentrated near the machine shop on the



northwest corner of the survey. Large iron support beams are included with some of the surface debris. The surface debris is scattered eastward though the survey area, and represented by Lobes C to I.

Lobe B is located on the southeast portion of the survey area. A large gradient anomaly is noted at this location. It is believed to be due to be a result of surface rock with a high magnetic susceptibility and not buried ferrous debris. This is because exposed bedrock was noted along these lines at locations where high gradients were noted. If the gradient anomaly had been caused by buried ferrous debris, one would expect more variation in the gradient readings and changes in polarity of the gradient readings. This reflects the fact that the individual ferrous debris items would be randomly oriented with respect to each other. Finally, the magnetic base station readings at the time this data was surveyed (see Figure 5) show a large spike in the background total field readings. If the magnetic susceptibility of the surface rock is high enough this may have contributed to the high magnetic gradients measured by inducing additional magnetic field components in the rock adding to the vertical gradients measured.

The geophysical results of this area do not suggest the presence of buried debris; however, it is noted that some buried material may be present in small quantities beneath the larger concentration of surface debris.

3.3 OLD CAMP

The Old Camp is located approximately 70 m south of the tailings pond (Photos 4,5,6). This area was used for housing during summer mining operations, and later used as a collection point for refuse. The surface debris covering the Old Camp area consists of metal cans, metal frames and beams, two antenna shafts, furniture, and kitchen appliances. Over ten fuel drums were counted in the area. The geophysical survey results are shown in Figures 6 (a,b,c) and cover an area southwest of the main surface debris area. The survey detected a low vertical gradient which has been attributed to geological features throughout except for areas Lobes J and K.

Lobe J corresponds to ferrous surface debris near a waste rock berm. The debris includes a metal bucket, wires, and a steel antenna. If there is buried debris, quantities would be small and would be contained below the surface debris within the berm.

Lobe K is located in a slight surface depression and corresponds to surface debris such as cans and other ferrous debris. The high vertical gradient in Figure 6a (greater than 200 nT/m) and total magnetic field (Figures 6b, 6c) would not account for smaller ferrous objects such as cans. This indicates that there exists the potential of a medium sized buried ferrous object, or a shallow rock with high ferromagnetic properties.

If any buried debris is present, it will be contained to the area where the surface debris is located.



3.4 SOUTH MILL ACCESS ROAD

The South Mill Access road is located south of the Mill Building (Photo 6). The area was used as an access road moving material to and from the mill. The overall vertical gradient was low, except at Lobe L where a large rock with magnetic properties is located. The only surface debris in this area was a metal spike at the southeast corner of the survey. At the north end of the survey, the higher vertical gradient is attributed to a shallow ferromagnetic rock. The geophysical results are represented in Figures 7 (a,b,c).

Buried debris is not suspected in this area.

3.5 MILL AREA

The Mill Area surveyed is located west of the Mill building, and north of the Tailings Pond (Photos 7, 8). The geophysical results are presented in Figures 8 (a,b,c). A vertical gradient of between 70-130 nT/m is found throughout the area and is attributed to be the result of magnetic rock. A pile of large ferrous surface debris at the southeast corner is indicated as Lobe M.

All ferrous material detected in the geophysical survey can be seen at the surface. Buried debris is not suspected in this area.

3.6 WASTE ROCK PILE 1

The Waste Rock Pile that was surveyed is located west of the Mine adit and vestibule, and south of the access road to the Ida Bay site (Photos 9, 10). The surveyed results are presented in Figures 9 (a,b,c). The presence of magnetic rock results in a mid to high gradient throughout the survey area. Lobes N and O are the result of a pipe and fuel drums located at the surface.

Buried debris is not suspected at this location.

4.0 LIMITATIONS

Several different factors may affect the accuracy of the interpreted data. This section discusses limitations due to the presence of surface debris, the performance of the gradiometer, the presence of ferromagnetic rock, and the performance of the GPS.

When locating areas of buried debris; all geophysical equipment, including gradiometer surveys, are limited by the presence of ferrous debris at the surface. The gradiometer survey cannot discriminate between surface anomalies and buried anomalies. It is recommended that Earth Tech should perform a final correlation between the geophysical results and the mapping of surface debris that they have documented. This will confirm that all mapped high gradients can be correlated with known surface debris.

It is also believed that rock containing ferromagnetic minerals was found throughout the surveyed area. In general, basic igneous rocks have very high magnetic susceptibilities compared to sedimentary rocks. The survey results through most areas (Ida Access, Milling Area, South Milling Area, and Waste Rock Pile 1) indicate a medium range vertical gradient



of 40-120 nT/m, with anomalous patterns indicative of the presence of magnetic rock. Lobe B in the Machine Shop Area and the anomaly at the northern end of the South Mill Access Road are noted to have an even higher vertical gradient; however, they are not consistent with anomalies seen by buried debris and are therefore attributed to ferromagnetic rock.

The base map of the Roberts Bay site was compiled by AMEC based on survey data collected by AMEC, and previous site drawings. This map has been used by EBA to place the contoured geophysical results in UTM coordinates. The accuracy of the geophysical map placements was verified by topography contours, locations of features (e.g. tailings pond and buildings), field notes, and the walk path of the geophysical surveyor collecting the geophysical data

5.0 RECOMMENDATIONS AND CONCLUSION

This report summarizes the geophysical data collected by EBA during the August 2005 investigation. It is recommended that the results of the geophysics investigation be correlated with the surface inventory data collected by Earth Tech.

A total of six areas were investigated at the Roberts Bay mine site. A gradiometer system was used with the objective of identifying locations with possible buried debris. The Old Camp Area is identified as a location with possible buried debris (Lobe K). All other areas contain magnetic gradient anomalies that can be explained by either surface debris or ferromagnetic rock. A review of the total magnetic field readings does not suggest any locations with large quantities of buried material.

Geophysical data was not collected at Ida Bay due to an on site decision by Earth Tech and the PWGSC.

It is important to note that the geophysical results simply identify where ferrous (metallic) debris are present, and therefore provides a method to prioritize debris areas that need to be addressed.

6.0 CLOSURE

We trust that this report summarizes the results of the geophysical data collection at Roberts Bay and Ida Bay in 2005, and the information provided satisfies your present requirements. Please do not hesitate to contact the undersigned should you have any comments or questions regarding this report.

Respectfully submitted, EBA Engineering Consultants Ltd.



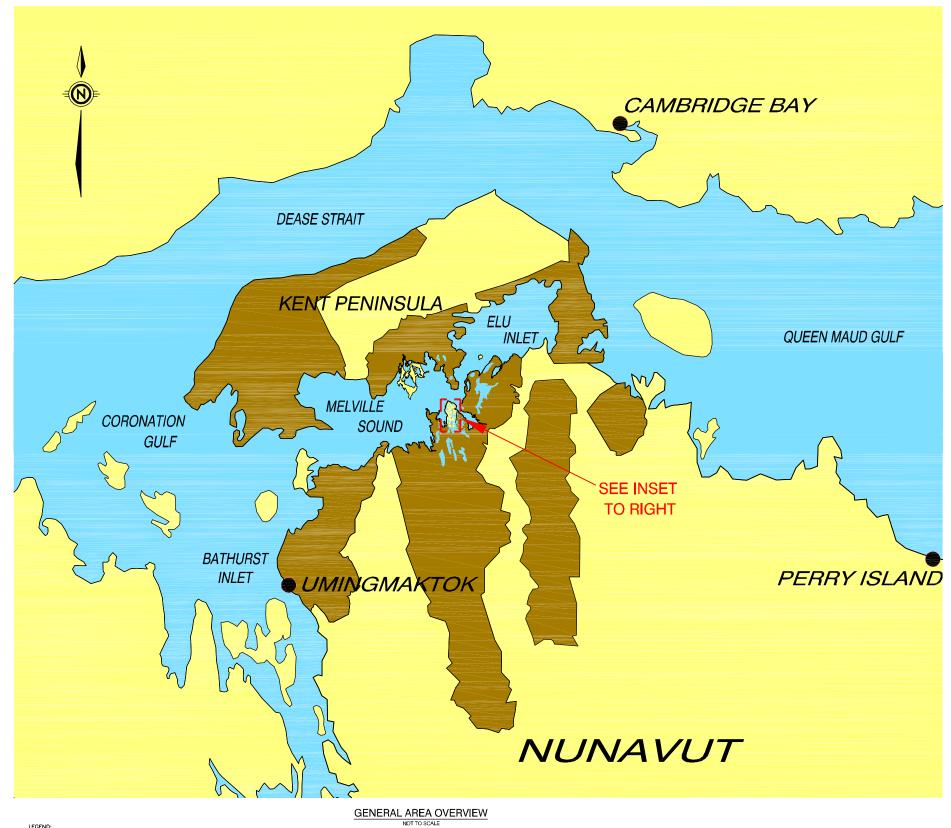
Jessie Arthur, Geoph.I.T Junior Geophysicist; Arctic Group Direct Line: 780.451.2130 x253 jarthur@eba.ca

Neil Parry, BSc.(Hon), MBA Senior Geophysical Scientist, Arctic Group Direct Line: 780.451.2130.x274 nparry@eba.ca



FIGURES







ROBERTS BAY & IDA BAY MINE SITE OVERVIEW

GRAPPIC SCALE
0 500m 1000m

LEGEND:

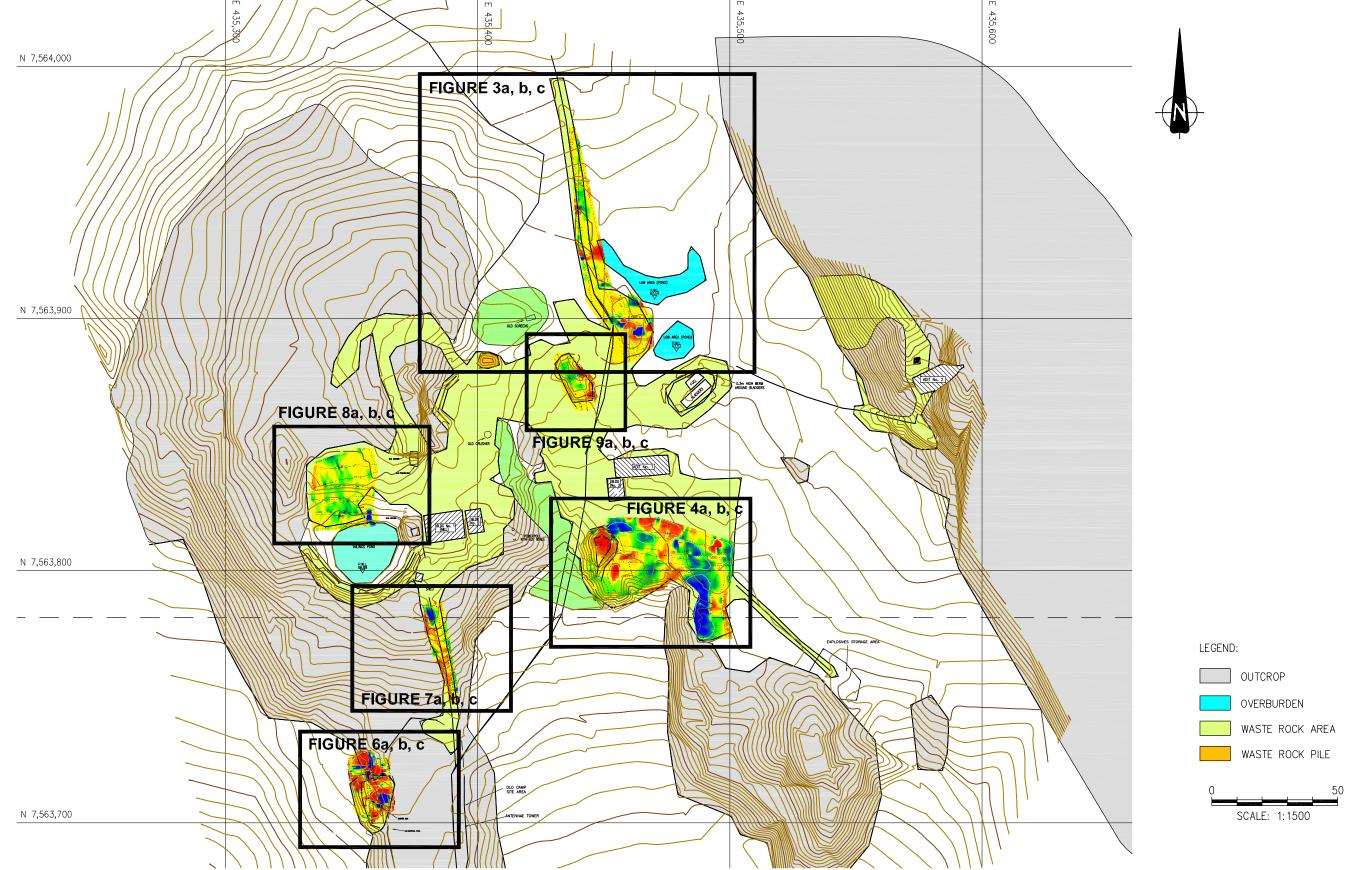
INUIT OWNED LANDS NUNAVUT LAND

MINE SITE AREA

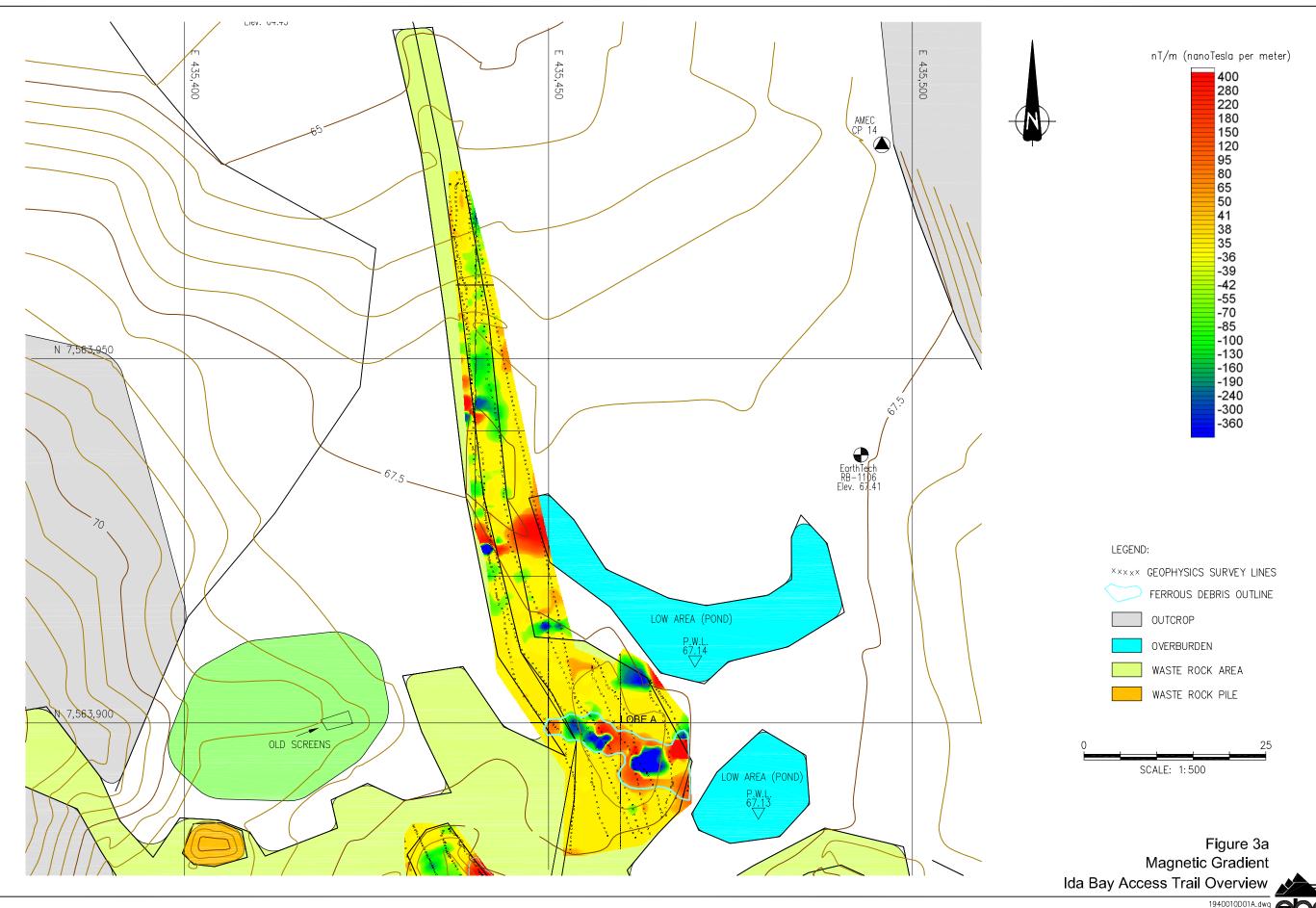
EXISTING TRAIL (ROUGH, QUAD ONLY)

