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Environment

**Geotechnical Investigation
Proposed Residential Subdivision
W½-11-37-04-W3M
East of Saskatoon, Saskatchewan**

Prepared for Chris Cebryk

Prepared By:




Cory Zubrowski, P.Eng.
Senior Geotechnical Engineer

Reviewed By:


Chris Gauthier, P. Eng.
Intermediate Geotechnical
Engineer

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TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION AND CHARACTERIZATION	1
2.1 Site Location, Description.....	1
2.2 Physiography	1
2.3 Topographic Setting	1
2.4 Geology.....	2
2.4.1 Regional Geological Setting.....	2
2.4.2 Geology of Study Site	4
2.5 Hydrogeology	5
2.5.1 Regional Hydrogeological Setting.....	5
2.5.2 Hydrogeology of Study Area.....	6
2.6 Groundwater Wells, Dugouts.....	7
3.0 SCOPE.....	7
4.0 GEOTECHNICAL INVESTIGATION DETAILS.....	8
4.1 Drilling Investigation.....	8
4.2 Geotechnical Laboratory Testing	8
5.0 SUBSURFACE CONDITIONS	10
5.1 Soil Profile.....	10
5.2 Groundwater, Seepage and Sloughing.....	10
5.3 Cobbles and Boulders.....	12
6.0 GEOTECHNICAL RECOMMENDATIONS	12
6.1 Geotechnical Considerations.....	12
6.2 Frost Action	14
6.2.1 Procedures to Mitigate Frost Action in Buried Utilities	14
6.2.2 Frost Action and Foundations	15
6.3 Site Preparation.....	15

6.3.1	General	15
6.3.2	Proof Rolling	16
6.3.3	Roadways and Parking Areas	17
6.3.3.1	Fill Sections.....	17
6.3.3.2	Excavation Sections.....	17
6.3.4	Temporary Excavations and Dewatering	18
6.4	Fill Materials, Placement and Compaction.....	19
6.4.1	General	19
6.4.2	Subgrade Fill	19
6.4.3	Structural Fill	20
6.4.4	Utility Trench Backfill.....	21
6.4.5	Fill Settlement	22
6.5	Foundations.....	22
6.5.1	Limit States Versus Working Stress Design	22
6.5.2	Footings.....	23
6.5.3	Drilled, Cast-in-Place Concrete Piles	25
6.5.4	Lateral and Tension Forces.....	26
6.6	Earth Retaining Structures	28
6.7	Grade Supported Concrete Floor Slabs.....	33
6.7.1	Unheated Slabs.....	34
6.8	Foundation Concrete.....	34
6.9	Grade Beams	35
6.10	Subdivision Roads and Parking Areas.....	35
6.11	Slope Stability Commentary	37
7.0	CONSTRUCTION CONTROL AND MONITORING.....	37

APPENDICES

- I Terms, Symbols and Abbreviations
- II Surrounding Land Usage and Registered Water Wells
- III Site Plan – Borehole Locations
- IV Borehole Logs
- V Laboratory Testing Results

LIST OF TABLES

Table 4.1 – Soil Texture Classification.....	9
Table 5.1 – Groundwater monitoring results.	11
Table 6.1 – Estimated frost penetration depth under various surface covers.	14
Table 6.2 – Base and sub-base gradation specifications.	21
Table 6.3 – Estimated fill settlement vs. compaction level.	22
Table 6.4 – Ultimate shaft resistance (drilled piles).	25
Table 6.5 – Modulus of horizontal subgrade reaction, K_h	27
Table 6.6 – Recommended P-multiplier, P_m , values for design by row position.	27
Table 6.7 – Soil parameters for design.	28
Table 6.8 – Typical compaction equipment data for estimating compaction-induced loads.....	29
Table 6.11 – Proposed graveled structure design thickness.	36

NOTICE TO READERS

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The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect MDH's best judgment based on information available at the time of preparation of this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered or project parameters change, modifications to this report may be necessary.

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1.0 INTRODUCTION

This report presents the results of the geotechnical site investigation conducted for the proposed residential subdivision to be constructed within W½-11-37-04-W3M, east of Saskatoon, Saskatchewan. The report provides design considerations and recommendations for residential foundation construction and development of the subdivision utilities and roadways, and also provides an assessment of the subsurface conditions for the design of on-site wastewater disposal systems. The geotechnical investigation included the drilling program along with field and laboratory soil testing.

2.0 SITE DESCRIPTION AND CHARACTERIZATION

2.1 Site Location, Description

The proposed residential subdivision, which is currently utilized as farmland/grassland, will be constructed within W½-11-37-04-W3M, approximately 5 km northeast of Saskatoon, Saskatchewan. The subject site is bound by Fleury Road (gravel road) to the north, farmland to the east and south, and farmland/residential development to the west (farmland adjacent to the NW¼ -11-37-04-W3, residential subdivision adjacent to the SW¼ -11-37-04-W3). Provincial Highway No. 41 is located approximately 800 m to 2,500 m west of the western boundary of the proposed subdivision (highway runs diagonally in a southwest-northeast direction). The study area consists of rolling hills, with local drainage trending toward several low-lying areas. Based on topographic survey data provided by Webb Surveys, the ground surface elevation within the study area ranges from about 549 to 565 m above sea level (masl). The location of the study area and surrounding land usage has been shown as Figure II.1, Appendix II.

2.2 Physiography

The study area is situated in the physiographic region known as the Saskatchewan Rivers Plain (Acton et al., 1960), which is characterized as gently undulating to rolling glacial-alluvial plains (glacial lake plains), Aeolian plains (dunes) and till plains. The surficial soil deposits typically consist of variable textured lacustrine and alluvial sands, silt and clays, Aeolian sands, glacial till and localized bedrock exposures in the South Saskatchewan River.

2.3 Topographic Setting

Based on topographic survey data provided by Webb Surveys, the ground surface elevation within the study area ranges from about 549 to 565 masl.

2.4 Geology

2.4.1 Regional Geological Setting

Successive marine transgression and regression in the Upper Cretaceous Period deposited a thick, complex sequence of marine silt and clay deposits across central Saskatchewan. The Upper Cretaceous aged Lea Park Formation shale constitutes the base of “freshwater” exploration associated with the shallow hydrostratigraphy in the study area; the Lea Park Formation (and its stratigraphic equivalent, the Pierre Formation) is a known marker horizon (i.e. it provides stratigraphic control) for most of southern Saskatchewan. The Lea Park Formation is composed of non-calcareous, grey, marine clay and silt (“shale”) found across the entire Saskatoon area. There are no known receptors for contaminants below this formation in the study area.

Marine regression in the Upper Cretaceous Period resulted in the deposition of calcareous and non-calcareous stratified sands, silts, and clays over the Lea Park Formation shale. These stratified sands, silts, and clays are called the Judith River Formation. This unit is found only as erosional remnants in the study area.

The Bearpaw Formation is the uppermost “bedrock” unit encountered in the Saskatoon area. It is composed of non-calcareous, grey, marine clay, silt, and sand (“shale”) which conformably overlies the Judith River Formation.

Prior to glaciation, the Saskatoon area was mature and well integrated with a complex series of water courses and deep valleys. Erosion and subsequent alluvial and colluvial deposition of Tertiary-aged sediments filled these valleys. These sediments are generally comprised of preglacial quartz and chert sands and gravels, interbedded with organic rich silts and clays. Millions of years of deposition resulted in these preglacial deposits partially infilling these valleys.

The preglacial Tyner and Battleford Valleys form the dominant bedrock features in the Saskatoon area. These valleys were cut into the bedrock surface primarily before and during the first glaciation (and to a lesser extent during subsequent glaciations) in the early Pliocene Epoch. These valleys carried melt-water, depositing significant accumulations of clastic deposits within the lowland. The Tyner Valley runs from southwest to central Saskatchewan and the Battleford Valley runs from northwest to central Saskatchewan. These valleys have numerous tributaries, mesas, and plateaus and a complex hydrostratigraphy.

The stratified preglacial sediments deposited between the bedrock surface and the glacial sediments are formally called the Empress Group (Whitaker and Christiansen, 1972). These preglacial sediments sit unconformably on the bedrock surface and have been informally called the lower unit of the Empress Group. The sediments from the bedrock surface to the ground surface are collectively called “drift”. They are divided into preglacial and postglacial drift.

Over the past 2 million years, Saskatchewan has undergone at least eight periods (and possibly ten periods) of significant glacial advance. The final deglaciation occurred in the Pleistocene Epoch between approximately 17,000 and 10,000 years ago (Christiansen, 1979). Glaciation in the Pleistocene resulted in a complex arrangement of proglacial and glacial sediments interbedded with non-glacial stratified sediments (fluvial, deltaic, lacustrine, aeolian, etc.) deposited between glaciations and during interstadial deglaciation. Erosional valleys produced during interglacial periods commonly intersect preglacial valleys forming complex stratigraphic arrangements. The glaciofluvial, fluvial, alluvial and colluvial sediments that were deposited during preglacial and interglacial periods in the valleys were covered by tills during the final stages of glaciation, forming deep buried valley aquifer systems that are often flanked by more regionally extensive blanket aquifer systems. These systems are now buried with deposits from subsequent glacial and non-glacial periods, with limited indication of their presence at depth. They form the most significant freshwater aquifers in the province.

The complex arrangement of glacial, glaciofluvial, and glaciolacustrine deposits within the study area are formally divided into two primary groups: 1) the Sutherland Group, and 2) the Saskatoon Group (Christiansen, 1992). Both the Saskatoon Group and the Sutherland Group are primarily comprised of unsorted till formed by glacial erosion and reworking of Precambrian igneous and metamorphic rocks, Paleozoic limestones, and Cretaceous marine shales during glacial advance. Significant intratill and intertill stratified deposits also comprise the Quaternary deposits.

The oldest till units of the Sutherland Group have a higher clay content compared to the overlying Saskatoon Group tills due to a higher percentage of marine shale being incorporated into the matrix of the till. Similarly, the Saskatoon Group tills have higher carbonate contents due to incorporation of more Paleozoic limestones and dolomites into the matrix. The lithological compilation, combined with carbonate content signatures, can be used to help identify each formation. The stratified deposits between these two groups, and between the individual till formations, represent the major aquifers across the study area.

Melting of the last glacier (between about 17,000 and 10,000 years ago) deposited a till plain characterized by a hummocky topography of kettles and eskers, covered with glacial and glaciofluvial/glaciolacustrine deposits and postglacial sediments (Surficial Stratified Deposits). These features form the surface topographic features in the area.

The complex stratigraphic arrangements of the Tertiary and Quaternary deposits were further complicated by extensive faulting due to either the dissolution of the deep evaporite deposits beneath the area and subsequent collapse of near surface sediments (Christiansen and Sauer, 2001), or by continental tectonic extension in the Cenozoic possibly combined with melting of gas hydrates during glacial retreat (Gendzwill and Stauffer, 2006). These depressions were infilled (generally with till) during subsequent glaciations, often resulting in discontinuous and hydraulically isolated accumulations of stratified deposits. Delineation of these collapse structures is important as they are often significant enough to displace aquifer units, resulting in lateral connectivity disruptions and significant aquifer boundary effects during water production.

The hydrostratigraphy of interest in the study area (in ascending order) is:

1. The Lea Park Formation;
2. The Judith River Formation;
3. The Bearpaw Formation;
4. The Empress Group;
5. The Sutherland Group:
 - a. The Mennon Formation;
 - b. The Dundurn Formation; and
 - c. The Warman Formation;
6. The Saskatoon Group:
 - a. The Floral Formation;
 - b. The Battleford Formation; and
 - c. The Surficial Stratified Deposits.

2.4.2 Geology of Study Site

Based on a review of available published geological information (Hydrogeology Mapping of NTS Mapsheet Saskatoon 73B, MDH Report No. M1890-1030109, dated April, 2011), the subsurface deposits in the study area consist of at least 100 m of surficial stratified deposits and glacial drift deposits (Saskatoon and Sutherland Group deposits), followed by Cretaceous aged bedrock of the Bearpaw Formation.

2.5 Hydrogeology

2.5.1 Regional Hydrogeological Setting

Deposits of silts, sands, gravels, and cobbles form relatively high hydraulic conductivity units that form the paths of least resistance for groundwater flow and solute transport. These units are called aquifers. An aquifer is defined as saturated geologic unit that is permeable enough to transmit significant quantities of water under ordinary hydraulic gradients, or as the term is commonly used in the water-well industry: an aquifer is a saturated geologic unit that is permeable enough to yield economic quantities of water to wells (e.g. Freeze and Cherry, 1979; Kruseman and de Ridder, 1990). Aquifers can be part of a geological formation, the entire formation or group of formations. Conversely, silt and clay rich deposits form low hydraulic conductivity units that impede groundwater flow and solute transport. An aquitard is a saturated geologic unit which is permeable enough to transmit water in significant quantities when viewed over large areas and long periods, but does not yield economic quantities of water to wells (Kruseman and de Ridder, 1990). These units are called aquitards and generally have hydraulic conductivities of less than 1×10^{-7} m/s. The spatial arrangement of aquifers and aquitards in three-dimensions form the hydrostratigraphy of a site. When combined with the physical characteristics of the hydrostratigraphic units, an overall view of the hydrogeology can be determined.

Gravel, sand, silt, and/or clay predominantly comprise the Surficial Stratified Deposits, the intertill stratified deposits, the Empress Group sediments, and the Upper Cretaceous sand/silt stratified units; the lithology of these stratified deposits can vary significantly over short distances and be aquifers or aquitards depending on lithology, hydraulic connectivity, potential well yields, etc. Although none of these horizons are comprised of laterally continuous gravels and sands, the complexities of the mappable stratified deposits do not preclude the potential of finding lithologies capable of supplying small quantities of water. The actual amount of water available will be based on the site specific hydraulic properties of the sediments, and the thickness and lateral continuity of higher permeability sediments.

Bedrock silts, sands, gravels, and preglacial valley fill sediments form major “freshwater” aquifers across Saskatchewan. The preglacial Battleford and Tyner Valleys are the major bedrock buried valley aquifer systems in the area.

In addition to the major buried valley aquifers incised into the marine shales, the overlying Quaternary aged stratum contains both blanket and channel deposits of sand and gravel that were deposited by retreating and/or advancing glaciers. These deposits are found between the major till units and are called intertill stratified deposits. These intertill stratified deposits can form broad, laterally extensive aquifers and/or small channel aquifers, depending on their depositional setting and subsequent erosion. Although intratill deposits are abundant, they generally form only isolated, discontinuous pockets, and are therefore not significant with respect to groundwater sourcing.

In the Saskatoon area, there are several major mappable horizons, above the Lea Park Formation, that may contain aquifer sediments, these are as follows (in ascending order):

1. The Judith River Formation Stratified Deposits (Judith River Aquifer);
2. The Ardkeneth Member Stratified Deposits (Ardkeneth Aquifer);
3. The Cruikshank Member Stratified Despoits (Cruikshank Aquifer);
4. The Empress Group Stratified Deposits (Empress Group Aquifer);
5. The Mennon Formation Stratified Deposits (Mennon Aquifer);
6. The Lower Dundurn Formation Stratified Deposits (Lower Dundurn Aquifer);
7. The Upper Dundurn Formation Stratified Deposits (Upper Dundurn Aquifer);
8. The Warman Formation Stratified Deposits (Warman Aquifer);
9. The Lower Floral Formation Stratified Deposits (Lower Floral Aquifer);
10. The Middle Floral Formation Stratified Deposits (Upper Floral Aquifer);
11. The Battleford Formation Stratified Deposits (Battleford Aquifer); and
12. The Surficial Stratified Deposits (Surficial Aquifer).

2.5.2 Hydrogeology of Study Area

Based on a review of available published geological information (Hydrogeology Mapping of NTS Mapsheet Saskatoon 73B, MDH Report No. M1890-1030109, dated April, 2011), the study area potentially overlies the Judith River, Ardkeneth, Empress, Lower Floral and Upper Floral Aquifers. The estimated depths to the respective aquifers are approximately as follows:

- ♦ Judith River and Ardkeneth Aquifers: >100 mbgl;
- ♦ Empress Aquifer: >85 mbgl;
- ♦ Lower Floral Aquifer: >60 mbgl;
- ♦ Upper Floral Aquifer: <25 mbgl.

The South Saskatchewan River (SSR) is located approximately 7 to 8 km west of the study area. The SSR is a regional discharge receptor for many of the aquifer systems in the area. As such, the expected direction of regional groundwater flow is toward the west.

2.6 Groundwater Wells, Dugouts

A review of the Saskatchewan Water Security Agency (WSA) database revealed that there are at least 163 registered water wells within a 5 km radius of the subject site. One water well was noted within the NW¼-11-37-04-W3M. Approximately 25% of the wells are relatively deep, small diameter wells whereas the remaining ~75% are relatively shallow, large diameter wells. The wells are typically concentrated in areas of higher residential development (i.e., residential subdivisions similar to the proposed subdivision), with sparse distribution in areas of lower residential density. The distribution of the registered wells has been shown on Figure II.2, Appendix II.

A visual review of the subject site and the surrounding 10 quarter sections revealed 2 dugouts coinciding with individual residences, and multiple dugouts within the Eagle Ridge residential subdivision.

3.0 SCOPE

The general scope of work for this project was to complete a geotechnical investigation for the study area in support of development of the proposed residential subdivision, including residential foundations, subdivision utility installation, subdivision roadways and on-site wastewater disposal systems. The scope of work also included slope stability assessment.

The following work was completed:

- ◆ Drill 29 boreholes in a general grid pattern throughout the study area (32 boreholes were proposed, but 3 were eliminated (boreholes 613596-04, 28 and 32) due to practical site access constraints for a rubber-tired drill rig);
- ◆ Install piezometers in all boreholes for groundwater monitoring purposes;
- ◆ Log all boreholes, conduct geotechnical field tests and collect soil samples for laboratory testing;
- ◆ Perform laboratory testing of select soil samples obtained from boreholes, including water contents, grain size distribution analysis, Atterberg limits and unit weights; and,
- ◆ Produce a report that summarizes the field investigation and provides design considerations and recommendations for the proposed residential development.

4.0 GEOTECHNICAL INVESTIGATION DETAILS

4.1 Drilling Investigation

The drilling program was conducted between 2 and 11 July 2013. Boss Drilling Ltd. from Saskatoon, Saskatchewan utilized a truck-mounted CME 75 drill rig equipped with an automatic standard penetration test (SPT) hammer to drill the boreholes.

A total of 29 boreholes were drilled with depths ranging from 5.6 m to 12.1 mbgl. The Site Plan showing the location of the boreholes is presented on Figure III.1, Appendix III.

Disturbed soil samples were collected from the auger cuttings (grab samples) and from the SPT sampler. All soil samples were transported to the MDH soil testing laboratory in Saskatoon. The soil samples were stored in a humidity-controlled room at the MDH laboratory to prevent drying prior to testing. Soil samples collected for each borehole are shown on the borehole logs in Appendix IV.

Field testing included SPT's and pocket penetrometer tests (PP). The results of field tests are presented on the borehole logs in Appendix IV. The Terms, Symbols and Abbreviations used on the borehole logs are available in Appendix I.

The approximate borehole locations were determined using handheld GPS coordinates (ground surface elevations were not obtained).

Piezometers were installed in all boreholes. The boreholes were backfilled with bentonite chips (as directed by the Client). The piezometers were decommissioned (backfilled with bentonite, cut off below ground level) on 30 July 2013.

4.2 Geotechnical Laboratory Testing

Geotechnical laboratory tests were conducted on soil samples obtained from the boreholes. The basic soil characteristic tests included water contents, grain size distribution analysis, Atterberg limits and unit weights.

The detailed laboratory test results are provided in Appendix V. Select laboratory test results are also annotated on the borehole logs presented in Appendix IV. The results of the laboratory analysis have been used to establish the soil texture classification of the near-surface soils, which is required for the design of on-site wastewater disposal systems. The results of the soil texture classification, as per the "Saskatchewan Onsite Wastewater Disposal Guide", have been presented in Table 4.1.

Table 4.1 – Soil Texture Classification.

Borehole	Sample Depth (m)	Grain Size Analysis (%)			Soil Texture Classification
		Sand and Gravel	Silt	Clay	
613596-01	1.0	39	43	18	Loam
613596-02	1.0	3	60	37	Silty clay loam
613596-03	1.0	50	32	18	Loam
613596-05	1.0	59	30	11	Sandy loam
613596-06	1.0	24	55	21	Silt loam
613596-07	1.0	46	34	20	Loam
613596-08	1.0	44	36	20	Loam
613596-09	1.0	37	40	23	Loam
613596-10	0.5	21	55	24	Silt loam
613596-11	1.0	17	60	23	Silt loam
613596-12	1.0	9	55	36	Silty clay loam
613596-13	1.0	16	63	21	Silt loam
613596-14	1.0	10	47	43	Silty clay
613596-15	1.0	40	42	18	Loam
613596-16	1.0	2	62	36	Silty clay loam
613596-17	1.0	44	35	21	Loam
613596-18	1.2	30	50	20	Silt loam
613596-19	1.0	70	22	8	Sandy loam
613596-20	1.0	41	41	18	Loam
613596-21	1.1	31	49	20	Silt loam / loam
613596-22	1.0	12	60	28	Silty clay loam / silt loam
613596-23	1.2	9	59	32	Silty clay loam
613596-24	1.0	7	70	23	Silt loam
613596-25	1.0	41	37	22	Loam
613596-26	1.0	49	34	17	Loam
613596-27	1.1	29	49	22	Silt loam / loam
613596-29	1.0	25	56	19	Silt loam
613596-30	1.0	35	61	24	Loam
613596-31	1.0	53	33	14	Loam / sandy loam

5.0 SUBSURFACE CONDITIONS

5.1 Soil Profile

The general soil profile consisted of organic topsoil overlying variable deposits of silt/clay in the majority of the boreholes (to depths of approximately 0.2 to 3.0 mbgl), followed by an extensive deposit of glacial till, which extended to a depth of at least 12.1 mbgl, the maximum depth drilled. The surficial silt/clay deposits were not encountered in boreholes 613596-03, 08, 19, 25, 26, 27 and 31. Inter/intra till sand/silt deposits were encountered in boreholes 613596-01, 10 and 21. Extensive concentrations of cobbles/boulders were encountered in most boreholes during test drilling.

