
**GRANULAR RESOURCE INVESTIGATION
LAC DE GRAS, NWT
GEOTECHNICAL REPORT**

Submitted to:

INDIAN AND NORTHERN AFFAIRS CANADA

Prepared by:

**EBA ENGINEERING CONSULTANTS LTD.
YELLOWKNIFE, N.W.T.**

0701-96-12174

FEBRUARY, 1997



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1.0 INTRODUCTION

1.1 GENERAL

This report presents the results of geotechnical investigations conducted within the mineral claim block of the NWT Diamonds Project, operated by BHP Diamonds Inc. (BHP), and located approximately 300 km northeast of Yellowknife, N.W.T. In particular, two eskers were evaluated: the airstrip (airport) esker near the Koala Lake camp/processing facility and the Misery Lake esker, situated approximately 30 kilometers to the southeast of Lac de Gras. The objective of the investigations was to determine ground stratigraphy and to delineate ground ice conditions in the eskers.

Verbal authorization to proceed with the investigation was received by telephone on March 11, 1996 from Mr. Steven Traynor, of Indian and Northern Affairs Canada (INAC). The investigation was completed under INAC contract number 95-50170. The contract was received by EBA Engineering Consultants Ltd. (EBA) of Yellowknife, N.W.T., on March 19, 1996.

1.2 SCOPE OF WORK

The scope of work, as outlined in "Statement of Work, Consulting and Professional Services" (Appendix D in INAC contract number 95-50170) is as follows:

1.2.1 Field Program Planning

- carry out a review of existing information from in-house archives and from stereo-airphotos;
- consult briefly with the scientific authority regarding the consultant's recommendations on proposed geotechnical boreholes;
- provide recommendations on the location and objectives of proposed geophysical surveys;
- advise the Scientific Authority of any recommended changes in the location and extent of field work that may impact on land use permits or overall schedules and costs of the field program; and
- meet in Yellowknife with the Scientific Authority to finalize the details of the field program objectives, schedule and costs.

1.2.2 Field Operations

- provide supervision of field drilling operations. Log boreholes and obtain samples;
- assist drilling contractor in locating the pre-selected drill sites in the field and using GPS, determine precise coordinates of the actual borehole locations;
- ensure terms and conditions of permits related to daily field activities at the drilling site are adhered to;
- recommend and ensure use of appropriate sampling methods and frequencies, and prepare samples for shipment to Yellowknife; and
- maintain a daily log of activities associated with the drilling program.

1.2.3 Report Preparation

- provide a description of the work undertaken on the project, with particular emphasis on any unique features encountered;
- provide a description of the physical setting of the subject area;
- provide a general location map and site plan, showing all borehole locations;
- provide borehole logs and cross-sections; and
- provide daily inspection reports.

2.0 PROJECT DETAILS

The project entails investigation of granular material and ground ice conditions in the airstrip and Misery Lake eskers located within the BHP mineral claim block. Geotechnical data obtained from the field drilling program is intended to be used for establishing baseline information to assess environmental impacts related to development and for developing recommendations for effective mitigative measures and monitoring programs. In addition, the geotechnical data obtained from the boreholes will help evaluate quality and quantities of granular material available. Scientific information obtained from ground ice samples will help ascertain characteristics such as geological setting, configuration of ground ice, and distribution of ground ice. A site location plan is presented in Figure 1.

3.0 METHOD OF INVESTIGATION

3.1 REVIEW OF AVAILABLE INFORMATION

EBA met with INAC on March 15, 1996 to finalize details of field program objectives, schedule and costs. Present at the meeting were Mr. Ed Hoeve, P.Eng., of EBA, Mr. Robert Lachance, P.Eng., of EBA, Mr. Steven Traynor of INAC, and Mr. Mike Beven of INAC. During the meeting, Mr. Traynor provided the following information:

- Koala Mine Airport Esker Evaluation by EBA Engineering Consultants Ltd. of Edmonton, Alberta (Job No. 0101-94-11439.3, March 1995)
- 1995 Archaeological Investigations for BHP Diamonds Inc. by Points West Heri Consulting Ltd. of Langley, B.C.
- Eskers, Carnivores and Dens, a 1995 Baseline Study Update by BHP Diamonds Inc., Yellowknife, N.W.T.
- Color stereo-airphotos for the airstrip esker study area (G9308037-7-189, G9308037-7-188) and color stereo-airphotos for the Misery Lake esker study area (G9308038-4-86, G9308038-3-116, G9308038-3-117) from Geographic Air Survey Ltd.

Additional reports, listed in the References, were also reviewed.

3.1.1 REGIONAL QUATERNARY GEOLOGY

The regional Quaternary geology of the region has been described by Rampton (1994). The region has been subjected to multiple glaciations during the Quaternary period; all glacial phenomena have been attributed to the last glaciation (the Late Wisconsinian). During the Late Wisconsinian period, the region was subject to glaciers flowing in a variety of directions. Striations indicate that the earliest flow was to the southwest. Subsequently, flow was to the west and west-northwest.

During the Late Wisconsinian Glaciation, thick till was deposited on the bedrock over most of the area. Large boulder concentrations on areas of thin till adjacent to areas of thick till having few to moderate boulder concentrations on their surface suggest that much till has been removed by subglacial meltwater erosion (leaving only the boulders as lag). This hypothesis is supported by fossil plunge pools and whirlpools and by erosion scallops, all flanking till uplands.

During the waning stages of glaciation, there was an abundant supply of subglacial meltwater. This meltwater not only resulted in the formation of numerous eskers, but resulted in the erosion of large amounts of till. Fines were winnowed from the upper part of the exposed till and small patches of sand and gravel were commonly deposited on the till surface. Subglacial glaciofluvial deposits were also deposited as irregular hills, knolls, transverse ridges, and sheets of bar-like features. In some areas, the till was completely removed by meltwater and bedrock was exposed. Subglacial meltwater has affected a large portion of the area.

During the last part of the Late Wisconsinian Glaciation, a trunk esker crossed the claim block in a west-northwest direction from just north of Duchess Lake to south of Yamba Lake. Eskers and glaciofluvial corridors south of the trunk eskers primarily have a north-northwest trend, whereas areas north of the trunk glacier have trends ranging from west to southwest. Striations indicate that the late glacial flow was parallel to the trend of the eskers and meltwater corridors.

Following deglaciation, the level of some of the lakes stood higher than present as evidenced by trim lines. The lack of deltas and well-developed beaches indicate that these high lake levels were short-lived.

During the Holocene period, thin alluvial deposits formed along some streams, and pond deposits have accumulated in shallow depressions. Organic deposits have also formed on some poorly drained floodplains, pond deposits and low, flat areas.

3.1.2 Surficial Geology

The NWT Diamonds Project area lies within the Bear-Slave Upland of the Canadian Shield (Bostock, 1970). The claim block is primarily underlain by granitoids that have intruded Yellowknife Supergroup phyllites, slates, graywackes, and schists (Folinsbee, 1949; Thompson et al., 1994). In general, the area has moderate surface relief with no more than 50 m differential elevation between low and high points.

The surficial geology of the region has been described by Ward (1993). The surficial deposits that overlie the bedrock consist of glacial till, glaciofluvial deposits, organics and alluvial flood plain deposits. The glacial till has a variable thickness up to 15 m and consists of a sand matrix

containing silt, gravel, cobbles, and boulders in varying proportions. Glaciofluvial deposits consist of eskers and outwash sands. Organics reach a thickness of up to 2 m in bogs and fens; in raised areas, the thickness of organics is much less. Alluvial floodplain deposits are gravel to silt-sized sediments with thicknesses of up to 5 m.

There are numerous shear zones and fault traces in the area. The glacier movement that was dominant in affecting the landscape advanced in a north-northwest direction (Ward et al., 1994).

In many locations, the surface of the till has been water-washed, removing fine-grained soils and leaving a surface layer of cobbles and boulders. In some areas, the terrain is typified by extensive boulder fields as a result of the fines having been completely removed, leaving open voids among the boulders.

3.1.3 Previous Work

EBA conducted a drilling program of the Airstrip Esker in July, 1994. A total of seven boreholes were drilled, of which three were along the esker crest and thermistor strings were installed to approximately 19 m depth below then-grade. In addition, EBA conducted a ground penetrating radar (GPR) survey of the Airstrip Esker in August, 1994. GPR profile lines were surveyed along the longitudinal axis of the Airstrip Esker adjacent to the lake and across four transverse lines. The objective of the GPR survey was to delineate areas of massive ground ice and the esker/till stratigraphic contact. Locations of the boreholes drilled and the GPR survey lines are presented in Figure 1.

The results of the GPR survey were reported in EBA (1995). The interpreted GPR profiles are presented in Appendix I of that report.

3.1.4 Archaeological Sites

An archaeological investigation of the Lac de Gras area was carried out for BHP by Points West Heri Consulting Ltd. of Langley, B.C. In the archaeological report, reference was made to the investigation of a portion of the Lac du Sauvage Esker. The south portion of the Lac du Sauvage esker investigated is also referred to as the Misery Lake Esker. Artifacts found on, and at the base of, the south portion of the Lac du Sauvage esker were limited to "quartz flakes", and "unworked quartz flakes".

In addition to the findings of the archaeological investigation, and based on information received by Mr. Traynor from Mr. Tom Andrews, Chief Archaeologist of the Prince of Wales Heritage Centre in Yellowknife, N.W.T., it is believed that a Christian burial site is located in the vicinity of the Misery Lake Esker.

3.1.5 Eskers, Carnivores and Dens

Based on the "Eskers, Carnivores and Dens, a 1995 Baseline Study Update" report prepared by BHP, one wolverine den is located within the proposed study area of the Misery Lake Esker. A fox den, two collapsed bear dens, and two wolf dens were reported to be located just north of the study area.

3.2 DRILLING AND SAMPLING

The drilling investigation was carried out between March 16 and March 25, by Mr. Robert Lachance, P.Eng., of EBA, Yellowknife, N.W.T. The drilling contractor was Midnight Sun Drilling Ltd., of Whitehorse, Y.T. The drill rig used was a CME 750 equipped with extra-wide, low pressure tires, a CRREL core barrel and extractor, a tent, and 150 mm diameter solid and hollow stem augers.

Boreholes, INAC-1 to INAC-3, were drilled on the Airstrip Esker and Boreholes, INAC-4 to INAC-8, were drilled on the Misery Lake Esker. All boreholes were located by Mr. Steven Traynor.

Borehole INAC-1 was located approximately 20 m north of Borehole E3, where massive ice was encountered during the 1994 drilling program. Borehole INAC-2 was located near the south end of the adjacent lake, near previously-observed exposed massive ice. Borehole INAC-3 was drilled at approximately 140 m south of INAC-1. Borehole locations along the airstrip esker are presented in Figure 2.

Borehole INAC-4 was drilled near Lac de Gras, near the south end of the Misery Lake Esker. Boreholes INAC-5 and INAC-6 were drilled near the centre of the Misery Lake Esker study area, and Boreholes INAC-6, INAC-7, and INAC-8 were drilled at the north end of the Misery Lake Esker study area near a proposed borrow site. Borehole locations along the Misery Lake Esker are shown in Figure 3.

Borehole logs are presented in Appendix A. Borehole data presented in digital (ESEBase) format with two copies of this report (Appendix E). Summaries of daily activities are presented in Appendix C. Selected photographs are presented in Appendix D.

Disturbed samples retained from the drilling program for laboratory analysis include 59 grab samples, collected at regular drilling intervals, and 19 bulk samples. Ten relatively undisturbed samples were recovered using a CRREL core barrel. All samples were double bagged in preparation for transporting to EBA's Yellowknife laboratory. Excess ice content was determined on site for selected grab samples. Frozen samples were placed in vertical containers, covered and thawed. After thawing, the containers were gently vibrated and allowed to sit for several hours. The cover was then removed, the depth of surface water above the soil was measured, and the soil samples, including excess water, were placed back into their original bags. The depth of the surface water and sample height were used to determine excess ice, by volume.

3.3 LABORATORY TESTING

Laboratory testing on soil samples retained from the drilling program included moisture content determinations and grain size analyses. Grab samples were transported by air on March 26, 1996 and bulk samples were delivered by Mr. Traynor to EBA's Yellowknife laboratory on April 10, 1996. All laboratory testing was conducted in accordance with ASTM procedures and specifications.

Moisture content results are presented on the borehole logs in Appendix A. Results from grain size curves are presented on borehole logs and on sieve report sheets presented in Appendix B.

4.0 SITE DESCRIPTIONS

4.1 KOALA AIRSTRIP ESKER

4.1.1 Surface Description

The Airstrip Esker is a prominent north-south oriented ridge located approximately 1 km southeast of the existing Koala camp/processing facility. Existing roads make the esker readily

accessible. The esker has a base area of approximately 20 hectares and ranges from 7 m to 12 m in height. A long linear portion of the esker forms a natural dam that impounds an unnamed lake on the east side at a water level of approximately 470 m. The esker currently serves as a natural granular base for part of the winter road connecting Koala camp to the Lupin winter road. The portion of the esker near the south end of the lake has been used as a borrow source for construction material.

Surface vegetation had been removed where extraction of granular material had already taken place. On the west slope of the esker, in areas where the surface remains undisturbed, vegetation is limited to moss and lichen. Organic cover was not found at any of the three locations investigated during the field program. Borehole locations are presented in Figure 2.

4.1.2 Soil Conditions

The general stratigraphy of the airstrip esker has been described by EBA (1995) and can be generally described as comprising granitic rock that is overlain by glacial till, in turn overlain by glaciofluvial sand and gravel. This was confirmed by the present site investigation.

At Borehole INAC-1, 9.1 m of sand with varying quantities of gravel, silt, and an occasional cobble or boulder was found to overlie massive ice. Massive ice interbedded with occasional layers of sand or silt was found from 9.1 to 13.1 m. Probable glacial till underlaid the ice.

In Borehole INAC-2, ground stratigraphy consisted of a gravel and sand mixture to 1.3 m, over 0.9 m of massive ice, over alternating layers of gravel and sand. In Borehole INAC-3, a 0.8 m layer of a gravel and sand mixture was found over 4.5 m of gravel over 0.8 m of massive ice over probable glacial till.

Depth to bedrock could not be confirmed with the drilling equipment utilized for the field investigation. Drilling depths ranged from 7.0 m in Borehole INAC-3 to 15.8 m in Borehole INAC-1, and averaged 10.7 m. For Boreholes INAC-1 and INAC-2, boreholes were terminated on possible bedrock, or on boulders near the bedrock surface. Borehole INAC-3 was terminated due to time limits set for completion of the drilling program at the airstrip esker site.

Moisture contents ranged from 2 percent at 1.1 m in Borehole INAC-3 to 79 percent at 4.8 m in Borehole INAC-1, and averaged 15 percent. Moistures varied widely due to variability in ice content.

4.1.3 Permafrost

Surficial permafrost features, such as circular depressions and sinkholes, noted on the natural esker surface indicate the presence of massive ground ice. Thermokarst terrain, which can be described as irregular topography resulting from the melting of excess ground ice and subsequent thaw settlement, is evident along the west side of the esker. Melt water from the thawing ice has been observed along the base of the esker's west side in several places.

Ground temperature readings obtained from the three thermistor strings installed in the esker indicate that the ground temperatures below depth of significant seasonal influence vary between -1.5 °C and -3°C. The active layer thickness as inferred from the ground temperature obtained to date ranges from 1.2 m to 1.8 m. The active layer thickness information presented above was determined on the crest of the esker where the surface had been previously disturbed.

Massive ground ice exists at various locations within the airstrip esker. A massive ice layer 5.8 m thick in Borehole E3 was documented in EBA (1995) and exposed massive ice was reported near Borehole INAC-2 on the east slope of the airstrip esker. Massive ice was also discovered in Boreholes INAC-1 to INAC-3. The ice encountered in the present investigation was observed to be massive with trace soil inclusions and occasional sand and silty sand lenses and ranged in thickness from 0.8 m to 4.0 m. Total ice thickness was 5.3 m in Borehole INAC-1, 0. m in Borehole INAC-2, and 0.8 m in Borehole INAC-3.

Well bonded, non-visible excess ice was found in all three boreholes. In Borehole INAC-1, excess ice ranged from 7 percent at 5.8 m to 55 percent at 4.8 m, and averaged 18 percent. In Borehole INAC-2, well bonded non-visible excess ice averaged less than 5 percent, and in Borehole INAC-3, well bonded non-visible excess ice ranged from 10 percent to 15 percent and averaged 13 percent.

4.2 MISERY LAKE ESKER

4.2.1. Surface Description

The Misery Lake Esker is located approximately 1.5 km northeast of Misery Lake and is oriented northwest-southeast. A 1.5 m portion of the esker, extending from Lac de Gras to the

south end of an unnamed lake, was investigated. The esker roughly parallels the natural drainage path, to the east of the esker, from the unnamed lake at approximate elevation 451.6 m southeast to Lac de Gras at elevation 416 m. The Misery Lake Esker ranges from 2 m to 8 m in height.

The surface of the esker was snow-covered during the site investigation. Based on air photo interpretations, surface vegetation is sparse, and where present, comprises mainly lichen and moss. Traces of organics in the form of rootlets, lichens and mosses were found at locations drilled on the Misery Lake Esker. Borehole locations are presented in Figure 3.

4.2.2 Soil Conditions

The general stratigraphy of the airstrip can be generally described as comprising granitic rock that is overlain by glacial till, in turn overlain by glaciofluvial sand and gravel. The glaciofluvial sand and gravel contains varying degrees of silt, cobbles and boulders. Borehole logs for the five boreholes investigated in the Misery Lake Esker are presented in Appendix B.

In Boreholes INAC-4 to INAC-7 inclusive, ground stratigraphy consisted of granular material comprised mainly of varying quantities of sand and gravel with traces to some silt, cobbles and boulders. Traces of clay were found at 4.2 m in Borehole INAC-4, and at 4.0 m and 5.0 m in Borehole INAC-5. Sand and silt was found between 7.3 m and 9.0 m in Borehole INAC-5, and between 2.4 m and 3.6 m in Borehole INAC-8. Massive ice was found between 6.2 m and 6.7 m in INAC-8. The total thickness of ice is unknown as INAC 8 was terminated in ice due to auger breakage.

Boreholes depths ranged from 4.1 m in Borehole INAC-7 to 11.0 m in Borehole INAC-5, and averaged 8.1 m. As with the Airstrip Esker, verification of depth to bedrock could not be determined from drill hole data. Boreholes were terminated on possible bedrock or on boulders in Boreholes INAC-4 to INAC-7 inclusive. Borehole INAC-8 was terminated in massive ice.

Moisture contents ranged from 2 percent at 1.8 m in Borehole INAC-4 to 25 percent at 5.0 m in Borehole INAC-8 and averaged 13 percent.

4.2.3 Permafrost

Previous subsurface information related to ground stratigraphy and ground ice content was not available for the Misery Lake esker. From air photographs, ice wedges are visible near the north end of the Misery Lake study area. Massive ice of unknown thickness was found at the base of Borehole INAC-8.

Approximately 5 percent or less well bonded non-visible excess ice was found at 4.8 and 6.5 m in Borehole INAC-4 and at 4.0, 5.0, and 6.8 m in Borehole INAC-5. Frozen soil was generally friable above permafrost elevations and, where excess ice was not encountered, frozen soils were well bonded and non-visible.

4.3 GROUND CONDITIONS

Groundwater was not encountered in any boreholes in either the Airstrip Esker or Misery Lake Esker study areas. Groundwater will follow the active layer/frozen soil boundary during the thaw season.

5.0 CLOSURE

The text of this report is present in digital (WP6.1) format with two copies of the report (Appendix E).

We trust that this adequately documents the investigation and findings. EBA Engineering Consultants Ltd. has appreciated the opportunity to work on this project and would like to acknowledge the cooperation and guidance provided by Mr. Steven Traynor of INAC and Midnight Sun Drilling Co. Ltd. Please contact the undersigned if you have questions or comments.

Respectfully submitted,

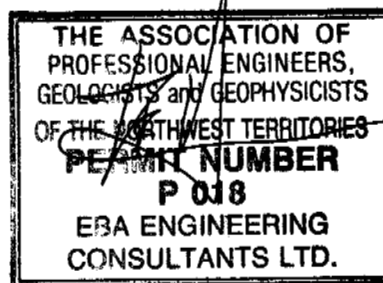
EBA ENGINEERING CONSULTANTS LTD.