Figure 1
Site Location Plan

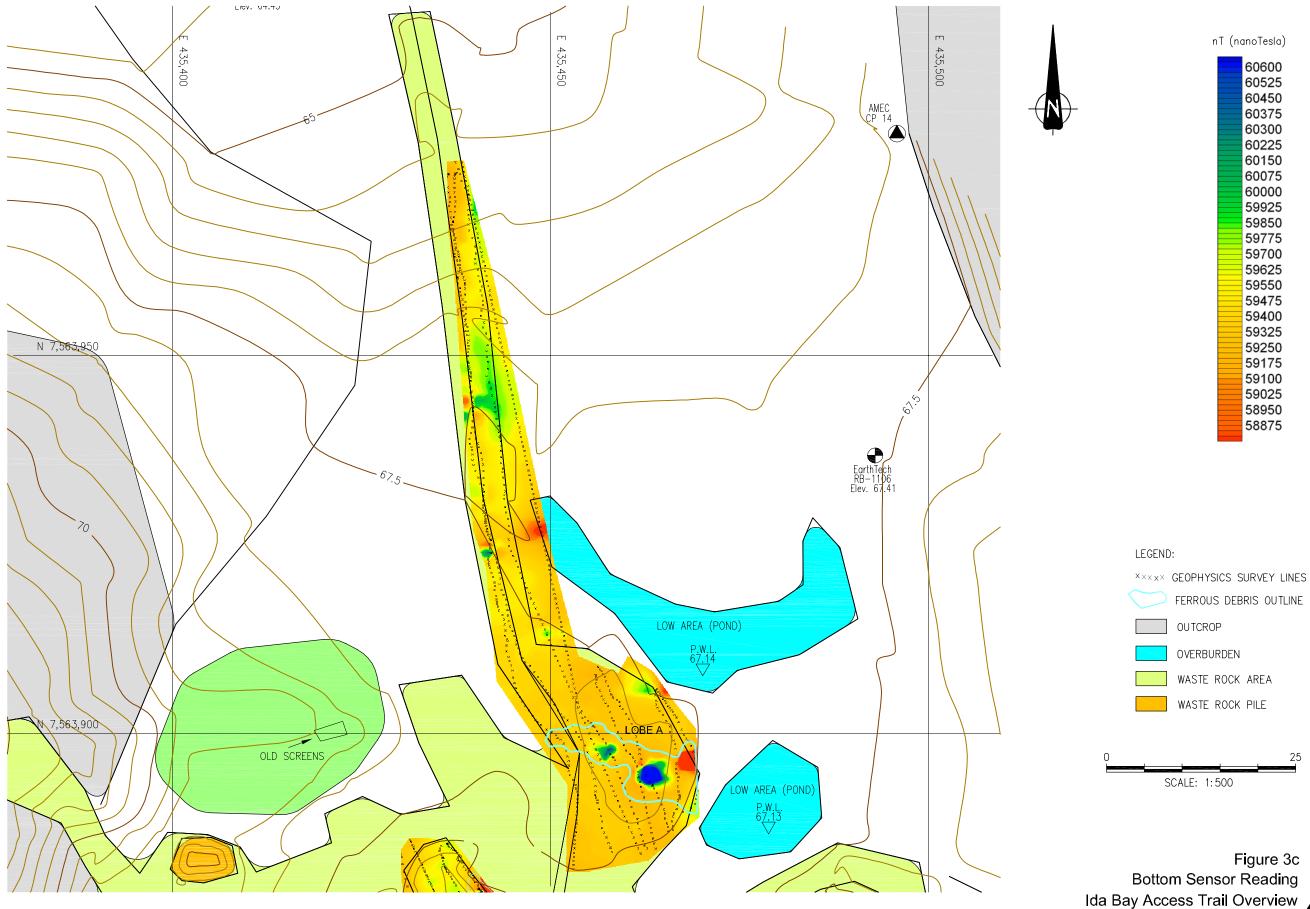
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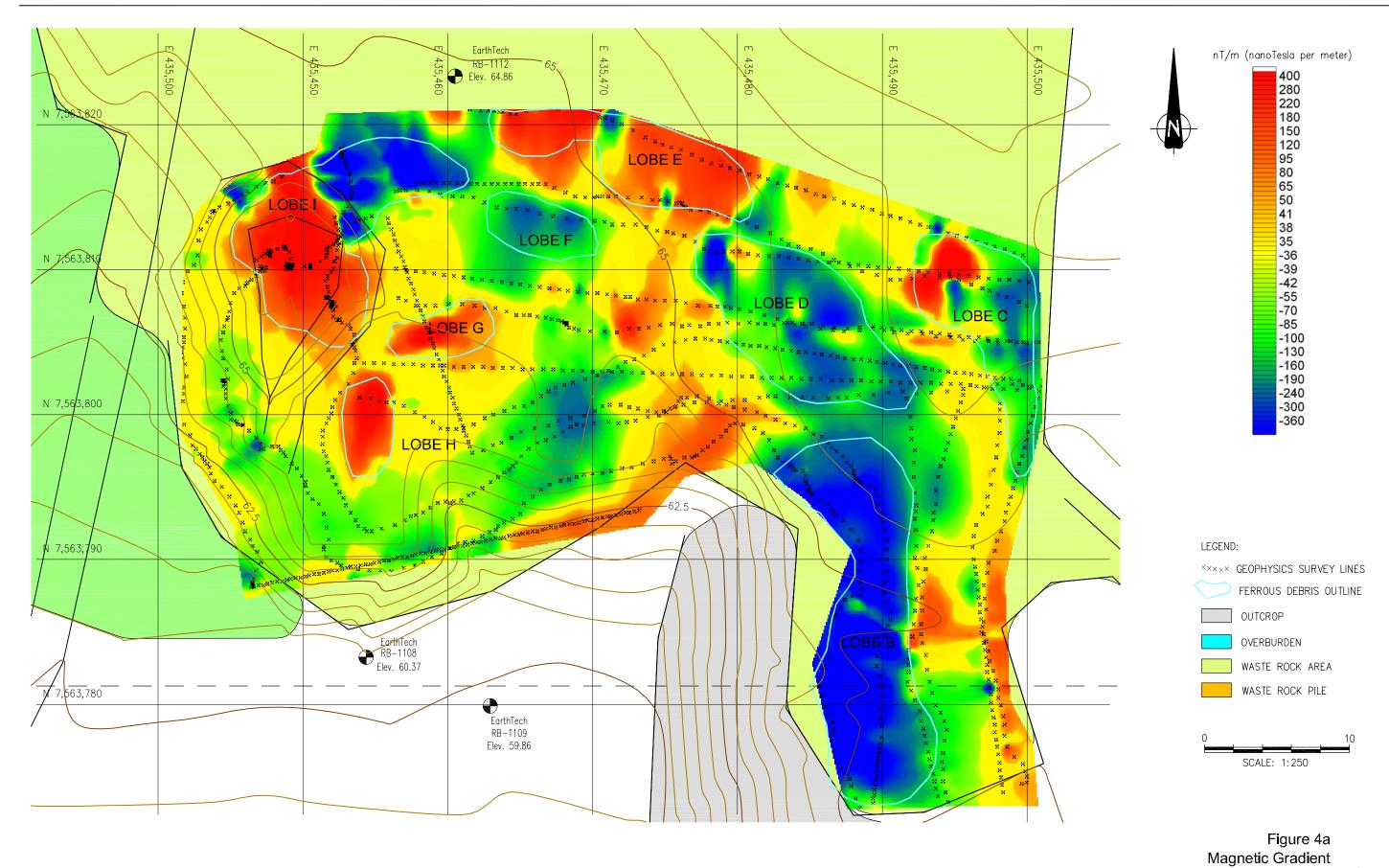