The silt/clay deposits were typically soft to firm, low to medium plasticity and moist. The glacial till soils were typically low to medium plasticity and moist. The upper portion of the glacial till soils was soft to firm and moist to wet at many locations, becoming progressively stiffer with depth (i.e., very stiff to hard). Where encountered, the inter/intra till sand/silt deposits were typically loose to compact/soft and wet (groundwater seepage/sloughing conditions).

5.2 Groundwater, Seepage and Sloughing

Standpipe piezometers were installed in all boreholes. The location of the piezometers has been shown on Figure III.1, Appendix III. The piezometers were constructed using ~ 1 m of horizontally slotted 50 mm diameter PVC screen attached to 50 mm diameter PVC riser pipe. The annular space surrounding the piezometer screen was filled with filter sand and/or native sand/silt (sloughed material). The annular space above the sand pack consisted of bentonite chips, extending to ground surface. The piezometer installation details are presented in Appendix IV following the corresponding borehole logs. The piezometers were decommissioned (backfilled with bentonite, cut off below ground level) on 30 July 2013.

The groundwater levels recorded during this investigation have presented in Table 5.1. A review of Table 5.1 reveals that the groundwater level was situated approximately 1.3 to 10.5 mbgl. It is noted that several sloughs exist within the study area (surface outcropping of the groundwater table). It must also be noted that higher and potentially perched groundwater levels should be expected during or following spring thaw or periods of precipitation, and that the groundwater levels will fluctuate seasonally.

The apparent direction of near-surface groundwater flow was variable, and generally mirrored the topographic surface (i.e., flow from high areas to low areas).

Table 5.1 – Groundwater monitoring results.

Piezometer ID	Groundwater Depth (mbgl)
	30 July 2013
613596-01	2.25
613596-02	2.18
613596-03	1.71
613596-05	3.03
613596-06	1.57
613596-07	5.15
613596-08	3.40
613596-09	2.46
613596-10	1.66
613596-11	2.54
613596-12	1.58
613596-13	5.12
613596-14	2.47
613596-15	5.35
613596-16	2.56
613596-17	DRY (>6.1)
613596-18	3.19
613596-19	10.53
613596-20	3.30
613596-21	2.17
613596-22	4.70
613596-23	5.99
613596-24	2.00
613596-25	5.09
613596-26	5.56
613596-27	3.13
613596-29	1.32
613596-30	4.05
613596-31	1.72

Groundwater seepage and sloughing conditions were encountered during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown on the borehole logs in Appendix IV.

5.3 Cobbles and Boulders

Cobbles and/or boulders were encountered in the majority of the boreholes during test drilling, with extensive concentrations being encountered at some locations (i.e., boulder pavements). Multiple drilling attempts were required to advance the borehole to the target depth at many locations (due to auger refusal on cobbles/boulders). The depths at which cobbles/boulders were encountered have been shown on the borehole logs in Appendix IV. Glacial till is comprised of a heterogeneous mixture of clay, silt, sand and gravel-sized particles. Due to the nature of formation and deposition, glacial till also inherently contains larger particle sizes (cobbles and boulders). Cobbles and boulders are often located randomly within glacial till deposits but can also form sorted layers, such as boulder pavements. The actual location and frequency of cobbles and boulders varies and the probability of encountering such deposits increases with the number of holes drilled, volume of soil excavated, number of piles installed, etc. Considering this, cobbles and boulders should be anticipated during excavation and installation of foundations at this site.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 Geotechnical Considerations

The subsurface soil profile consisted of variable deposits of silt/clay (at the majority of the boreholes locations) overlying glacial till. The silt/clay deposits were soft to firm, as was the upper portion of the glacial till deposits at many locations. Groundwater seepage and sloughing were encountered during test drilling. The groundwater level was situated from at-surface (existing sloughs) to 10.5 mbgl at the time of the field investigation. Higher and potentially perched groundwater conditions may be encountered in the future.

It is anticipated that the majority of the proposed residences will have basements (where feasible) and attached garages/decks. It is understood that footings foundations will preferably be utilized for the majority of the residences, while pile foundations will likely be utilized for the garages and decks. It is anticipated that the residences and garages will utilize grade-supported concrete floor slabs.

It is recommended that basement floor elevations should be maintained a minimum of 600 mm above the current groundwater table (depth to groundwater varies appreciably across the site). Where it is not possible to maintain this clearance above the groundwater table (i.e., in close proximity to existing sloughs and in low-lying areas of the site), basements are not recommended due to the potential for flooding. It is anticipated that subdivision development could induce the development of perched groundwater conditions which will fluctuate seasonally depending on the amount of precipitation, surficial runoff, snow melt, irrigation etc. As such, maintaining adequate drainage adjacent to the residences and providing perimeter and sub-floor drainage systems will be critical to minimize the potential for water seepage through the foundations. Additionally, extending downspouts well away from the residences is essential.

The subgrade soil conditions at the typical footings depth (i.e., 1.2 to 3 mbgl) consisted of variable deposits of silt/clay and glacial till. Footings based below the depth of frost penetration on suitable naturally deposited, undisturbed soil (free of organics, deleterious materials or overly soft/weak soils) should perform satisfactorily. For continually heated residences with basements or for adequately insulated foundations (i.e., strategically placed rigid polystyrene insulation), it will be possible to base the footings at a higher elevation (minimum of 1.2 m below finished grade) provided that the footings are based on suitable naturally deposited, undisturbed soil. Soft/weak soils will be encountered at the design footing elevation at some locations. In these areas, it will be necessary to over-excavate and replace some of these soils with compacted structural fill, base the footings below these soils and/or widen the footings to reduce the bearing pressure exerted on the soil.

A deep foundation system consisting of drilled, cast-in-place concrete piles would perform satisfactorily as a foundation support. Temporary casing will be required to complete the installation of drilled piles at some locations. Helical screw piles are commonly used for residential foundations in the Saskatoon area. However, considering the frequency of cobbles/boulders encountered during test drilling, screw piles are not recommended due to the (high) potential for premature pile refusal and/or pile damage.

Design considerations and recommendations have been presented for frost action; site preparation; fill materials, placement and compaction; foundations; earth retaining structures; grade-supported concrete floor slabs; foundation concrete; grade beams; subdivision roads and parking structures; and, slope stability commentary.

6.2 Frost Action

The near-surface subgrade soils are considered to be susceptible to frost heaving if provided access to water. According to U.S. Corps of Engineers (USACE) Frost Design Soil Classification, the soil types encountered in this area can be classified as F3 or F4.

The estimated frost depth of the subgrade soils was calculated using the modified Berggren equation provided in the Canadian Foundation Engineering Manual (CFEM) under various surface covers. The estimated frost penetration depths are summarized in Table 6.1.

Table 6.1 – Estimated frost penetration depth under various surface covers.

Surface Cover	Design Return Period		
	Normal	10 Year Extreme	50 Year Extreme
	Estimated Frost Penetration Depth (m)		
Gravel	2.0	2.1	2.4
Asphalt	2.0	2.1	2.4
Concrete	1.9	2.0	2.2

6.2.1 Procedures to Mitigate Frost Action in Buried Utilities

The native soil near ground surface is considered to be frost susceptible. MDH recommends that buried utilities that are frost sensitive should have a minimum soil cover of 3.0 m. Frost sensitive utilities buried with less than the recommended soil cover should be protected with rigid polystyrene insulation to avoid frost effects that may cause damage to the utility pipes. Rigid insulation placed under areas subject to vehicular wheel loads should be provided with a minimum cover of 600 mm of compacted granular base and/or pavement. The design of the insulation system (depth, extent, thickness, etc.) will depend on several factors and should be determined in consultation with MDH.

6.2.2 Frost Action and Foundations

The volume increase that occurs when water changes to ice is one of the causes of frost heave. However it is also recognized that a phenomenon known as ice segregation is the predominant mechanism: water is drawn from unfrozen soil to the freezing zone where it accumulates to form layers of ice, forcing soil particles apart and causing the soil surface to heave. The magnitude of frost heave due to ice segregation can be much more severe than that of a simple state change in the soil porewater. As such, movement-sensitive foundations should be founded below the depth of frost penetration. Alternatively, measures to prevent ice segregation must be taken (i.e. dewatering, insulation, heating the area, replacement of frost-prone soil with stable fill, etc.) Such measures (if required) should be designed in consultation with MDH.

A different form of frost action, called 'adfreezing', occurs when soil freezes to the surface of a foundation. Heaving pressures developing at the base of the freezing zone are transmitted through the adfreezing bond to the foundation, producing uplift forces capable of appreciable vertical displacements. Relatively little is known of the magnitude of the forces that may be generated, but bond strengths of adfreezing in the order of 100 kPa for steel surfaces and 70 kPa for wood and concrete have been measured. Providing a bond-breaker between the foundation and the soil can reduce the potential for foundation movements due to adfreezing forces.

6.3 Site Preparation

6.3.1 General

Excess water should be drained from the work areas as quickly as possible both during and after construction. Initial grading operations should be focused on providing surface drainage, such that precipitation and surface run-off is directed away from work areas.

Following stripping of topsoil and excavation to design subgrade elevation, the exposed subgrade should be inspected by qualified MDH personnel to verify the removal of unsuitable materials and to provide additional recommendations, as appropriate. Unsuitable materials include topsoil, organic matter, vegetation, oversized material and other deleterious materials. Topsoil may be stockpiled and re-used for non-structural areas only, such as landscaping.

As a minimum (unless otherwise stated), all exposed subgrade soil within the proposed development areas should be scarified to a minimum depth of 200 mm, moisture conditioned (wetted or dried) to within $\pm 2\%$ of optimum moisture content, and compacted to at least 96% of Standard Proctor Maximum Dry Density (SPMDD) tested in accordance with ASTM Method D 698. If weak soil conditions are encountered and scarification/compaction is not practical, subgrade stabilization techniques will be required (as discussed in the following section).

6.3.2 Proof Rolling

To verify that competent and uniform soil subgrade support conditions have been achieved, proof rolling of the subgrade should be performed by two passes of a dual-wheel truck (or comparable equipment) with a minimum of 80 kN single axle load. Soils which display rutting or appreciable deflections upon proof-rolling should be over-excavated to expose more competent soil and replaced with suitable engineered fill. Alternately, the use of geosynthetics (woven geotextile, geogrid in conjunction with non-woven geotextile, or, combination geotextile/geogrid products), possibly in conjunction with some over-excavation, may be an alternative. If geosynthetics are utilized, it is recommended that granular fill materials be placed directly over the geosynthetics. The geosynthetics should be placed in accordance with the manufacturer's recommendations. Construction techniques should be designed to minimize the potential for damage to the geosynthetics and underlying subgrade soils (i.e., end-dump and spread methods, use of long reach and/or low contact pressure equipment, etc.). MDH should be retained to provide guidance with respect to subgrade improvement measures.

Following efforts to stabilize the soil, proof rolling should be repeated. All proof rolling and compaction efforts should include documentation detailing the findings, including photographs where possible. All finished subgrades should be protected from construction traffic and erosion as soon as possible.

6.3.3 Roadways and Parking Areas

For subgrade support of the roadway and parking areas, a uniformly smooth subgrade surface should be prepared, containing no ruts, pot holes, loose soils, or any imperfections that can retain water on the surface. Isolated pockets of unsuitable material should be removed and replaced with similar material adjoining the excavation to allow for uniform performance. As a minimum, the soils in all areas supporting vehicle traffic should be excavated to provide a minimum 300 mm sub-cut below design subgrade elevations and re-compacted to provide a uniform bearing condition. The following soil subgrade recommendations should be followed, depending on whether the design soil subgrade is above or below the existing grade. The prepared subgrade should be crowned or cross-sloped to facilitate the flow of surface water off the roadway/parking area. A minimum of 3% cross-slope is recommended. Sub-surface drainage systems can be used to control the moisture profile within the subgrade soils and to improve the long-term performance of the structures.

6.3.3.1 Fill Sections

If the exposed subgrade surface is more than 300 mm below the design subgrade elevation, the subgrade should only be prepared by scarifying to a minimum depth of 200 mm, moisture conditioning (wetted or dried) to within $\pm 2\%$ of optimum moisture content, and compacting to 98% of SPMDD.

If the exposed subgrade surface is less than 300 mm below the design subgrade elevation, the subgrade should be over-excavated to a minimum depth of 300 mm below the design subgrade surface. The lateral extent of over-excavation should be at least 1.5 m, or equal to the depth of over-excavation, whichever is greater. The exposed subgrade should then be scarified and compacted as outlined above. All fill soils placed to raise the subgrade elevation to design grade should be placed in loose lifts, moisture conditioned, and compacted as outlined above.

6.3.3.2 Excavation Sections

If the design subgrade elevation requires excavation, the subgrade should be over-excavated to a minimum depth of 300 mm below the design subgrade surface. The lateral extent of over-excavation should be at least 1.5 m, or equal to the depth of over-excavation, whichever is greater. The exposed soil subgrade should then be scarified and compacted as outlined above.

Subgrade preparation should not be performed on very soft, loose or wet subgrade as construction equipment may further weaken the subgrade. Subsequent to scarification and compaction, the prepared subgrade should be proof rolled as discussed in Section 6.3.2 to create a uniform bearing condition and firm even surface. Recommendations to stabilize saturated, yielding or pumping subgrade conditions, should they be encountered, should be determined in consultation with MDH. If any problems are encountered during the subgrade preparation, or if the site conditions deviate from those indicated by the boreholes, qualified MDH personnel should be notified to provide additional recommendations.

6.3.4 Temporary Excavations and Dewatering

The temporary slope angle of the excavations shall follow the recommendation stated in the Occupation Health and Safety Regulations, 1996 (OH&S). According to subsections (3) and (4) of part 260 of the OH&S Regulations, the majority of the subgrade soils within the anticipated depth of excavation may be classified as Type 4 soil. The maximum slope angle for temporary excavations in Type 4 soil shall be 3H:1V (18.4°). Variability in surface soils exists, and it is recommended that qualified MDH personnel conduct an inspection of any excavations prior to workers entering the excavated area, and written records of the inspections be maintained. The excavation slopes should be checked regularly for signs of spalling, cracking, tension cracks at crest, etc., particularly after periods of rain. Local flattening of the excavation slopes may be required if instabilities of the cut slopes are observed. For temporary excavations, equipment, spoil piles, rocks and construction materials should be kept at least 1 m from the edge of the excavation (as stated in OH&S Regulations part 260(1)). For excavations that will remain open for a relatively long time period, it is recommended that the stockpiling distance from the crest of the excavation should be equal to or greater than the depth of excavation.

Excavations that are made close to and beneath the level or elevation of existing footings or structures should be avoided if possible (if applicable). Where such excavations are unavoidable, the temporary excavation should be cut at a slope not steeper than 1H:1V, extending from a point at least 0.5 m away from the base of the existing footing. No vertical unsupported cuts shall be made. Shoring systems may be required in some areas. The design of the shoring system and all excavations adjacent to existing footings or structures should be reviewed and monitored by MDH.

Drainage trenches with periodic low points for standard sump pumps should be sufficient for dewatering shallow excavations at this site. As it is difficult to estimate the amount of water that will be encountered, close monitoring of groundwater ingress into the excavations is recommended. Other dewatering methods may be required if conventional methods prove to be insufficient. Surface drainage should be directed away from the crest of any excavation, particularly where workers and equipment will be present.

For permanent excavations, the required slope angle will vary. Slope stability analysis will be required to determine the recommended slope angle. MDH can provide this analysis, if required.

6.4 Fill Materials, Placement and Compaction

6.4.1 General

All proposed fill material should comply with the recommendations provided in this report and should be approved by MDH prior to use. All fill soils should be free of appreciable amounts of deleterious and/or organic materials, large particle sizes and contaminants. Fill soils should not be placed in a frozen state, or placed on a frozen subgrade. All lumps of materials should be broken down during placement.

Prior to placement of fill material, representative bulk samples (about 25 kg) should be taken of the proposed fill soils and laboratory tests should be conducted to determine (as applicable) Atterberg limits, natural moisture content, grain size-distribution and standard Proctor moisture-density relationship. These test results will be necessary for the proper control of construction for the engineered fill.

Prior to placing any fill, the exposed subgrade surface should be prepared in accordance with the preceding sections. It is important that the fill soils be compacted uniformly in order to maintain uniformity and minimize the potential of subsequent differential vertical movements.

6.4.2 Subgrade Fill

Subgrade fill, if required to achieve a uniformly level subgrade surface, should be placed in loose lifts (150 mm thickness, maximum), moisture conditioned (wetted or dried) to within $\pm 2\%$ of optimum moisture content, and compacted to at least 96% of SPMDD tested in accordance with ASTM Method D 698. Subgrade fill, if required, should preferably consist of locally available glacial till soils or approved imported soil (granular soil or non-expansive (low plasticity) fine grained soil).

6.4.3 Structural Fill

Well-graded granular material is preferred as structural fill at this site due to the relative ease of compaction and more uniform/rapid settlement response (as compared to poorly graded granular soils or fine grained soils). If the use of well graded granular fill is cost prohibitive, then the use of locally available glacial till soils or suitable imported fill may be permissible. It should be noted that the settlement response of non-granular materials or poorly graded granular materials will be less uniform and will take longer to develop as compared to well graded granular materials. Additional time and effort will also be required to moisture condition and place these materials. Beneath hard-surfaced, grade-supported structures, a nominal thickness of structural granular fill (base course and sub-base course materials) will be required.

All structural fill should be placed in thin lifts (150 mm thickness, maximum), moisture conditioned (wetted or dried) to within $\pm 2\%$ of optimum moisture content, and uniformly compacted to at least 98% of SPMDD tested in accordance with ASTM Method D 698. Where not contained by grade beams or suitable curbs, the structural fill should extend laterally 1 m or equal to the full depth of fill (whichever is the greater) beyond the footprint of grade-supported structures (asphalt surfacing, concrete slabs etc.).

The recommended gradation requirements for base course and sub-base course material have been presented in Table 6.2. Alternate gradations may be acceptable but should be approved by MDH prior to use.

For granular sub-base course material, the uppermost 300 mm of the fill should meet the gradation requirements presented above. For lower levels of sub-base fill, over-sized particles may be incorporated. For quality control testing of fill material containing over-sized particles, the gradation should be determined on samples with all over-sized materials (i.e., greater than 50 mm) removed.

Table 6.2 – Base and sub-base gradation specifications.

Sieve Size		Percent Passing by Weight	
		Base Course	Sub-Base
		Type 33	Type 6
50	mm		100
31.5	mm		
25	mm		
22.4	mm		
18	mm	100	
16	mm		
12.5	mm	75 - 100	
9	mm		
5	mm	50 - 75	
2	mm	32 - 52	0 - 80
900	µm	20 - 35	
400	µm	15 - 25	0 - 45
160	µm	8 - 15	0 - 20
71	µm	6 - 11	0 - 6
Plasticity Index		0 - 6	0 - 6
Fractured Face %		Min 50	
Lightweight pieces %		Max 5	

Note: Adopted from Saskatchewan Highway and Transportation Design Manual.

6.4.4 Utility Trench Backfill

Utility bedding materials will vary depending on the type of utility. Utility bedding material gradation, placement, thickness, compaction, etc. should be in accordance with the utility manufacturer's specifications and recommendations. Care must be taken to ensure damage does not occur to the utilities as a result of placement/compaction of the bedding material and overlying fill materials.

Below buildings/structures and concrete-surfaced areas, the use of well graded granular fill is recommended above the bedding material (as discussed above) as this type of material will settle less and more uniformly as compared to common fill (i.e., locally excavated soil). Within all other areas (where some potential settlement of the excavation backfill material may be permissible), the use of locally excavated soil as backfill should be suitable. In areas where there will be no surface cover (asphalt, concrete etc.), it is recommended that the excavations be capped with low hydraulic conductivity soils to limit surface water ingress into the utility trench. In areas where there will be a permeable surface cover (i.e., graveled areas, landscape areas, etc.), the drainage adjacent to the utility trench should provide for positive drainage away from the trench.

6.4.5 Fill Settlement

Fill materials will tend to settle due to self weight and any imposed loading. The amount of settlement is unpredictable due to a number of variables associated with the properties of the fill material and underlying subsoils. The settlement of fill materials can be reduced by adhering to strict placement and compaction specifications for the entire fill thickness (i.e., utilizing thin uniform lifts, maintaining moisture content near optimum, compacting to a uniform, high density condition). Maintaining a uniform fill thickness will also serve to minimize differential movements across the fill area. The estimated settlements of cohesive and non-cohesive fill materials as a function of compaction level have been presented in Table 6.3.

Table 6.3 – Estimated fill settlement vs. compaction level.

Compaction Level (%SPMDD)	Estimated Fill Settlement (% of Fill Thickness)	
	Cohesive Soils	Non-Cohesive Soils
100	0.5	<0.5
98 to 100	1.0	0.5
95 to 98	1.5	1.0
90 to 95	4.0	3.0
<90	>4.0	>3.0

SPMDD = Standard Proctor Maximum Dry Density ($\pm 2\%$ of optimum moisture content).

6.5 Foundations

6.5.1 Limit States Versus Working Stress Design

MDH understands that working stress and/or limit states design methodologies may be considered for foundation design. For the purposes of this report, ultimate geotechnical design parameters have been presented. To determine factored parameters (limit states design), the ultimate parameters should be multiplied by the applicable geotechnical resistance factors (ϕ) as per the National Building Code of Canada 2010 (NBCC). The recommended geotechnical resistance factors (ϕ) as per the National Building Code of Canada 2010 (NBCC) are as follows:

1. Shallow Foundations
 - (a) Vertical bearing resistance from semi-empirical analysis using laboratory and in-situ test data ($\phi = 0.5$)
 - (b) Sliding
 - (i) based on friction [$c = 0$] ($\phi = 0.8$)
 - (ii) based on cohesion/adhesion [$\tan \phi = 0$] ($\phi = 0.6$)
2. Deep Foundations
 - (a) Resistance to axial load
 - (i) semi-empirical analysis using laboratory and in-situ test data ($\phi = 0.4$)
 - (ii) analysis using static loading test results ($\phi = 0.6$)
 - (iii) analysis using dynamic monitoring results ($\phi = 0.5$)
 - (iv) uplift resistance by semi-empirical analysis ($\phi = 0.3$)
 - (v) uplift resistance using loading test results ($\phi = 0.4$)
 - (b) Horizontal load resistance ($\phi = 0.5$)

Ultimate geotechnical resistances to axial loads for deep foundations were calculated using semi-empirical analysis using laboratory and in-situ test data. Resistance factors of ($\phi = 0.4$) for normal loading and ($\phi = 0.3$) for uplift resistance need to be applied to the ultimate geotechnical resistances presented for deep foundations.