Prepared by:

Reviewed by:

Robert Lachance, P.Eng.
Project Engineer

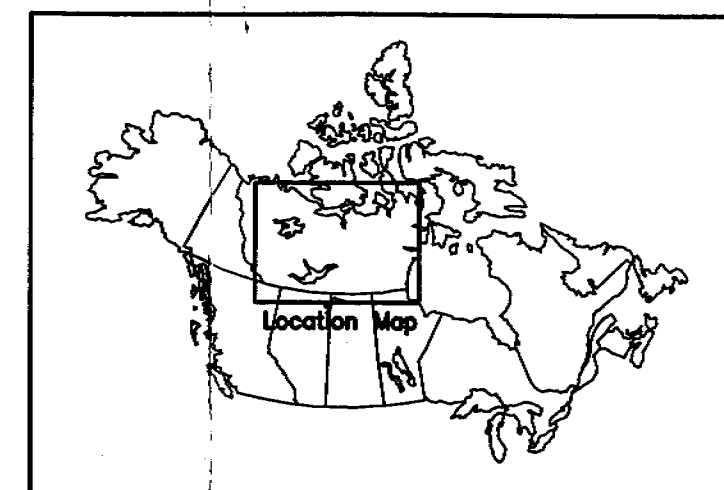
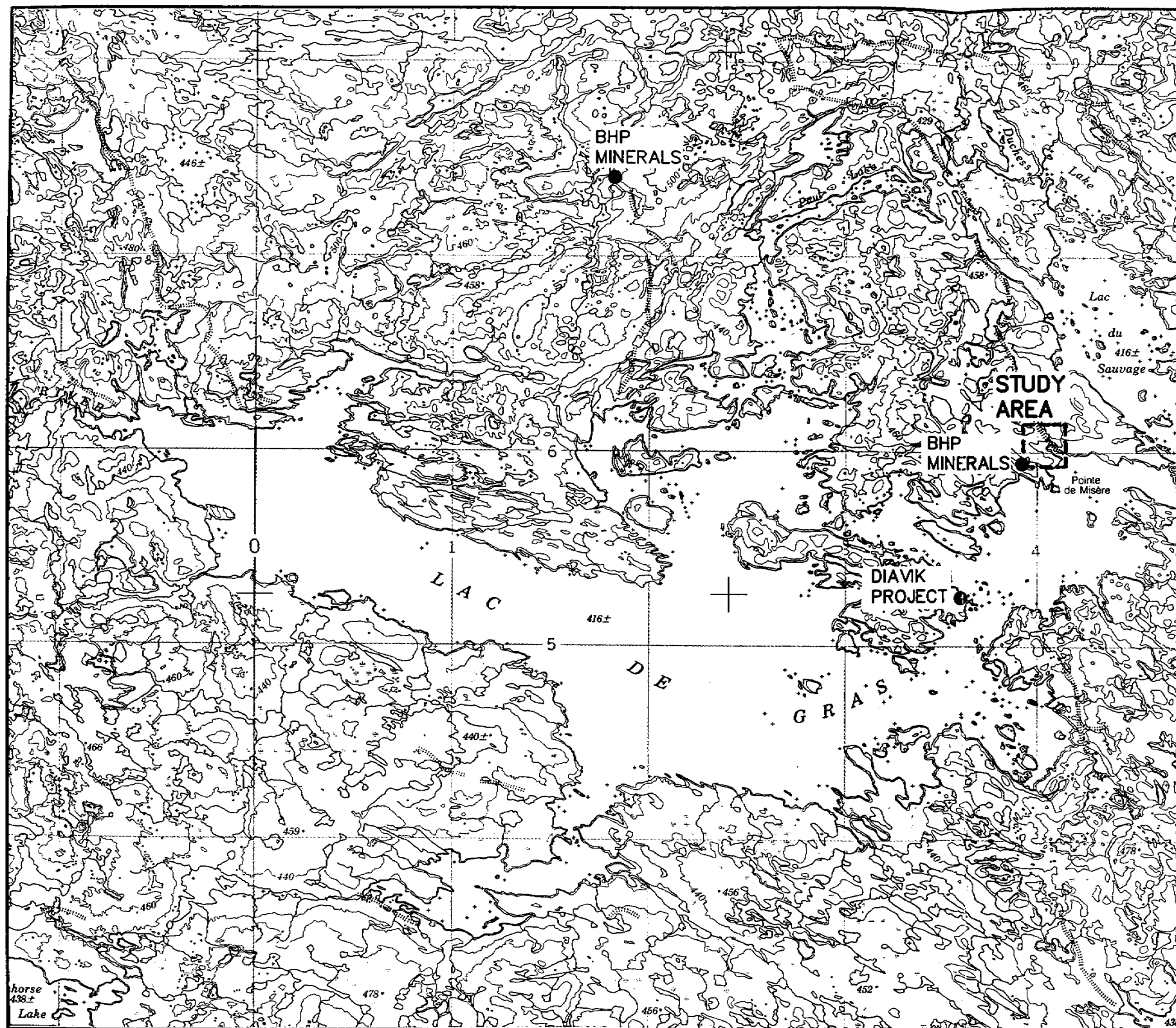
T.E. Hoeve, P.Eng.
Project Director, N.W.T.



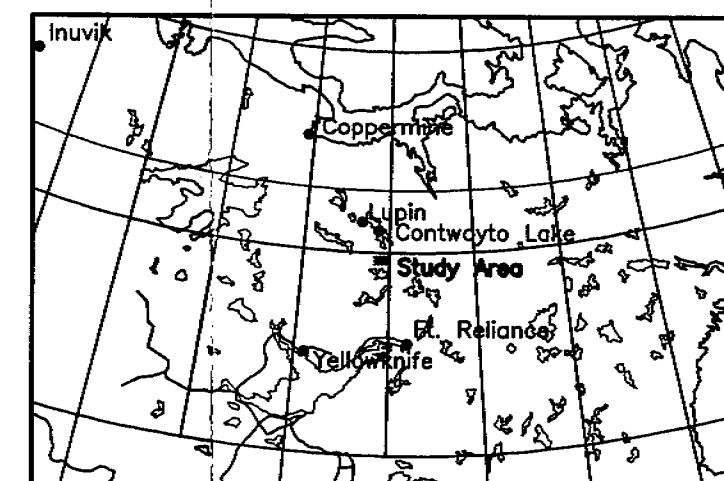
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FIGURES



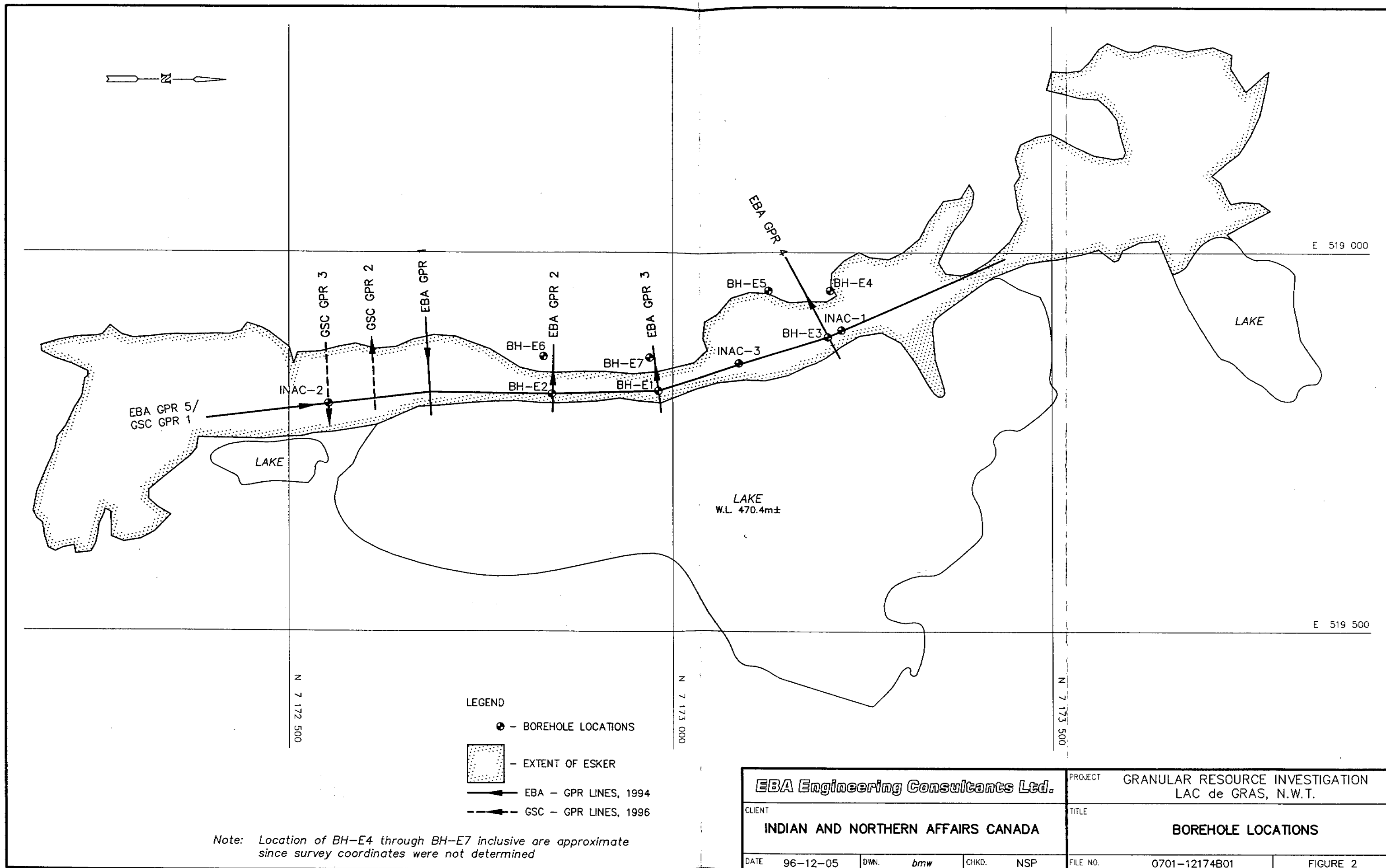
INDEX MAP
N.T.S.



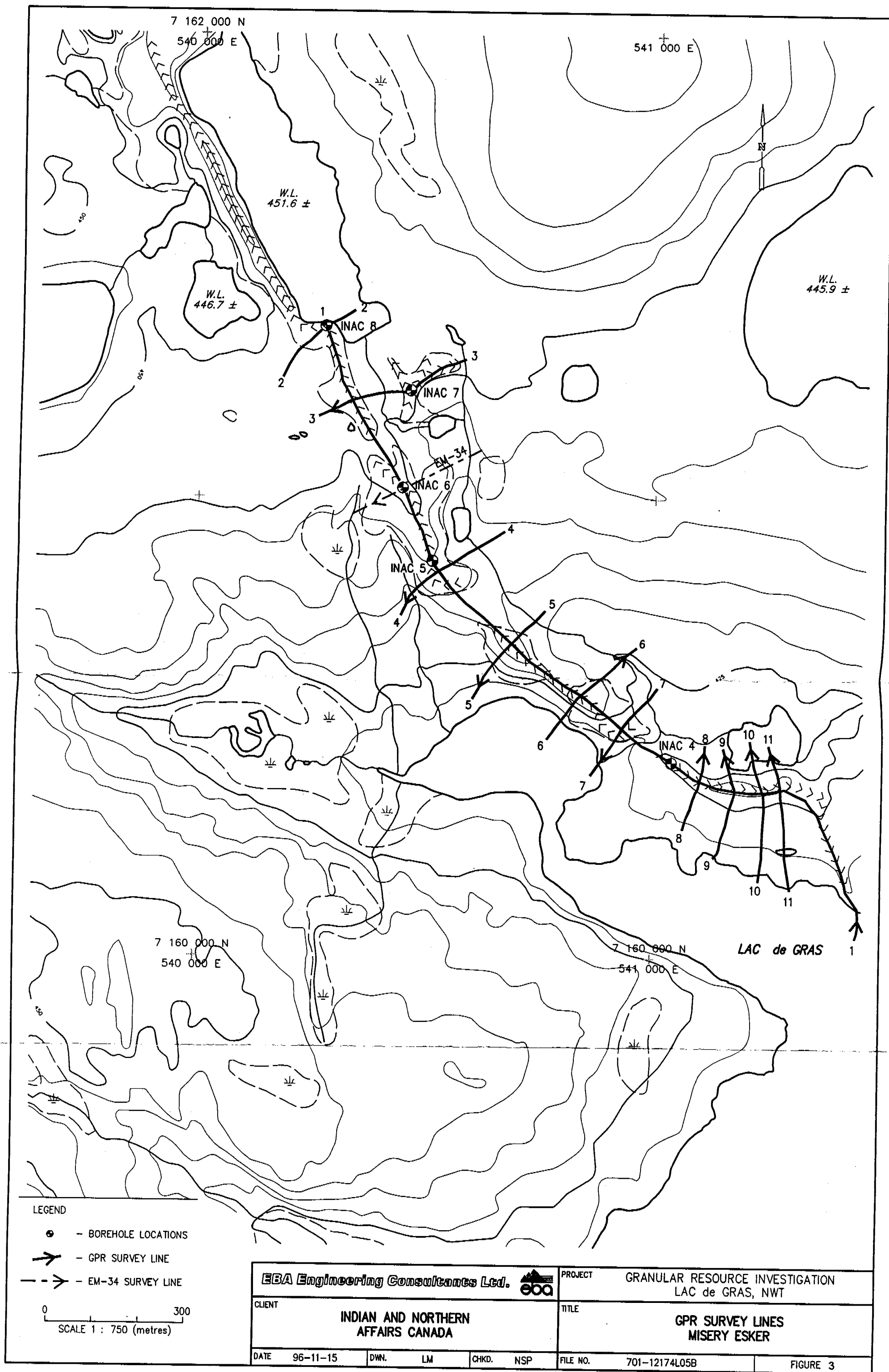
LOCATION MAP
N.T.S.


0 2 4 6 8 10
kilometres

EBA Engineering Consultants Ltd.				PROJECT GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT	
CLIENT INDIAN AND NORTHERN AFFAIRS CANADA				TITLE GENERAL LOCATION PLAN	
DATE 96-11-10	DWN. LM	CHKD. NSP	FILE NO. 701-12174L15A	FIGURE 1	



EBA Engineering Consultants Ltd.				PROJECT GRANULAR RESOURCE INVESTIGATION LAC de GRAS, N.W.T.	
CLIENT INDIAN AND NORTHERN AFFAIRS CANADA				TITLE BOREHOLE LOCATIONS	
DATE	96-12-05	DWN.	bmw	CHKD.	NSP
FILE NO.	0701-12174B01	FIGURE 2			



EBA Engineering Consultants Ltd. 				PROJECT GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT	
CLIENT INDIAN AND NORTHERN AFFAIRS CANADA				TITLE GPR SURVEY LINES MISERY ESKEER	
DATE 96-11-15	DWN. LM	CHKD. NSP	FILE NO. 701-12174L05B	FIGURE 3	

APPENDIX A
BOREHOLE LOGS

UNIFIED SOIL CLASSIFICATION†

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP GM, GC, SM, SC Borderline classification requiring use of dual symbols	$C_u = D_{60}/D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand clay mixtures		Atterberg limits plot above 'A' line and plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly-graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above 'A' line and plasticity index greater than 7	

FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	PLASTICITY CHART For classification of fine-grained soils and fine fraction of coarse-grained soils Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols Equation of 'A' line: $PI = 0.73(LL - 20)$
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		OL	Organic silts and organic silty clays of low plasticity	
	SILTS AND CLAYS Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
		CH	Inorganic clay of high plasticity, fat clays	
		OH	Organic clays of medium to high plasticity	

HIGHLY ORGANIC SOILS	PT	Peat, muck and other highly organic soils	*Based on the material passing the 3 in. (75 mm) sieve 1 ASTM Designation D 2487, for identification procedure see D 2488
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*Based on the material passing the 3 in. (75 mm) sieve
†ASTM Designation D 2487, for identification procedure see D 2488

GROUND ICE DESCRIPTION

ICE NOT VISIBLE

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
N	Nf	Poorly-bonded or friable	
	Nbn	No excess ice, well-bonded	
	Nbe	Excess ice, well-bonded	

NOTE:

- Dual symbols are used to indicate borderline or mixed ice classifications
- Visual estimates of ice contents indicated on borehole logs $\pm 5\%$
- This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes

LEGEND

Soil Ice

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
V	Vx	Individual ice crystals or inclusions	
	Vc	Ice coatings on particles	
	Vr	Random or irregularly oriented ice formations	
	Vs	Stratified or distinctly oriented ice formations	

VISIBLE ICE GREATER THAN 50% BY VOLUME

ICE	ICE + Soil Type	Ice with soil inclusions	
	ICE	Ice without soil inclusions (greater than 25 mm (1 in.) thick)	

SYSTEM INTERNATIONAL UNITS

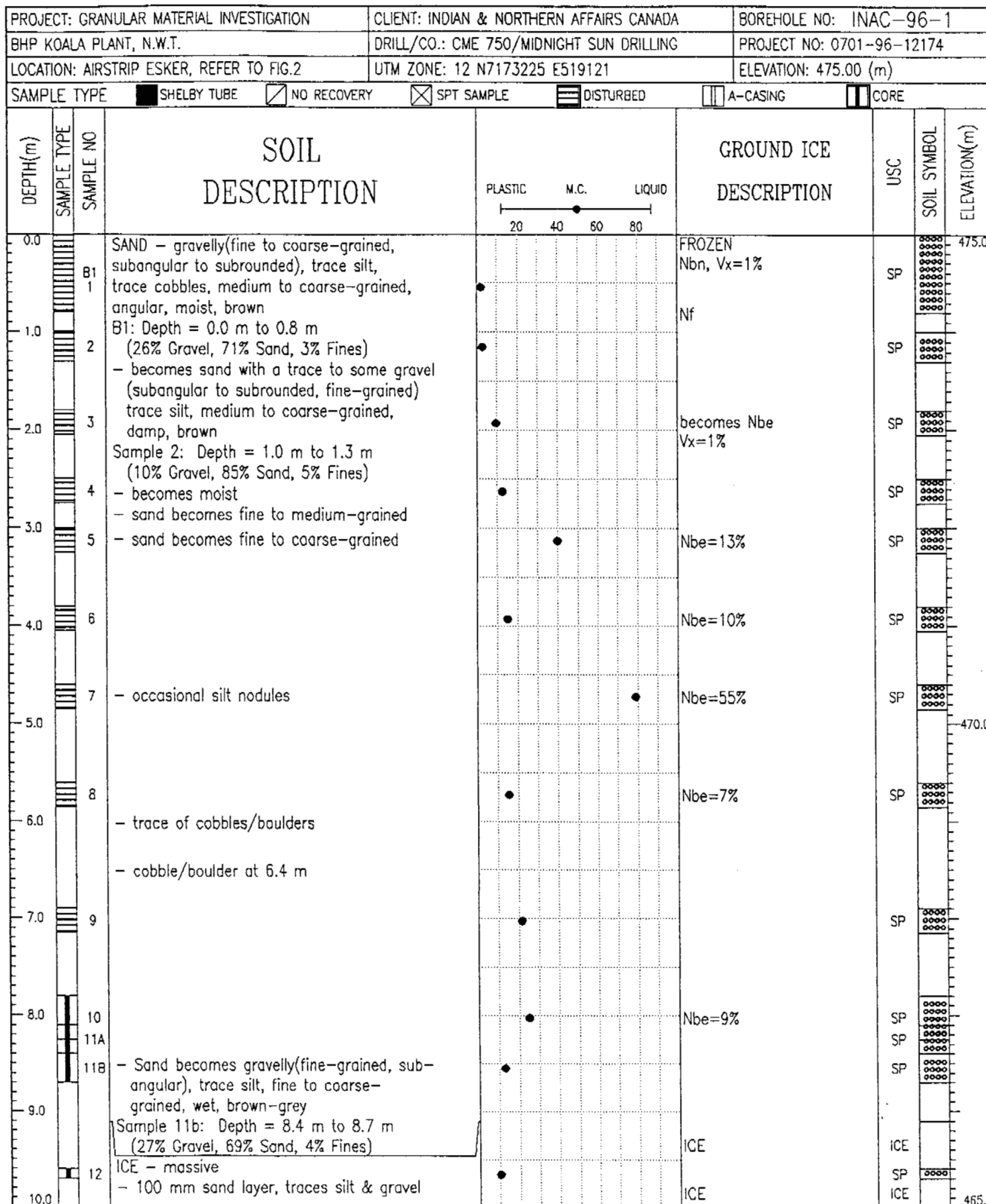
QUANTITY	NAME	SYMBOL	EXPRESSED IN TERMS OF OTHER SI UNITS	EXPRESSED IN TERMS OF BASE AND SUPPLEMENTARY UNITS
SI UNITS				
length	metre	m		
mass	kilogram	kg		
time	second	s		
electric current	ampere	A		
thermodynamic temperature	kelvin	K		
amount of substance	mole	mol		
luminous intensity	candela	cd		
SI SUPPLEMENTARY UNITS				
plane angle	radian	rad		
solid angle	steradian	sr		
EXAMPLES OF SI DERIVED UNITS WITH SPECIAL NAMES				
frequency	hertz	Hz	1/s	s ⁻¹
force	newton	N	m · kg/s ²	m · kg · s ⁻²
pressure, stress	pascal	Pa	N/m ²	m ⁻¹ · kg · s ⁻²
energy, work, quantity of heat	joule	J	N · m	m ² · kg · s ⁻²
power, radiant flux	watt	W	J/s	m ² · kg · s ⁻³
EXAMPLES OF SI DERIVED UNITS WITHOUT SPECIAL NAMES				
velocity - linear	metre per second		m/s	m · s ⁻¹
- angular	(radian per second)		rad/s	rad · s ⁻¹
acceleration - linear	(metre per second) per second		m/s ²	m · s ⁻²
- angular	(radian per second) per second		rad/s ²	rad · s ⁻²
concentration (of amount of substance)	mole per cubic metre		mol/m ³	mol · m ⁻³
dynamic viscosity	pascal second		Pa · s	m ⁻¹ · kg · s ⁻¹
moment of force	newton metre		N · m	m ² · kg · s ⁻²
surface tension	newton per metre		N/m	kg · s ⁻²
heat flux density, irradiance	watt per square metre		W/m ²	kg · s ⁻³
heat capacity, entropy	joule per kelvin		J/K	m ² · s ⁻² · K ⁻¹
specific heat capacity, specific entropy	joule per kilogram kelvin		J/(kg · K)	m ² · s ⁻² · K ⁻¹
specific energy	joule per kilogram		J/kg	m ² · s ⁻²
thermal conductivity	watt per metre kelvin		W/(m · K)	m · kg · s ⁻³ · K ⁻¹

