



April 28, 2017

Government of Yukon
Department of Community Services
Land Development Branch (C13)
Box 2703
Whitehorse, YT Y1A 2C6

ISSUED FOR USE
FILE: W14103567-30.001
Via Email: annika.palm@gov.yk.ca

Attention: Annika Palm, EIT, Project Manager, Infrastructure Development (C13)

Subject: 2017 Lift Station Upgrades
Village of Mayo, YT

1.0 INTRODUCTION

1.1 General

The Government of Yukon, Department of Community Services (YG) retained Tetra Tech Canada Inc. (Tetra Tech) to provide geotechnical input for the above captioned project. This evaluation was authorized by Ms. Annika Palm, EIT, Project Manager – Infrastructure Development Branch in the form of contract No.C00037775, signed on March 29, 2017.

1.2 Project Background

March 16, 2017 email correspondence between Ms. Palm and Mr. Chad Cowan, P.Eng summarized the scope of work being completed for the 2017 Mayo Lift Station Upgrades project.

Tasks include:

- Installing a temporary sewer main bypass between MH 1 on the north side of First Avenue and the sewage lagoon forcemain at a location approximately 25 m west of MH 55 on the south side of First Avenue.
- The bypass tie-in will be along the north face of the dyke; therefore reconstruction along the dyke sideslope must be addressed.
- Cathodic protection will include the installation of a new anode which extends from the steel wet well inside the lift station (a thermite weld on the top of the tank) and extending to a predetermined location west of the lift station structure.
- Removal of the old wet well structure (old timber structure located east of the lift station) and backfill with granular materials.
- Repair and/or replacement of concrete aprons as well as resurfacing of the sections of First Avenue impacted by this project.

2.0 EXISTING INFORMATION

To assess the geotechnical conditions in the vicinity of the lift station site and the adjacent section of First Avenue, a search of in-house projects and testhole databases was completed. Geotechnical information from the projects listed below was used for evaluation purposes and the development of recommendations for this project.

- Project Number 10506-01 (1991) – Sewage Lift Station and Forcemain project. Borehole 10506-01 was advanced to a depth of 10.7 m in close proximity to the lift station site.
- Project Number W14101540 (2011) – Proposed New NNDFN project. Two boreholes were drilled to at least 15 m on the proposed store site located along the north side of First Avenue west of Center Street.

Site plans, borehole logs and associated laboratory testing data utilized for this project is presented in Appendix B of this letter report.

3.0 SITE CONDITIONS

3.1 Surface Features

The lift station is located on the top of the flood control dyke that was constructed along the north side of the Stewart River. The elevation of the top of the dyke is approximately 1.7 m above First Avenue at the subject site.

First Avenue between Centre Street and Congdon Street runs parallel to the dyke. This section is flat and it has been confirmed that it is surfaced with Bitumous Surface Treatment (BST). There are grass covered ditches on both sides and a separate wood boardwalk along the north side.

3.2 Subsurface Conditions

3.2.1 Dyke and Lift Station Site

Information presented in the 1991 Sewage Lift Station and Forcemain project suggests that the dyke was constructed with 2.5 m of sandy gravel fill placed and compacted over a clean sand subgrade. Below the sand, sandy silt and silty sand were noted to a depth of 10.7 m. Groundwater was noted at 5.6 m on May 8, 1991. No bedrock or permafrost was encountered during the 1991 evaluation but it should be understood that there is always potential for permafrost at depth throughout the Village of Mayo town site.

3.2.2 First Avenue between Center Street and Congdon Street

Boreholes advanced along First Avenue in 1991 and on the NNDFN Store site in 2011 suggests that sandy silt and silty sand with fine gravel will be encountered during the construction of the temporary forcemain. Groundwater was noted at 3.3 m during the 1991 project and around 6.0 m on the proposed NNDFN Store site.

4.0 RECOMMENDATIONS

4.1 Temporary Force Main Construction

The temporary forcemain will pump sewage from MH 1 across First Avenue to the forcemain that runs west to the sewage treatment facility. No challenges related to deep utility construction are anticipated. Trench exaction by conventional means (excavator equipped with a clean-up bucket is preferred) is possible. Material excavated along the trench will likely be frost susceptible silt and sand. This material will be acceptable as backfill at depth but as a minimum, the existing granular roadway structure along First Avenue should be re-established.

4.2 General Deep Utility Recommendations

The excavation of deep utility trenches must conform to Yukon *Occupational Health and Safety Regulations* guidelines. The fine-grained soils may be prone to sloughing if allowed to completely dry prior to trench backfill. Therefore, trench side slopes cut to 1.0:1.0 (horizontal:vertical) should ensure safe, compliant, working conditions.

All material excavated from the temporary force main trench can be considered for backfill. However, compatibility will be dependent upon moisture content. Contractors should assume that moisture conditioning will be necessary.

Backfill should be placed in 200 mm thick lifts and compacted to 95% of SPMDD (standard proctor maximum dry density) for material placed below 1.0 m from grade and 98% of SPMDD for backfill placed in the final 1.0 m from grade.

It is recommended that a Class "B" pipe bedding configuration (commonly used on YG and City of Whitehorse projects with 150 mm of bedding under the pipe, beside the pipe and 300 mm above the pipe) be specified for this project. When compacted to at least 95% of SPMDD, this bedding configuration will ensure proper support and protection of the utility lines during backfill.

Bedding may be imported bedding sand (believed to be preferred by Village of Mayo Public Works staff), or bedding stone in areas where wet and unstable conditions are encountered.

Bedding sand and stone used on this project should conform to the gradation specifications presented in Table 1.

Table 1: Recommended Pipe Bedding Materials Specifications

Bedding Sand		25 mm Bedding stone	
Particle Size (mm)	% Passing by Mass	Particle Size (mm)	% Passing by Mass
10.000	100	25.000	100
5.000	80 – 100	20.000	70 - 100
2.000	55 – 100	12.500	55 – 100
0.630	25 – 65	10.00	30 – 80
0.250	10 – 40	5.000	0 – 40
0.080	2 – 15	2.000	0 – 10

4.3 Soil Corrosivity

Cathodic protection of the Lift Station's steel wet well is proposed. The following information is provided for use on this and future projects.

4.3.1 Factors Contributing To Soil Corrosivity

Soil corrosivity and corrosion are not considered to be directly measurable; however, research suggests that the main factors contributing to soil corrosivity include:

- Aeration – since well aerated soils generally have lower water retention properties (based on the grain size properties of the surrounding soils) and better evaporation rates, loamy and sandy soils are desirable around ductile iron pipes, steel tanks and fittings. However, typical construction methods (moisture conditioning and compaction processes), can affect the aeration potential.
- pH – The acidity of a soil can lead to extreme corrosion rates and pitting. When pH levels are below 4.5 (very acidic) or above 9.1 (strongly alkaline), high corrosion loss rates can be expected.
- Moisture Content and Resistivity – Since water is one of the components necessary for electrochemical corrosion (along with oxygen and metal), the moisture content of the soil is probably the most important factor

in assessing potential. Increased moisture contents will result in lower resistivity in soil and therefore increasing potential for corrosion. Interesting to note, however, research suggests that once the soil is saturated the additional moisture has no increased effect on resistivity.

- Temperature – Soils at or below freezing will have increased resistivity for a given moisture content and if this happens rapidly (which would be the case in the Yukon), the increase in resistivity results in a corresponding decrease in the corrosive potential of the soil.

4.3.2 Soil Corrosivity Testing

To assess potential for corrosivity, ALS (analytical lab preferred by the undersigned) performs a suite of tests that includes:

- Physical tests including Conductivity, percent of Moisture, pH, Redox Potential, and Resistivity.
- Leachable Anions and Nutrient testing including Chloride and Sulphide testing.
- Anion and Nutrient testing including Sulphate testing.

4.3.3 Interpretation of Corrosivity Results

Although soil corrosivity is not a directly measurable soil parameter, there are systems and methods that attempt to predict potential and resulting corrosion of metallic pipe and fittings based on soil properties. Two of the more widely used methods are the American Water Works Association (AWWA) 10 point scoring method that bases potential on the weighted aggregation of 5 soil properties, and the Spicklemire (2002) 25 point scoring method which is similar to the AWWA method but has additional factors. For the purpose of this exercise, the AWWA method was used to assess the ALS results. The five soil parameters used to calculate the weighted aggregation includes resistivity, pH, redox potential, sulphides and moisture content. If the total is greater than 10 points, protective measures such as cathodic protection of cast iron alloys is warranted.