For working stress design, the ultimate geotechnical design parameters presented in this report should be divided by the appropriate F.S. (typically 2.5 to 3.5) to determine the “allowable” parameters.

6.5.2 Footings

A footing foundation system based within suitable naturally deposited, undisturbed soil (free of organics, deleterious materials or overly soft soils) should perform satisfactorily at this site.

Groundwater levels vary considerably across the site, and at some locations footings may be based below the groundwater table. Dewatering of the footing excavations at these locations will be required. The means of dewatering should be left to the contractor, but the techniques discussed in Section 6.3.4 should suffice.

The following recommendations should be considered in the design of a footing foundation system:

- 1) For residences with a heated basement, footings should be founded within suitable naturally deposited, undisturbed soil at a minimum depth of 1.2 m below finished grade. Footings not protected with a continuous heat source and a minimum of 1.2 m of ground cover should be based below the depth of frost penetration or protected with strategically placed rigid polystyrene insulation. In this case, MDH should review the proposed insulation details.
- 2) It is preferable that footings should be founded directly on firm (or stronger), suitable naturally deposited, undisturbed soil. If unsuitable soils (i.e., organics, deleterious materials, overly soft soils) are encountered at the design footing elevation, it will be necessary to completely remove/replace these soils with compacted granular fill or base the footings below these soils. If soft soils are encountered at the design footing elevation, it will be acceptable to over-excavate to more suitable soils (firm or stronger) and backfill with compacted granular fill or lean mix concrete to re-establish the design footing elevation, or, to widen the footings (see point #6 below). In this case, the uppermost 300 mm of the granular fill should consist of granular base course material, while lower lifts of granular fill may consist of granular sub-base material. The granular fill should be placed and compacted in thin lifts (150 mm maximum thickness) and the lateral extent of the fill should be at least equal to the vertical thickness of the fill.
- 3) A serviceability limit states (SLS) bearing pressure of 75 kPa may be utilized for design of the footings (to limit foundation settlement to 25 mm or less).
- 4) An ultimate limit states (ULS) bearing pressure of 200 kPa (unfactored) may be used for design of the footings (i.e., bearing capacity against soil shear failure).
- 5) Footing excavations should be cleaned to remove all loose, disturbed soil, and to expose suitable naturally deposited, undisturbed soil. If the subgrade soil is disturbed during excavation, the disturbed soil should be removed to an undisturbed, level surface. Over-excavated areas should be backfilled with lean mix concrete or compacted granular fill, as discussed above.
- 6) A minimum dimension of 1,000 mm is recommended for square and rectangular footings. A minimum width of 450 mm is recommended for strip footings. If soft soils are encountered at the design footing elevation and these soils are not over-excavated/replaced (as per point #2 above), then the footings dimensions should be increased by 50%.

- 7) A representative of MDH should inspect the prepared footing excavations prior to the construction of footings to ensure that suitable soil conditions exist.
- 8) The footings should not be constructed on loose, softened, desiccated, frozen or wet subgrade soil or fill. Cohesive subgrade soils should be covered as soon as possible after excavation to minimize the potential for drying/wetting of the soil. Where silt/sand soils are encountered at the footing elevation, a mud slab (lean mix concrete) is recommended to reduce the potential for disturbance of the silt/sand soils.
- 9) Frost should not be allowed to penetrate beneath the footings prior to, during or after construction. If the foundation is constructed during freezing conditions, the subgrade soil at the design footing elevation must be protected from freezing.
- 10) The finished grade should be landscaped to provide for positive site drainage away from the foundation.

6.5.3 Drilled, Cast-in-Place Concrete Piles

Drilled straight shaft, cast-in-place concrete piles may be designed on the basis of skin friction only.

The ultimate shaft resistance values of the subgrade soils are presented in Table 6.4.

Table 6.4 – Ultimate shaft resistance (drilled piles).

*Depth Below Existing Grade (m)	Ultimate Shaft Resistance (kPa)
0 to 2	0
2 to 3	40
Below 3	75

*Zone of zero skin friction may be reduced to 1.0 m for piles extending below basement levels (if applicable).

The following recommendations should be considered in the design of drilled, cast-in-place concrete piles:

- 1) To minimize frost heave potential, drilled straight shaft concrete piles should be extended to a minimum depth of 6 m below finished ground surface. Pile reinforcement must be adequate to withstand all vertical, lateral and tensile forces within the pile.
- 2) A minimum pile diameter of 300 mm is recommended. Larger auger sizes will likely be required at some locations to allow for the removal of cobbles/boulders.

- 3) A minimum centre-to-centre pile spacing of three pile diameters is recommended.
- 4) Casing will be required where groundwater seepage and sloughing conditions are encountered to maintain the pile holes open and dry for placement of the reinforcing steel and concrete. The annular space between the casing and drilled hole must be filled with concrete. As the casing is extracted, concrete in the casing must have adequate head to displace all water in the annular space. Water which accumulates on top of the pile upon removal of the casing must be removed to ensure the integrity of the concrete is not compromised. Concrete placement by tremie methods will be required if conventional concrete placement methods are insufficient.
- 5) Pile holes should be filled with concrete as soon as possible after drilling to reduce the risk of groundwater seepage and/or sloughing soil. Excess water should not be allowed to collect within the drilled hole. If excess water collects in the drilled hole, it will be necessary to remove the water (by pumping or bailing) prior to placing reinforcing steel and concrete. Vibration of the concrete in the upper 3 m of the pile shaft is required to produce uniform strength concrete.
- 6) Continuous monitoring by MDH during pile installation is recommended to document the installation of each drilled, straight shaft concrete pile installed at this site.

6.5.4 Lateral and Tension Forces

It is anticipated that the foundations may be required to withstand vertical compressive loading and tensile loading as well as lateral loading.

For drilled, cast-in-place straight shaft concrete piles the vertical tensile capacity can be determined using the skin friction values (tension) presented in Table 6.4. Concrete piles must be adequately reinforced throughout their entire length to withstand the vertical tensile forces within the pile.

If the piles designed to support the vertical loading conditions are inadequate to support the lateral loading conditions, it may be necessary to increase the pile diameter, utilize pile groups or incline (batter) the piles.

Pile deflection typically governs the design of laterally loaded piles. Horizontal subgrade reaction theory may be utilized to estimate lateral pile deflection. The estimated coefficients of horizontal subgrade reaction (k_h) have been presented in Table 6.5.

Table 6.5 – Modulus of horizontal subgrade reaction, K_h .

Zone (mbgl)	Modulus of Horizontal Subgrade Reaction, K_h (kN/m ³)
0 to 1.5D	0
1.5D to 3	2,500/D
3 to 5	5,000/D
Below 5	10,000/D

mbgl = metres below existing ground level. D = pile diameter in metres.
For pile diameters in excess of 1.0 m, the zone of zero horizontal subgrade reaction should not exceed 1.5 m.

Utilizing horizontal subgrade reaction theory, the parameters presented in Table 6.6 may be utilized for pile groups.

Table 6.6 – Recommended P-multiplier, P_m , values for design by row position.

Pile Spacing (c-c)	Design P-multiplier, P_m			
	3D	4D	5D	6D
Lead Row	0.7	0.85	1.0	1.0
2nd Row	0.5	0.65	0.85	1.0
3rd and Higher Rows	0.35	0.5	0.7	1.0

Where c - c = centre to centre, D = pile diameter. The reduction factors are for pile spacings in the direction of the applied load.

Where a more thorough lateral analysis is required, the p-y method of analysis is recommended. If required, MDH can conduct p-y analysis as part of the design process. Specific pile/pile group details will be required, including vertical and lateral pile loads, type of pile, diameter of pile, length/embedment of pile, pile cap/pile connection details, pile spacing, etc.

6.6 Earth Retaining Structures

The determination of lateral earth pressures will be required for the design of subsurface foundation walls, sumps, retaining walls, etc. (if applicable). Horizontal soil forces for structural design should be determined using the earth pressure coefficients presented in Table 6.7 and the following equation:

$$\sigma_h = K\sigma_v = K\gamma H$$

where:

- σ_h = horizontal force,
- K = earth pressure coefficient,
- σ_v = vertical stress,
- γ = soil unit weight,
- H = height (retained soil thickness)

The recommended soil parameters are provided in Table 6.7.

Table 6.7 – Soil parameters for design.

Soil Type	*Effective Angle of Internal Friction	* K_p	* K_a	* K_o	**Coefficient of Sliding Friction	Total Unit Weight (γ) (kN/m ³)	Submerged Unit Weight (γ') (kN/m ³)	Undrained Shear Strength (kPa)
Silt/Clay	22°	2.20	0.45	0.63	0.28	18.5	8.7	0
Glacial Till	28°	2.77	0.36	0.53	0.37	22.0	12.2	(50/100)****
Granular Fill	33°	3.39	0.29	0.46	0.45	21.5	11.7	0
***Cohesive Fill	25°	2.46	0.41	1.0	0.33	21.0	11.2	75

* Friction angle and earth pressure coefficients = 0 for undrained analysis. The coefficients apply only if the slope angle behind the wall equals zero.

** For concrete cast directly against the subgrade soil.

*** For low plasticity cohesive backfill compacted in accordance with the report specifications.

**** Firm/stiff

For estimating the horizontal force on structures backfilled with granular fill, the width of the granular section should be at least 1 m and the granular backfill should be sloped upward at no steeper than 1H:1V away from the structure. If this width of granular backfill cannot be achieved, the native soil earth pressure coefficients should be utilized.

The shape of the lateral pressure distribution will depend on the degree of compaction achieved in the soil backfill against the wall. Where the backfill adjacent to the wall will be compacted to 95% of the SPMDD or greater, the design earth pressure should adopt a combined trapezoidal/triangular distribution as per Figure 6.1. The typical relationships to be used in calculating the lateral pressures for structural design are provided in Figure 6.1 and the load of typical compactors are provided in Table 6.8. Where subdrainage will not be provided, two cases should be considered in the calculation of the lateral pressures:

- 1) The case immediately following fill placement and compaction, where the groundwater level has not been re-established. In this case the total soil unit weights provided in Table 6.7 should be used.
- 2) The longer term case where the groundwater level is re-established. In this case buoyant soil unit weights ($\gamma' = \gamma - 9.8 \text{ kN/m}^3$) should be used to calculate the horizontal stress below the depth of the groundwater level and a hydrostatic pressure component due to water pressure will need to be added.

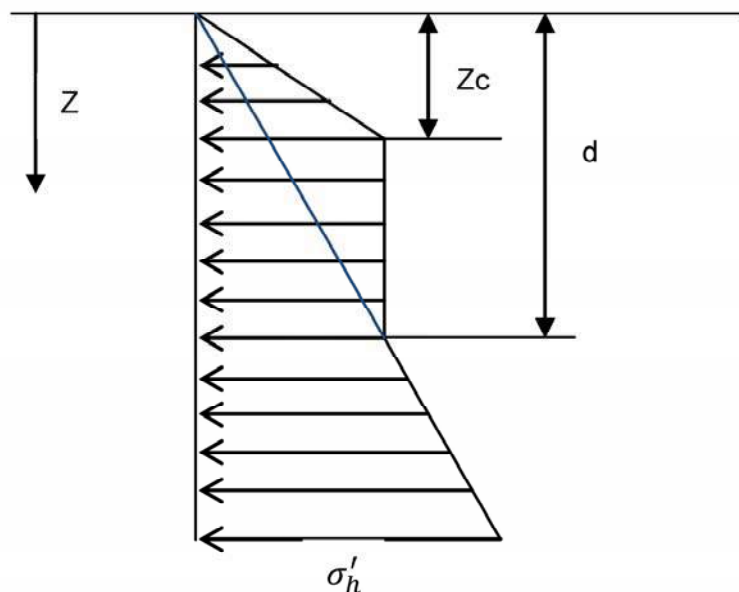
The greater of case 1) or 2) above should be used for design.

Table 6.8 – Typical compaction equipment data for estimating compaction-induced loads.

Equipment Type	Dead Weight of Roller (kN)	Centrifugal Force (kN)	Roller Width (mm)	P (kN/m)
Single-drum walk-behind	2.3	8.3	560	18.9
Dual-drum walk-behind	1.6	10.1	560	20.9
Dual-drum walk-behind	12.1	8.8	760	27.5
Dual-drum walk-behind	9.2	19.8	750	38.7

The above recommendations assume horizontal ground beyond the earth retaining structures. In addition to earth pressure, lateral stresses generated by line, point or surcharge loads, from such as equipment and/or embankment fill, also require consideration in the design of retaining structures. It is not, however, realistic to present recommendations within this report for all possible combinations of load conditions and soil conditions. MDH would be pleased to assist with the design of such cases upon request.

To reduce the potential for development of lateral hydrostatic or frost forces due to accumulation of water behind the wall, it is recommended that a zone of clean, free-draining, non-frost susceptible granular soil be provided behind the wall. The width of the free-draining fill zone should be at least 1.0 m, and the fill should contain less than 5% particles by weight smaller than 0.075 mm in size (Number 200 US Standard sieve). A perforated drainage pipe should be installed along the base of the walls with positive drainage to a discharge point. The structural engineer may present other options to deal with the effects of lateral hydrostatic or frost forces acting upon structures. In areas that are not paved, the upper 500 mm of backfill should consist of low permeability fill material to reduce the potential of surface water infiltration behind the wall. The ground or pavement surface should be graded to promote positive drainage away from the wall. A conceptual drawing showing a typical subsurface drainage arrangement of an earth retaining structure is presented as Figure 6.2.



$$Z_c = K \sqrt{\frac{2P}{\pi\gamma}}$$

$$d = \frac{1}{K} \sqrt{\frac{2P}{\pi\gamma}}$$

$$\text{For } Z_c \leq Z \leq d \rightarrow \sigma'_h = \sqrt{\frac{2P\gamma}{\pi}}$$

$$\text{For } Z > d \rightarrow \sigma' = K_o \gamma Z$$

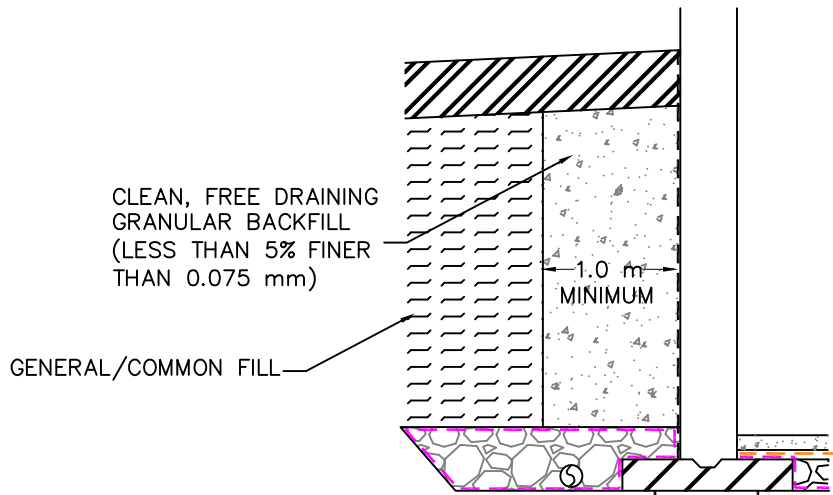
γ = Soil unit weight

$K = K_o$ (See report text)

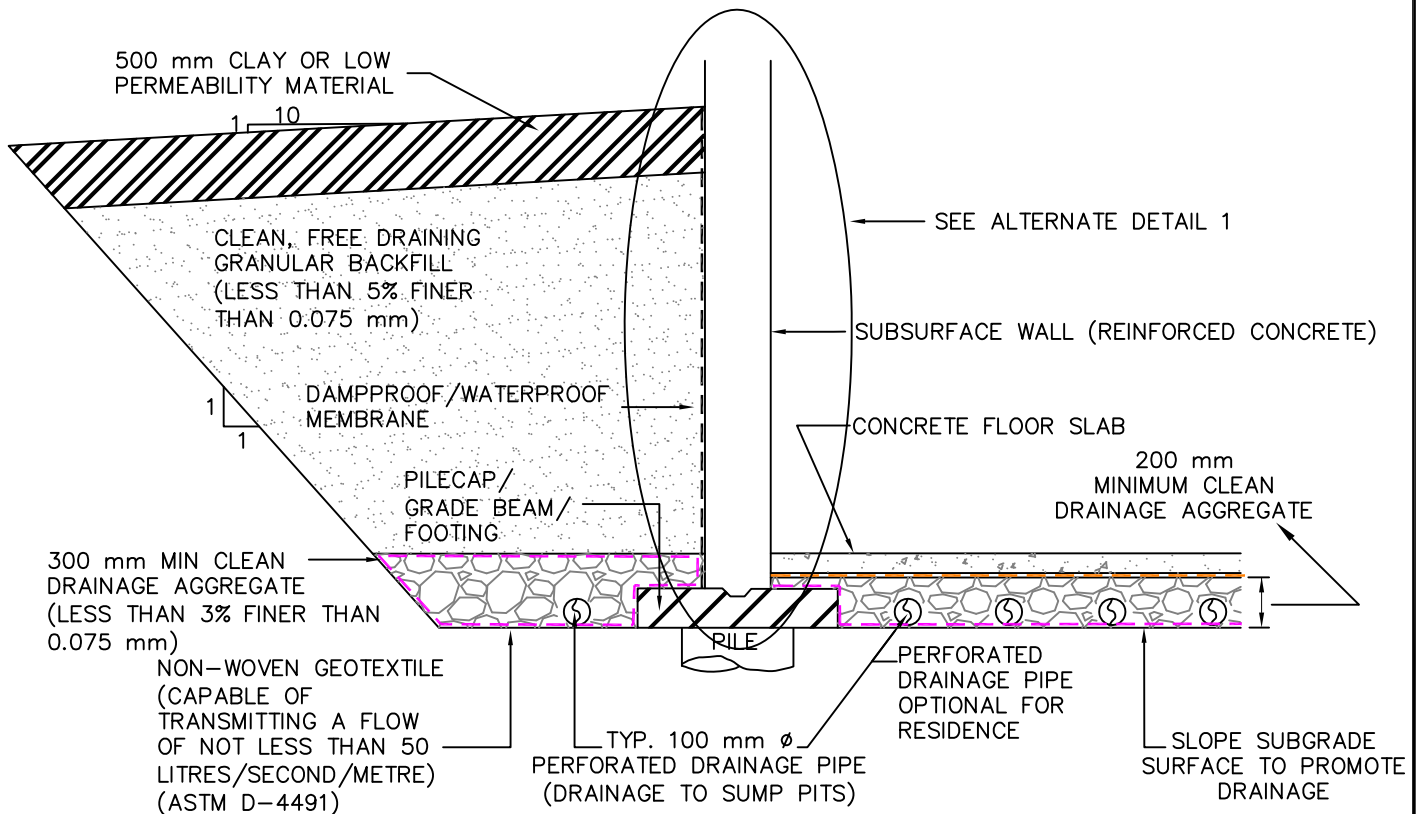
$$P_{(Roller Load)}^* = \frac{\text{dead weight of roller} + \text{centrifugal force}}{\text{width of roller}}$$

*See Table 6.8 for typical compactor loads.

LEGEND		REFERENCE DRAWINGS				 SNC • LAVALIN									
	DWG No	DATE	DESCRIPTION		CLIENT	PROJECT LOCATION									
	REVISIONS				CHRIS CEBRYK	W1/2-11-37-4-W3M									
					TITLE	HORIZONTAL PRESSURE ON WALLS INDUCED BY COMPACTION EFFORT									
NOT TO SCALE						DES BY	CZ	DRN BY	CPS	CHK BY	CZ	APP BY	CZ		
	REV	DATE	DESCRIPTION		DRN	APP	DATE	2013 08 19	DWG No	613596-63-2	FIG No	6.1	REV	0	8.5 X 11



ALTERNATE DETAIL 1
SCALE: NOT TO SCALE



LEGEND		REFERENCE DRAWINGS					 SNC • LAVALIN							
NON—WOVEN GEOTEXTILE — — — — —														
	DWG No	DATE	DESCRIPTION			CLIENT								
	REVISIONS					CHRIS CEBRYK	PROJECT LOCATION W1/2-11-37-4-W3M							
POLYETHYLENE VAPOUR BARRIER — — — — —							TITLE CONCEPTUAL SUB—SURFACE DRAINAGE SYSTEM FOR EARTH RETAINING STRUCTURES AND GRADE—SUPPORTED FLOOR SLABS							
NOT TO SCALE	REV	DATE	DESCRIPTION	DRN	APP	DES BY DATE	CZ 2013 08 19	DRN BY DWG No	CPS 613596-63-1	CHK BY FIG No	CZ 6.2	APP BY REV	CZ 0	8.5 X 11

6.7 Grade Supported Concrete Floor Slabs

The near-surface subgrade soils consisted of variable deposits of silt/clay and glacial till. Grade-supported concrete slabs should perform satisfactorily provided that some floor slab movements can be tolerated and the recommendations presented in Sections 6.3 and 6.4 are adhered to. If some differential movements/floor cracking cannot be tolerated, then a structural slab should be constructed.