OTHER UNITS PERMITTED FOR USE WITH SI

QUANTITY	NAME	SYMBOL	DEFINITION
time	minute	min	1 min = 60 s
	hour	h	1 h = 3,600 s
	day	d	1 d = 86,400 s
	year	a	
plane angle	degree	°	1° = (°/180) rad
	minute	'	1' = (°/10,800) rad
	second	"	1" = (°/648,000) rad
	hectare	ha	1 ha = 10,000 m ²
area	litre	L	1,000 L = 1 m ³
volume	degree Celsius	°C	0° C = 273.15° K
temperature			temperature interval 1 °C = 1 K
mass	tonne	t	1 t = 1,000 kg = 1 Mg

MULTIPLYING FACTOR	PREFIX	SYMBOL	MULTIPLYING FACTOR	PREFIX	SYMBOL
1,000,000,000,000,000,000 = 10 ¹⁸	exa	E	0.1 = 10 ⁻¹	deci*	d
1,000,000,000,000,000 = 10 ¹⁵	peta	P	0.01 = 10 ⁻²	centi*	c
1,000,000,000,000 = 10 ¹²	tetra	T	0.001 = 10 ⁻³	milli	m
1,000,000,000 = 10 ⁹	giga	G	0.000,001 = 10 ⁻⁶	micro	μ
1,000,000 = 10 ⁶	mega	M	0.000,000,001 = 10 ⁻⁹	nano	n
1,000 = 10 ³	kilo	k	0.000,000,000,001 = 10 ⁻¹²	pico	p
100 = 10 ²	hecto*	h	0.000,000,000,000,001 = 10 ⁻¹⁵	femto	f
10 = 10 ¹	deca*	da	0.000,000,000,000,000,001 = 10 ⁻¹⁸	atto	a

* to be avoided where possible



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LOGGED BY: RGL
REVIEWED BY: TEH
Fig. No: BH-01

COMPLETION DEPTH: 15.8 m
COMPLETE: 96/03/20

Page 1 of 2

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-1						
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174						
LOCATION: AIRSTRIP ESKER, REFER TO FIG.2		UTM ZONE: 12 N7173225 E519121		ELEVATION: 475.00 (m)						
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE										
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC	M.C.	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
10.0		13	SAND - some silt, trace gravel, brown					SM		465.0
		14	ICE - massive - 100 mm silt layer, grey				ICE	ICE		
11.0								ML		
12.0								ICE		
13.0		15	SILT - trace of fine sand, trace iron oxides at soil/ice interface, grey				Nbe=15%	ML		
			ICE - massive							
14.0										
15.0			GRAVEL (Probable Till) - sandy, some cobbles and boulders							460.0
16.0			END OF BOREHOLE AT 15.8 m							
17.0			- BOREHOLE TERMINATED ON POSSIBLE BEDROCK							
18.0			- 75 mm DIAMETER PVC TUBING INSTALLED TO 7.4 m FOR DOWN HOLE LOGGING BY THE GSC							
19.0			- SLOUGH AT 10.1 m FROM GROUND SURFACE							
20.0			- NO WATER IN HOLE (ABOVE 10.1 m) AT COMPLETION. SOME OF WET SAMPLES MAY HAVE RESULTED FROM MELTING ICE.							455.0

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Fig. No: BH-01

COMPLETION DEPTH: 15.8 m

COMPLETE: 96/03/20

Page 2 of 2

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-2						
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174						
LOCATION: AIRSTRIP ESKER, REFER TO FIG.2		UTM ZONE: 12 N7172626 E519158		ELEVATION: 475.00 (m)						
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input checked="" type="checkbox"/> CORE										
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC 20 40 60 80	M.C. 20 40 60 80	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
0.0		1	GRAVEL AND SAND - (fine to coarse-grained, angular sand), same cobbles and boulders, trace silt, fine to coarse-grained, sub-rounded to rounded, brown				FROZEN NF Nbe=2%			475.0
1.0		B1	- boulder (0.3 m diameter)							
2.0		2	B1: Depth = 0.9 m to 1.4 m (57% Gravel, 38% Sand, 5% Fines) ICE - massive, trace soil inclusions				ICE			
3.0		B2	GRAVEL - sandy, some cobbles and boulders, trace to some silt, brown-grey				Vs=50% (From 2.4 to 2.6 m) Nbe<5%			
4.0			B2: Depth = 2.3 m to 3.6 m (57% Gravel, 36% Sand, 7% Fines) - cobble and boulder content decreases to trace				Nbe<5%			
5.0		4	- some cobbles and boulders							
6.0		B3	SAND - silty, angular, fine to coarse-gr., wet, brown-grey				Nbn			470.0
7.0			B3: Depth = 5.2 m to 6.7 m (0% Gravel, 78% Sand, 22% Fines)							
8.0		5	GRAVEL - sandy, some silt, cobbles and boulders, wet, brown-grey							
9.0		6	SAND - some silt, trace gravel (fine-gr., subangular), brown-grey							
			GRAVEL (Possible Till) - sandy, some boulders and cobbles. trace to some silt, grey							
10.0			END OF BOREHOLE AT 9.3 m. - BOREHOLE TERMINATED ON POSSIBLE BEDROCK - 75 mm DIAMETER PVC TUBING INSTALLED TO							465.0

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Fig. No: BH-02

COMPLETION DEPTH: 9.1 m

COMPLETE: 96/03/21

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PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-2						
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174						
LOCATION: AIRSTRIP ESKER, REFER TO FIG.2		UTM ZONE: 12 N7172626 E519158		ELEVATION: 475.00 (m)						
SAMPLE TYPE <input type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE										
DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC	M.C.	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
10.0			9.2 m FOR DOWN HOLD LOGGING BY THE GSC - AUGER BIT LOST IN BOREHOLE - SLOUGH AT 7.1 m BEFORE CLEAN OUT FOR GSC - BOREHOLE DRY AT COMPLETION							485.0
11.0										
12.0										
13.0										
14.0										
15.0										460.0
16.0										
17.0										
18.0										
19.0										
20.0										455.0
EBA Engineering Consultants Ltd. Yellowknife, N.W.T.				LOGGED BY: RGL		COMPLETION DEPTH: 9.1 m				
				REVIEWED BY: TEH		COMPLETE: 96/03/21				
				Fig. No: BH-02				Page 2 of 2		

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-3	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: AIRSTRIP ESKER, REFER TO FIG.2		UTM ZONE: 12 N7173092 E519144		ELEVATION: 474.90 (m)	
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC 20 40 60 80	M.C.	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
0.0		B1	GRAVEL AND SAND - (sand is fine to medium-gr., angular), trace silt, fine to coarse-grained, subangular, light brown B1: Depth = 0.1 m to 0.8 m (49% Gravel, 45% Sand, 6% Fines)				FROZEN NF	GP	▲▲▲▲	474.0
1.0		B2	GRAVEL - sandy (fine to medium-grained, angular), trace silt, cobbles and boulders fine to coarse-gr., subangular, lt. brown B2: Depth = 0.8 m to 1.5 m (68% Gravel, 28% Sand, 3% Fines)					GW	△△△△	
2.0		B3	B3: Depth = 1.5 m to 2.3 m (76% Gravel, 18% Sand, 6% Fines) - 100 mm diameter cobble - 175 mm diameter boulder - 300 mm diameter boulder - 400 mm diameter boulder				- becomes Nbe	GP	▲▲▲▲	
3.0		3								
4.0			- cobble and boulder content decreases, wet				Nbe=10%	GP	▲▲▲▲	
5.0		4	ICE - trace to some soil inclusions - 150 mm layer of gravel				Nbe=15%	GP	▲▲▲▲	
6.0			GRAVEL (Possible Till) - sandy, some cobbles and boulders, trace to some silt, brown-grey							469.0
7.0		5						GP	▲▲▲▲	
8.0			END OF BOREHOLE AT 7.0 m - BOREHOLE TERMINATED AT 18:00 HOURS - 75 mm DIAMETER PVC TUBING INSTALLED TO 5.0 m FOR DOWN HOLE LOGGING BY THE GSC - SLOUGH AT 5.2 m BELOW GROUND SURFACE - BOREHOLE DRY AT COMPLETION							
9.0										
10.0										

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Fig. No: BH-03

COMPLETION DEPTH: 7.0 m

COMPLETE: 96/03/21

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PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-4	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: MISERY LK. REFER TO FIGURE 3		UTM ZONE: 12 N7160379 E541109		ELEVATION: 427.80 (m)	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT SAMPLE	<input type="checkbox"/> DISTURBED
		<input type="checkbox"/> A-CASING	<input type="checkbox"/> CORE		

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC 20 40 60 80	M.C.	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
0.0		B1	SAND - silty, traces of clay and gravel (subrounded to subangular), fine to coarse-grained, subangular to angular, brown B1: Depth = 0.0 m to 0.8 m (26% Gravel, 48% Sand, 26% Fines) - becomes gravelly (fine-grained, sub-rounded to subangular)				FROZEN NF	SP		427.0
1.0		2	GRAVEL - sandy, some cobbles and boulders, some silt, brown				- becomes Nbn	GW		
2.0		B2	GRAVEL AND SAND - some cobbles and boulders, trace silt, brown					GW		
3.0		3	B2: Depth = 2.3 m to 3.1 m (57% Gravel, 39% Sand, 4% Fines)					GW		
4.0		B3	SAND - gravelly (fine to coarse-grained, subrounded to subangular), some silt to silty, fine to coarse-grained, angular, moist, brown B3: Depth = 3.8 m to 4.2 m (29% Gravel, 50% Sand, 21% Fines)				- becomes Nbe	SM		
5.0		4	GRAVEL (Probable Till) - sandy, silty, trace cobbles and boulders, trace clay, moist, brown				Nbe=5% (from 5.0 to 5.4 m)	GM		
6.0		5	- 600 mm diameter boulder					GM		422.0
7.0		6	- cobble					GM		
		7	- some cobbles and boulders				Nbe<5% (from 6.5 m to end of borehole)	GM		
8.0			- boulder							
9.0			END OF BOREHOLE AT 7.9 m - BORHOLE TERMINGATED ON POSSIBLE BEDROCK - SLOUGH AT 5.9 m BELOW GROUND SURFACE - BOREHOLE DRY AT COMPLETION - 75 mm DIAMETER PVC TUBING INSTALLED TO 5.7 m FOR DOWN HOLE LOGGING BY THE GSC							
10.0										

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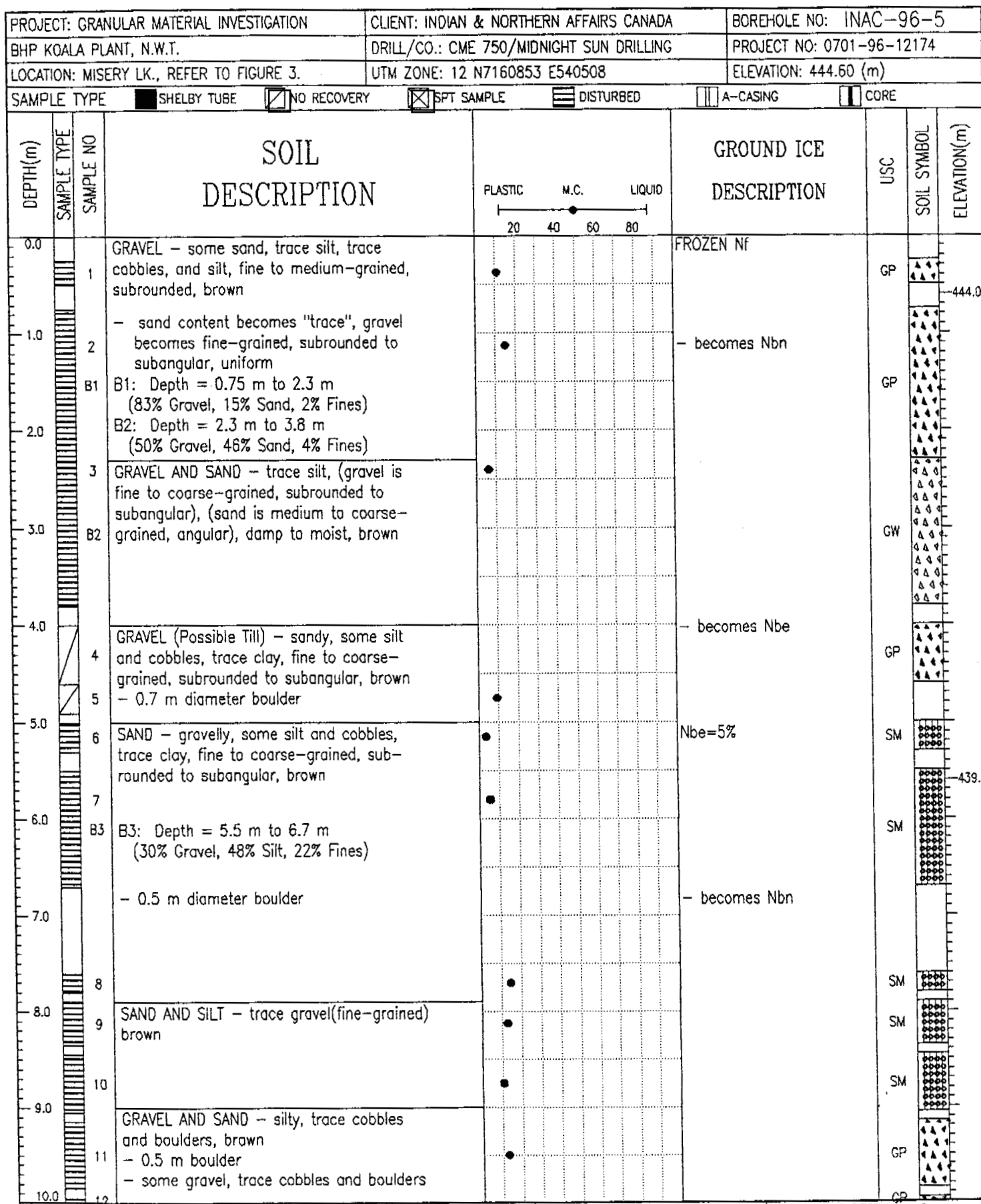
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Fig. No: BH-04

COMPLETION DEPTH: 7.9 m

COMPLETE: 96/03/22

Page 1 of 1



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Fig. No: BH-05

COMPLETION DEPTH: 11.0 m

COMPLETE: 96/03/23

Page 1 of 2

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-5	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: MISERY LK., REFER TO FIGURE 3.		UTM ZONE: 12 N7160853 E540508		ELEVATION: 444.60 (m)	
SAMPLE TYPE <input type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC	M.C.	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
10.0		12	- some gravel, trace cobbles GRAVEL AND SAND (continued)					GP		434.0
11.0			- probable boulder END OF BOREHOLE AT 11.0 m. - BOREHOLE TERMINATED ON PROBABLE BOULDER - 75 mm DIAMETER PVC TUBING INSTALLED TO 10.6 m FOR DOWN HOLE LOGGING BY THE GSC - ONE DRILLING BIT LOST IN BOREHOLE DURING CLEANOUT - SLOUGH AT 9.8 m BEFORE CLEAN OUT BY GSC - BOREHOLE DRY AT COMPLETION							429.0
12.0										
13.0										
14.0										
15.0										
16.0										
17.0										
18.0										
19.0										
20.0										

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LOGGED BY: RGL
REVIEWED BY: TEH
Fig. No: BH-05

COMPLETION DEPTH: 11.0 m
COMPLETE: 96/03/23

Page 2 of 2

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-6	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: MISERY LK., REFER TO FIGURE 3.		UTM ZONE: 12 N7161018 E540449		ELEVATION: 451.40 (m)	
SAMPLE TYPE		<input checked="" type="checkbox"/> SHELBY TUBE <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE			

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	PLASTIC	M.C.	LIQUID	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
0.0		1	GRAVEL - sandy(subrounded to subangular, fine to medium-grained), some silt and cobbles, subrounded to subangular, fine to coarse-grained, wet, brown	•			FROZEN - Nf	GP	▲▲▲	451.0
1.0		2	SAND - trace gravel(subrounded to subangular, fine-grained), trace silt, subangular to angular, medium to coarse-grained, moist, brown	•				SP	○○○○	
2.0		3	- cobbles/coarse gravel	•				SP	○○○○	
			- sand becomes fine to coarse-grained							
		B1	SAND AND GRAVEL(angular, fine to coarse-grained), trace silt, moist to wet					SP	○○○○	
3.0		4	B1: Depth = 2.3 m to 2.8 m (47% Gravel, 50% Sand, 3% Fines) - silt content increases to "some"	•				GP	▲▲▲	
		5		•				GP	▲▲▲	
		B2	GRAVEL - sandy (fine to coarse-grained), some silt, cobbles and boulders, fine-gr., rounded to subrounded, moist to wet, brown					GP	▲▲▲	
4.0		6	- 350 mm diameter boulder at 2.9 m. - silt content decreases to "trace of"	•			Nbn	SW-SM	○○○○	
		B3	B2: Depth = 3.3 m to 3.6 m (85% Gravel, 13% Sand, 2% Fines) - silt content increases to "some silt"					SW-SM	○○○○	
5.0		7	SAND AND GRAVEL - (gravel is fine to coarse-grained), trace silt, medium to coarse-grained, moist, brown	•			Nbn	SP	○○○○	446.0
6.0		8	B3: Depth = 4.1 m to 5.3 m (45% Gravel, 45% Sand, 10% Fines)	•				SP	○○○○	
7.0		9	SAND - some gravel(subangular), trace to some silt, tr. cobbles, medium to coarse-grained, subrounded to subangular, moist, brown	•				SP	○○○○	
			- trace to some gravel	•			Vx=1%	SP	○○○○	
8.0		10		•				SP	○○○○	
9.0		11	SAND AND GRAVEL (Possible Till) - some fines, trace cobbles, brown	•			Nbn	SP	○○○○	
		B4	B4: Depth = 9.1 m to 9.9 m (38% Gravel, 43% Sand, 19% Fines)					SP-SM	○○○○	
10.0										

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Fig. No: BH-06

COMPLETION DEPTH: 10.7 m

COMPLETE: 96/03/23

Page 1 of 2

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-6	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: MISERY LK., REFER TO FIGURE 3.		UTM ZONE: 12 N7161018 E540449		ELEVATION: 451.40 (m)	
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	<div style="text-align: center;"> PLASTIC M.C. LIQUID </div>	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
10.0			GRAVEL - sandy, some cobbles and boulders, some silt, brown - boulder at 9.9 m.					441.0
11.0			GRAVEL (continued) END OF BOREHOLE AT 10.7 m. - BOREHOLE TERMINATED DUE TO BROKEN BIT UNDERSIZED HOLE FOR REPLACEMENT BITS. - 75 mm DIAMETER PVC PIPE INSTALLED TO 8.8 m FOR DOWN HOLE LOGGING BY THE GSC ON POSSIBLE BEDROCK - SLOUGH AT 8.8 m FROM GROUND SURFACE - BOREHOLE DRY AT COMPLETION					
12.0								
13.0								
14.0								
15.0								436.0
16.0								
17.0								
18.0								
19.0								
20.0								

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LOGGED BY: RGL
REVIEWED BY: TEH
Fig. No: BH-06

COMPLETION DEPTH: 10.7 m
COMPLETE: 96/03/23

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INAC		BOREHOLE NO: INAC-96-7	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: MISERY LK., REFER TO FIGURE 3.		UTM ZONE: 12 N7161229 E540457		ELEVATION: 451.90 (m)	
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input type="checkbox"/> CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	<div style="text-align: center;"> PLASTIC M.C. LIQUID 20 40 60 80 </div>	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
0.0		B1	GRAVEL - some sand(fine to coarse-grained) trace silt, fine to coarse-grained, sub-rounded to subangular, moist, brown		FROZEN - Nf	GP		
1.0		2	B1: Depth = 0.0 m to 0.5 m (80% Gravel, 16% Sand, 4% Fines)			GP		451.0
2.0			- gravel becomes fine-grained, sand becomes medium to coarse-grained					
3.0		3	SAND - some gravel (fine-grained, sub-rounded to subangular), some silt, fine to coarse-grained, subrounded to angular, moist, brown	•	Nbn	SP		
4.0		4	Sample 3: Depth = 2.4 m to 2.9 m (17% Gravel, 67% Sand, 16% Fines)	•		SP		
			GRAVEL (Possible Till) - some sand and silt, trace cobbles, brown					
			BOULDER OR POSSIBLE BEDROCK					
5.0			END OF BOREHOLE AT 4.1 m.					
			- BOREHOLE TERMINATED IN BOULDER OR POSSIBLE BEDROCK					
			- BOREHOLE DRY AT COMPLETION					
			- SLOUGH AT 2.4 m BELOW GROUND SURFACE					
6.0								445.0
7.0								
8.0								
9.0								
10.0								

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Yellowknife, N.W.T.