It is doubtful that previous soil corrosivity testing was performed during the original Lift Station wet well installation. If considered to be a value added analysis, soil samples of the fine grained silts and the silty sand can be collected during the excavation of the temporary force main and tested so that even though cathodic protection is part of this project, the potential for future tank corrosion can be assessed.

4.3.4 Anode Installation

It is understood that a thermite weld will attach a cable to the steel wet well. The cable will then run along the floor slab and out of the lift station structure along the top of the foundation concrete. A trench will then be excavated to a safe depth for anode installation. Both Option 1 and Option 2 have the cable exiting the structure at the top of the foundation concrete. If the cable is buried in a thin trench running to the anode location, very little potential for disturbance to the soils beneath the thickened slab-on-grade foundation exists. The key is to make the trench as narrow as possible (perhaps hand excavated) when working close to the building.

4.4 Pavement Structure

It is understood that cold mix will be utilized for patching along First Avenue where the temporary force main trench was excavated. It must be acknowledged that BST surfacing is not a structural element and traffic loads will be carried by the basecourse, sub-base and subgrade soils below the driving surface.

The trench detail on Sheet C103 of the 65% Submission drawings specify 50 mm of hot mix asphalt; 100 mm of basecourse gravel and 200 mm of pit run sub-base gravel. It is felt that with the poor quality subgrade soils likely to be encountered, the following pavement structure should be considered.

- 500 mm of pit run sub-base gravel placed and compacted over a prepared subgrade surface.

- 150 mm of 20 mm crushed basecourse gravel.
- 50 mm of cold mix patching material until BST surfacing or actual paving is proposed.

4.4.1 Roadway Reconstruction

All imported granular materials (crushed basecourse and pit run sub-base) must meet the gradation limits presented in Table 3. If non-compliant materials are proposed, a sample can be submitted to Tetra Tech for testing and an opinion regarding use can be supplied. As an alternative sub-base material, an appropriate 50 mm crushed sub-base gravel specification has also been provided.

Table 3: Imported Gravel Gradation Specifications

20 mm CRUSHED BASECOURSE AGGREGATE		80 mm PIT RUN SUB-BASE AGGREGATE		50 mm CRUSHED SUB-BASE AGGREGATE	
Particle Size (mm)	% Passing by Mass	Particle Size (mm)	% Passing by Mass	Particle Size (mm)	% Passing by Mass
20.000	100	80.000	100	50.000	100
12.500	64 – 100	25.000	55 - 100	25.000	55 - 100
5.000	36 – 72	12.500	42 - 84	12.500	38 - 71
2.500	18 – 54	5.000	26 - 65	5.000	22 - 54
1.250	12 – 42	1.250	11 - 47	2.500	14 - 42
0.315	4 – 22	0.315	3 - 30	1.250	9 - 33
0.080	3 - 6	0.080	0 - 8	0.315	3 - 20
				0.080	0 - 7

All sub-base materials must be placed in lifts not exceeding 200 mm in thickness and the contractor should be prepared to moisture condition each lift to facilitate compaction. Basecourse materials can be placed in a single lift and final tight-blading should be performed immediately prior to BST construction.

If soft areas are encountered during roadway reconstruction, additional subcut may be required (down to a dry, stable surface). When the subcut areas are being backfilled, all materials placed within the final meter must be compacted to at least 98% of SPMDD. Below 1.0 m from finished grades, 95% of SPMDD is considered acceptable.

4.5 Approach Slab and Apron Replacement

The replacement of two concrete aprons and the repair of a third is proposed. The fill used for dyke construction was good quality granular material so no additional subcut is recommended. However, it is recommended that the new concrete aprons be constructed on a prepared surface of 150 mm of 20 mm crushed basecourse aggregate and a recompacted sub-base surface. Moisture conditioning and compaction to 98% of SPMDD is required.

Since all concrete placed is exterior, it should correspond to the CSA A23.1 Exposure Class C-2 for concrete that will be subject to seasonal freeze thaw cycles in a non-saturated environment. Project specifications should reflect a 32 MPa 28 day compressive strength with 5%-8% entrained air.

5.0 CONSTRUCTION TESTING AND MONITORING

All geotechnical recommendations presented herein are site-specific and based on the assumption that an adequate level of monitoring will happen during construction. An adequate level of construction monitoring also provides opportunity to verify that the recommendations based on geotechnical data obtained from the historical boreholes is applicable to the entire site. Appropriate quality assurance and quality control (QA/QC) testing should be undertaken during construction to confirm that construction is completed in accordance with the

recommendations provided in this report. For this project, appropriate QA/QC inspection and testing is considered to include:

- Geotechnical inspection(s) during excavation(s).
- Laboratory testing on samples of proposed fill materials to confirm compliance to specified gradation requirements (by sieve analysis) and compaction (proctor moisture density testing) requirements.
- Compaction and concrete testing during construction to ensure the objectives of the project are met.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Government of Yukon, Department of Community Services and their agents. Tetra Tech Canada Inc. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Government of Yukon, Department of Community Services, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech Canada Inc.'s Services Agreement. General Conditions are provided in Appendix A of this report.

7.0 CLOSURE

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

Respectfully submitted,
Tetra Tech Canada Inc.

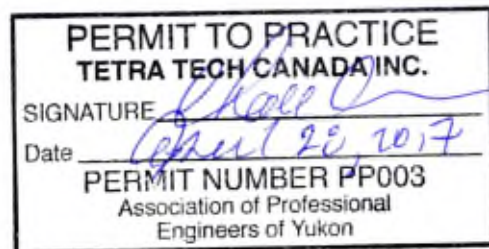


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Attachments: Appendix A: Tetra Tech General Conditions
Appendix B: Historical Testhole Logs



APPENDIX A

TETRA TECH CANADA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

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

1.1 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 TETRA TECH's Client. TETRA TECH 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 TETRA TECH's Client unless otherwise authorized in writing by TETRA TECH. Any unauthorized use of the report is at the sole risk of the user.

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1.2 ALTERNATE REPORT FORMAT

Where TETRA TECH submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed TETRA TECH's instruments of professional service); only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by TETRA TECH shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of TETRA TECH's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except TETRA TECH. TETRA TECH's instruments of professional service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH 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.

1.4 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. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.5 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained 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.

1.6 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred 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. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.7 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.

1.8 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.9 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and 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.

1.10 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental 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.

1.11 DRAINAGE SYSTEMS

Where temporary or 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.

1.12 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.

1.13 SAMPLES

TETRA TECH 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, otherwise samples will be discarded.

1.14 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of the report, TETRA TECH may rely on information provided by persons other than the Client. While TETRA TECH endeavours to verify the accuracy of such information when instructed to do so by the Client, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

HISTORICAL TESTHOLE LOGS

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

GENERAL DESCRIPTIVE TERMS

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.

Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated - composed of thin layers of varying colour and texture.

Interbedded - composed of alternate layers of different soil types.

Calcareous - containing appreciable quantities of calcium carbonate.;