For continually heated areas, the following recommendations should be incorporated into the design of reinforced, grade-supported, cast-in-place concrete slabs at this site:

- 1) Prepare the site in accordance with Sections 6.3 and 6.4.
- 2) For basement floor slabs, over-excavate to allow for the placement of a minimum of 200 mm of clean, drainage aggregate below the floor slab. The drainage aggregate should be well graded granular material with a maximum aggregate size of 25 mm, and should contain less than 3% particles by weight smaller than 0.075 mm in size (Number 200 US Standard sieve). It is recommended that a continuous layer of high permeability, non-woven geotextile should be placed between the subgrade soils and the drainage aggregate. The subgrade surface should be graded to allow for free drainage to a sump pit(s). The sump pit should be perforated to allow water from the sub-slab drainage layer to be collected. All water discharged from the sump pit(s) should be directed well away from the residences, and must not be directed into the on-site wastewater disposal system. [Refer to Figure 6.2 for additional details].
- 3) For floor slabs constructed near existing grade, over-excavate, as required to allow for the placement of a minimum of 300 mm of approved structural fill between the subgrade soils and the underside of the concrete slab (thickness of over-excavation will need to be increased where unsuitable and/or overly soft soils are encountered). The uppermost 150 mm of the fill should consist of crushed, granular base course material. Lower lifts of fill may consist of granular sub-base material or approved fine grained soils. All structural fill should be placed in thin lifts (150 mm thickness, maximum), moisture conditioned (wetted or dried) to within $\pm 2\%$ of optimum moisture content, and uniformly compacted to at least 98% of SPMDD tested in accordance with ASTM Method D 698.
- 4) Separation joints should be used to isolate the slab from foundation walls, columns, etc.
- 5) Reinforce the concrete slab and provide control joints at regular intervals to provide for controlled cracking.

- 6) The finished grade should be landscaped to provide for positive site drainage away from the structure.
- 7) Concrete slabs should not be constructed on loose, softened, desiccated, frozen or wet soil.
- 8) Frost should not be allowed to penetrate beneath the concrete slab just prior to, during or after construction.
- 9) Continuous quality control inspection by MDH should be provided during fill placement.
- 10) Separate the slab from the drainage aggregate by means of a polyethylene vapour barrier.
- 11) If insulation is to be utilized below the floor slab, a 1.0 m (minimum) width of un-insulated space should be retained around the perimeter of the residence to allow heat loss to the foundation.

6.7.1 *Unheated Slabs*

Grade-supported concrete slabs exposed to freezing conditions will be subject to differential movements associated with frost action. The potential for differential movements associated with frost action can be minimized by over-excavating and replacing a greater thickness of subgrade soil with low frost-susceptible granular fill (in the order of 1,000 to 1,500 mm is recommended), by placing sub-horizontal rigid polystyrene insulation below the slabs and/or by providing minimal heat (5 degrees celcius minimum) and air circulation within the building during freezing conditions (if applicable). If insulation is to be utilized, the insulation should have a minimum thickness of 100 mm and should extend below the slab and sub-horizontally away from the outer edges of the slab a minimum distance of 2.4 m. The insulation should be covered with a minimum of 300 mm of soil cover to provide protection against damage, and should be positively sloped away from the slab.

If differential movements cannot be tolerated, the slab should be constructed as a structural slab (i.e., pile supported) over a compressible void form.

6.8 Foundation Concrete

Water-soluble sulphate salts (gypsum crystals) exist in the geologic deposits in this region. Sulphate resistant cement is recommended for all foundation concrete in direct contact with the naturally occurring subgrade soils at this site. If imported fill material is utilized, it is recommended that the fill soil be tested for sulphate content to determine whether the above-stated recommendations remain valid. However, it should be noted that most fine grained soils encountered in Saskatchewan contain concentrations of sulphates.

The recommendations stated above for the subsurface concrete at this site may require further additions and/or modifications due to structural, durability, service life or other considerations which are beyond the geotechnical scope. A designer competent in concrete mix design should complete the specifications for the concrete mix.

6.9 Grade Beams

Grade beams should be constructed to allow for a minimum of 100 mm of net void space between the underside of the grade beam and the subgrade soil (compressible void form). The finished grade adjacent to each grade beam should be capped with hard-surfacing or well compacted, low permeable material and should be positively drained away from the grade beam so that surface runoff is not allowed to infiltrate and collect in the void space. If water is allowed to accumulate in the void space, the beneficial effect will be negated and frost heaving may occur.

6.10 Subdivision Roads and Parking Areas

Suitable borrow materials (i.e., glacial till) exist on site for the construction of subdivision road embankments (silt soils and soft glacial till soils are not recommended for roadway construction). It is anticipated that the majority of traffic will be light passenger vehicles, but that infrequent heavy truck traffic may enter the proposed subdivision. It is also anticipated that the subdivision access roads and parking structures will be gravel surfaced.

The following recommendations should be considered in the design of the subdivision access roads and parking areas.

- 1) Prepare the site in accordance with Sections 6.3 and 6.4.
- 2) The soaked CBR (California Bearing Ratio) rating of the compacted subgrade soil is estimated to be 3. Based on the estimated soaked CBR rating, the following access road structures have been presented.

Table 6.9 – Proposed graveled structure design thickness.

Structure	Light Traffic	Medium Traffic	Heavy Traffic
	Axle load ~35 kN	Axle load ~55 kN	Axle load ~80 kN
Base Course (mm)	150	200	200
Sub-Base Course (mm)	250	325	450
Geosynthetic	Recommended	Recommended	Recommended
Total Structure (mm)	400	525	650

- 3) The granular base and sub-base course material should meet the aggregate gradation requirements presented in Table 6.2.
- 4) Positive surface drainage is recommended to reduce the potential for moisture infiltration through the roadway/parking lot structures. A minimum cross-slope of 3% is recommended.
- 5) It is assumed that a subdivision grading/drainage plan will be prepared by others. To enhance the performance of roadway and parking structures, maintaining adequate drainage at all times will be critical. Adequate maintenance of culverts, ditches etc. will be required to ensure that the drainage systems are functioning as intended.
- 6) The subgrade surface should be graded to promote drainage to the outer edges of the roadway/parking areas. The roadway/parking lot grades should be designed such that the granular sub-base course material can freely discharge into ditches, thereby providing a capillary break to maintain an unsaturated condition in the overlying traffic structure (this will be particularly important in low-lying/wetland areas).
- 7) For glacial till borrow material, embankment/ditch sideslopes should be no steeper than 3 horizontal to 1 vertical (3H : 1V).
- 8) Erosion protection is recommended for all sideslopes and around drainage control structures. Rip-rap may be required at some locations.
- 9) Traffic areas should be separated on the basis of traffic loading (i.e., light, medium, heavy). If heavier traffic is allowed to travel on lighter traffic structures, premature distress/failure of the lighter traffic structures will occur.
- 10) Periodic maintenance such as grading and pothole filling will be required.

- 11) It is recommended that the roadway grades should be maintained at least 600 mm above the surrounding terrain to minimize snow accumulation on the roads, and that the shoulder of the road should be at least 1.2 m above the ditch bottom elevation.
- 12) Geosynthetics are recommended to provide material separation, subgrade stabilization, uniform structure thickness and extended/improved performance of the structure. Site-specific geosynthetic design details should be determined in consultation with MDH (intended application, type of geosynthetic, location within structure, depth of soil subcut required, etc.). Depending on the geosynthetic design details chosen, the actual graveled structure may vary from what is presented in Table 6.11.

6.11 Slope Stability Commentary

An assessment of slope stability was required for the proposed scope of work for this project. Based on the topographic information provided by Webb Surveys, the maximum slope height within the proposed development area (from top of hill to base of slope) is about 8 to 10 m, and the maximum slope angle is about 15 degrees. Based on these limiting scenarios, stability of the natural slopes within the proposed development area is not considered to be an issue.

Where natural slopes are proposed to be altered by construction and are greater than 3.0 m in height, slope stability should be assessed on a case-by-case basis. For example, where the slopes are steepened, material is excavated near the base of the slope, underground utilities are located within the slope, or where structures are proposed in the vicinity of the crest of the slope.

7.0 CONSTRUCTION CONTROL AND MONITORING

The recommendations presented in this report are based on the premise that full time inspection, monitoring, and control testing are provided by qualified MDH personnel during site development and construction. Hence, quality control should be provided as follows:

- Inspection during site grading, clearing/excavation and proof rolling to verify the removal of unsuitable materials;
- In-situ density and moisture content testing during subgrade preparation and placement of fill/backfill;
- Inspection during pile construction; and,
- Materials and concrete laboratory testing during construction.

APPENDIX I

Terms, Symbols and Abbreviations

Terms, Symbols and Abbreviations

Field geological description of a soil is achieved through a brief description of the following points. All points should be included to accurately describe a soil for geoenvironmental applications:

- 1) Lithology/texture (size, proportion, and shape);
 - 2) Colour and oxidation;
 - 3) Consistency and plasticity (cohesive soils);
 - 4) Condition (non-cohesive soils);
 - 5) Moisture; and
 - 6) Other miscellaneous descriptors.
-

1) Lithology / Texture

The texture of a soil is a combination of the size and shape of the particles and the relative proportions of each of the constituents (eg. subrounded to subangular gravel, sandy, some silt, trace cobble).

Particle Size (ASTM D2487-85)

Boulder	300mm plus
Cobble	75 – 300 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75mm
Fine:	0.075 – 0.425 mm
Medium:	0.425 – 2 mm
Coarse:	2 – 4.75 mm

Relative Proportions (by weight)

Parent Material	>35%, main fraction
Modifier	20 – 35%
eg: gravely, sandy, silty, clayey, etc.	
Some	10 – 20%
Trace	0 – 10%

Particle Shape (coarse grained soils)

Rounded	No edges and smoothly curved sides
Subrounded	Well-rounded corners and edges, nearly plane sides
Subangular	Similar to angular but have rounded edges
Angular	Sharp edges and relatively plane sides with unpolished surfaces

Gradation (coarse grained soils)

Well Graded	Having a wide range of grain sizes and substantial amount of all intermediate sizes
Uniform (Poorly Graded)	Possessing particles of predominantly one size
Gap Graded	Possessing particles of several distinct sizes

2) Colour and Oxidation

A soil's colour may be described either qualitatively in the field at the soils natural moisture content using common colours (eg. light grey, light brown, dark grey, etc.) or quantitatively by comparison with a colour chart. Soil colour is typically quantified using the Munsell Book of Colour. The soil colour description is characterized by a combination of hue, value and chroma. The hue notation of a colour indicates its relation to red, yellow, green, blue and purple; the value notation indicates its lightness; and the chroma notation indicates its strength (or departure from a neutral of the same lightness (eg 2.5Y4/2). Quantitative determination of colour using a Munsell Book of Soil Colours is completed after the soil has been allowed to dry at a low temperature.

When a soil is exposed to an oxygen rich environment it oxidizes and the soils colour departs from neutral (eg from dark grey (5Y4/1) to dark reddish brown (5Y4/2)). The colour change is generally a result of iron oxidation and staining (red) or manganese staining (purple to black). The oxidation may occur throughout the entire soil mass or commonly as fracture and joint coatings and haloes.

3) Consistency and Plasticity (Cohesive Soils)

The consistency of a soil is a qualitative description of a cohesive soils ability to resist deformation and may be correlated to the undrained shear strength. Consistency and undrained shear strength (S_u) of a soil may be field-tested using the thumb and thumbnail or more accurately with a pocket penetrometer.

The plasticity of a soil is a measure of the soils ability to deform without rupture. The plasticity of a cohesive soil should be estimated as low ($LL < 30$), medium ($30 < LL < 50$), or high ($LL > 50$) plasticity. The plasticity can be verified in the laboratory through Atterberg Limit testing.

Consistency	Undrained Shear Strength - S_u (kPa) (CFEM, 2 nd edition, 1985)	Field Identification (ASTM D 2488-84)
Very Soft	<12	Thumb will penetrate soil more than 25mm
Soft	12 – 25	Thumb will penetrate soil about 25mm
Firm	25 – 50	Thumb will indent soil about 6 mm
Stiff	50 – 100	Thumb will indent but penetrate only with great effort (CFEM)
Very Stiff	100 – 200	Readily indented by thumbnail (CFEM)
Hard	>200	Thumb will not indent but readily indented with thumbnail
Very Hard	N/A	Thumbnail will not indent soil

Note: 1) Pocket penetrometer readings can be used to measure S_u directly where S_u is equal to approximately $\frac{1}{2}$ of the pocket penetrometer reading (i.e. The pocket penetrometer measures unconfined compressive strength (approx $2S_u$)).
2) Torvane measures undrained shear strength (S_u) directly.

4) Compactness Condition (Non-Cohesive Soils)

A Standard Penetration Test (SPT) is used to estimate the compactness condition of a soil.

Compactness Condition	SPT N-Index (Blows / 300mm)
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	>50

5) Moisture Conditions (ASTM D2488-84)

- Dry - No moisture, dusty, dry to touch
- Moist - Damp but contains no visible water
- Wet - Visible, free water, indicating soil is below water table

6) Other Descriptors

- Primary structure - structure formed during soil deposition (eg. stratified, laminated, lensed, bedded, massive, cross-bedded, etc.)
- Secondary structure - structure formed following original deposition (eg. cementation, salt crystallization, jointing, fissuring, fracturing, slickensides, blocky, brecciated, mottled, etc.)
- Carbonate content - weakly, moderately, or strongly calcareous (based on effervescence in dilute (10%) HCl acid)
- Organics (spongy feel, fibrous texture)
- Sensitivity (sands)
- Odour

7) Soil Type Symbols

	FILL		SAND		GYPSIFEROUS TILL
	TOPSOIL OR ORGANIC SOIL		GRAVEL		CALCAREOUS SHALE OR LIMESTONE
	CLAY OR SHALE		COBBLES		COAL
	SILT		OXIDIZED TILL		SALT
	SAND-SILT INTERBED		UNOXIDIZED TILL		DIAMICTON

8) Sampling Symbols (left hand side of testhole log)

	CORE (any type)		SPLIT TUBE		BAGGED CUTTINGS
	NO RECOVERY		JAR		SHELBY TUBE

9) Oxidized Zones (right hand side of testhole log)

	OXIDIZED ZONES		UNOXIDIZED ZONES
---	----------------	---	------------------

10) Field and Laboratory Test Symbols

W_p W_N W_L ----- -----●-----	▲ POCKET PENETROMETER	× SIEVE ANALYSIS
W_p PLASTIC LIMIT		
W_N NATURAL MOISTURE CONTENT		
W_L LIQUID LIMIT		

11) Piezometer and Inclinator Symbols

	GROUT		BENTONITE CHIPS OR PELLETS		CUTTINGS		FRAC SAND
			STATIC WATER LEVEL ▼				

Common Abbreviations

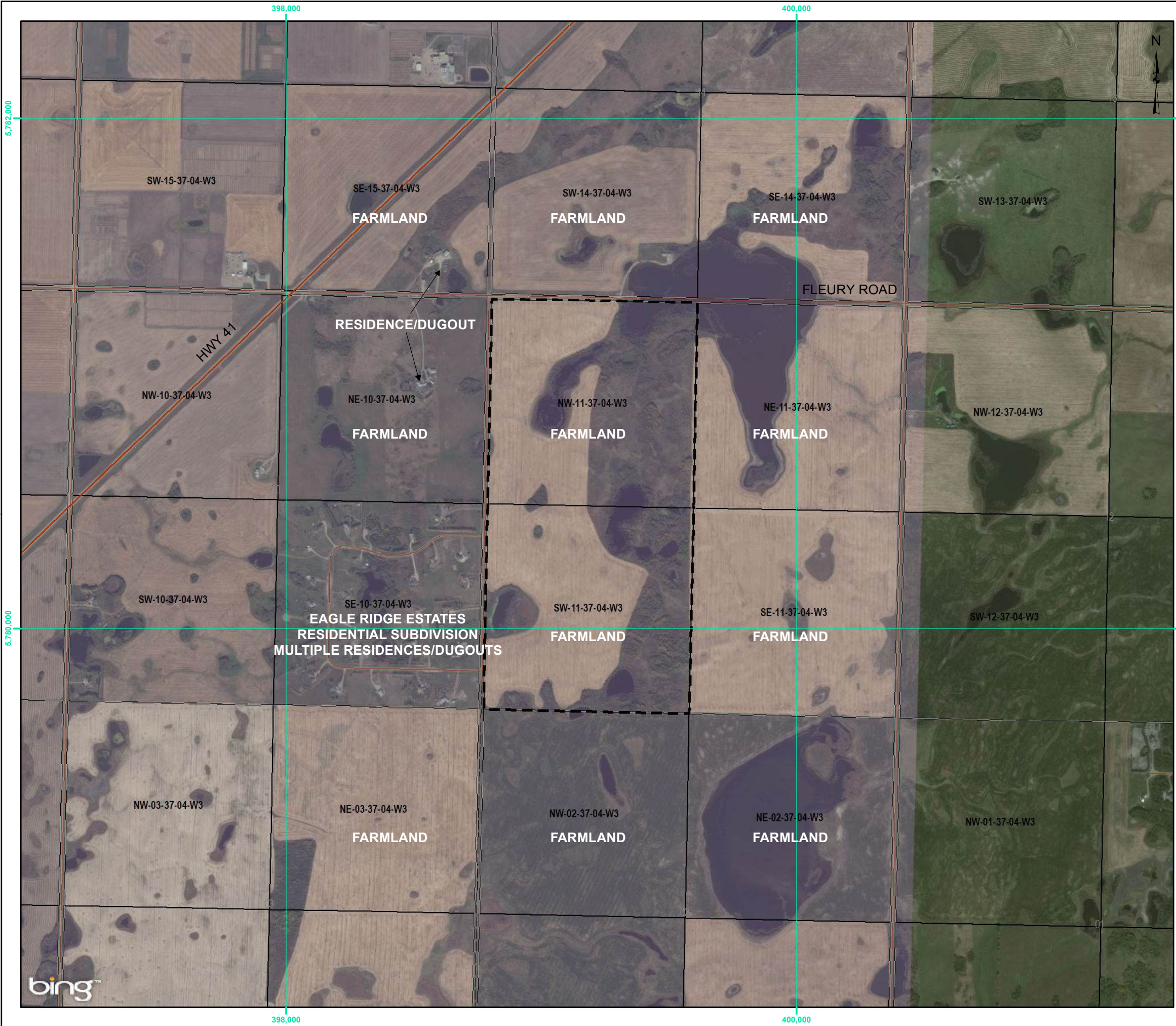
Pale = pl.	Calcareous = calc.
Olive = ol.	Non-Calcareous = noncalc.
Light = lt.	Laminated = lam.
Yellow = ylw.	Predominantly = predom.
Brown = br	Carbonate = carb.
Grey = gr.	Quartz = qz.
Green = grn.	Ablation = abl.
Pink = Pk.	Weathered = wthrd.
Dark = dk.	Material = mat.
Very = v.	Mottled (Mottling) = mot.
Large = lg.	Fracture = frac.
Strongly = st.	Iron = Fe
Weakly = wkly.	Manganese = Mn
Subrounded = sbrnd.	
Subangular = sbang.	
Rounded = rnd.	
Angular = ang.	
Medium = m.	
Fine = f.	
Coarse = c.	

