GEOTECHNICAL INVESTIGATION
PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1-W5, NW-SW 12-41-1-W5, LACOMBE COUNTY, ALBERTA

Parkland GEO

GEOTECHNICAL INVESTIGATION
PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1-W5, NW-SW 12-41-1-W5, LACOMBE COUNTY, ALBERTA

Prepared for:

A.D. WILLIAMS ENGINEERING INC.
RED DEER, ALBERTA

Prepared by:

PARKLAND GEOTECHNICAL LTD.
RED DEER, ALBERTA
PROJECT NUMBER: RD2894
AUGUST 2008

TABLE OF CONTENTS

TABLES

APPENDICES

1.0 INTRODUCTION

A new recreational vehicle (RV) resort is proposed on the east shore of Gull Lake in Lacombe County, Alberta. Parkland Geotechnical Consulting Ltd. (ParklandGEO) was commissioned to conduct a geotechnical investigation for the proposed development at the site. The scope of work was outlined in ParklandGEO's proposal letter dated April 14, 2007 (File#:PRO1336). Authorization to proceed with the investigation was given by Mr. Dan Colter of A.D. William Engineering Inc., on behalf of the Owner.

This report summarizes results of field and laboratory testing programs and presents geotechnical recommendations for the proposed development. Geotechnical recommendations are provided with respect to design and installation of underground services, roadway subgrades and flexible pavement design. This report confirms the preliminary recommendations submitted on July 8, 2008.

2.0 SITE DESCRIPTION

The subject site is located within SW 14-41-28-W4M in Lacombe County, Alberta. This site location is shown on the Key Plan, Figure 1. The proposed new RV vehicle resort is on the east side of Range Road 12, north of TWP Road 410 and on the west shore of the Gull Lake. Access to the site is via TWP Road 411 or Range Road 11. The subject site was primarily vacant agricultural land covered with grass at the time of the drilling. The natural topography of the site was gently rolling with a ground surface elevation ranging from 900.0 m to 930.5 m based on the contour information provided A.D. Williams Engineering Ltd. (see the Contour Plan, Figure 4, in Appendix A). The high area of the site was at the northwest corner of the site (at the location of Borehole 20), sloping down towards the south, east and north. The adjacent sites to the east were Gull Lake, and to the west, south and north were farmland. The present site development is shown on the 2007 Aerial Photograph provided in Figure 3, in Appendix A.

3.0 FIELD AND LABORATORY PROGRAMS

On April 24, 25 and 26, 2008, twenty five boreholes were drilled at the site to depths of ranging from 5.0 to 6.5 m below grade. The boreholes were drilled with a truck mounted solid stem auger drill. The locations of the boreholes are shown on the attached Site Plan, Figure 2, in Appendix A. The soil encountered was visually examined during excavation and logged according to the Modified Unified Soil Classification System. Soil samples were taken at 1.0 m intervals in order to determine the soil/moisture profile. Standard Penetration Tests were taken at selected depth intervals in all boreholes. All soil samples were returned to the Red Deer laboratory for further testing to determine the soil classification and strength properties.

Standpipes were installed in all boreholes at the completion of drilling. Groundwater levels were measured at completion, and on May 5, 2008. The borehole ground surface elevations were surveyed by A.D. Williams Engineering Inc., and referenced to a geodetic datum.

4.0 SOIL CONDITIONS

The soil profile encountered at this site was topsoil; silty sand; silty clay, clay till overlying bedrock. This is considered to be the typical soil profile in the area. Drilling refusal was met on bedrock at a depth of 5.7 and 5.0 m below grade in Borehole 16 and 23, respectively. Detailed descriptions of the soil conditions encountered at each borehole can be seen in the borehole logs in Appendix A. Individual laboratory test results and definitions of the terminology and symbols used on the borehole logs are also attached in Appendix A. The following is a brief description of the soil types encountered.

4.1 TOPSOIL

Topsoil was encountered at all borehole locations at the site. The thickness of the topsoil varied between 100 and 200 mm at the borehole locations. It is likely that topsoil thicknesses will vary between boreholes and thicken deposits may be present. The topsoil was moderately organic, black and moist, and it is considered to be weak and highly compressible when subjected to loads.

4.2 SILTY SAND

Silty sand was encountered below the topsoil or silty clay in Boreholes 4, 6, 9, 11, 14, 16, 20 and 24. The sand deposits were fine grained, poorly graded and non to low plastic with varying proportions of silt and clay. The sand deposits were considered to be loose to compact. The moisture contents of the silty sand were about 5 to 10 percent. These sand deposits were considered to be a relatively stable subgrade material. However, like all fine grained sands, this sand will be sensitive to disturbance if encountered in a wet to saturated condition. The estimated CBR for this sand is between 5 and 8 percent in a soaked condition.

4.3 SILTY CLAY

A layer of silty clay was encountered below the topsoil or silty sand in all boreholes except in Boreholes 3, 9, 14 and 20 at depths of ranging from 0.1 to 2.8 m below grade. The silty clay was medium plastic and of a firm to stiff consistency. The moisture contents of the silty clay were about 15 to 27 percent. In general, these soils were considered to be relatively wet, weak and moderately to highly frost susceptible if found within the depth of frost. The estimated CBR for this silty clay is between 3 and 5 percent in a soaked condition.

4.4 CLAY TILL

Clay till was encountered below the topsoil or silty clay and silty sand deposits in all boreholes at depths of between 0.1 and 3.0 m below grade. In the clay till, the proportions of sand, silt and clay were roughly equal. Although not encountered during this investigation the local till is known to have inclusions of boulders and sand lenses. The plasticity of the clay till was low to medium and the consistency of clay till was stiff to hard. Moisture contents in the till generally ranged from about 10 to 20 percent with a typical value of 15 percent.

4.5 BEDROCK

Weathered bedrock was encountered below clay till at depths of ranging from 2.5 to 5.4 m in Boreholes 16, 17, 21, 22 and 23. The local bedrock consisted of fine sandstone. The upper bedrock is considered to be weak poorly cemented and weathered rock, which has the consistency of a very dense soil. The local bedrock is considered to be highly erodible when exposed to the elements and the competency of the rock increases with depth.

4.6 WATER SOLUBLE SULPHATES

Soil samples at a depth of 2.0 m in Boreholes 1, 3, 5, 7, 9, 11, 13, 14, 15, 17 and 25 were tested for water soluble sulphate concentration tests. The concentrations of sulphates are expressed as a percent of the dry mass of soil. The concentrations of water soluble sulphate were all 0.04 which indicates a "negligible potential for sulphate attack on buried concrete in direct contact with soil."

5.0 GROUNDWATER

Groundwater seepage and sloughing was observed during drilling in a few boreholes as noted on the logs in Appendix A. Groundwater levels were measured at the time of completion, and on May 5, 2008, about ten days after the drilling. The measured groundwater tables varied between 0.2 and 5.1 m below grade in Boreholes 1 to 14, 17 and 18, and other boreholes are dry. Following table summarizes the observed groundwater conditions.

TABLE 1
GROUNDWATER LEVELS (m)

Borehole #	Ground Elevations (m)	Borehole Depth (m)	Groundwater Levels at Completion	Groundwater Levels on May 5, 2008
1	907.495	6	Dry	2.4
2	902.364	6	Wet	0.2
3	900.042	6.5	Dry	0.2
4	900.542	6	Wet	0.2
5	905.12	6.5	Wet	2.5
6	908.227	6	Dry	n/a
7	906.43	6.5	Dry	2.9
8	907.826	6	Dry	4.4
9	905.453	6.5	Dry	3.6
10	907.464	6	Wet	2.1
11	907.759	6.5	Wet	3.4
12	908.609	6	Dry	2.4
13	911.376	6.5	Dry	2.9
14	909.96	6	Dry	5.1
15	911.92	6.5	Dry	Dry
16	913.189	5.7	Dry	Dry
17	911.716	6.5	Wet	3.1
18	920.081	6	Dry	3.7
19	922.318	6.5	Dry	Dry
20	930.55	6	Dry	Dry
21	924.668	6.5	Dry	Dry
22	916.419	6	Dry	Dry
23	905.171	5	Dry	Dry
24	901.733	6	Dry	Dry
25	900.168	6.5	Dry	Dry

The groundwater levels at the site were considered to be at or above the seasonal average, due to high seasonal precipitation in the early summer of 2008. The groundwater tables mirrored the surface topography and ranged from elevations of about 900.0 m to 916.38 m below grade, sloping down towards the east and south of the site. The elevations of the groundwater table at the borehole locations are shown on Figure 5, in Appendix A. Groundwater elevations are expected to fluctuate higher on a seasonal basis and will be highest after periods of heavy precipitation or snow-melt.

Groundwater seepage is expected for deep excavations at this site. The volumes of groundwater encountered will be dependent on seasonal conditions and the size and permeability of non and low plastic soil layers.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GEOTECHNICAL EVALUATION

The proposed RV resort is near the east shore of Gull Lake. It is understood that the resort layout will include a golf course, environmental reserve, business area, R.V storage, seasonal lease lots, daily rental lots and parking accessed via an internal road network. The subsurface conditions at this site are considered to be suitable for the proposed resort development. Geotechnically the conditions are considered to be fair to good at this site. It is expected that site grading will be undertaken to level and raise areas to smooth out grades at the site. The main geotechnical concerns regarding soil conditions and foundations at the site are:

- silty clay and/or silty sand will encounter some problems if backfill or deep grading fills are placed during periods of extended wet weather. Surficial silty clay or silty sand will be the most sensitive and weak when wet or groundwater table is high. The use of filter cloth as a separation barrier on the subgrade is strongly recommended. An observational approach based on the actual conditions at the time of construction is considered the best way to optimize costs by identifying problem areas before construction activity leads to subgrade failure.

- for the majority of roadways and parking areas, the subbase of the pavement structure may be placed on a prepared silty clay or silty sand subgrade. The level of subgrade support from the upper soils will range from low in the clay to low/moderate in the silty sand.

- the silty soils will be moderately frost susceptible if they are present and given access to free water or groundwater within the zone of seasonal frost (estimated to an average depth of 2.5 m). The depth to the local water table for this site is considered to be within the potential depth of frost in the low areas.

- concerns about trench settlement should influence the layout of the underground services in the proposed resort to minimize or handle the potential for non-uniform subgrade due to trenching below roadways.

- It is understood that the roads will be paved and the resort will either have gravel or asphalt concrete pads for parking in each lot. For this development, relatively high semi static loads of wheel axes are expected to be placed on the pads. This may cause pavement distress. The use of a gravel parking matt for each lot will provide better long-term performance with less operational maintenance cost compared with asphalt concrete pavement.

- groundwater seepage is expected for open excavations at this site due to the shallow groundwater table. The volumes of groundwater encountered will be dependent on seasonal

conditions and the size of sandy soil layers for deeper excavations. De-watering may be required for open excavation at this site.

The general foundation conditions at this site are considered to be fair to good. Conventional footings will be capable of supporting light to moderate foundation loads with bearing capacities in the order of at least 100 kPa.

6.2 SITE PREPARATION

It is recommended that all vegetation and topsoil be stripped from areas to be graded or developed. Topsoil could be stockpiled for future landscaping use at the site. It is understood that the development will be levelled with a minimal cut and fill operation, and for economic reasons, the native soil is expected to be used as general fill to raise lower areas of the site.

Fill required to bring the site up to grade should be: select sand; well graded coarse gravel; or low to medium plastic, inorganic clay. Most of the native surficial sand soils and clay till are considered to be suitable for this purpose. The native medium plastic silty clay which is considered to be suitable for use as backfill materials, but will require moisture adjustment to allow good levels of compaction.

The engineered grading fill placed during site grading at this site should be compacted to at least 95 percent of SPMDD. Uniformity of compaction is most important. The lift thicknesses should be governed by the ability of the selected compaction equipment to uniformly achieve the recommended density. It is recommended that a maximum lift thickness of 200 mm for granular fill and 150 mm for clay fill be utilized. Granular fill is best compacted with large smooth drum vibratory rollers. Clay fill is best compacted with large vibratory "padfoot" or "sheepsfoot" rollers. In areas which require higher compaction, it is recommended that granular fill be placed at moisture contents zero to 2 percent below OMC and that clay fill be placed at moisture contents about 0 to 2 percent above OMC. This will help reduce compactive effort and potential risk of subgrade disturbance needed to achieve maximum density.

Special consideration must be given to deep fill areas below proposed structures where the depth of fill is greater than 1.0 m below final grade. The engineered fill placed below structures should be uniformly compacted to at least 98 percent of SPMDD at a moisture content within 2 percent of OMC for fills 1.0 to 1.5 m deep. The control of moisture content is considered to be important for the relatively dry, silty fill, because future wetting of these fill soils may cause significant settlement. These settlements could occur long after original construction depending on changes in the groundwater regime due to development (ie. lawn watering, servicing, etc.) and on normal seasonal conditions. If these density levels cannot be achieved using common fill during site grading, the footing bearing surfaces should be sub cut and underlain with select granular fills compacted to at least 98 percent. The depth of subcut should be determined at the time of construction and will depend on factors such as; age of fill, initial compaction, depth of fill, water table, footing configuration and loads. To reduce settlement potential and compactive effort needed to achieve maximum density, it is recommended that granular fill be placed at moisture contents zero to 2 percent below OMC.

If subgrade conditions are soft, a thicker initial lift may be required to form a working base for subsequent construction. This condition is best addressed in the field at the time of construction. If subgrade conditions warrant the use of subgrade improvement gravel, it is possible, for lower lifts, to use less expensive select coarse gravel with a maximum aggregate size of 150 mm.

6.3 SERVICE TRENCH INSTALLATION

6.3.1 Service Trench Excavation

If communial services are proposed the site may be subject to underground servicing requirements. The side slope of conventional unsupported trench excavations is dependent on the local soil conditions at any given location. Where the deep excavations are proposed, conventional trenched excavations with sloping sides and/or moveable shields are considered to be feasible. The latest edition of the Construction Safety Regulations of the Occupational Health and Safety Act of Alberta should be followed. Open excavations at this site will require relatively flat side-slopes, particularly if wet conditions are encountered due to rain or runoff. Given the availability of space around the site, an open excavation is expected to be most economical. Side-slopes above the groundwater table should be at least 1H:1V or flatter. If saturated zones are encountered within the cut, flatter side slopes and/or dewatering may be required.

The degree of stability of excavated trench walls directly decreases with time and, therefore, construction should be directed at minimizing the length of time service trenches are left open. Groundwater seepage from the sides of the trenches and from the base of the excavation are expected to be encountered after precipitation or snow melt. Base heave and/or boiling of the trench bottom can occur where a significant differential hydrostatic head exists at the bottom of the excavation and soils are not cohesive (eg. silty sand or sand lenses in the till). Dewatering and other pressure relief measures are available to minimize problems with the stability of the trench bottom.

Surface grading should be undertaken so that surface water is not allowed to pond adjacent to service trenches. Surcharge loads, including excavation spoil, should be kept back from the crest of the excavation a minimum distance equal to the excavation depth. Monitoring and maintenance of the slopes should be carried out on a regular basis.

Installation of underground services and utilities requires an observational approach be adopted which should combine past local experience, contractor's experience and geotechnical input. It would be desirable for the selected excavation contractor to be experienced in similar conditions and/or, alternatively, to excavate test pits in advance of construction to familiarize field personnel with subsurface conditions. Quality workmanship is essential, because disturbed wet, cohesionless soils at depth are very expensive measures to rehabilitate.

6.3.2 Pipe Bedding

Minor deflections of the trench bedding are expected. Underground utility pipes should be of a type which will maintain watertight joints (i.e. rubber gasket) after minor shifting has occurred. Bedding requirements are a function of the class of pipe and trench configuration, as well as site specific

geotechnical considerations. In general, granular pipe bedding should be relatively well graded sand or sand gravel mixture which can be readily compacted around the pipe to achieve a high frictional strength. Bedding soils must have an appropriate gradation so that migration of natural soils into the granular system is minimized. Uniform or gap-graded sands and gravels should not be used as bedding materials unless adequate provision is made to surround such soils with a filter fabric or graded granular filter compatible with the existing subsoils.

In the event of significant groundwater seepage or wet base conditions, additional measures may be required. Typically these measures include placement of a working mat of free draining gravel and filter cloth after lowering of the water table and removal of disturbed soils. This layer of gravel is intended to be a safe working base and the thickness required will be based on keeping groundwater below the working surface. The function of the geotextile in pipe bedding applications is to act as a separation barrier between the coarse bedding materials and the native fine grained soils, therefore it needs to be strong enough to withstand construction activity.

6.3.3 Trench Backfill

It is assumed that trench backfill will consist of excavated silty sand, silty clay materials. The native silty sand and silty clay are considered to be suitable for backfill, but may require adjustment of the natural moisture content to achieve proper compaction. Clay till materials are considered ton suitable for use as trench backfill, but must be broken down into smaller pieces in order to allow proper compaction and avoid short term bridging of backfill soils which could lead to long term settlement. Soil used for trench backfill should be free of frozen material, organics, and any other undesirable debris.

To minimize fill settlement under self-weight, it is recommended to use soil with a moisture content within 5 percent of OMC. When excavated soils are excessively wet, the material should be dried or blended prior to use as trench backfill. Suitable replacement soils would include imported sand borrow materials with an appropriate moisture content relative to OMC.

Lift thicknesses for backfill should be governed by the ability of the selected compaction to achieve specified density throughout the entire lift. Uniformity is of most importance. The nominal lift thickness for select granular fill is 200 mm. Clay backfill should be placed in thin lifts with a nominal compacted thickness of 150 mm. This is especially important when backfilling very stiff clay soils. The backfill should be uniformly compacted to a minimum of 95 percent of the SPMDD. For road areas, the backfill should be compacted throughout the depth of the fill to a minimum 97 percent of SPMDD.

Some settlement of the compacted backfill in trenches under self-weight is expected to occur. The magnitude and rate of settlement would be dependent on the backfill soil type, the moisture condition of the backfill at the time of placement, the depth of the service trench, drainage conditions and the initial density achieved during compaction. Density monitoring of backfill placement is recommended to encourage better attention to quality workmanship in placement.

Fill materials with variable moisture contents recompacted as trench backfill would not be expected to provide uniform roadway subgrades for the support of pavement sections. If trench settlement in

road areas is a concern, it is suggested to consider a deep subgrade preparation of the upper 0.5 to 1.0 of the subgrade to help make the subgrade more uniform. This construction procedure is used with success on similar deep trench backfill situations in the City of Red Deer. Design considerations required for roadway subgrade construction on recompacted and natural materials at this site are discussed in the section 6.5 of this report.

To minimize the effects of potential settlements on completed roadway surfaces, it is recommended that staged asphalt pavement construction be adopted and that placement of final asphalt concrete surfacing materials be delayed as long as possible, subsequent to completion of trench backfilling.

6.3.4 Concrete for Underground Structures

Water-soluble sulphate concentrations from the samples tested indicated negligible potential for chemical attack of subsurface concrete. Therefore, General Use (Type GU) hydraulic cement is suitable for use in all subsurface concrete in contact with native soil at the site in accordance with CSA Standard CAN3-A23.1-M04. The recommended minimum 28 day compressive strength is 25 MPa with a water cement ratio of 0.5. All concrete exposed to a freezing environment either during or after construction should be air entrained.

6.4 ROADWAY SUBGRADE CONSTRUCTION

The native surficial soils were estimated to have CBR values in the order of 3 to 8 in a soaked condition depending on the type of subgrade soil. These estimated CBR values are indicative of a low to moderate level of subgrade support. Support in areas of sandy subgrade will provide higher levels of support.