LOGGED BY: RGL
REVIEWED BY: TEH
Fig. No: BH-07

COMPLETION DEPTH: 4.1 m
COMPLETE: 96/03/24

Page 1 of 1

PROJECT: GRANULAR MATERIAL INVESTIGATION		CLIENT: INDIAN & NORTHERN AFFAIRS CANADA		BOREHOLE NO: INAC-96-8	
BHP KOALA PLANT, N.W.T.		DRILL/CO.: CME 750/MIDNIGHT SUN DRILLING		PROJECT NO: 0701-96-12174	
LOCATION: MISERY LK., REFER TO FIGURE 3.		UTM ZONE: 12 N7151358 E540273		ELEVATION: 453.80 (m)	
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT SAMPLE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> A-CASING <input checked="" type="checkbox"/> CORE					

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SOIL DESCRIPTION	<div style="text-align: center;"> PLASTIC M.C. LIQUID 20 40 60 80 </div>	GROUND ICE DESCRIPTION	USC	SOIL SYMBOL	ELEVATION(m)
0.0		B1	SAND - gravelly (fine to coarse-grained), grained, angular to subangular, brown some cobbles, some fines, fine to coarse- B1: Depth = 0.0 m to 0.8 m (31% Gravel, 57% Sand, 12% Fines)		FROZEN - Nf			453.0
1.0		1	SAND - some silt, trace gravel (fine-gr.) fine to medium-grained, grey	•			SM	
2.0		2		•	Nbn		SM	
3.0		3	SAND AND SILT - fine-grained, brown	•			SM	
4.0		4	Sample 4: Depth = 3.2 m to 3.5 m (0.0% Gravel, 53% Sand, 47% Silt)	•			SM	
5.0		5	SAND - trace silt, brown	•			SP	
6.0		6	- brown sand is interbedded with thin (2 mm) layers of black mineral	•			SP	
7.0		7		•			SP	
8.0		8		•			SP	448.0
9.0			ICE - massive with a trace of soil inclusions					
10.0			END OF BOREHOLE AT 6.7 m. - BOREHOLE TERMINATED DUE TO BROKEN AUGER - TWO AUGER FLIGHTS, ONE BIT AND ONE AUGER CATCHER LOST IN HOLE - BOREHOLE DRY AT COMPLETION - NO APPARENT SLOUGH					

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Yellowknife, N.W.T.

LOGGED BY: RGL

REVIEWED BY: TEH

Fig. No: BH-08

COMPLETION DEPTH: 6.2 m

COMPLETE: 96/03/24

Page 1 of 1

APPENDIX B

LABORATORY TEST RESULTS

AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-01

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)
AND MISERY LAKE ESKER

Sample Location: AIRSTRIP ESKER

INAC-1, BULK SAMPLE No. 1

Project Number: 0701-96-12174

DEPTH = 0.0 m to 0.8 m

Date Sampled: 96/03/19 By: RGL

Time: Temp:

Client: I.N.A.C.

Date Tested: 96/04/26 By: RGL

Natural Moisture Content: 11.7 %

Crushed Faces: Faces:

Attention: MR. STEVE TRAYNOR

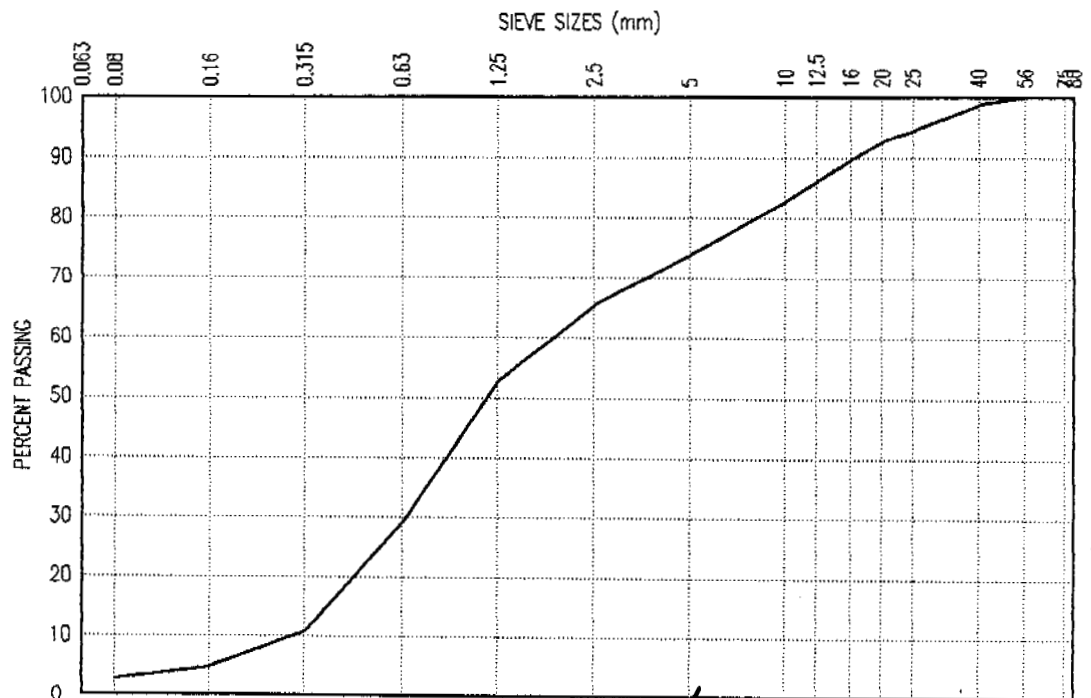
Soil Description: SAND - gravelly, trace fines, brown

Remarks: (Gravel = 26%, Sand = 71%, Fines = 3%)

D10 = 0.29 mm, D30 = 0.65 mm, D60 = 1.9 mm

Cu = 7, Cc = 0.8 (SP)

Sieve	% Passing
75	100
56	100
40	99
25	94
20	93
16	90
12.5	86
10	83
5	74
2.5	65
1.25	53
0.63	29
0.315	11
0.16	4.6
0.08	2.7



Reviewed By: *[Signature]*

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EBA Engineering

AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-02

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-1, SAMPLE 2

Project Number: 0701-96-12174

DEPTH = 1.0 m to 1.3 m

Date Sampled: 96/03/19 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/15 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

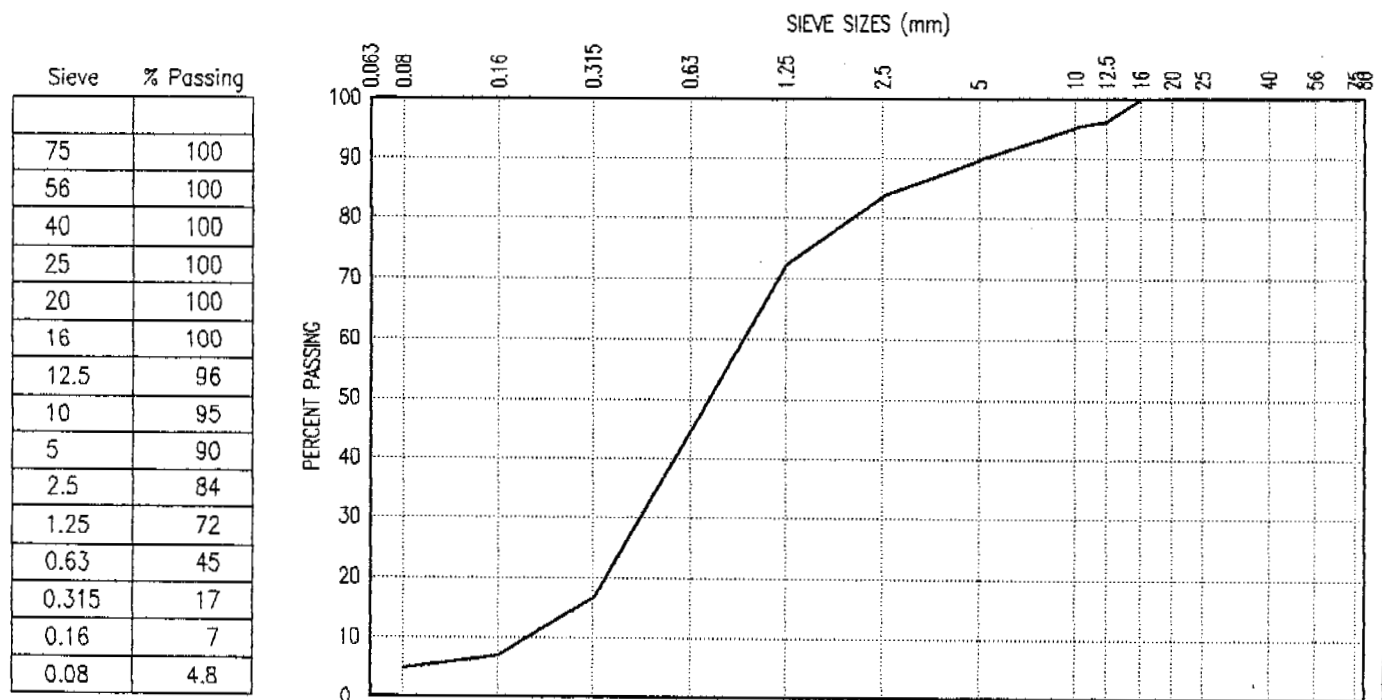
Attention: MR. STEVE TRAYNOR

Soil Description: SAND - trace to some gravel, trace fines(silt), brown

Remarks: (Gravel = 10%, Sand = 85%, Fines = 5%)

D10 = 0.20 mm, D30 = 0.45 mm, D60 = 0.95 mm

Cu = 4.8, Cc = 1.1 (SP)



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-03

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-1, SAMPLE 11b

Project Number: 0701-96-12174

DEPTH = 8.4 m to 8.7 m

Date Sampled: 96/03/19 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/15 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

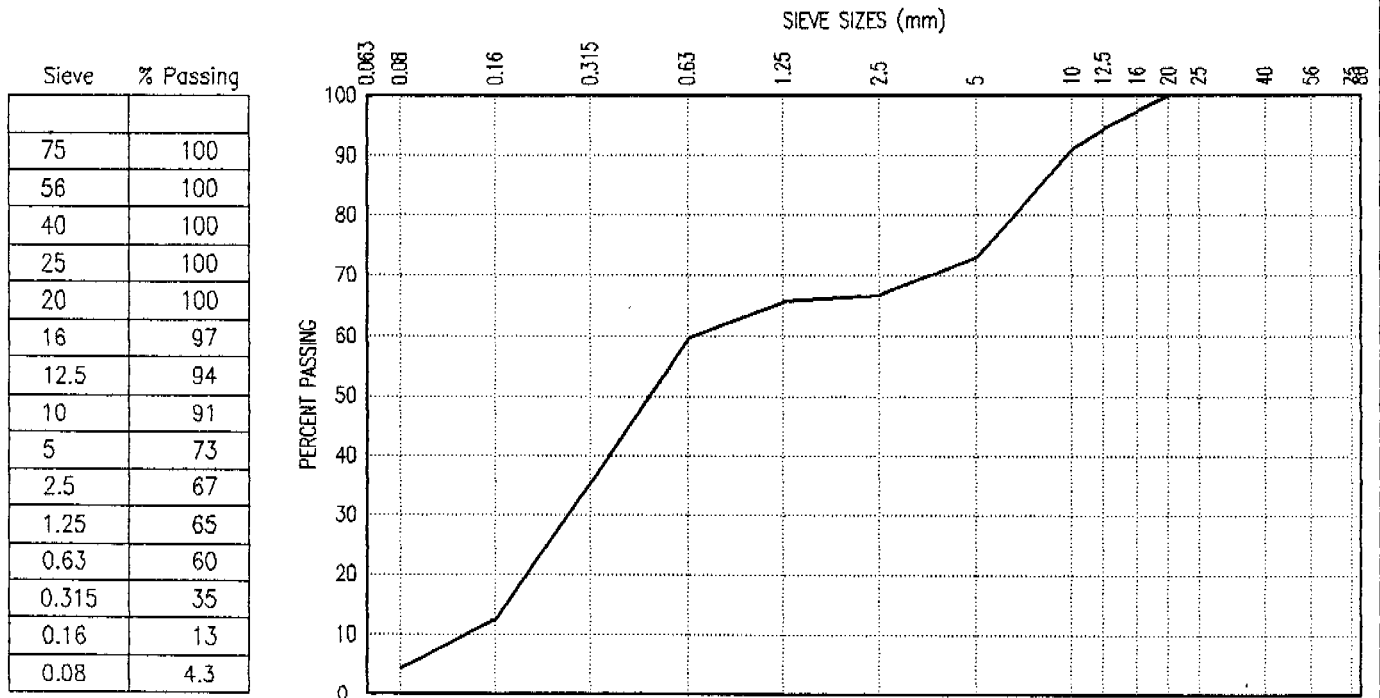
Attention: MR. STEVE TRAYNOR

Soil Description: SAND - gravelly, trace fines(silt), brown-grey

Remarks: (Gravel = 27%, Sand = 69%, Fines = 4%)

D10 = 0.12 mm, D30 = 0.26 mm, D60 = 0.63 mm

Cu = 5.3, Cc = 0.9 (SP)



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-04

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-2, BULK SAMPLE No. 1

Project Number: 0701-96-12174

DEPTH = 0.9 m to 1.4 m

Date Sampled: 96/03/20 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/02 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

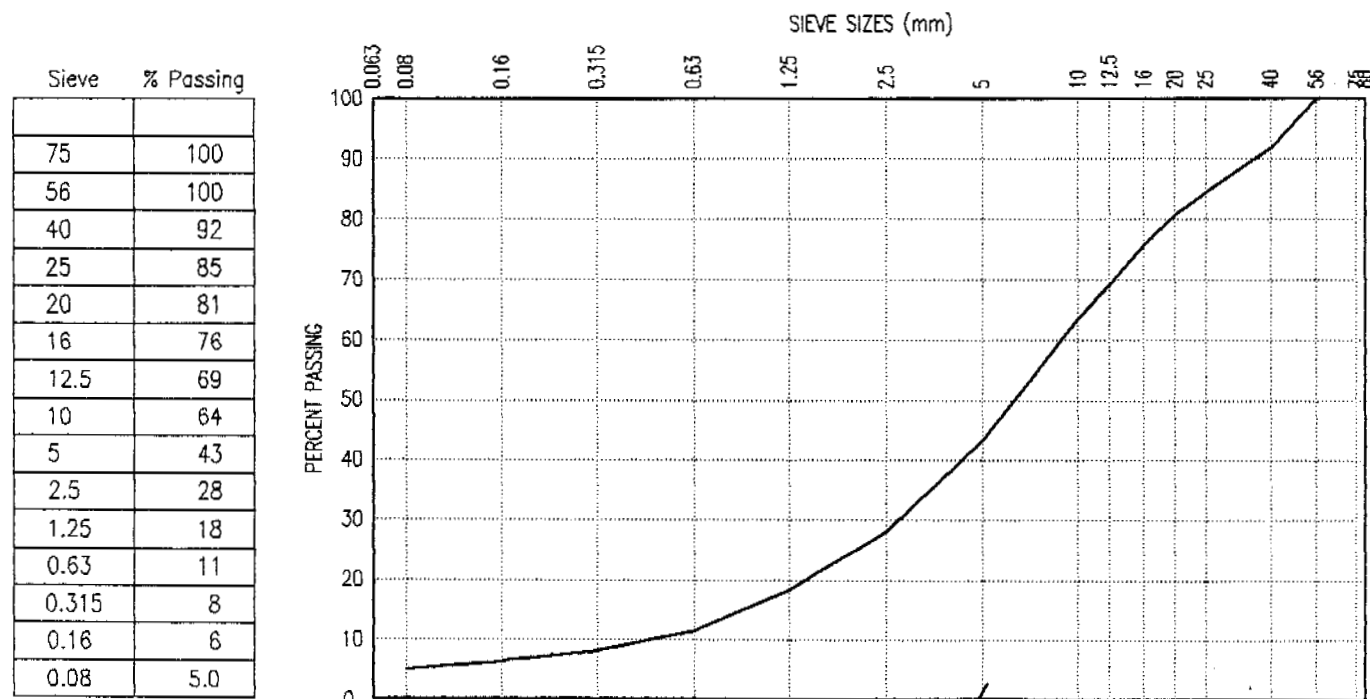
Attention: MR. STEVE TRAYNOR

Soil Description: GRAVEL AND SAND - trace silt, brown

Remarks: (Gravel = 57%, Sand = 38%, Silt = 5%)

D10 = 0.48 mm, D30 = 2.9 mm, D60 = 8.7 mm

Cu = 18, Cc = 2.0 (GW)



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-05

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: INAC-2, BULK SAMPLE No. 2

AND MISERY LAKE ESKER

DEPTH = 2.3 m TO 3.6 m

Project Number: 0701-96-12174

Date Sampled: 96/03/21 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/21 By: RGL

Natural Moisture Content: 2.8 %

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

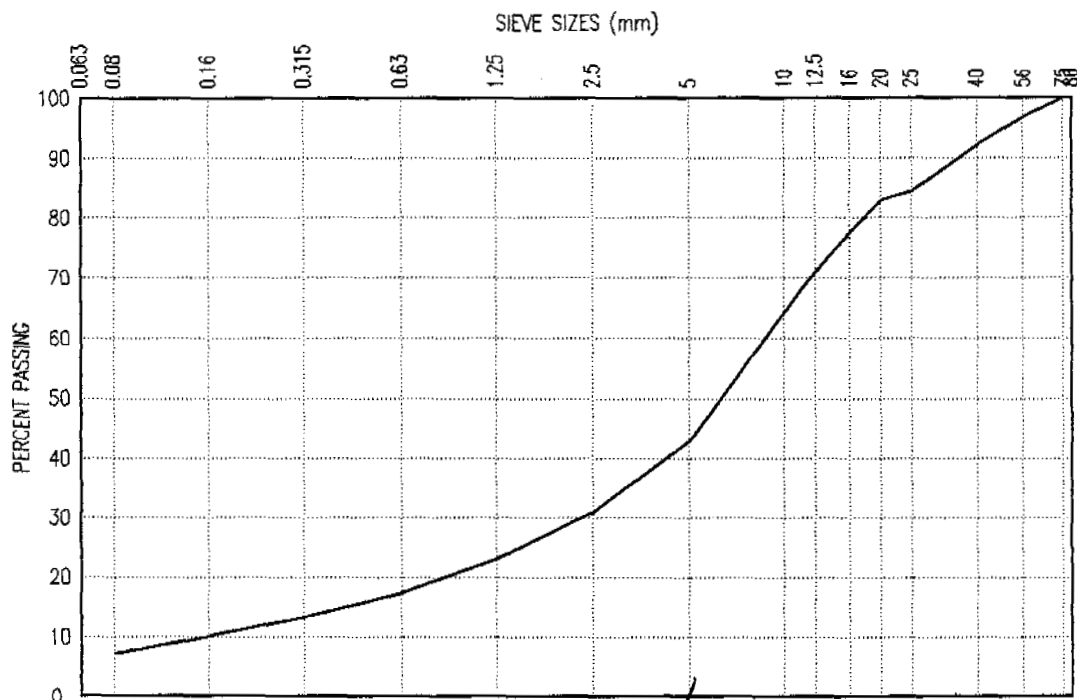
Soil Description: GRAVEL AND SAND - trace to some fines, brown-grey

Remarks: Some of fines component may be from rock flour manufactured at auger tip.

