GEOTECHNICAL EVALUATION
PROPOSED MAIN WASTE DUMP
MINTO PROJECT
YUKON TERRITORY

0201-95-11509

APRIL, 1998

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PROPOSED MAIN WASTE DUMP
MINTO PROJECT
YUKON TERRITORY

Submitted to:

MINTO EXPLORATIONS LIMITED
WEST VANCOUVER, BC

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
EDMONTON, ALBERTA

0201-11509

APRIL, 1998

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1.0 INTRODUCTION

Minto Explorations Ltd. (Minto) is currently proposing to construct two waste dumps to the west and southwest of the proposed open pit at the Minto project site, located approximately 90 km northwest of Carmacks, Yukon. The waste dumps will be used to separately stockpile ice-rich overburden and non ice-rich overburden/waste rock excavated from the pit area. This report only addresses the design of the waste dump for the latter material (hereafter referred to as the main dump). The intent is to provide a separate report at a later date for the ice-rich overburden dump once the detailed quantity calculations for the ice-rich overburden have been completed by Minto.

The main dump will be constructed throughout the mine life to an approximate final elevation of 3050 feet above mean sea level (MSL). The main dump will include waste rock as well as thaw stable overburden from the open pit. In addition to mined overburden/waste rock, the main dump will also contain a low grade oxidized ore stockpile for processing during periods of elevated copper prices.

The intent is to construct the dump by placing the waste material at its angle of repose (approximately 1.5H:1V) with setbacks or benches at regular 50 foot (vertical) intervals. The maximum height of the dump will be approximately 265 feet, although the dump height varies along its entire length due to the sidehill location of the dump. A general site plan identifying the main features of the mine site development including the approximate footprint of the proposed main dump is shown on Figure 1.

2.0 SITE DESCRIPTION

The terrain to the west of the open pit has two distinct landforms, valley bottom and uplands terrain. The valley bottom terrain is typically a colluvium blanket overlying residuum soil. It is poorly drained and has down slope movement due to solifluction and colluvial processes. The uplands terrain is typically well drained residuum soils with a variable thickness of overlying colluvium. The valley bottom terrain has ice-rich material scattered throughout, particulary on the north facing slopes. Whereas the south facing uplands terrain typically does not contain ice-rich soil.

The angle of the existing valley slope through the location of the proposed main dump is approximately 10H:1V on the lower portion of the slope underlying the toe of the dump. Further up the valley, the slope angle steepens to 4.6H:1V. The outline of the dump has tentatively been situated by Minto as shown on Figures 1 and 2.

3.0 STRATIGRAPHY

A field drilling and testpit program was undertaken in the fall of 1997 to confirm the subsurface conditions underlying the proposed main dump. Details of the field program and basic laboratory test data are presented in a separate report to Minto dated February, 1998. A site plan identifying the borehole locations from the latest drilling program, as well as previous boreholes (EBA, 1997) in the area, are presented on Figure 2. Copies of the borehole and testpit logs that were drilled/excavated in the immediate vicinity of the main dump have been included in Appendix B.

The general stratigraphy in the area of the main dump is consistent with the drilling from previous EBA investigations on the site, which comprises colluvium overlying residuum underlain by bedrock. Of particular importance is that permafrost was not found in any of the boreholes drilled within the footprint of the main dump. A series of holes were also drilled south of the original proposed dump toe to evaluate the possibility of extending the dump further down the valley slope. Several of the boreholes (97-G09, 12, 17 and 22) south of the west dump toe indicated ice-rich permafrost and/or high moisture contents, which presents a concern with regard to the strength properties of the soils and the stability of a dump which may extend further down slope.

The stratigraphy beneath the main dump comprises a thin to non-existent veneer of organic topsoil overlying silt and sand colluvium. The colluvium is thickest beneath the toe of the dump and gradually thins out towards the crest of the dump. Typically, the colluvium consists of silt and/or sand. The silt colluvium contains some sand, a trace of gravel, is brown in colour and damp. The sand colluvium is generally well-graded, with some fines, a trace of gravel and occasional cobbles.

Beneath the colluvium is a residuum soil layer which is thin at the toe of the dump and gradually increases in thickness towards the crest of the dump. The residuum soil layer is variable in thickness and is underlain by granodiorite bedrock. The residuum is derived from the underlying parent bedrock and is typically a well-graded sand with a trace of gravel and fines and occasional cobbles. Evidence of bedrock exposures is evident in the upper area of the main dump.

4.0 SHEAR STRENGTH AND PORE WATER PRESSURE PARAMETERS

4.1 LABORATORY TESTING

Relatively undisturbed Shelby tube samples from the 1997 field program were obtained from Testpits 97-01 and 02. Two Shelby tubes were recovered from a depth of 1 to 2 feet from Testpit 97-01 and two Shelby tubes were taken from Testpit 97-02 between 3 and 4 feet. Laboratory tests conducted on these samples include: natural moisture contents, Atterberg limits, grain size distribution and direct shear tests. Results of these laboratory tests are presented on the test pit logs in Appendix B or in Appendix C.

The sample retrieved from Testpit 97-01 is a silty sand or sandy silt colluvium, which is considered to be representative of the colluvium that has been encountered in the drilling conducted on site. The sample recovered from Testpit 97-02 is a low plastic silty clay layer, which is considered an anomoly based on the extensive drilling undertaken to date, and is believed to be confined to isolated areas.

4.2 SHEAR STRENGTH PARAMETERS

4.2.1 Colluvium

As discussed above, the silty sand material is believed to be representative of the colluvium found on the surface of the existing ground where the proposed main dump will be placed. Direct shear testing of the silty sand colluvium sample from Testpit 97-01 indicates a peak friction angle of 35° and a residual friction angle of 28°. In the

present stability analyses, the residual friction angle has been used due to the knowledge that downslope movement and reworking of this material has occurred over time.

4.2.2 Residuum

The residuum soil found beneath the main dump is typically a silty sand with some fine gravel. Index testing and engineering judgement have been used in estimating the friction angle for this material to be 35°, which is consistent with values used in previous analyses for the tailings/water retention dam.

4.2.3 Waste Rock

Steffen, Robertson and Kirsten Ltd. (SRK) reviewed Minto rock core taken during the 1993 exploration program and produced a report of geotechnical properties of the rock mass present on site with respect to open pit design, hanging wall design and underground mining design issues. The bedrock is described as weathered to a depth of about 100 feet and it was recommended that ripping with bulldozers could be used for pit excavation (SRK, 1994). It is believed that this observation justifies that some of the waste rock excavated from the open pit could be treated as "soil like" waste rock with a friction angle of 35°. It is anticipated that the majority of the waste rock produced will be "rock like" with a friction angle of 37° to 38°.

Segregation of the waste rock is expected to occur due to construction placement. When weaker zones within the pit are encountered a significant portion of the excavated material will be primarily sand and gravel rather than rock. The potential exists for inclined sand and fine gravel ("soil like" waste rock) layers to form within the rockfill mass parallel to the dump face. These "soil like" zones will govern the strength properties of the rockfill mass with the waste dump and therefore the lower friction angle (of 35°) was used in the stability analysis.

4.3 PORE WATER PRESSURE PARAMETERS

4.3.1 Natural Stratigraphy

No perched groundwater table has been identified during any of the geotechnical drilling to date. However, evidence of free flowing water was noted near the base of the active layer and in sandy layers within the colluvium. Therefore it is possible that a shallow perched groundwater table may exist for short periods of the year. For the present stability analyses, a groundwater table at original ground surface was assumed, which is a conservative assumption.

4.3.2 Waste Dump

The maximum degree of saturation expected for the waste rock material is in the order of 40 to 50% with an estimated field capacity in the order of 60 to 70% (Dawson, 1994). These estimated saturation values do not suggest that a phreatic surface will develop within the dump due to the anticipated relatively free draining nature of the waste rock. If possible, the water levels within the dump should be monitored on an ongoing basis with piezometers located beneath the toe of the dump. Visual observations of the amount of seepage exiting the toe of the dump should be made and recorded on an ongoing basis.

Although the majority of the dump will comprise relatively free draining coarse rock, it is known that the main dump will also include thaw stable fine grained colluvium and residuum. This finer grained soil is capable of retaining a significant amount of water and may possibly generate localized pore pressures within the dump. It will be important to ensure that the finer grained material is placed within the interior of the dump and that only the coarser free draining rock is placed around the perimeter of the dump.

4.4 SUMMARY OF SHEAR STRENGTH AND PORE WATER PRESSURE PARAMETERS

Table 1 presents a summary of the shear strength and pore water pressure parameters used in the stability analysis of the main dump.

TABLE 1
SHEAR STRENGTH AND PORE PRESSURE PARAMETERS USED IN SLOPE STABILITY ANALYSIS

MATERIAL	BULK DENSITY (pcf)	FRICTION ANGLE (degrees)	PORE PRESSURE
Waste Rock	124.8	35	None
Colluvium	114.6	28	Original Grade
Residuum	124.1	35	Original Grade

5.0 STABILITY ANALYSIS

Drilling conducted during the latest field program confirms that the main dump is founded on competent thaw stable uplands terrain. Accordingly, the stability analyses have been conducted using conventional soils parameters without having to incorporate the effects of ice-rich soils.

5.1 DESIGN FACTORS OF SAFETY

Limit equilibrium methods were used in assessing the stability of the main dump using the classical factor of safety approach. The Mined Rock and Overburden Piles Investigation and Design Manual (1991) (Waste Rock Design Manual) published by the British Columbia Mine Waste Rock Pile Research Committee presents interim guidelines regarding minimum factors of safety which should be used in mine waste pile design. EBA has conducted the design according to the factors of safety that are presented in Table 2. These minimum guidelines have been chosen from ranges of values using experience and the site database of borehole logs, test pits and laboratory test results.

TABLE 2
DESIGN FACTORS OF SAFETY

STABILITY CONDITION	MINIMUM DESIGN FACTOR OF SAFETY
Long Term Deep Seated Stability	1.3
Seismic (Pseudo static) Stability	1.0

5.2 SEISMIC LOADING PARAMETERS

The Waste Rock Design Manual recommends that seismic stability should be evaluated using pseudostatic horizontal accelerations that correspond to a 10% probability of exceedance in 50 years. The horizontal acceleration that corresponds to this magnitude of earthquake at the project site is 0.15 g. It should be noted that the Waste Rock Design Manual considers that pseudostatic assessments based on anticipated peak ground accelerations tend to yield very conservative results. Therefore, the use of a relatively low factor of safety (1.0) is considered acceptable.

5.3 GEOMETRY

To provide a stable long term slope angle it is proposed that a series of benches be used for the main waste dump. Utilizing benches allows the site operator to place the waste at an angle of repose, minimizing time and effort flattening the slope angle of the dump face, while providing a shallower overall slope. The benches also act as catchment areas in the event of a shallow slip surface failure. The vertical height of the benches has been proposed by Minto to be 50 feet. As the maximum height of the waste dump is 265 feet, the final lift was assumed to be 65 feet high.

The section used in the slope stability analysis is shown in plan on Figure 2 and in section on Figure 3.

5.4 MAIN DUMP STABILITY ANALYSIS

5.4.1 Static Analysis

The initial analyses commenced with individual bench slopes of 1.5H:1V and bench widths of 35 feet, which provides an average overall slope angle of 2H:1V. The stability analyses for the static case indicates that the critical failure surface is a relatively shallow slip surface. For shallow toe failures, the factor of safety was determined to be 1.05. As the height of the dump increases and the failure surface extends up to the higher benches, the factor of safety increases. For a failure surface extending half way up the face of the final slope, the factor of safety is 1.47 and for a failure surface extending to the crest yields a factor of safety of 1.52.

It was apparent that the critical zone from a stability perspective is the toe of the dump. Accordingly, the first bench was flattened to a slope angle of 2H:1V but the remainder of the bench slopes were left at 1.5H:1V. The analyses for this revised geometry indicates a factor of safety of 1.38 for the shallow toe failures. The factor of safety for failure planes extending half way and all the way to the crest were determined to be 1.55 and 1.56, respectively. These analyses satisfied the minimum factor of safety of 1.3 recommended by the Waste Rock Design Manual.

To optimize the design, it was decided to narrow the benches widths to 25 feet, which reduces the overall slope angle to 1.9H:1V. As described in the preceding paragraph, the lowest bench slope was set at 2H:1V and the remainder of the bench slopes were set at 1.5H:1V. As in the previous analysis, the critical failure surface comprised a shallow toe failure with a factor of safety of 1.38. The factors of safety for the mid slope and full slope failure surfaces were calculated to be 1.44 and 1.45, respectively. These analyses satisfied the minimum factor of safety of 1.3 recommended by the Waste Rock Design Manual. The following table presents a summary of the static analyses as discussed in the preceding paragraphs. Figure 3 presents a section illustrating the location of the critical shallow, mid-slope and full slope failure surfaces.

TABLE 3
FACTORS OF SAFETY - STATIC ANALYSIS

LOWER BENCH SLOPE ANGLE	SLOPE ANGLE - UPPER BENCHES	BENCH WIDTH (FEET)	FACTOR OF SAFETY		
			TOE FAILURE	MID-SLOPE FAILURE	UPPER SLOPE FAILURE
1.5H:1V	1.5H:1V	35	1.05	1.47	1.52
2H:1V	1.5H:1V	35	1.38	1.55	1.56
2H:1V	1.5H:1V	25	1.38	1.44	1.45

5.4.2 Seismic Analysis

A series of pseudostatic analyses were undertaken to analyze the factor of safety due to a seismic event. The dynamic loading was applied using acceleration values of 0.05g, 0.10g and 0.15g. The dynamic analyses were conducted using a 2H:1V lower bench and 1.5H:1V upper benches. Utilizing a bench width of 25 feet the factor of safety for a shallow toe failure, mid-slope and upper slope failure was calculated for the three dynamic loading conditions given above. For the design case of 0.15g, the factor of safety was 0.98 which is marginally below the minimum factor of safety of 1.0. A second set of analyses were conducted flattening the lower slope to 2.1H:1V. This increased the minimum factor of safety to 1.01. Decreasing the bench widths to 20 feet was also evaluated, but factors of safety less than unity were calculated. A summary of the pseudostatic stability analyses is presented on Table 4.