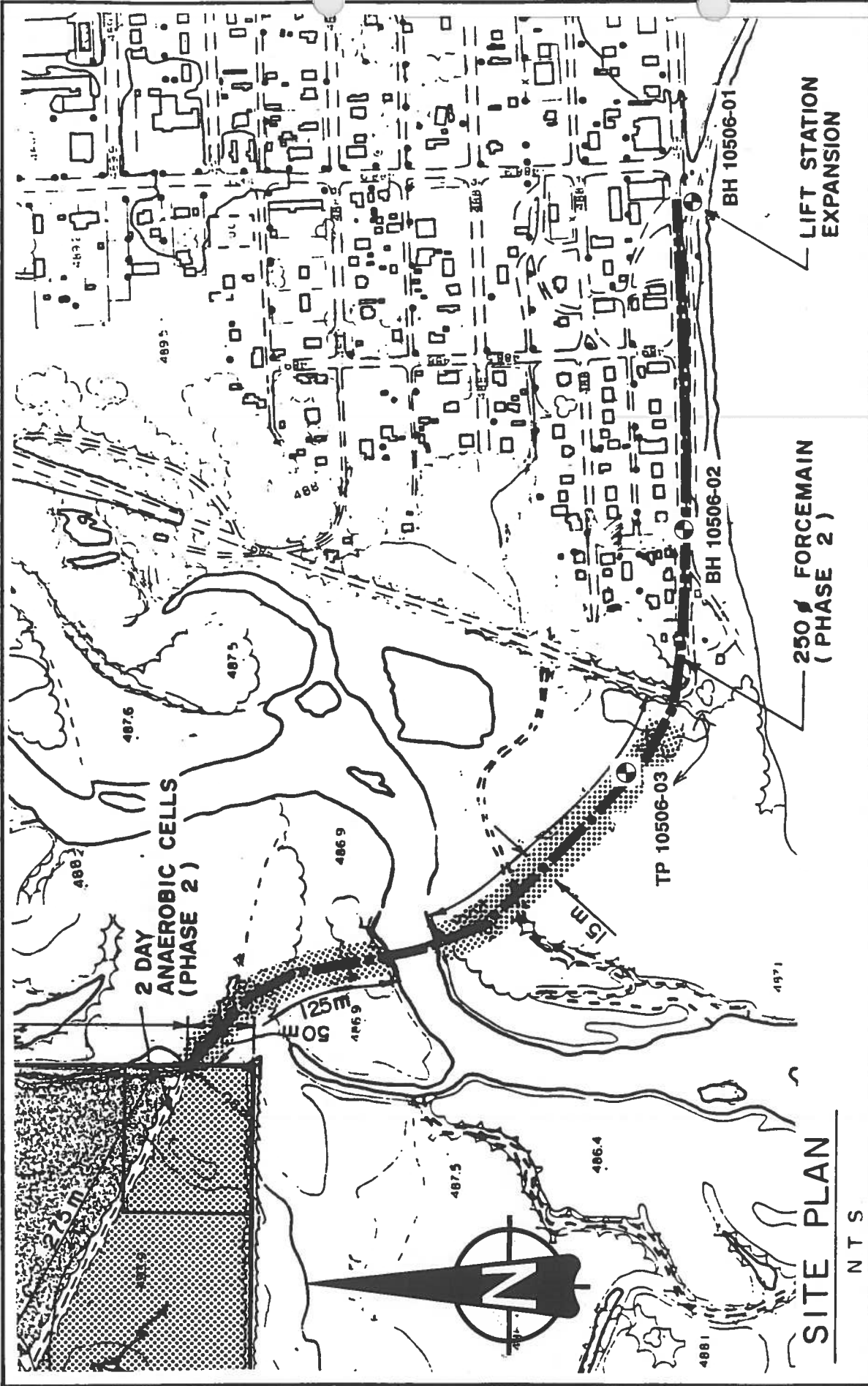
Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.

Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION		GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA					
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm 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 Not meeting both criteria for GW				
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures					
		GRAVELS WITH FINES	GC	Clayey gravels, gravel-sand-clay mixtures					
		GRAVELS WITH FINES	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines					
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, 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 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting both criteria for SW			
			SP	Poorly graded sands and gravelly sands, little or no fines					
		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 or plasticity index greater than 7	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols	
		FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS Liquid limit	<50			ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity	For classification of fine-grained soils and fine fraction of coarse-grained soils. <div style="text-align: center;"> PLASTICITY CHART </div>
				>50			MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
			CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit	<30			CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays	
				30-50			CI	Inorganic clays of medium plasticity, silty clays	
>50	CH			Inorganic clays of high plasticity, fat clays					
ORGANIC SILTS AND CLAYS Liquid limit	<50		OL	Organic silts and organic silty clays of low plasticity					
	>50	OH	Organic clays of medium to high plasticity						
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils	*Based on the material passing the 75 mm sieve Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA					

SOIL COMPONENTS					OVERSIZE MATERIAL	
FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded COBBLES 75 mm to 300 mm BOULDERS > 300 mm	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR		
GRAVEL	coarse	75 mm	19 mm	>35 %	"and"	Not rounded
	fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"	
SAND	coarse	4.75 mm	2.00 mm	10 to 20 %	"some"	ROCK FRAGMENTS >75 mm ROCKS > 0.76 cubic metre in volume
	medium	2.00 mm	425 µm	>0 to 10 %	"trace"	
	fine	425 µm	75 µm			
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior			



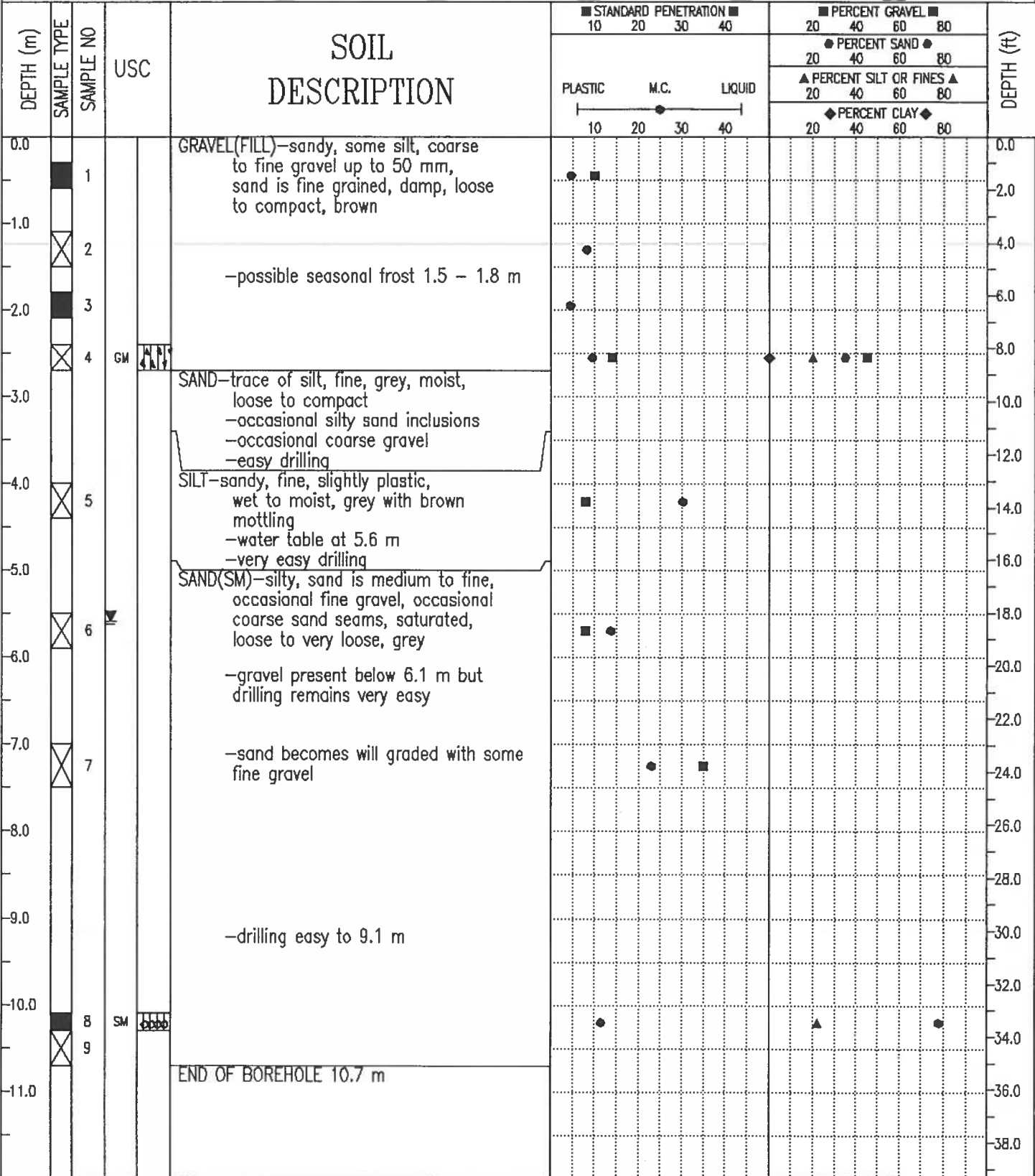
SITE PLAN

N T S

<p>PROJECT SEWAGE LIFT STATION AND FORCE MAIN MAYO, YUKON</p>	<p>CLIENT EBA Engineering Consultants Ltd.</p>
<p>TITLE SITE PLAN AND APPROXIMATE BOREHOLE/TESTPIT LOCATIONS</p>	<p>STANLEY ASSOCIATES ENGINEERING LTD.</p>
<p>DWG NO. 10506-01</p>	<p>DATE 1991-05-30 DWN CHKD <i>[Signature]</i></p>

SEWAGE FORCEMAIN/WET WELL CONSTRUCTION	CLIENT: STANLEY ASSOCIATES ENGINEERING	TESTHOLE No. 10506-01
LIFT STATION ON DYKE	DRILL: CME 75 C/W HOLLOW STEM AUGERS	Project No: 0201-10506
MAYO, YUKON	UTM ZONE: 8 N7051550.00 E455450.00	ELEVATION 0.00 (m)

SAMPLE TYPE GRAB SAMPLE NO RECOVERY STANDARD PEN. SPLIT SPOON CORREL BARREL



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

COMPLETION DEPTH 10.7 m

COMPLETE 91/05/08

LOGGED BY CRH

DWG NO.