(57% Gravel, 36% Sand, 7% Fines)

D10 = 0.16 mm, D30 = 2.3 mm, D60 = 8 mm, Cu = 50.0, Cc = 4.1 (GP-GM)

Sieve	% Passing
75	100
56	97
40	92
25	84
20	83
16	78
12.5	71
10	64
5	43
2.5	31
1.25	23
0.63	17
0.315	13
0.16	10
0.08	7.2



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-06

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-2, BULK SAMPLE No. 3

Project Number: 0701-96-12174

DEPTH = 5.2 m to 6.7 m

Date Sampled: 96/03/20 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/21 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

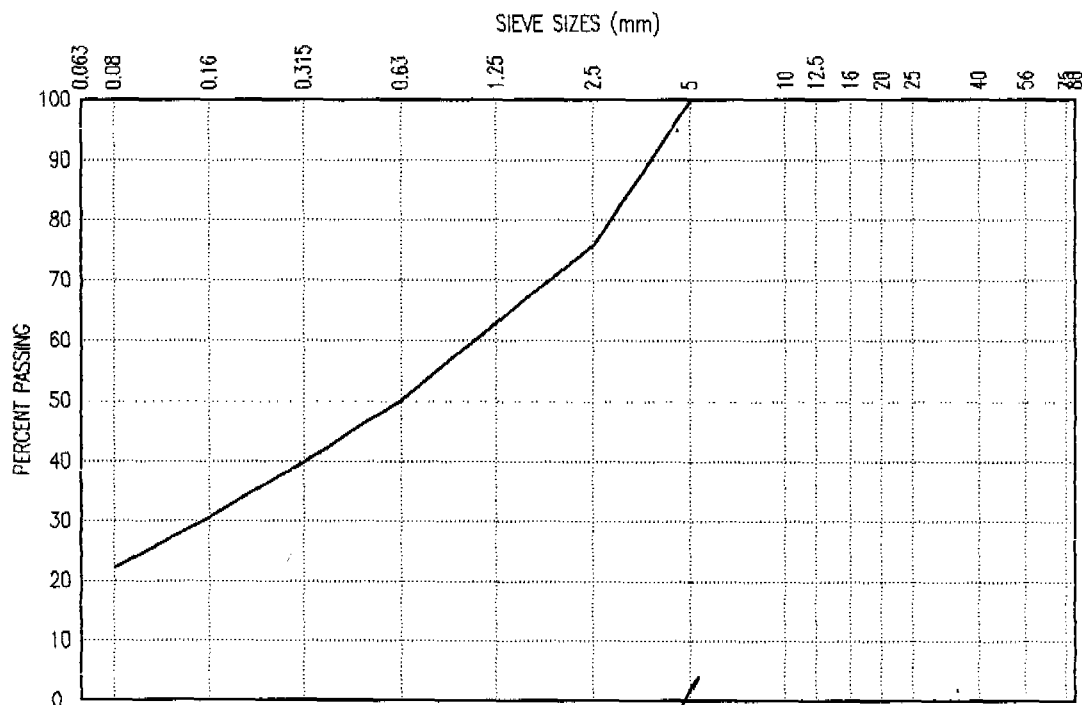
Soil Description: SAND - silty, grey

Remarks: (Gravel = 0.0%, Sand = 78%, Fines = 22%)

D10 = n/a, D30 = 0.15 mm, D60 = 1 mm

Cu = n/a, Cc = n/a (SP)

Sieve	% Passing
75	100
56	100
40	100
25	100
20	100
16	100
12.5	100
10	100
5	100
2.5	76
1.25	63
0.63	50
0.315	40
0.16	31
0.08	22.1



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-07

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-3, BULK SAMPLE No. 1

Project Number: 0701-96-12174

DEPTH = 0.1 m to 0.8 m

Date Sampled: 96/03/21 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/04 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

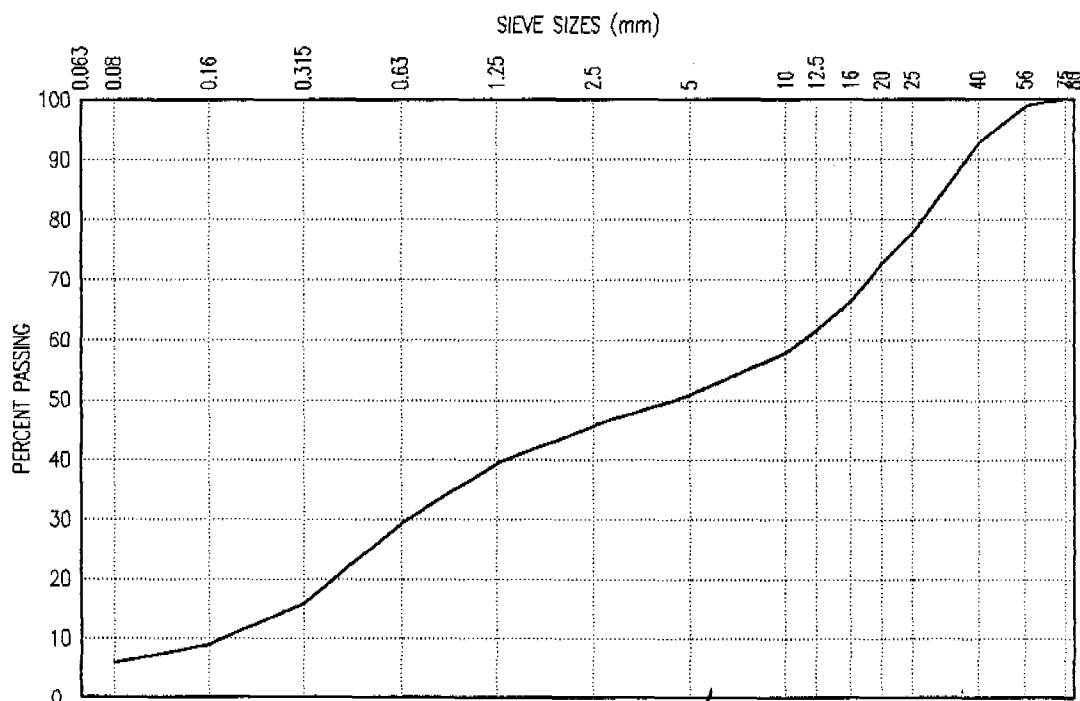
Soil Description: GRAVEL AND SAND - trace silt

Remarks: (Gravel = 49%, Sand = 45%, Silt = 6%)

D10 = 0.18 mm, D30 = 0.65 mm, D60 = 11.1 mm

Cu = 61.7, Cc = 0.21 (GP)

Sieve	% Passing
75	100
56	99
40	93
25	78
20	73
16	66
12.5	62
10	58
5	51
2.5	45
1.25	39
0.63	29
0.315	16
0.16	9
0.08	5.9



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-08

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-3, BULK SAMPLE No. 2

Project Number: 0701-96-12174

DEPTH = 0.8 m to 1.5 m

Date Sampled: 96/03/21

By: RGL

Time:

Temp:

Client: I.N.A.C.

Date Tested: 96/05/05

By: RGL

Natural Moisture Content: 5.3 %

Crushed Faces:

Faces:

Attention: MR. STEVE TRAYNOR

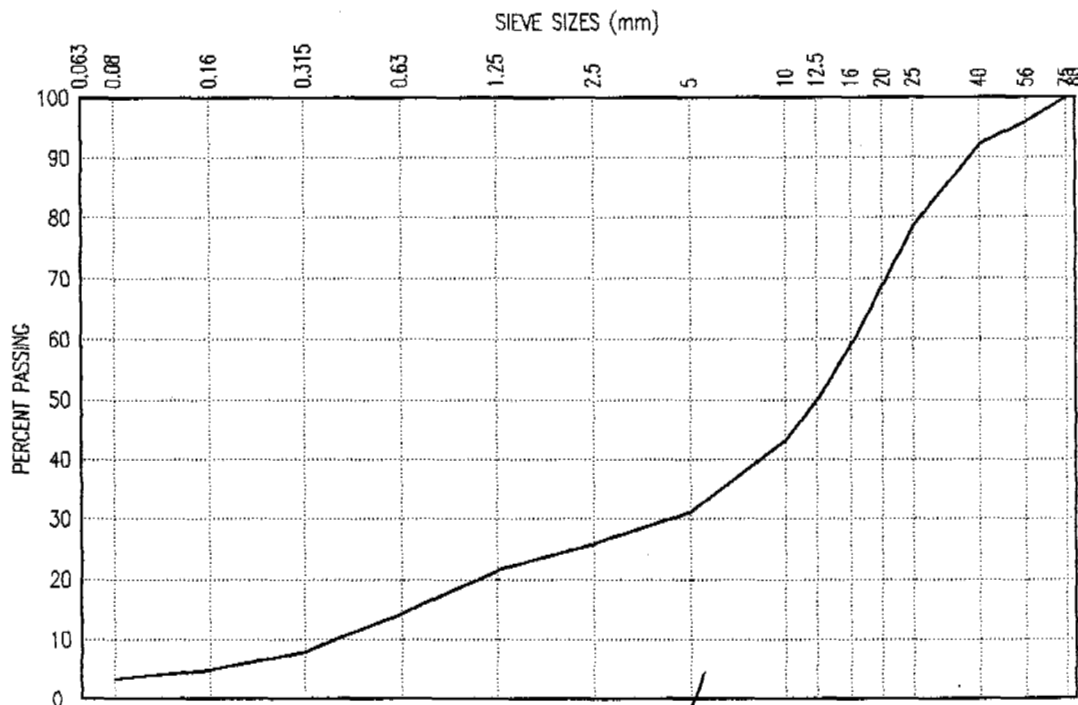
Soil Description: GRAVEL - sandy, trace silt, brown

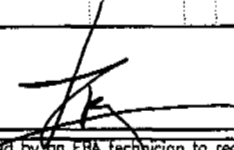
Remarks: (Gravel = 69%, Sand = 28%, Silt = 3%)

D10 = 0.39 mm, D30 = 4.2 mm, D60 = 16.5 mm

Cu = 42, Cc = 2.7 (GW)

Sieve	% Passing
75	100
56	96
40	92
25	79
20	69
16	59
12.5	50
10	43
5	31
2.5	26
1.25	21
0.63	14
0.315	8
0.16	5.0
0.08	3.4



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-09

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: AIRSTRIP ESKER

AND MISERY LAKE ESKER

INAC-3, BULK SAMPLE No. 3

Project Number: 0701-96-12174

DEPTH = 1.5 m to 2.3 m

Date Sampled: 96/03/21 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/04 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

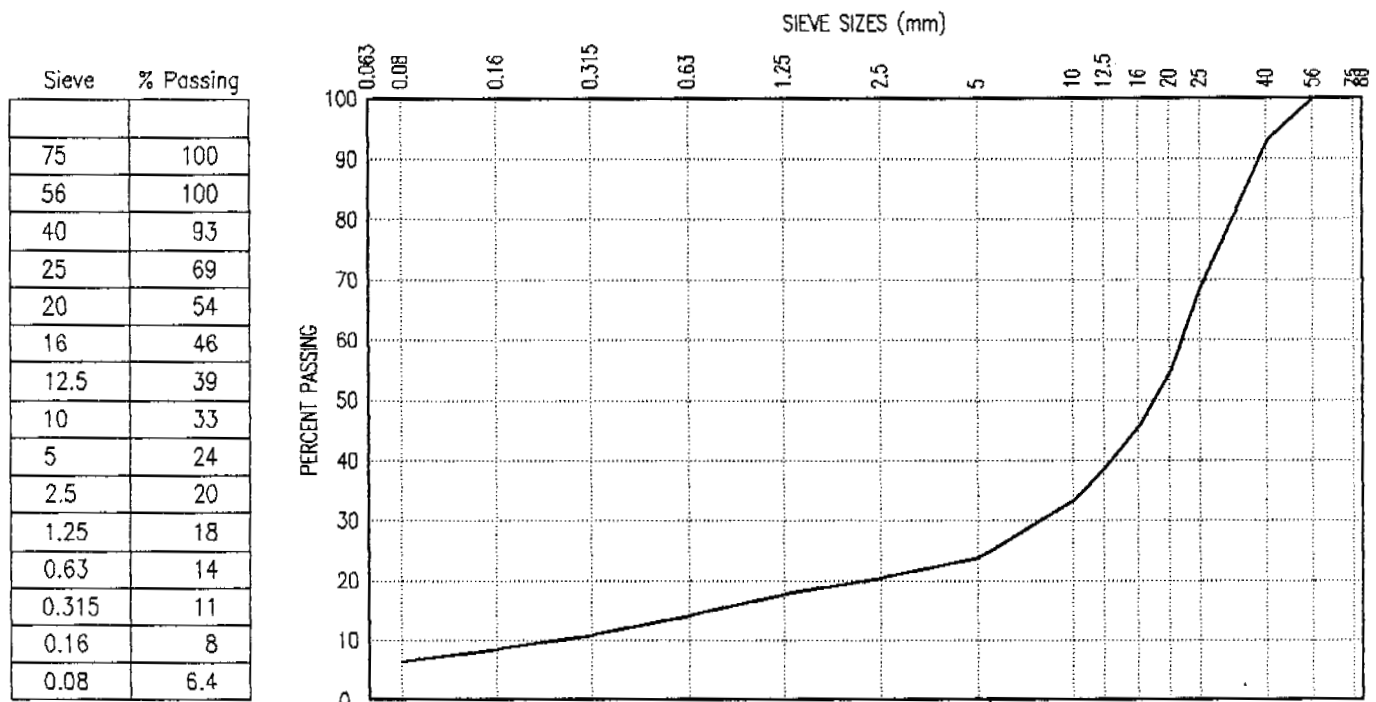
Attention: MR. STEVE TRAYNOR

Soil Description: GRAVEL - some sand, trace silt, brown

Remarks: (76% Gravel, 18% Sand, 6% Silt)

D10 = 0.22 mm, D30 = 7.8 mm, D60 = 22 mm

Cu = 100, Cc = 12.6 (GP)



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-10

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-4, BULK SAMPLE No. 1

Project Number: 0701-96-12174

DEPTH = 0.0 m to 0.8 m

Date Sampled: 96/03/22 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/04 By: RGL

Natural Moisture Content: 11.0 %

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

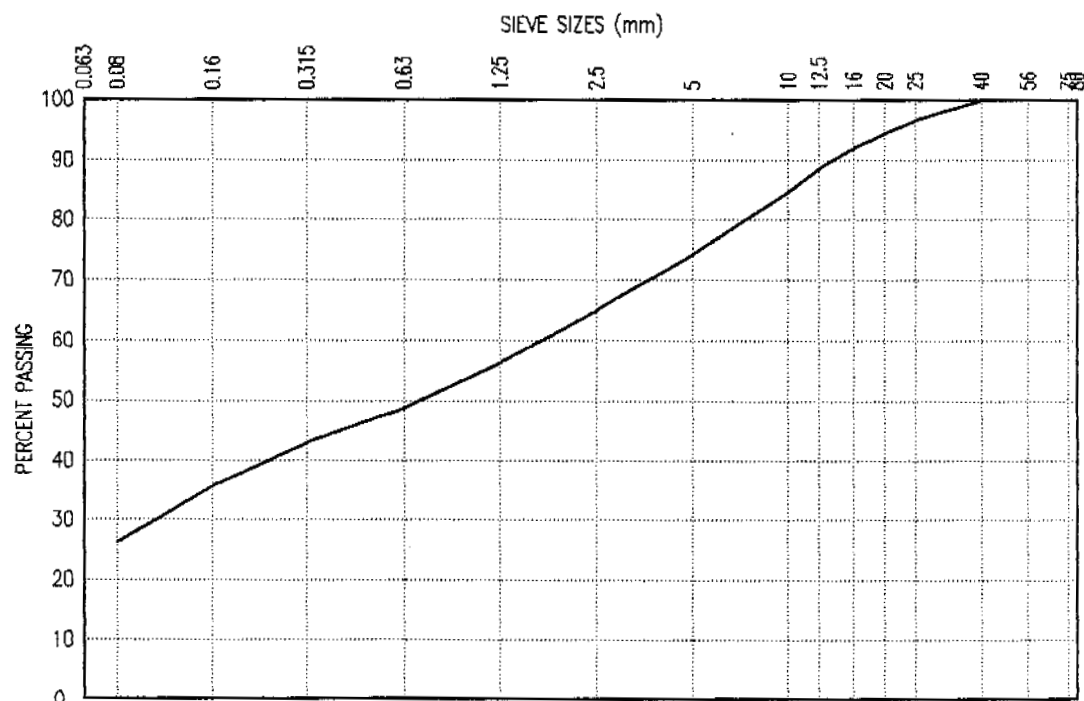
Soil Description: SAND - gravelly, silty, brown

Remarks: (Gravel = 26%, Sand = 48%, Fines = 26%)

D10 = n/a, D30 = 0.11 mm, D60 = 1.59

Cu = n/a, Cc = n/a (SM)

Sieve	% Passing
75	100
56	100
40	100
25	96
20	94
16	92
12.5	89
10	85
5	74
2.5	65
1.25	56
0.63	49
0.315	43
0.16	36
0.08	26.2



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-11

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-4, BULK SAMPLE No. 2

Project Number: 0701-96-12174

DEPTH = 2.3 m to 3.1 m

Date Sampled: 96/03/22 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/25 By: RGL

Natural Moisture Content: 3.4 %

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

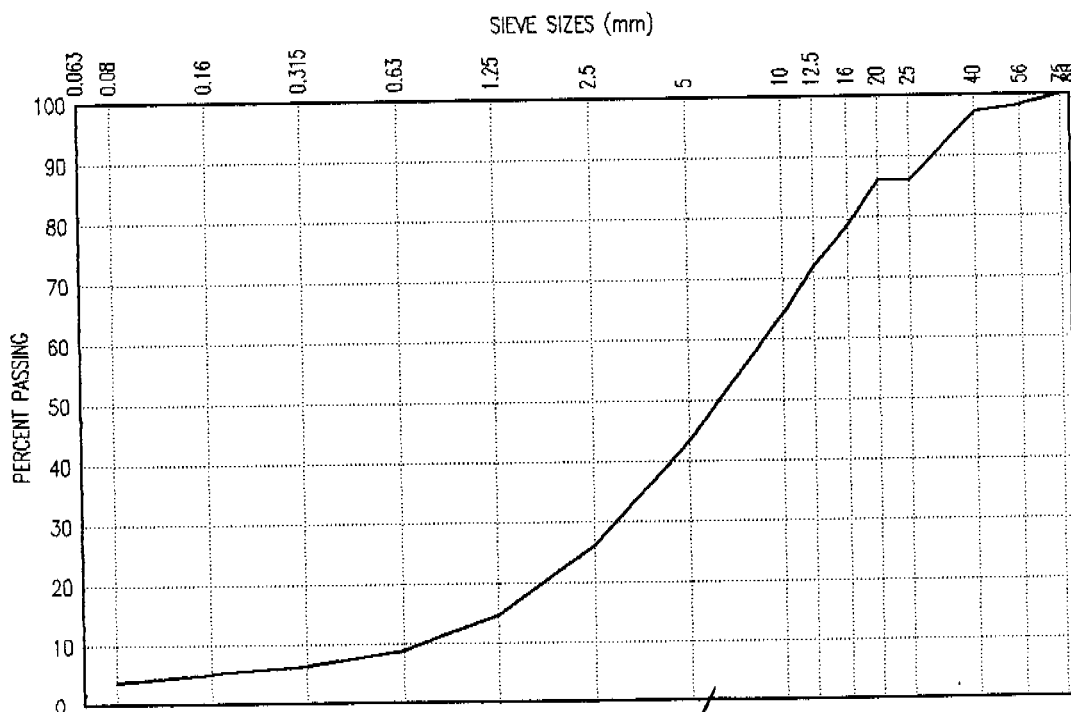
Soil Description: GRAVEL AND SAND - trace fines(silt), brown