TABLE 4
FACTORS OF SAFETY - PSEUDO STATIC ANALYSIS

LOWER BENCH SLOPE ANGLE	SLOPE ANGLE - UPPER BENCHES	SEISMIC LOADING	FACTOR OF SAFETY		
			TOE FAILURE	MID-SLOPE FAILURE	UPPER SLOPE FAILURE
2H:1V	1.5H:1V	0.05g	1.22	1.27	1.28
2H:1V	1.5H:1V	0.10g	1.09	1.14	1.15
2H:1V	1.5H:1V	0.15g	0.98	1.02	1.03
2.1H:1V	1.5H:1V	0.15g	1.01	1.03	1.04

Based on these pseudostatic analyses, a suitable factor of safety to handle a design seismic event is achieved by using bench widths of 25 feet with a lower bench slope angle of 2.1H:1V and upper bench slope angles of 1.5H:1V.

It should be noted that the stability of the intermediate and upper bench faces (placed at the angle of repose) is less than unity when subjected to a design seismic event. This may result in some localized surface instability which should be contained by the intermediate benches. Of primary importance is that the larger scale deep seated surfaces indicate a factor of safety greater than 1.0.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Numerous papers have been written addressing problems associated with the construction and operation of mine waste including cold climatic regions (Stepanek, 1986). Controlling surface runoff and groundwater is a key element in maintaining stability for many waste dump configurations. The above stability analyses have assumed that there is no pore pressure buildup within the mass of the waste dump pile. Providing that the material in the dump is free draining, this is a reasonable assumption. It is known however, that during early development of the pit, finer grained (non-ice rich) overburden will be deposited in the main dump. Therefore, the potential exists in the long term, for this fine grained material to retain water and eventually develop pore pressures or generate a perched water table condition within the dump.

The critical zone for stability as indicated by the slope stability analyses is the outer perimeter of the dump. Ensuring that pore pressures do not buildup in this area is critical to the overall stability of the dumps. Therefore, it is recommended that only coarse rock be placed in the outer perimeter of the dump. This critical area can be defined by extending a vertical line down from the final crest of the dump. Both fine grained soils and rock may be placed inside this line, but only coarse free draining rock should be placed outside this limit.

All other reasonable precautions should be undertaken to minimize the possibility of developing pore pressures within the waste material. These include the construction of interceptor berms or ditches uphill of the dump to control surface runoff from draining into the waste rock and overburden. These interceptor ditches should channel surface runoff around the edges of the dump and discharge any surplus water away from the main dump.

The use of benches or terraced construction is recognized as an effective strategy for increasing the stability of a dump (Dawson, 1994). Terrace construction limits the continuity of finer layers that could otherwise extend over a much longer slope face if a zone of finer grained waste material was being deposited along the face of the dump.

Another construction technique that minimizes the risk of forming weak layers parallel to the dump face is to advance the dump across or perpendicular to the valley slope. This construction method would tend to generate weak planes that run perpendicular to the face of the waste dump, rather than parallel to the dump face.

The static and dynamic stability analyses indicate tht the first or lowest bench in the main dump should be placed at a slope angle of 2.1H:1V. This applies to the entire perimeter of the main dump. Minimum bench widths of 25 feet should be used when constructing any additional benches. Upper levels of the dump may be constructed by placing the rockfill at the angle of the repose (approximately 1.5H:1V).

As indicated by the stability analyses, the critical area is the toe of the dump. Consequently, the toe of the main waste dump should be checked for instability during spring thaw and following major precipitation events to monitor the performance of the dump toe area. Should there be any indications of impending instability (such as tension cracks), consideration should be given to review the site by a qualified engineer as well as possible installation of pneumatic piezometers, slope inclinometers and additional survey monuments to monitor the performance of the dump.

Based on the results of the drilling program the proposed location of the main dump is considered acceptable. As indicated in Section 3.0, several boreholes drilled downslope

of the proposed toe dump indicated ice rich permafrost. Consequently it is recommended that the west half of the dump toe not be extended further downslope. However, it is possible to consider moving the east side of the dump toe (east of 96-G04) to the southeast, closer to the open pit. A reasonable setback from the edge of the pit should be used to ensure the dump does not have a negative impact on the stability of the open pit walls. To date EBA has not been involved with any stability aspects of the open pit.

7.0 CLOSURE

We trust this report for the analysis and design of the proposed main waste dump satisfies your present requirements. Should you have any questions or concerns with regards to any aspects of the report or our recommendations, please contact our office at your convenience.

Respectfully submitted,
EBA Engineering Consultants Ltd.

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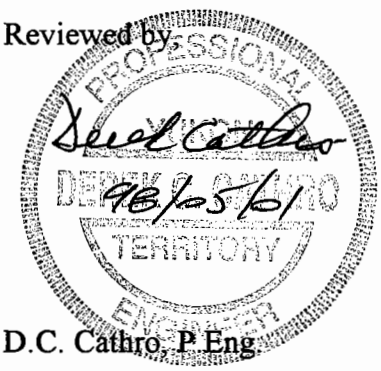
Reviewed by:



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AFR/tr

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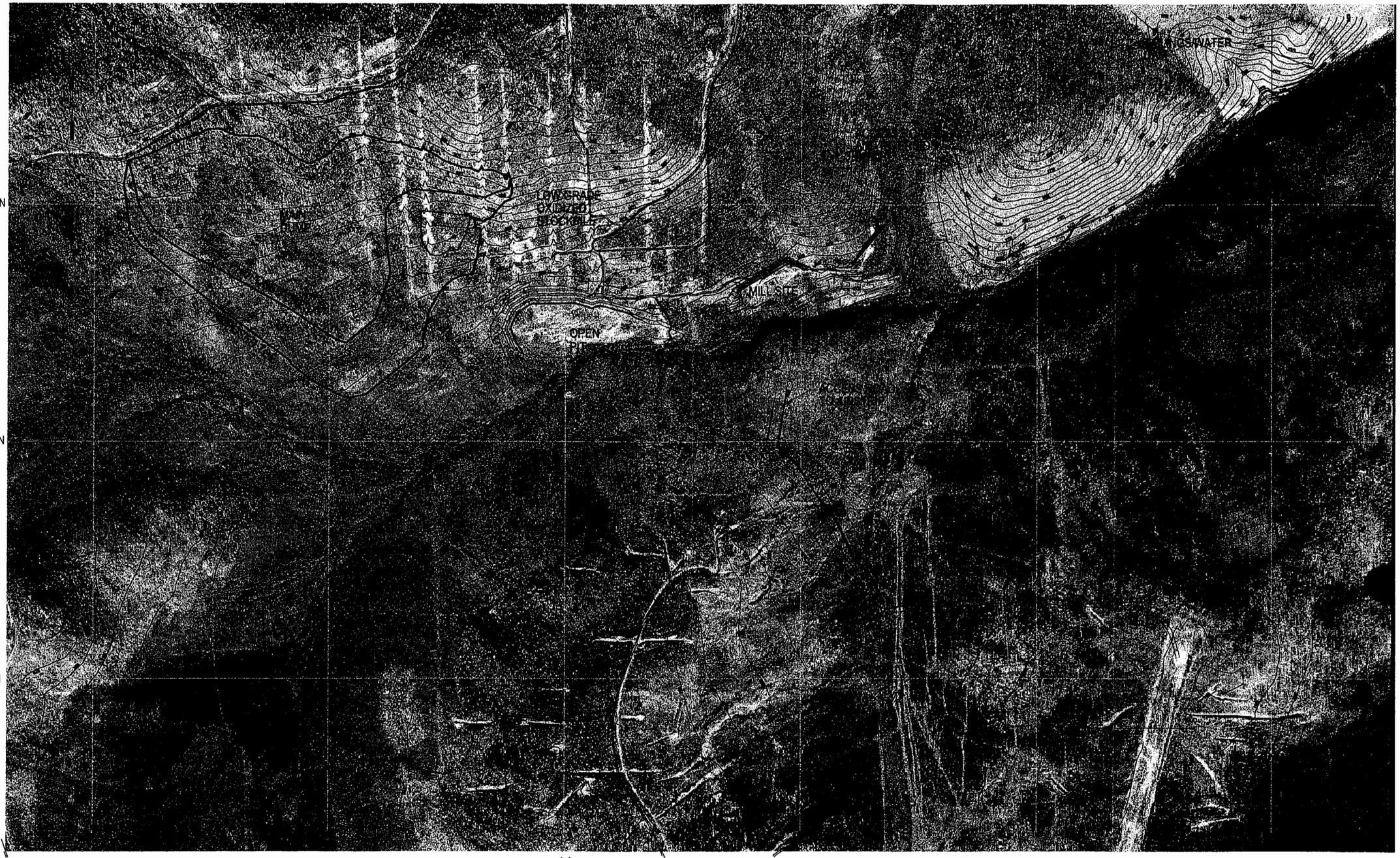
FIGURES

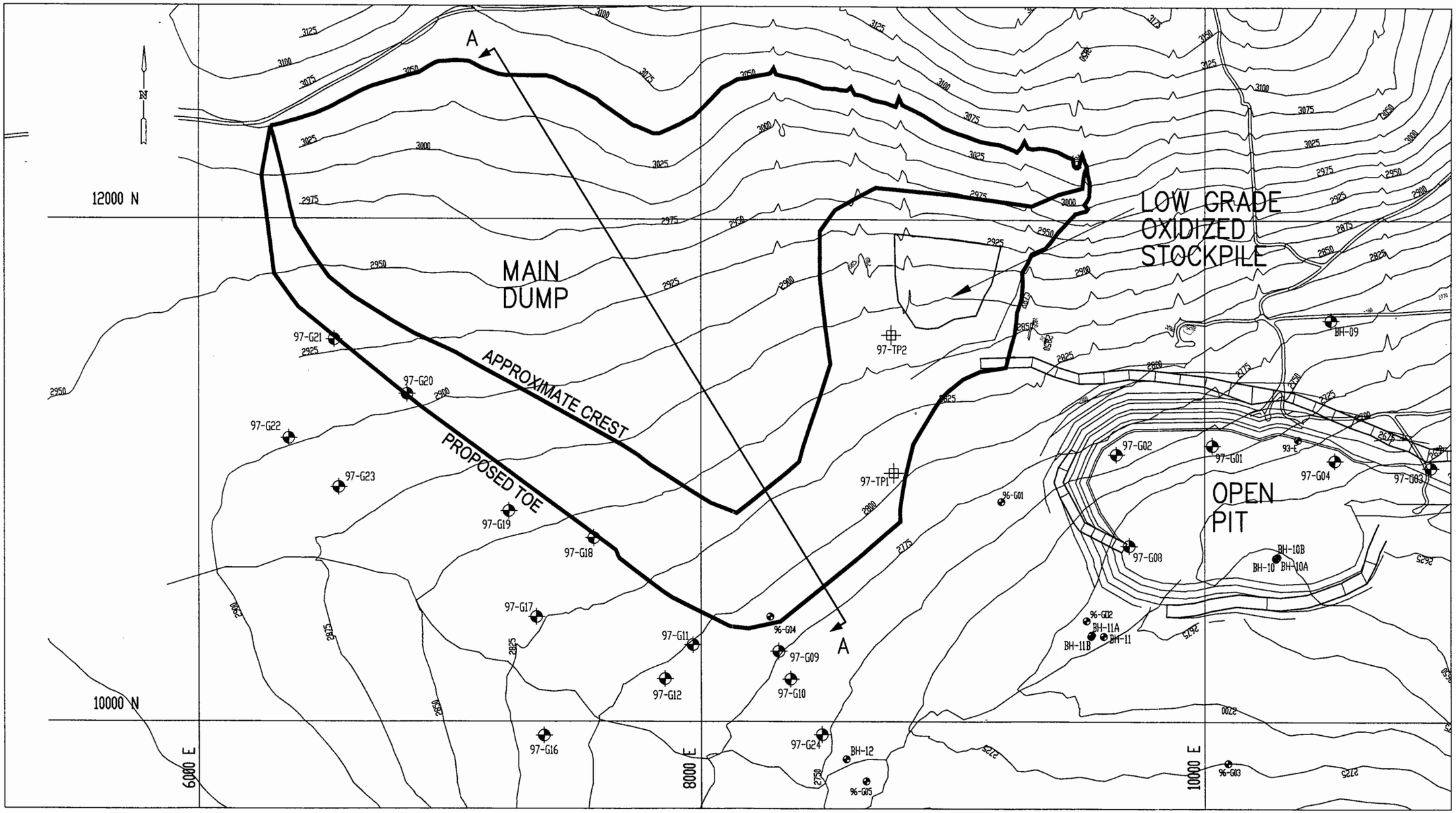


1/8" = 100' APPROXIMATELY
CONTOUR INTERVAL = 25'

EBA Engineering Consultants Ltd.