Page 1 of 1

PARTICLE - SIZE ANALYSIS OF SOILS

Project: Access Road/Forecmain Evaluation
Mayo, Yukon

Project Number: 0201-10506

Date Tested: 91-05-14

Borehole Number: 10506-01

Depth: 1.8 - 2.1 m

Soil Description: GRAVEL (GM)-sandy, some silt

Cu: _____

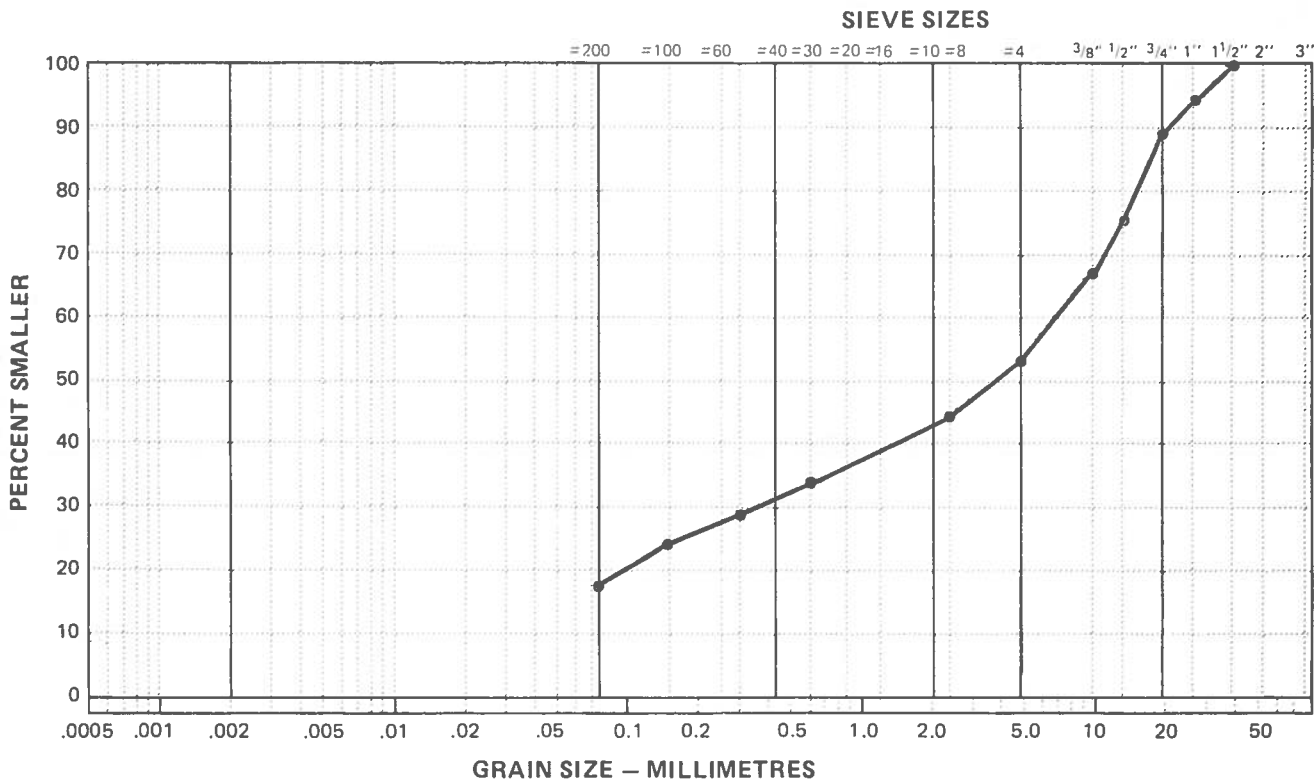
Cc: _____

Natural Moisture Content: 4.5 %

Remarks: _____

SIEVE	PERCENTAGE PASSING
3"	
1 1/2"	
1"	95.9
3/4"	89.8
1/2"	76.7
3/8"	67.8
No. 4	53.3
No. 10	45.3
No. 20	39.5
No. 40	34.3
No. 60	29.6
No. 100	24.6
No. 200	18.8