Examples

1. SILT TILL: sandy, some gravel, trace clay, pale yellow (2.5Y7/4), to dark greyish brown (2.5Y4/2), oxidized, soft to very soft, calcareous, moderate Fe staining along fractures
2. SILT TILL: trace sand, some clay, trace to some gravel, grey (5Y5/1), unoxidized, stiff to very stiff, medium plasticity, calcareous
3. SILT TILL: clayey, some sand, some gravel, grey (5Y6/1) to greyish brown (2.5Y5/2) to light brownish grey (2.5Y6/2), oxidized to unoxidized, high plasticity, calcareous
4. SAND: predominantly medium grained, trace to some gravel (rounded to subrounded), moderately graded, trace silt, carbonate and igneous lithos
5. GRAVEL: subrounded to subangular, some sand to sandy (coarse grained), poorly to moderately graded, igneous and carbonate lithos
6. CLAY SHALE: trace silt, grey (5Y4/1), hard, non-calcareous, laminated

APPENDIX II

Surrounding Land Usage and Registered Water Wells



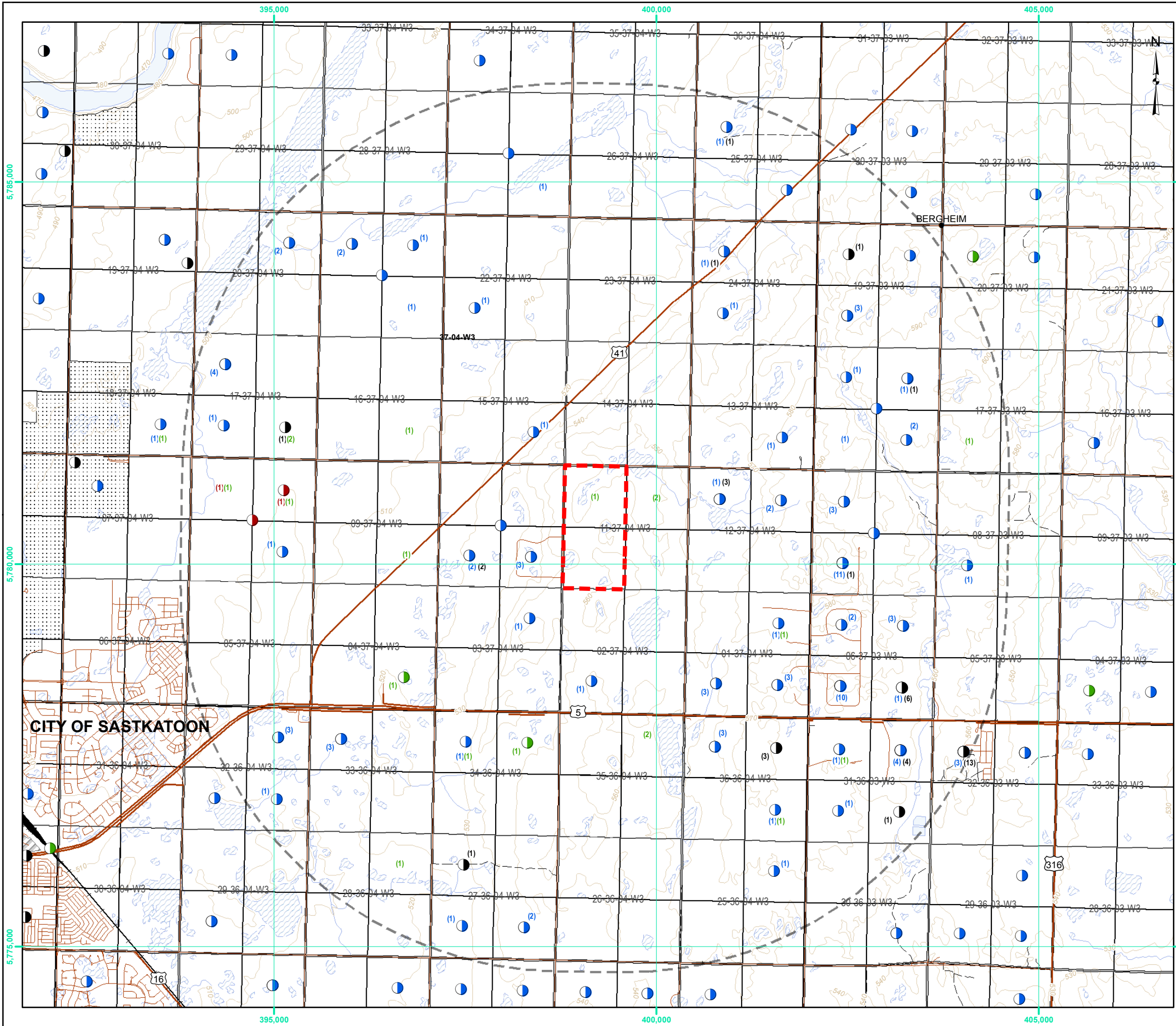
LEGEND

- HIGHWAY
- ROAD
- RESOURCE/RECREATION ROAD
- RAILWAY
- STUDY AREA

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N.
2. IMAGERY: © 2010 DIGITALGLOBE IMAGE COURTESY OF USGS © 2010 GEOEYE © 2013 MICROSOFT CORPORATION

REFERENCE DRAWINGS						
DWG No.	DATE	DESCRIPTION				
REVISIONS						
REV	DATE	DESCRIPTION	DRN BY	CHK		
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CLIENT		PROJECT LOCATION				
CHRIS CEBRYK		W½-11-37-04-W3M				
TITLE						
SURROUNDING LAND USAGE						
DES BY	CZ	DRN BY	KG	DATE 2013 07 17	FIG No. 11.1	REV 0
CHK BY	CZ	APP BY	CZ	DWG No. 613596-G-21-E-001	11x17	



- LEGEND**
- WSA OBSERVATION WELL

WSA WITHDRAWAL WELL

WSA WATER TEST HOLE

WSA OTHER WELL

HIGHWAY

ROAD

RESOURCE/RECREATION ROAD

SERVICE LANE

RAILWAY

WATERCOURSE

10 METER ELEVATION CONTOUR (masl)

PARK

FIRST NATIONS LANDS

WATERBODY

WATERBODY (INTERMITTENT)

STUDY AREA

5 KM PERIMETER OF STUDY AREA
- NOTES**

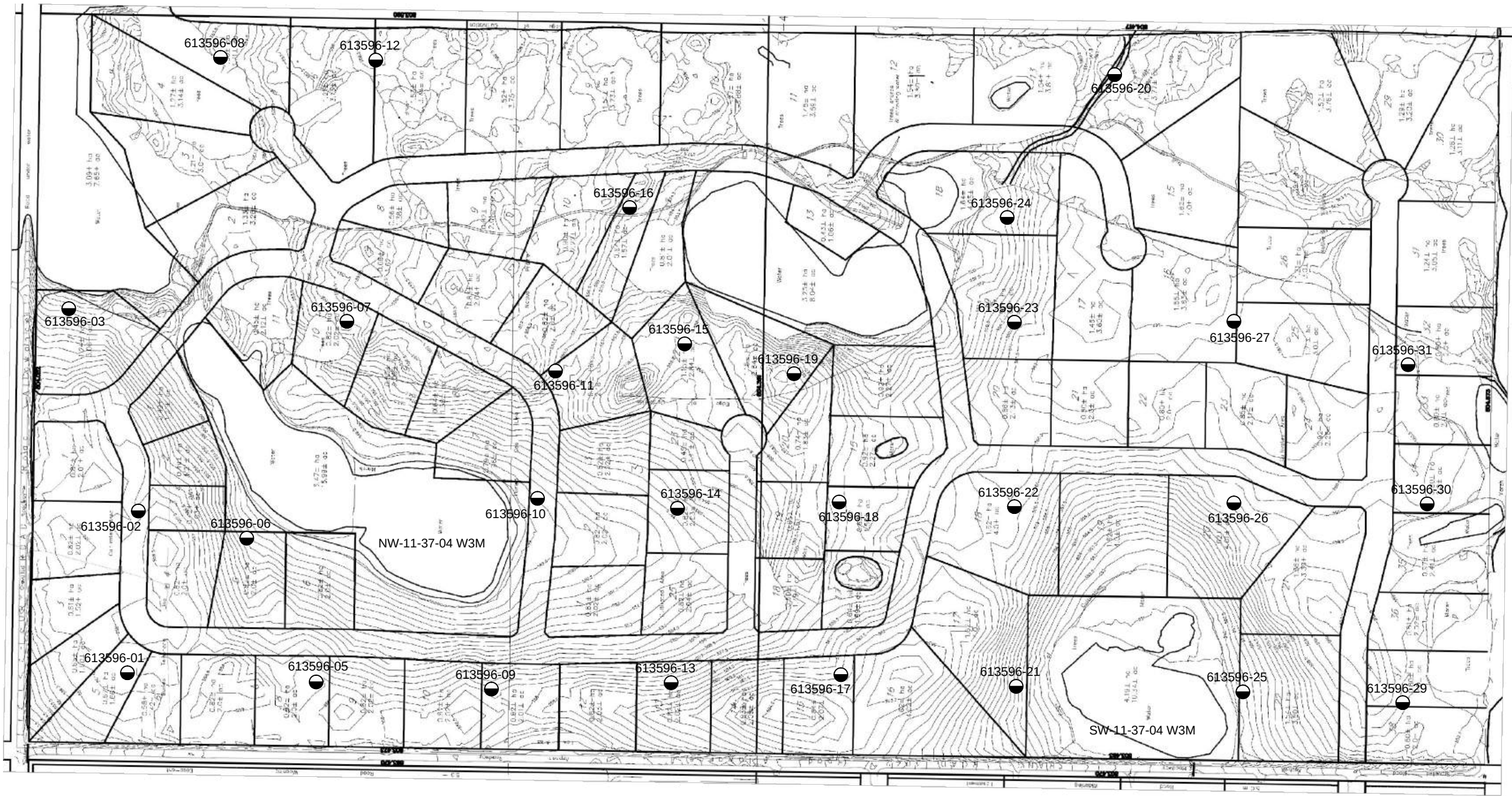
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N.

2. WATER SECURITY AGENCY OF SASKATCHEWAN (WSA) WATER WELL DRILLER'S RECORDS (WWD) OBTAINED FROM THE WSA WELLS DATABASE AND MAY BE SUBJECT TO ERROR. DRILLER'S RECORDS ARE PLACED IN THE GEOGRAPHIC CENTER OF THE AVAILABLE LAND DESCRIPTION AND LOCATION WILL BE SUBJECT TO ERROR.

3. COLORED LABELS REFLECT THE NUMBER OF RECORD TYPE PER QUARTER SECTION.
- | REFERENCE DRAWINGS | | | | | | | |
|---|------|-------------------|--------|---------------------------|--|--|--|
| | | | | | | | |
| | | | | | | | |
| DWG No. | DATE | DESCRIPTION | | | | | |
| REVISIONS | | | | | | | |
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| | | | | | | | |
| REV | DATE | DESCRIPTION | DRN BY | CHK | | | |
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| <div><div><div><div></div><div>SNC • LAVALIN</div></div></div></div> | | | | | | | |
| CLIENT | | PROJECT LOCATION | | | | | |
| CHRIS CEBRYK | | W1/2-11-37-04-W3M | | | | | |
| TITLE | | | | | | | |
| REGISTERED WATER WELLS | | | | | | | |
| DES BY | CZ | DRN BY | KG | DATE 2013 08 07 | | | |
| CHK BY | CZ | APP BY | CZ | DWG No. 613596-G-01-E-001 | | | |
| FIG No. 11.2 | | REV 0 | | | | | |
- Path: P:\Chris Cebryk\613596 Proposed Cebryk Development\3_GIS\2_Drawings\613596-G-01-E-001 (WSA Records).mxd

APPENDIX III

Site Plan – Borehole Locations



LEGEND		NOTES		REVISIONS					0 5 10 15 20 m SCALE 1:500 SNC • LAVALIN			CLIENT		PROJECT LOCATION		
MONITOR WELL LOCATION								CHRIS CEBRYK		W1/2-11-37-4 W3M						
		-	-		-	-										
		REV	DATE	DESCRIPTION			DRN	APP								
		REFERENCE DRAWINGS					TITLE									
							SITE PLAN - BOREHOLE LOCATIONS									
		1	2012 10	WEBB SURVEYS PLAN SHOWING TOPOGRAPHY ON W1/2 11-37-4 W3 RM OF CORMAN PARK No 344												
DWG No	DATE	DESCRIPTION			DES BY	CZ	DRN BY	C. WU	DATE	2013 07 23	FIG No	III.1	REV			
					CHK BY	CZ	APP BY	CZ	DWG No	613596-61-1		11X17				

\\Chris Cebryk\613596 Proposed Cebryk Dev

Appendix IV

Borehole Logs

BOREHOLE 613596-01

CHRIS CEBRYK

W1/2-11-37-4-W3M

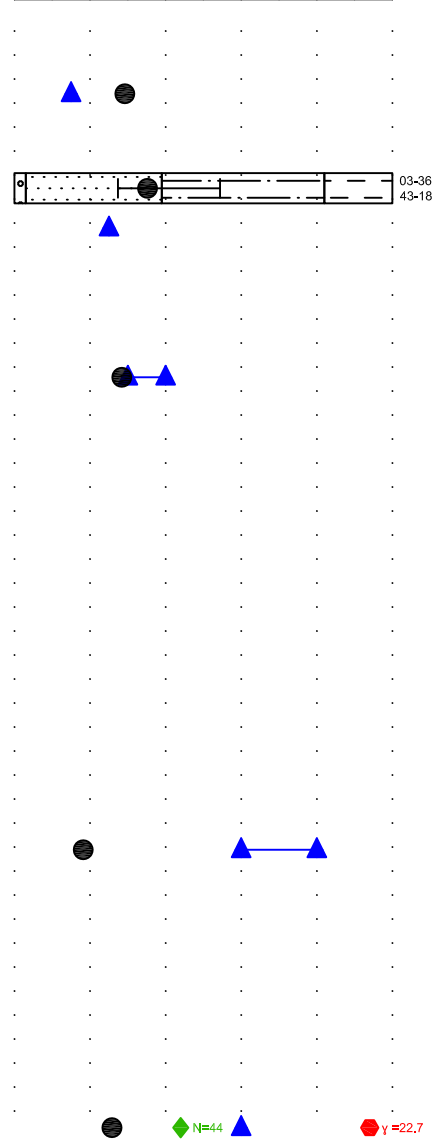
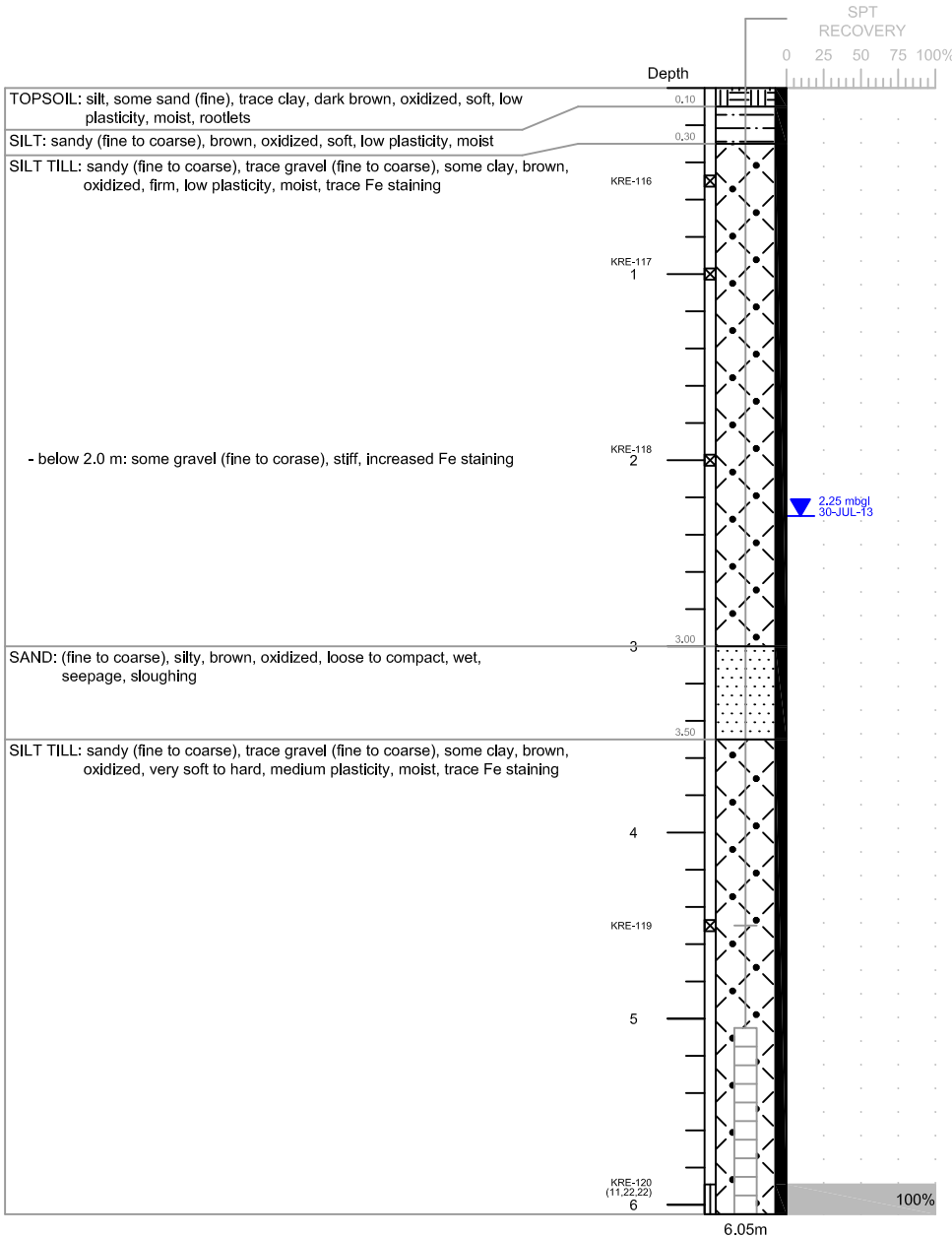
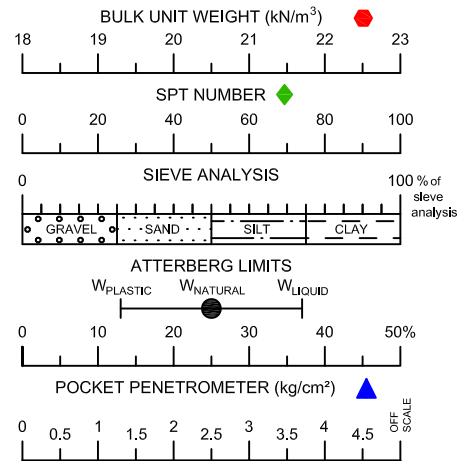
2013

5781183 N 398883 E

NW13-11-37-W3

NAD 83 ZONE 13

73B/1



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depth are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 09

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-01

CHRIS CEBRYK

W1/2-11-37-4-W3M

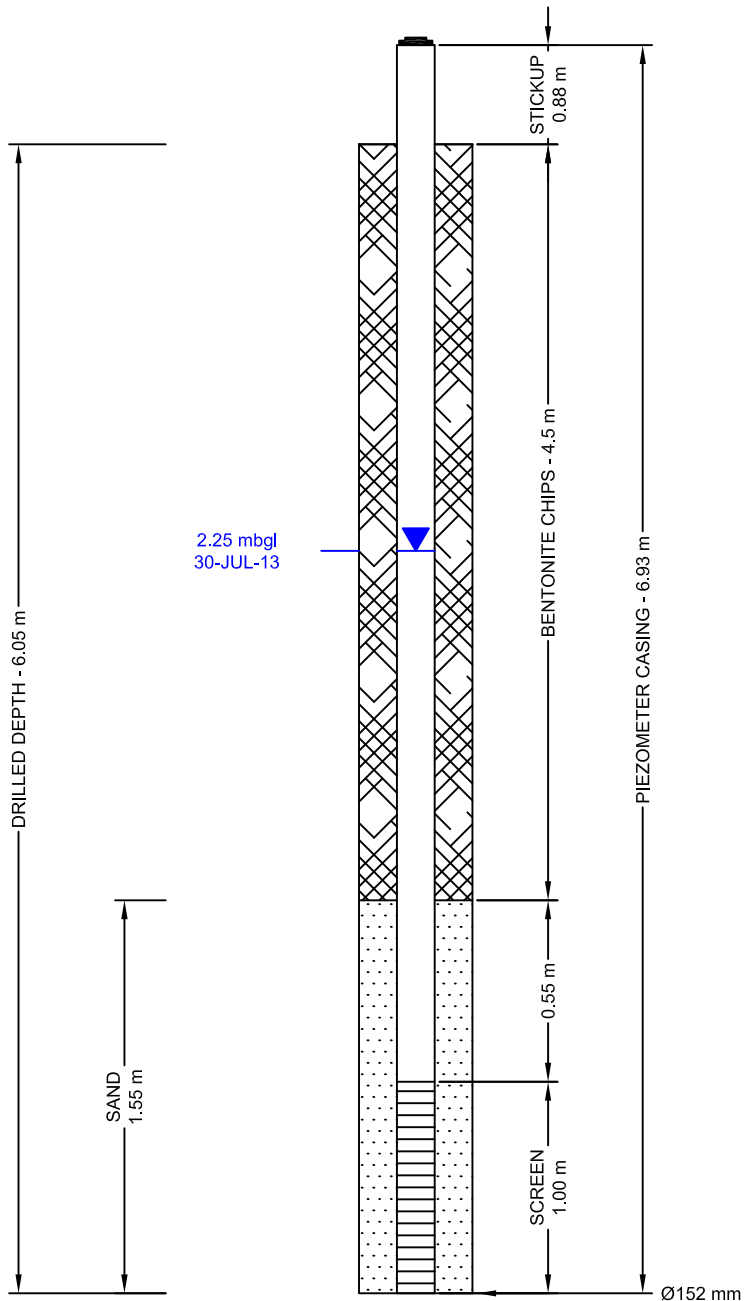
2013

5781183 N 398883 E

NW13-11-37-04-W3

NAD 83 ZONE 13

73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-02

CHRIS CEBRYK

W1/2-11-37-4-W3M

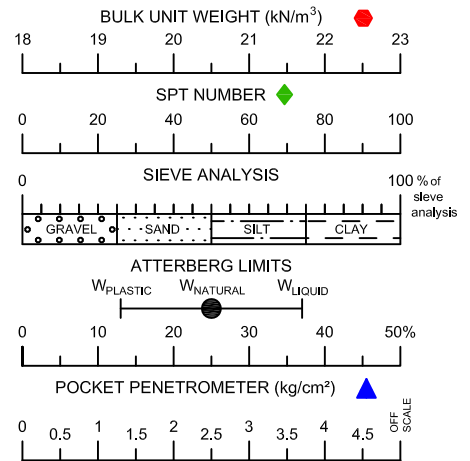
2013

5781171 N 399062 E

NE13-11-37-04-W3

NAD 83 ZONE 13

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT AND CLAY: trace sand (fine), brown, oxidized, soft, medium plasticity, moist -organics / topsoil to 0.7m

SILT TILL: sandy (fine to coarse), trace gravel (fine to medium), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-at 1.8 m: cobbles / boulders