PROJECT	MINTO PROJECT NORTHWEST OF CARMACKS, YUKON
CLIENT	MINTO EXPLORATIONS LTD.
TITLE	GENERAL SITE PLAN

DATE	DWN.	CHKD.	FILE NO.	
98-02-20	DRG	CKG	201-11509L07C	FIGURE 1



0 1000
SCALE (FEET)

– BOREHOLE LOCATION (1997)

– BOREHOLE LOCATION (PRIOR TO 1997)

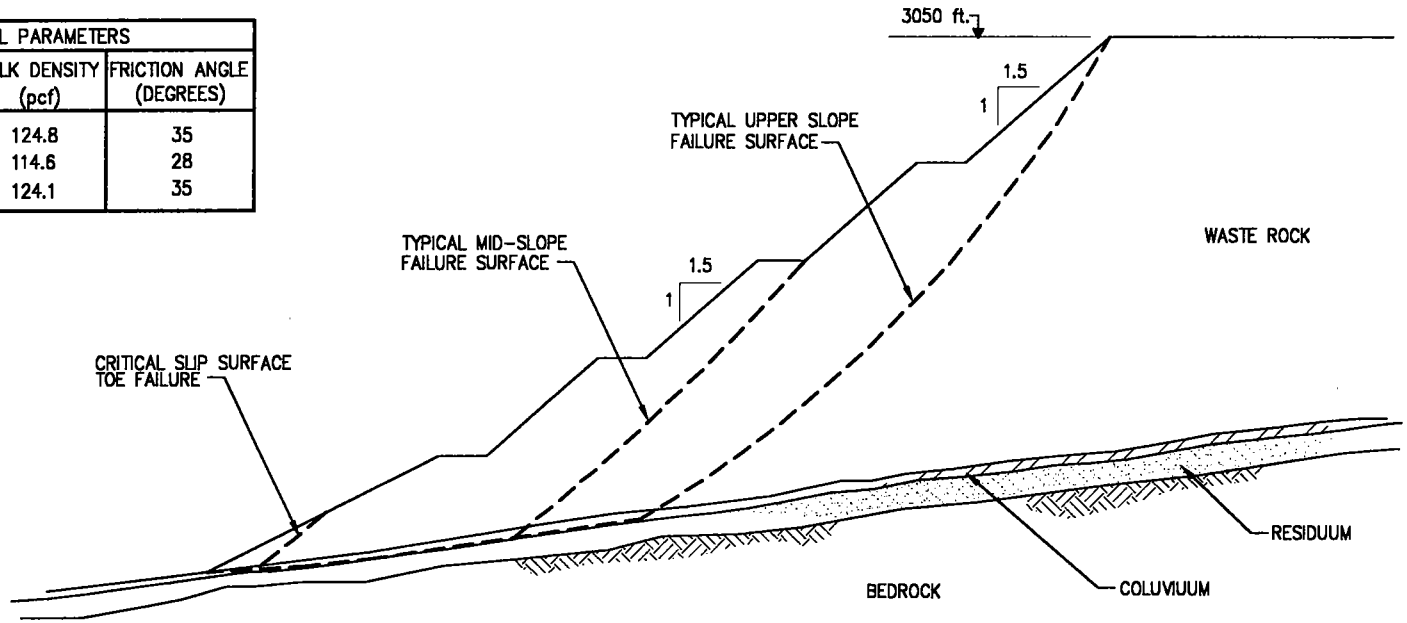
– TESTPIT LOCATION (1997)

2850 – TOPOGRAPHIC CONTOURS (FEET)

EBA Engineering Consultants Ltd.				PROJECT	MINTO PROJECT NORTHWEST OF CARMACKS, YUKON
CLIENT MINTO EXPLORATIONS LTD.				TITLE	SITE PLAN AND BOREHOLE LOCATIONS PROPOSED MAIN WASTE DUMP
DATE 98-02-23	DWN. DRG	CHKD. AFR		FILE NO. 201-11509D13B	FIGURE 2

LOWER BENCH SLOPE ANGLE	SLOPE ANGLE UPPER BENCHES	BENCH WIDTH (FEET)	FACTOR OF SAFETY		
			TOE FAILURE	MID-SLOPE FAILURE	UPPER SLOPE FAILURE
1.5H:1V	1.5H:1V	35	1.05	1.47	1.52
2H:1V	1.5H:1V	35	1.38	1.55	1.56
2H:1V	1.5H:1V	25	1.38	1.44	1.45

SOIL PARAMETERS		
MATERIAL	BULK DENSITY (pcf)	FRICTION ANGLE (DEGREES)
WASTE ROCK	124.8	35
COLLUVIUM	114.6	28
RESIDUUM	124.1	35



SECTION A – A

0 100
feet

EBA Engineering Consultants Ltd.

PROJECT: MINTO PROJECT
NORTHWEST OF CARMACKS, YUKON

CLIENT: MINTO EXPLORATION LTD.

TITLE: SLOPE STABILITY ANALYSIS – STATIC CASE
MAIN WASTE DUMP

DATE	98-02-26	DWN.	DRG	CHKD.	AFR	FILE NO.	201-11509D14B	FIGURE 3

APPENDIX A
GENERAL CONDITIONS

EBA Engineering Consultants Ltd. (EBA)
GEOTECHNICAL REPORT
GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions"

A.1 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client. Any such unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request. This report should be read in its entirety.

A.2 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

A.3 LOGS OF TEST HOLES

The test hole (test pits, boreholes) logs are a compilation of conditions and classification of soils and rocks interpreted from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

A.4 STRATIGRAPHIC AND GEOLOGICAL SECTIONS

The stratigraphic and geological sections indicated on drawings contained in this report are evolved from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of exact locations of geological units is necessary, additional investigation and review may be necessary.

A.5 GROUNDWATER CONDITIONS

Groundwater conditions represented in this report refer only to those observed at the times recorded on logs of test holes and/or wells, and/or within the text of this report. These conditions may vary with geological detail between test holes and/or wells; annual, seasonal and special meteorologic conditions; and with construction activity. Where instruments have been established to record groundwater variations on an ongoing basis, the records will be specifically referred to. Interpretation of groundwater conditions from observations and records is judgemental and constitutes an evaluation of circumstances as influenced by geology, meteorology and construction activity. Deviations from these observations may occur.

A.6 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

A.7 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Preservation of adjacent ground and structures from the adverse impact of construction activity is required. Therefore support of excavation walls, of ground adjacent to anticipated construction and of structures adjacent to the construction must be provided.

A.8 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity may affect structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

A.9 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgemental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein to the benefit of the project.

A.10 DRAINAGE SYSTEMS

Where temporary and permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

A.11 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

A.12 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the client's expense upon written request, or samples will be discarded.

A.13 STANDARD OF CARE

Services performed by EBA for this report are conducted in a manner consistent with that level and skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made, concerning the test results, comments, recommendations, or any other portion of this report.

A.14 ENVIRONMENTAL AND REGULATORY ISSUES

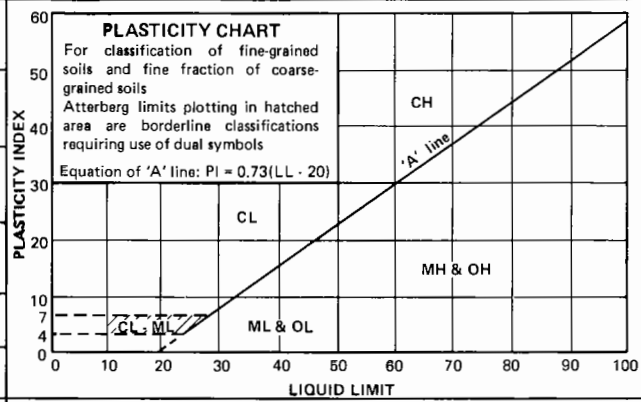
EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site, unless otherwise specifically indicated in the report.

APPENDIX B
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	$C_U = D_{60}/D_{10}$ 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		
			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		

Classification on basis of percentage of fines
Less than 5% pass No. 200 sieve: GW, GP, SW, SP
More than 12% pass No. 200 sieve: GM, GC, SM, SC
5% to 12% pass No. 200 sieve: Borderline classification requiring use of dual symbols



*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	

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)	

NOTE:
1. *Dual symbols are used to indicate borderline or mixed ice classifications*
2. *Visual estimates of ice contents indicated on borehole logs ± 5%*
3. *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 ■

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	TEST PIT NO: 97-TP01
GEOTECHNICAL EVALUATION - MAIN DUMP	EXCAVATOR: CAT 235	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2805 m

SAMPLE TYPE ■ GRAB ▨ NO RECOVERY ▥ SHELBY TUBE

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					TOPSOIL & ORGANIC LAYER
					SAND AND SILT - trace to some gravel, trace of clay well graded sand, fine grained gravel, moist, light brown
		1	ML		- 150 mm clayey layer, olive brown, wet
					- PP = 2.6 & 3.3 tsf on tube sample
1.0		2			SAND - some gravel, trace of silt, well graded sand, fine to med. grained sub rounded gravel, damp, light greyish brown
			GW-GM		GRAVEL(RESIDUUM) - sandy, trace of silt, well graded, brown, fine to coarse grained, damp to moist
2.0					- seepage from side of TP
		3			
		4			
3.0					END OF TESTPIT @ 2.9 m(REFUSAL)
					NOTE: TP located about 120m West of 96-1
					- Mine Coordinates N 10990.00 E 8770.00
4.0					

■ STANDARD PENETRATION ■ 10 20 30 40

PLASTIC M.C. LIQUID 10 20 30 40

■ PERCENT GRAVEL ■ 20 40 60 80

● PERCENT SAND ● 20 40 60 80

▲ PERCENT SILT OR FINES ▲ 20 40 60 80

◆ PERCENT CLAY ◆ 20 40 60 80

DEPTH(ft) 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

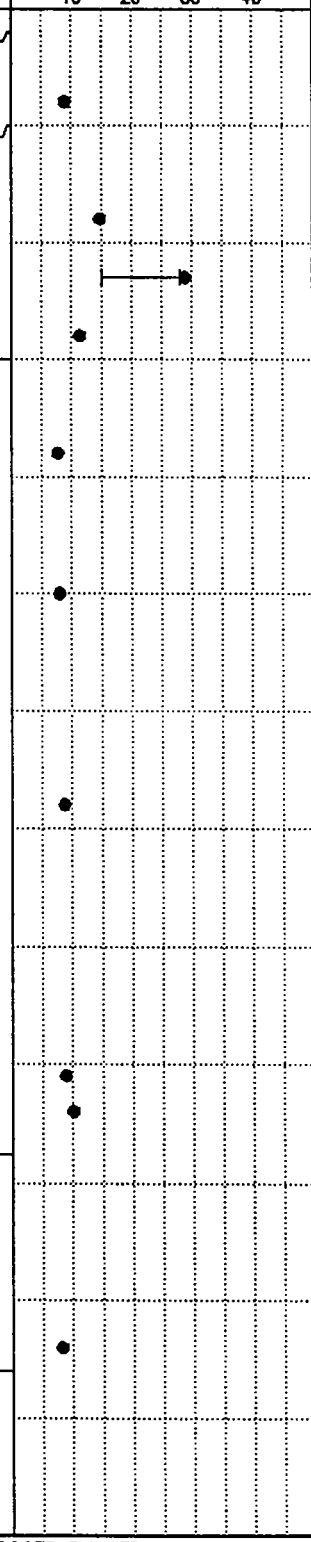
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: AFR	COMPLETION DEPTH: 2.9 m
	REVIEWED BY: CRH	COMPLETE: 97/10/01
	Fig. No:	Page 1 of 1

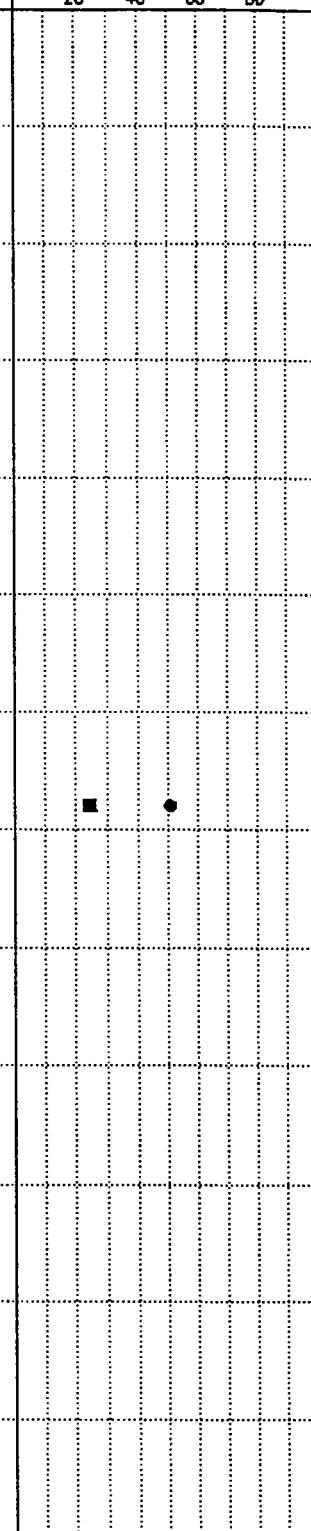
98/02/23 03:26PM (YUKON-T4)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	TEST PIT NO: 97-TP02
GEOTECHNICAL EVALUATION - MAIN DUMP	EXCAVATOR: CAT 235	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2863 m

SAMPLE TYPE ■ GRAB ▨ NO RECOVERY ▥ SHELBY TUBE

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					TOPSOIL, VEGETATION MAT VENEER
	■	5			SAND - some silt, trace of gravel, well graded sand, fine to med. grained gravel, light brown
	■	6			CLAY - silty, sandy, trace of gravel, trace of clay, low plastic, firm to stiff, damp, light brownish grey
1.0	▥		CL	▨	- PP = 1.7 & 3.4 tsf on tube sample
	■	7			
	■	8			SAND - silty, trace of gravel, cobbles and boulders, well graded sand, fine to med, grained gravel, damp, greyish brown
2.0					- occasional pockets of decomposed granodiorite
	■	9			- coarser with depth
					- occasional blocks of till-like material
3.0					
	■	10	SM		- becomes gravelly around 3.3 m
4.0					
	■	11			
	■	12			
	■	13			SAND & SILT (TILL-LIKE) - some gravel
5.0					
	■	14			
6.0					END OF TESTPIT @ 5.8 m
					NOTE: Dry on completion
					- Mine Coordinates N 11540.00 E 8760.00





DEPTH(ft): 0.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0, 14.0, 16.0, 18.0, 20.0