Remarks: (Gravel = 57%, Sand = 39%, Fines = 4%)

D10 = 0.75, D30 = 3.1, D60 = 8.1

Cu = 10.8, Cc = 1.6 (GW)

Sieve	% Passing
75	100
56	98
40	97
25	86
20	86
16	79
12.5	72
10	64
5	43
2.5	26
1.25	15
0.63	9
0.315	6
0.16	5
0.08	3.8



Reviewed By: _____

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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-12

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-4, BULK SAMPLE No. 3

Project Number: 0701-96-12174

DEPTH = 3.8 m to 4.2 m

Date Sampled: 96/03/22 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/04 By: RGL

Natural Moisture Content: 1.6 %

Crushed Faces: _____ Faces: _____

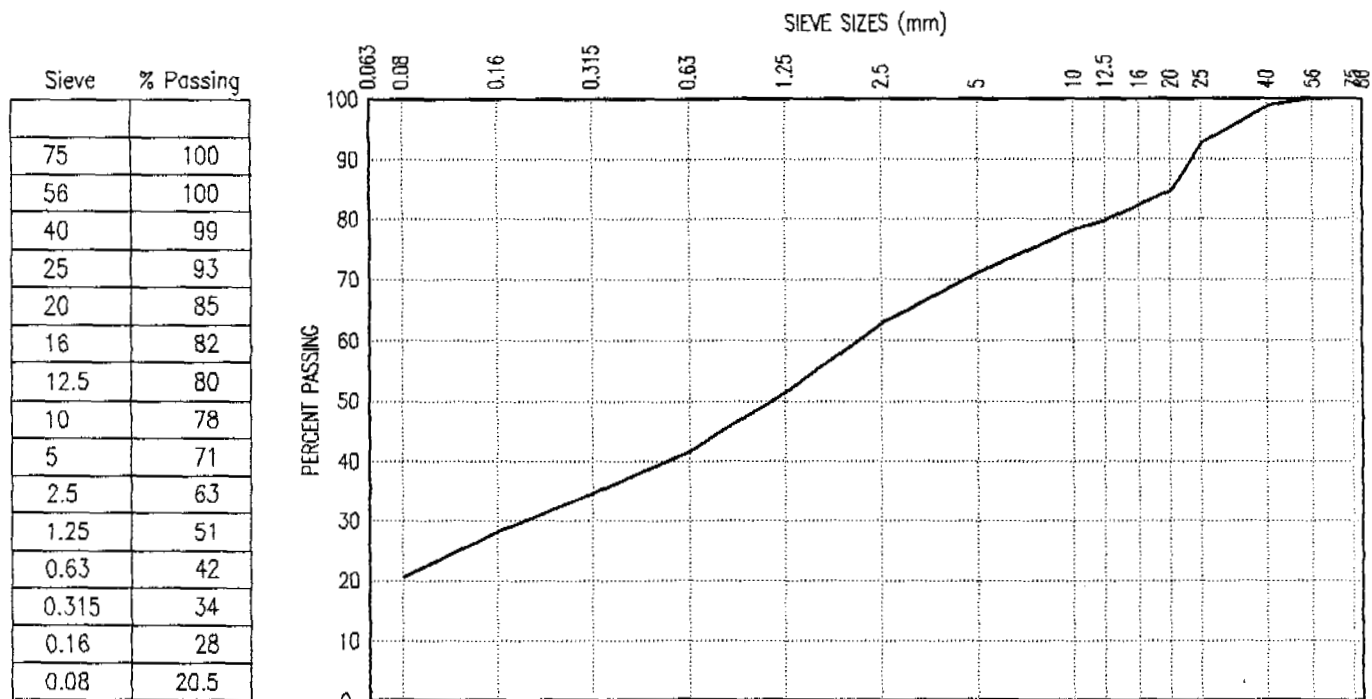
Attention: MR. STEVE TRAYNOR

Soil Description: SAND - gravelly, some silt to silty, brown

Remarks: (Gravel = 29%, Sand = 50%, Fines = 21%)

D10 = n/a, D30 = 0.19, D60 = 2.0

Cu = n/a, Cc = n/a (SM)



Reviewed By: _____

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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-13

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-5, BULK SAMPLE No. 1

Project Number: 0701-96-12174

DEPTH = 0.8 m to 2.3 m

Date Sampled: 96/03/22 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/23 By: RGL

Natural Moisture Content: 7.0 %

Crushed Faces: _____ Faces: _____

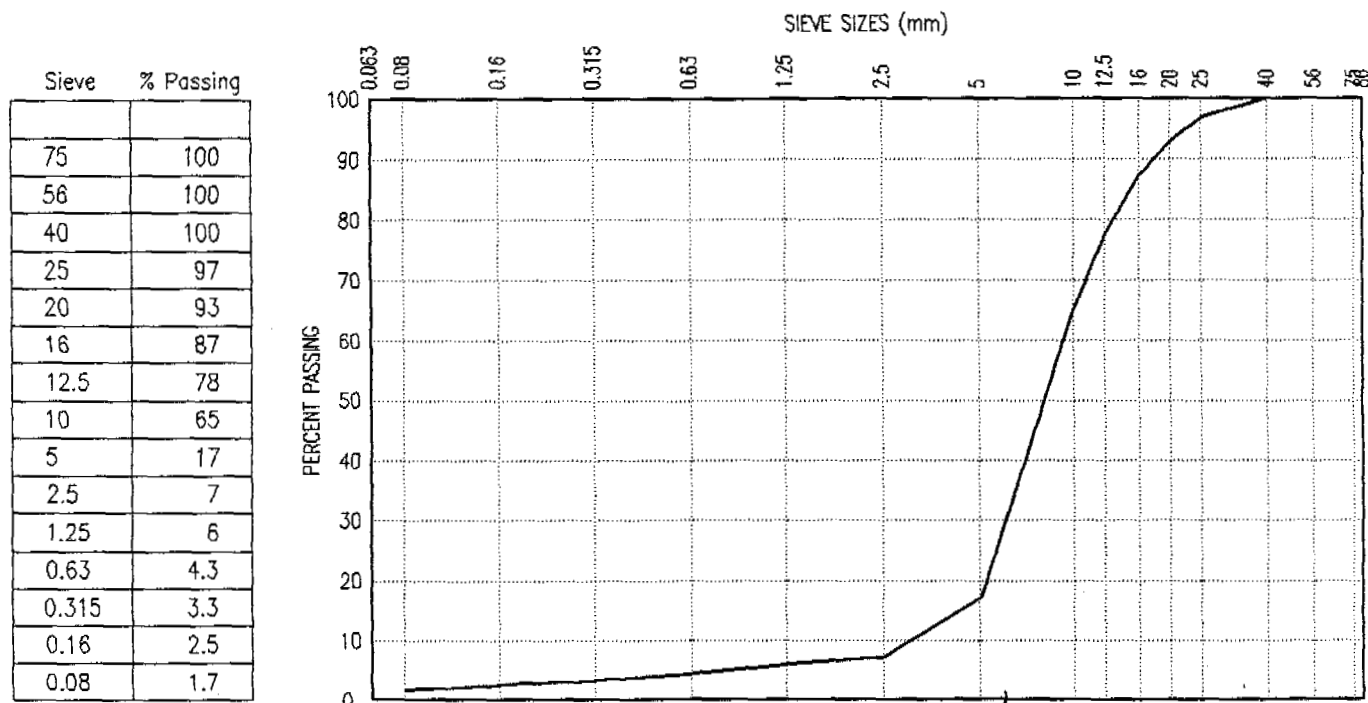
Attention: MR. STEVE TRAYNOR

Soil Description: GRAVEL - some sand, trace fines(silt)

Remarks: (Gravel = 83%, Sand = 15%, Fines = 2%)

D10 = 3.1 mm, D30 = 6.6 mm, D60 = 8.7 mm

Cu = 2.8, Cc = 1.6 (GP)



Reviewed By: _____

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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-14

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-5, BULK SAMPLE No. 2

Project Number: 0701-96-12174

DEPTH = 2.3 m to 3.8 m

Date Sampled: 96/03/22 By: RGL

Time: Temp:

Client: I.N.A.C.

Date Tested: 96/05/04 By: RGL

Natural Moisture Content: 5.9 %

Crushed Faces: Faces:

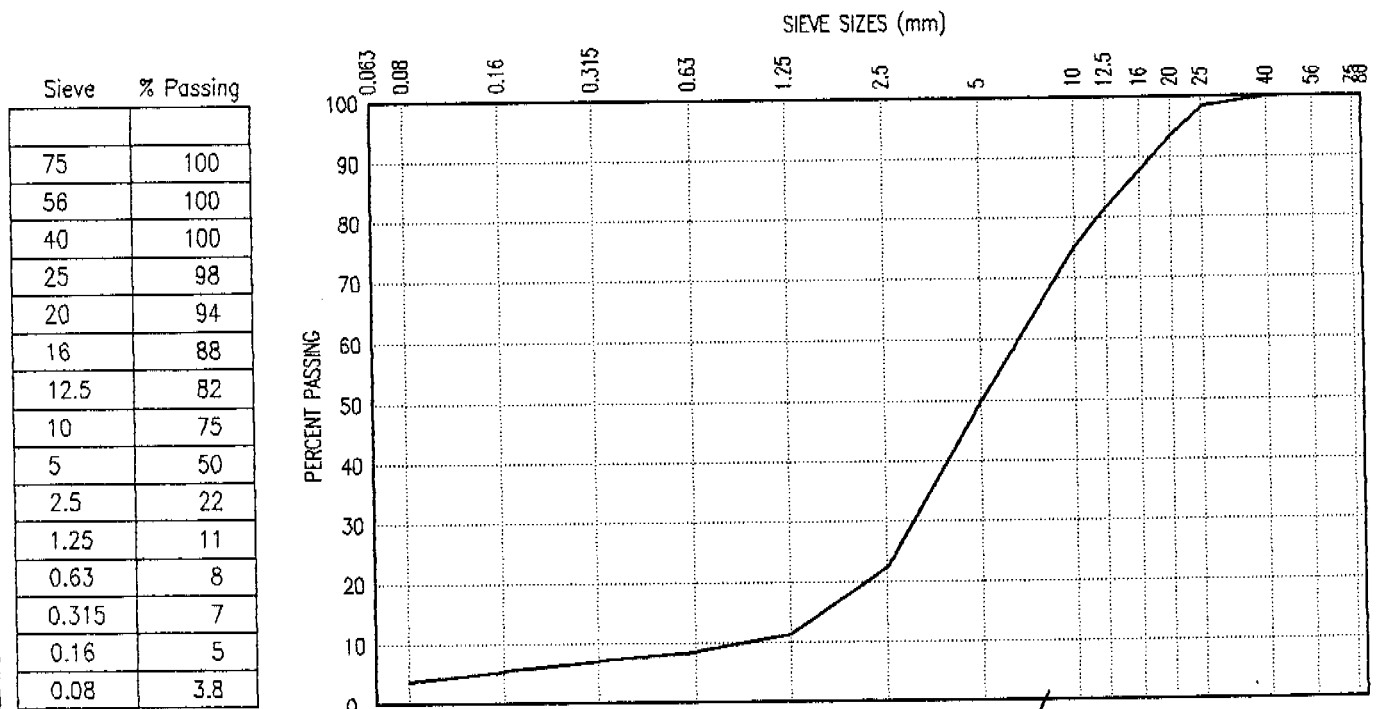
Attention: MR. STEVE TRAYNOR

Soil Description: GRAVEL AND SAND - trace fines(silt), brown

Remarks: (Gravel = 50%, Sand = 46%, Fines = 4%)

D10 = 0.89, D30 = 3.0, D60 = 6.6

Cu = 7, Cc = 1.5 (GW)



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EBA Engineering

AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-15

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)
AND MISERY LAKE ESKER

Sample Location: MISERY LAKE ESKER

INAC-5, BULK SAMPLE No. 3

Project Number: 0701-96-12174

DEPTH = 5.5 m to 6.7 m

Date Sampled: 96/03/22 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/02 By: RGL

Natural Moisture Content: 9.3 %

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

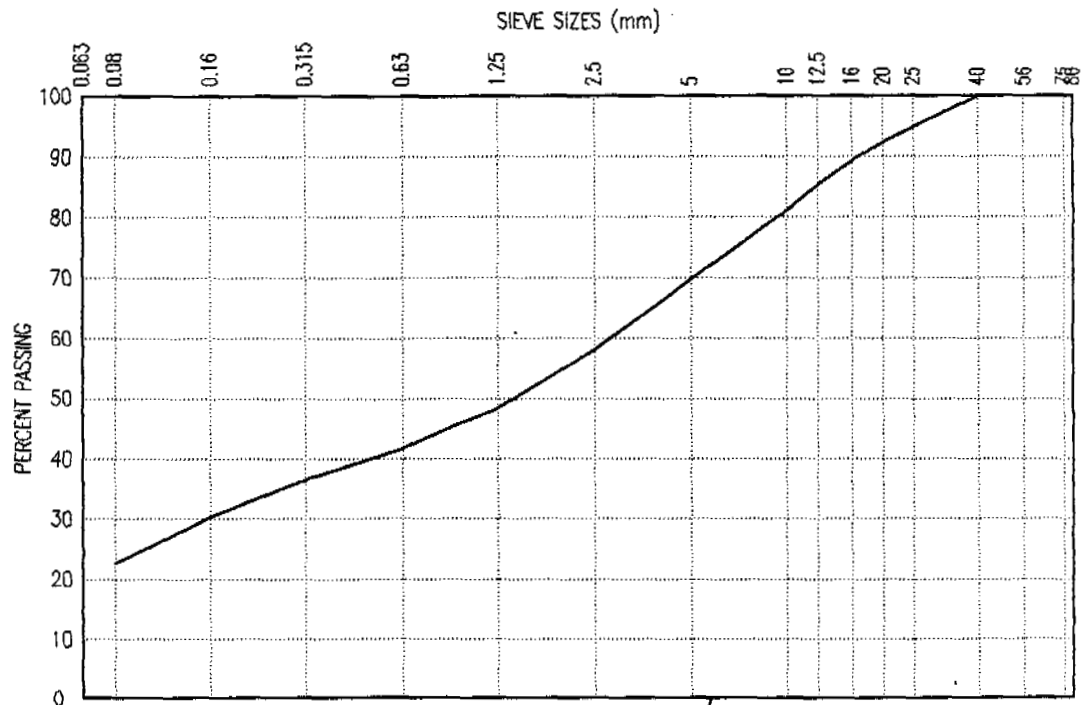
Soil Description: SAND - gravelly, silty, brown

Remarks: (Gravel = 30%, Sand = 48%, Fines = 22%)

D10 = n/a, D30 = 0.16, D60 = 2.9

Cu = n/a, Cc = n/a (SM)

Sieve	% Passing
75	100
56	100
40	100
25	95
20	92
16	89
12.5	85
10	81
5	70
2.5	58
1.25	48
0.63	42
0.315	36
0.16	30
0.08	22.5



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EBA Engineering

AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-16

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-6, BULK SAMPLE No. 1

Project Number: 0701-96-12174

DEPTH = 2.3 m to 2.8 m

Date Sampled: 96/03/23 By: RGL

Time: Temp:

Client: I.N.A.C.

Date Tested: 96/04/25 By: RGL

Natural Moisture Content:

Crushed Faces: Faces:

Attention: MR. STEVE TRAYNOR

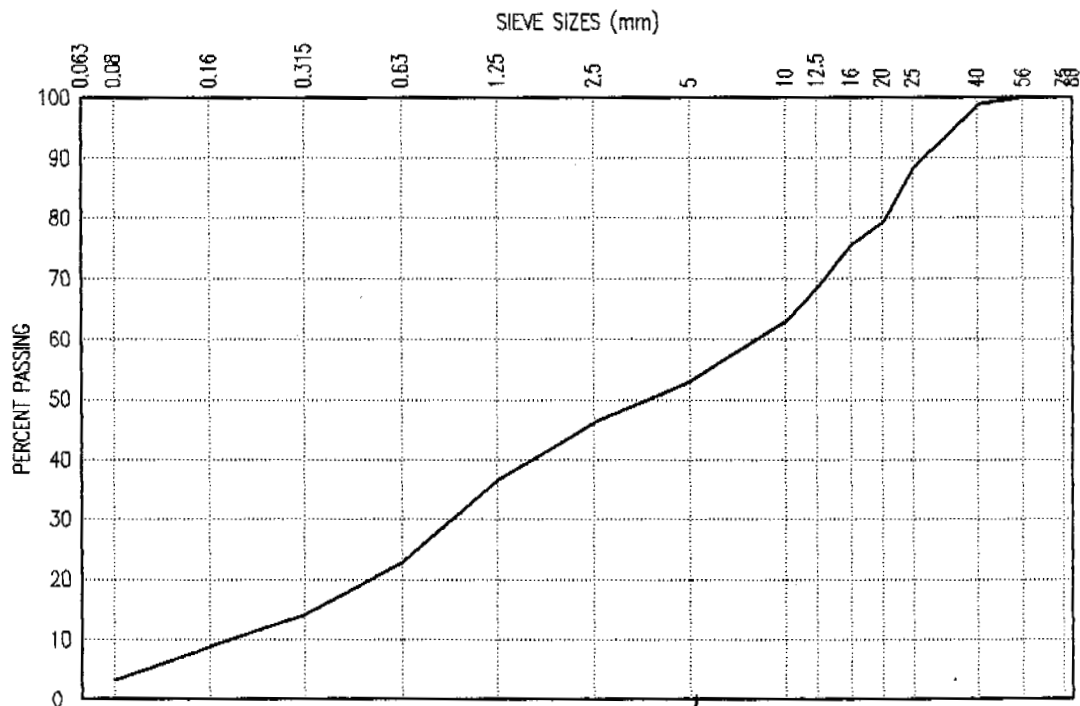
Soil Description: SAND AND GRAVEL - (SP) trace silt

Remarks: (47% Gravel, 50% Sand, 3% Fines)

D10 = 0.18 mm, D30 = 0.85 mm, D60 = 8 mm

Cu = 44.4, Cc = 0.5 (SP)

Sieve	% Passing
75	100
56	100
40	99
25	88
20	79
16	76
12.5	68
10	63
5	53
2.5	46
1.25	36
0.63	23
0.315	14
0.16	9
0.08	3.3



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EBA Engineering

AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-17

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)
AND MISERY LAKE ESKER

Sample Location: MISERY LAKE ESKER

INAC-6, BULK SAMPLE No. 2

Project Number: 0701-96-12174

DEPTH = 3.3 m to 3.6 m

Date Sampled: 96/03/23 By: RGL

Time: Temp:

Client: I.N.A.C.