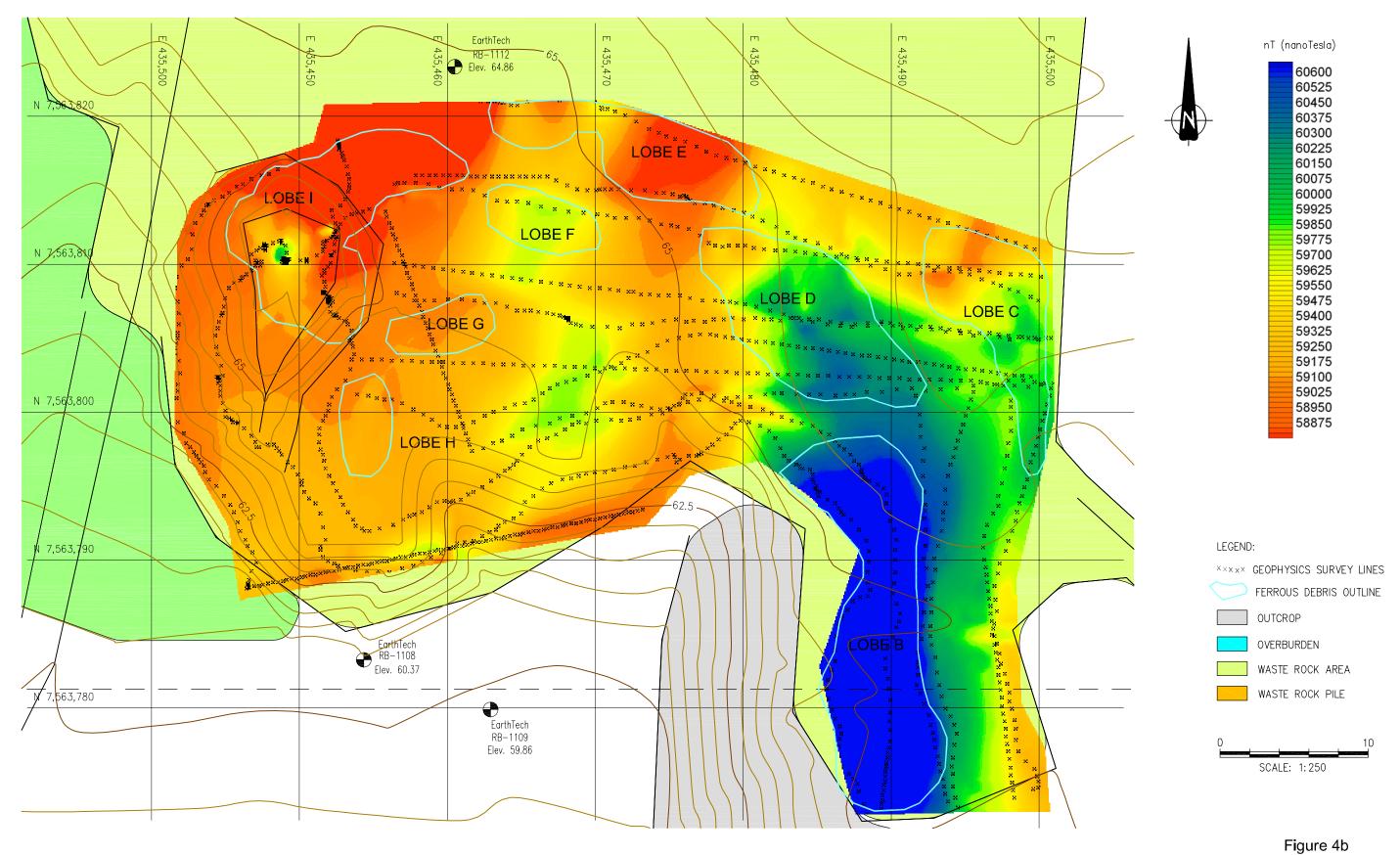




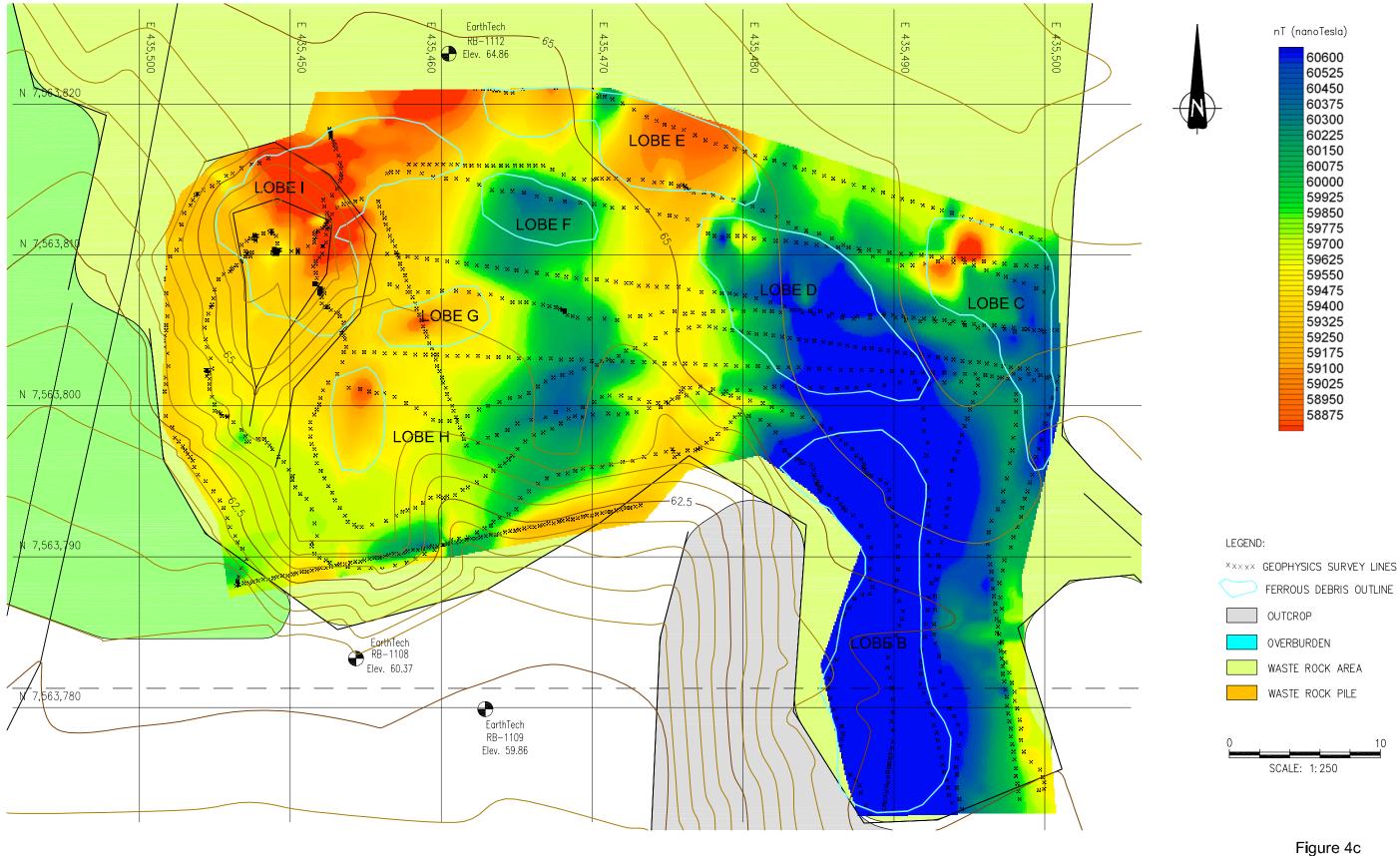
Machine Shop Area Overview

1940010D01A.dwg



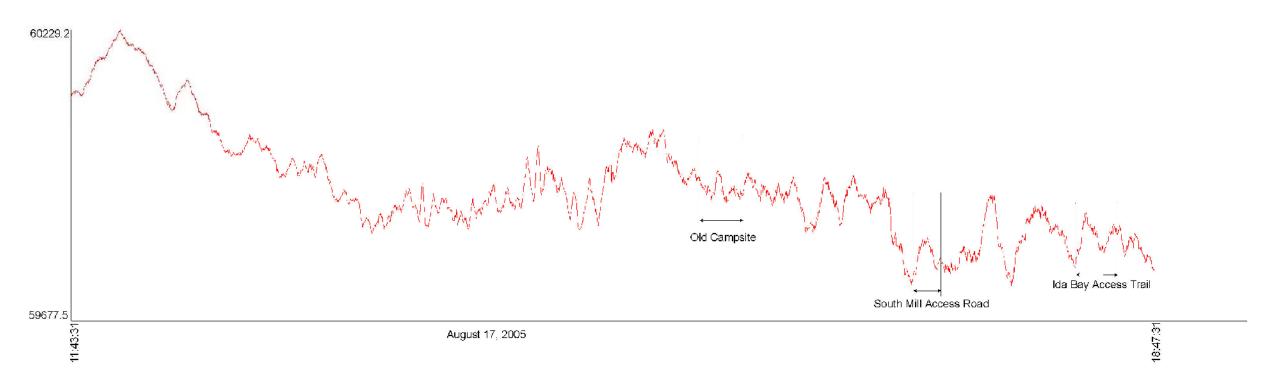


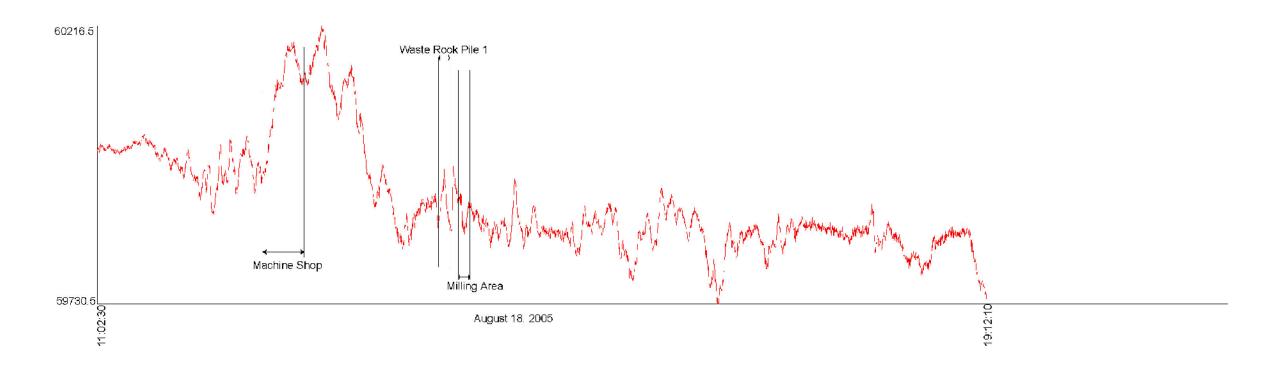


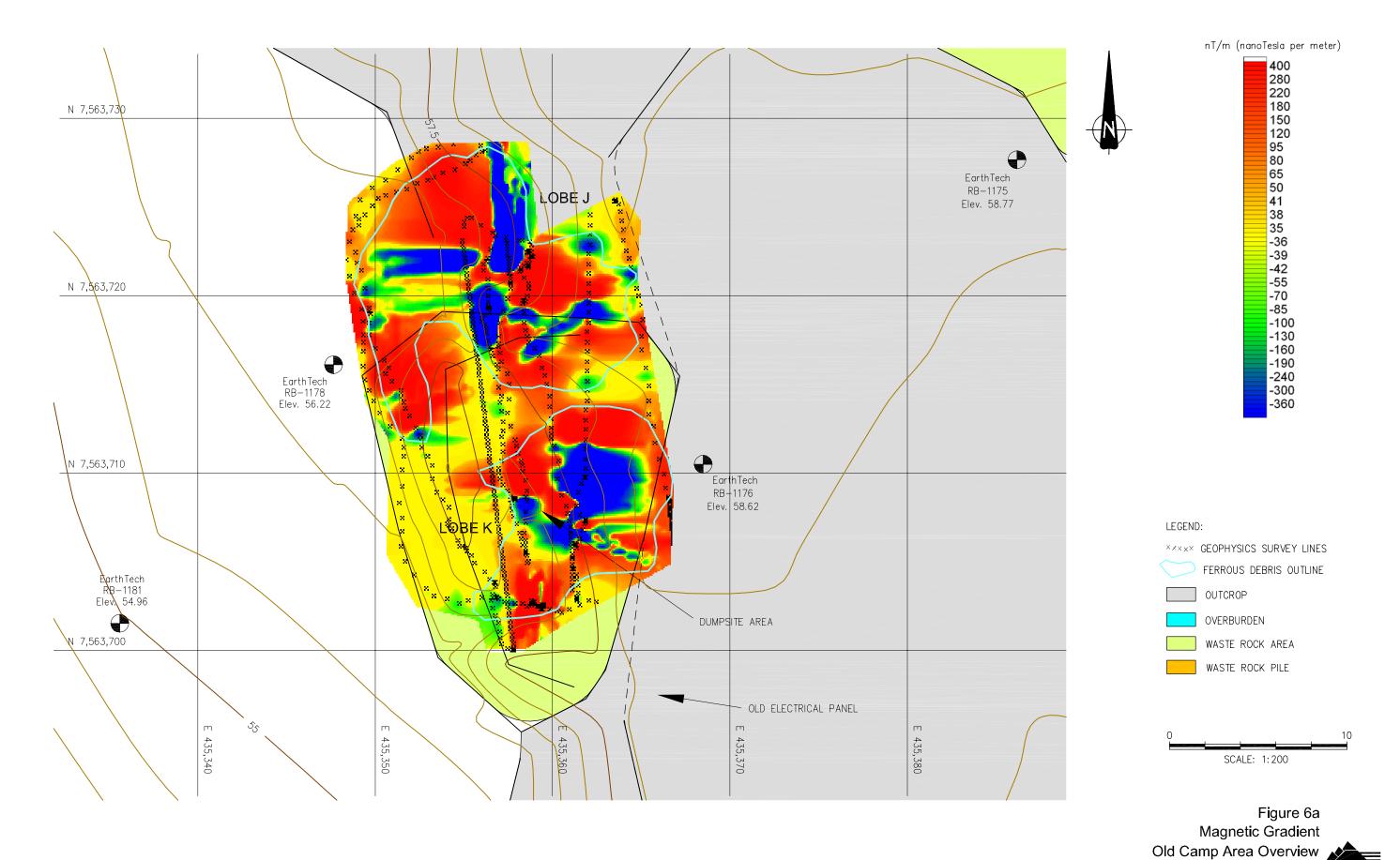


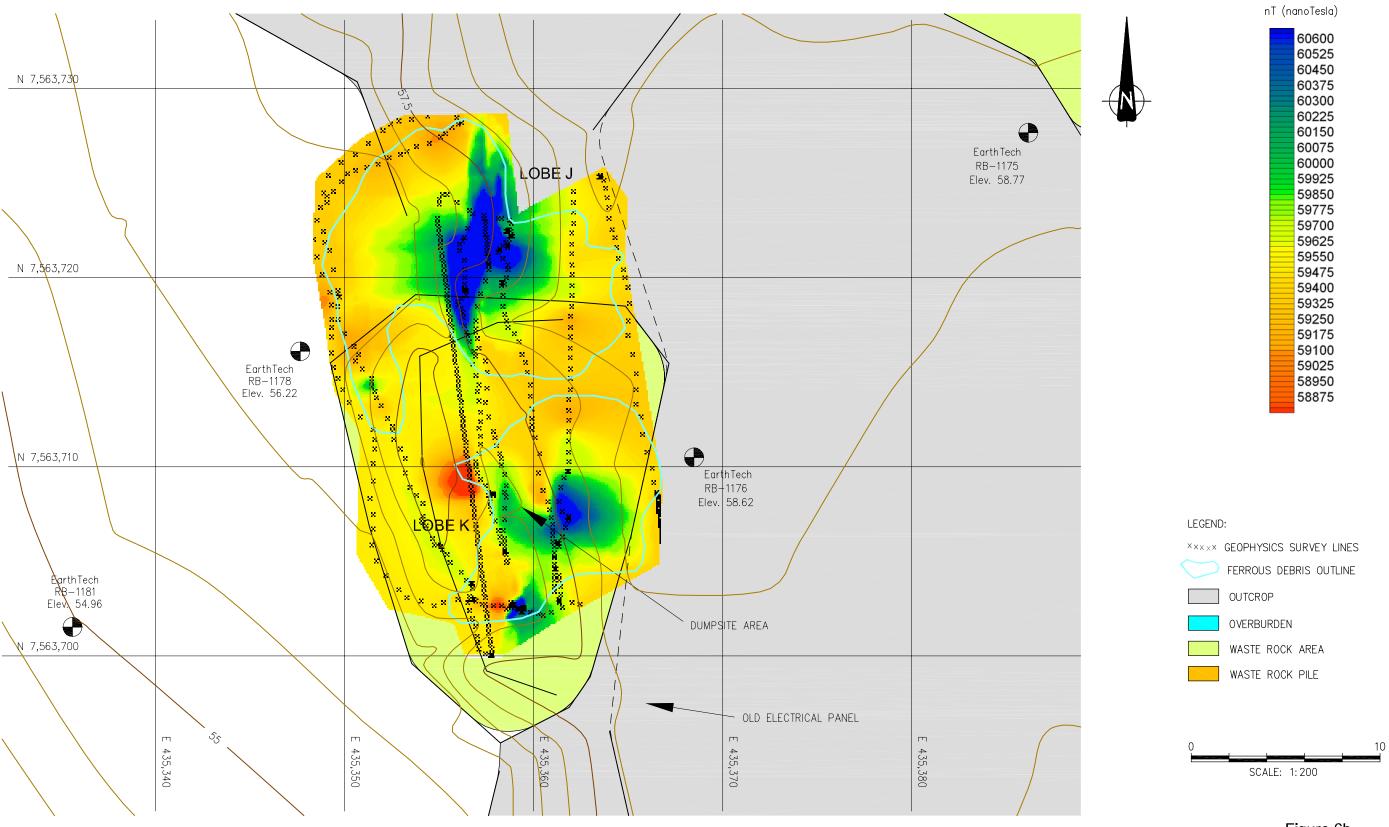


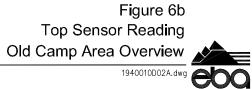
Plotting of Base Station Readings (Clock bias: 0.0s and Field Bias: 0.000nT)