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



PARTICLE - SIZE ANALYSIS OF SOILS

Project: Access Road/Forcemain Evaluation
Mayo, Yukon

Project Number: 0201-10506

Date Tested: 91-05-14

Borehole Number: 10506-01

Depth: 10.1 - 10.4 m

Soil Description: SAND (SM)-silty

Cu: _____

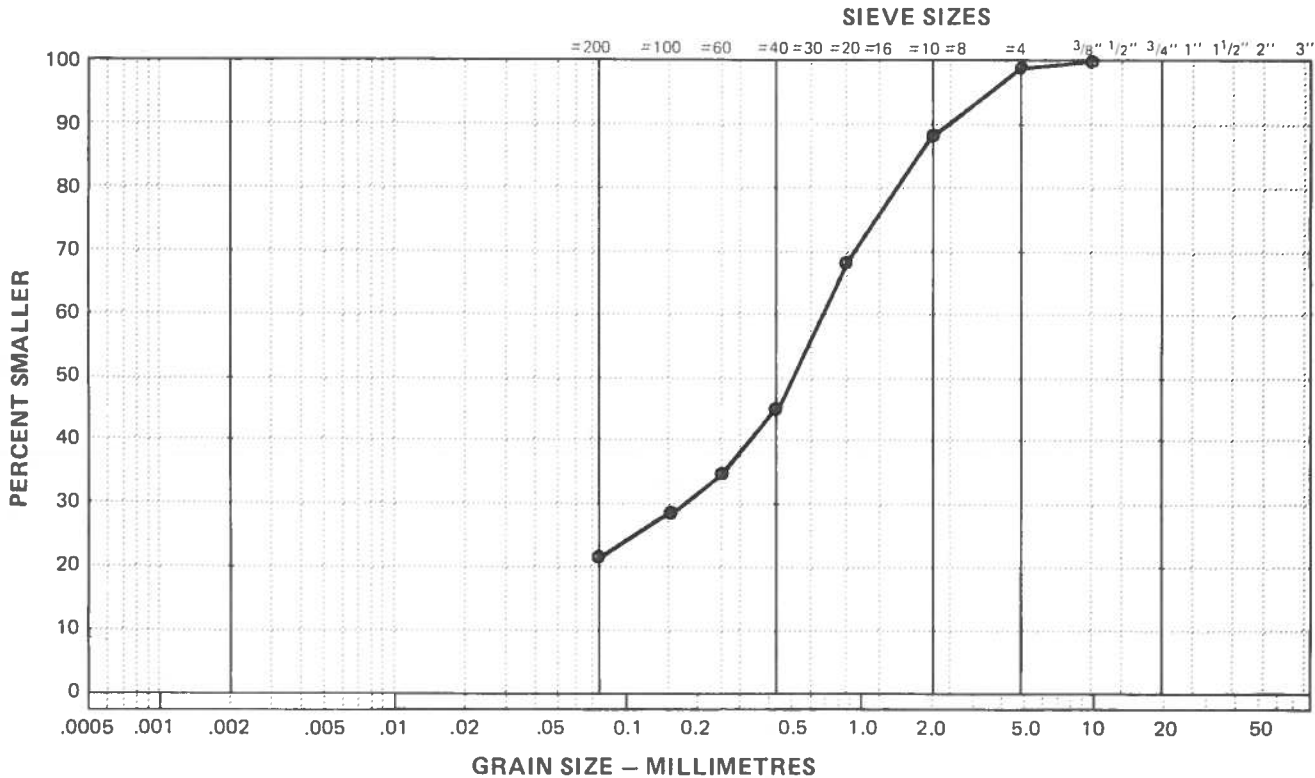
Cc: _____

Natural Moisture Content: 11.5 %

Remarks: _____

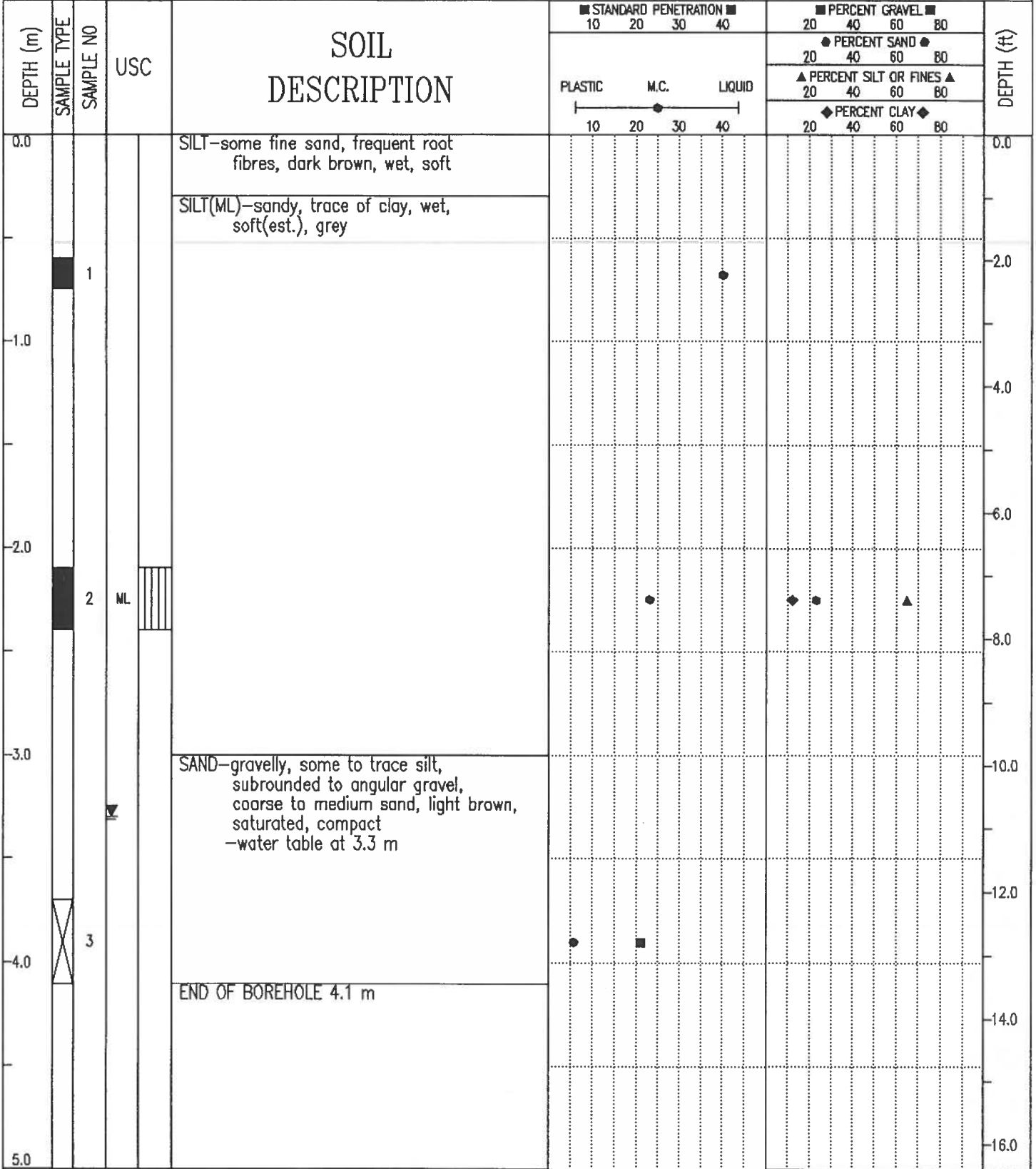
SIEVE	PERCENTAGE PASSING
3"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
No. 4	99.6
No. 10	88.5
No. 20	68.8
No. 40	46.2
No. 60	35.1
No. 100	28.9
No. 200	21.5

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



SEWAGE FORCEMAIN/WET WELL CONSTRUCTION	CLIENT: STANLEY ASSOCIATES ENGINEERING	TESTHOLE No. 10506-02
BETWEEN DYKE AND ROADWAY	DRILL: CME 75 C/W HOLLOW STEM AUGERS	Project No: 0201-10506
MAYO, YUKON	UTM ZONE: 8 N7051575.00 E455300.00	ELEVATION 0.00 (m)

SAMPLE TYPE GRAB SAMPLE NO RECOVERY STANDARD PEN. CRREL BARREL



EBA Engineering Consultants Ltd.
Whitehorse, Yukon

COMPLETION DEPTH 4.1 m

COMPLETE 91/05/08

LOGGED BY CRH

DWG NO.