Date Tested: 96/05/25 By: RGL

Natural Moisture Content: 8.7 %

Crushed Faces: Faces:

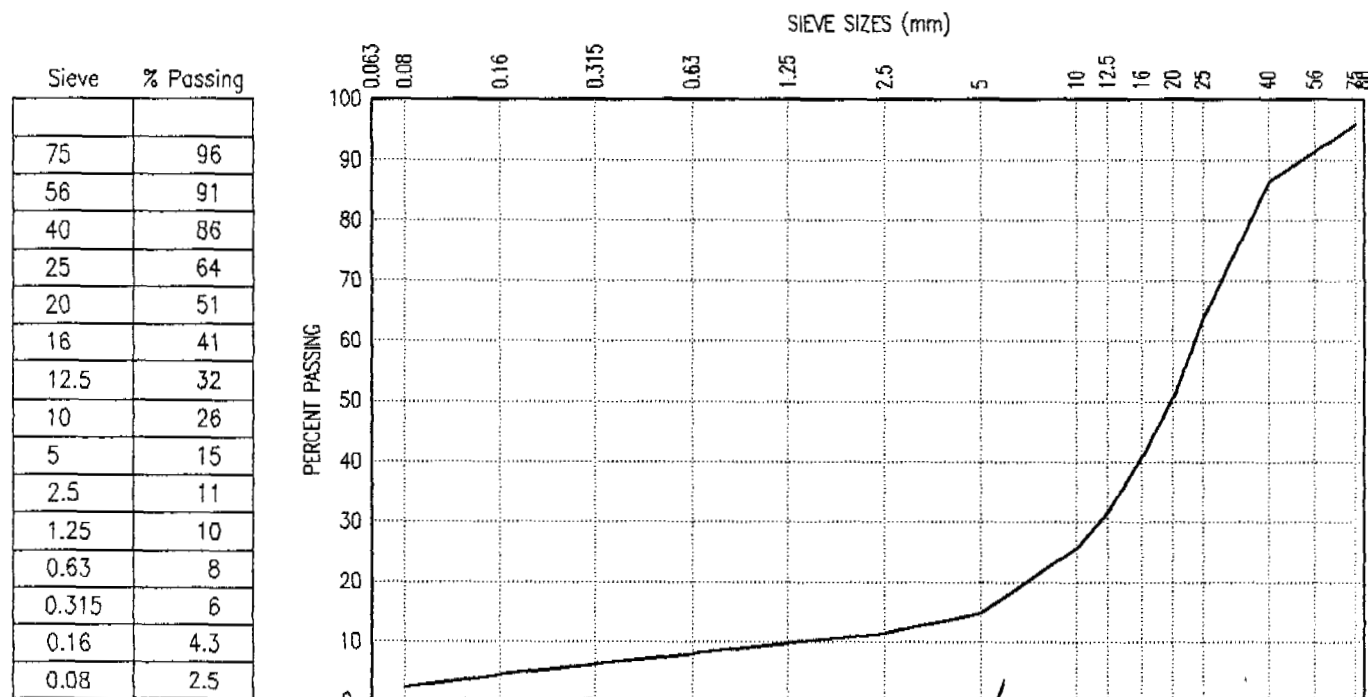
Attention: MR. STEVE TRAYNOR

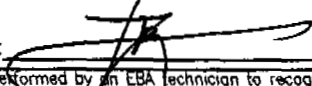
Soil Description: GRAVEL - some sand, trace fines

Remarks: (Gravel = 85%, Sand = 13%, Fines = 2%)

D10 = 1.25 mm, D30 = 11.4 mm, D60 = 23.4 mm

Cu = 19, Cc = 4.4 (GP)



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-18

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)
AND MISERY LAKE ESKER

Sample Location: MISERY LAKE ESKER

INAC-6, BULK SAMPLE No. 3

Project Number: 0701-96-12174

DEPTH = 4.1 m to 5.3 m

Date Sampled: 96/03/23 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/05/04 By: RGL

Natural Moisture Content: 7.5 %

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

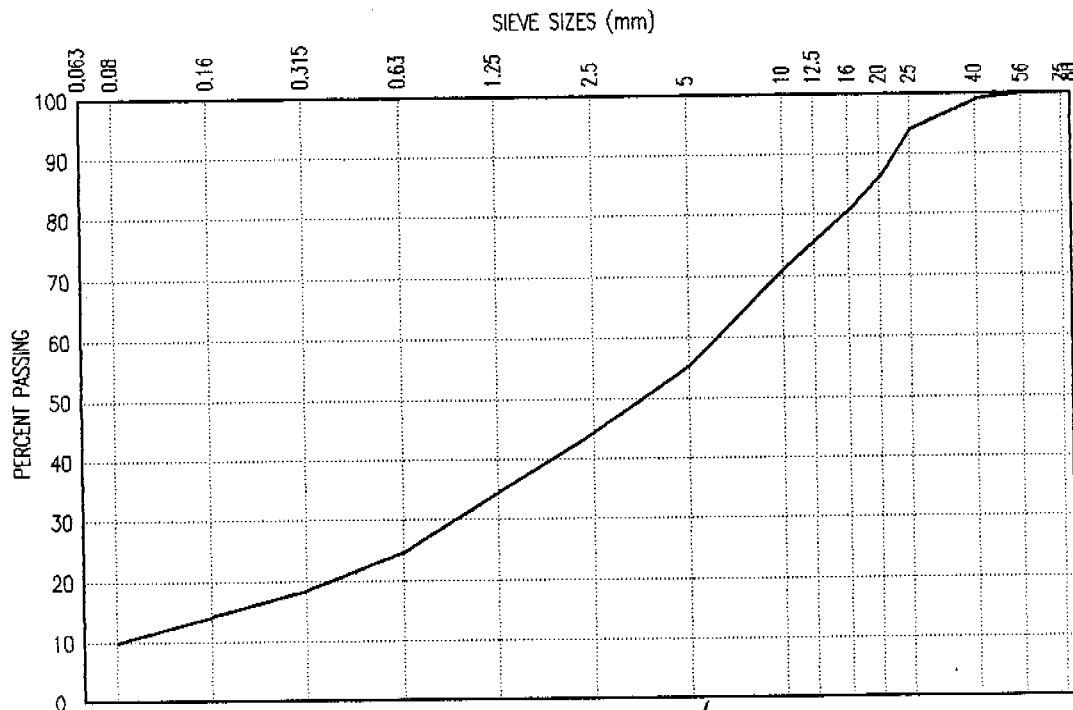
Soil Description: SAND AND GRAVEL - trace to some fines, brown

Remarks: (Gravel = 45%, Sand = 45%, Fines = 10%)

D10 = 0.08 mm, D30 = 0.92 mm, D60 = 6.2 mm

Cu = 78, Cc = 1.7 (SW)

Sieve	% Passing
75	100
56	100
40	99
25	94
20	86
16	81
12.5	76
10	71
5	55
2.5	44
1.25	34
0.63	24
0.315	18
0.16	14
0.08	9.8



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-19

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)
AND MISERY LAKE ESKER

Sample Location: MISERY LAKE ESKER

INAC-6, BULK SAMPLE No. 4

Project Number: 0701-96-12174

DEPTH = 9.1 m to 9.9 m

Date Sampled: 96/03/23 By: RGL

Time: Temp:

Client: I.N.A.C.

Date Tested: 96/04/22 By: RGL

Natural Moisture Content:

Crushed Faces: Faces:

Attention: MR. STEVE TRAYNOR

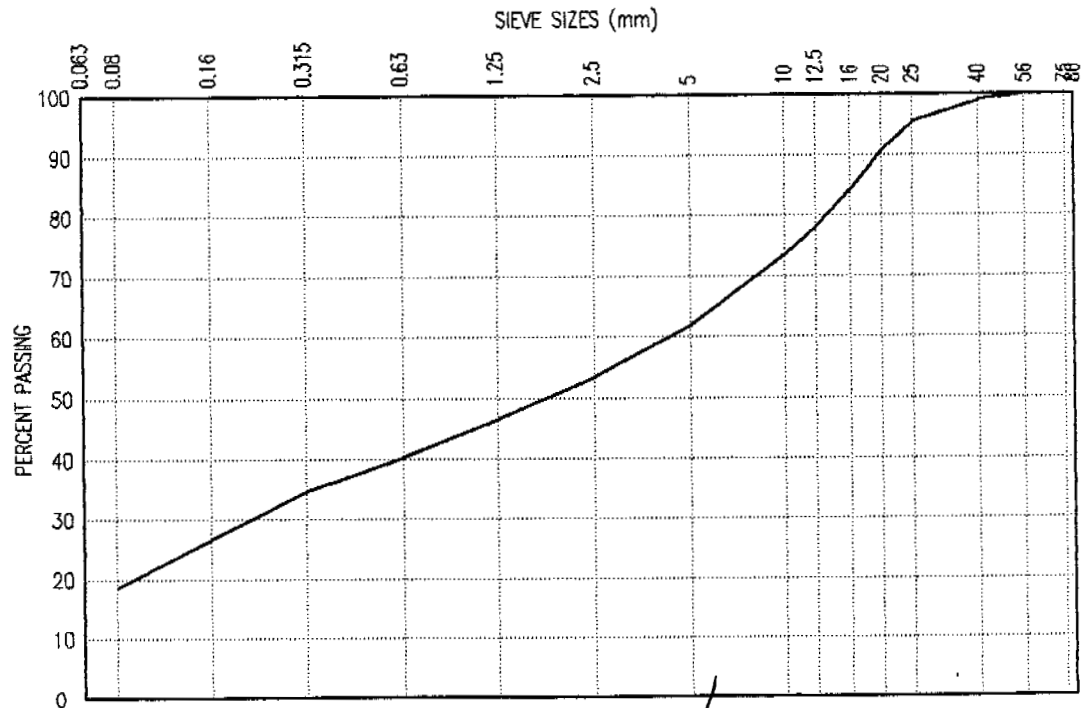
Soil Description: SAND AND GRAVEL - some fines, brown

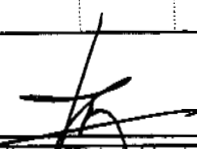
Remarks: (38% Gravel, 43% Sand, 19 % Fines)

D10 = n/a, D30 = 0.21 mm, D60 = 4.2 mm

Cu = n/a, Cc = n/a (SM)

Sieve	% Passing
75	100
56	100
40	99
25	95
20	91
16	84
12.5	78
10	73
5	62
2.5	53
1.25	46
0.63	40
0.315	34
0.16	27
0.08	18.6



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-20

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-7, SAMPLE 3

Project Number: 0701-96-12174

DEPTH = 2.4 m to 2.9 m

Date Sampled: 96/03/24 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/15 By: RGL

Natural Moisture Content: _____

Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

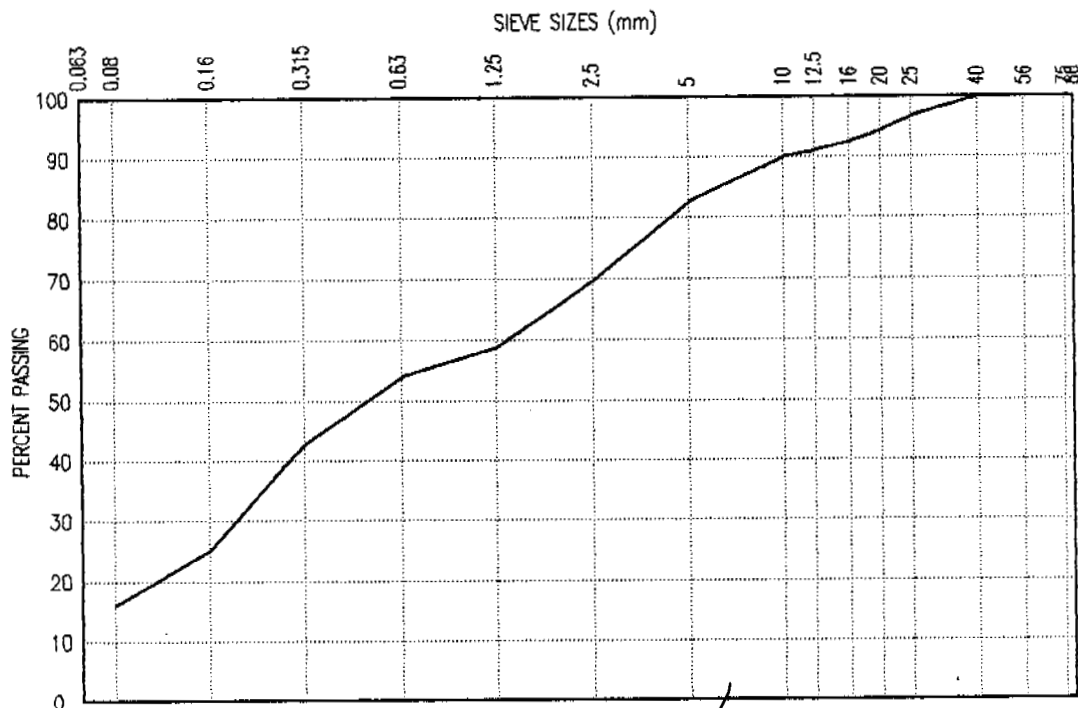
Soil Description: SAND - some gravel, some fines, brown

Remarks: (Gravel = 17%, Sand = 67%, Fines = 16%)

D10 = n/a, D30 = 0.19 mm, D60 = 1.33 mm

Cu = n/a, Cc = n/a (SM)

Sieve	% Passing
75	100
56	100
40	100
25	97
20	94
16	92
12.5	91
10	90
5	83
2.5	70
1.25	59
0.63	54
0.315	43
0.16	25
0.08	16.1



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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-21

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-7, BULK SAMPLE 1

Project Number: 0701-96-12174

DEPTH = 0.0 m to 0.5 m

Date Sampled: 96/03/24 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/21 By: RGL

Natural Moisture Content: 4.9 %

Crushed Faces: _____ Faces: _____

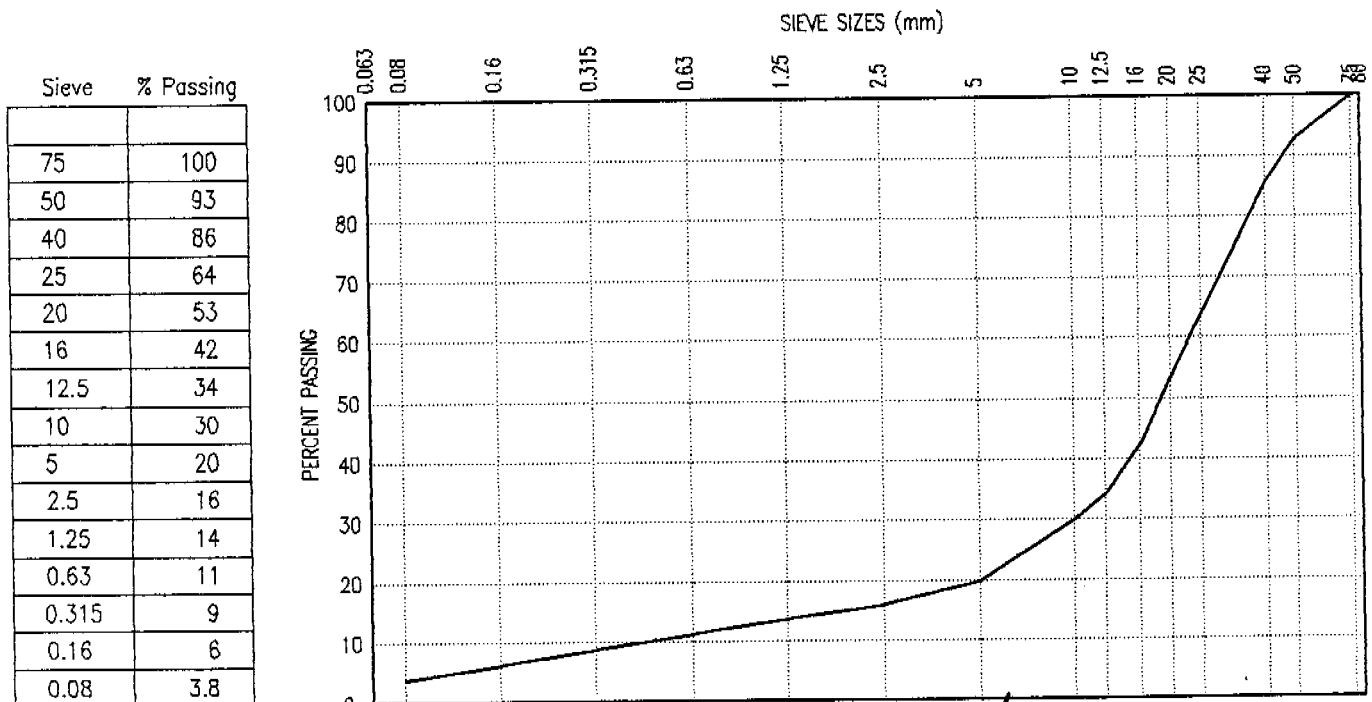
Attention: MR. STEVE TRAYNOR

Soil Description: GRAVEL - some sand, trace silt, brown

Remarks: (80% Gravel, 16% Sand, 4% silt)

D10 = 0.45 mm, D30 = 10 mm, D60 = 23 mm

Cu = 51, Cc = 9.7 (GP)



Reviewed By: [Signature]

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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-22

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)

Sample Location: MISERY LAKE ESKER

AND MISERY LAKE ESKER

INAC-8, SAMPLE 4

Project Number: 0701-96-12174

DEPTH = 3.2 m to 3.5 m

Date Sampled: 96/03/24 By: RGL

Time: _____ Temp: _____

Client: I.N.A.C.

Date Tested: 96/04/15 By: RGL

Natural Moisture Content: _____

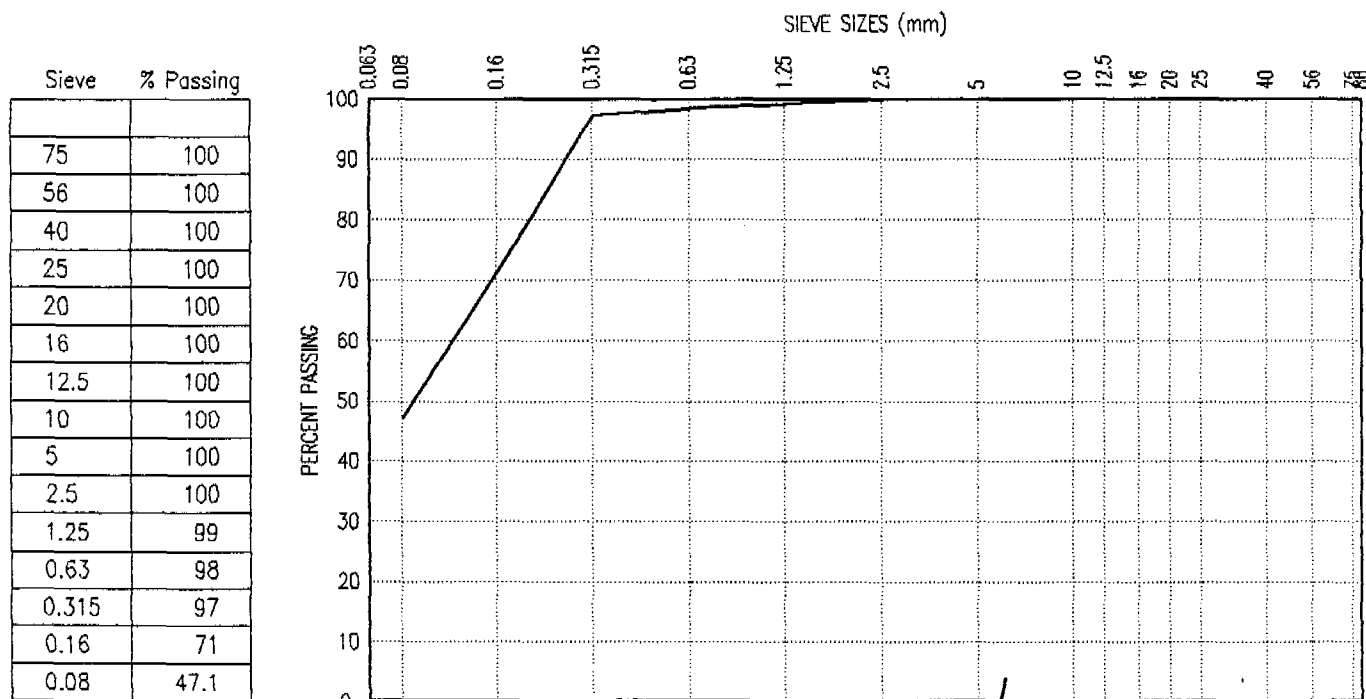
Crushed Faces: _____ Faces: _____

Attention: MR. STEVE TRAYNOR

Soil Description: SAND AND SILT

Remarks: (Gravel = 0.0%, Sand = 53%, Silt = 47%)

(SM)



Reviewed By: _____

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AGGREGATE ANALYSIS REPORT

Project: GRANULAR MATERIAL INVESTIGATION

Sample Number: 137-23

Address: LAC DE GRAS, AIRSTRIP ESKER (BHP KOALA)
AND MISERY LAKE ESKER

Sample Location: MISERY LAKE ESKER

Project Number: 0701-96-12174

INAC-8, BULK SAMPLE No. 1

DEPTH = 0.3 m to 0.6 m

Date Sampled: 96/03/24 By: RGL

Time: Temp:

Client: I.N.A.C.