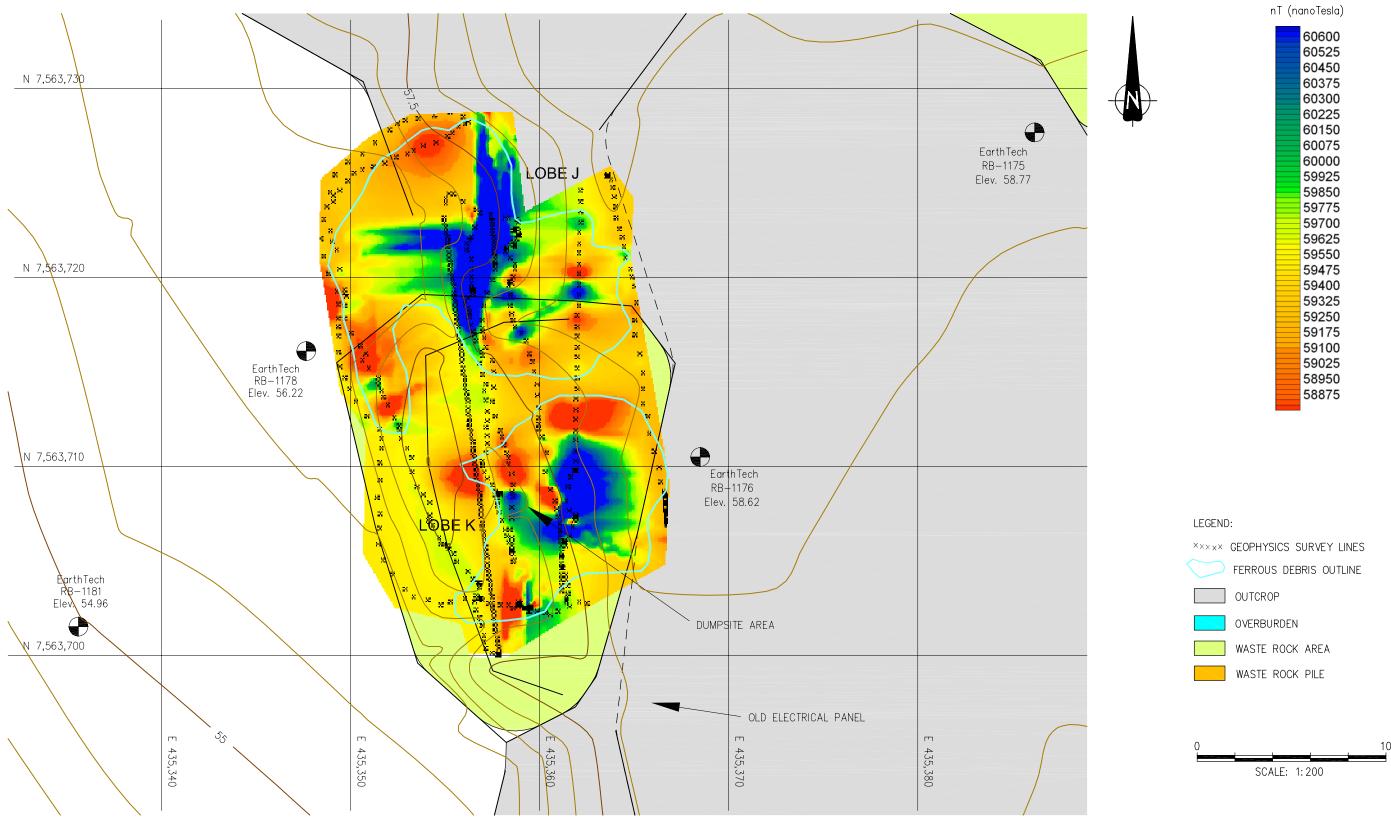






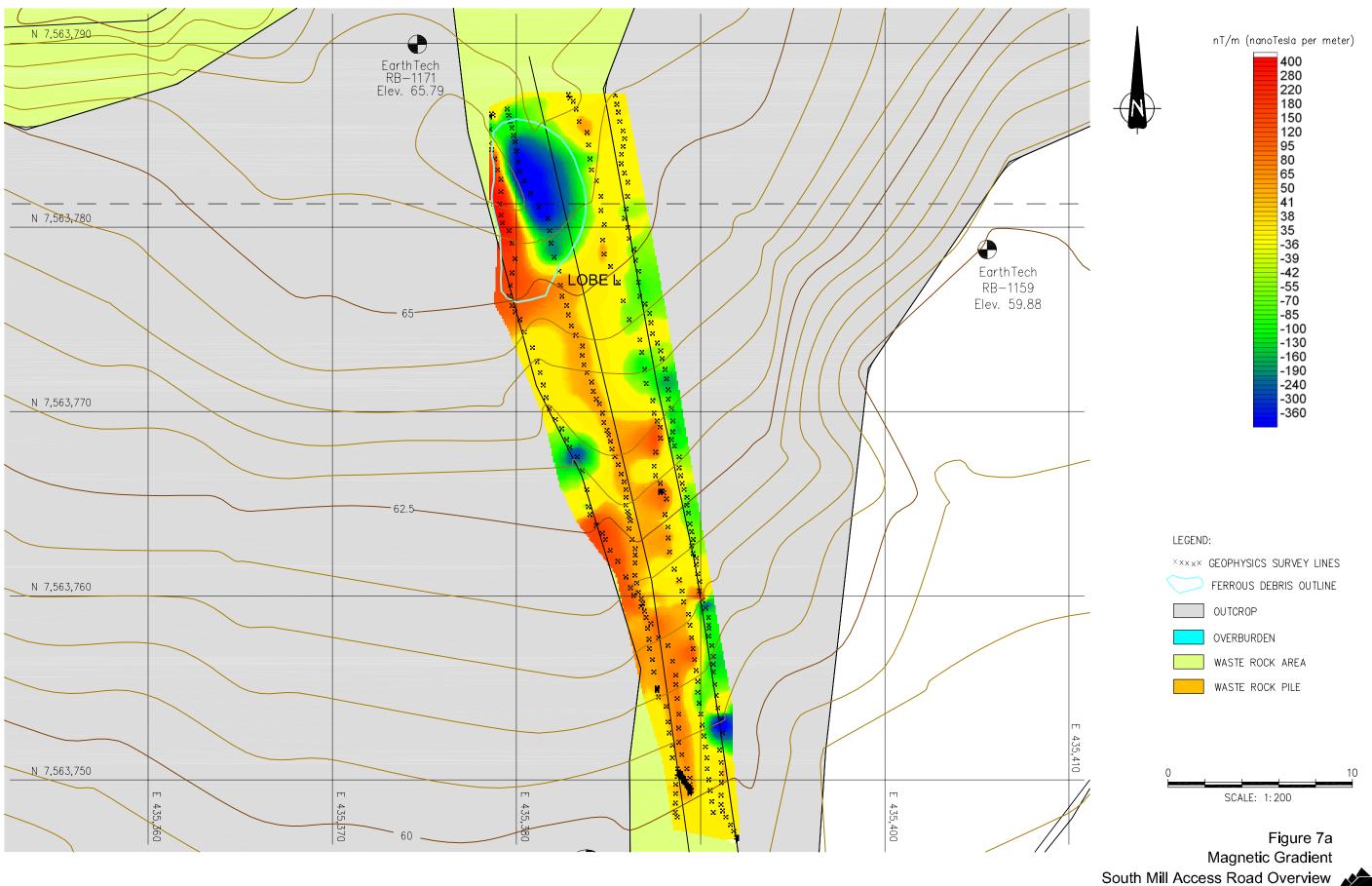




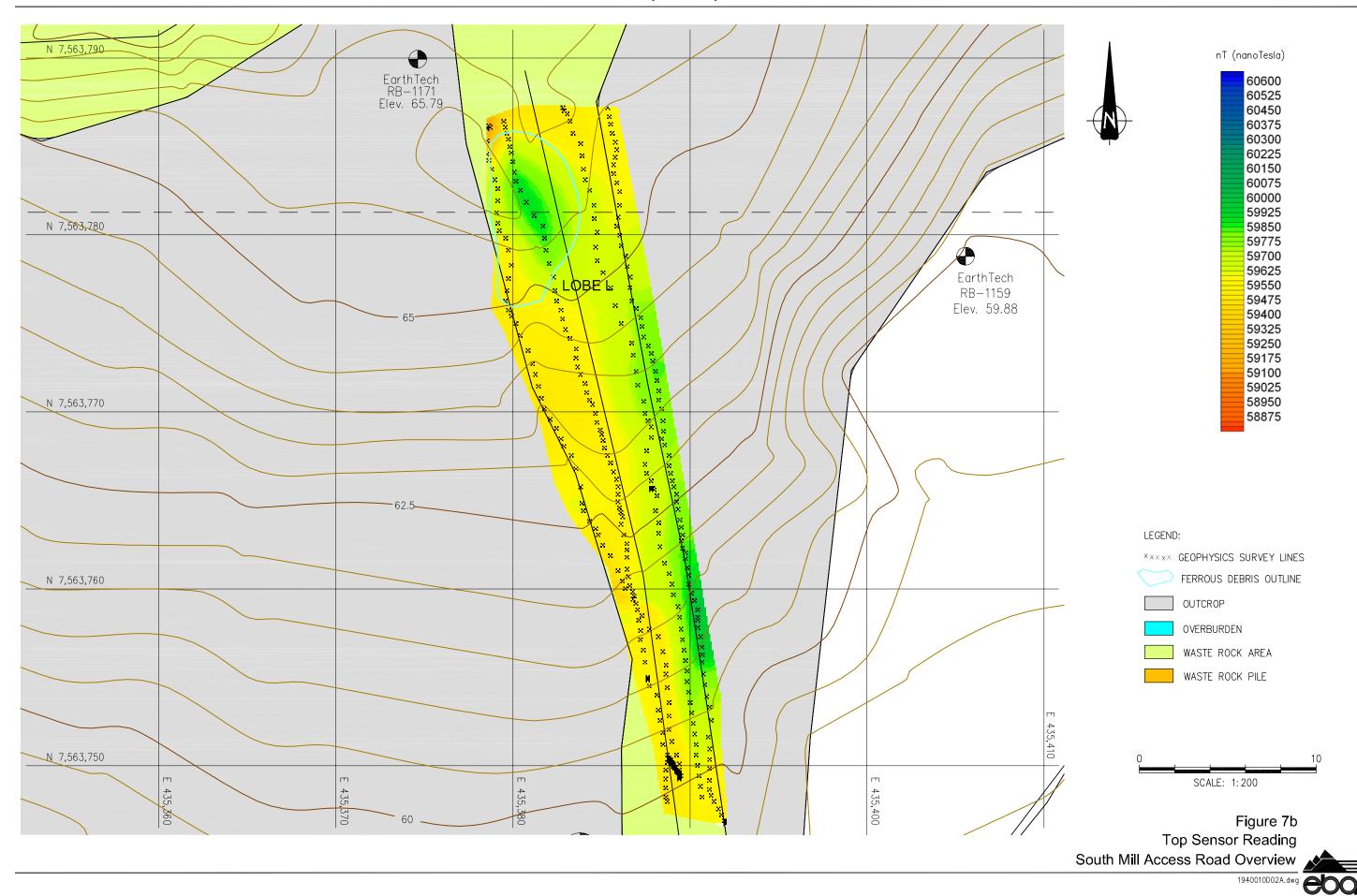


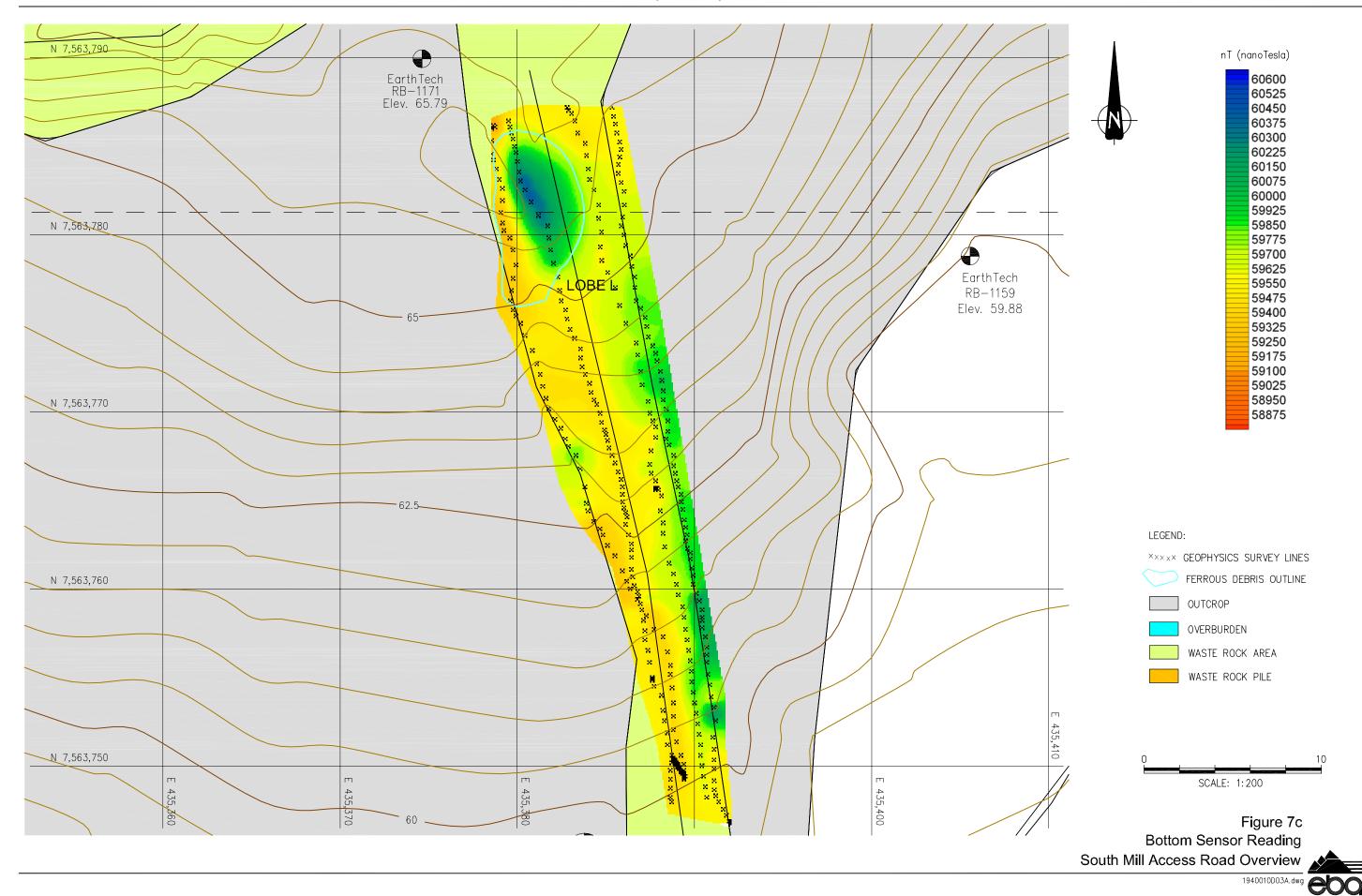


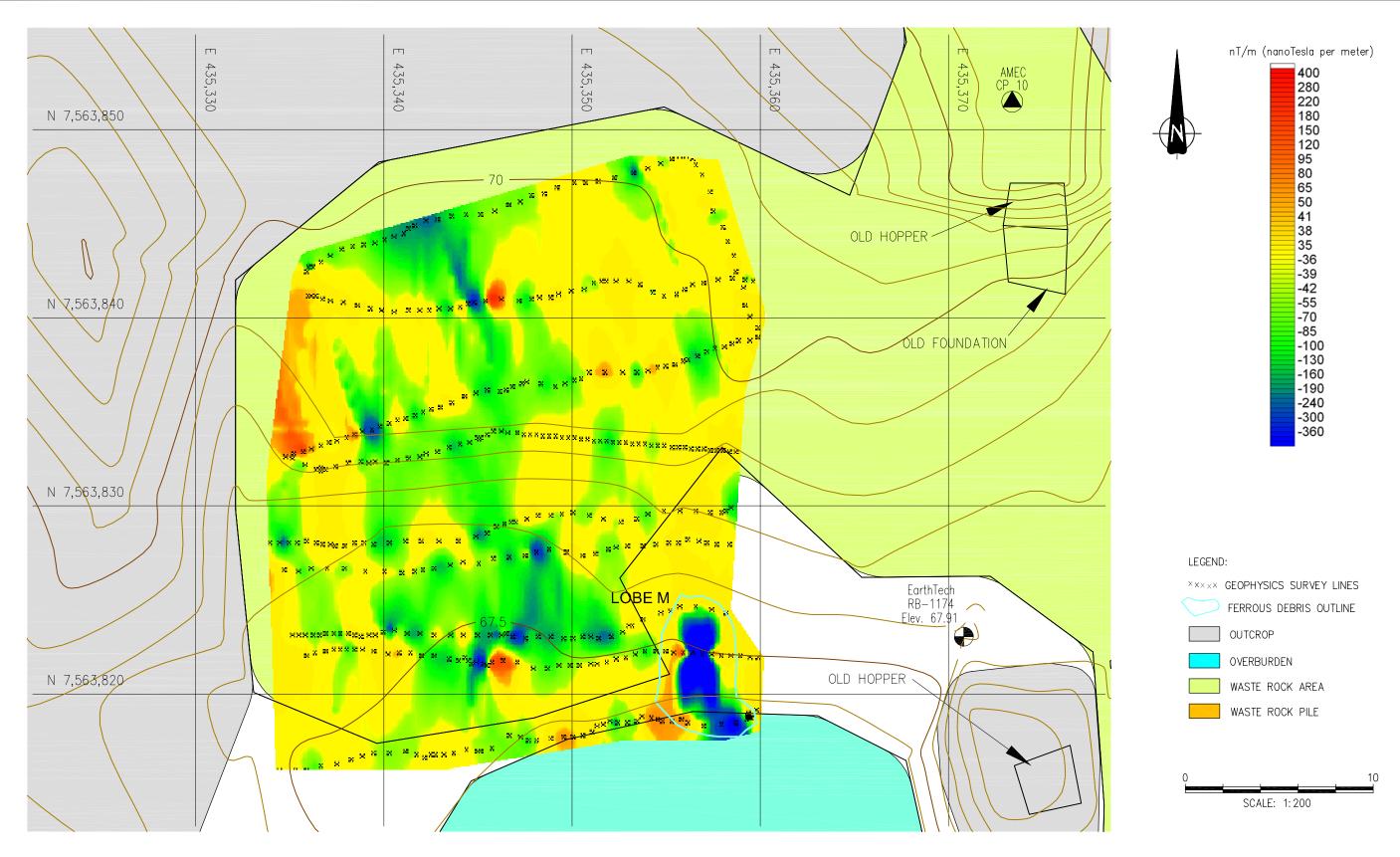


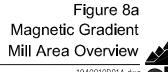


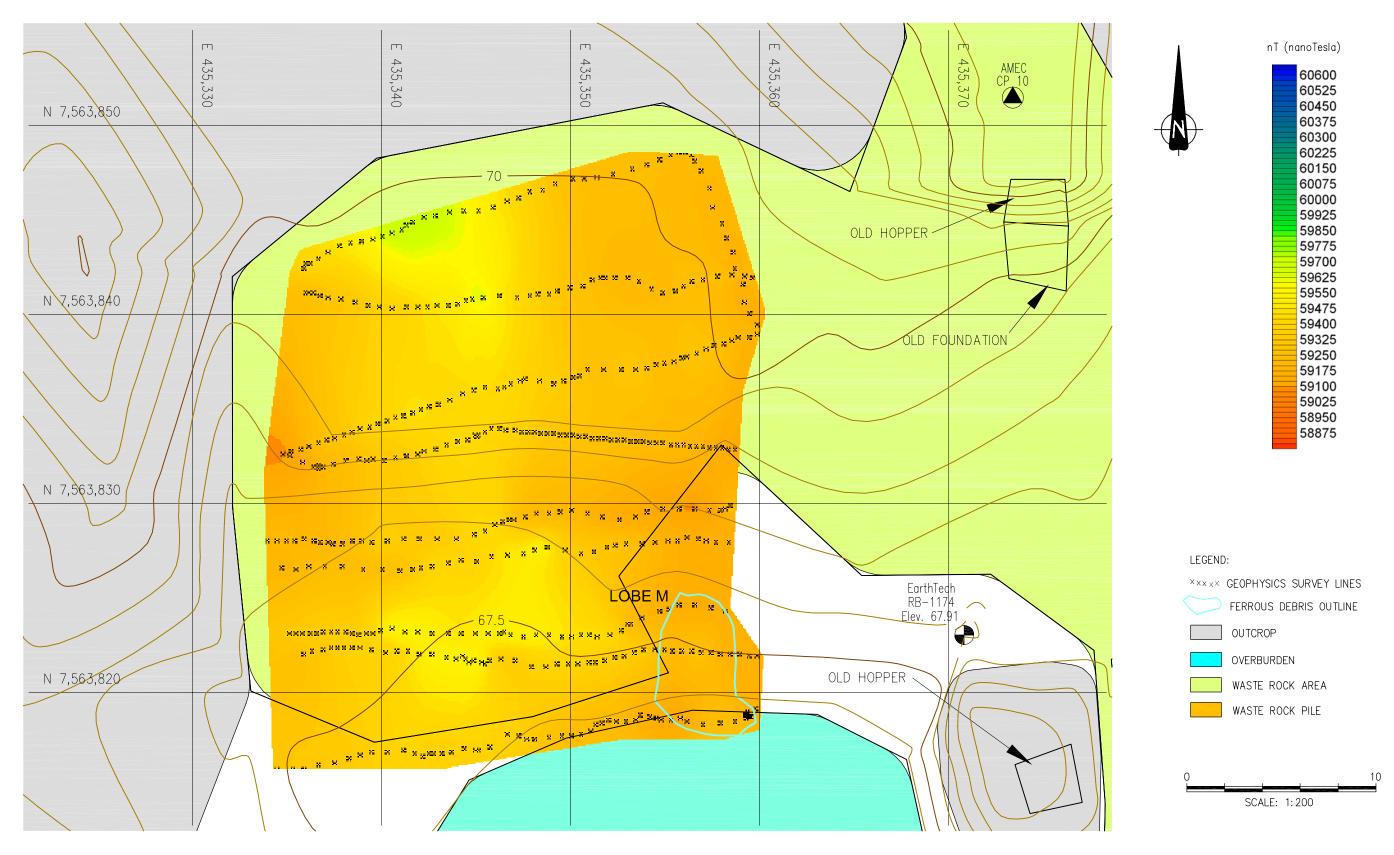


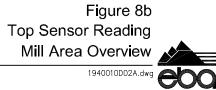


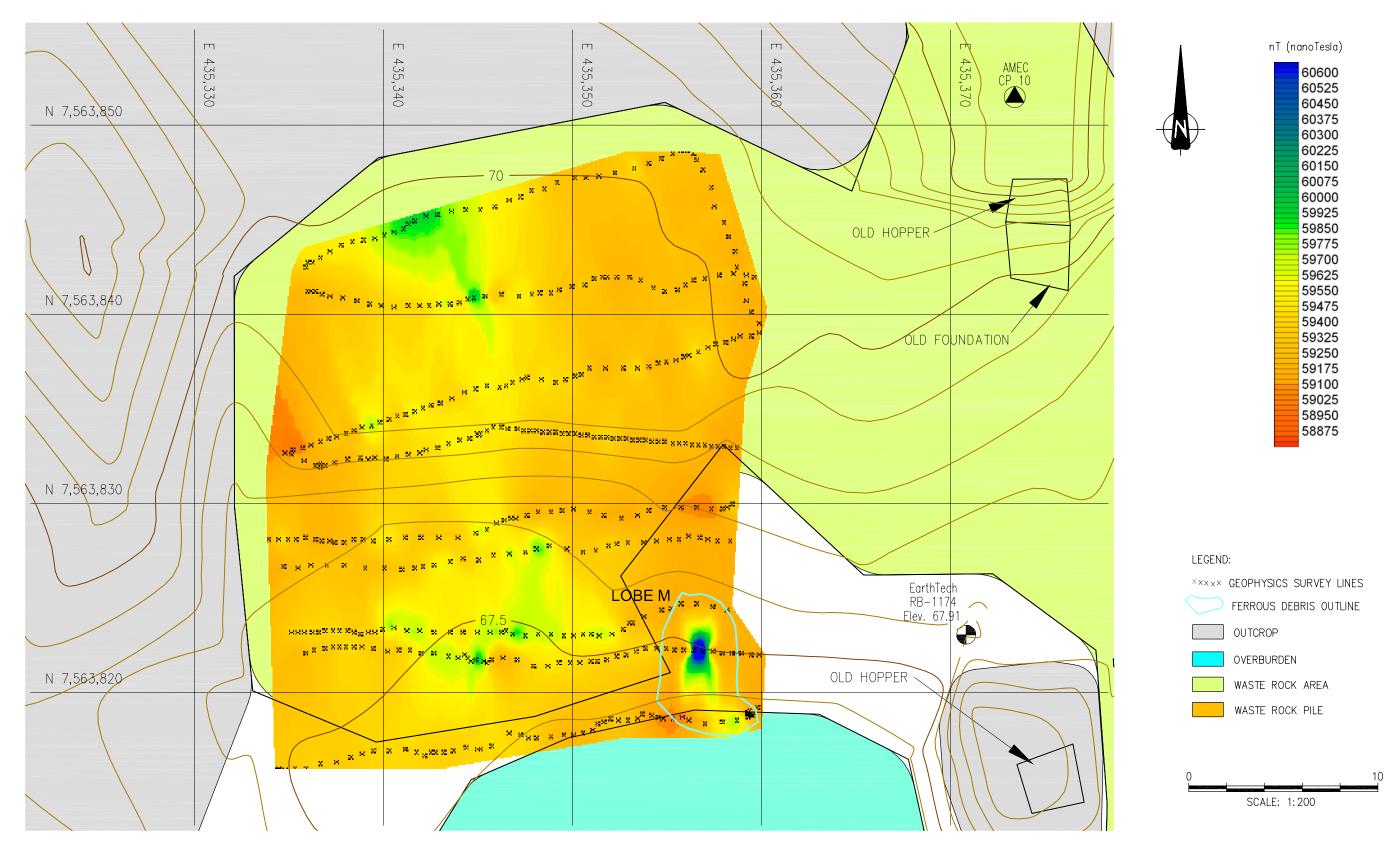


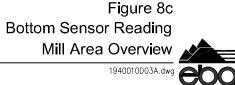


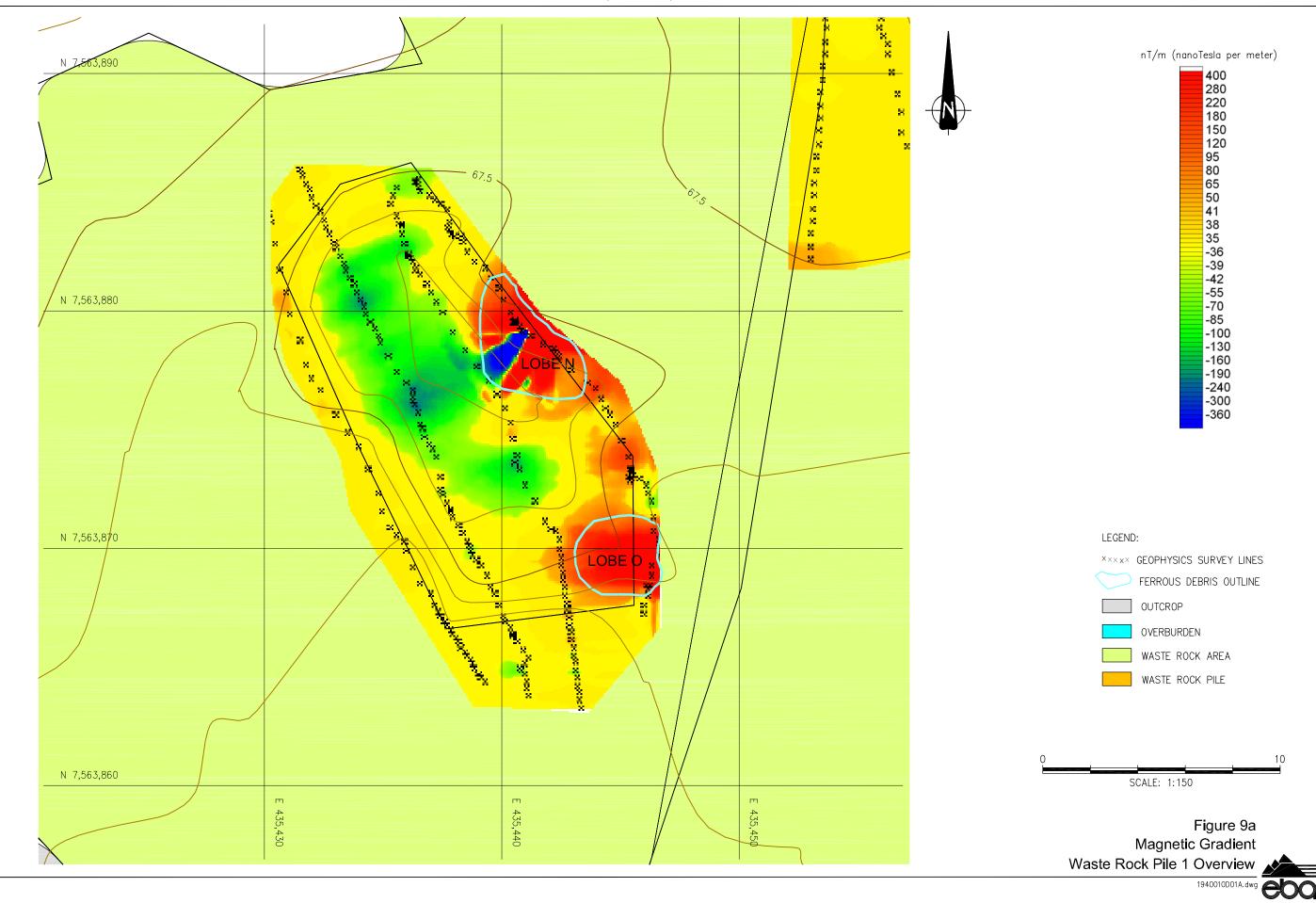


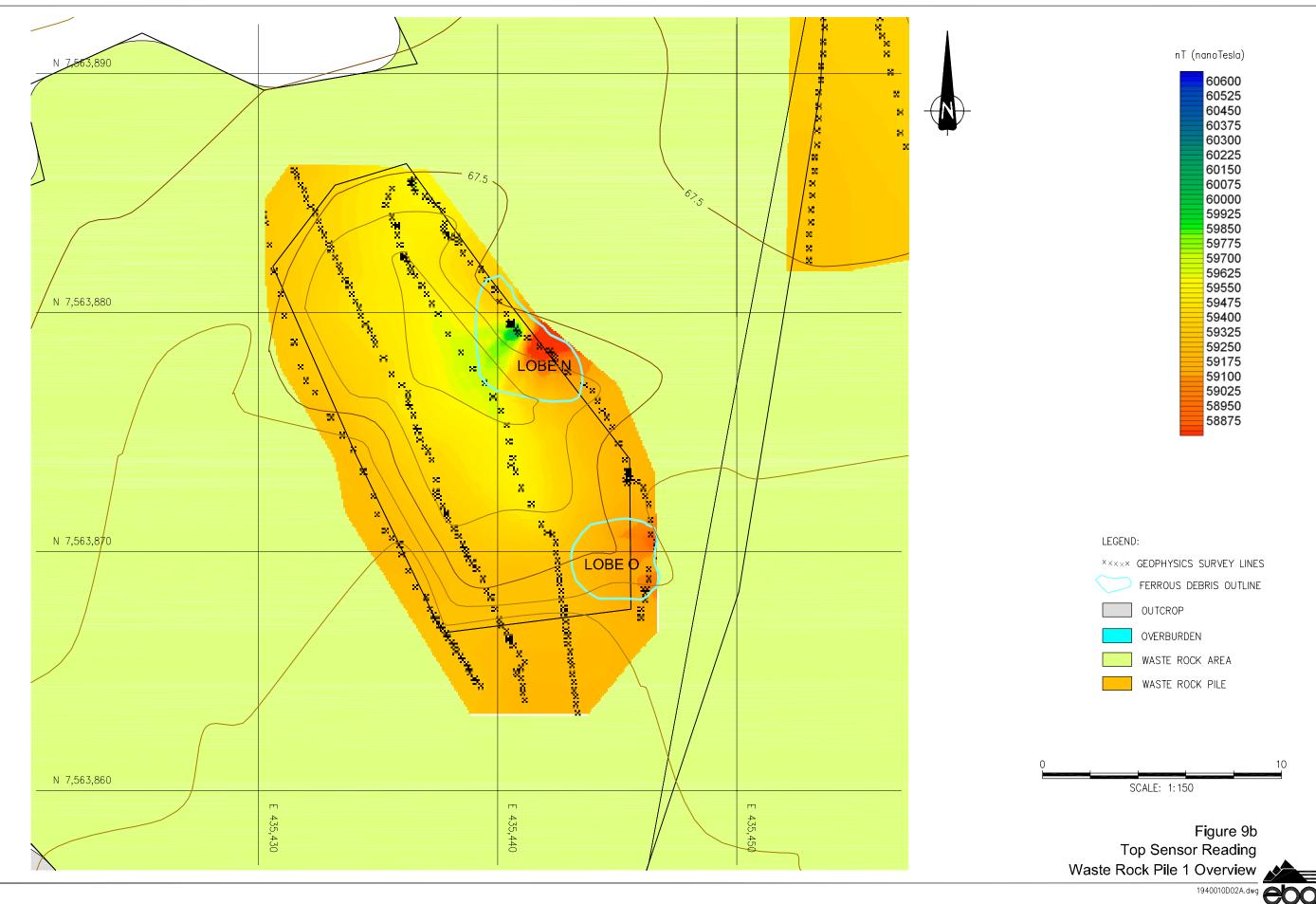


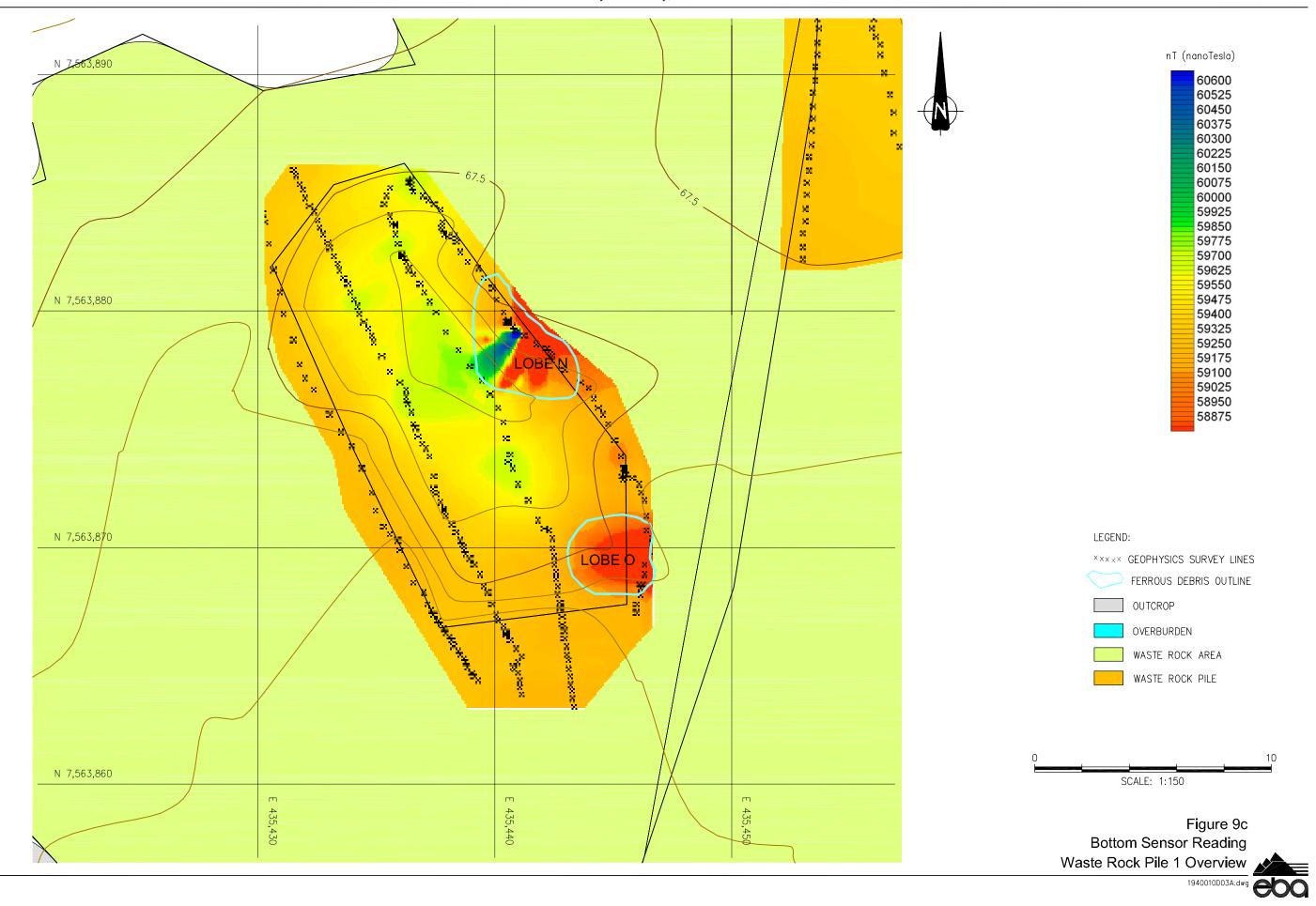












PHOTOGRAPHS





Photo 1
Ida Access Road - West of survey area facing East.



Photo 2

Machine Shop Area - East of survey area, facing West.



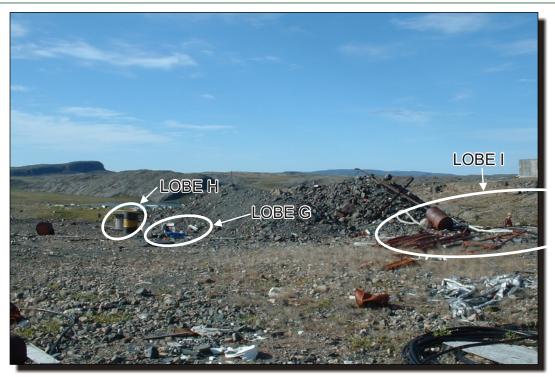


Photo 3

Machine Shop Area - North-Central corner of survey, facing West.



Photo 4
Old Camp Area - North of survey area, facing South.





Photo 5
Old Camp Area - Northeast of survey area, facing North.



Photo 6
Old Camp Area - East of survey area, facing Northeast.





Photo 7
South Mill Access Road - Southwest of survey area, facing North.



Photo 8
Mill Area - South edge of survey area, facing southeast corner.





Photo 9
Mill Area - Delons at Southeast corner of surveyed area.



Photo 10
Waste Rock Pile 1 - East of rock pile, facing West.





Photo 11
Waste Rock - West of rock pile, facing East.



APPENDIX D TESTPIT LOGS

Borehole Number: ET-1100 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435447 E, 7563743 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 ft m	**************************************	Ground Surface Organics				0.000
		Sand Fine to medium, tace gravel, none to trace silt, moist		*	No monitoring well installed	-
_		Well graded sand with 10-20% gravel, subrounded to subangular below 0.25 m				-
1.0		Saturated at 0.51 m Water and soil sloughing in borehole at 0.56 m				-
-		Auger refusal at 0.74 m from grade			· ~ 14	` -
2.0-						-
_						-
3.0		End of Log	· 12*			-
1.0					wite	-1.000
4.0-						-
						- -
5.0						-

Date: August 17, 2005

Time Completed: 10:50 am

Completion Depth: 0.74 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1101 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435477 E, 7563592 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 fl m	**************************************	Ground Surface Organics Silt Soft, grey, saturated		4	No monitoring well installed	0.000 - - - -
1.0		Frozen at 0.30 m End of Log			e en skels	-
2.0						-
3.0-					estaliseld.	-1.000 — -
4.0						

Date: August 17, 2005

Time Completed: 11:20 am

Completion Depth: 0.30 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1102 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435417 E, 7563557 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 ft m		Ground Surface				0.000