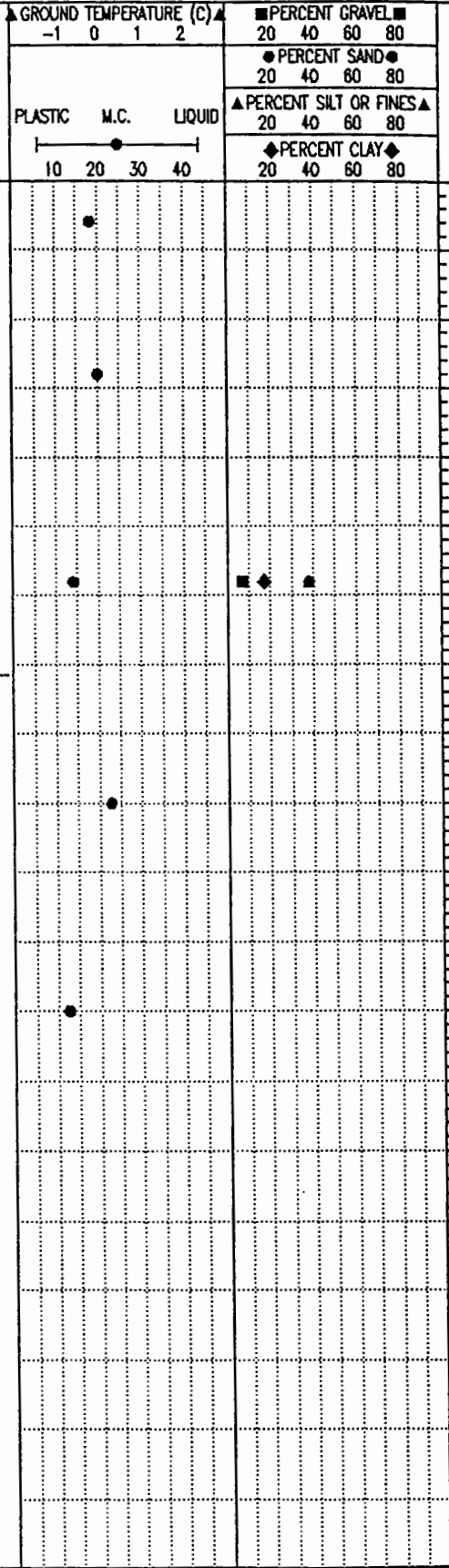
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: AFR	COMPLETION DEPTH: 5.8 m
	REVIEWED BY: CRH	COMPLETE: 97/10/01
	Fig. No:	Page 1 of 1

98/02/23 0:2:3PM (YUKON-TB)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G09
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2776.3 m

SAMPLE TYPE: ■ GRAB SAMPLE ⊘ NO RECOVERY ⊠ STANDARD PEN. ▭ 75 mm SPOON ▯ CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0	■	57			MOSS AND ROOT MAT	UNFROZEN
					SILT & SAND - some clay, trace of gravel, fine grained sand, low to non-plastic, soft, very moist, olive brown	
1.0	■	58			- hole sloughing	
					- becomes some gravel to gravelly fine to med. grained sub-rounded below 1.8 m - damp to moist below 1.8 m - silt content decreases below 1.8 m - sand content increases below 1.8 m	
2.0						
3.0	■	59				
					- grinding and hard drilling below 3.4 to 3.7 m - coarse grained sand, some silt, some gravel fine to med. grained 3.4 m to 3.7 m	PERMAFROST Nf
4.0						
	■	60			- some sand below 3.7 m - silt content increases, trace of clay below 3.7 m - no gravel below 3.7 m	-0.8 degree C.
5.0					- grinding below 5.2 m	
					SAND - gravelly, some silt, coarse grained sand, fine to med. grained sub-rounded gravel, compact, moist, brownish grey	
6.0	■	61				0.0 degree C.
					END OF BOREHOLE @ 6.1 m (REFUSAL) - sloughing from top of hole NOTE: Mine Coordinates N 10280.00 E 8310.00	
7.0						
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: CRH	COMPLETE: 97/09/11
	Fig. No:	Page 1 of 1

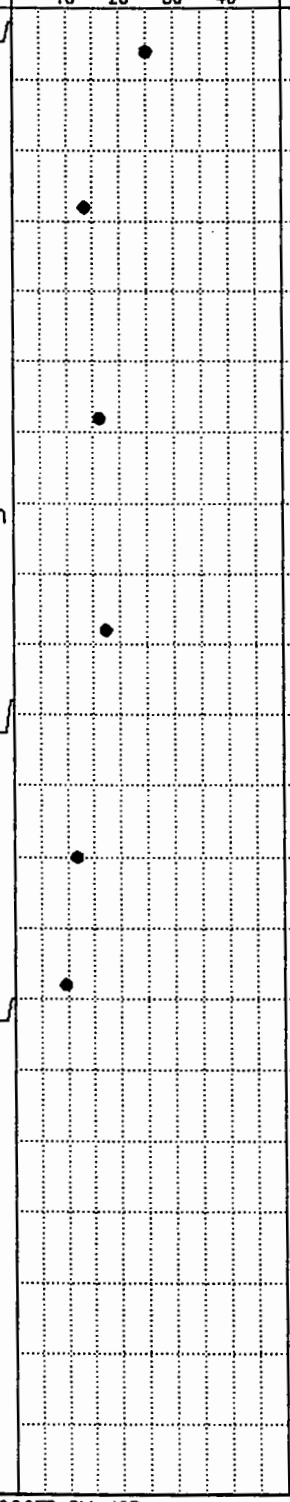
98/02/17 11:47AM (YUK-PT10)

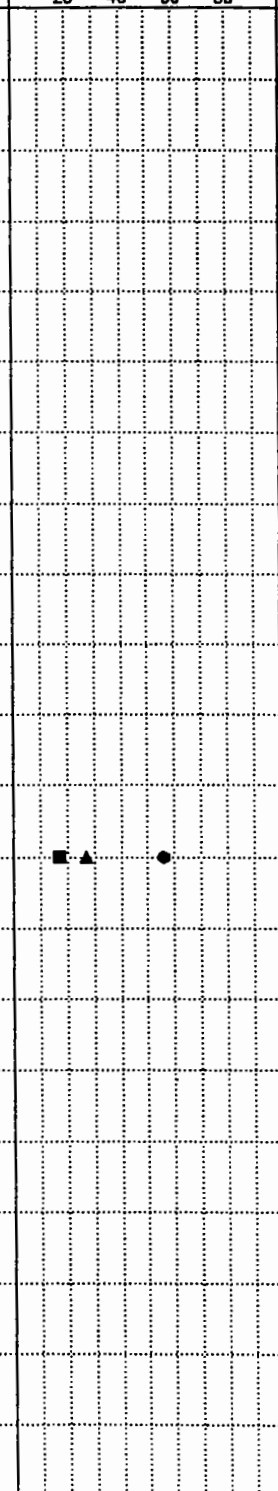
THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G10
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2768.8 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0						MOSS AND ROOT MAT
		62				SILT - sandy, well graded sand, low plastic, soft, very moist, olive brown
1.0						- trace of fine grained gravel below 0.5 m
		63				- color changes to light greyish brown around 0.9 m
2.0						- becomes gravelly, fine to med. grained below 2.2 m
3.0		64				- 0.0 degree C. at 3.0 m - some visable ice inclusion Vr > 10% various depths from 3.2 m - 4.5 m
4.0						
		65				
5.0						- dense hard drilling below 4.9 m
						SAND - silty, some gravel, coarse grained sand, fine to med. grained sub-angular gravel, moist, dense, light greyish brown
6.0		66		SM		
		67				- grinding and hard drilling below 6.7 m - broke off fish tail bit, lost in hole
7.0						END OF BOREHOLE @ 7.0 m (REFUSAL) - major slough throughout NOTE: Mine Coordinates N 10169.00 E 8357.00
8.0						
9.0						
10.0						





INSTRUMENTATION DATA

DEPTH(ft): 0.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0, 14.0, 16.0, 18.0, 20.0, 22.0, 24.0, 26.0, 28.0, 30.0, 32.0, 34.0

EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 7 m
	REVIEWED BY: CRH	COMPLETE: 97/09/11
	Fig. No:	Page 1 of 1

98/01/14 09:54AM (YUKON-10)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G11
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2798.7 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOT MAT	UNFROZEN
		68			SILT & SAND - some clay, fine to med. grained sand, very moist, greyish brown	
1.0					- trace of fine grained sub-rounded gravel below 0.4 m	
		69			- sand content increases slightly below 0.4m	
2.0						
		70				
3.0						PERMAFROST -0.6 degree C. Nf
4.0					- moisture content decreases around 3.7 m - coarse grained sand below 3.7 m	
		71				
5.0					- silt content decreases to some silt below 4.8 m	
6.0		72			- becomes silty, clayey below 5.9 m	
					END OF BOREHOLE @ 6.1 m (REFUSAL) - major slough throughout - no water table encountered NOTE: Mine Coordinates N 10306.00 E 7968.00	
7.0						
8.0						
9.0						
10.0						

GROUND TEMPERATURE (C): -1 0 1 2

PLASTIC M.C. LIQUID: 10 20 30 40

PERCENT GRAVEL: 20 40 60 80

PERCENT SAND: 20 40 60 80

PERCENT SILT OR FINES: 20 40 60 80

PERCENT CLAY: 20 40 60 80

DEPTH(m): 0.0 2.0 4.0 6.0 8.0 10.0

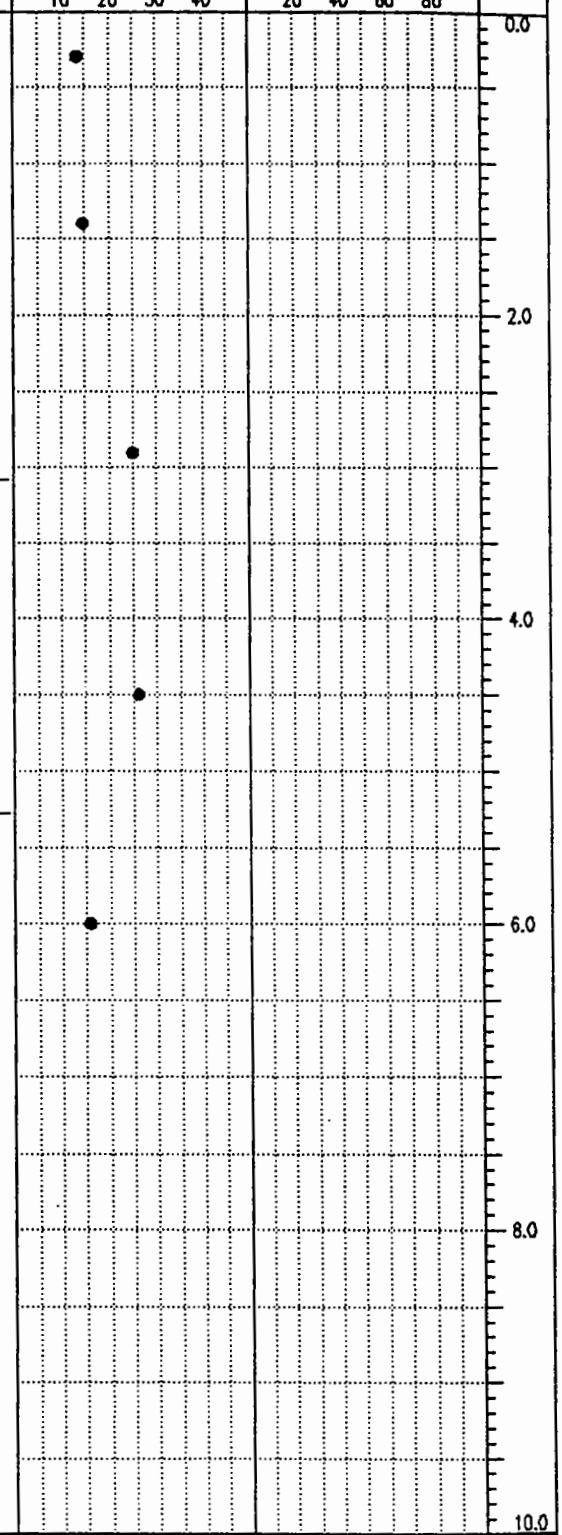
EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: CRH	COMPLETE: 97/09/12
	Fig. No:	Page 1 of 1

98/02/17 11:48AM (YUK-PT1D)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G12
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2793.9 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	GROUND ICE DESCRIPTION
0.0					MOSS AND ROOTMAT	UNFROZEN
		73			SILT & SAND - fine to med. grained sand, low plastic, soft, moist, greyish brown	
					- water at 0.5 m	
1.0					- trace of fine grained gravel below 0.5 m	
		74				
					SAND - some silt, med. grained uniform sand, soft, wet, light greyish brown	
2.0						
		75				
3.0						PERMAFROST
						-0.8 degree C.
						Nf
					- drill slightly firmer below 3.7 m	Vx, <5%
4.0						
		76				-0.9 degree C.
5.0					- trace of some gravel fine to med. grained below 4.9 m	
					- unfrozen below 5.2 m	UNFROZEN
6.0		77				
					END OF BOREHOLE @ 6.1 m	
					- major slough throughout	
					- water at 0.5 m	
7.0					NOTE: Mine Coordinate N 10170 E 7858	
8.0						
9.0						
10.0						



EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: CRH	COMPLETE: 97/09/12
	Fig. No:	Page 1 of 1

98/02/17 11:30AM (YUK-PT10)

THE MINTO PROJECT	CLIENT: MINTO EXPLORATIONS LTD	BOREHOLE NO: 97-G18
GEOTECHNICAL EVAL. - WASTE DUMP AREA	DRILL: CME-75 c/w SOLID SHAFT AUGERS	PROJECT NO: 0201-97-11509
MINTO CREEK, YUKON	UTM ZONE: - N - E -	ELEVATION: 2841.5 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0						MOSS AND ROOT MAT
		104				SILT & SAND - trace of gravel, well graded sand, fine to med. grained angular and sub-rounded gravels, moist, loose, mottled brown and grey
1.0		105				SAND - silty, some gravel, well graded sand, fine to med. grained angular and sub-rounded gravel, loose, moist, light greyish brown
						- sand becomes coarse grained below 2.1 m
2.0		106		SP-SM		- some silt below 2.1 m - some fine grained gravel below 2.1 m - trace of silt below 2.1 m - very wet below 2.1 m, possible water table
3.0						
4.0		107				- sand becomes fine to med. grained below 4.3 m - trace of fine grained gravel below 4.3 m
5.0						
		108				
6.0						
7.0		109		SM		- silty, some clay below 7.1 m
						END OF BOREHOLE @ 7.3 m - major sloughing NOTE: Mine Coordinates N 10730.00 E 7575.00
8.0						
9.0						
10.0						