-at 2.1 m: cobbles / boulders

-at 3.0 m: cobbles / boulders

-at 4.0 m: cobbles / boulders

-at 4.26 m: cobbles / boulders

-at 4.5 m: cobbles / boulders
-below 4.5 m: very stiff to hard

Depth

SPT RECOVERY

0 25 50 75 100%

KRE-121

KRE-122

KRE-123

KRE-124

KRE-125

KRE-126

5.80m

2.18 mbgl

30-JUL-13

100%

N-10

01-02

60-37

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 10

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-02

CHRIS CEBRYK

W1/2-11-37-4-W3M

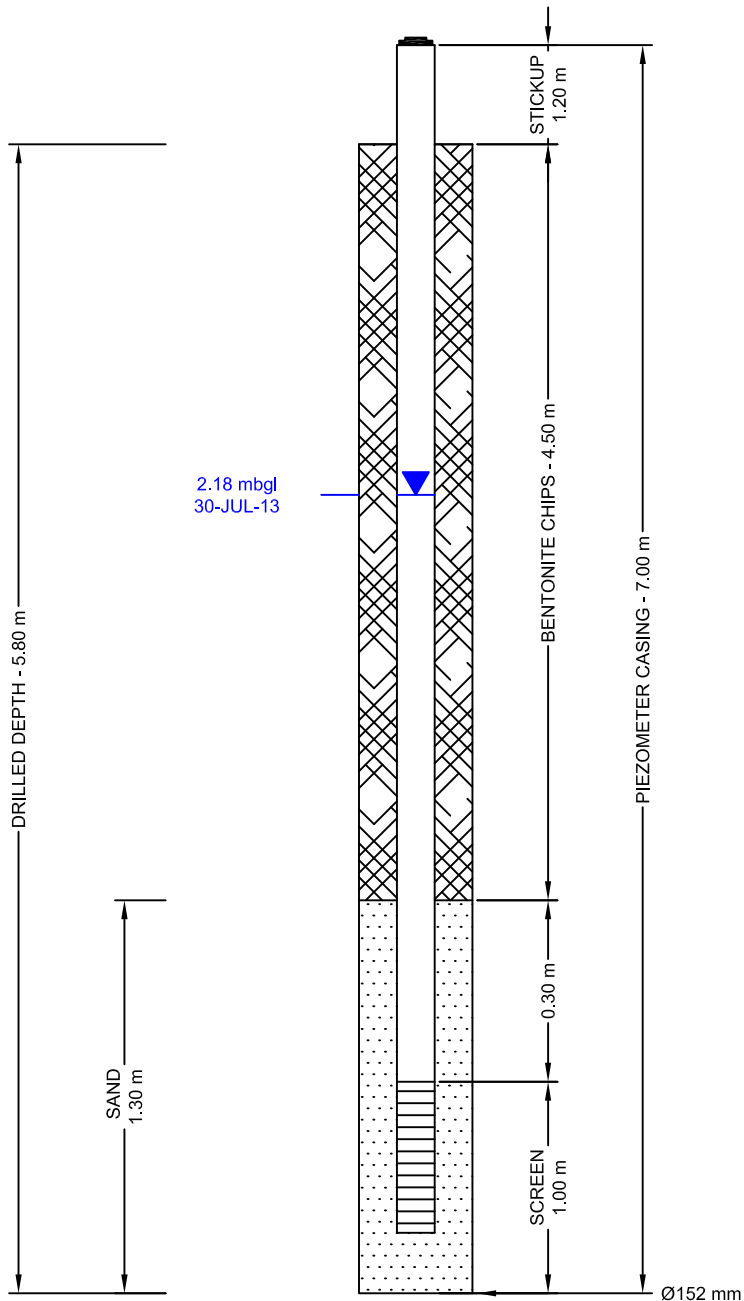
2013

5781171 N 399062 E

NE13-11-37-04-W3

NAD 83 ZONE 13

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-03

CHRIS CEBRYK

W1/2-11-37-4-W3M

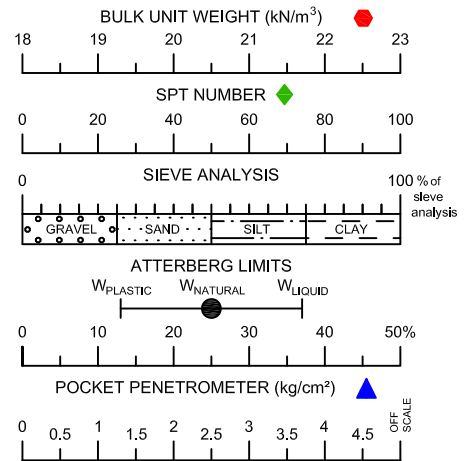
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5781248 N 399286 E

NW14-11-37-04-W3

NAD 83 ZONE 13

73B/1



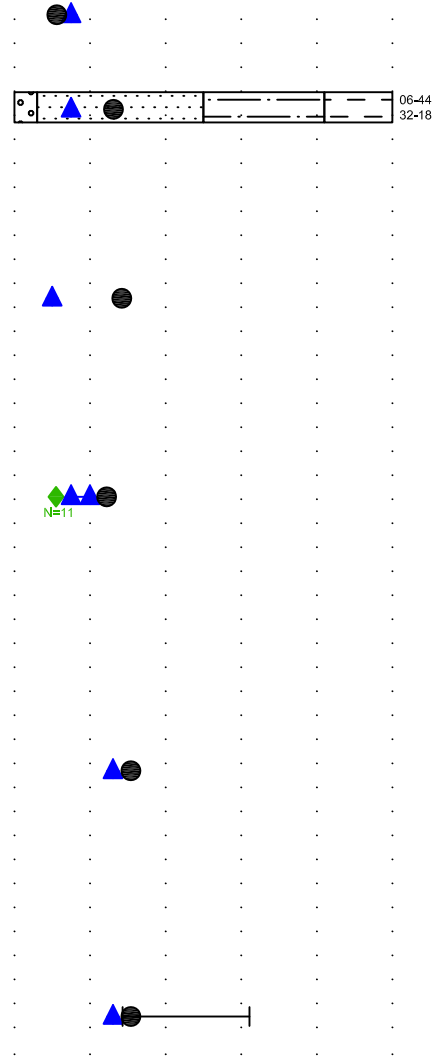
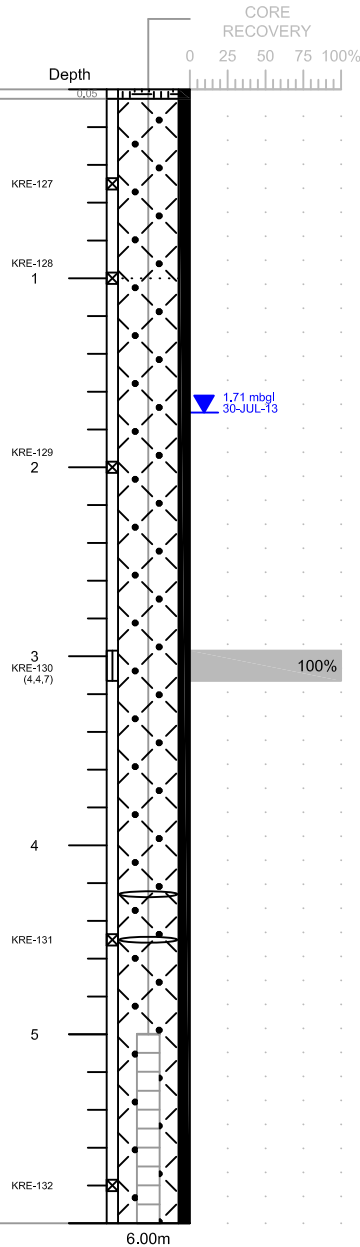
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-at 1.0 m: sand seam, wet, seepage

-at 4.26 m: cobbles / boulders

-at 4.5 m: cobbles / boulders



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 13

DATE INSTALLED 2013 07 13

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-03

CHRIS CEBRYK

W1/2-11-37-4-W3M

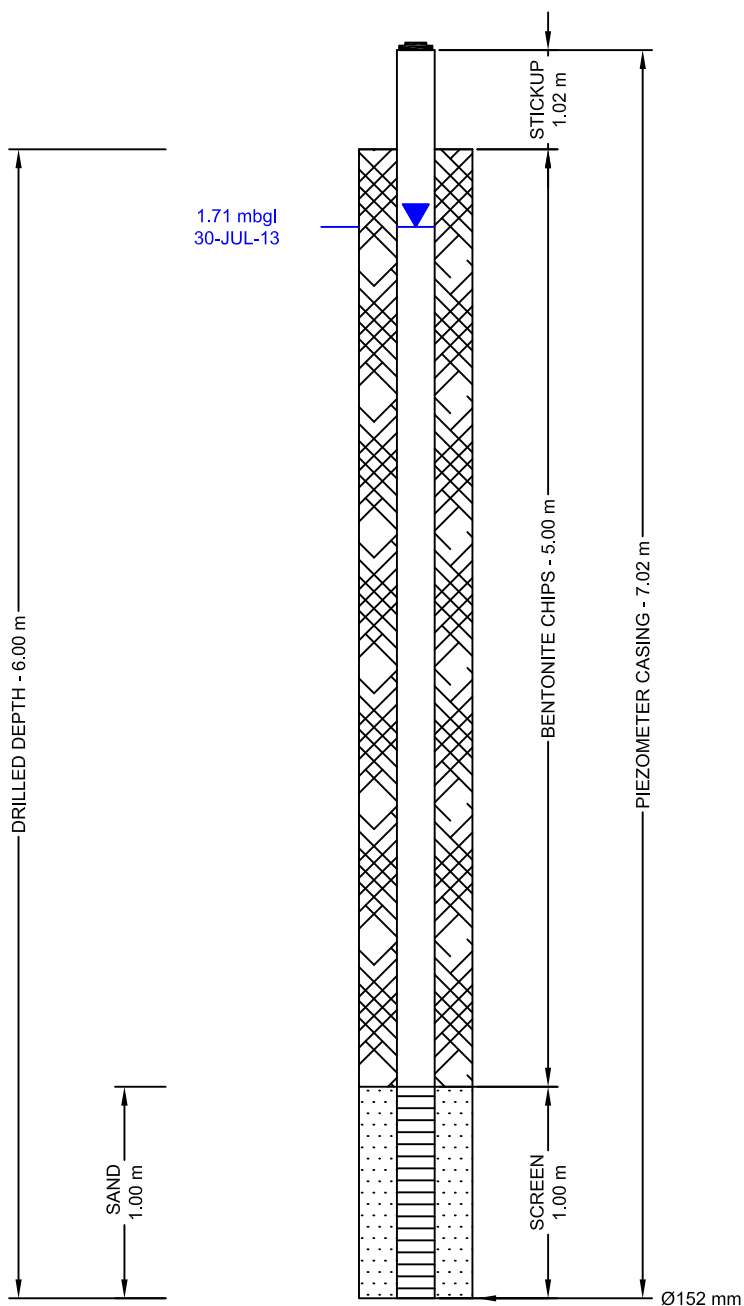
2013

5781248 N 399286 E

NW14-11-37-04-W3

NAD 83 ZONE 13

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 13

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 08



SNC • LAVALIN

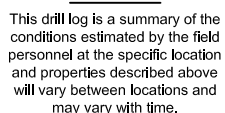
CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

73B/1



PIEZOMETER 613596-05

CHRIS CEBRYK

W1/2-11-37-4-W3M

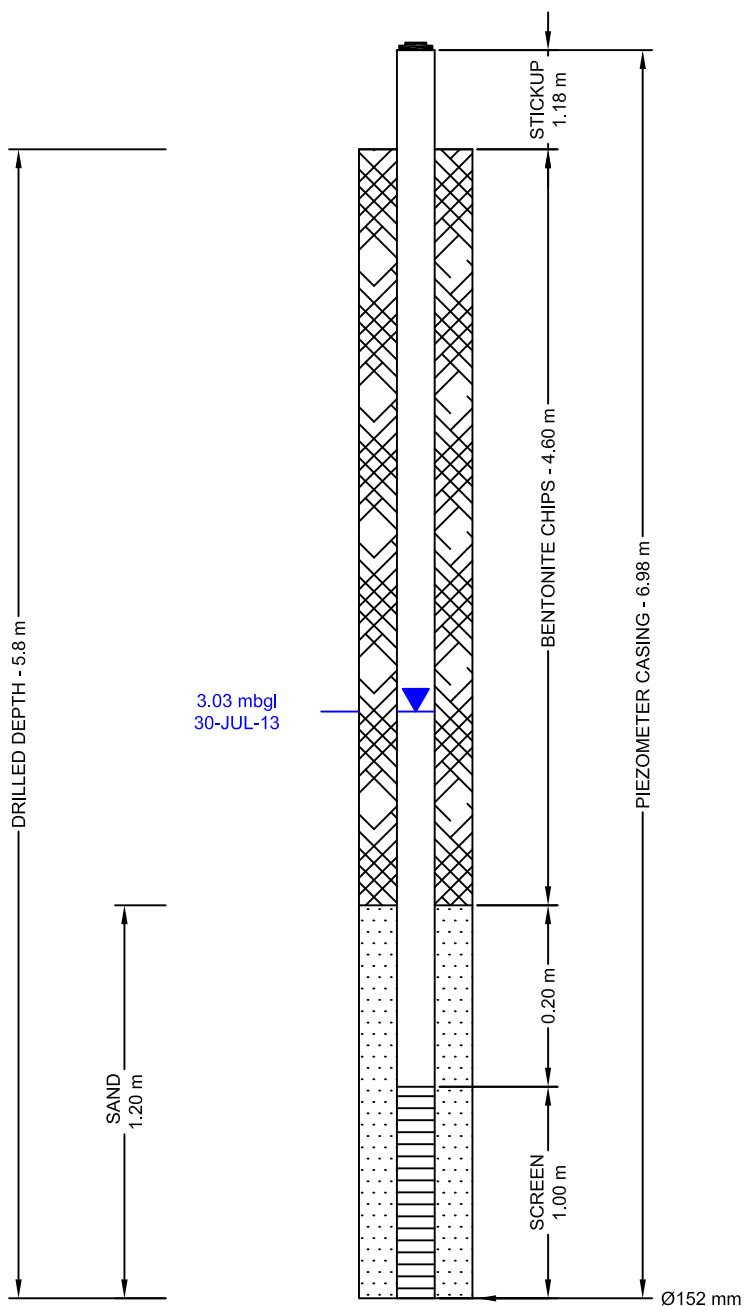
2013

5780974 N 398873 E

SW13-11-37-04-W3

NAD 83 ZONE 13

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 08



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CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-06

CHRIS CEBRYK

W1/2-11-37-4-W3M

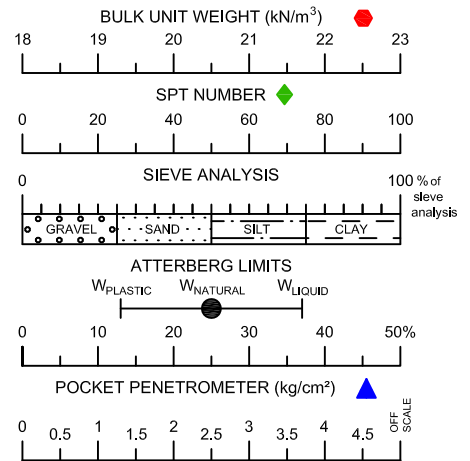
2013

5781051 N 399032 E

NAD 83 ZONE 13

SE13-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine), some clay, dark brown/black, oxidized, soft, low plasticity, moist

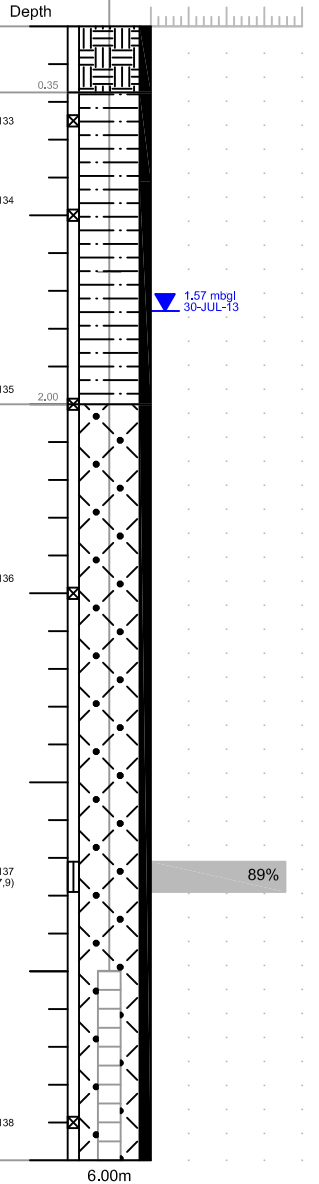
- organics/topsoil to 0.8 m
- below 0.8 m: brown, moist, Fe staining

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, soft, low to medium plasticity, moist to wet, Fe staining

- below 2.2 m: wet sand layer (fine to coarse) approximately 3 to 5 cm thick, Fe staining

- below 3.0 m: stiff, moist

- below 5.0 m: mottled, grey/brown



NOTES

- Borehole sloughed to 2.3 m immediately after drilling (I.A.D.).
- Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
- (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
- Depths are in metres below ground level (mbgl).
- Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 10

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-06

CHRIS CEBRYK

W1/2-11-37-4-W3M

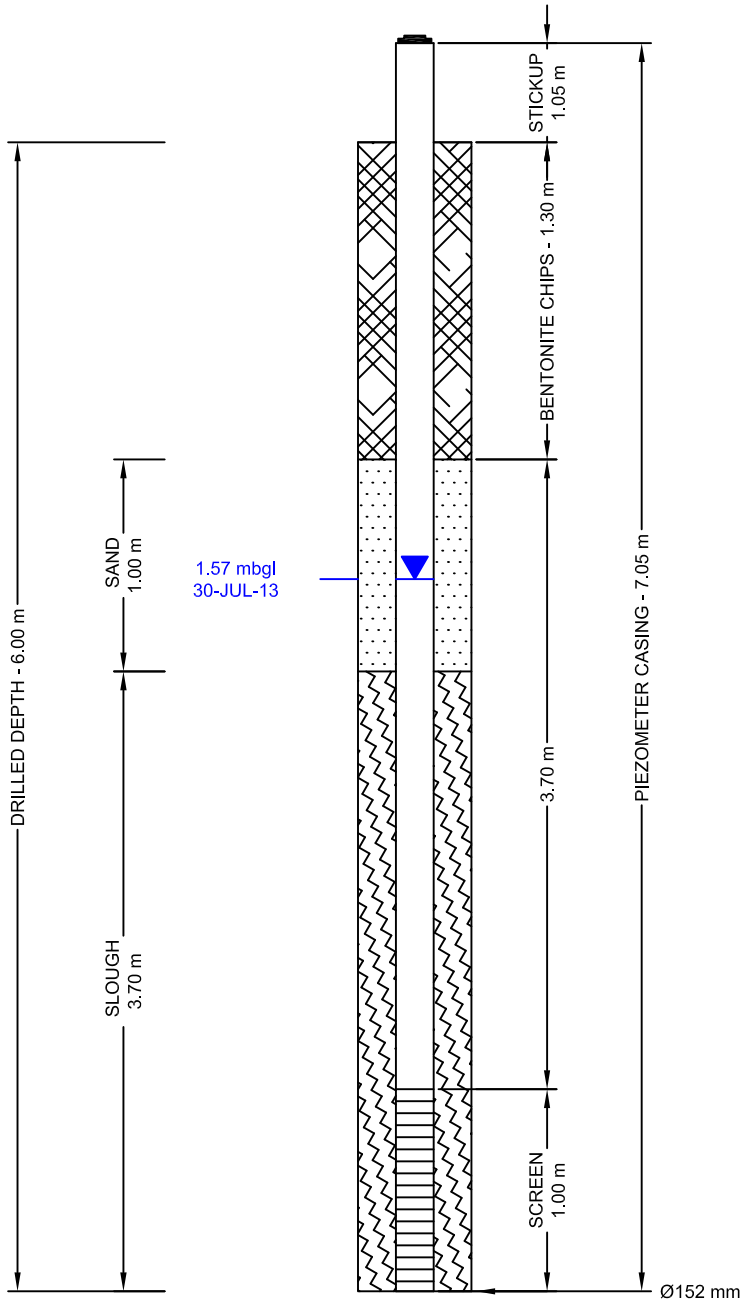
2013

5781051 N 399032 E

NAD 83 ZONE 13

SE13-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

73B/1

PIEZOMETER 613596-07

CHRIS CEBRYK

W1/2-11-37-4-W3M

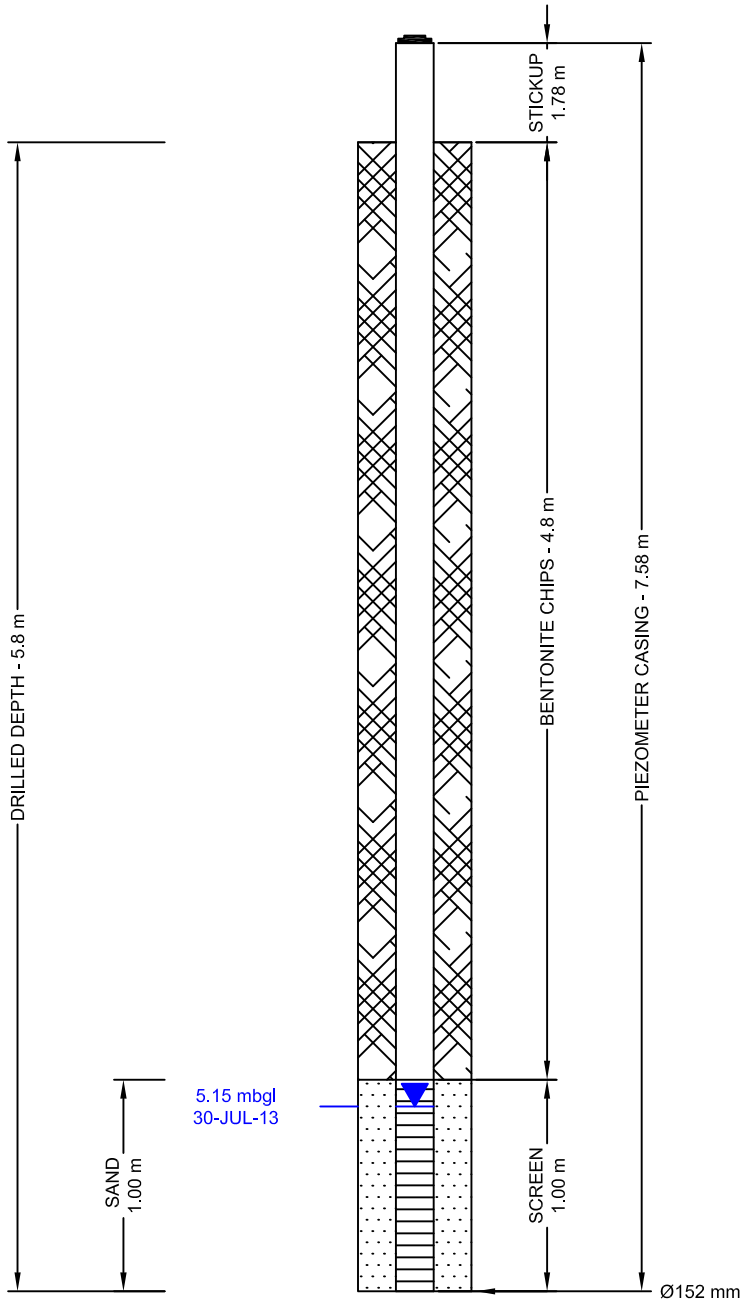
2013

5780940 N 399272 E

NAD 83 ZONE 13

SW14-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

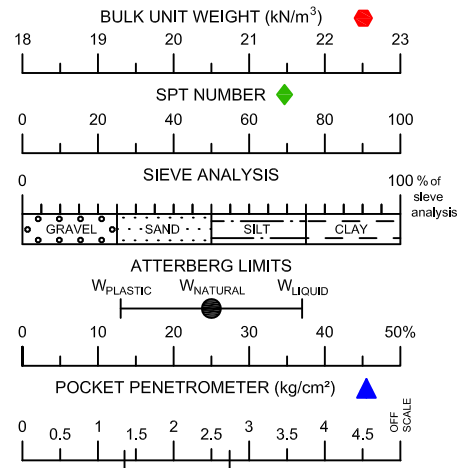
BOREHOLE 613596-08**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5781080 N 399564 E