- 0.0		Organics				
		Sand Fine, grey		*	No monitoring well installed	_
_		Saturated at 0.20 m				_
1.0-		Water in borehole at 0.51 m Frozen at 0.61 m				
-		1102611 at 0.01 iii		1.7	- w 40	-
2.0						
-		End of Log	12.1			- - - -
3.0-					winds	 -1.000
4.0-						- - - -
5.0						·

Date: August 17, 2005

Time Completed: 12:00 pm **Completion Depth:** 0.61 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1103 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435575 E, 7563671 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 ft m	**************************************	Ground Surface				0.000
	****	Organics Saturated				
-	<u>幸</u> , <u>幸</u> , <u>幸</u> , <u>幸</u>	Sand Silty, fine, trace gravel and occasional cobble, angular to subangular, grey, saturated, sloughing			No monitoring well installed	-
1		Brown below 0.43 m				_
1.0-		Gravel and cobble content decreases with depth				-
-					د مد ت م	· .
2.0-			. ± £			
3.0						1
1.0		End of Log			andred	-1.000 — - - -
5.0-						-

Date: August 17, 2005
Time Completed: 12:30 pm
Completion Depth: 0.97 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1104 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435456 E, 7563271 N

					Headspace		
Depth		Soil Type	Soil Description	Sample	(ррт) 100 300 500	Well	Elevation (m)
0.0	0.0		Ground Surface				0.000
-			Organics				-
_			Silt Firm, sandy, light brown, moist, becoming finer with depth		6	No monitoring well installed	
1.0-			Dark brown silt, moist, with trace sand, occasional cobble and occasional fine sand seam at 1.22 m				-
2.0-							-
3.0-	- 1.0			- 12		und	-1.000 - - - -
4.0		1	End of Log				
5.0							-

Date: August 17, 2005 Time Completed: 1:30 pm Completion Depth: 1.22 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1105 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435510 E, 7563891 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 0.0	****** ****** ****** ******** ******	Ground Surface Organics Sandy	_			0.000
1.0-		Sand Well graded, trace gravel, occasional subrounded to angular pieces to 2" size, brown			No monitoring well installed	_
		Gravel Sandy, with shells Moist to wet at 0.61 m			· ·· any	
2.0-	**************************************	Wet below 0.76 m				
_	22.2	End of Log	' # ' u			-
3.0					minglester i serie me	-1.000— -
4.0-						1
5.0						_

Date: August 17, 2005 Time Completed: 4:00 pm Completion Depth: 0.76 m Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1106
Project Name: Roberts Bay
Project Number: 88045

Client:

Location: 0453493 E, 7563936 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 fl m		Ground Surface				0.000
- 0.0	****	Organics				_