Date Tested: 96/04/25 By: RGL

Natural Moisture Content: 3.5 %

Crushed Faces: Faces:

Attention: MR. STEVE TRAYNOR

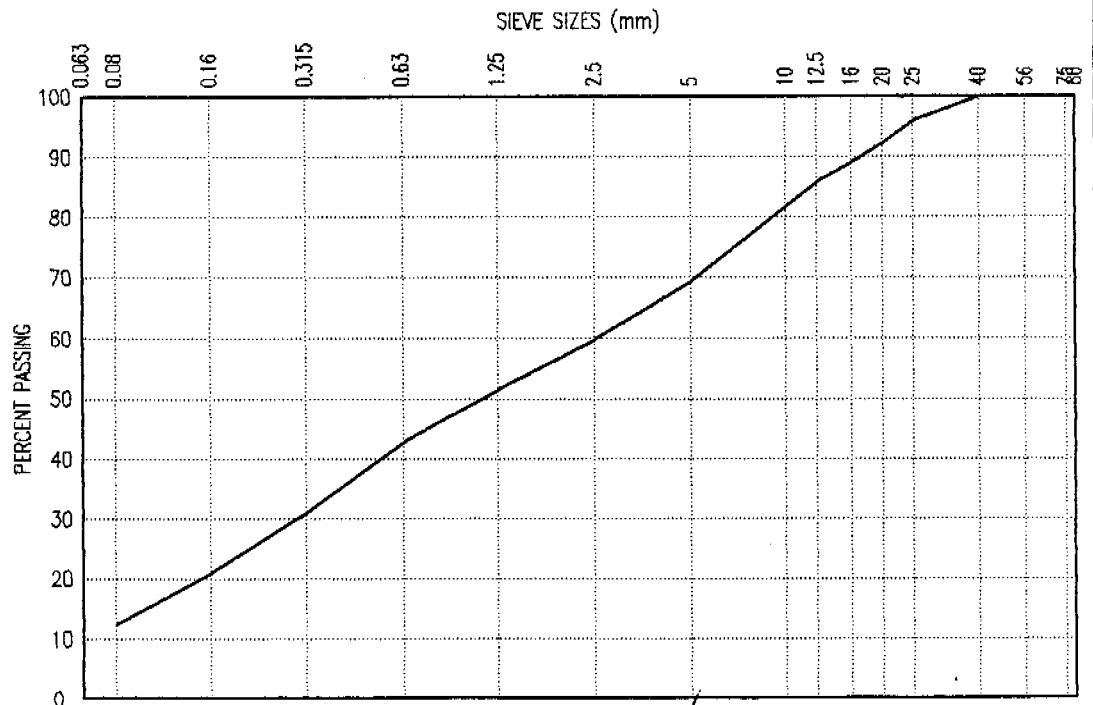
Soil Description: SAND - gravelly, some fines, brown

Remarks: (Gravel = 31%, Sand = 57%, Fines = 12%)

D10 = n/a, D30 = 0.29 mm, D60 = 2.6 mm

Cc = n/a, Cu = n/a

Sieve	% Passing
75	100
56	100
40	100
25	96
20	92
16	89
12.5	86
10	82
5	69
2.5	60
1.25	51
0.63	43
0.315	31
0.16	21
0.08	12.4



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APPENDIX C
INSPECTION REPORTS

INSPECTION REPORT

Project: Esker Investigation
Location: Misery Lk & Airstrip
Eskers (BHP Koala)
Project Number: 0701-96-12174

Date: MARCH 16/96
General Contractor: —
Contractor's Representative: P—
EBA Representative: RGL

9:00

Set out to BHP ^{on} Winter Road from Yellowknife

- roads were mostly clear but rough
- jacked RTL semi on road to BHP Koala from Lupin Rd.
delayed for ~ 1/2 hr.

4:30-5:00 pm

Arrived on site:

- Safety orientation (incl. driving on BHP property)

Hours Worked: _____ Page _____ of _____



INSPECTION REPORT

Project: ESKER Investigation

Date: MARCH 17/96

Location: Misery Lk & Airstrip

General Contractor: —

Eskers (Keala-BMA)

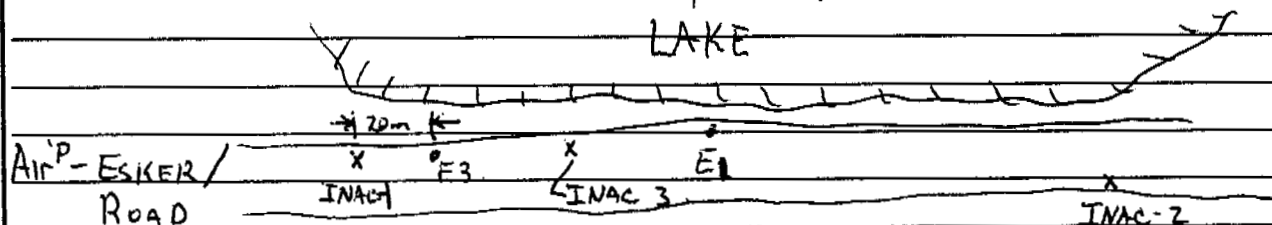
Contractor's Representative: —

Project Number: 0701-46-12174

EBA Representative: RGL

7:45 am Discussed with Steve - location of boreholes on airstrip esker.

- Steve wants them called "INAC -"
- Will do two, maybe 3 if possible (boreholes)
- One BH 20m compside of E3 on EBA Radar Line
- 2nd near EBA radar line, south end of Lake
- 3rd (if time permits) is between E3 & E1



3:30 - Drove to airstrip esker - located INAC-1 & INAC-2. INAC-3 ~ 1/2 distance between E3 & E1.

(1.5)
~15 m of massive ice @ E3

Exposed ice on esker slope near INAC-2

Plan is to sample every 2.5' of auger advance (~1/2 auger flight) & core (CRREL) if ice is encountered.

Hours Worked: _____ Page 1 of 1



INSPECTION REPORT

Project: Esker Investigation Date: MARCH 18/96
Location: Misery Lake & Airstrip Eskers General Contractor:
Contractor's Representative:
Project Number: 0701-96-12174 EBA Representative: RGL

~8:30am:

- Set out for Misery Lake Esker. Esker is ~ 2 Km off of Lupin Road, turnoff from Lupin is approx. 9 Km toward Yellowknife from BHP Koala turnoff.
- GSC Truck & INAC Truck Together - each with one snowmobile. Steve Wolf, Mike & Steve from INAC, & myself were present.
- RGL & STEVE (INAC) set out on snowmobile for Esker Site, RGL stayed on site while STEVE returned to trucks on Lupin Ice road. (One Ski Snowmobile not working)
- General location of first two boreholes were determined after STEVE T. returned to site.

1:15 - RETURNED TO Camp (Arrived 1:10 to 1:15)

5:30 OTHER borehole locations determined from air photo during meeting with Steve T.

~6:00 Drillers arrived on site at ~ 6:00 pm. Safety orientation at 7:30 pm.

Hours Worked: _____ Page _____ of _____



INSPECTION REPORT

Project: Esker Investigation

Date: MARCH 19 / 96

Location: Misery Lk & BHP Amstrip

General Contractor: Midnight Sun Drilling

Eskers

Contractor's Representative: Randy

Project Number: 0701-96-12174

EBA Representative: RGL

7:00

Drillers Set out for INAC-1 - Borehole location was set at ~60' 62' (18.4m) to the campside of E3. Borehole was located by STEVE T. & RGL.

- Started at 10:00 (drilling).
- Hit massive ice at ~9m
- Through ice at ~5:00-5:30 pm
- Eric (PAMP manager) called on radio - whiteout condition anticipated
- Hole was not completed - crew, RGL, Mike & STEVE ~~was~~ returned to camp.

STEVE Wolf (GSC) took samples of soil & ice.
Mark (GSC) was present for part of coring.
Mike (INAC) also present.

Hours Worked: _____ Page 1 of 1



INSPECTION REPORT

Project: Esker Investigation

Date: MARCH 20 / 96

Location: Misery Lake, BHP Airstrip
Eskers

General Contractor: Midnight Sun

Contractor's Representative: Randy

Project Number: 0701-96-12174

EBA Representative: RG1

7:30

Road to site cleared, drillers set out.

9:00: IVAC-1 is completed. Final Depth 52' (15.8m)

9:15: Wind / Temp considered too extreme (STEVE T. & RGL)
to set up over next Borehole (IVAC-2)

9:30 Arrived back at camp to wait-out winds. Initial info
suggested winds would recede by noon - Later info indicated
winds may continue all day.

Steve T. plans to try again after lunch. If not possible
to drill after lunch, drilling will continue on Thursday -
3 days left for Misery LK - Should still be OK for 4 holes.
Drillers feel two per day is possible.

15:00

- STARTED IVAC-2

- Depth of hole = 6.7m at end of day (~ 18:30 hrs)

- Returned to camp after 7:00 (19:00 hrs).

Hours Worked: _____

Page _____

of _____



INSPECTION REPORT

Project: ESKER Investigation

Date: MARCH 21 / 96

Location: Airstrip Esker, BHP Koaia

General Contractor: Midnight Sun

Contractor's Representative: Randy

Project Number: 0701-96-12174

EBA Representative: RGL

INAC-2

- On site @ ~ 7:30
- Completed INAC-2 - Final depth = 9.1 m
- Borehole cleared out twice for PVC installation (GSC instrument ation)
- Borehole & PVC installation completed before 12:00
- Drillers lost one bit in borehole. Shear pin snapped when bit (rotation) caught on rock during clearing of hole.

INAC-3

- Started at 13:25
- Completed ~ 7:00 (49:00 hrs)
- GSC installed PVC to depth of 5 m.

Discussion With Client:

Steve Traynor went over borehole locations at Misery Lake esker. He will be there to mark locations on March 22/96

Hours Worked: _____ Page 1 of 1



INSPECTION REPORT

Project: Esler Investigation

Date: MARCH 22 / 96

Location: Misery Lake, BHP Koala

General Contractor: Midnight Sun

Contractor's Representative: Randy

Project Number: 0701-96-12174

EBA Representative: RGL

Iunc-4

- Started at 12:00, Completed at 2:15:30
- Final depth of borehole was 7.9m
- Refusal on probable boulder.

Iunc-5

- Started at 16:20
- Depth of borehole at 18:15 was 6.7m
- Returned to camp at 18:15

STEVE Traynor ^{located} ~~set up~~ Iunc 6 & Iunc 7.

Hours Worked: _____ Page 1 of 1



INSPECTION REPORT

Project: ESKER INVESTIGATION

Date: March 23 / 96

Location: Misery Lake Esker

General Contractor: Midnight Sun

BHP-Koala

Contractor's Representative: Randy

Project Number: 0701-96-12174

EBA Representative: AGL

INAC-5

- Completed borehole at ~11:30
- Final Depth was 11m.
- Drillers lost bit while cleaning out hole (1st time down)
- PVC installed?

INAC 6

- Setup 12:00-12:45
- Started @ 12:45
- End of borehole at 9.9m
- Bit broke, but was not lost - can be repaired
- new bits were too wide to continue hole. Borehole was terminated at 9.9m.
- PVC installed to 9.1m
- camp manager (Jim McDermitt) visited at ~15:15

Returned to camp after 7:00 (19:00 hours)

Hours Worked: _____ Page 1 of 1



INSPECTION REPORT

Project: ESKER INVESTIGATION

Date: MARCH 24 / 96

Location: Misery Lake Esker
BHP - Koala

General Contractor: Midnight Sun

Contractor's Representative: Randy

Project Number: 0701-96- 12174

EBA Representative: AGL

INAC 7

- Started at 8:30 Finished at 10:40
- End of Borehole at 3.8^{4.1}m. Refusal on probable bedrock.

INAC 8

- Started @ ~ 12:00 (to 15:30)
- Borehole terminated when bit & two augers were lost in hole
- drillers lost catches trying to retrieve augers.
- borehole abandoned ~ 15:30
- Returned to camp @ ~ 5:30 (17:30 hrs)

Conversation with Client:

Steve Traynor asked that report be completed, in draft form, by March 29/96 & have it delivered and date-stamped at INAC to Pat Newton or Irene Kearney.

Hours Worked: _____ Page 1 of 1



INSPECTION REPORT

Project: Esker Investigation

Date: March 25²⁶/96

Location: _____

General Contractor: Midnight Sun

Contractor's Representative: Randy

Project Number: 0701-96-12174

EBA Representative: RGL

MARCH 25

- Prepared Samples for Shipping
- Worked with GPS software

MARCH 26

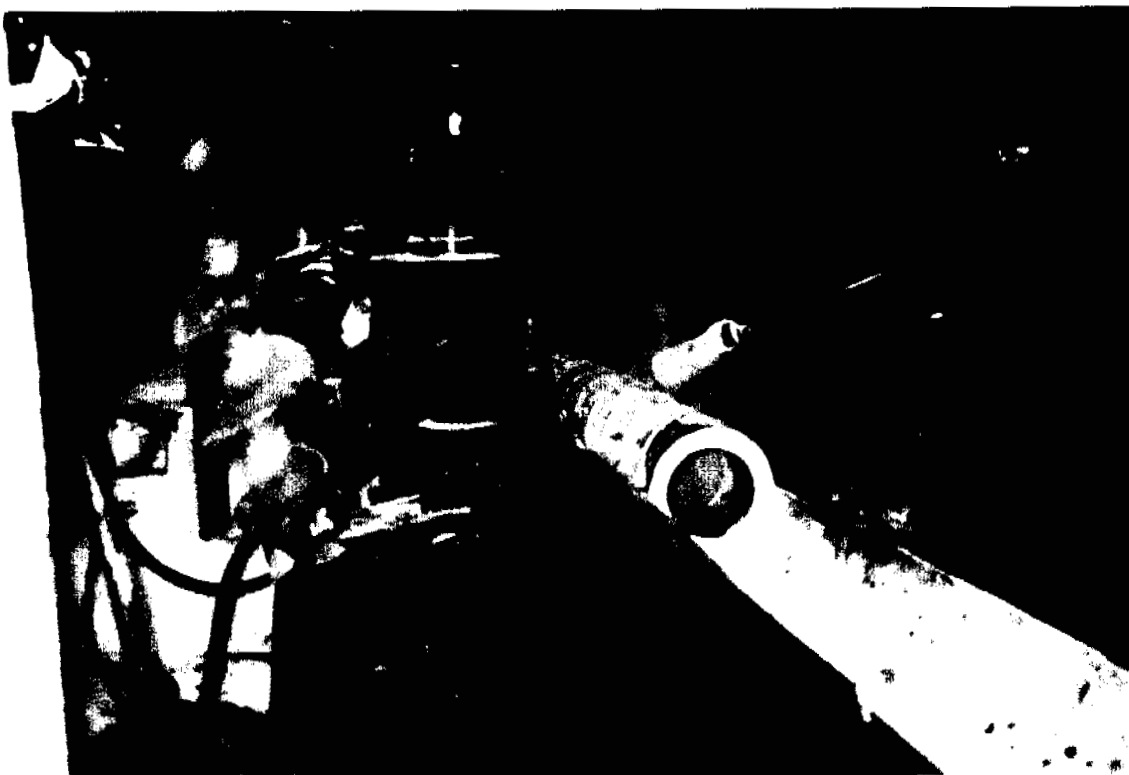
- Read thermistors at airstrip esker
- Prepared Samples

Out on plane at ~ 2:00

Hours Worked: _____ Page 1 of 1

APPENDIX D
SELECTED PHOTOGRAPHS

P5



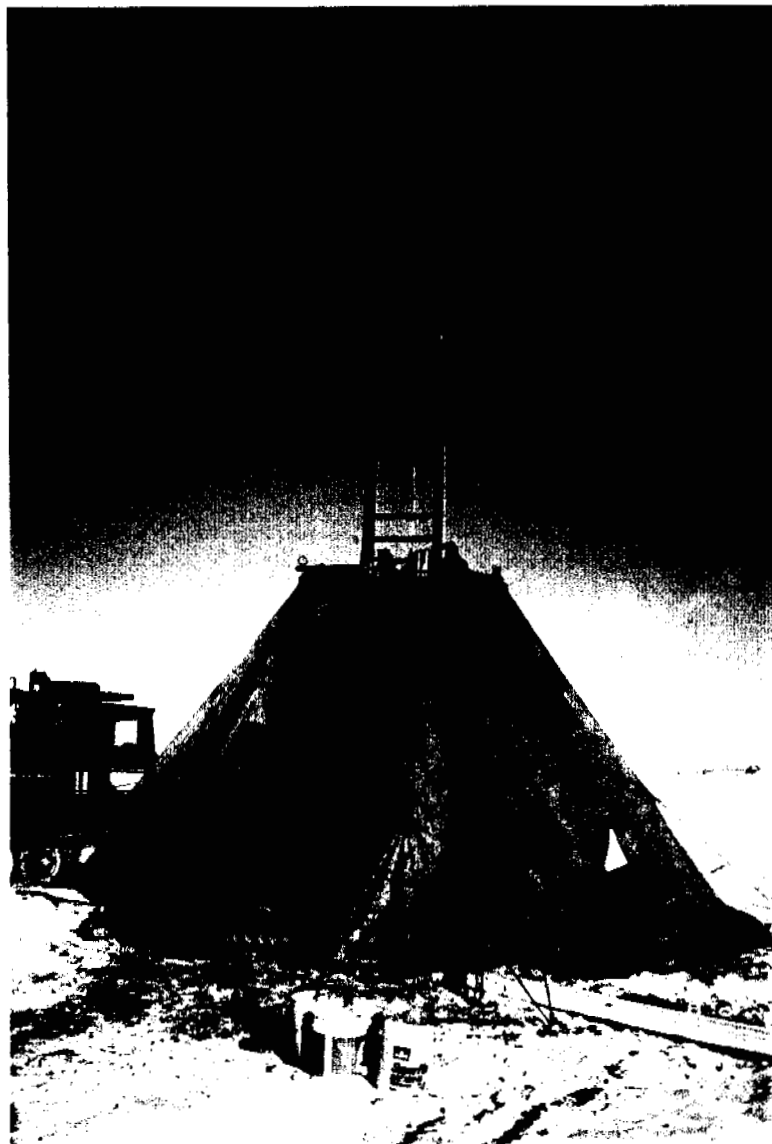
Midnight Sun crew extracting a core from a CRREL sampler.

10



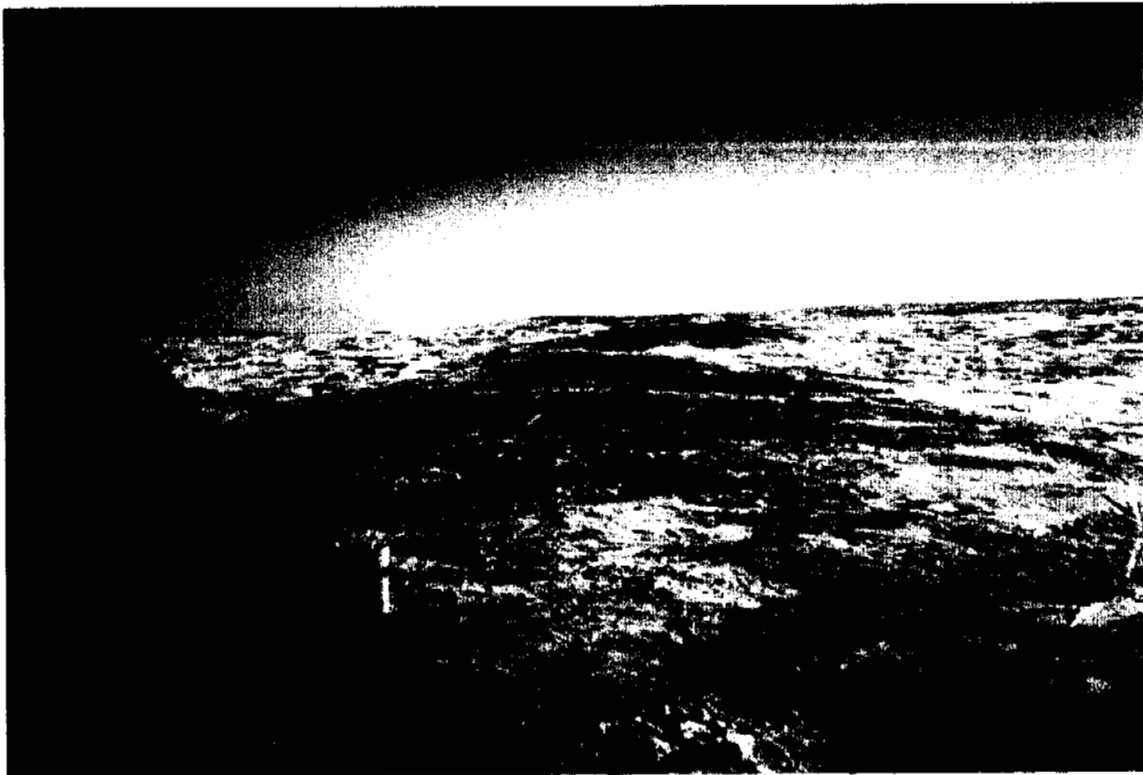
Midnight Sun Drilling. Nodwel.

11



Midnight Sun Drilling. Tent and CME 750 rig.

4



Scene from location of Borehole 8. Misery Lake Esker.

APPENDIX E

DATA DISKS