Page 1 of 1

PARTICLE - SIZE ANALYSIS OF SOILS

Project: Access Road/Forcemain Evaluation
Mayo, Yukon

Project Number: 0201-10506

Date Tested: 91-05-21

Borehole Number: 10506-02

Depth: 2.1 - 2.4 m

Soil Description: SILT (ML) - sandy, trace of clay

Cu: _____

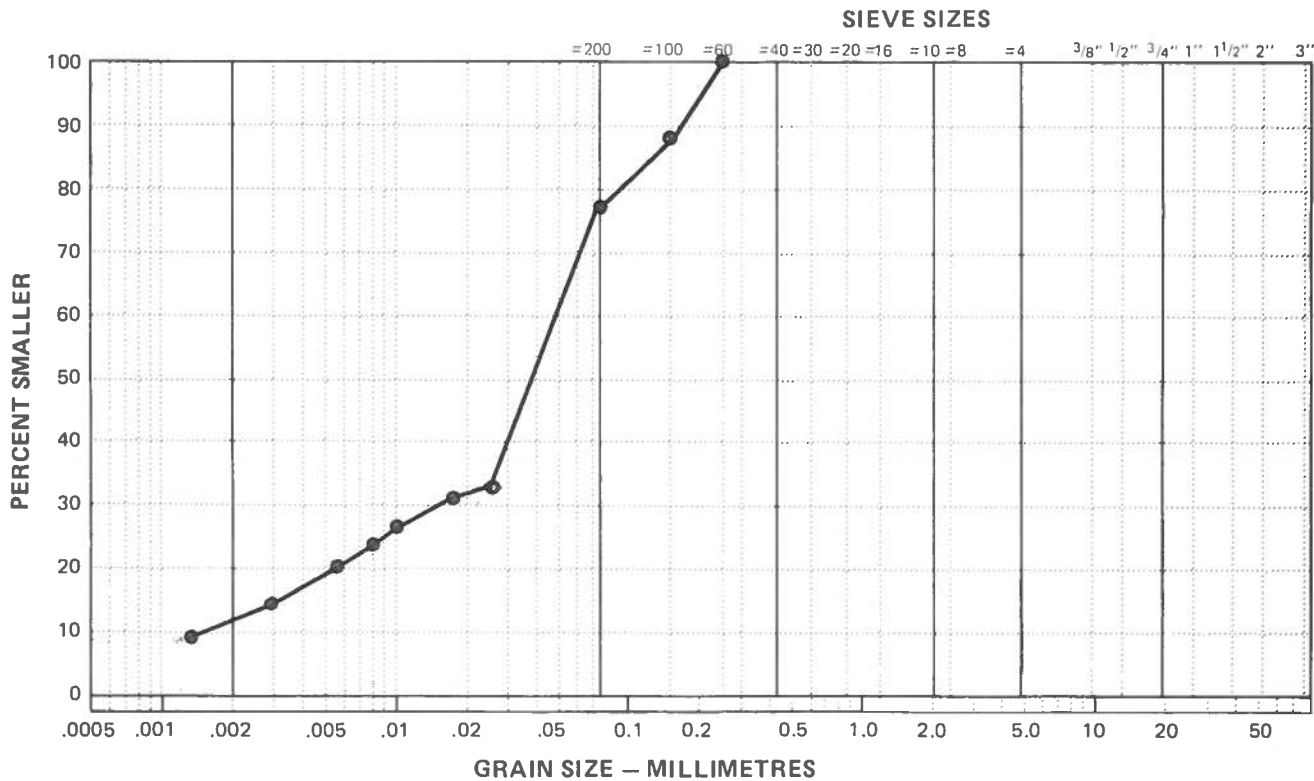
Cc: _____

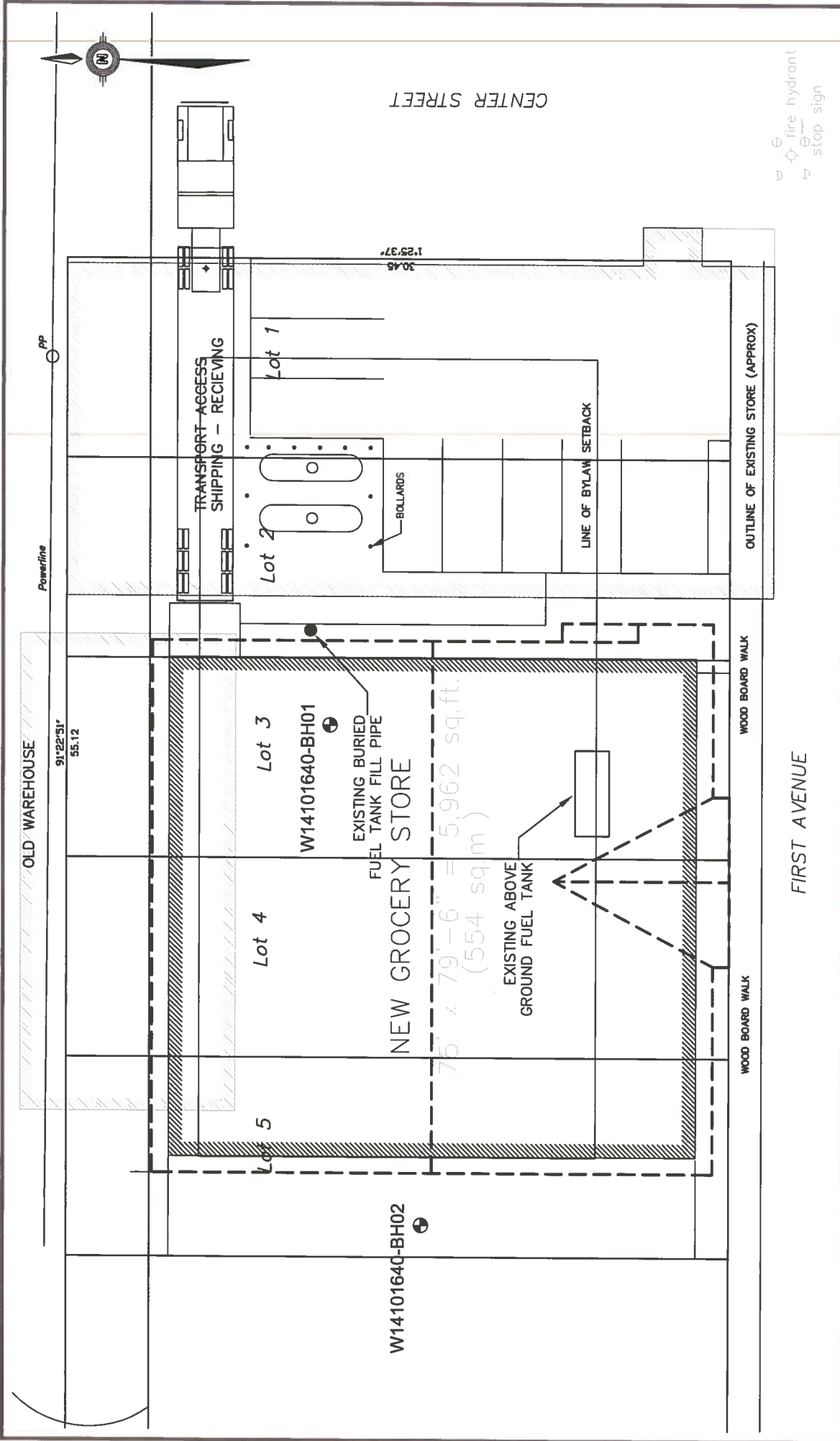
Natural Moisture Content: 23.1 %

Remarks: _____

SIEVE	PERCENTAGE PASSING
3"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
No. 4	
No. 10	
No. 20	
No. 40	
No. 60	100.0
No. 100	88.2
No. 200	77.1

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE





LEGEND:
 ⊕ - BOREHOLE LOCATION

NOTES
 BASED ON DRAWING PROVIDED BY CLIENT, AS PRODUCED BY SINCLAIR & ASSOCIATES

Scale: 1:250 (metres)

STATUS
 ISSUED FOR REVIEW

CLIENT
 KGS Group

PROJECT NO.
 W14101540

OFFICE
 EBA-WHSE

DWN
 JSB

CHK
 JRT

REV
 0

DATE
 May 6, 2011

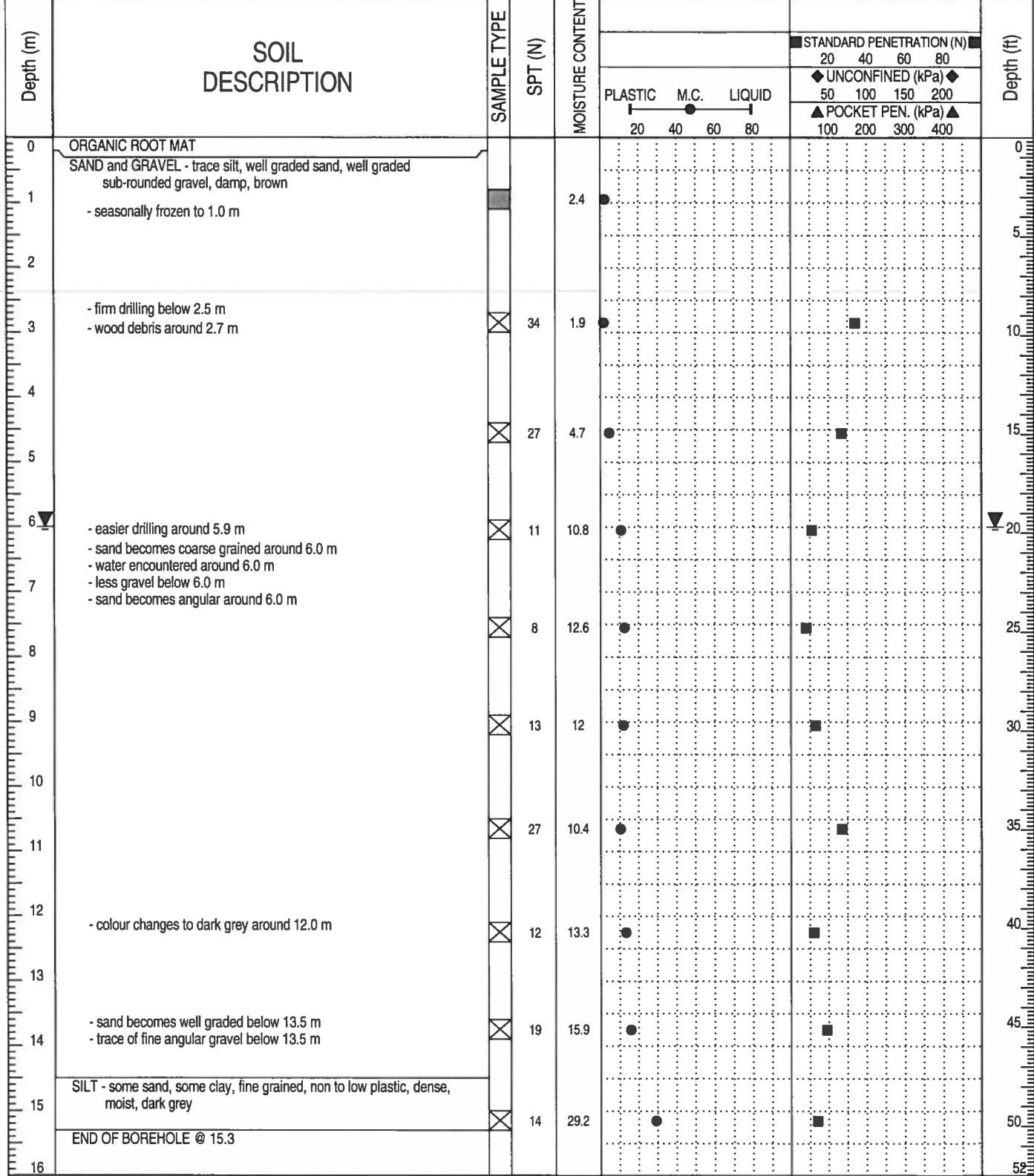
Proposed New NNDFN Store Geotechnical Evaluation
 Lots 3, 4 & 5, Block 4 - Mayo, YT