1.0-		Sand Silty, trace gravel, occasional cobble to 6" diameter, occasional silt seam with some clay, grey, wet			No monitoring well installed	-
2.0					* - T2	-
		End of Log				- -
3.0-			' 2"		winds	 -1.000
4.0-						- - - - -
5.0~						-

Date: August 17, 2005 Time Completed: 4:45 pm Completion Depth: 0.61 m **Driller:** Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1107 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435411 E, 7564001 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ррт) 100 300 500	Well	Elevation (m)
0.0 fl m	Sakakasak	Ground Surface				0.000
1.0	**************************************	Organics Sand Till Silty, trace gravel, occasional cobble, angular to subangular, brown, moist Sand till with trace silt, well graded, moist below 1.22 m			No monitoring well installed	- - - -
2.0-					r oc Bess	
3.0-			·£		andrica.	-1.000
4.0-						- - - -
5.0		End of Log				-

Date: August 17, 2005
Time Completed: 5:15 pm
Completion Depth: 1.37 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1108 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435454 E, 7563784 N

	T			Hoodenses		
Depth	Soil Type	Soil Description	Sample	Headspace (ppm) 100 300 500	Well	Elevation (m)
0.0 fl m	- <u>- 1 1</u>	Ground Surface				0.000
	******* ******	Organics	_			_
_		Sand Fine to medium grained, trace gravel, brown, moist		*.	No monitoring well installed	-
_		End of Log				-
1.0-						_
1.0				40° 34.		_
_					· - w	-
2.0-						
2.0						
_						-
						_
3.0-			1 2 1			
						_
1.0					und	-1.000
			and Addition			
4.0						1
						-
						1
						1
5.0						1

Date: August 18, 2005 Time Completed: 3:10 pm Completion Depth: 0.18 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1109 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435463 E, 7563783 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
1.0-		Muskeg Sand Silty, trace gravel and cobble to 2" diameter, grey, wet			No monitoring well installed	0.000
2.0-		End of Log			e e u ughte	-
3.0-	,				windowski	-1.000 - - -
4.0 — — — — — —						-

Date: August 18, 2005 Time Completed: 3:20 pm Completion Depth: 0.41 m Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1110 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435439 E, 7563706 N

				Headspace		
Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 f m	****	Ground Surface Peat				0.000
1.0					No monitoring well installed	-
		Silt \Frost at 0.33 m /				
2.0-		End of Log			e e la	
1.0 					winds . www.	-1.000 —
4.0-						- - - -

Date: August 18, 2005 Time Completed: 3:30 pm **Driller:** Kimber Osiowy

Completion Depth: 0.33 m

Drill Type: Shovel and hand auger

Borehole Number: ET-1114 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435159 E, 7563786 N