NAD 83 ZONE 13

NE14-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low plasticity, moist

- below 1.0 m: trace Fe staining

- below 1.5 m: soft to firm

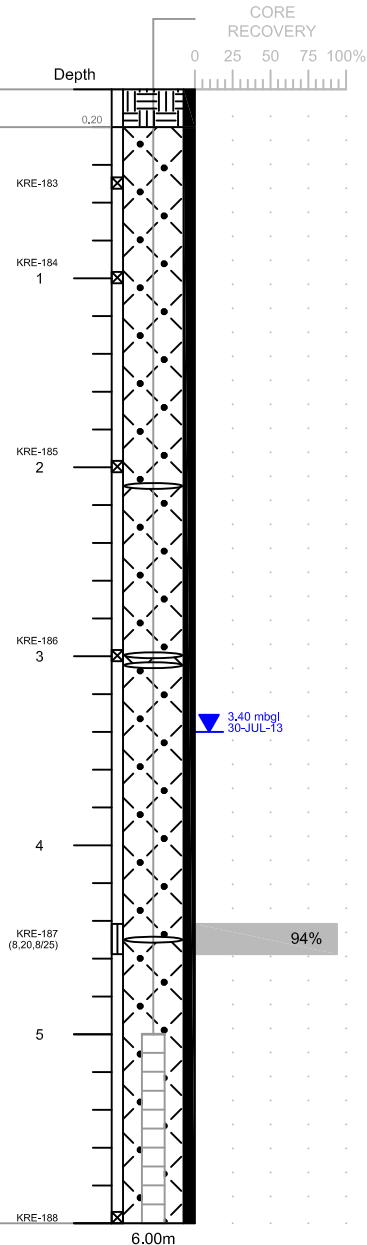
-at 2.1 m: cobbles/boulders

-below 3.0 m: some sand, very stiff

-at 3.0 to 3.1 m: cobbles/boulders

-at 4.5 m: cobbles/boulders

-below 4.5 m: very stiff, medium plasticity

**NOTES**

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**SNC • LAVALIN****CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** K. EBEL, B.Sc., G.I.T.**LOGGED BY** K. EBEL, B.Sc., G.I.T.**DATE DRILLED** 2013 07 11**DATE INSTALLED** 2013 07 11**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 19

PIEZOMETER 613596-08

CHRIS CEBRYK

W1/2-11-37-4-W3M

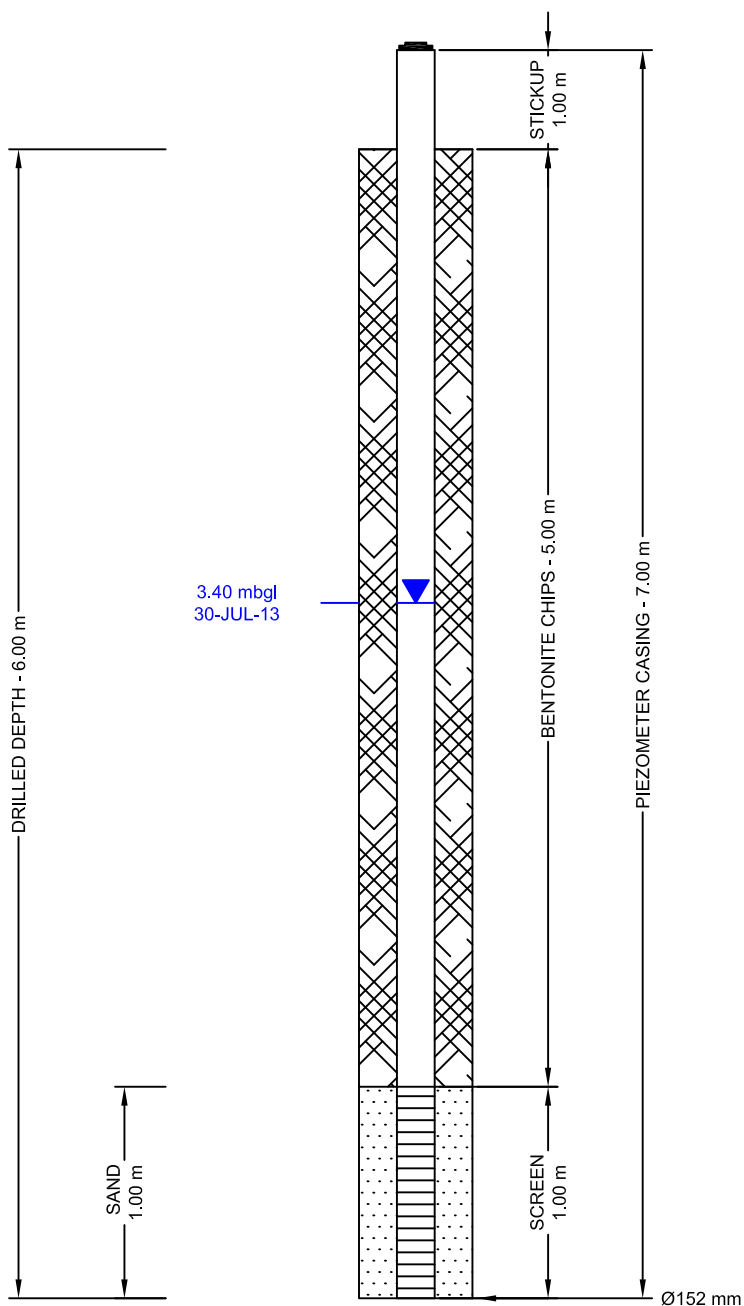
2013

5781080 N 399564 E

NAD 83 ZONE 13

NE14-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC

- belled couplings

NOTES

All depths are expressed in metres above or below
natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 11

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

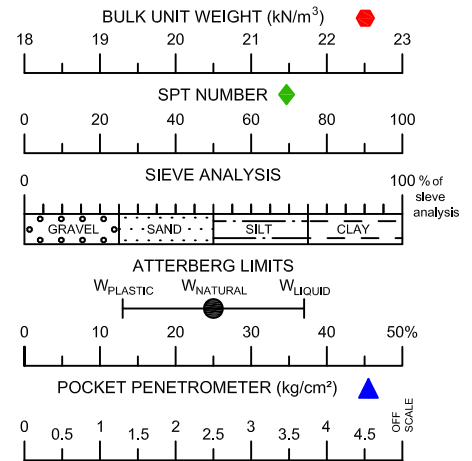
BOREHOLE 613596-09**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780780 N 398865 E

NAD 83 ZONE 13

NW12-11-37-04-W3

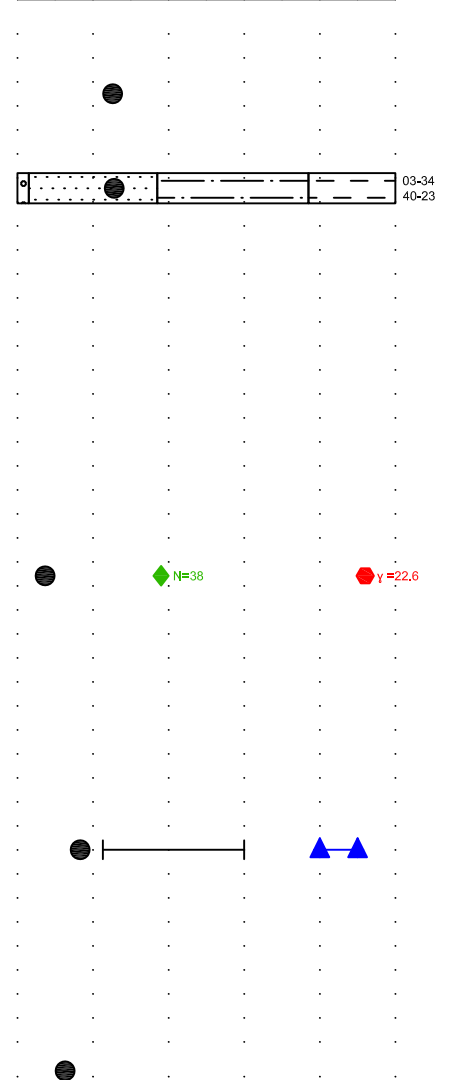
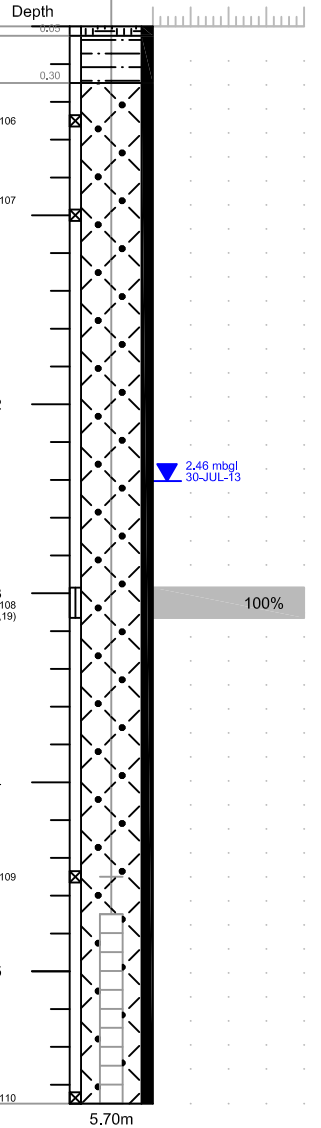
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, light brown, oxidized, low to medium plasticity, damp to moist
-below 0.3 m: damp crumbly

SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, very stiff, medium plasticity, moist, trace Fe staining

**NOTES**

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** K. EBEL, B.Sc., G.I.T.**LOGGED BY** K. EBEL, B.Sc., G.I.T.**DATE DRILLED** 2013 07 09**DATE INSTALLED** 2013 07 09**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 19

PIEZOMETER 613596-09

CHRIS CEBRYK

W1/2-11-37-4-W3M

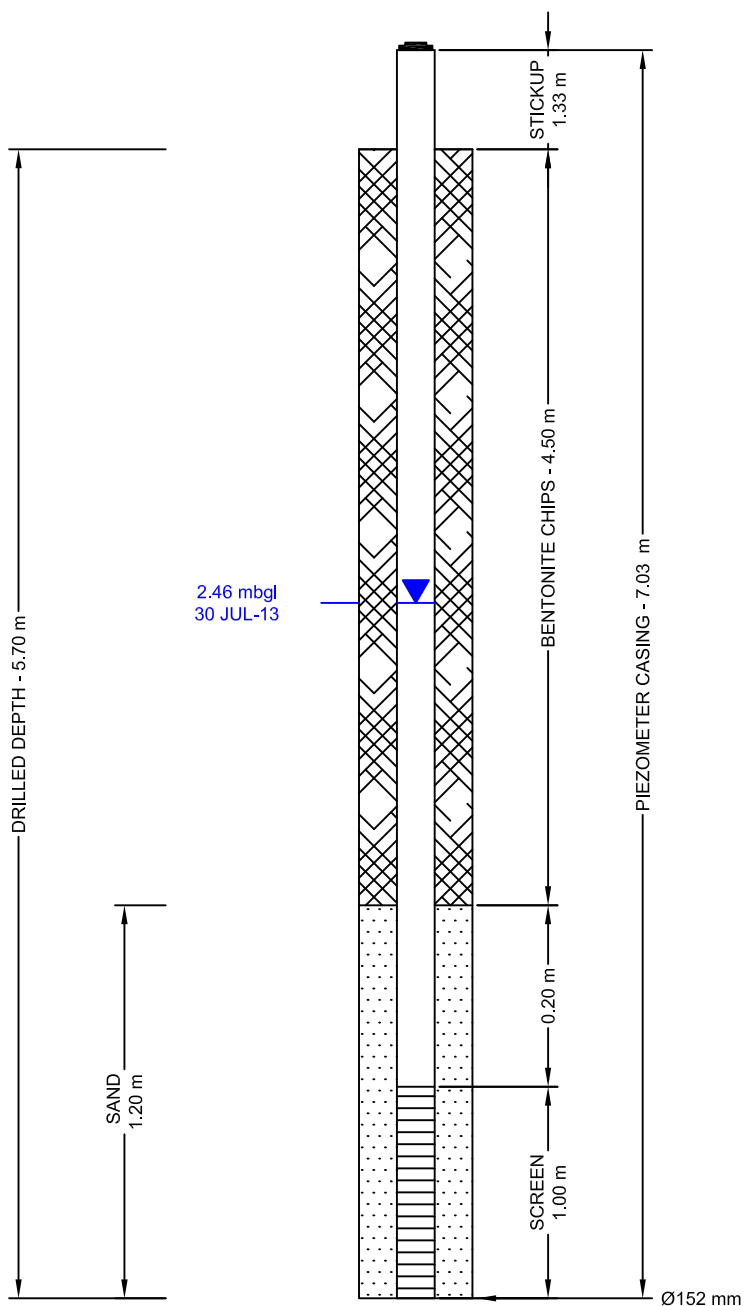
2013

5780729 N 399076 E

NAD 83 ZONE 13

NE12-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

73B/1



- below 5.4 m: some clay

DATE INSTALLED	2013 07 10
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P:\Chris Cebryk\613596 Proposed Cebryk Development\2. Drafting\1. Boreholes\BH-613596-10.dwg

PIEZOMETER 613596-10

CHRIS CEBRYK

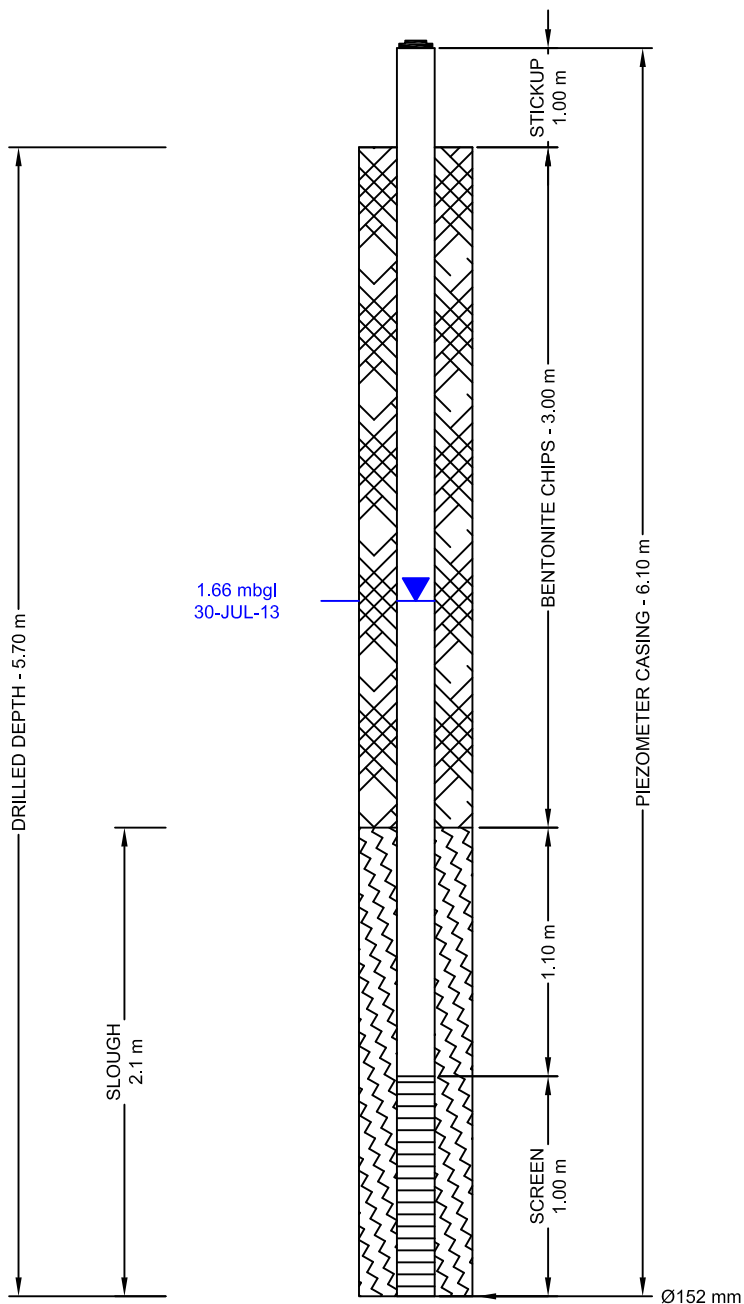
W1/2-11-37-4-W3M

2013

5780729 N 399076 E

NAD 83 ZONE 13

73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 08



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-11

CHRIS CEBRYK

W1/2-11-37-4-W3M

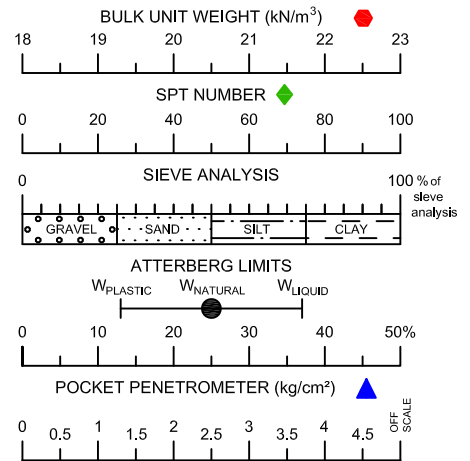
2013

5780709 N 399217 E

NAD 83 ZONE 13

NW11-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, brown, oxidized, soft, medium plasticity, moist, organics

-below 0.9 m: firm to stiff

SILT TILL: some sand (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

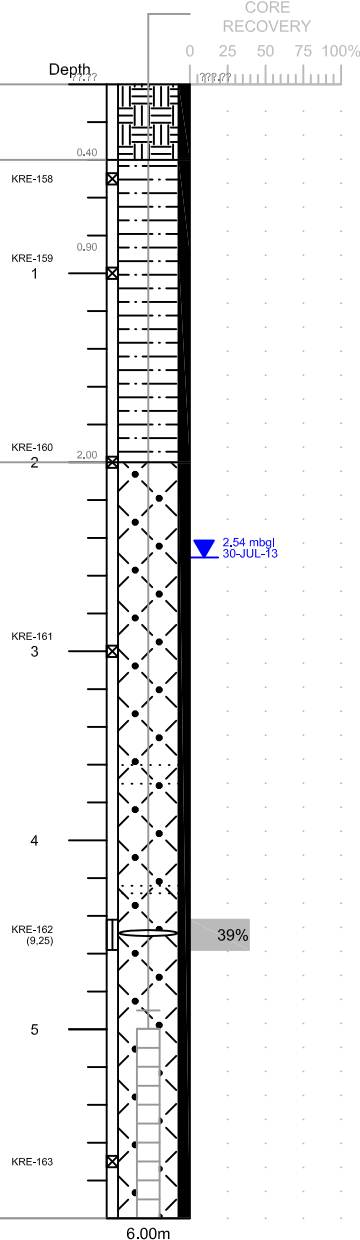
-below 3.0 m: very stiff

-3.6 to 3.7 m: sand lenses

-4.24 to 4.28 m: sand lenses

-at 4.5m: cobbles/boulders

-below 5.0m: Fe staining



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 10

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-11

CHRIS CEBRYK

W1/2-11-37-4-W3M

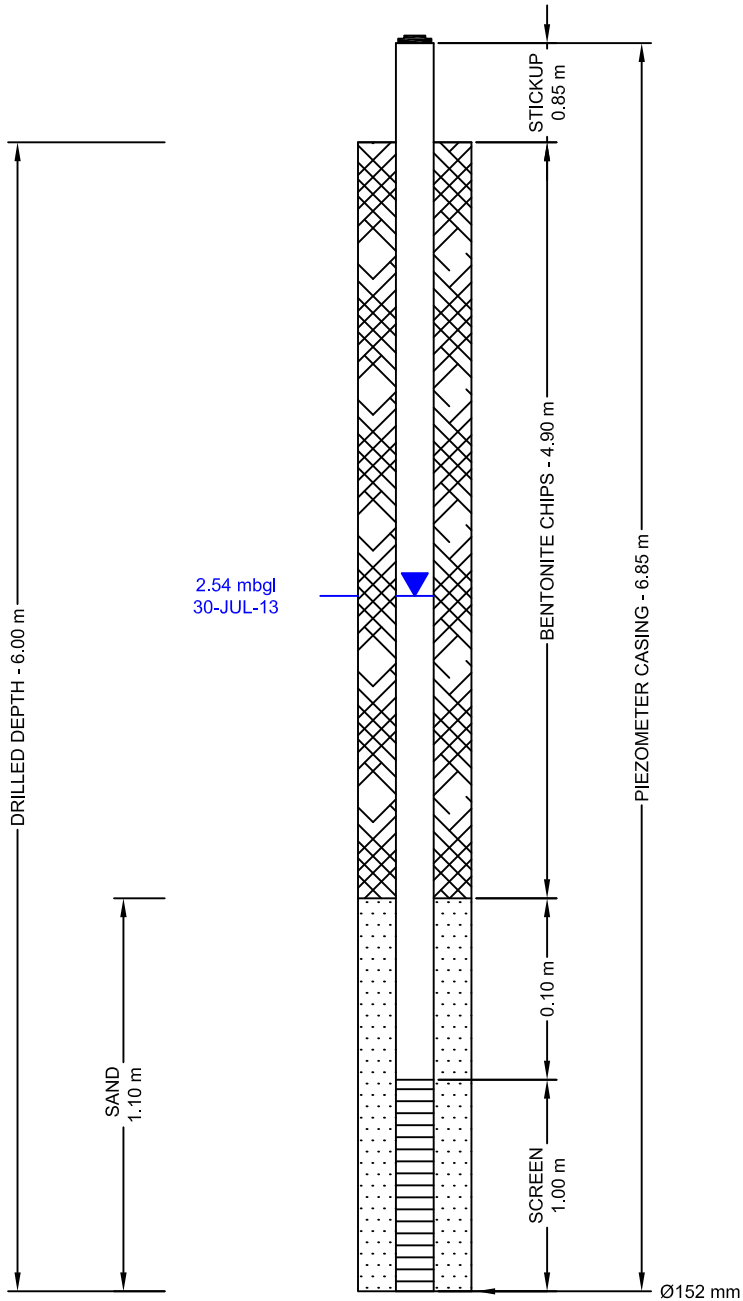
2013

5780709 N 399217 E

NAD 83 ZONE 13

NW11-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

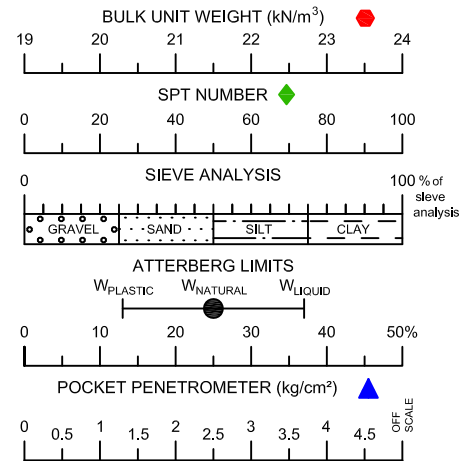
BOREHOLE 613596-12**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780908 N 399561 E