The exposed subgrade surface should be proof-rolled to identify soft areas. Soft areas should be sub-cut and replaced with suitable fill compacted to 95 percent of SPMDD. The depth of excavation should be sufficient to remove the soft material or to bridge over the soft material. The excavation of sensitive soils should be performed by a tracked backhoe rather than dozer equipment to minimize disturbance to the subgrade. The recommended type of subgrade fill would be a relatively clean coarse graded gravel with a maximum aggregate size of 150 mm. A proposed coarse gravel gradation specification is provided below:

TABLE 2
150 mm COARSE GRADED GRAVEL

Sieve Size (mm)	Percent Passing By Weight
150	100
75	80 - 100
25	50 - 75
5	25 - 55
0.08	2 - 10

This material is generally placed at the same time as the granular subbase of the pavement section resulting in a thick lift of coarse granular material below the asphalt and base course gravel layers. Based on local experience, the gravel subbase thickness required to establish a stable construction base will be in the order of 200 mm to 500 mm.

Construction procedures should be designed to minimize disturbance to the subgrade. If the subgrade is failed during construction, it can lead to costly replacement of weakened soils. The need for any special construction procedures is best determined based on observations at the time of construction. Therefore, construction of roads will require careful monitoring by an experienced soils technician to avoid costly construction problems.

6.5 FLEXIBLE PAVEMENT DESIGN

Proposed pavement designs for roads and RV pads are expected to undergo light traffic within this RV Resort. For design purposes the Design Traffic in equivalent axle loads (80 kN axles) is 1×10^5 for the local road. The pavement sections provided below are based on a design CBR of 3 for the native subgrade in a soaked condition or a subgrade which has been improved to an equivalent level as described in Section 6.4. The majority of surficial soils across this site are expected to meet this minimum subgrade support condition. Based on these assumptions the following flexible pavement sections for both asphalt concrete pavement and gravel pavements are proposed:

TABLE 3
FLEXIBLE PAVEMENT DESIGN

	Local Road or Parking Pads		
Design Traffic (ESAL's)	1×10^5		
Asphalt Concrete 25 mm Crushed Base Gravel Granular Sub-Base (minimum)	- 300 -	- 150 mm 300 mm	75 mm 250 mm

The base and subbase layer given above is a minimum assuming the subgrade is stable. Based on local experience, there is the potential for some localized soft or sensitive areas. If subgrade improvement gravel is required, it may be placed with the subbase in a single lift, effectively increasing the subbase layer. Local experience suggests a total course gravel subbase layer of 500 mm to 800 mm may be required depending on weather and subsurface conditions at the time of construction.

The performance of the proposed pavement design sections will be, in part, dependent on achieving an adequate level of compaction in subgrade and pavement materials. The recommended levels of compaction for the granular materials in the pavement section should be a minimum of 98 percent of SPMDD. The asphalt concrete should be compacted to a minimum of 97 percent of Marshall density based on a 50 blow laboratory Marshall test for the local streets and a 75 blow Marshall test for the collector roads.

Pavement materials should conform to the Lacombe County specifications. Alternatively, the following pavement specifications are recommended.

TABLE 4
ASPHALT CONCRETE

Stability (kN minimum)	5.4
Flow (mm)	2 - 4
Air Voids (percent)	3 - 5
VMA (minimum percent)	14.5
Asphalt Cement (penetration grade)	150-200 (A)

Aggregate materials for base and subbase gravel should be composed of sound, hard, durable particles free from organics and other foreign material. It is recommended to use aggregates conforming to the following Alberta Transportation (AT) specifications.

TABLE 5
RECOMMENDED AGGREGATE SPECIFICATIONS

	AT Specifications
Asphalt Gravel	Designation 1, Class 16
Crushed Base Gravel	Designation 2, Class 20 or 25
Subbase Gravel	Designation 2, Class 50

A copy of the Alberta Transportation aggregate specification is provided in Appendix A. Based on availability of local materials at the time of tendering or construction, alternate materials could be considered upon review by the geotechnical engineer. One alternative specification for subbase is gravel meeting the gradation given in Table 2, Section 6.4 of this report.

If a geotextile is required to act as a separation barrier between the subgrade and gravel layer, the recommended geotextile specification would be:

Minimum Grab Tensile Strength	900 N
Maximum Elongation at Break	30 percent
Minimum Mullen Burst Strength	2500 kPa
Minimum Tear Strength	400 N
Maximum Equivalent Opening Size	600 microns

Woven fabrics typically have more favourable stress/strain characteristics (30% elongation at failure) than non-woven filter fabrics (100 % elongation at failure). Therefore, the woven fabric will mobilize more strength as the subgrade deflects under construction traffic loads. Non-woven fabrics would be suitable for use as a separation barrier in subdrainage trenches. Proposed geosynthetic filter fabrics should be reviewed based on the proposed end use. A slightly less robust geotextile could be given consideration if initial field performance ratings dictate. If sand fill is used on top of the native subgrade, a filter fabric is not required because there is limited potential for upward migration of fines and no need for a separation barrier.

The road surface should be sloped and graded to effectively remove all surface water as rapidly as possible. To minimize the occurrence of surface water ponding in the roadways, finished surface grades and cross slopes in the order of two percent are recommended. Allowing water to pond on the

pavement surface will lead to infiltration of water into the subgrade which could result in weakening of the subgrade soils.

No special pre-design considerations are given to thickening the pavement section over backfilled trenches. The settlement of trenches is caused mainly by the long term self weight of the fill, not the short term live loads from traffic. The road section or the thickness of granular subbase placed in the road bed should be determined by the level of support expected from the subgrade based on field observations. To minimize distress to pavement structures, trench backfill should be compacted to the higher density levels as previously recommended. To minimize the effects of potential settlements on completed roadway surfaces, it is recommended that staged asphalt pavement construction be adopted and that placement of final asphalt concrete surfacing materials be delayed as long as possible subsequent to completion of trench backfilling.

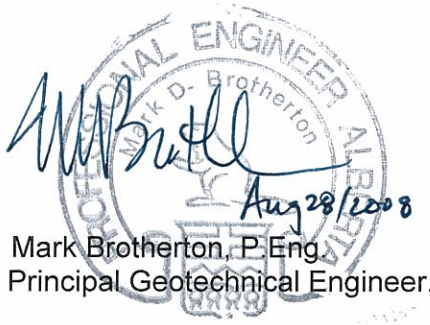
6.6 INSPECTION

During construction, it is recommended that on-site construction testing and monitoring be performed to verify that actual site conditions are consistent with assumed conditions and actual conditions meet or exceed design criteria. Based on Alberta Building Code, adequate levels of inspection are considered to be: review of all completed bearing surface prior to concrete placement; full time monitoring of deep foundations and monitoring, and compaction control of engineered fill.

7.0 LIMITATIONS

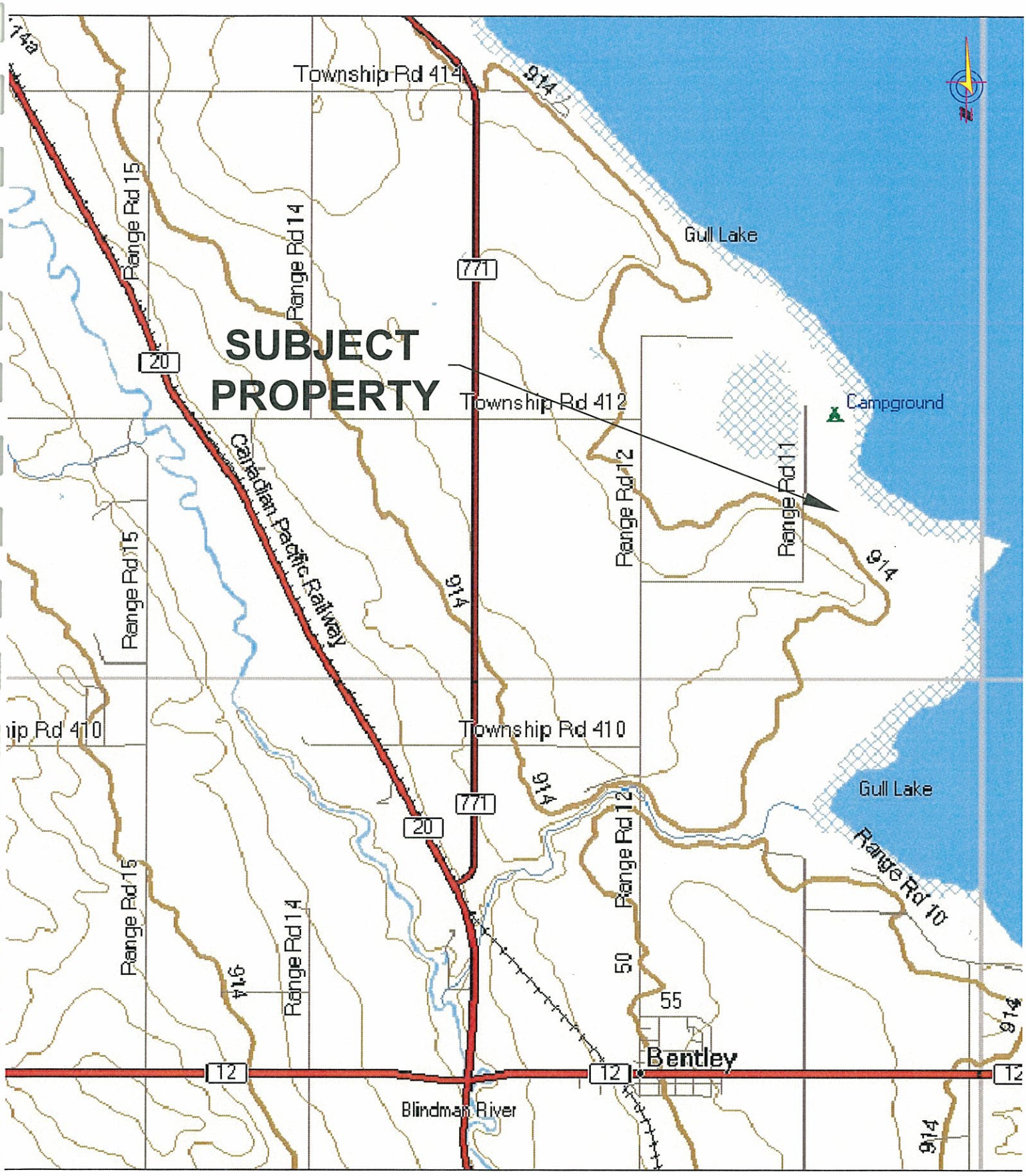
This report is based on local experience and the findings at twenty five borehole locations. If different subsoil and groundwater conditions be encountered, this office should be notified and recommendations submitted herein will be reviewed and revised as required. This report has been prepared for the exclusive use of **A.D. Williams Engineering Inc.**, and their approved agents for specified application to the proposed Sandy Point - Gull Lake Development in 1-41-1-W5, NW-SW 12-41-1-W5 in Lacombe County, Alberta. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Respectfully Submitted,
PARKLAND GEOTECHNICAL CONSULTING LTD.
A.P.E.G.G.A. Permit #07312



Minqiang Tu M.Eng., P.Eng.
Geotechnical Engineer

Mark Brotherton, P.Eng.
Principal Geotechnical Engineer.

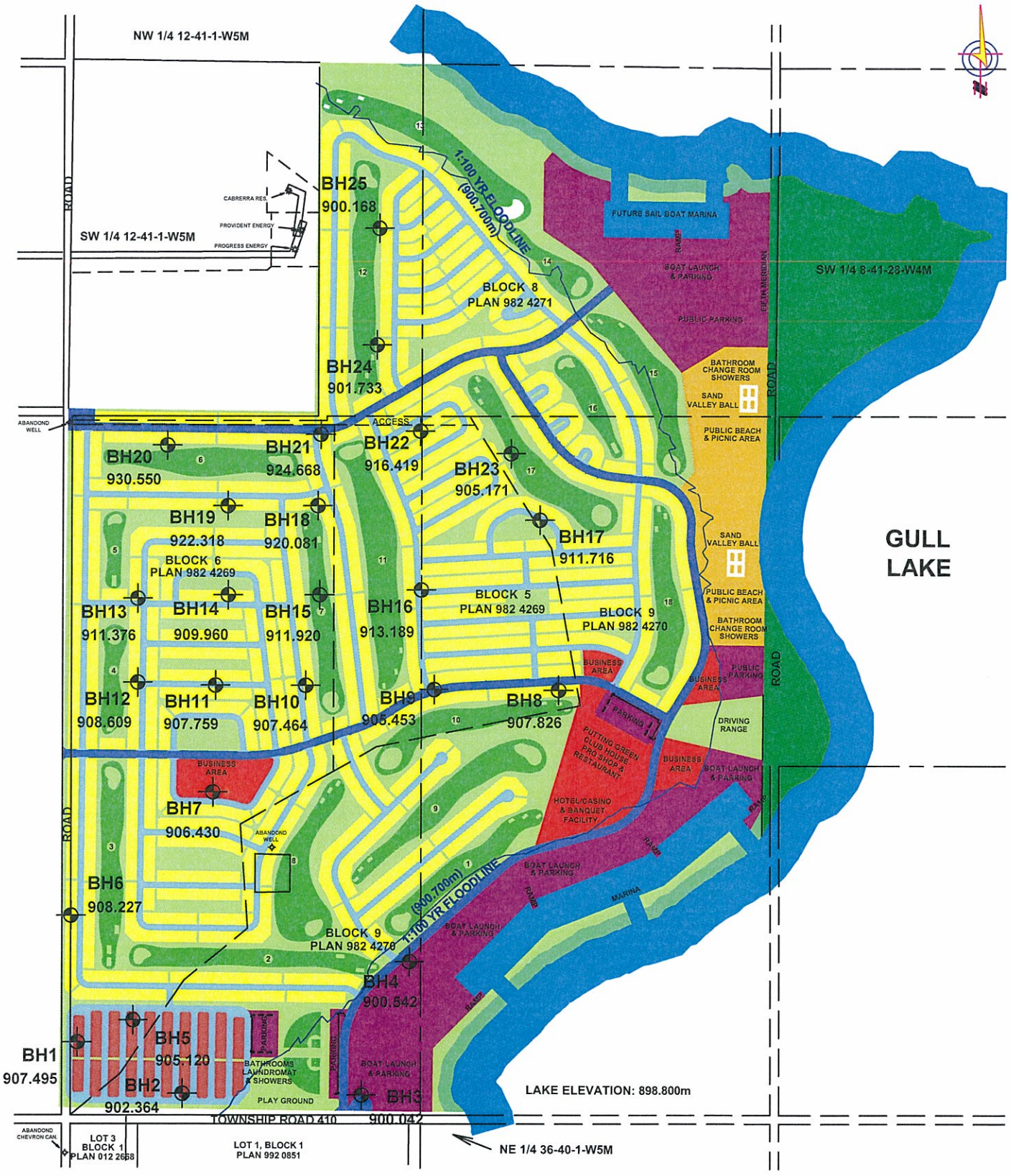


Parkland GEO	CLIENT: A. D. Williams Engineering Inc. Consulting Engineers	**KEY PLAN**

PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1W5M, NW-SW 12-41-1-W5M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	AUGUST 2008

SCALE:	JOB NO.	DRAWING NO.
NTS	RD2894	FIGURE 1



APPROXIMATE BOREHOLE LOCATIONS

Parkland GEO

CLIENT:

A. D. Williams Engineering Inc.
Consulting Engineers

SITE PLAN

PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1-W5M, NW-SW 12-41-1-W5M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	AUGUST 2008

SCALE:	JOB NO.	DRAWING NO.
1:12500	RD2894	FIGURE 2

Parkland GEO

CLIENT:

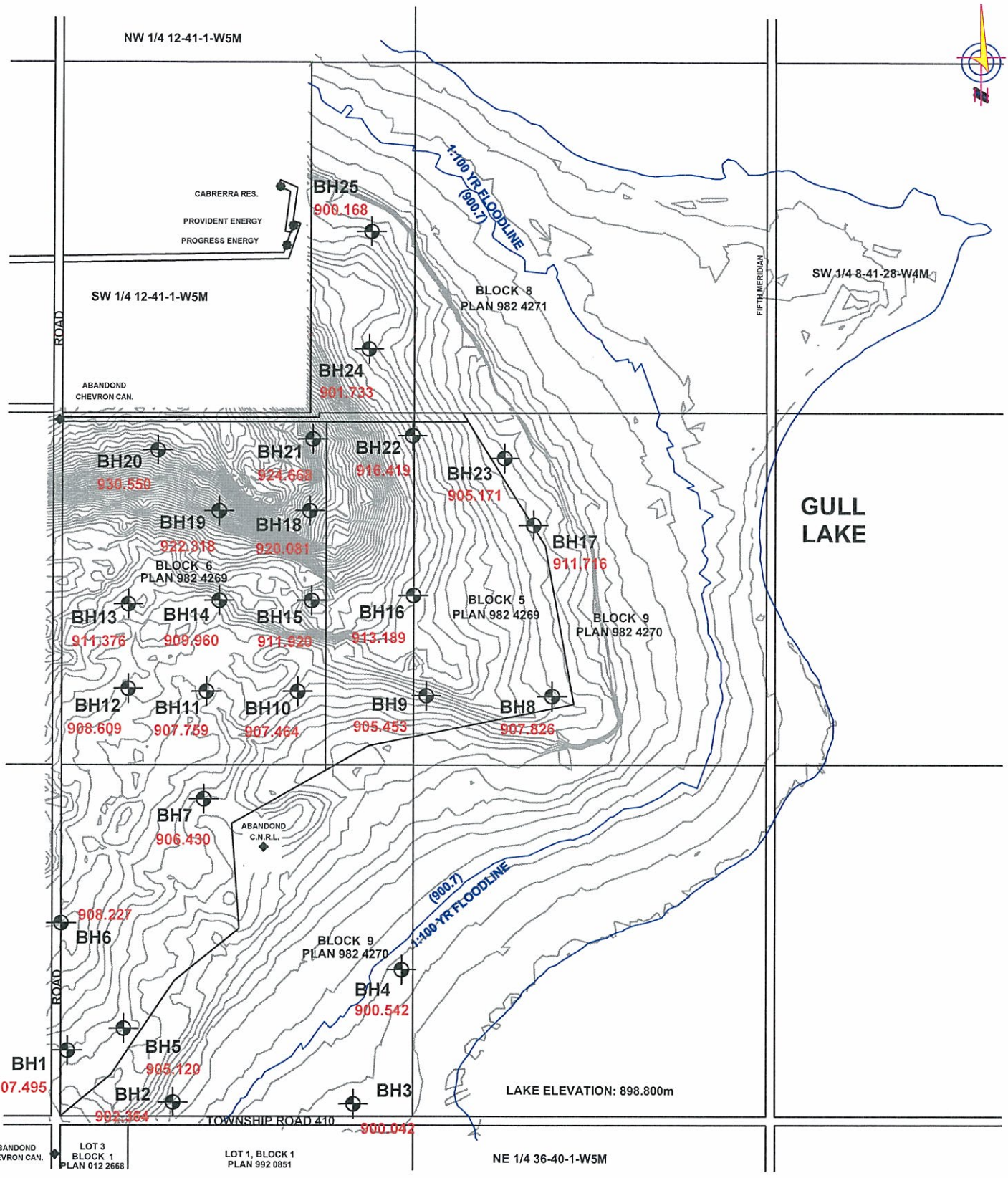
A. D. Williams Engineering Inc.
Consulting Engineers

2007 AERIAL

PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1-W5M, NW-SW 12-41-1-W5M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	AUGUST 2008

SCALE:	JOB NO.	DRAWING NO.
1:12500	RD2894	FIGURE 3



APPROXIMATE BOREHOLE LOCATIONS

Parkland GEO

CLIENT:

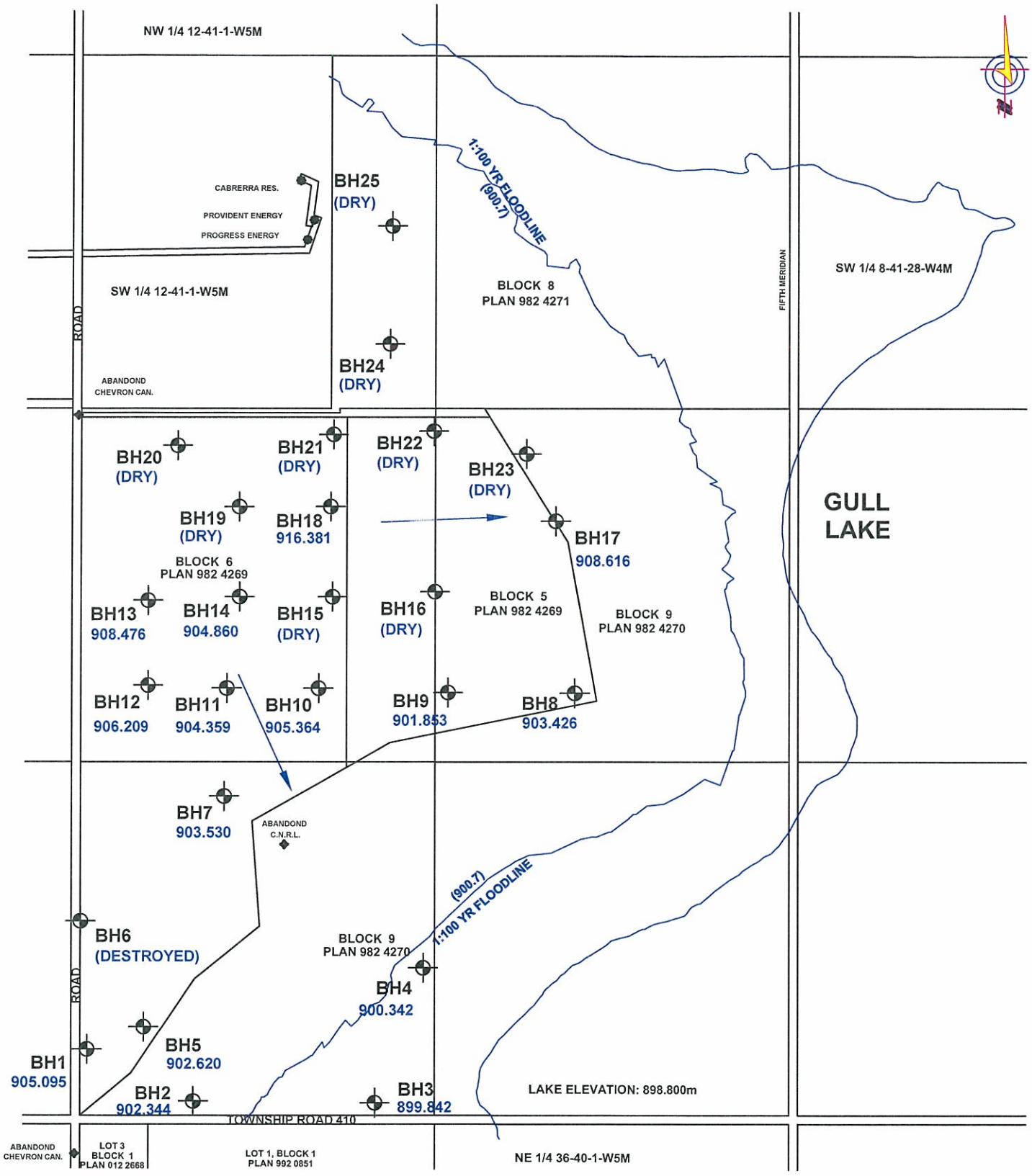
A. D. Williams Engineering Inc.
Consulting Engineers

CONTOUR PLAN

PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1-W5M, NW-SW 12-41-1-W5M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	AUGUST 2008

SCALE:	JOB NO.	DRAWING NO.
1:12500	RD2894	FIGURE 4



APPROXIMATE BOREHOLE LOCATIONS

NOTE: INFERRED GROUNDWATER DIRECTION

Parkland GEO

CLIENT:

A. D. Williams Engineering Inc.
Consulting Engineers

GROUNDWATER ELEVATIONS

PROPOSED SANDY POINT - GULL LAKE DEVELOPMENT
1-41-1-W5M, NW-SW 12-41-1-W5M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	AUGUST 2008

SCALE:	JOB NO.	DRAWING NO.
1:12500	RD2894	FIGURE 5

Parkland GEO

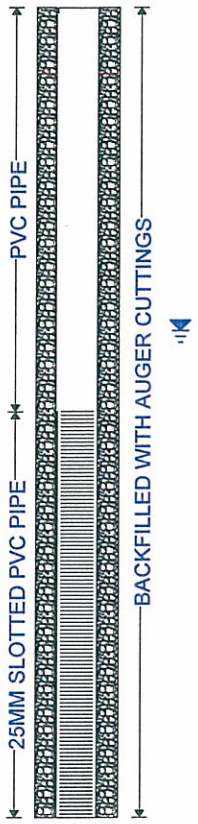
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 1

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								907.50
	Topsoil Moderately organic, black, moist.			G	1G1				
1	***Clay*** Silty, trace sand, firm, medium plastic, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=45% SILT=38% SAND=17& GRAVEL=0%		
					1D1	7			
2	-trace sand at 2.0m.						SO4=0.04%		905.60
									904.70
3	***Till*** Clay, silty, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.								
4				G	1G2				
5					1D2	15			
6									901.50
	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.4m on May 5, 2008.								
7									
8									
9									
10									897.50



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 907.495
NORTHING:
EASTING:

Parkland GEO

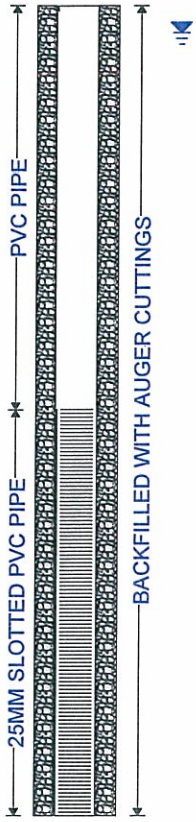
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 2

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								902.36
0	***Topsoil*** Moderately organic, black, moist.								
1	***Clay*** Silty, trace sand, soft to firm, medium plastic, brown, moist.								
2	-little gravel at 2.0m				2D1	4			900.46
2	-wet at 2.6m.								899.86
3	***Till*** Clay, silty, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.								899.36
5					2D2	9			
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Wet upon completion. Water level at 0.2m on May 5, 2008.								896.36
10									892.36



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 902.364
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 3

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								900.04
0	***Topsoil*** Moderately organic, black, moist.								
	Till Clay, silty, trace gravel, stiff to very stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.						GRAIN SIZE ANALYSIS: CLAY=35% SILT=35% SAND=29% GRAVEL=1% SO4=0.04%	PVC PIPE; BACKFILLED WITH AUGER CUTTINGS	
1									
2									
3					3D1	10			
4									
5	-wet at 5.0m.							25MM SLOTTED PVC PIPE	895.14
6					3D2	16			893.54
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 0.2m on May 5, 2008.								
8									
9									
10									890.04

LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 900.042
NORTHING:
EASTING:

Parkland GEO

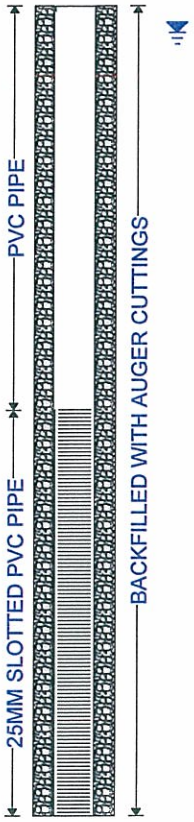
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 4

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								900.54
	Topsoil Moderately organic, black, moist.								900.24
	Sand Silty, little clay, fine grained, poorly graded, loose, brown, moist.			G	4G1				
1	***Clay*** Silty, trace sand, firm to stiff, medium plastic, brown, occasional rust stains, moist.						GRAIN SIZE ANALYSIS: CLAY=40% SILT=43% SAND=17% GRAVEL=0%		
					4D1	8			
2	***Till*** Clay, silty, sandy, trace gravel, firm, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.								898.54
3									
4									
					4D2	7			
5									
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Wet upon completion. Water level at 0.2m on May 5, 2008.								894.54
7									
8									
9									
10									890.54



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 900.542
NORTHING:
EASTING:

Parkland GEO

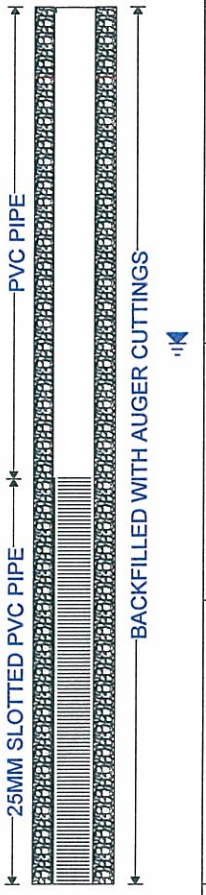
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 5

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								905.12
0	***Topsoil*** Moderately organic, black, moist.								
	Clay Silty, sandy, firm to stiff, low plastic, brown, moist.						SO4=0.04%		
2									902.62
	Till Clay, silty, sandy, trace gravel, firm, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.			G	5G1				
3					5D1	11			
4	-wet at 4.5m.								900.72
5									
6					5D2	16	No Sample Recovery		898.62
	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Wet upon completion. Water level at 2.5m on May 5, 2008.								
7									
8									
9									
10									895.12



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 905.120
NORTHING:
EASTING:

Parkland GEO

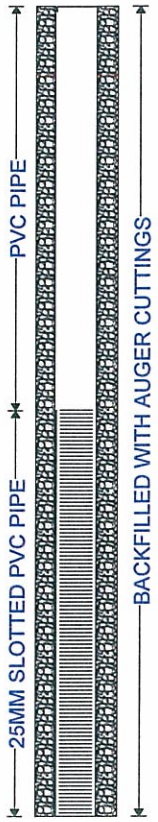
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 6

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								908.23
0	***Topsoil*** Moderately organic, black, moist.								
1	***Sand*** Silty, clayey, fine grained, poorly graded, loose, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=19% SILT=18% SAND=63% GRAVEL=0%		
2	***Clay*** Silty, trace sand, firm, low plastic, brown, moist.				6D1	5			906.73
3	***Till*** Clay, silty, sandy, stiff to very stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.								905.73
4									
5					6D2	16			
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Standpipe destroyed May 5, 2008.								902.23
7									
8									
9									
10									898.23



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 908.227
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 7

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								906.43
	Topsoil Moderately organic, black, moist.			G	7G1				
1	***Clay*** Silty, trace sand, firm, medium plastic, brown, moist.		•						
2			•				SO4=0.04%		
									903.93
	Till Clay, silty, sandy, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.								
3			•		7D1	13			
4			•						
5			•						
6			•		7D2	14			
									899.93
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.9m on May 5, 2008.								
8									
9									
10									896.43

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 906.430
NORTHING:
EASTING:

Parkland GEO

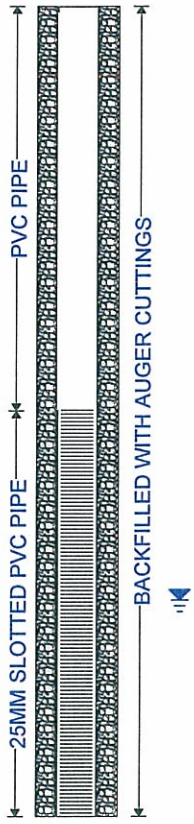
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 8

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								907.83
	Topsoil Moderately organic, black, moist.								
	Clay Silty, trace sand, firm, low plastic, brown, moist.								906.93
1	***Till*** Clay, silty, sandy, stiff to very stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.						GRAIN SIZE ANALYSIS: CLAY=34% SILT=37% SAND=28% GRAVEL=1%		
2					8D1	19			
3									
4									
5					8D2	14			
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 4.4m on May 5, 2008.								901.83
7									
8									
9									
10									897.83



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 907.826
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 9

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								905.45
	Topsoil Moderately organic, black, mosit.								905.05
1	***Sand*** Silty, fine grained, poorly graded, loose, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=39% SILT=38% SAND=23% GRAVEL=0%		
	Till Clay, silty, sandy, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.						SO4=0.04%		
2									
3					9D1	15			
4									
5									
6	-sand lens at 6.3m.				9D2	12			899.25
									898.95
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 3.6m on May 5, 2008.								
8									
9									
10									895.45

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 905.453
NORTHING:
EASTING:

Parkland GEO

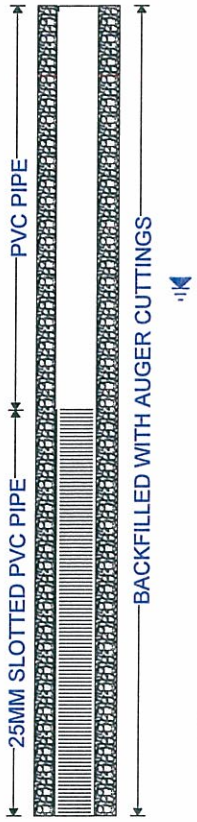
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 10

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								907.46
	Topsoil Moderately organic, black, moist.								
1	***Clay*** Silty, sandy, trace gravel, stiff, low plastic, brown, moist.								906.26
	Till Clay, silty, sand, trace gravel, stiff to very stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.				10D1	10			
2									
3									
4	-wet at 4.3m. -sand lens at 4.4m.			G	10G1				903.26
					10D2	16			
5									
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Wet upon completion. Water level at 2.1m on May 5, 2008.								901.46
7									
8									
9									
10									897.46



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 907.464
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 11

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								907.76
0	***Topsoil*** Moderately organic, black, moist.								907.36
1	***Sand*** Silty, fine grained, poorly graded, loose, brown, moist.								
	Clay Silty, sandy, trace gravel, stiff, low plastic, brown, moist.						SO4=0.04%		
2									905.36
	Till Clay, silty, sandy, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.								
3					11D1	11			
4									
5									
6					11D2	16			901.26
	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Wet upon completion. Water level at 3.4m on May 5, 2008.								
7									
8									
9									
10									897.76

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 907.759
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 12

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								908.61
0	***Topsoil*** Moderately organic, black, moist.			G	12G1				
1	***Clay*** Silty, sandy, trace gravel, stiff, low plastic, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=38% SILT=38% SAND=23% GRAVEL=1%		907.61
	Till Clay, silty, sandy, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.				12D1	9		PVC PIPE; BACKFILLED WITH AUGER CUTTINGS	
2									
3									
4									
					12D2	15		25MM SLOTTED PVC PIPE	
5									
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.4 on May 5, 2008.								902.61
7									
8									
9									
10									898.61

LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 908.609
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 13

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								911.38
0	***Topsoil*** Moderately organic, black, moist.								911.18
1	***Clay*** Silty, little sand, firm, low plastic, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=35% SILT=46% SAND=18% GRAVEL=1%		909.88
2	***Till*** Clay, silty, trace sand, stiff to very stiff, medium plastic, brown, moist. -occasion coal inclusions at 1.8m. -trace gravel at 2.3m.						SO4=0.04%		909.68 / 909.18
3					13D1	8			
4									
5									
6	-little sand at 6.1m.				13D2	16			905.38 / 904.88
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.9m on May 5, 2008.								
8									
9									
10									901.38

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 911.376
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 14

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m)
0	GROUND SURFACE	909.96
	Topsoil Moderately organic, black, moist.	909.76
	Sand Little silt, trace gravel, fine grained, poorly graded, soft, brown, moist.	909.06
1	***Till*** Clay, silty, trace sand, trace gravel, stiff, low plastic, brown, moist.	
2		
3		
4	-medium plastic at 4.3m.	905.76
5		
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 5.1m on May 5, 2008.	903.96
7		
8		
9		
10		899.96

Moisture (Wp |-----X-----| Wl) 25 50 75

Type	Sample No	SPT (N)	Comments
G	14G1		GRAIN SIZE ANAYSIS: CLAY=39% SILT=34% SAND=26% GRAVEL=1%
	14D1	11	SO4=0.04%
	14D2	9	

Well Completion Details: PVC PIPE; BACKFILLED WITH AUGER CUTTINGS; 25MM SLOTTED PVC PIPE

LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 909.960
NORTHING:
EASTING:

Parkland GEO

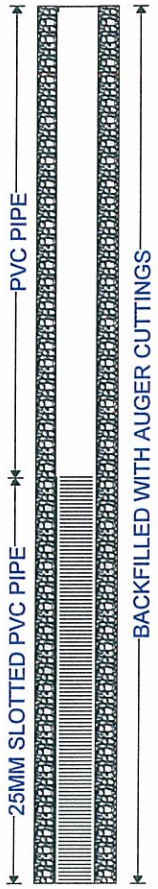
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 15

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								911.92
0	***Topsoil*** Moderately organic, black, moist.								911.67
	Clay Silty, trace sand, trace gravel, stiff, low plastic, brown, moist. -occasion coal inclusions at 1.3m.								910.72
2	***Till*** Clayey, silty, trace sand, trace gravel, stiff, medium plastic, brown, moist. -occasion rust stains at 2.5m.						SO4=0.04%		910.02
									909.52
3					15D1	50	Hit a rock.		
4	-little sand at 4.0m.								908.02
5									
6					15D2	9			
	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								905.42
7									
8									
9									
10									901.92



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 911.920
NORTHING:
EASTING:

Parkland GEO

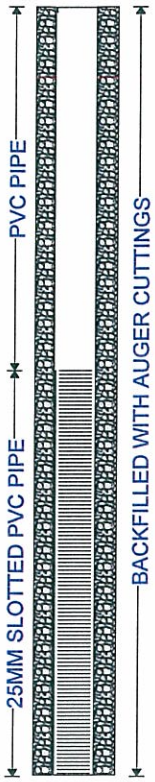
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 16

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								913.19
0	**Topsoil** Moderately organic, black, moist.			G	16G1				912.99
	Clay Silty, low plastic, soft, brown, moist.								912.29
1	**Sand** Silty, clayey, trace gravel, loose, non plastic, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=13% SILT=20% SAND=60% GRAVEL=6%		911.69
	Till Clay, silty, trace gravel, stiff, low plastic, brown, moist.				16D1	12			
2									
3									
	-occasional rust stains at 3.8m.								909.49
4									908.79
	-medium plastic at 4.5m.				16D2	10			908.39
5	-some sand at 4.9m.								
	Weathered Bedrock Sandstone, hard, brown, moist.								907.79
6	End of hole at 5.7m due to auger refusal. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								907.49
7									
8									
9									
10									903.19



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 913.189
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 17

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								911.72
	Topsoil Moderately organic, black, moist.								911.52
1	**Clay** Silty, little sand, stiff, low plastic, brown, moist.		•				GRAIN SIZE ANALYSIS: CLAY=43% SILT=39% SAND=17% GRAVEL=1%		910.32
2	**Till** Clay, silty, trace sand, medium plastic, stiff, brown, moist. -occasional rust stains and coal inclusions at 2.5m.		•				SO4=0.04%		909.32
3			•		17D1	10			
4	-wet at 4.8m.		•						907.12
5	**Weathered Bedrock** Sandstone, hard, grey, wet.		•						906.82
6			•		17D2	20			905.22
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Wet upon completion. Water level at 3.1m on May 5, 2008.								
8									
9									
10									901.72