SITE PLAN SHOWING BOREHOLE LOCATIONS

Figure 1

eba
 A TETRATECH COMPANY

New NDNFN Store		CLIENT: KGS Group	PROJECT NO. - BOREHOLE NO.
Geotechnical Evaluation		DRILL: Nodwell CME 75 w/hollow stem augers	W14101540-BH01
Lots 3, 4, & 5, Block 4, Mayo, YT		7051779N; 455473E; Zone 8	
SAMPLE TYPE	<input type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE	
BACKFILL TYPE	<input type="checkbox"/> BENTONITE <input type="checkbox"/> PEA GRAVEL <input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT <input type="checkbox"/> DRILL CUTTINGS <input type="checkbox"/> SAND	

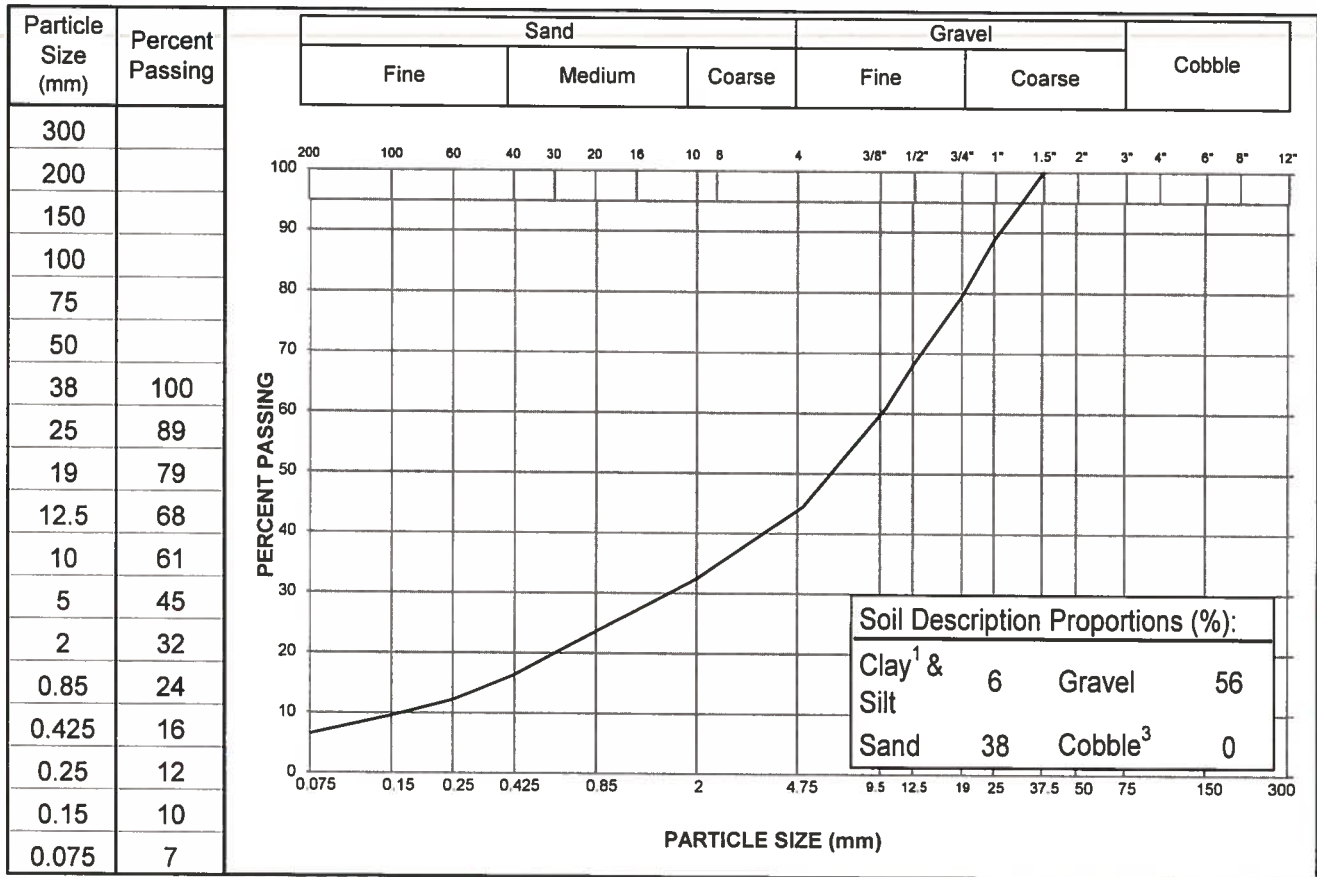


	LOGGED BY: JSB	COMPLETION DEPTH: 15.3m
	REVIEWED BY: CPC	COMPLETE:
	DRAWING NO:	Page 1 of 1

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	New NDNFN Store Geotechnical Evaluation	Sample No.:	
Project No.:	W14101540	Material Type:	
Site:	Mayo, YT	Sample Loc.:	BH01
Client:	KGS Group	Sample Depth:	4.4 - 4.7 m
Client Rep.:	Jason Mann	Sampling Method:	SPT
Date Tested:	April 8, 2011	By: SMS/PME	Date sampled: April 4, 2011
Soil Description ² :	GRAVEL and SAND - trace silt	Sampled By:	JSB
Moisture Content:	4.7%	USC Classification:	Cu: 59.0 Cc: 1.8



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____
 Remarks: _____

Reviewed By: *Jason Mann*

New NDNFN Store		CLIENT: KGS Group		PROJECT NO. - BOREHOLE NO.			
Geotechnical Evaluation		DRILL: Nodwell CME 75 w/hollow stem augers		W14101540-BH02			
Lots 3, 4, & 5, Block 4, Mayo, YT		7051779N; 455444E; Zone 8					
SAMPLE TYPE		<input type="checkbox"/> DISTURBED	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE		<input type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	MOISTURE CONTENT	PLASTIC		M.C.	LIQUID	STANDARD PENETRATION (N)				Depth (ft)
					20	40			20	40	60	80	
0	ORGANIC ROOT MAT											0	
0	SAND - silty, trace gravel, well graded sand, fine grained sub-rounded gravel, light grey and brown											0	
1	- becomes sandy silt around 0.8 m											1	
2	- seasonally frozen to 1.8 m											2	
3	- trace silt below 2.7 m											3	
3	- some gravel to gravelly below 2.7 m		19	32.1								10	
4												11	
5												15	
5			22	1.7								15	
6												20	
6	- water encountered at 6.0 m											20	
6	- sand becomes coarser grained around 6.0 m											20	
6	- trace to some sub-angular fine to medium grained gravel below 6.0 m											20	
7												21	
7												22	
8												25	
8			18	9.5								25	
9												26	
9	- sand becomes well graded around 9.0 m											27	
9												28	
9			23	9.8								30	
10												31	
10												32	
11												35	
11			21	9.7								35	
12												36	
12	- colour changes to dark grey around 12.0 m											37	
12												38	
12			17	12.5								40	
13												41	
13												42	
14												45	
14	- trace to some silt below 13.5 m											45	
14												46	
14			20	15.4								45	
15												47	
15												48	
15												49	
15			17									50	
16	END OF BOREHOLE @ 15.4 m											52	



EBA Engineering Consultants Ltd.