CONE PENETRATION 20 40 60 80

PLASTIC M.C. LIQUID 10 20 30 40

PERCENT GRAVEL 20 40 60 80

PERCENT SAND 20 40 60 80

PERCENT SILT OR FINES 20 40 60 80

PERCENT CLAY 20 40 60 80

INSTRUMENTATION DATA

DEPTH(ft) 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0

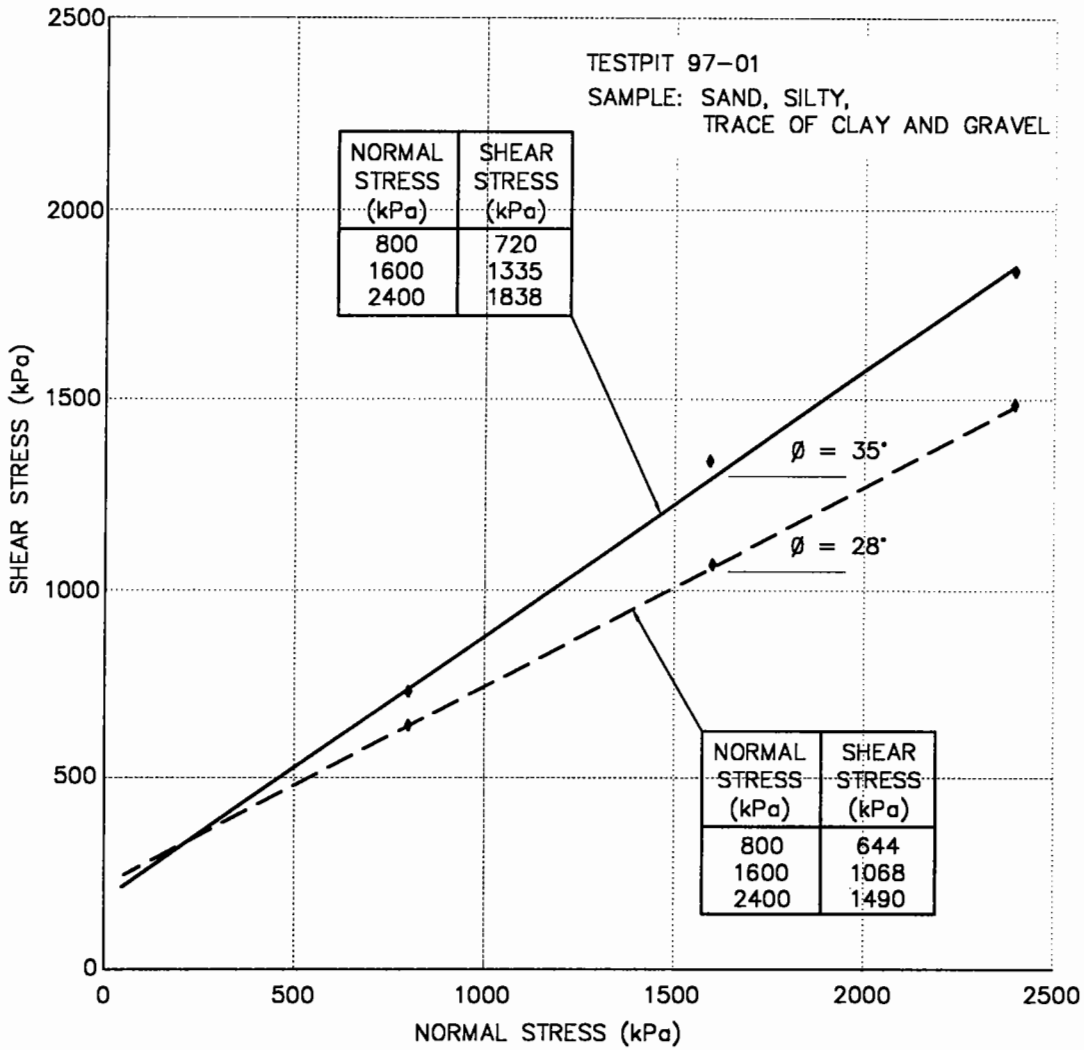
EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: *.*
REVIEWED BY: CRH	COMPLETE: 97/09/13
Fig. No:	Page 1 of 1

98/01/14 10:15AM (YUKON-10)

APPENDIX C
LABORATORY TEST RESULTS

DIRECT SHEAR TEST RESULTS
SILTY SAND COLLUVIUM



——— Peak Shear Stress Mohr Coulomb Failure Envelope

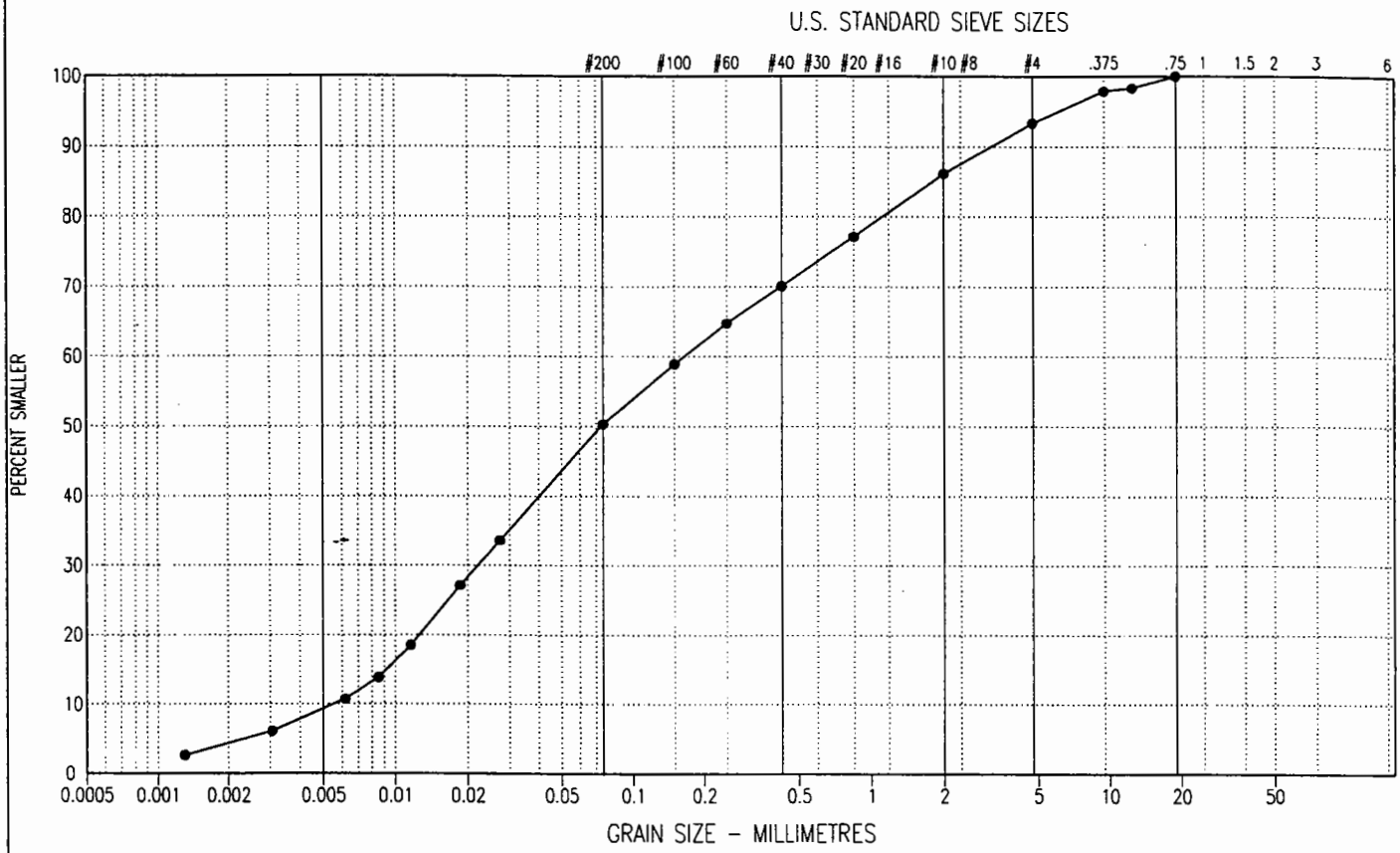
– – – Residual Shear Stress Mohr Coulomb Failure Envelope

Figure C-1

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	TP1(1A)	1.00 – 2.00	8.9	41.4	43.0	6.7	29.7	0.5	

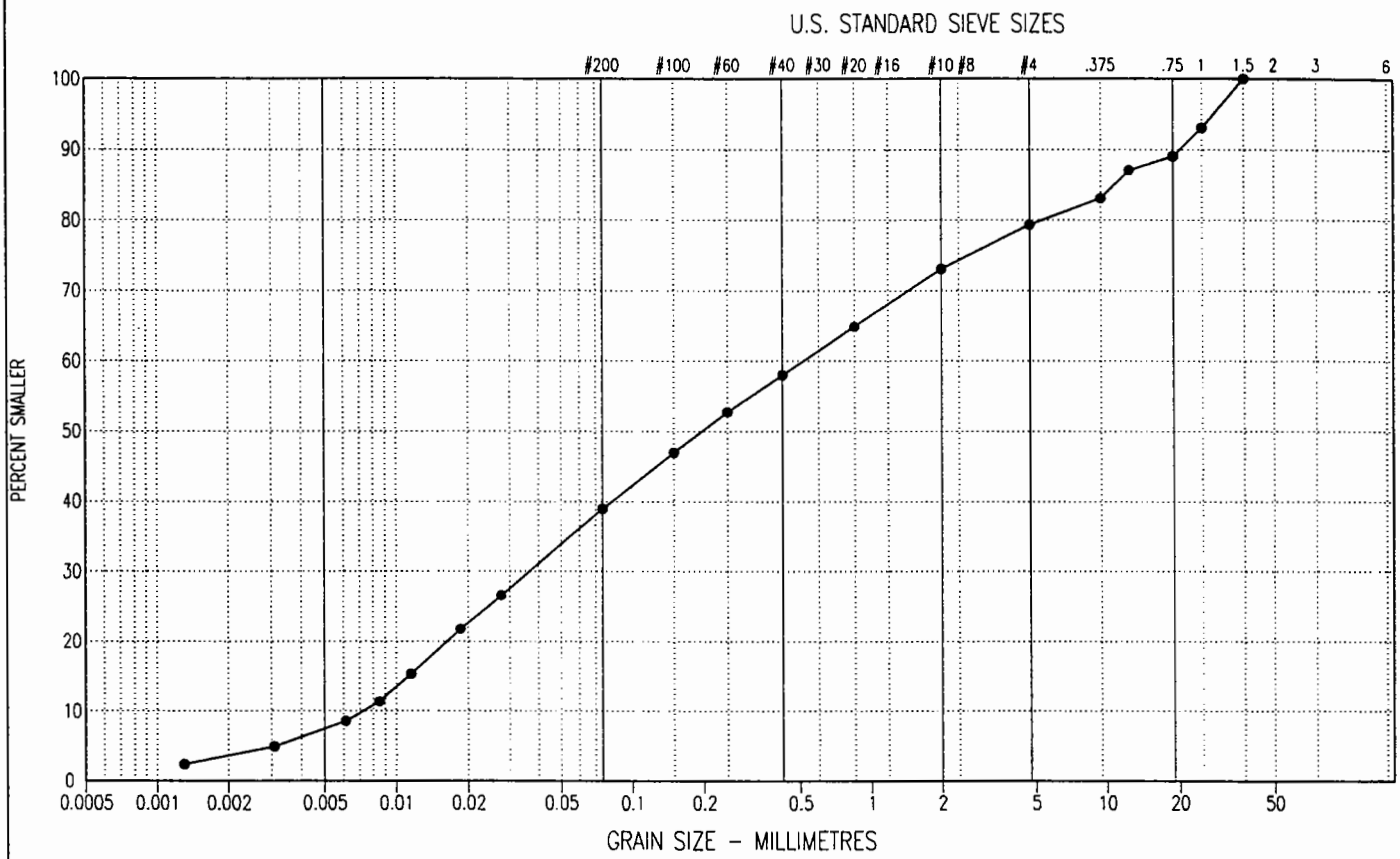
Project: 0201-11509 Date Tested: 97/10/17 BY: SK

Tested in accordance with ASTM D422 unless otherwise noted.