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 911.716
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 18

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								920.08
	Topsoil Moderately organic, black, moist.								919.88
	Clay Silty, trace sand, firm, low plastic, brown, moist. -occasional coal inclusions at 0.9m. -trace gravel at 1.3m.			G	18G1				918.68
	Till Clay, silty, trace sand, stiff to hard, low plastic, brown, dry to moist.				18D1	12			917.28
	-very stiff at 2.9m.								915.98
	-hard at 4.2m.				18D2	38			915.28
	-some clay at 4.9m.								914.08
	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 3.7m on May 5, 2008.								910.08

PVC PIPE
25MM SLOTTED PVC PIPE
BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 920.081
NORTHING:
EASTING:

Parkland GEO

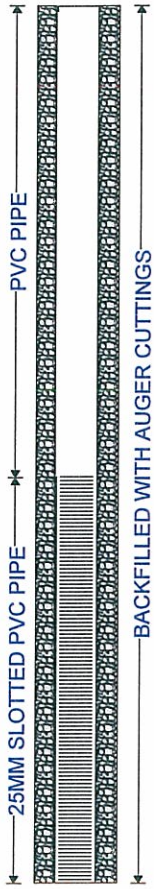
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 19

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								922.32
	Topsoil Moderately organic, black, moist.								922.12
1	***Clay*** Silty, trace sand, low plastic, firm, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=34% SILT=36% SAND=30% GRAVEL=0%		921.32
	Till Clay, silty, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.			G	19G1				
2									
3					19D1	10			
4									
5									
6					19D2	13			
	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								915.82
7									
8									
9									
10									912.32



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 922.318
NORTHING:
EASTING:

Parkland GEO

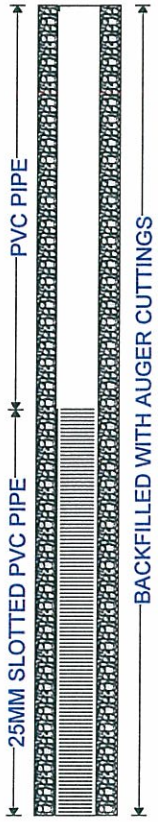
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 20

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								930.55
	Topsoil Moderately organic, black, moist.								930.35
	Sand Silty, fine grained, poorly graded, non plastic, brown, moist.								929.75
1	***Till*** Clay, silty, sandy, trace gravel, low plastic, stiff, brown, moist.						GRAIN SIZE ANALYSIS: CLAY=27% SILT=42% SAND=30% GRAVEL=1%		
2	-some sand at 2.5m. -little clay at 2.6m.								928.15
3									
4				G	20G1				
5									
6				G	20G2				924.55
	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								
7									
8									
9									
10									920.55



LOGGED BY: CJ
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 930.550
NORTHING:
EASTING:

Parkland GEO

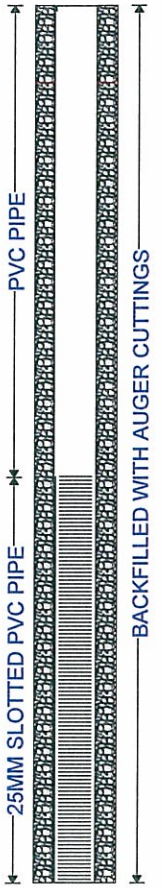
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 21

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								924.67
	Topsoil Moderately organic, black, moist.								924.42
1	***Clay*** Silty, firm to stiff, low plastic, brown, moist. -trace gravel at 0.5m.								
									922.87
2	***Till*** Clay, silty, sandy, trace gravel, stiff, low plastic, brown, occasional coal inclusions, occasional rust stains, moist.								922.17
3	***Weathered Bedrock*** Sandstone, hard, brown, moist. -dense at 2.7m.				21D1	50			
4									
5									
6					21D2	50			918.17
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								
8									
9									
10									914.67



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 924.668
NORTHING:
EASTING:

Parkland GEO

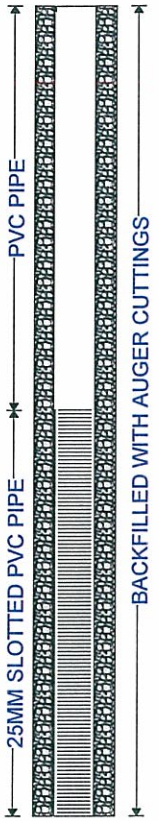
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 22

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								916.42
0	**Topsoil** Moderately organic, black, moist.								916.22
	Clay Silty, firm, low plastic, brown, moist.			G	22G1				915.92
1	**Till** Clay, sitly, sandy, trace gravel, stiff, low plastic, brown, occasional coal inclusions, occasional rust stains, moist.						GRAIN SIZE ANALYSIS: CLAY=35% SILT=38% SAND=26% GRAVEL=1%		
2					22D1	12			
3									913.12
	Weathered Bedrock Sandstone, hard, brown, moist.								
4									
5					22D2	50			
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								910.42
7									
8									
9									
10									906.42



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 916.419
NORTHING:
EASTING:

Parkland GEO

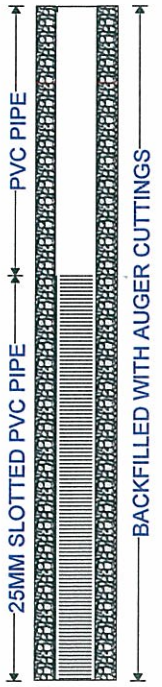
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 23

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								905.17
0	***Topsoil*** Moderately organic, black, moist.								904.97
	Clay Silty, firm, low plastic, brown, moist.			G	23G1				904.57
1	***Till*** Clay, silty, sandy, trace gravel, stiff to very stiff, medium plastic, brown, moist.								
2									
3					23D1	17			901.57
4	***Weathered Bedrock*** Sandstone, hard, brown, moist.								
5	End of hole at 5.0m. Auger refusal at 5.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								900.17
6									
7									
8									
9									
10									895.17



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 905.171
NORTHING:
EASTING:

Parkland GEO

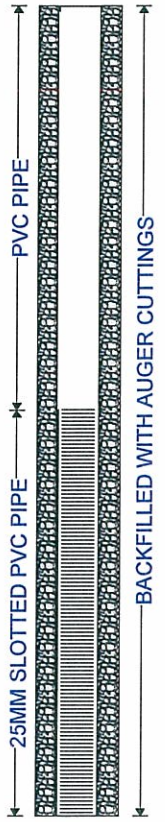
CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 24

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								901.73
	Topsoil Moderately organic, black, moist.								901.53
1	***Clay and Silt*** Trace sand, firm, low plastic, brown, moist. -some sand at 1.3m.								900.53
					24D1	17			900.03
2	***Sand*** Silty, trace clay, fine grained, poorly graded, compact, brown, moist.								
3									897.93
4	***Till*** Clay, silty, sandy, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, moist.								
					24D2	11			
5									
6	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								895.73
7									
8									
9									
10									891.73



LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 901.733
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Inc.
SITE: 1-41-1W5, NW-SW 12-41-1W5
NOTES:

BOREHOLE NO.: 25

PROJECT NO.: RD2894
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								900.17
	Topsoil Moderately organic, black, moist.								899.97
	Clay Silty, trace sand, trace gravel, low plastic, stiff, brown, moist.			G	25G1				899.17
1	***Till*** Clay, silty, sandy, trace gravel, stiff, medium plastic, brown, occasional coal inclusions, occasional rust stains, moist.						GRAIN SIZE ANALYSIS: CLAY=33% SILT34% SAND=33% GRAVEL=0% SO4=0.04%		
2									
3					25D1	11			
4									
5									
6					25D2	14			
	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Well dry on May 5, 2008.								893.67
7									
8									
9									
10									890.17

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH AUGER CUTTINGS

LOGGED BY: CB
CONTRACTOR: J.E.D. Anchors & Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 24, 2008
CALIBRATION:

GROUND ELEVATION: 900.168
NORTHING:
EASTING:

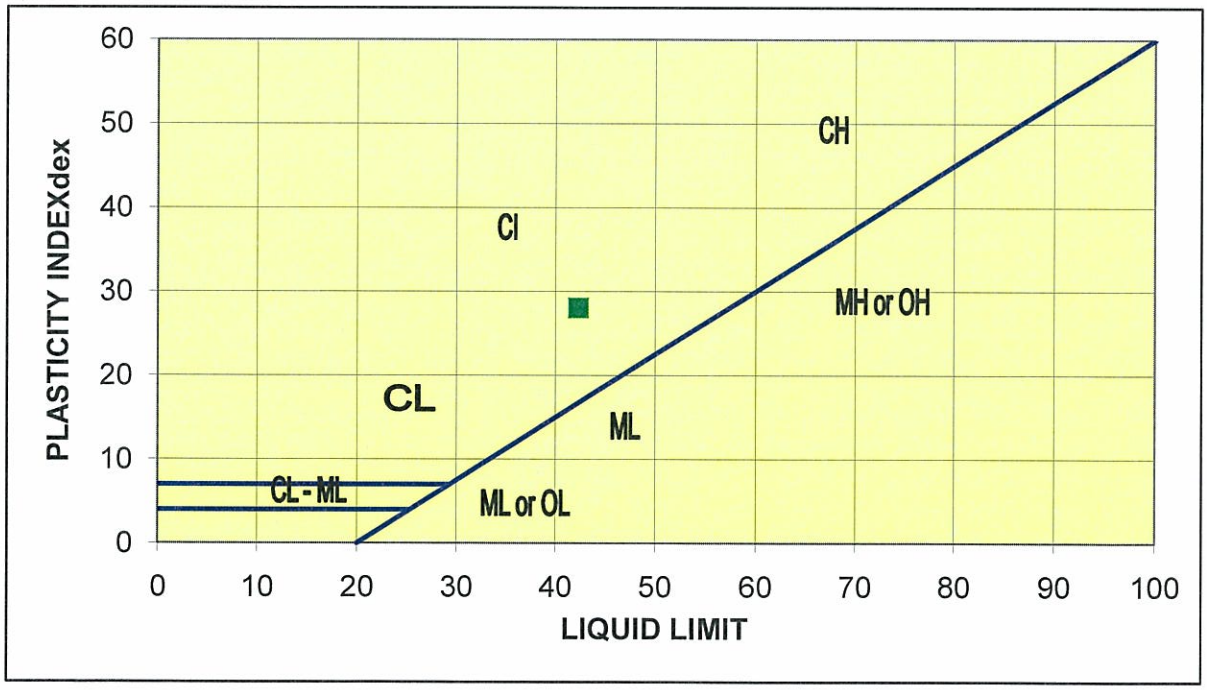
PROJECT# RD2894
PROJECT Sandy Point - Gull Lake Development
BOREHOLE 1
DEPTH 1.0 m
SAMPLE # MC1
DATE July 15/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	29	30
Wt. Sample Wet + Tare	45.831	45.867
Wt. Sample Dry + Tare	37.120	37.208
Wt. Water	8.711	8.659
Tare Container	16.241	16.188
Wt. Dry Soil	20.879	21.020
Moisture Content	41.721	41.194
Corrected for Blow Count	42.477	42.113
Liquid Limit Average	**42.3**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.783	8.570	8.751
Wt. Dry Worm + Tare	8.474	8.291	8.443
Wt. Water	0.309	0.279	0.308
Tare Container	6.281	6.355	6.280
Wt. Dry Worm	2.193	1.936	2.163
Moisture Content	14.090	14.411	14.239
Plastic Limit Average		**14.2**	

PLASTICITY INDEX (PI) = LL-PL	**28.0**



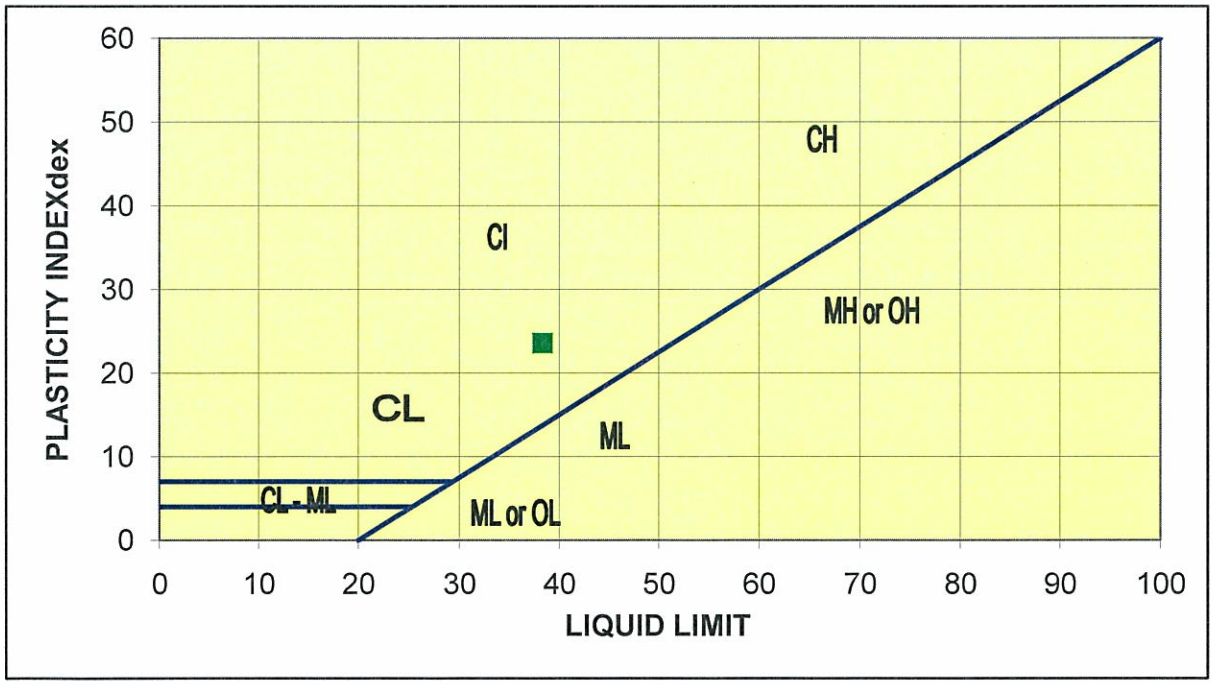
PROJECT# RD2894
PROJECT Sandy Point - Gull Lake Development
BOREHOLE 9
DEPTH 1.0 m
SAMPLE # MC1
DATE July 15/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	20	21
Wt. Sample Wet + Tare	43.298	44.945
Wt. Sample Dry + Tare	35.607	36.943
Wt. Water	7.691	8.002
Tare Container	16.213	16.340
Wt. Dry Soil	19.394	20.603
Moisture Content	39.657	38.839
Corrected for Blow Count	38.600	38.028
Liquid Limit Average	**38.3**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.623	8.454	8.590
Wt. Dry Worm + Tare	8.324	8.172	8.301
Wt. Water	0.299	0.282	0.289
Tare Container	6.304	6.267	6.324
Wt. Dry Worm	2.020	1.905	1.977
Moisture Content	14.802	14.803	14.618
Plastic Limit Average		**14.7**	

PLASTICITY INDEX (PI) = LL-PL	**23.6**



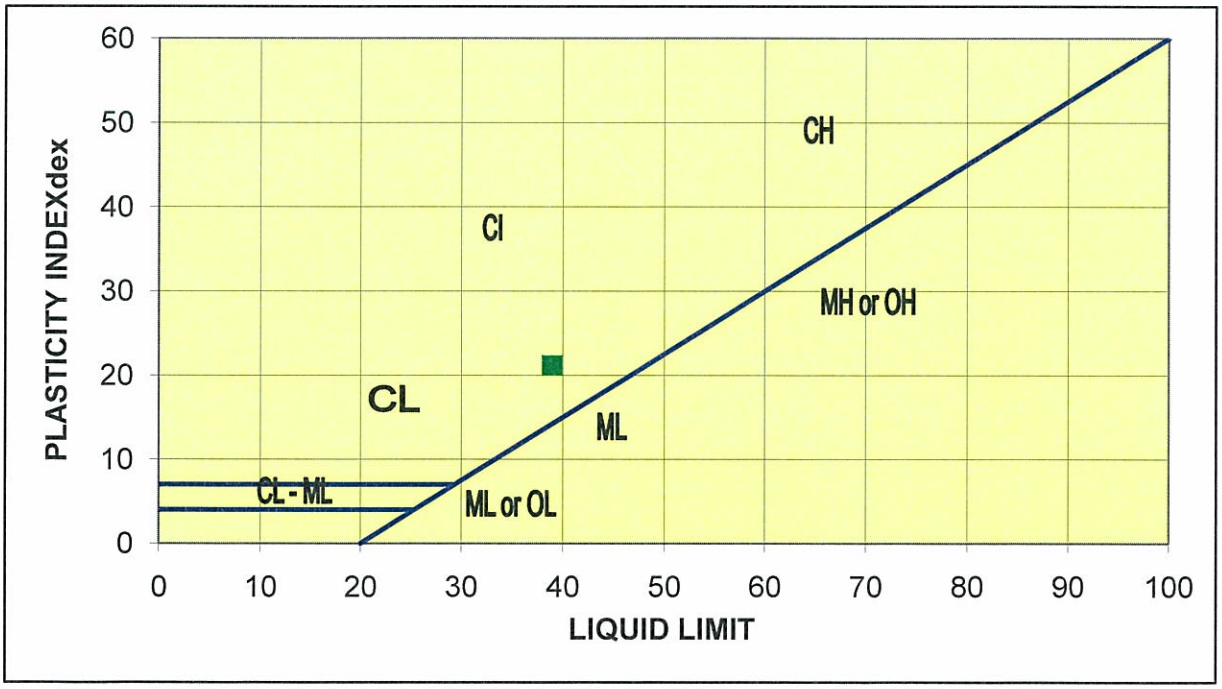
PROJECT# RD2894
PROJECT Sandy Point - Gull Lake Development
BOREHOLE 13
DEPTH 1.0 m
SAMPLE # MC1
DATE July 15/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	27	28
Wt. Sample Wet + Tare	46.574	45.864
Wt. Sample Dry + Tare	38.125	37.627
Wt. Water	8.449	8.237
Tare Container	16.180	16.227
Wt. Dry Soil	21.945	21.400
Moisture Content	38.501	38.491
Corrected for Blow Count	38.861	39.022
Liquid Limit Average	**38.9**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.337	8.608	8.737
Wt. Dry Worm + Tare	8.025	8.274	8.366
Wt. Water	0.312	0.334	0.371
Tare Container	6.292	6.346	6.309
Wt. Dry Worm	1.733	1.928	2.057
Moisture Content	18.003	17.324	18.036
Plastic Limit Average		**17.8**	