					Headspace		1
	Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0	fl m	********	Ground Surface Organics				0.000
		* * * * * * * * * * * * * * * * * * *	Sand Poorly-graded, trace silt, trace to some subangular to subrounded gravel, occasional cobble, medium brown, moist			No monitoring well installed	
1.0-							-
2.0-						- To my life	
3.0-	1.0					waka ≈€	-1.000 —
- 4.0			End of Log			with the	
5.0	_						-

Date: August 21, 2005 Time Completed: 4:20 pm Completion Depth: 1.07 m **Driller:** Kimber Osiowy

Drill Type: Shovel and hand auger

Borehole Number: ET-1115 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435146 E, 7563722 N

			10 = 1,700072214	T			,
4		Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 ft	m 0.0		Ground Surface				0.000
0.0	0.0	**************************************	Organics				-
-			Sand Silty, some gravel, dark brown, moist		2	No monitoring well installed	-
_	-		Wet at 0.23 m				-
1.0							_
	-		End of Log			* • 9±	
2.0	-			¥			-
3.0	- 1.0					unal .	-1.000 — - - -
4.0	-						-

Date: August 21, 2005 Time Completed: 4:40 pm Completion Depth: 0.30 m **Driller:** Kimber Osiowy **Drill Type:** Hand auger **Reviewed By:** KO

Borehole Number: ET-1116
Project Name: Roberts Bay
Project Number: 88045

Client:

Location: 0435147 E, 7563740 N

					Headspace		
	Depth	Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0	ft m 0.0	********	Ground Surface Organics		: : : : : :		0.000
			Sand Fine to medium, trace to some gravel			No monitoring well installed	- - - -
-2.0						e de la companya de l	
			End of Log				_
3.0-	_ 1.0			. a		un en	-1.000
4.0-	_						
5.0							

Date: August 21, 2005
Time Completed: 5:10 pm
Completion Depth: 0.61 m

Driller: Kimber Osiowy **Drill Type:** Hand auger **Reviewed By:** KO

Borehole Number: ET-1117 Project Name: Roberts Bay Project Number: 88045

Client:

Location: 0435353 E, 7563559 N

					Headspace		
Denth		Soil Type	Soil Description	Sample	(ppm) 100 300 500	Well	Elevation (m)
0.0 ft	m n n		Ground Surface				0.000
"."	0.0	****	Organics				
		11111					-
7			Sand Medium to coarse, some gravel and cobbles, brown		*	No monitoring well installed	-
	_		Auger refusal at 0.30 m				-
1.0			End of Log				
	-					14a	
2.0	-			18.1			-
3.0-							-
	- 1.0					undi	-1.000
4.0-	-						-
5.0	-						-

Date: August 21, 2005

Time Completed: 5:20 pm **Completion Depth:** 0.30 m

Driller: Kimber Osiowy

Drill Type: Shovel and hand auger

APPENDIX E S GEOTECHNICAL TESTING DATA

MOISTURE	CONTENT	TEST	RESUL	TS
	CONTENT			

ASTM Designation D2216

,	tyca wa	RNAT	IONAL	LTD. COMPANY
Gu	SEP	2	0	2005

Project: ROBERT'S BAY	Borehole No.:	Edmonton, AB
Address:		
Project No.: 4101234	Date Tested: Serr 13/	Ву:

						2005	
	Depth	Tare	Weight of Wet Soil	Weight of Dry Soil	M.C.	Visual Description of Soil ASTM D2488 □	Pock Per
	m	No.	g	['] g	%	ASTM Standard not Followed 🗹	Read
E	T-1100	-01	1530.4	1463.1	4.6	SAUD AND SHAVER (25 mm MAX), THENE SILT - BROWN	
E	T-1100	-02	1069.9	1018, 0	5.1	SAND, SPANERLY (19mm MAX)	
E	T-1101	-01	356.0	230.1	54.8	SILT, CLAYEY, Some SANS, MACE PORM STUDEN	
<u> </u>	-t-1102	8-01	354.0	301.6	17.4	SAND, SOME SILT, THEO CLAT,	
6	7-1103	-01	482.3	443.8	8.7	SAND SILM, SOME 25 mm CMVER,	
E	T-110S	- 0/	2659.1	2563.5	3,7	SAND AND EMPER (40 mm max), THEY SILT, ORGANICS - REDEA	************************
- -	-T-1107	-01	1138.0	8.854	10.6	SAND, STAVELLY (40 mm MAX), some SINT, CHY, THING CROADICS BROW	
- 6	FT-1114	-01	30%.9	3027.4	2.3	SAND AND TRAVER (40 mm Max), MILLO SILT - RUBLISH BADOWN	
-	ET-VU	6	\$19.9	498.6	4.3	SAND, SOME GRIVER (25 mm Max) TRUCK SILT, OR FAMICS - ORANGO BROK	
	=T~11)	7	563.3	545.L	3.3	SAND, SOME 25mm STUTER, THEE SILT, ORGANICS - RESALISH BROWN	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	ET-NC	0	685.L	661.1	3.1	SAND, SOME 28 - MINES SILT, ORGANKS - BROWN	

				aasaalaaa aanaa aana			C3*0350039*00#*0400
	**************************************	AND					*******************************



	. AGGF	egate analysis report	Γ	
Project: Roberts Bay,	Job #88045	Sample Numbe	er:500	
Address:		Sample Location	on: ET-1100-01	
Project Number: 0104-	-4101234			
Date Sampled: //	By: Client	Time:		Temp:
Client:_Earth Tech		Date Tested:	09/08/05	By: KA
17203-103 Av	enue		re Content: 4.6	
	erta T5S 1J4	•		Faces:
Ph(780) 488-6	6800 Fax(780) 488-2121			,
Attention: Gordon Wolle	ett			
Soil Description: Sand o	and Gravel(25mm max), trac	e silt - Brown		
				,
Remarks:			7 m 160 7 m 170	
	5 55	SIEVE SI	IZES (mm)	10
Sieve % Passing	0.063 0.075 0.15 0.25	0.425	4,75	9.5 12.5 25 80
		i i i		
	20	£		
	80			
	70			
25 100.0	۵ ۵			
19 97.8 12.5 93.7	PERCENT PASSING 09 09 09 09 09 09 09 09 09 09 09 09 09			
9.5 87.0	å 50 - − − − − − − − − − − − − − − − − − − −			
4.75 67.1	40			
2 35.5			'	
0.85 17.4	30			
0.425 10.1 0.25 4.2	20			
0.25 4.2 0.15 1.2	10			
0.075 0.5				

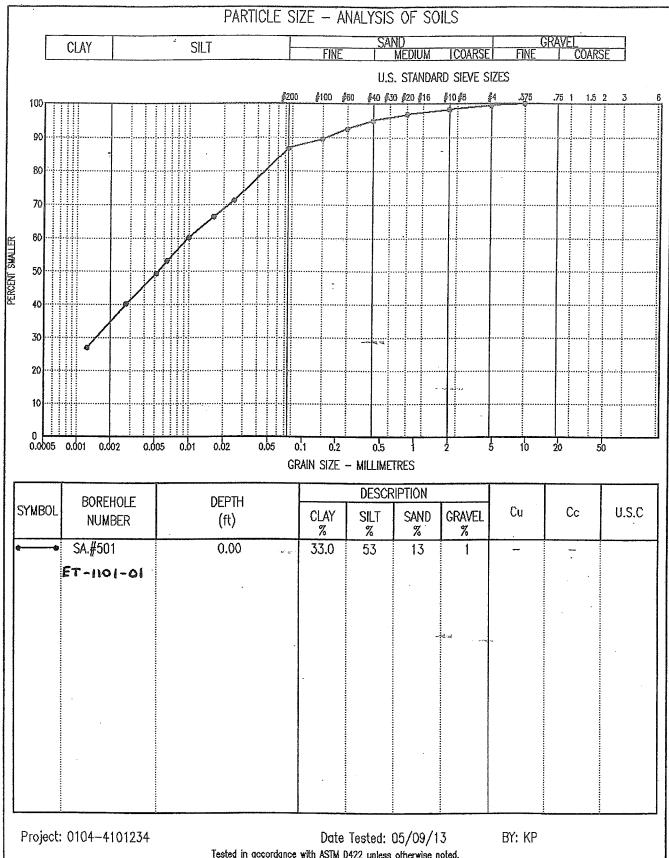
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LARGE AGGRE	EGATE ANALYSIS REPORT
Project: Roberts Bay, Job #88045	Sample Number: 499
Address:	
Project Number: 0104-4101234	
Date Sampled: / / By: Client	
Client:_ Earth Tech	
17203-103 Avenue	Natural Moisture Content: 5.1 %
Edmonton, Alberta T5S 1J4	Crushed Faces: Faces:
Ph(780) 488-6800 Fax(780) 488-2121	
Attention: Gardon Wollett	
Soil Description: Sand, Gravelly(19mm max), trace silt -	-Brown
Remarks:	13
	CIDIT CIZEC ()
Sieve % Passing 2000 51 52 52 54 52 54 54 55 55 55 55 55 55 55 55 55 55 55	2
Sieve % Passing 100 100 100 100 100 100 100 100 100 10	0.85
90	
80	
70	
19 100.0 \(\begin{array}{c} \begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\	
12.5 94.5	June
9.5 89.1	
9.5 89.1 E °	
19 100.0 12.5 94.5 9.5 89.1 4.75 74.4	
2 48.7	
2 48.7 0.85 32.9	
2 48.7 0.85 32.9 0.425 28.8	
2 48.7 0.85 32.9 0.425 28.8 0.25 10.2	
2 48.7 0.85 32.9 0.425 28.8 0.25 10.2 0.15 1.8 0.075 0.6	
2 48.7 0.85 32.9 0.425 28.8 0.25 10.2 0.15 1.8 10	

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AGGREGATE ANALYSIS REPORT Project: Roberts Bay, Job #88045 Sample Number: 504 Sample Location: ET-1105-01 Address: Project Number: 0104-4101234 Date Sampled: / / By: Client Time: Temp: Date Tested: 10/09/05 By: KA Client: Earth Tech Natural Moisture Content: 3.7 % 17203-103 Avenue Edmonton, Alberta T5S 1J4 Crushed Faces: Faces: Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gordon Wollett Soil Description: Sand and Gravel (40mm max), trace silt, organics - Brown Remarks: SIEVE SIZES (mm) % Passing 8 Sieve 80 40 100.0 70 25 97.1 PERCENT PASSING 60 19 93.2 12.5 77.6 9.5 72.8 4.75 53.6 2 34.8 30 0.85 24.8 0.425 16.5 20 0.25 7.0 0.15 10 2.6 0.075 1.4 Reviewed By:

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Samp Project Number: 0104-4101234 Date Sampled: / By: Client Time: Client: Earth Tech Date 17203-103 Avenue Edmonton, Alberta T5S 1J4 Crush Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gardon Wollett Soil Description: Sand, Gravelly(40mm max), some silt, clay, trace of the same of the s	Tested: 08/09/05 By: KA al Moisture Content: 10.6 % ed Faces: Faces: organics — Brown
Address:	Temp: Tested: 08/09/05 By: KA Il Moisture Content: 10.6 % Paces: Temp: Temp:
Project Number: 0104-4101234 Date Sampled: / By: Client Time: Client: Earth Tech Date	Temp: Tested: 08/09/05 By: KA Il Moisture Content: 10.6 % Ped Faces: Faces: Organics — Brown
Date Sampled: /	Tested: 08/09/05 By: KA al Moisture Content: 10.6 % ed Faces: Faces: organics — Brown
Date Sampled: / By: Client Time: Client: Earth Tech Date	Tested: 08/09/05 By: KA al Moisture Content: 10.6 % ed Faces: Faces: organics — Brown
Client: Earth Tech	Tested: 08/09/05 By: KA al Moisture Content: 10.6 % ed Faces: Faces: organics — Brown
17203-103 Avenue	ol Moisture Content: 10.6 % ed Faces: Faces: organics — Brown
Edmonton, Alberta T5S 1J4 Crush Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gordon Wollett Soil Description: Sand, Gravelly(40mm max), some silt, clay, trace of the same silt of the same si	ed Faces: Faces:
Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gordon Wollett Soil Description: Sand, Gravelly(40mm max), some silt, clay, trace of the same silt of the same silt. Sieve % Passing 100 90 80 90 80 40 100.0 70 90.1 19.5 91.4 12.5 81.9 9.5 77.7 4.75 70.4 88 40 90 90 90 90 90 90 90 90 90 90 90 90 90	organics — Brown
Attention: Gardon Wollett Soil Description: Sand, Gravelly(40mm max), some silt, clay, trace of the same silt and same silt. Sieve 7 Passing 100 25 80 80 80 80 80 80 80 80 80 80 80 80 80	
Sieve % Passing 100 80 80 80 80 80 80 80 80 80 80 80 80 8	
Sieve % Passing 100 50 50 50 50 50 50 50 50 50 50 50 50 5	
Sieve % Passing 100 50 50 50 50 50 50 50 50 50 50 50 50 5	a de Barra
90 80 40 100.0 25 97.1 19.5 91.4 12.5 81.9 9.5 77.7 4.75 70.4	SIEVE SIZES (mm)
90 80 40 100.0 25 97.1 19.5 91.4 12.5 81.9 9.5 77.7 4.75 70.4	2 4.75 12.5 19.5 25
80 40 100.0 25 97.1 19.5 91.4 NSSS 81.9 9.5 77.7 4.75 70.4	
40 100.0 70 25 97.1 19.5 91.4 NSS 60 12.5 81.9 9.5 77.7 4.75 70.4	
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25 97.1 19.5 91.4 12.5 81.9 9.5 77.7 4.75 70.4	
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0.425 45.4 20	
0.25 34.8	
0.15 28.1 10	
0.075 20.5	

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AGGREGATE ANALYSIS REPORT Project: Roberts Bay, Job #88045 Sample Number: 506 Sample Location: ET-1114-01 Address: Project Number: 0104-4101234 Date Sampled: / / By: Client _____Temp: Time: Client: Earth Tech Date Tested: 01/09/05 By: KA Natural Moisture Content: 2.3 % 17203-103 Avenue Edmonton, Alberta T5S 1J4 Crushed Faces: Faces: Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gordon Wollett Soil Description: Sand and Gravel (40mm max), Trace Silt - Reddish Brown Remarks: SIEVE SIZES (mm) Sieve % Passing 80 40 100.0 70 25 92.9 60 88.6 19 12.5 78.7 50 9.5 75.1 4.75 62.8 40 2 53.5 30 0.85 43.7 0.425 24.7 0.25 6.5 10 0.15 1.7 0.075 1.1 Reviewed By:

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AGGREGATE ANALYSIS REPORT Project: Roberts Bay, Job #88045 Sample Number: 515 Sample Location: IDA 05-01 Address: Project Number: 0104-4101234 By: Client Date Sampled: / / Temp: Time: Date Tested: 10/09/05 By: KA Client: Earth Tech Natural Moisture Content: 3.7 % 17203-103 Avenue Edmonton, Alberta T5S 1J4 Crushed Faces: Faces: Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gordon Wollett Soil Description: Sand and Gravel (40mm max), trace silt, organics__Reddish Brown Remarks: SIEVE SIZES (mm) % Passing Sieve 90 40 100.0 70 25 97.2 60 19 PERCENT PASSING 91.1 12.5 76.3 50 9.5 69.4 4.75 55.5 40 2 44.4 0.85 30.3 0.425 11.6 20 0.25 2.6 0.15 1.5 0.075 1.1 Reviewed By:

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AGGREGATE ANALYSIS REPORT Project: Roberts Bay, Job #88045 Sample Number: 516 Sample Location: IDA 05-02 Address: Project Number: 0104-4101234 Date Sampled: / / By: Client Time: Temp: Date Tested: 10/09/05 Client: Earth Tech By: KA Natural Moisture Content: 3.3 % 17203-103 Avenue Edmonton, Alberta T5S 1J4 Crushed Faces: Faces: Ph(780) 488-6800 Fax(780) 488-2121 Attention: Gordon Wollett Soil Description: Sand and Gravel (40mm max), trace silt, organics = Reddish Brown Remarks: SIEVE SIZES (mm) Sieve % Passing 90 80 40 100.0 70 25 89.2 60 19 80.7 12.5 66.6 50 9.5 62.0 4.75 52.5 40 2 42.9 0.85 30.2 0.425 13.6 20 0.25 2.1 10 0.15 1.0 0.075 Reviewed By:

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EBA Engineering Consultants Ltd.