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	TP1(1B)	1.00 – 2.00	7.2	31.7	40.4	20.7	74.4	0.4	SM

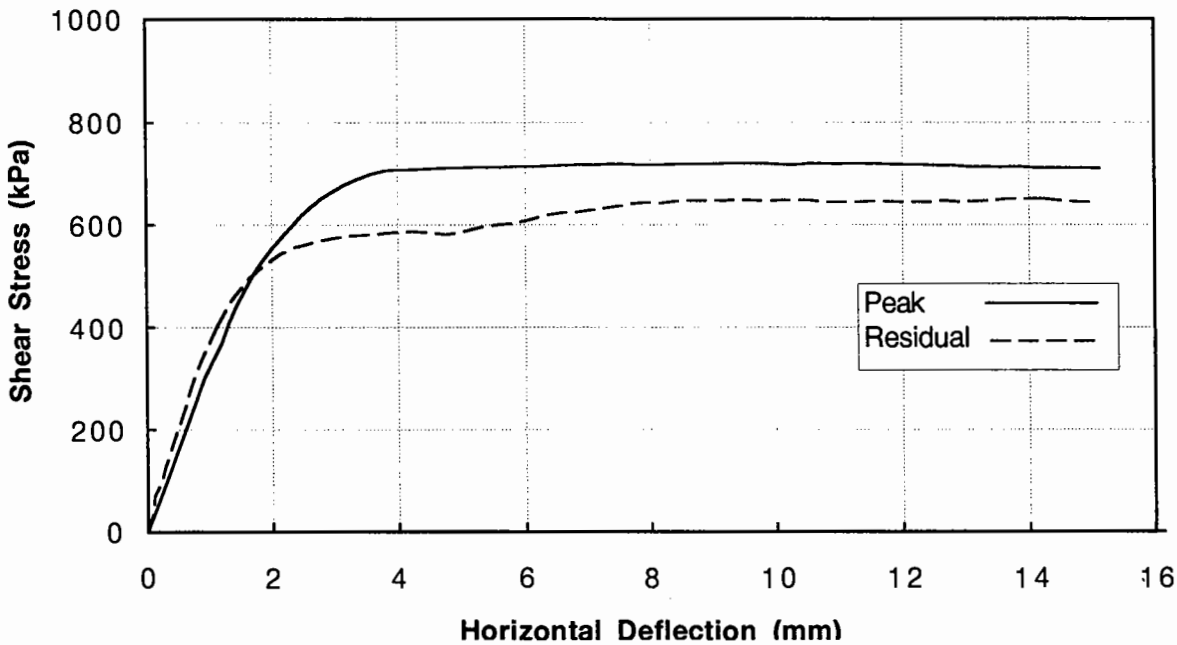
Project: 0201-11509 Date Tested: 97/10/17 BY: SK

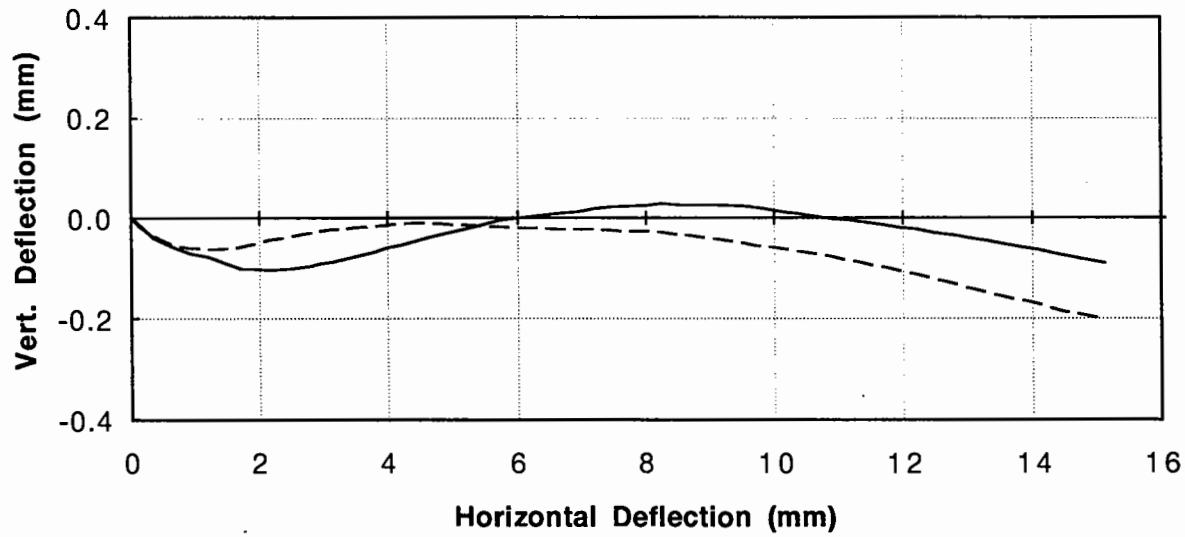
Tested in accordance with ASTM D422 unless otherwise noted.

EBA Engineering Consultants Ltd.

Direct Shear Test

Peak Stress= 720 kPa
Resid. Stress= 644 kPa





Test Hole Number: TP1 (1B)
Depth (ft): 1.0-2.0
Normal Stress(kPa): 800
Displ. Rate(mm/min.): 0.024
Test No.: DS-1

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 0201-11509
Date Tested: 97-10-16

Test Hole No.: TP1 (1B)
Depth (ft): 1.0-2.0
Test Number: DS-1

Initial Sample Conditions

Moisture Content (%): 10.3
Wet Density (Mg/m3): 2.314
Dry Density (Mg/m3): 2.098

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	6.93	0.013	716.8
0.36	-0.040	113.8	7.20	0.018	716.6
0.64	-0.057	209.3	7.46	0.022	718.1
0.93	-0.071	303.3	7.73	0.023	716.3
1.19	-0.078	367.4	7.99	0.024	717.0
1.31	-0.082	409.0	8.24	0.028	716.7
1.45	-0.090	446.7	8.51	0.026	718.5
1.72	-0.101	504.5	8.76	0.026	718.2
1.87	-0.102	532.2	9.02	0.027	718.6
2.03	-0.103	555.9	9.27	0.024	719.5
2.18	-0.104	578.4	9.54	0.024	719.5
2.33	-0.103	598.3	9.80	0.020	719.8
2.49	-0.102	618.1	10.14	0.013	717.4
2.65	-0.099	634.8	10.32	0.009	716.7
2.80	-0.096	650.1	10.58	0.004	718.7
2.96	-0.092	662.1	10.92	-0.002	717.8
3.16	-0.088	676.5	11.18	-0.005	719.1
3.37	-0.080	688.7	11.68	-0.014	718.6
3.58	-0.075	697.4	11.98	-0.020	717.2
3.79	-0.068	703.7	12.21	-0.022	716.7
3.99	-0.060	706.7	12.50	-0.030	715.9
4.20	-0.054	707.5	12.77	-0.034	715.4
4.41	-0.047	708.4	13.03	-0.040	713.3
4.62	-0.039	709.3	13.30	-0.045	713.7
4.83	-0.033	710.1	13.56	-0.051	712.4
5.04	-0.026	710.3	13.82	-0.058	713.6
5.26	-0.020	711.5	14.09	-0.063	710.9
5.46	-0.014	712.4	14.34	-0.071	710.3
5.68	-0.006	711.6	14.59	-0.077	710.5
5.89	-0.002	712.5	14.86	-0.084	709.9
6.13	0.002	713.4	15.12	-0.090	708.8
6.40	0.005	714.3			
6.67	0.009	715.7			

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RESIDUAL STRENGTH TEST

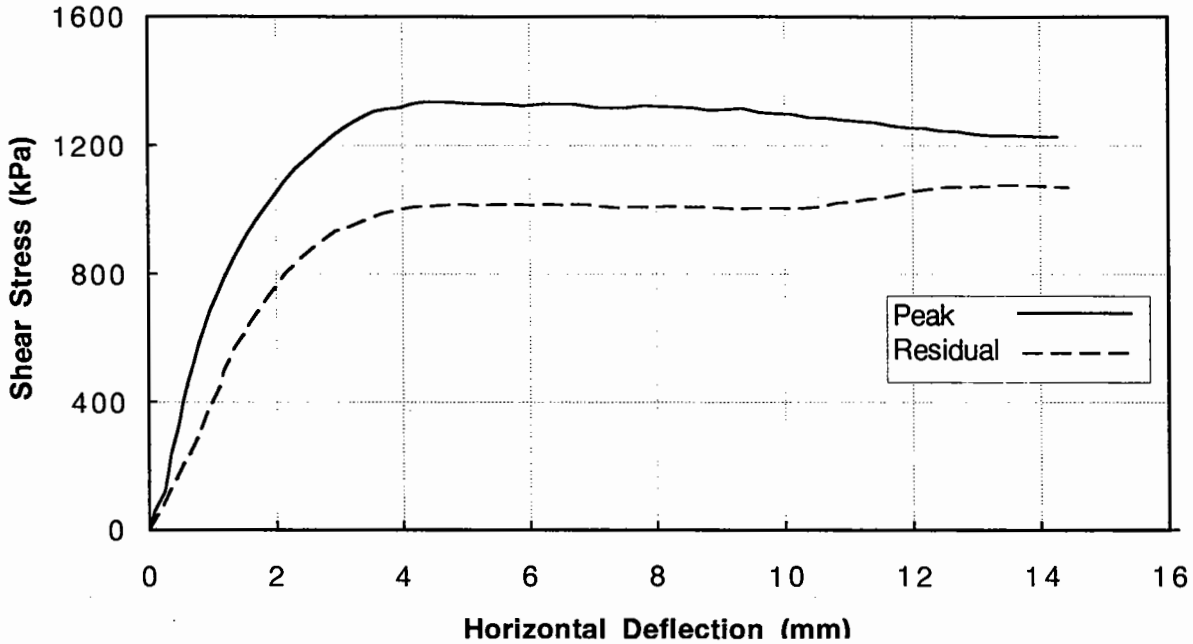
Test Hole No.: TP1 (1B) Test Number: DS-1
Depth (ft): 1.0-2.0

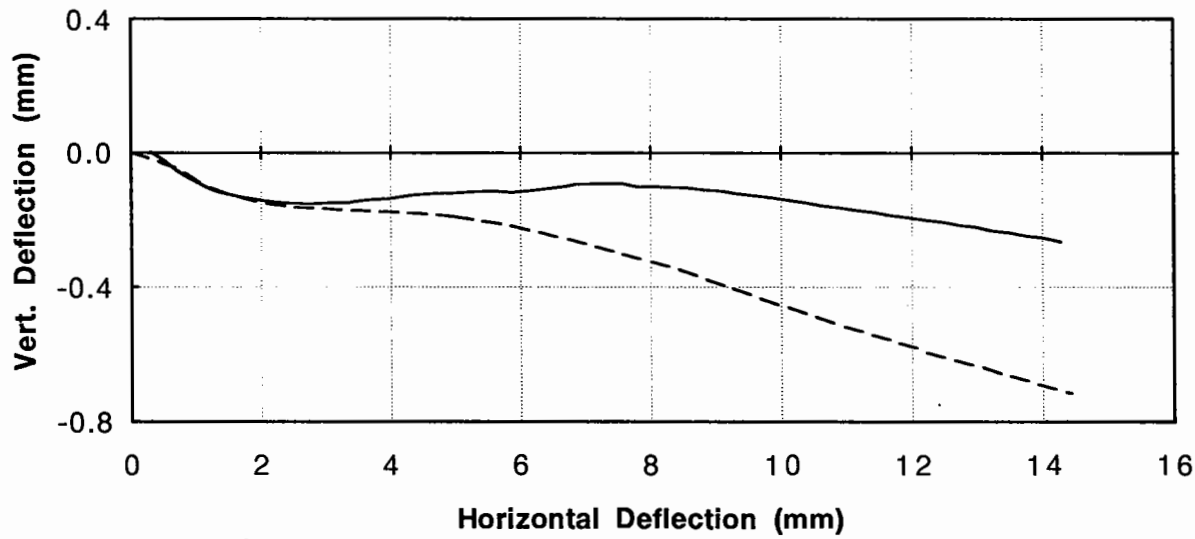
Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	9.46	-0.048	648.4
0.10	-0.012	36.5	9.73	-0.055	647.2
0.12	-0.016	70.2	9.99	-0.058	646.9
0.23	-0.025	96.2	10.25	-0.064	647.5
0.29	-0.032	126.1	10.52	-0.068	648.3
0.36	-0.037	152.3	10.79	-0.074	644.4
0.46	-0.043	188.4	11.06	-0.081	643.9
0.60	-0.050	242.1	11.32	-0.088	643.7
0.73	-0.055	289.4	11.59	-0.095	645.2
0.87	-0.059	334.1	11.86	-0.103	644.3
1.12	-0.062	401.5	12.12	-0.111	643.7
1.37	-0.062	454.9	12.38	-0.119	644.2
1.63	-0.059	492.9	12.65	-0.126	646.4
1.88	-0.053	519.8	12.92	-0.137	644.7
2.14	-0.045	542.4	13.18	-0.145	645.8
2.41	-0.038	557.3	13.44	-0.152	647.3
2.67	-0.033	565.6	13.70	-0.162	651.1
2.92	-0.026	571.9	13.97	-0.168	650.9
3.18	-0.022	576.2	14.23	-0.177	650.0
3.44	-0.020	578.9	14.49	-0.186	647.2
3.70	-0.017	581.9	14.76	-0.192	644.7
3.96	-0.015	583.8	15.03	-0.200	643.6
4.22	-0.011	586.8			
4.49	-0.010	584.1			
4.76	-0.011	580.9			
5.02	-0.013	585.9			
5.28	-0.015	594.4			
5.55	-0.017	599.5			
5.82	-0.018	603.2			
6.07	-0.020	608.9			
6.34	-0.020	619.0			
6.61	-0.023	622.3			
6.87	-0.022	624.1			
7.13	-0.022	628.6			
7.39	-0.024	634.3			
7.66	-0.027	638.8			
7.91	-0.027	642.6			
8.17	-0.027	641.3			
8.42	-0.031	645.9			
8.69	-0.035	647.0			
8.94	-0.039	646.1			
9.19	-0.045	646.5			

EBA Engineering Consultants Ltd.