PLASTICITY INDEX (PI) = LL-PL **21.2**



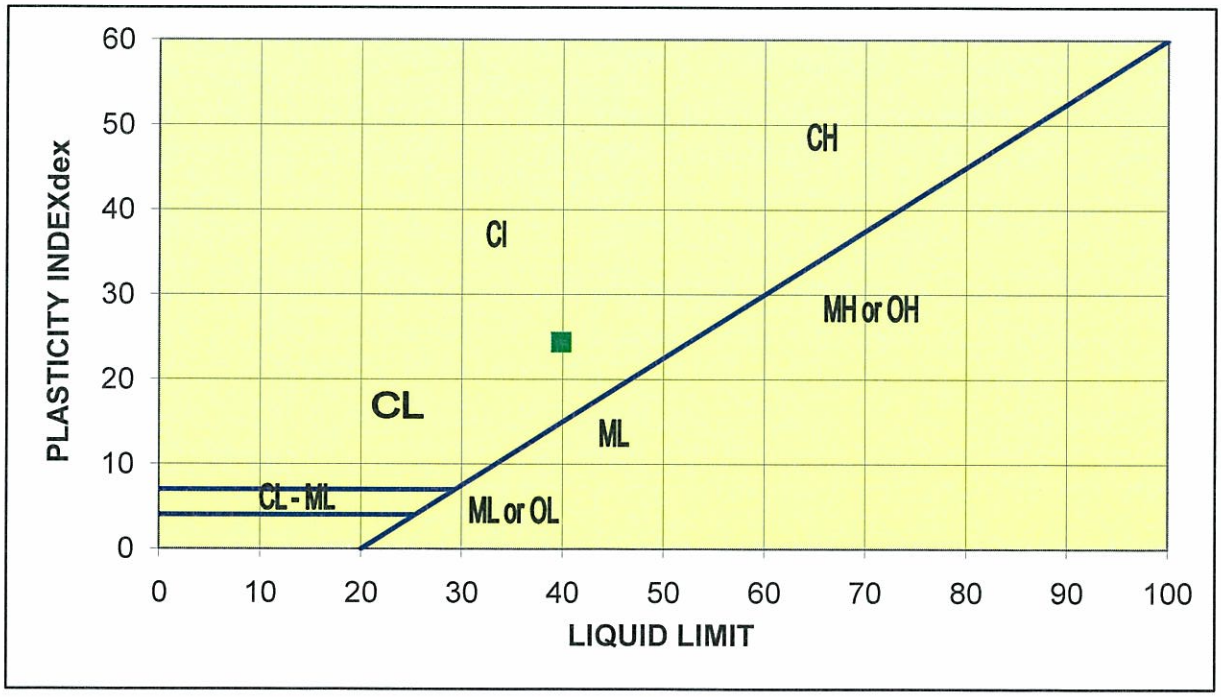
PROJECT# RD2894
PROJECT Sandy Point - Gull Lake Development
BOREHOLE 22
DEPTH 1.0 m
SAMPLE # MC1
DATE July 15/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	29	30
Wt. Sample Wet + Tare	47.521	45.600
Wt. Sample Dry + Tare	38.799	37.385
Wt. Water	8.722	8.215
Tare Container	16.535	16.271
Wt. Dry Soil	22.264	21.114
Moisture Content	39.175	38.908
Corrected for Blow Count	39.885	39.776
Liquid Limit Average	**39.8**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.717	8.570	8.623
Wt. Dry Worm + Tare	8.400	8.266	8.301
Wt. Water	0.317	0.304	0.322
Tare Container	6.297	6.298	6.259
Wt. Dry Worm	2.103	1.968	2.042
Moisture Content	15.074	15.447	15.769
Plastic Limit Average		**15.4**	

PLASTICITY INDEX (PI) = LL-PL	**24.4**



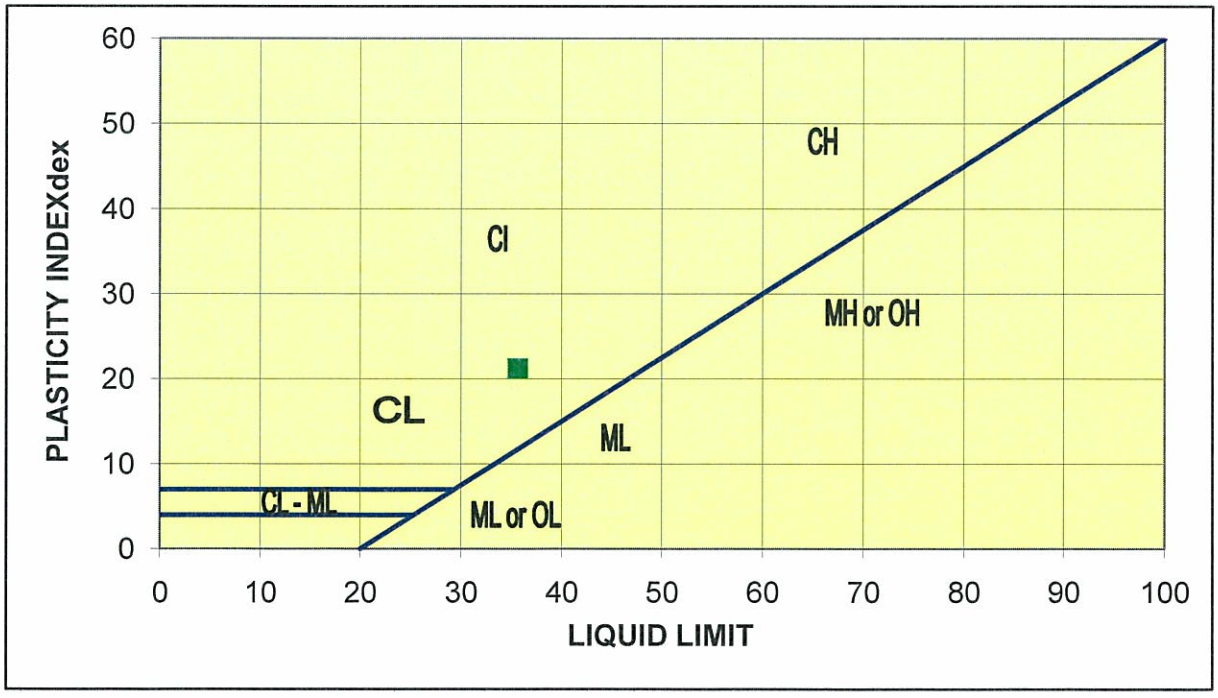
PROJECT# RD2894
PROJECT Sandy Point - Gull Lake Development
BOREHOLE 25
DEPTH 1.0 m
SAMPLE # MC1
DATE July 15/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	21	22
Wt. Sample Wet + Tare	45.667	45.037
Wt. Sample Dry + Tare	37.816	37.364
Wt. Water	7.851	7.673
Tare Container	16.194	16.163
Wt. Dry Soil	21.622	21.201
Moisture Content	36.310	36.192
Corrected for Blow Count	35.552	35.636
Liquid Limit Average	**35.6**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.484	8.781	8.776
Wt. Dry Worm + Tare	8.207	8.489	8.466
Wt. Water	0.277	0.292	0.310
Tare Container	6.304	6.451	6.290
Wt. Dry Worm	1.903	2.038	2.176
Moisture Content	14.556	14.328	14.246
Plastic Limit Average		**14.4**	

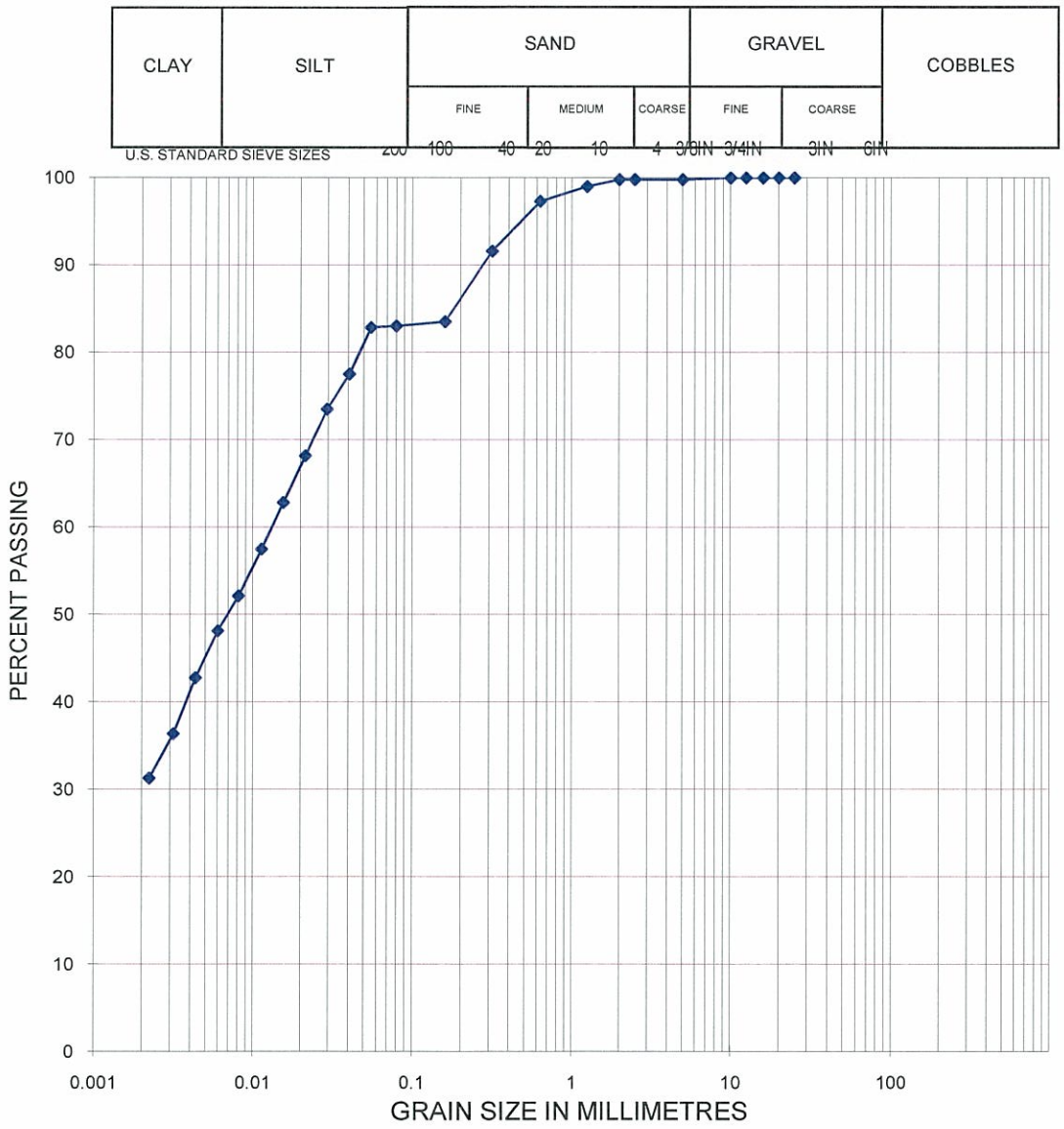
PLASTICITY INDEX (PI) = LL-PL	**21.2**



PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	1
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 15/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Clay, and silt, little sand

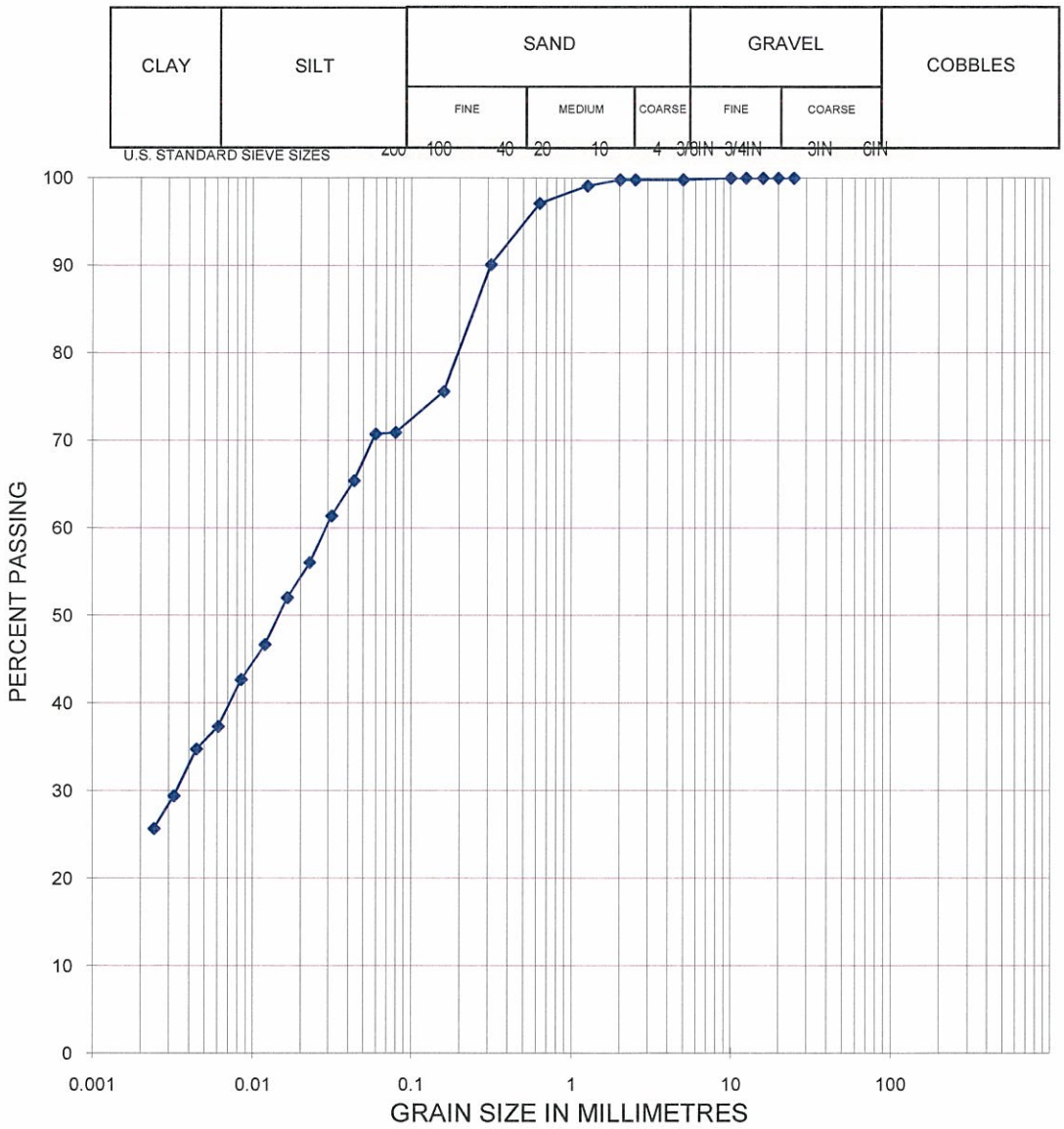
SUMMARY

D10	=	GRAVEL	0.20%
D30	=	SAND	17.03%
D60	=	SILT	38%
CU	=	CLAY	44.85%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	3
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Clay, and silt, some sand

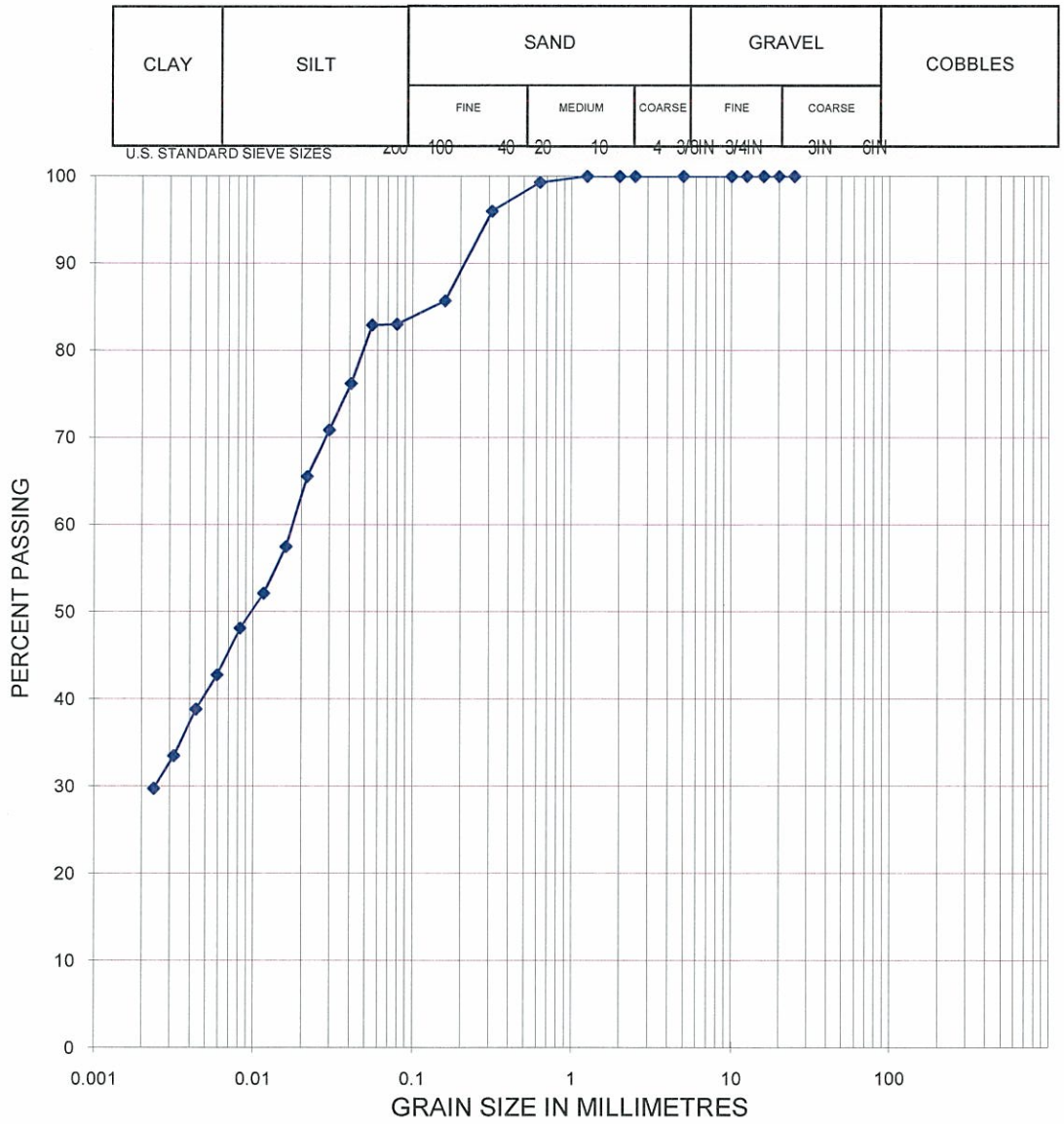
SUMMARY

D10	=	GRAVEL	0.20%
D30	=	SAND	29.14%
D60	=	SILT	35%
CU	=	CLAY	35.57%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	4
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