MOISTURE - DENSITY RELATIONSHIP

ASTM D698, D1557, or D2049

Project: Roberts Bay - Job #88045

Sample Number: 509

Project No.: 0104-4101234

Date Tested: 05/09/10

Client: Earth Tech

Moisture Content (as received): 3.7%

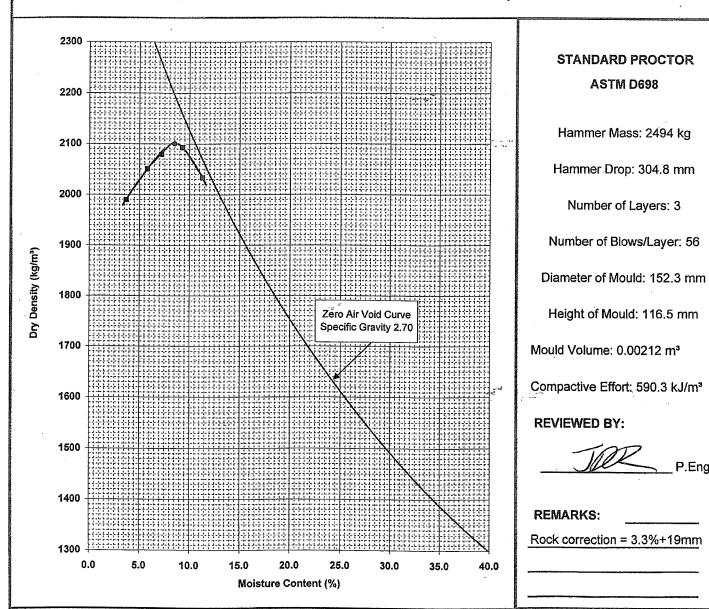
Soil Description: SAND, some gravel (25mm max.), tr. silt, organics -

Maximum Dry Density: 2100 kg/m3

brown

Optimum Moisture Content: 8.5%

Sample Location: ET-1100



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P.Eng.

EBA Engineering Consultants Ltd.

MOISTURE - DENSITY RELATIONSHIP

ASTM D698, D1557, or D2049

Project: Roberts Bay - Job #88045

Sample Number: 506

Project No.: 0104-4101234

Date Tested: 05/09/01

Client: Earth Tech

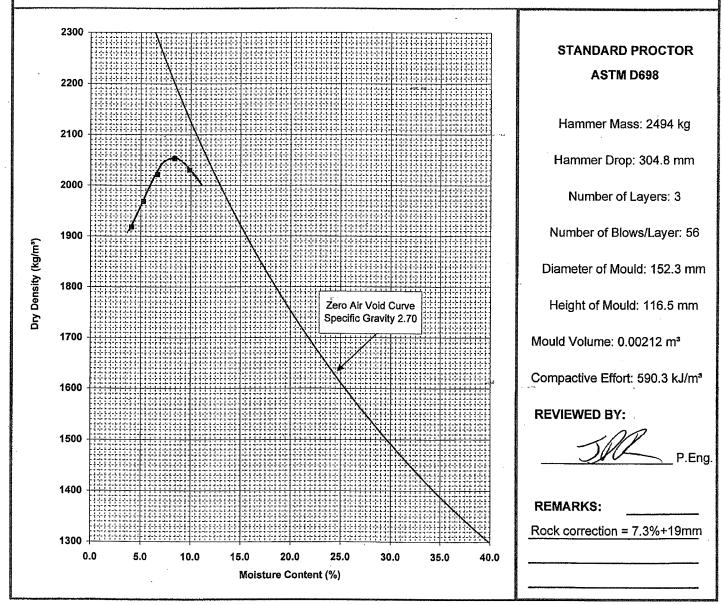
Moisture Content (as received): 2.6%

Soil Description: SAND, gravelly (40mm max.), tr. silt - reddish brown

Maximum Dry Density: 2055 kg/m³

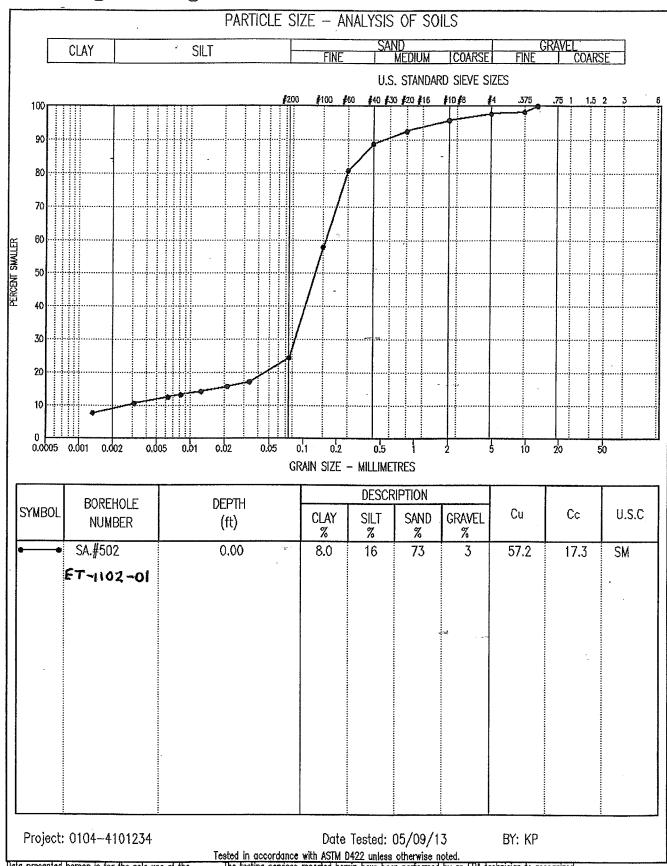
Sample Location: ET-1114-01

Optimum Moisture Content: 8.4%



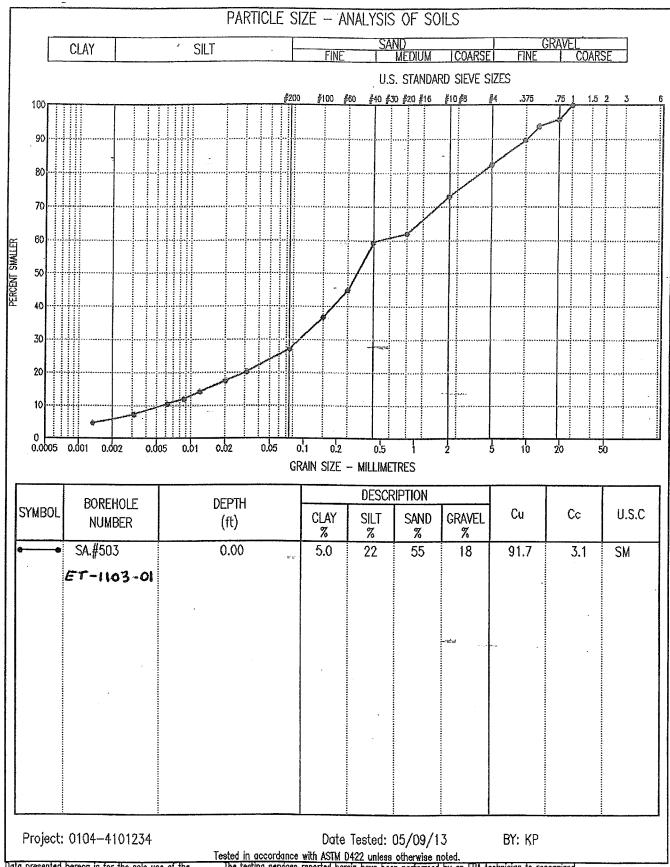
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APPENDIX F S GENERAL CONDITIONS

The production and use of this Report is conditional upon the following agreement by the Client and Others who may use or rely upon it.

1. MANDATE OF EARTH TECH

This Report has been prepared pursuant to the instructions of the Client, and is subject to the constraints imposed by those instructions. Earth Tech & Partners Ltd. ("Earth Tech") and the Client are aware of these instructions and constraints. Others, who wish to rely upon this Report in any manner, should inquire of the Client for the terms of Earth Tech's mandate in preparing this Report.

2. BASIS OF REPORT

2.1 Representations to Earth Tech by Client

This Report has been prepared for the specific site, development, design objective, and purpose described to Earth Tech by the Client and is specifically based on all of the aforesaid.

Inaccuracies or alterations, of any of the matters upon which this Report is based, will affect the reliability and applicability of this Report.

2.2 Representations to Earth Tech by Other Persons

Earth Tech may have relied upon the representations or opinions of persons other than the Client in the course of preparing this Report. Earth Tech may not have checked the accuracy of such representations or opinions except where directed to do so by the Client. The accuracy of these representations and opinions will affect the accuracy of this Report.

2.3 Time Sensitivity of Report

The findings expressed in this Report by Earth Tech were valid, in accordance with generally accepted engineering practice and procedures, at the time that they were made. The Client and Others are advised that the conditions upon which such findings were based, and the findings themselves may be subject to change as a result of the passage of time.

3. USE OF REPORT BY THE CLIENT

The Client recognizes that projects involving pollutants and hazardous waste, as defined below, create extraordinary risks. In consideration of the said extraordinary risks and in consideration of Earth Tech providing the services to the Client in connection with the project on which pollutants and hazardous wastes are involved, the Client agrees that Earth Tech's liability to the Client, including liability resulting from claims by Third Parties upon the Client, with respect to any matter in any way arising out of Earth Tech's involvement with pollutants and hazardous wastes associated shall be limited to or otherwise protected as provided in paragraphs (a) and (b) below.

(a) Earth Tech's liability to the Client in connection with pollutants and hazardous waste is absolutely limited, both in contract and in tort for any and all claims arising out of or in connection with the project to a total maximum aggregate amount not to exceed the cost of reperformance of the services at the sole cost of Earth Tech for that portion of the services proven to be in error.

It is further agreed that such limitation shall be exclusive of the liability of Earth Tech to the Client which may otherwise be provided for in this Agreement for claims unrelated to pollutants and hazardous wastes.

In further consideration of Earth Tech providing the services to the Client in connection with the project in which pollutants and hazardous wastes are involved, the Client agrees that in connection with incidents and claims initiated by Third Parties involving pollutants and hazardous wastes, the Client shall indemnify, defend and hold harmless Earth Tech of and from any and all suits, actions, legal and administrative or arbitration proceedings, claims, demands, damages, penalties, fines, losses, costs and expenses of whatsoever kind or character, arising or alleged to arise out of the services of Earth Tech or any claim against Earth Tech arising or alleged to arise from the acts, omissions or work of others. Such indemnification shall apply to the fullest extent permitted by law,

regardless of fault or breach of contract by Earth Tech and shall include the fees and charges of lawyers in defending or advising Earth Tech as to such claims under the Agreement.

Without limiting the generality of the foregoing, such indemnity extends to claims which arise out of the actual or threatened dispersal, discharge, escape, release or saturation (whether sudden or gradual) of any pollutant to hazardous waste in or into the atmosphere, or on, on to, upon, in or into the surface or subsurface, soils, water or water courses, persons, objects or any other tangible matter.

- (b) Nothing herein shall relieve Earth Tech from their obligations to provide the services required by this Agreement and generally as required by standard engineering practice current as of the date of the performance of the services.
- (c) For all purposes of this statement of limitations, "pollutants and hazardous wastes" shall mean any solid, liquid, gaseous or thermal irritant or contaminant, including without limitation smoke, vapour, soot, fumes, acids, alkalis, chemicals and wastes, including without limitation, pollutants, hazardous or special waste as defined in any federal, provincial or municipal laws.

4. SUBCONSULTANTS AND SUBCONTRACTORS

As a result of its mandate, Earth Tech may hire companies or individuals with special expertise or services not available within Earth Tech. These services are for the Client's benefit. The Client agrees to pay for the services of subconsultants and subcontractors. The Client also agrees to indemnify Earth Tech for any damage in any way resulting from the error, omission or negligent act of such subconsultants or subcontractors, including, without limiting the generality of the foregoing, the laboratory testing by subconsultants.

5. JOB SITE SAFETY

Earth Tech is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of Earth Tech personnel on the site shall not be construed in any way to relieve the Client or any other persons on site from their responsibilities for job site safety.

6. HAZARDOUS CONDITIONS AND EMERGENCY PROCEDURE

The Client undertakes to inform Earth Tech of all hazardous conditions, or possible hazardous conditions which are known to it. The Client recognizes that the activities of Earth Tech may uncover previously unknown hazardous materials or conditions and that such a discovery may result in the necessity to undertake emergency procedures to protect Earth Tech employees as well as other persons and the environment. These procedures may involve additional costs outside of any budgets previously agreed to. The Client agrees to pay Earth Tech for any expenses incurred as a result of such discoveries and to compensate Earth Tech through payment of additional fees and expenses for time spent by Earth Tech to deal with the consequences of such discoveries.

7. <u>NOTIFICATION OF AUTHORITIES</u>

The Client acknowledges that in certain instances the discovery of hazardous substances or conditions and materials may require that government bodies, and other persons, be informed and the client agrees that notification to such bodies or persons as required may be done by Earth Tech in its reasonably exercised discretion.

8. <u>USE OF REPORT BY OTHERS</u>

Others wishing to rely upon this Report in any manner may do so only upon condition that such use, and the consequences of such use, are entirely at their own risk and that they understand fully the terms of the Mandate and Basis of this Report.

It is further agreed by such Others that Earth Tech will not be liable to them in any manner including any liability in contract or in tort for any damages whatsoever arising from such use.