Direct Shear Test

Peak Stress= 1335 kPa
Resid. Stress= 1068 kPa





Test Hole Number:	TP1 (1A)
Depth (ft):	1.0-2.0
Normal Stress(kPa):	1600
Displ. Rate(mm/min.):	0.024
Test No.:	DS-2

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 0201-11509
Date Tested: 97-10-15

Test Hole No.: TP1 (1A)
Depth (ft): 1.0-2.0
Test Number: DS-2

Initial Sample Conditions

Moisture Content (%): 12.2
Wet Density (Mg/m3): 2.288
Dry Density (Mg/m3): 2.039

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	6.67	-0.102	1328.1
0.08	-0.001	54.8	6.87	-0.095	1323.5
0.24	0.000	118.8	7.08	-0.095	1316.8
0.31	0.001	183.3	7.28	-0.092	1317.1
0.35	-0.002	233.7	7.54	-0.092	1317.3
0.46	-0.015	317.5	7.80	-0.102	1323.9
0.54	-0.027	397.7	8.05	-0.102	1321.8
0.62	-0.040	465.0	8.30	-0.104	1318.8
0.71	-0.053	527.1	8.57	-0.106	1316.2
0.80	-0.065	584.7	8.83	-0.112	1309.6
0.98	-0.085	688.5	9.09	-0.115	1312.1
1.17	-0.103	778.4	9.34	-0.123	1314.3
1.37	-0.118	856.4	9.60	-0.129	1303.0
1.56	-0.127	923.5	9.85	-0.135	1298.8
1.75	-0.133	983.2	10.12	-0.141	1296.6
2.12	-0.147	1084.8	10.38	-0.149	1287.2
2.32	-0.149	1128.8	10.64	-0.159	1283.9
2.52	-0.151	1164.3	10.90	-0.164	1279.9
2.72	-0.153	1201.7	11.15	-0.173	1274.4
2.93	-0.150	1233.7	11.42	-0.178	1271.4
3.13	-0.149	1260.3	11.67	-0.188	1261.5
3.34	-0.149	1284.6	11.92	-0.193	1254.2
3.54	-0.144	1304.9	12.19	-0.202	1252.3
3.75	-0.140	1313.2	12.45	-0.208	1244.8
3.95	-0.138	1317.4	12.71	-0.217	1242.4
4.15	-0.132	1328.6	12.97	-0.223	1234.0
4.36	-0.128	1335.0	13.23	-0.234	1231.0
4.65	-0.123	1335.4	13.49	-0.240	1231.0
4.96	-0.121	1331.2	13.76	-0.249	1229.9
5.27	-0.116	1330.1	14.02	-0.255	1226.3
5.57	-0.114	1328.1	14.28	-0.266	1226.6
5.88	-0.118	1323.4			
6.26	-0.111	1328.1			

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RESIDUAL STRENGTH TEST

Test Hole No.: TP1 (1A)
Depth (ft): 1.0-2.0

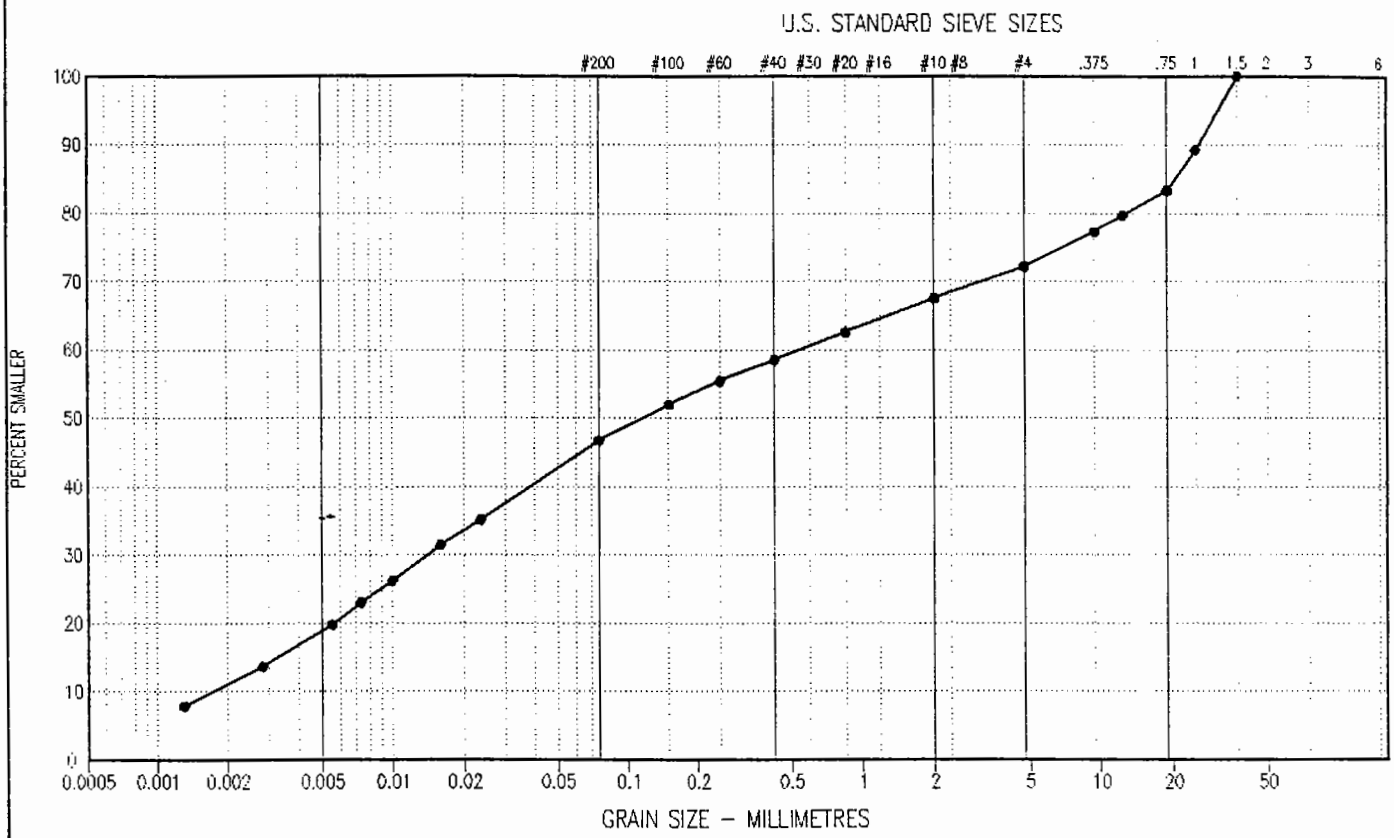
Test Number: DS-2

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	9.78	-0.442	1004.8
0.24	-0.014	81.9	10.04	-0.459	1004.0
0.43	-0.026	158.1	10.30	-0.472	1004.6
0.53	-0.035	202.4	10.55	-0.492	1009.2
0.75	-0.048	271.8	10.81	-0.509	1021.2
0.85	-0.062	329.6	11.06	-0.524	1023.9
0.96	-0.076	385.9	11.31	-0.540	1032.0
1.11	-0.098	444.8	11.57	-0.555	1039.1
1.18	-0.102	496.3	11.83	-0.570	1049.7
1.29	-0.110	541.7	12.09	-0.586	1058.6
1.42	-0.119	586.0	12.35	-0.602	1067.4
1.54	-0.127	630.1	12.61	-0.617	1069.9
1.66	-0.133	667.4	12.88	-0.631	1071.2
1.92	-0.146	740.4	13.13	-0.645	1073.0
2.17	-0.156	804.9	13.39	-0.659	1077.1
2.42	-0.161	855.3	13.65	-0.675	1075.9
2.68	-0.164	896.0	13.92	-0.690	1075.4
2.93	-0.167	932.3	14.17	-0.704	1070.9
3.19	-0.171	949.5	14.43	-0.718	1067.9
3.44	-0.173	971.4			
3.69	-0.174	988.4			
3.95	-0.177	999.9			
4.19	-0.179	1006.7			
4.45	-0.183	1011.4			
4.71	-0.187	1014.5			
4.97	-0.192	1017.3			
5.23	-0.200	1013.4			
5.49	-0.207	1016.8			
5.75	-0.215	1015.9			
6.00	-0.226	1014.5			
6.26	-0.238	1017.3			
6.53	-0.249	1015.1			
6.78	-0.261	1015.9			
7.05	-0.274	1012.9			
7.31	-0.289	1006.7			
7.62	-0.306	1008.4			
7.88	-0.319	1009.0			
8.23	-0.337	1010.4			
8.40	-0.347	1008.5			
8.66	-0.363	1009.2			
9.26	-0.406	1002.8			
9.52	-0.424	1004.3			

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	TP2(2A)	3.00 – 4.00	18.6	28.0	25.5	27.9	316.0	0.2	GM

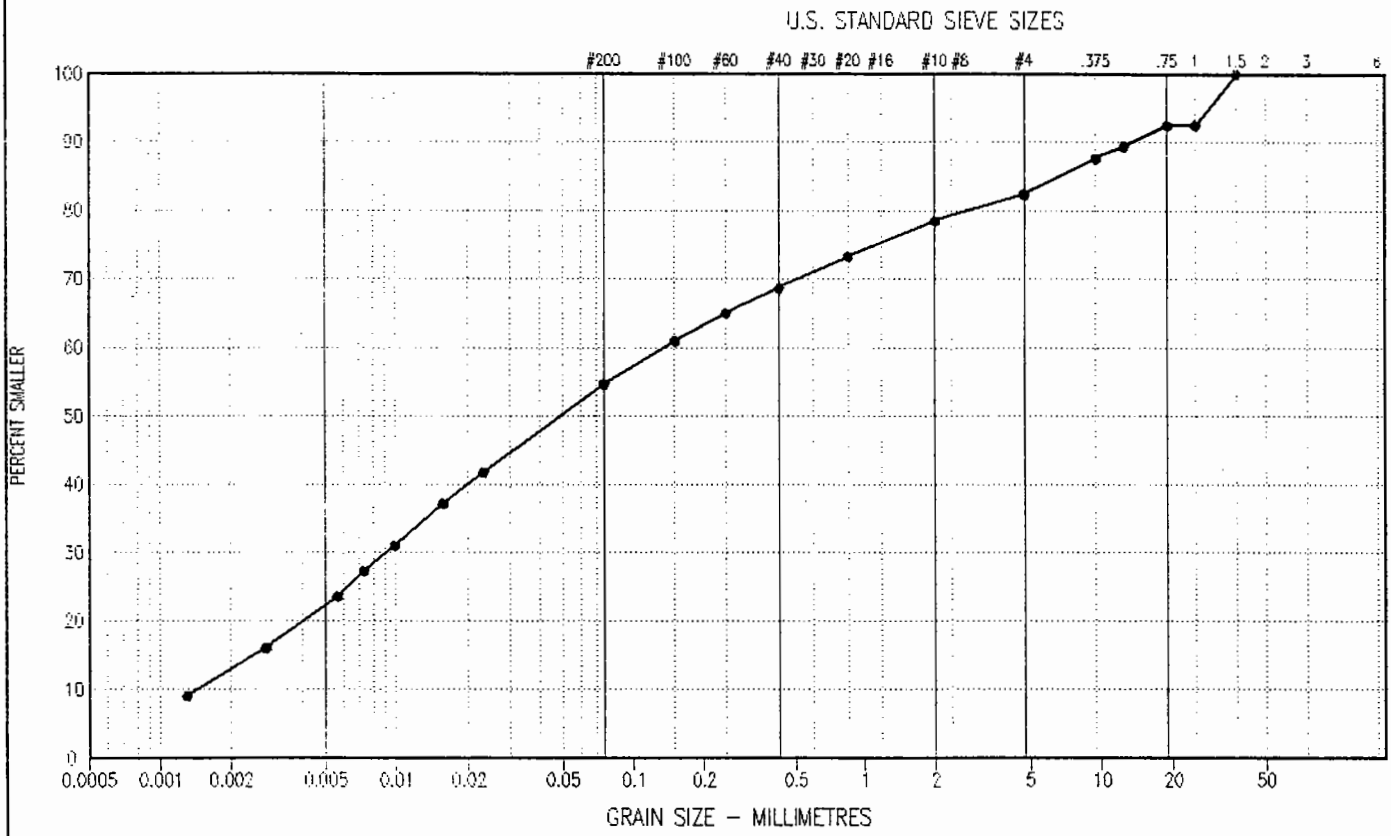
Project: 0201-11509 Date Tested: 97/10/23 BY: SK

Tested in accordance with ASTM D422 unless otherwise noted.

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION				Cu	Cc	U.S.C
			CLAY %	SILT %	SAND %	GRAVEL %			
●——●	TP2(2B)	3.00 – 4.00	21.7	32.9	27.7	17.7	92.3	0.4	

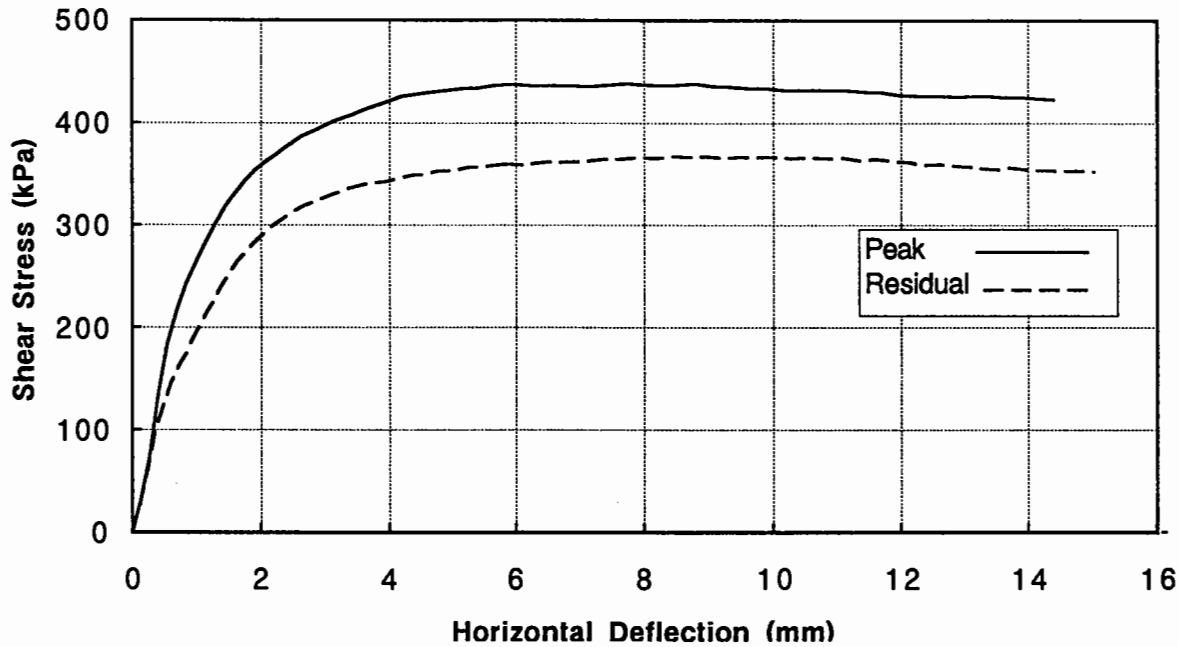
Project: 0201-11509 Date Tested: 97/10/23 BY: SK

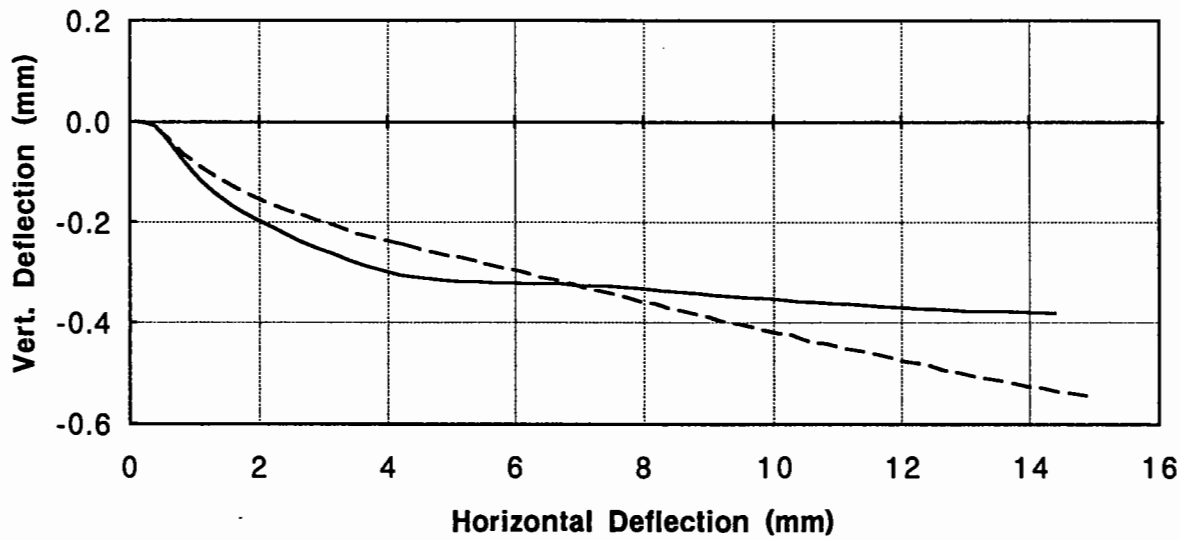
Tested in accordance with ASTM D422 unless otherwise noted.