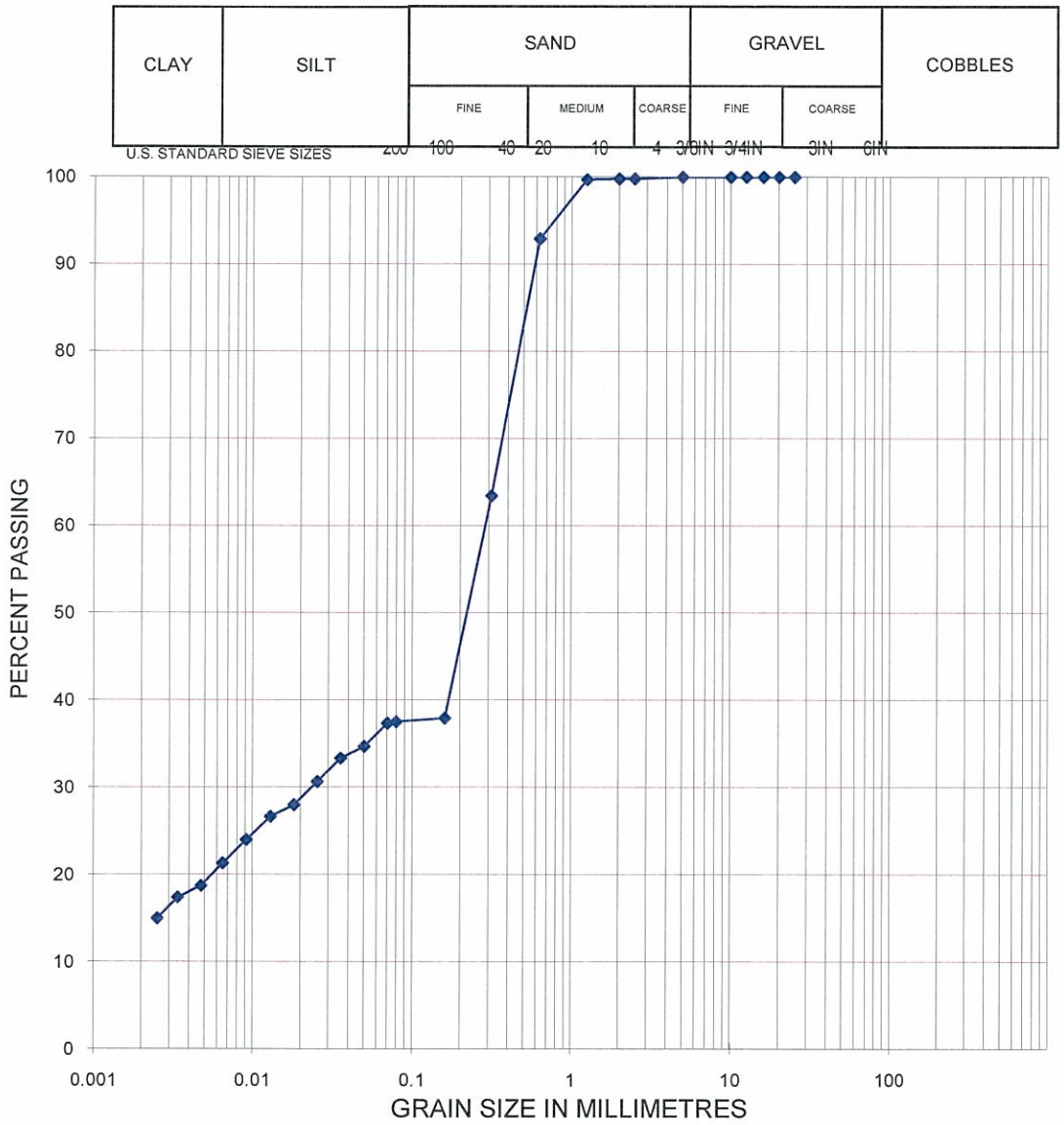
% Retained on 2 mm seive
Soil Type: Silt, and clay, little sand

SUMMARY

D10	=	GRAVEL	0.00%
D30	=	SAND	17.02%
D60	=	SILT	43%
CU	=	CLAY	40.31%
CC	=		

PROJECT	Sandy Point - Gull Lake Development		
PROJECT #	RD2894		
BOREHOLE	6	**DATE**	July 16/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Sand, little clay, little silt

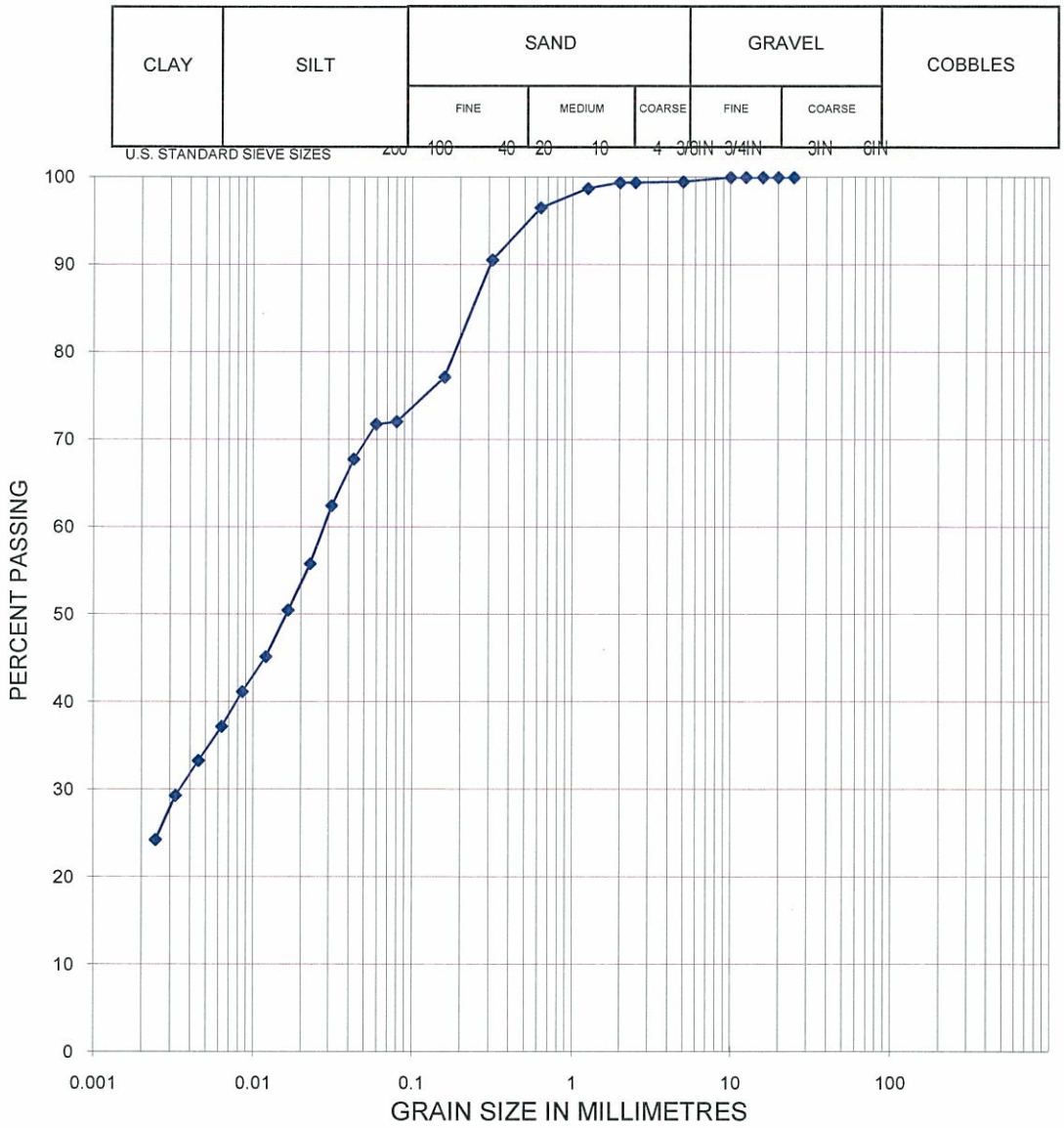
SUMMARY

D10	=	GRAVEL	0.00%
D30	=	SAND	62.59%
D60	=	SILT	18%
CU	=	CLAY	19.06%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	8
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Silt, some clay, some sand

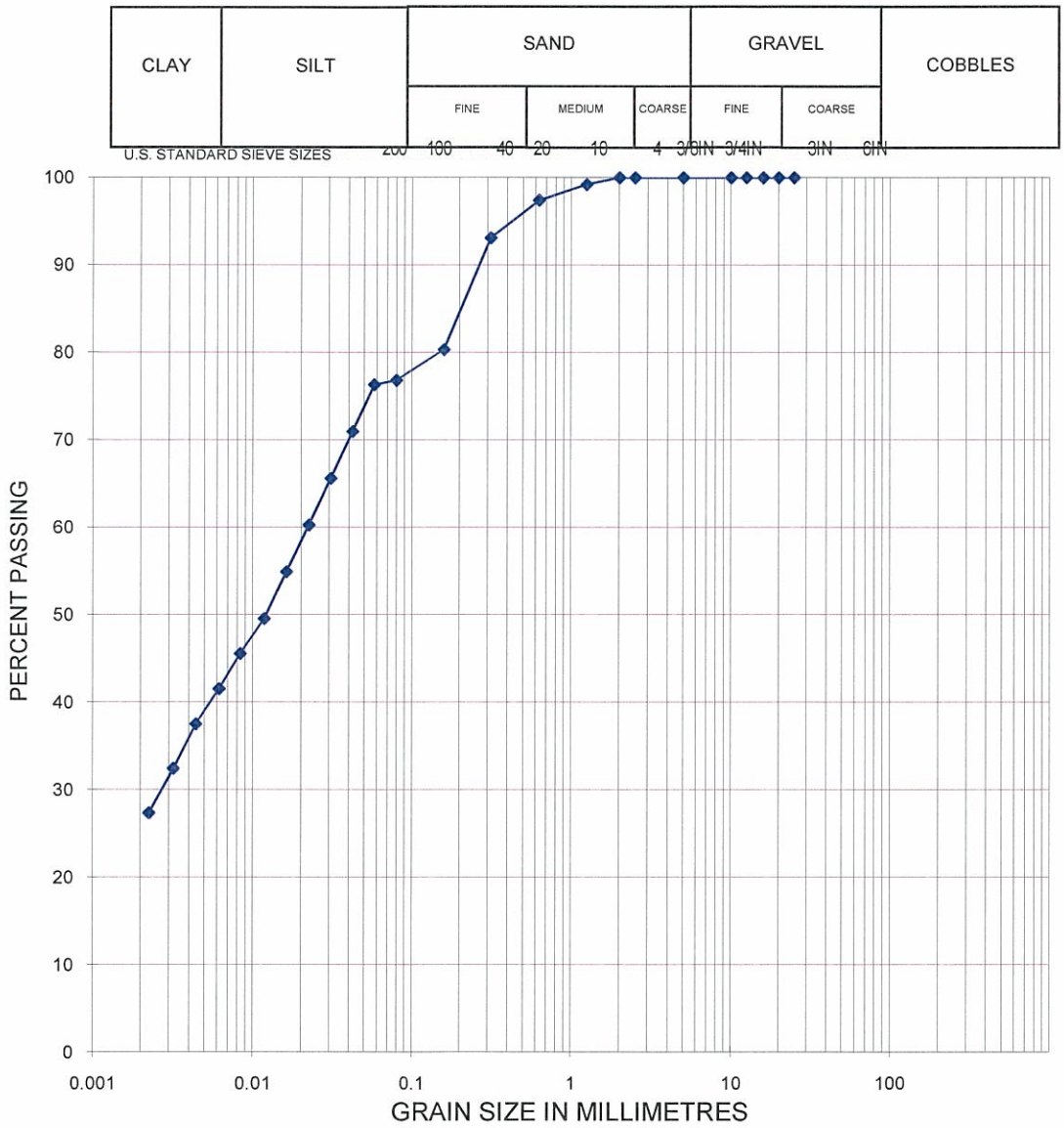
SUMMARY

D10	=	GRAVEL	0.50%
D30	=	SAND	28.07%
D60	=	SILT	37%
CU	=	CLAY	34.29%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	9
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 15/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Clay, and silt, some sand

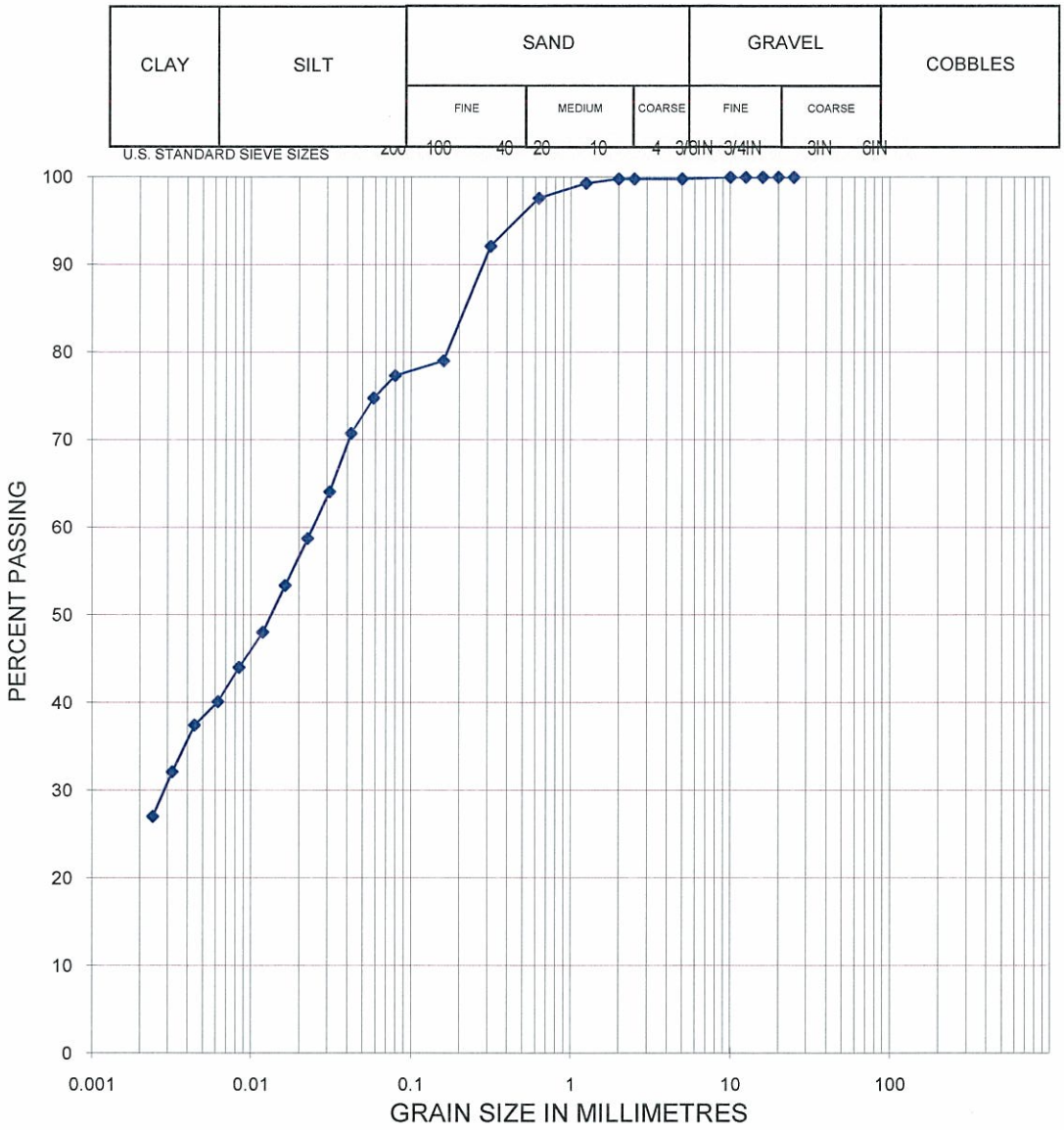
SUMMARY

D10	=	GRAVEL	0.00%
D30	=	SAND	23.32%
D60	=	SILT	38%
CU	=	CLAY	38.74%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	12
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Clay, and silt, some sand

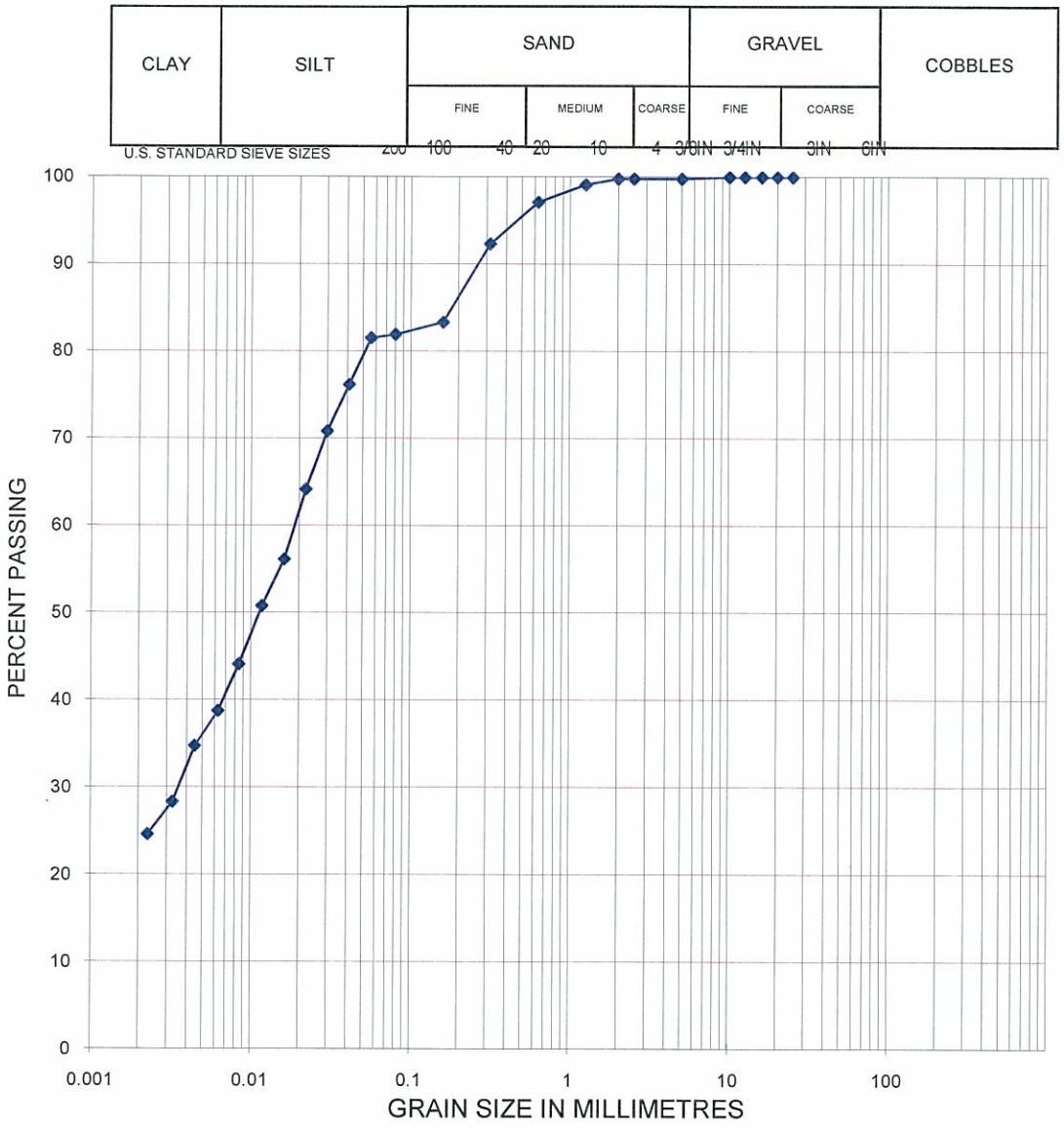
SUMMARY

D10	=	GRAVEL	0.20%
D30	=	SAND	23.29%
D60	=	SILT	38%
CU	=	CLAY	38.24%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	13
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 15/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Silt, and clay, little sand