LOGGED BY: JSB

REVIEWED BY: CPC

DRAWING NO:

COMPLETION DEPTH: 15.5m

COMPLETE:

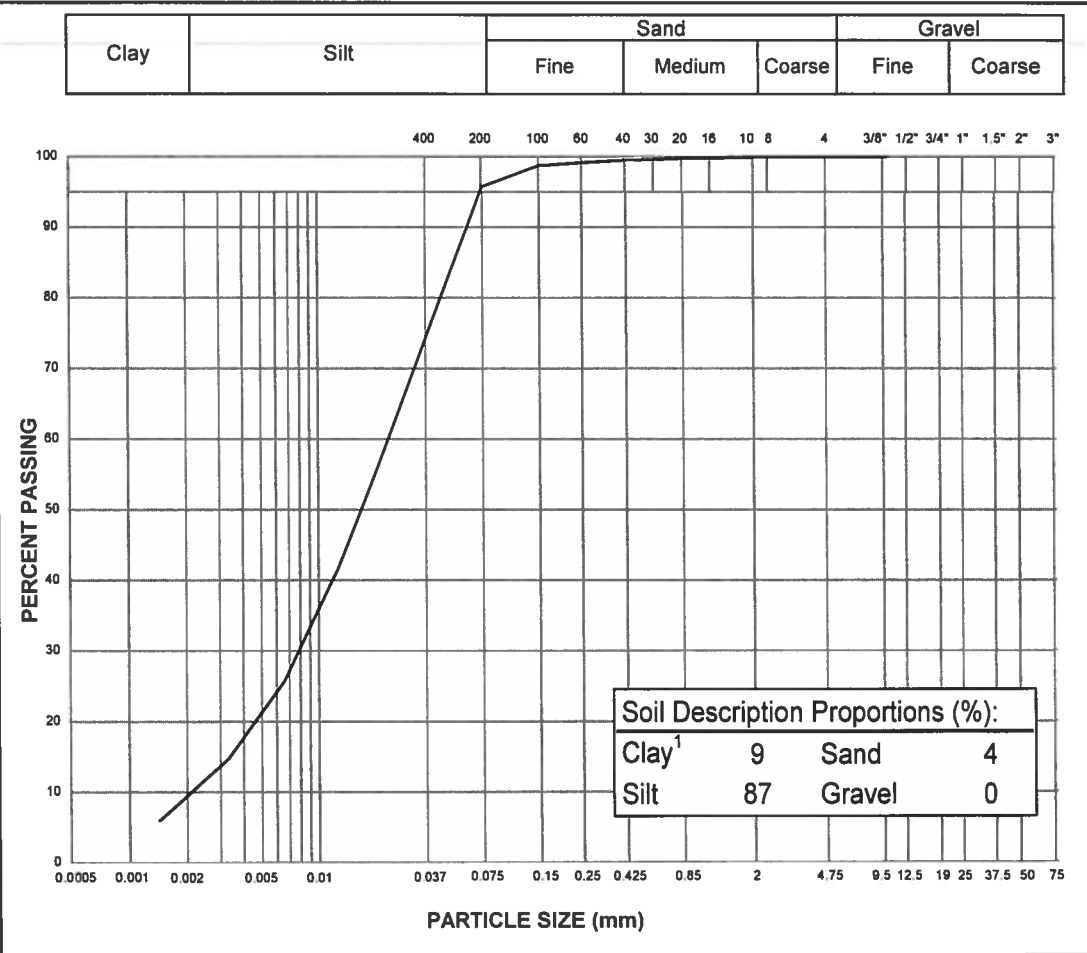
Page 1 of 1

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	New NDNFN Store Geotechnical Evaluation	Sample No.:	
Project No.:	W14101540	Material Type:	
Site:	Mayo, YT	Sample Loc.:	BH02
Client:	KGS Group	Sample Depth:	2.7 - 2.9 m
Client Rep.:	Jason Mann	Sampling Method:	Grab
Date Tested:	April 11, 2011	By: SMS/PE	Date sampled: April 4, 2011
Soil Description ² :	SILT - trace clay, trace sand	Sampled By:	JSB
Moisture Content:	32.1%	USC Classification:	Cu: 10.3 Cc: 1.2

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	100
5	100
2	100
0.85	100
0.425	100
0.25	99
0.15	99
0.075	96
0.0313	69.3
0.0207	56.4
0.0126	41.6
0.0091	33.6
0.0066	25.7
0.0033	14.8
0.0014	5.9



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

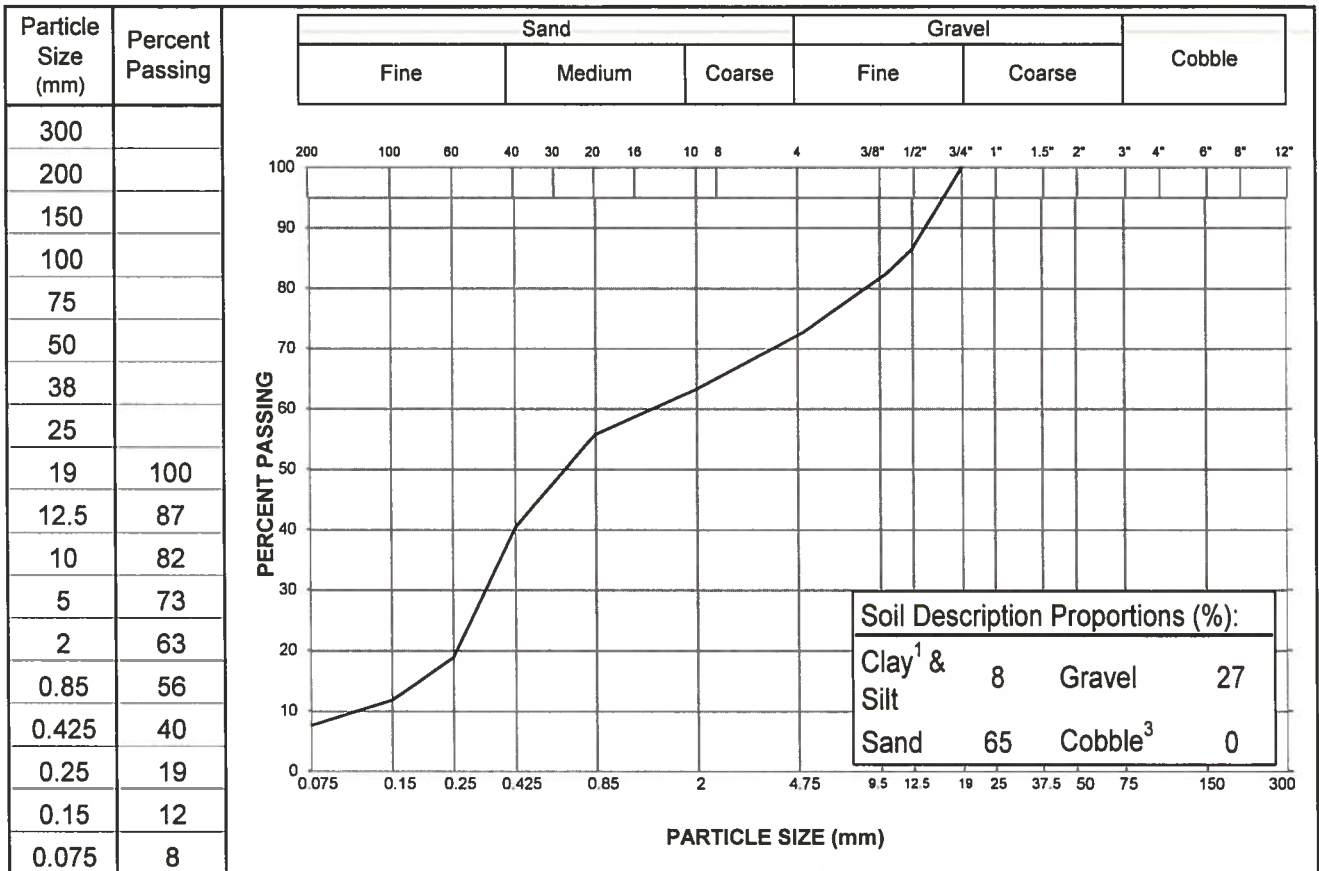
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PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project:	New NDNFN Store Geotechnical Evaluation	Sample No.:	
Project No.:	W14101540	Material Type:	
Site:	Mayo, YT	Sample Loc.:	BH02
Client:	KGS Group	Sample Depth:	2.9 - 3.2 m
Client Rep.:	Jason Mann	Sampling Method:	SPT
Date Tested:	April 8, 2011	By:	SMS/PME
		Date sampled:	April 4, 2011
Soil Description ² :	SAND - gravelly, trace silt	Sampled By:	JSB
		USC Classification:	Cu: 12.8 Cc: 0.7
Moisture Content:	2.6%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____
 Remarks: _____

Reviewed By: *Jason Mann*

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