EBA Engineering Consultants Ltd.

Direct Shear Test

Peak Stress= 438 kPa
Resid. Stress= 352 kPa





Test Hole Number:	TP2 (2B)
Depth (ft)	3.0-4.0
Normal Stress(kPa):	800
Displ. Rate(mm/min.):	0.024
Test No.:	DS-4

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 0201-11509
Date Tested: 97-10-22

Test Hole No.: TP2 (2B)
Depth (ft): 3.0-4.0
Test Number: DS-4

Initial Sample Conditions

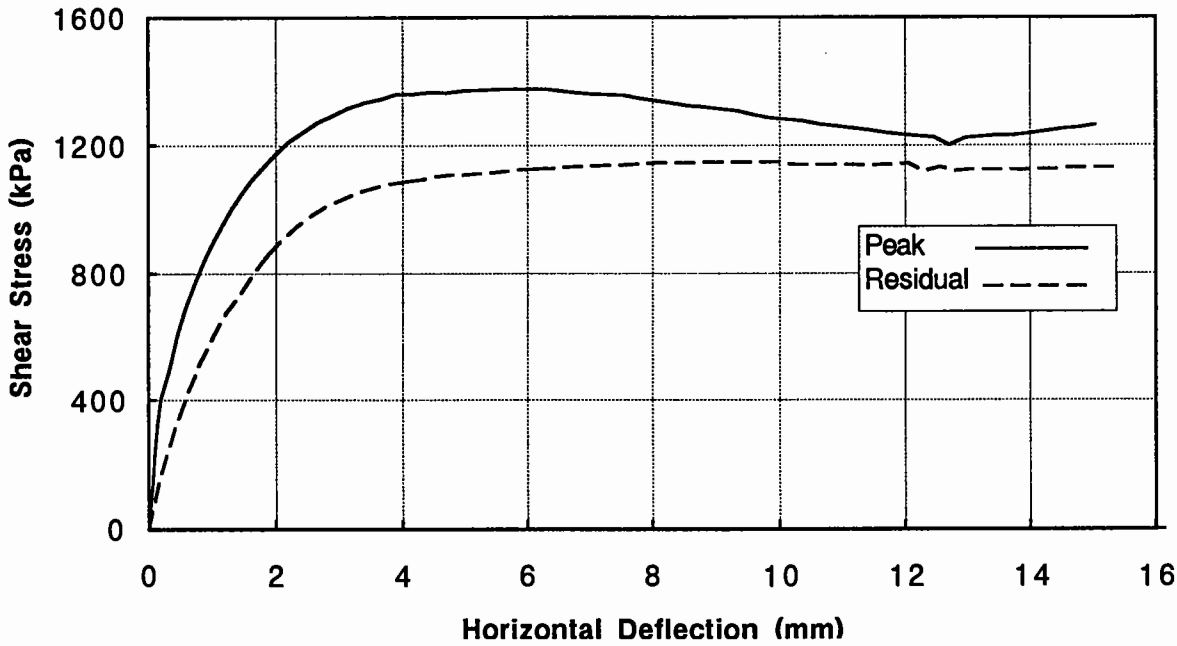
Moisture Content (%): 20.0
Wet Density (Mg/m3): 2.093
Dry Density (Mg/m3): 1.745

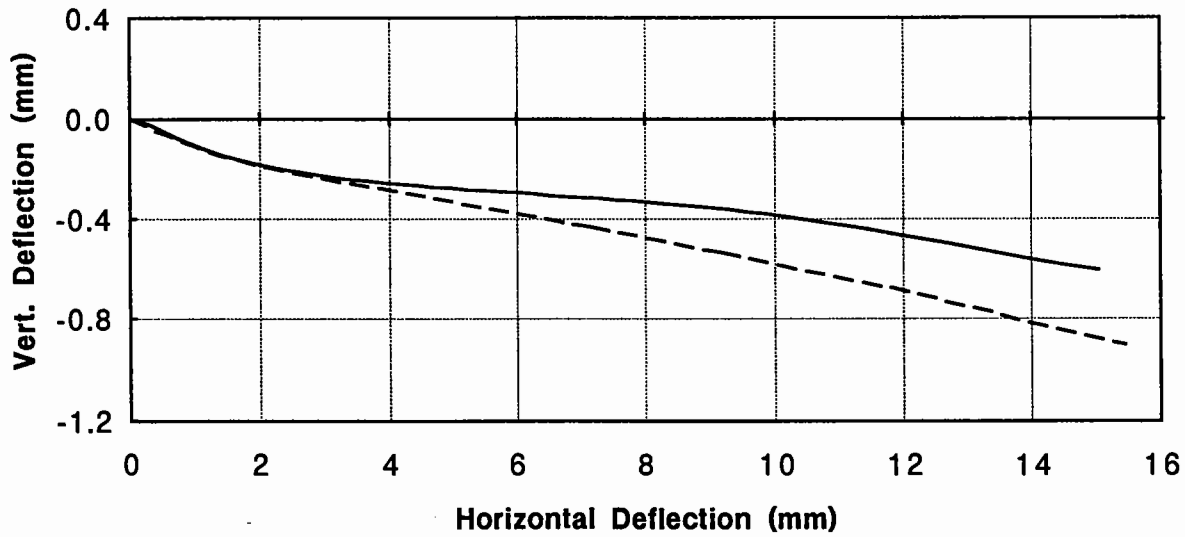
Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	6.97	-0.327	435.3
0.12	-0.001	29.1	7.23	-0.327	435.5
0.26	-0.003	70.8	7.48	-0.328	436.3
0.39	-0.010	133.6	7.74	-0.331	437.7
0.54	-0.029	182.5	8.01	-0.334	436.3
0.68	-0.053	216.1	8.27	-0.337	436.2
0.83	-0.078	243.3	8.53	-0.339	436.7
0.99	-0.102	264.8	8.79	-0.342	437.6
1.14	-0.123	283.9	9.06	-0.346	435.6
1.29	-0.140	301.7	9.33	-0.348	434.5
1.44	-0.155	318.0	9.58	-0.351	433.2
1.59	-0.170	330.4	9.85	-0.353	433.6
1.75	-0.181	342.9	10.12	-0.355	431.8
1.89	-0.190	352.5	10.39	-0.359	431.6
2.05	-0.201	361.0	10.65	-0.360	431.7
2.21	-0.212	368.0	10.92	-0.363	431.5
2.36	-0.221	375.4	11.19	-0.364	431.1
2.62	-0.237	385.7	11.45	-0.366	429.4
2.87	-0.251	393.5	11.72	-0.369	428.9
3.14	-0.264	401.8	11.98	-0.370	426.7
3.40	-0.278	407.3	12.24	-0.373	426.0
3.67	-0.288	414.0	12.51	-0.374	425.7
3.92	-0.298	419.4	12.77	-0.376	425.1
4.19	-0.306	425.5	13.03	-0.377	425.5
4.60	-0.313	429.2	13.31	-0.377	425.7
4.87	-0.317	431.1	13.57	-0.378	424.6
5.14	-0.319	432.7	13.84	-0.380	424.4
5.40	-0.320	433.6	14.12	-0.380	423.1
5.66	-0.321	435.6	14.39	-0.382	422.1
5.93	-0.322	437.2			
6.19	-0.323	436.1			
6.45	-0.324	435.9			
6.70	-0.324	435.8			

EBA Engineering Consultants Ltd.

Direct Shear Test

Peak Stress= 1375 kPa
Resid. Stress= 1129 kPa





Test Hole Number:	TP2 (2B)
Depth (ft):	3.0-4.0
Normal Stress(kPa):	2400
Displ. Rate(mm/min.):	0.024
Test No.:	DS-6

EBA Engineering Consultants Ltd.

Direct Shear Test

Project No.: 0201-11509
Date Tested: 97-10-15

Test Hole No.: TP2 (2B)
Depth (ft): 3.0-4.0
Test Number: DS-6

Initial Sample Conditions

Moisture Content (%): 15.9
Wet Density (Mg/m3): 2.199
Dry Density (Mg/m3): 1.897

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	5.73	-0.291	1374.6
0.04	0.000	65.7	6.00	-0.295	1374.3
0.07	-0.001	151.1	6.26	-0.299	1374.3
0.11	-0.004	242.7	6.52	-0.306	1368.4
0.15	-0.008	325.6	6.78	-0.312	1362.5
0.20	-0.014	402.9	7.03	-0.316	1359.7
0.33	-0.026	489.7	7.29	-0.318	1356.6
0.46	-0.043	601.5	7.55	-0.326	1354.4
0.60	-0.059	690.8	7.81	-0.327	1345.6
0.74	-0.078	766.7	8.32	-0.339	1331.6
0.88	-0.094	835.5	8.57	-0.345	1323.7
1.02	-0.109	896.7	8.82	-0.350	1318.7
1.17	-0.123	952.1	9.33	-0.363	1307.4
1.31	-0.137	1002.1	9.59	-0.372	1295.4
1.46	-0.149	1045.3	9.84	-0.379	1284.7
1.61	-0.159	1086.1	10.36	-0.399	1274.0
1.76	-0.169	1121.2	10.63	-0.410	1263.9
1.91	-0.179	1155.5	10.89	-0.420	1260.0
2.05	-0.188	1183.5	11.42	-0.439	1246.2
2.20	-0.195	1209.4	11.68	-0.454	1239.7
2.40	-0.204	1237.2	11.95	-0.464	1233.3
2.66	-0.216	1270.4	12.47	-0.487	1225.1
2.90	-0.226	1293.1	12.71	-0.499	1200.1
3.16	-0.235	1317.0	12.97	-0.510	1222.9
3.41	-0.243	1333.0	13.49	-0.537	1230.2
3.66	-0.250	1342.3	13.74	-0.549	1231.9
3.91	-0.257	1358.3	14.00	-0.562	1237.8
4.17	-0.262	1359.4	14.52	-0.585	1251.8
4.43	-0.267	1364.5	14.79	-0.595	1254.9
4.68	-0.274	1363.3	15.05	-0.606	1262.8
4.95	-0.277	1369.8			
5.21	-0.283	1372.1			
5.47	-0.286	1373.5			

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RESIDUAL STRENGTH TEST

Test Hole No.: TP2 (2B) Test Number: DS-6
Depth (ft): 3.0-4.0

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	10.22	-0.595	1140.0
0.23	-0.028	192.2	10.48	-0.610	1141.1
0.42	-0.052	309.3	10.75	-0.624	1141.1
0.61	-0.072	413.0	11.01	-0.637	1140.6
0.81	-0.094	510.7	11.27	-0.648	1138.3
1.01	-0.112	593.3	11.52	-0.663	1139.7
1.22	-0.133	672.0	11.79	-0.676	1140.3
1.44	-0.151	728.2	12.05	-0.691	1144.5
1.65	-0.165	799.5	12.30	-0.707	1121.5
1.88	-0.183	857.7	12.55	-0.722	1132.4
2.10	-0.196	905.7	12.81	-0.743	1120.9
2.34	-0.208	948.1	13.07	-0.756	1125.4
2.57	-0.221	983.0	13.32	-0.772	1125.4
2.81	-0.232	1013.0	13.59	-0.792	1124.3
3.06	-0.244	1033.5	13.85	-0.808	1123.4
3.31	-0.255	1055.4	14.11	-0.824	1126.2
3.56	-0.267	1069.8	14.38	-0.841	1126.0
3.81	-0.278	1081.3	14.65	-0.857	1131.9
4.07	-0.289	1089.7	14.92	-0.874	1131.3
4.33	-0.301	1095.6	15.19	-0.890	1130.5
4.59	-0.313	1103.8	15.47	-0.904	1129.0
4.85	-0.325	1108.8			
5.11	-0.337	1110.5			
5.37	-0.350	1115.6			
5.63	-0.363	1118.1			
5.89	-0.375	1124.3			
6.14	-0.385	1126.8			
6.39	-0.397	1128.8			
6.65	-0.409	1132.4			
6.90	-0.421	1134.7			
7.15	-0.433	1136.4			
7.40	-0.445	1139.2			
7.66	-0.458	1141.7			
7.90	-0.470	1145.1			
8.15	-0.482	1146.2			
8.41	-0.495	1147.6			
8.66	-0.509	1147.6			
8.92	-0.522	1149.3			
9.18	-0.538	1148.4			
9.44	-0.550	1147.9			
9.70	-0.565	1149.8			
9.96	-0.579	1149.6