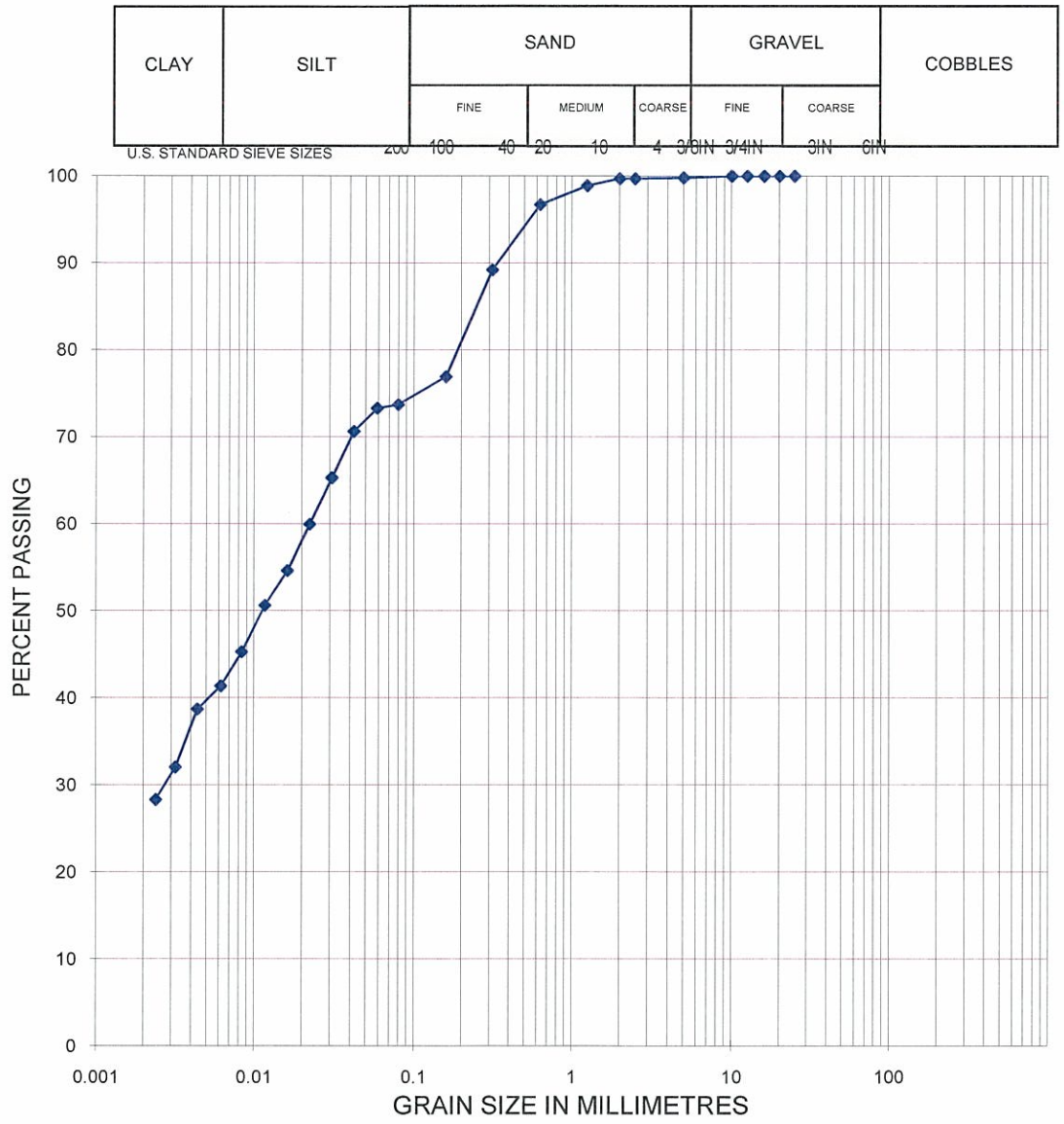
SUMMARY

D10	=	GRAVEL	0.20%
D30	=	SAND	18.18%
D60	=	SILT	46%
CU	=	CLAY	35.88%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	14
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Clay, some silt, some sand

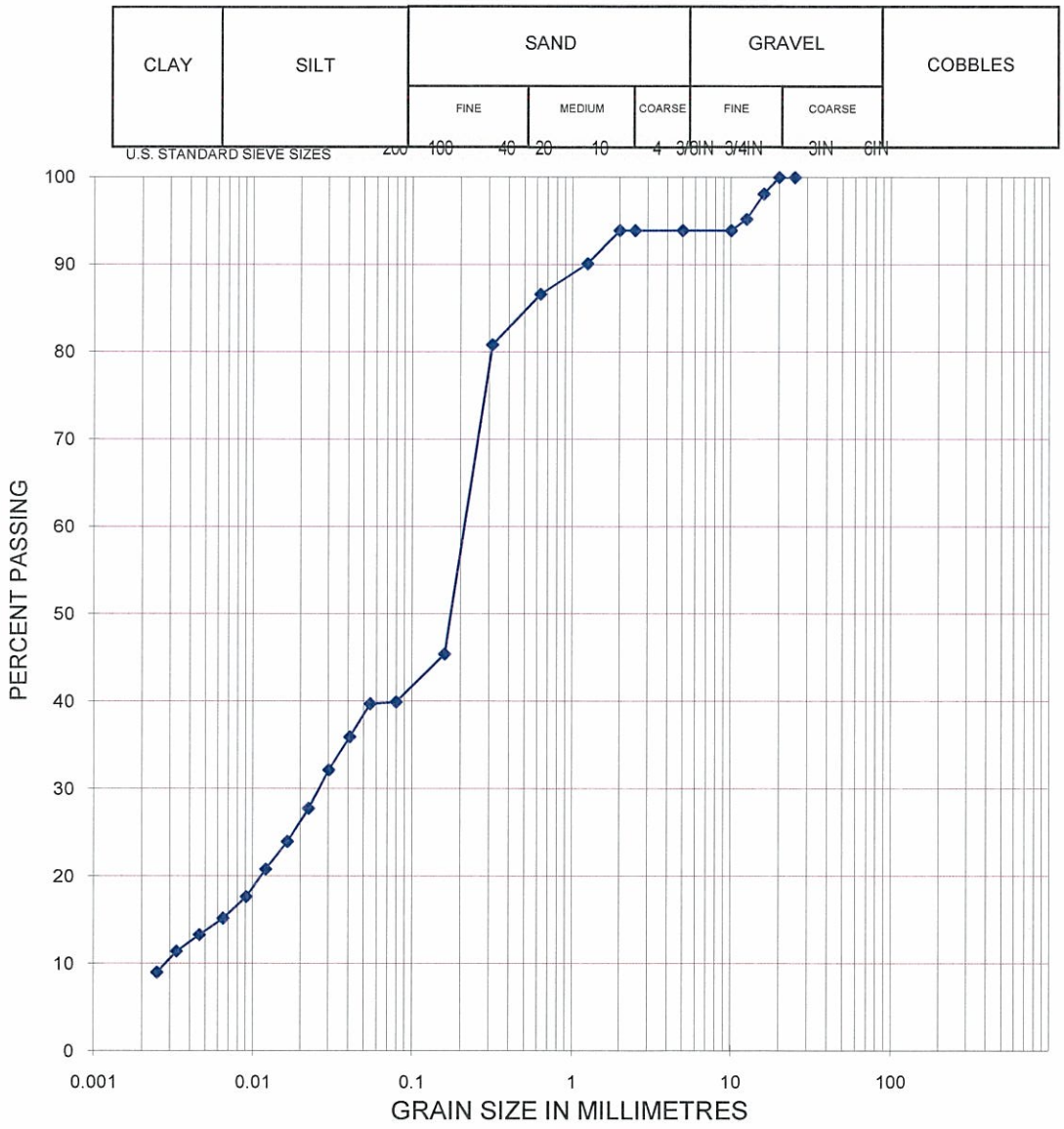
SUMMARY

D10	=	GRAVEL	0.20%
D30	=	SAND	26.40%
D60	=	SILT	34%
CU	=	CLAY	39.55%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	16
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Sand, some silt, little clay

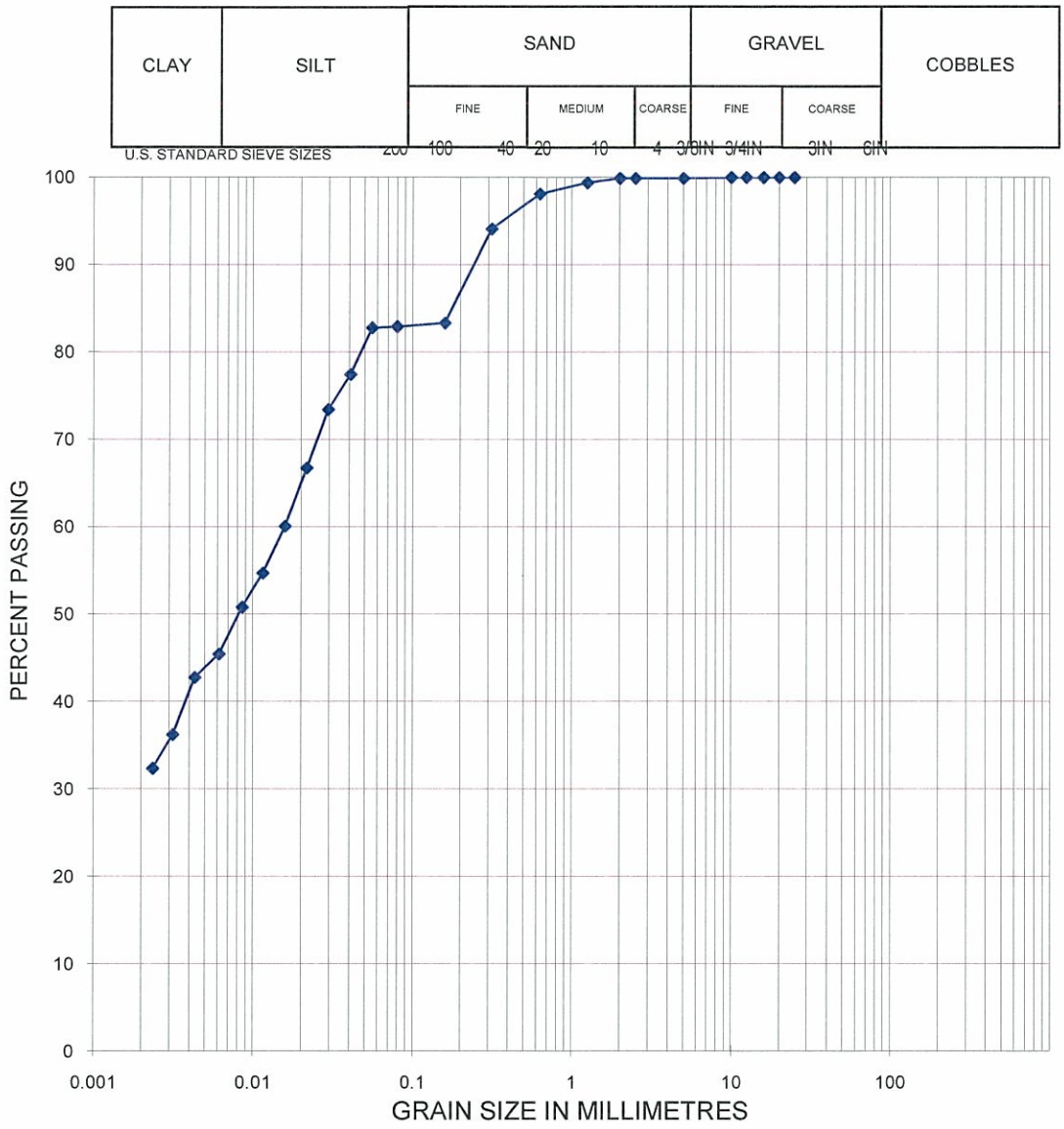
SUMMARY

D10	=	GRAVEL	6.10%
D30	=	SAND	60.08%
D60	=	SILT	20%
CU	=	CLAY	13.63%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	17
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Clay, and silt, little sand

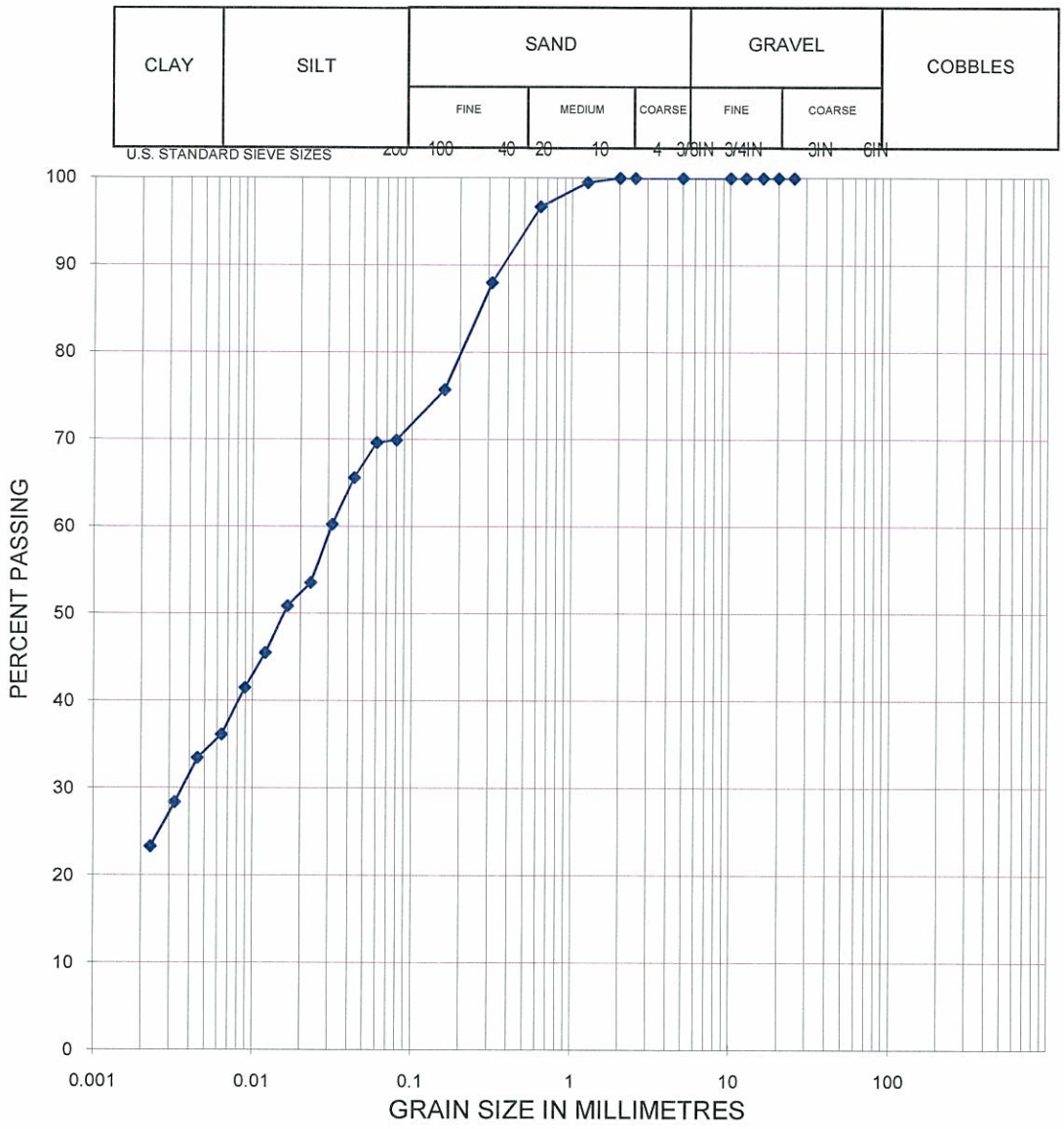
SUMMARY

D10	=	GRAVEL	0.10%
D30	=	SAND	17.13%
D60	=	SILT	39%
CU	=	CLAY	43.73%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	19
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 15/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Silt, some clay, some sand

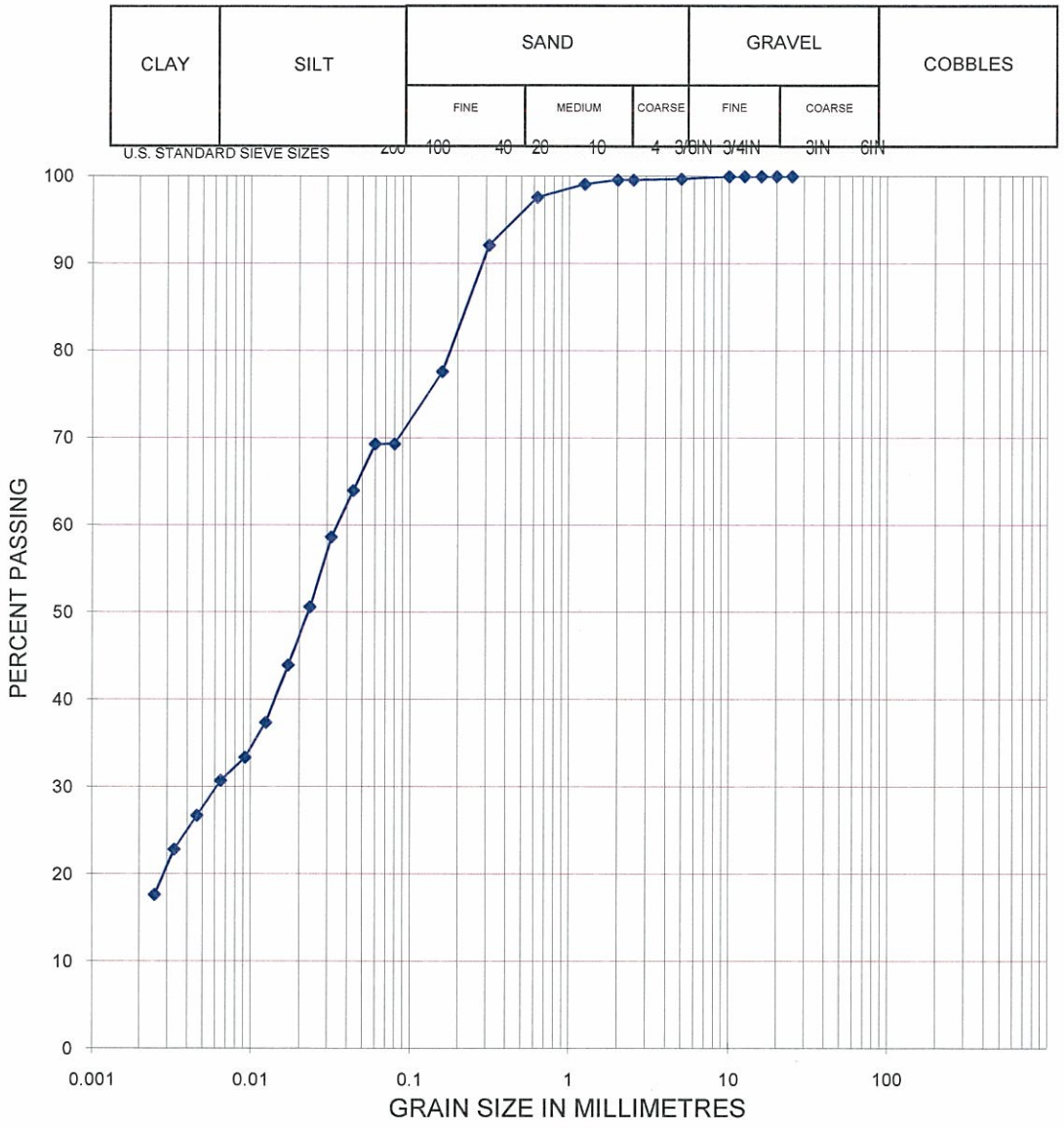
SUMMARY

D10	=	GRAVEL	0.00%
D30	=	SAND	30.18%
D60	=	SILT	36%
CU	=	CLAY	34.15%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	20
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 16/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Silt, some sand, some clay

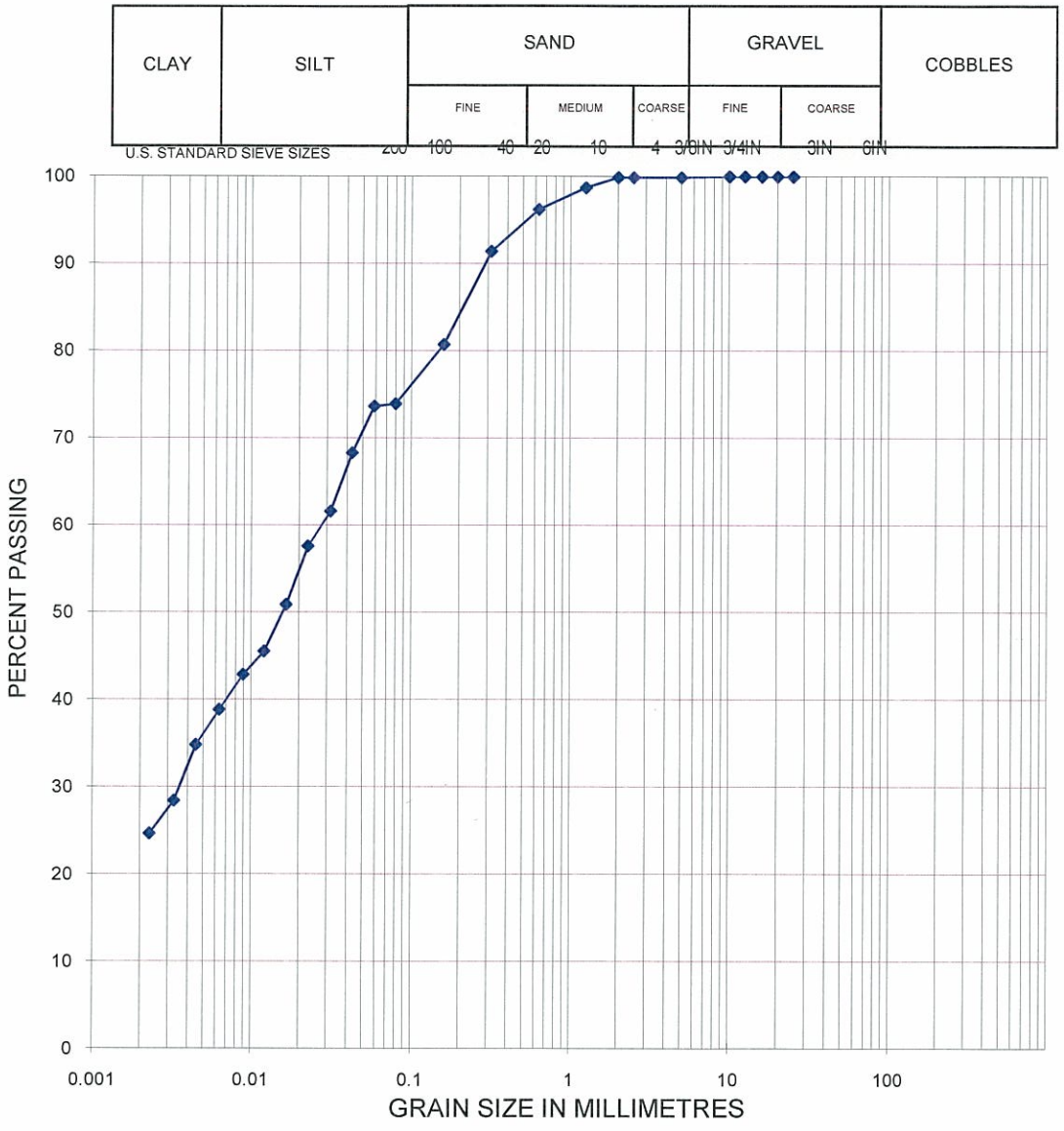
SUMMARY

D10	=	GRAVEL	0.30%
D30	=	SAND	30.70%
D60	=	SILT	42%
CU	=	CLAY	27.44%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	22
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 15/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Silt, and clay, some sand

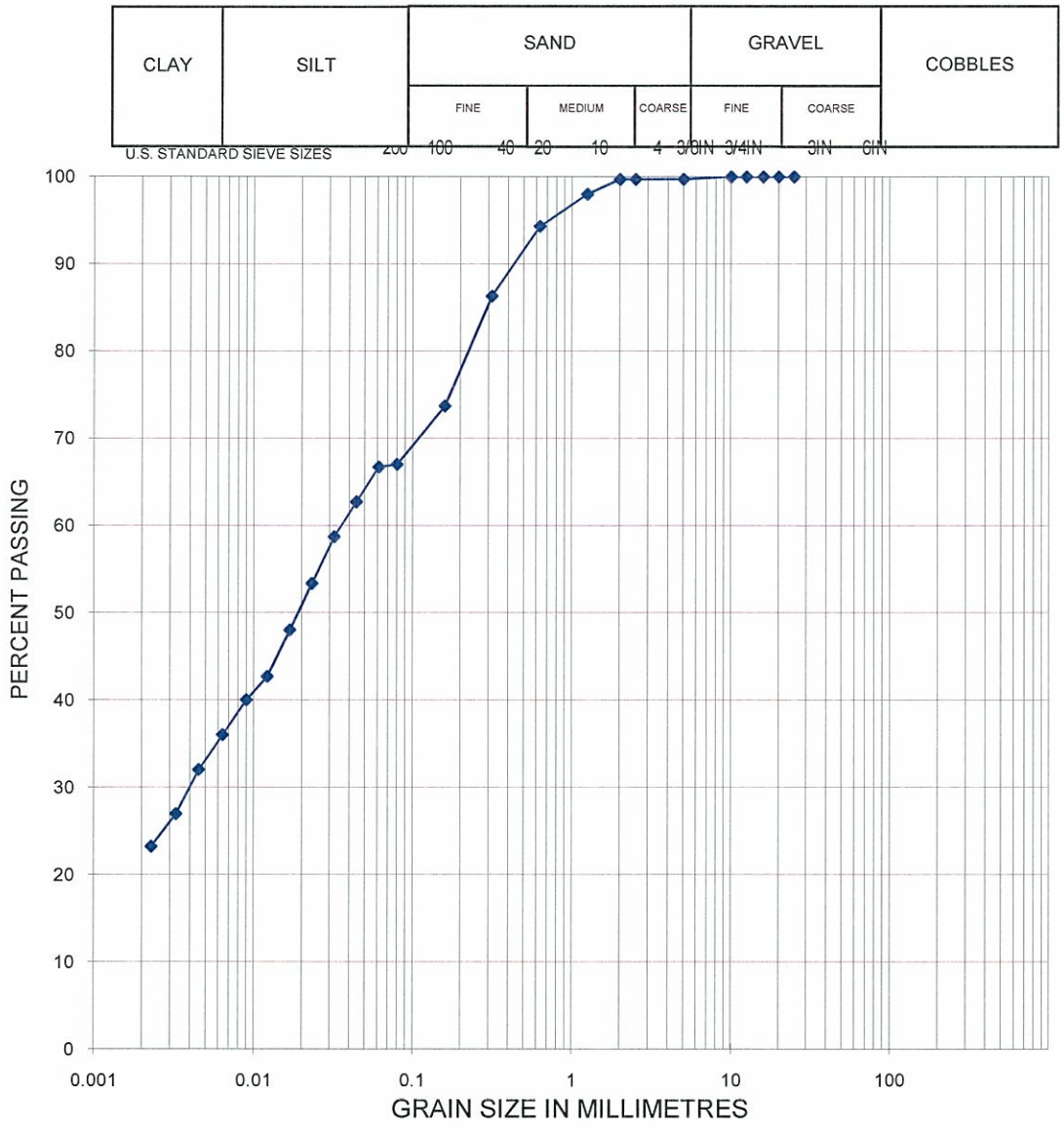
SUMMARY

D10	=	GRAVEL	0.10%
D30	=	SAND	26.17%
D60	=	SILT	38%
CU	=	CLAY	35.91%
CC	=		

PROJECT	Sandy Point - Gull Lake Development
PROJECT #	RD2894
BOREHOLE	25
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 15/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Silt, some sand, some clay

SUMMARY

D10	=	GRAVEL	0.30%
D30	=	SAND	33.08%
D60	=	SILT	34%
CU	=	CLAY	33.00%
CC	=		

MOISTURE DENSITY RELATIONSHIP WORKSHEET

PROJECT Sandy Point - Gull Lake Dev | PROJECT# RD2894
CLIENT | DATE APR. 29/08

	SAMPLE NUMBER	12X	14X	16X	18X	20X	
DRY DENSITY	Wt. Sample Wet + Mold	5893	5947	6012	6057	6053	
	Wt. Mold	4174	4174	4174	4174	4174	
	Wt. Sample Wet	1719	1773	1838	1883	1879	
	Volume Mold	945	945	945	945	945	
	Wet Density kg/m3	1819	1876	1945	1993	1988	
	Dry Density kg/m3	1616	1642	1664	1679	1653	

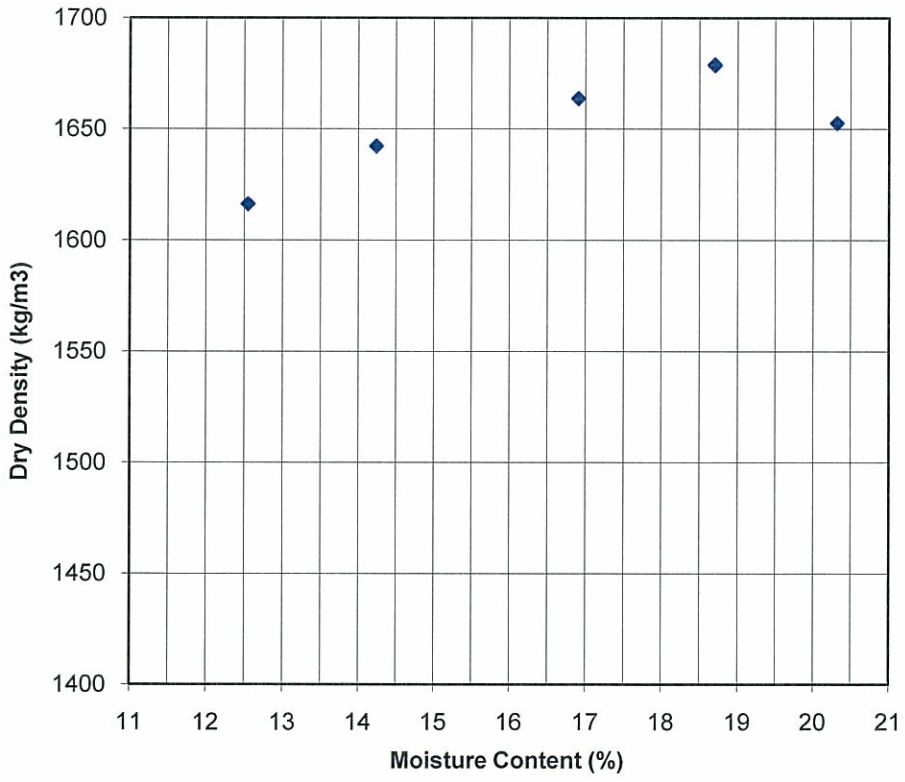
DATE SAMPLED APR. 29/08
CONTRACTOR
SOURCE/LOCATION
SAMPLED BY CJ

PROCTOR # **P08-0077**

	CONTAINER NUMBER	12X	14X	16X	18X	20X	
MOISTURE	Wt. Sample Wet + Tare	303.2	349.3	319.5	380.4	368	
	Wt. Sample Dry + Tare	271.4	308	275.9	323.3	308.9	
	Wt. Water	31.8	41.3	43.6	57.1	59.1	
	Tare Container	18	18	18	18	18	
	Wt. Dry Soil	253.4	290	257.9	305.3	290.9	
	Moisture Content	12.5	14.2	16.9	18.7	20.3	

PREPARATION DRY / MOIST
RAMMER TYPE AUTO /MANUAL

COMPACTION STANDARD ASTM D698 x
ASTM D1557 ☐



SOIL TYPE: **CLAY**

COMMENTS

PERCENT RETAINED
4.75 mm SIEVE 0
19.0 mm SIEVE

MAXIMUM DRY DENSITY **1679** kg/m3

OPTIMUM MOISTURE CONTENT **18.7** %

TECHNICIAN MS

CHECKED

Parkland GEO

Project: Sandy Point - Gull Lake Development

Subject: Geotechnical Testing - Soil Sulphate Test Results

Project #: RD2894 **Date:** July 10/08

Soil Sulphate Test Results

Laboratory: Parkland Geotechnical

Sample #: MC2 Borehole: 1 Depth: 2.0 m Result (% Sulphate): 0.04	Sample #: MC2 Borehole: 11 Depth: 2.0 m Result (% Sulphate): 0.04
Sample #: MC2 Borehole: 3 Depth: 2.0 m Result (% Sulphate): 0.04	Sample #: MC2 Borehole: 13 Depth: 2.0 m Result (% Sulphate): 0.04
Sample #: MC2 Borehole: 5 Depth: 2.0 m Result (% Sulphate): 0.04	Sample #: MC2 Borehole: 14 Depth: 2.0 m Result (% Sulphate): 0.04
Sample #: MC2 Borehole: 7 Depth: 2.0 m Result (% Sulphate): 0.04	Sample #: MC2 Borehole: 15 Depth: 2.0 m Result (% Sulphate): 0.04
Sample #: MC2 Borehole: 9 Depth: 2.0 m Result (% Sulphate): 0.04	Sample #: MC2 Borehole: 17 Depth: 2.0 m Result (% Sulphate): 0.04

Comments: _____

REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A231-M04)

EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO_4) IN SOIL SAMPLE, %	SULPHATE(SO_4) IN GROUND WATER SAMPLES, mg/L	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, MPa	MAXIMUM WATER/CEMENTING MATERIALS RATIO	PORTLAND CEMENT TO BE USED
S-1	Very Severe	over 2.0	over 10,000	35	0.4	HS
S-2	Severe	0.20 to 2.0	1 500 to 10 000	32	0.45	HS
S-3	Moderate	0.10 to 0.20	150 to 1 500	30	0.5	MS or HS

Tech: JB **Chkd:** _____

DESIGNATION		1			2					3				4			5	6		7	8
CLASS (mm)		10	12.5	16	16	20	25	40	50	12.5A	12.5B	12.5C	16	20	25	40	10	80	125	40	40
PER CENT PASSING METRIC SIEVE (CGSB 8 - GP - 2M) µm	125 000																		100		
	80 000																	100			
	50 000								100									55-100	55-100		
	40 000							100								100				100	100
	25 000						100		63-90						100			38-100	38-100		
	20 000					100								100		55-90					
	16 000			100	100		70-94	55-85	47-79				100					32-85	32-85		
	12 500		100	80-92						100	100	100	72-95								
	10 000	100	83-92	70-84	70-93	63-86	52-79	44-74	38-70	35-65	55-75	70-93	53-85	35-77	30-77	25-72	100			85-100	78-95
	5 000	60-75	55-70	50-65	50-70	40-67	35-64	32-62	28-59	0-15	0-15	30-70	27-64	15-55	15-55	8-55	45-70	20-65	20-65		60-85
	1250	30-45	30-45	30-45	26-45	20-43	18-43	17-43	16-42	0-3	0-3	9-34	9-34	0-30	0-30	0-30	20-45			40-100	27-57
	630	22-38	22-38	22-38	19-38	14-34	12-34	12-34	12-34												
	315	15-30	15-30	15-30	14-30	9-26	8-26	8-26	8-26			0-18	0-18				9-22	6-30	6-30	17-100	5-29
	160	9-20	9-20	9-20	9-20	5-18	5-18	5-18	5-18			0-13	0-13				5-15				0-15
	80	4-10	4-10	4-10	4-10	2-10	2-10	2-10	2-10	0-2	0-2	0-8	0-8	0-12	0-12	0-12	0-10	2-10	2-15	6-30	0-5
% FRACTURE BY WEIGHT (2 FACES)	ALL +5000	60+	60+	60+	60+	60+	60+	50+	40+	75+	75+	60+	60+	40+	40+	25+	N/A	N/A	N/A	N/A	N/A
PLASTICITY INDEX (PI)		0-4	0-4	0-4	0-6	0-6	0-6	0-6	0-6	N/A	N/A	0-4	0-4	0-8	0-8	0-8	0-6	0-8	0-8	0-10	0-5
L.A. ABRASION LOSS PER CENT MAX.		40	40	40	50	50	50	50	50	35	35	35	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FLAKINESS INDEX		N/A								MAX 15		N/A									
COEFFICIENT OF UNIFORMITY (Cu)		N/A																		3+	N/A

DESIGNATION

1. ASPHALT CONCRETE AGGREGATE (CLASS 10 FOR SURFACE PREPARATION COURSE ONLY)
2. GRANULAR AND ASPHALT STABILIZED BASE COURSES, SUB-BASES AND DUST ABATEMENT AGGREGATES.
3. SEAL COAT AGGREGATE
4. GRAVEL SURFACING AGGREGATE
5. SANDING MATERIAL
6. PIT-RUN GRAVEL FILL
7. CEMENT STABILIZED BASE COURSE AGGREGATE
8. GRANULAR FILTER AGGREGATE

88 MAY 13 11:47:11 69

Alberta
TRANSPORTATION AND UTILITIES

CHART	3.2 A
	Date
Original	MARCH 1984
Revised	DEC. 1985
Revised	FEB. 1987
Revised	MAR. 1988

SPECIFICATIONS FOR AGGREGATE

EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following two pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The borehole logs may include test data from laboratory soil testing, if applicable. The materials, boundaries and conditions have been established only at the borehole locations at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile usually have gradual rather than distinct unit boundaries as shown on this graphical representation.

1. **PRINCIPAL SOIL TYPE** - The major soil type by weight of material or by behavior.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.75 mm to 0.425 mm
Silt & Clay	Smaller than 0.075 mm

2. **DESCRIPTION OF MINOR SOIL TYPE** - Minor soil types are identified by weight of minor component.

Percent	Descriptor
35 to 50	and
20 to 35	some
10 to 20	little
1 to 10	trace

3. **RELATIVE STRENGTH OF COARSE GRAINED SOIL** - The following terms are used relative to Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

Description	N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

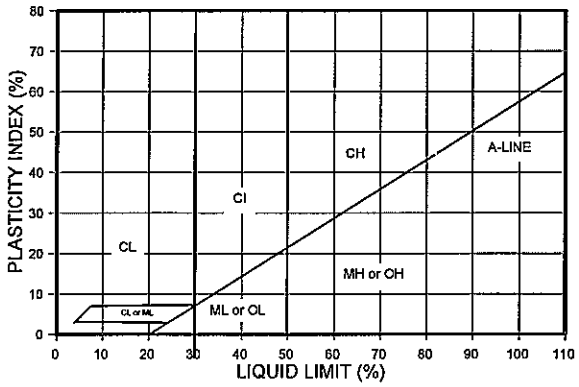
4. **CONSISTENCY OF FINED GRAINED SOIL** - The following terms are used relative to unconfined strength in kPa and Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

Description	Unconfined Compressive Strength (kPa)	N Value
Very Soft	less than 25	Less than 2
Soft	25 to 50	2 to 4
Firm	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very Stiff	200 to 380	15 to 30
Hard	Over 380	Over 30

Parkland GEO

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO	NOT MEETING ALL OF THE ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. MORE THAN
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ALL OF THE ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. MORE THAN
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLUOR, SILTY SANDS OF SLIGHT	CLASSIFICATION IS BASED ON THE PLASTICITY CHART BELOW	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY		
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY		
	ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART	$W_L < 50\%$	OL		ORGANIC SILT, AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

5. Soils are classified and described according to their engineering properties and behaviour.
6. Boundary classifications for soils with characteristics of two groups are given combined group symbols, eg. GW-GC is a well graded gravel-sand mixture with clay binder between 5 and 12 %.
7. Soil classification is in accordance with the Unified Soil Classification System, with the exception that an inorganic clay of medium plasticity (CI) is recognized.
8. The use of modifying adjectives may be employed to define the estimated percentage range by weight of minor components.

Parkland GEO