NAD 83 ZONE 13

SE14-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, brown, oxidized, firm, medium plasticity, moist

SILT AND CLAY: trace sand (fine), brown, oxidized, soft to firm, low to medium plasticity, moist

-trace organics to 1.5 m

-below 1.5m: interbedded wet sand, lenses

SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brownish-grey, oxidized, firm to stiff, medium plasticity, moist, trace Fe staining

-below 3.6 m : light brown, very stiff to hard

-at 4.8 m: cobbles/boulders

-5.1 m: cobbles/boulders

-at 5.9 m: cobbles/boulders

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** K. EBEL, B.Sc., G.I.T.**LOGGED BY** K. EBEL, B.Sc., G.I.T.**DATE DRILLED** 2013 07 11**DATE INSTALLED** 2013 07 11**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 19

PIEZOMETER 613596-12

CHRIS CEBRYK

W1/2-11-37-4-W3M

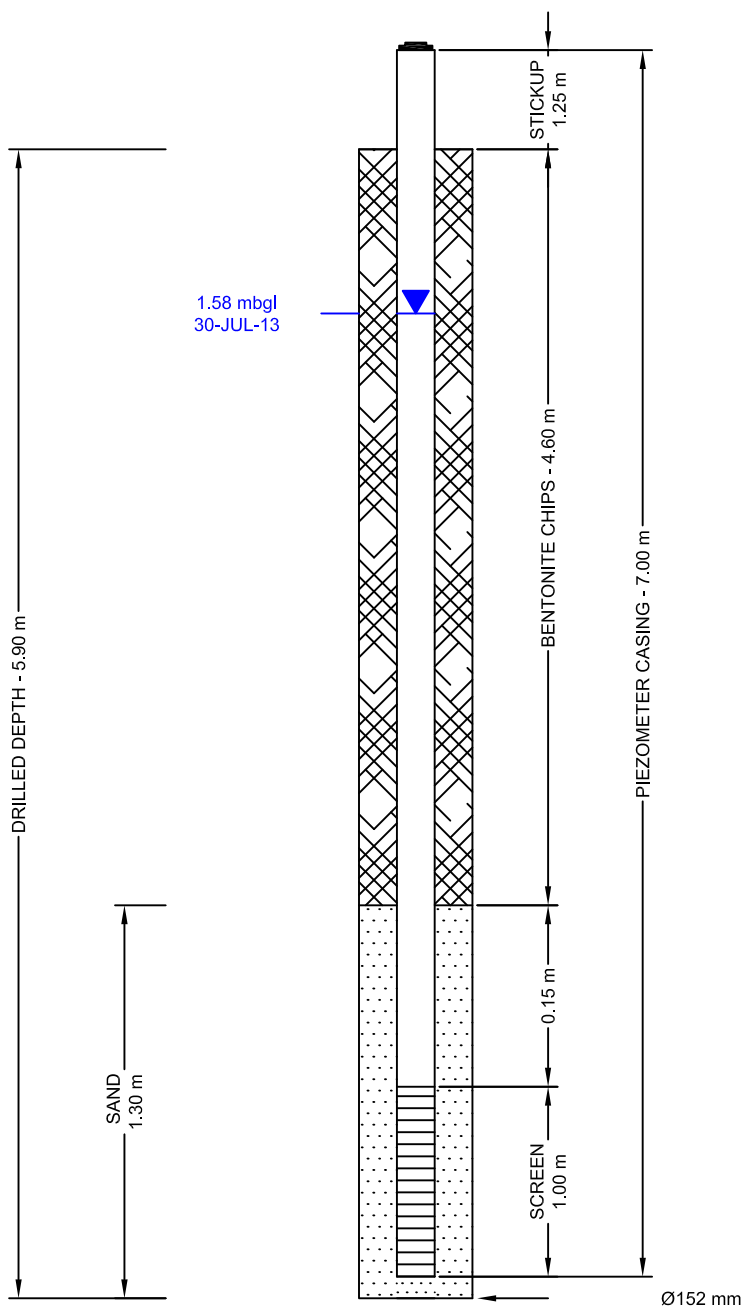
2013

5780908 N 399561 E

NAD 83 ZONE 13

SE14-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

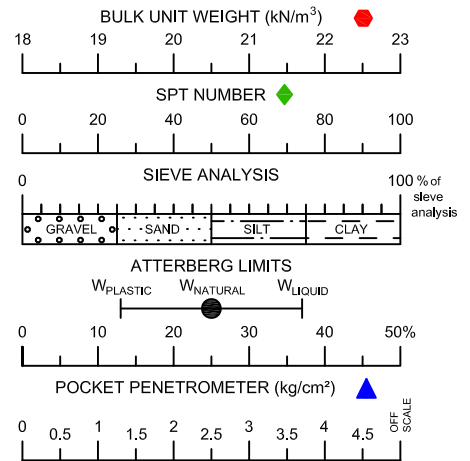
BOREHOLE 613596-13**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780581 N 398872 E

NAD 83 ZONE 13

SW12-11-37-04-W3

73B/1



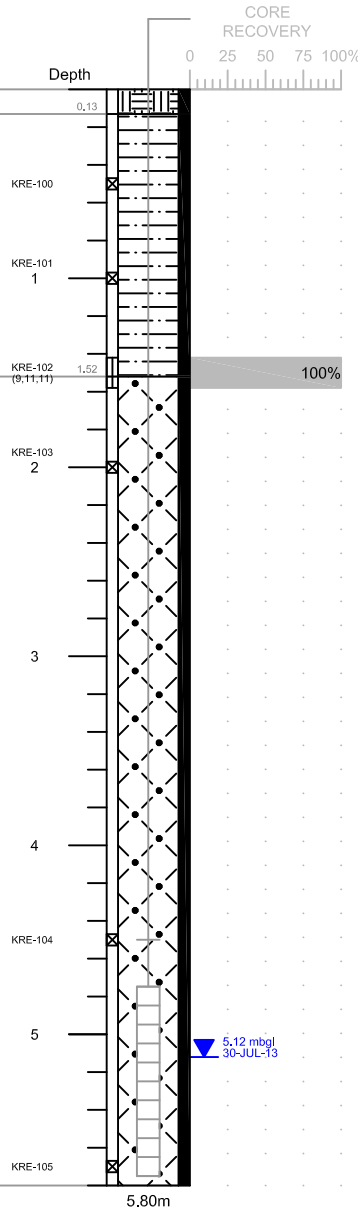
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine), some clay, light brown, oxidized, firm, medium plasticity, moist

-below 0.8 m: trace gypsum

-below 1.0 m: trace gravel (fine to coarse), Fe staining

SILT TILL: sandy (fine to coarse), trace cobble, trace to some gravel (fine to coarse), some clay, brown, oxidized, very stiff, low plasticity, damp to moist, crumbly, Fe staining, trace gypsum crystals

01-15
63-21

N=22

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**SNC • LAVALIN****CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** K. EBEL, B.Sc., G.I.T.**LOGGED BY** K. EBEL, B.Sc., G.I.T.**DATE DRILLED** 2013 07 09**DATE INSTALLED** 2013 07 09**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 09

PIEZOMETER 613596-13

CHRIS CEBRYK

W1/2-11-37-4-W3M

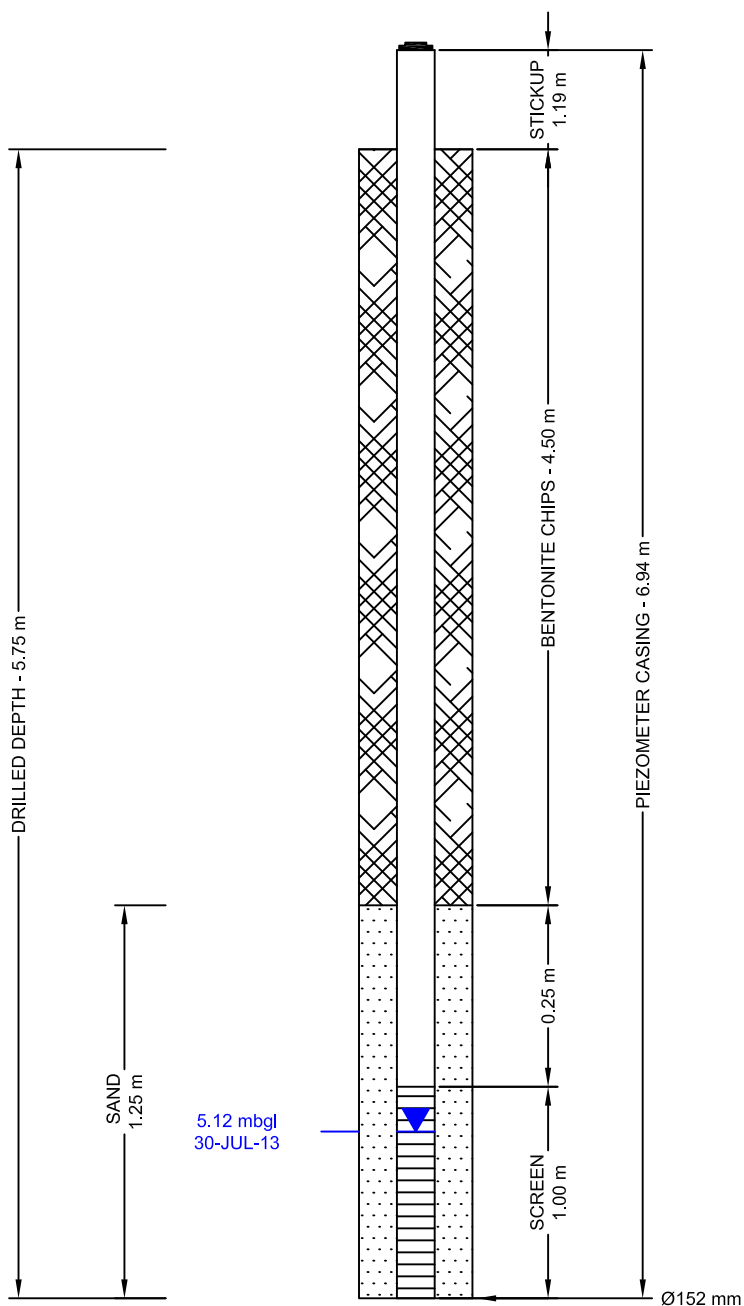
2013

5780581 N 398872 E

NAD 83 ZONE 13

SW12-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 09

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE NOT TO SCALE **DATE** 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-14

CHRIS CEBRYK

W1/2-11-37-4-W3M

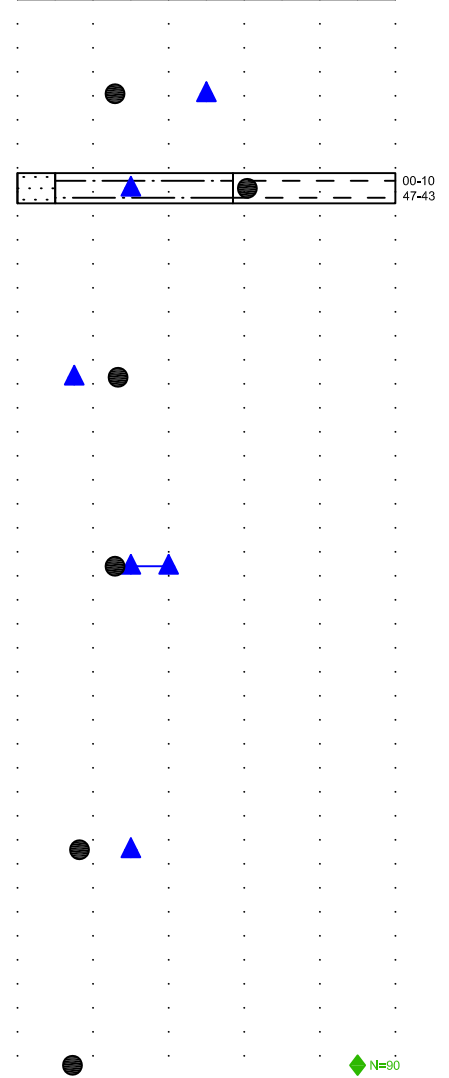
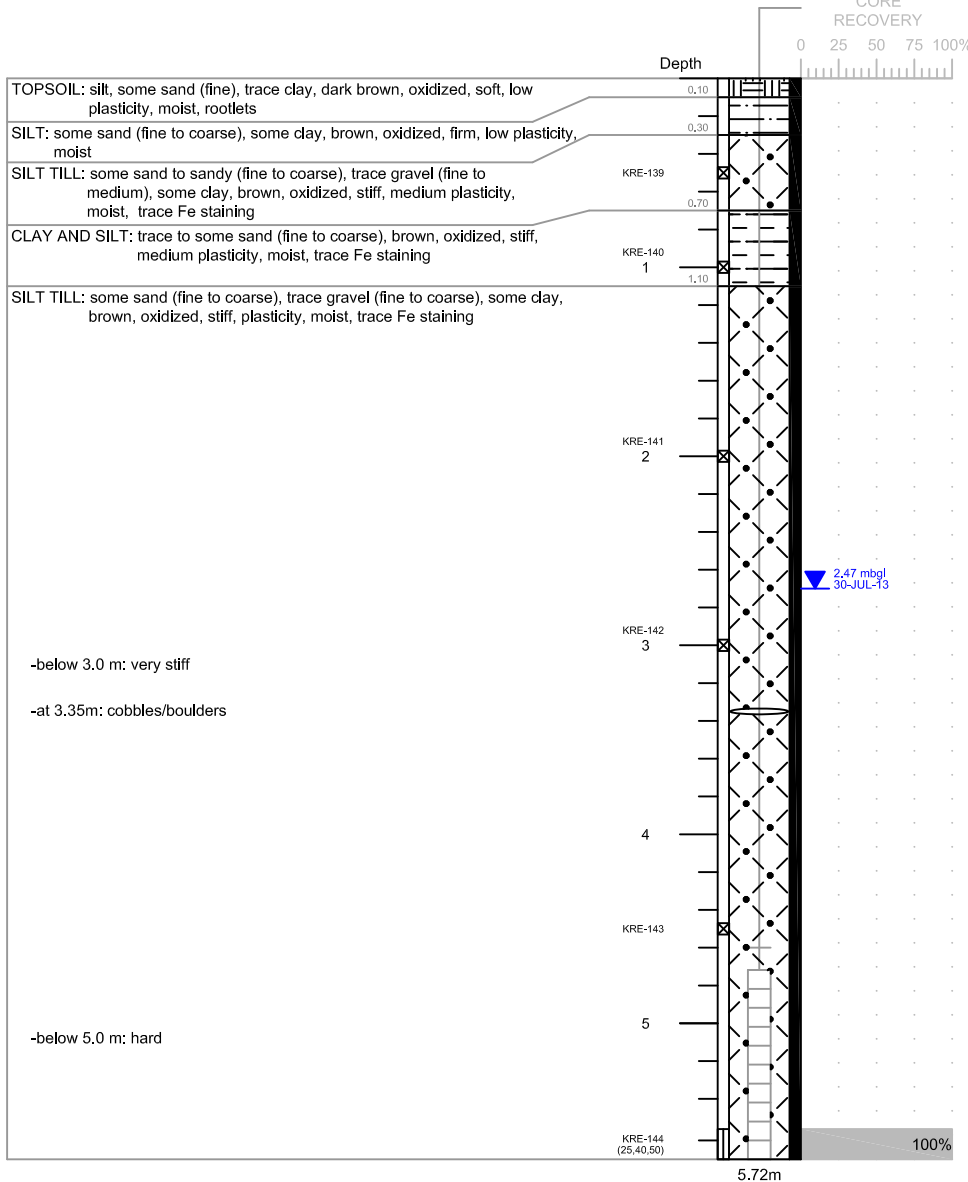
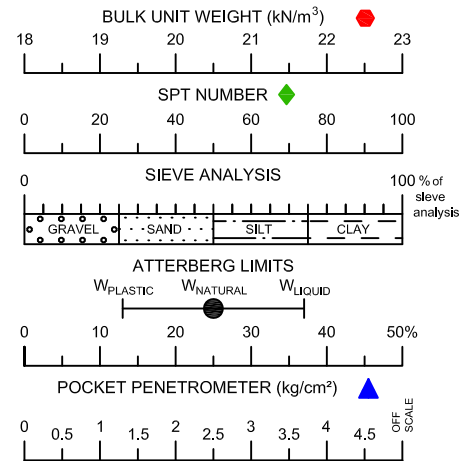
2013

5780574 N 399065 E

NAD 83 ZONE 13

SE12-11-37-04-W3

73B/1



NOTES

- Borehole open and dry immediately after drilling (I.A.D.).
- Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
- (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
- Depths are in metres below ground level (mbgl).
- Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 10

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-14

CHRIS CEBRYK

W1/2-11-37-4-W3M

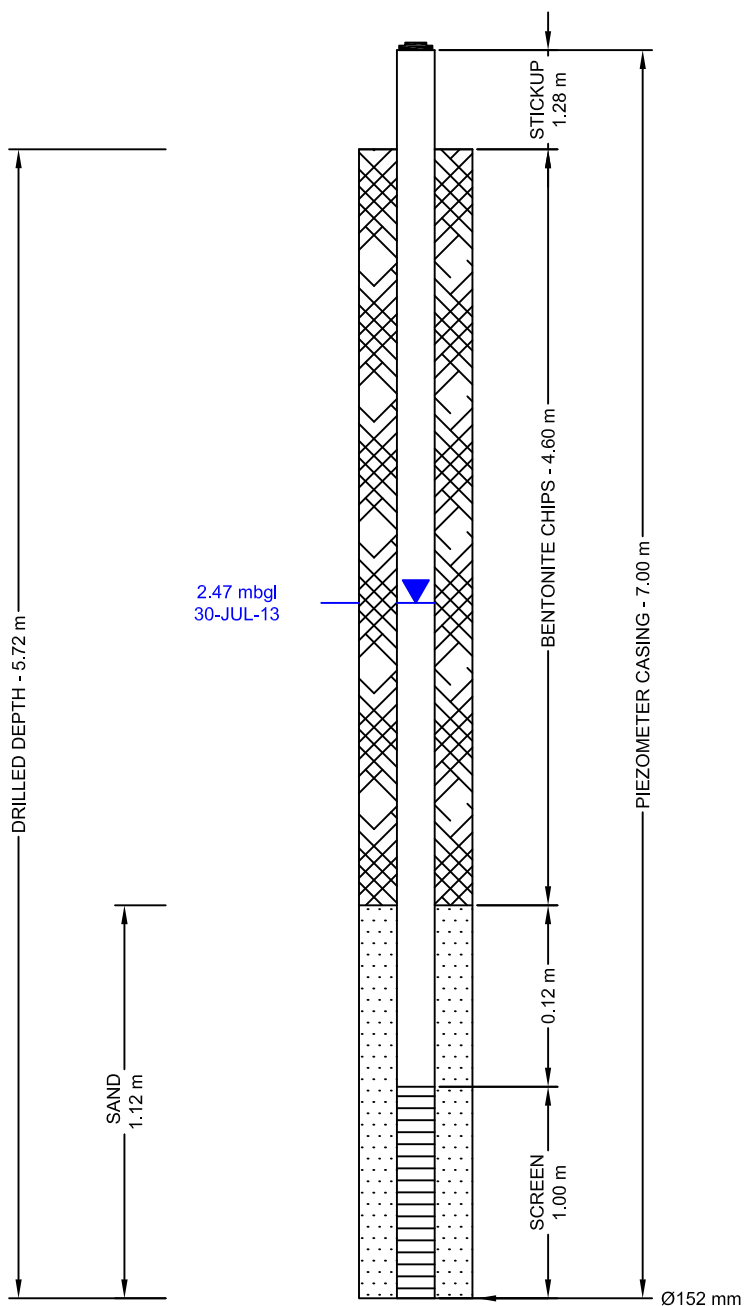
2013

5780574 N 399065 E

NAD 83 ZONE 13

SE12-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 10

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-15

CHRIS CEBRYK

W1/2-11-37-4-W3M

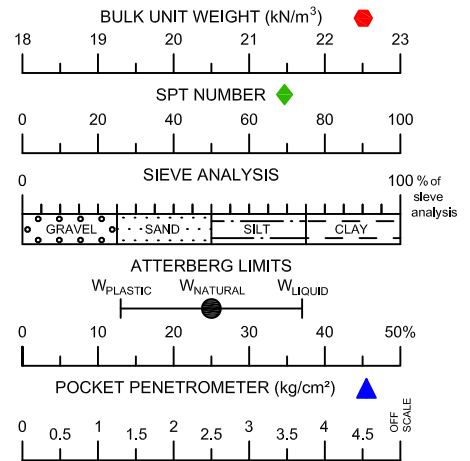
2013

5780566 N 399247 E

NAD 83 ZONE 13

SW11-11-37-04-W3

73B/1



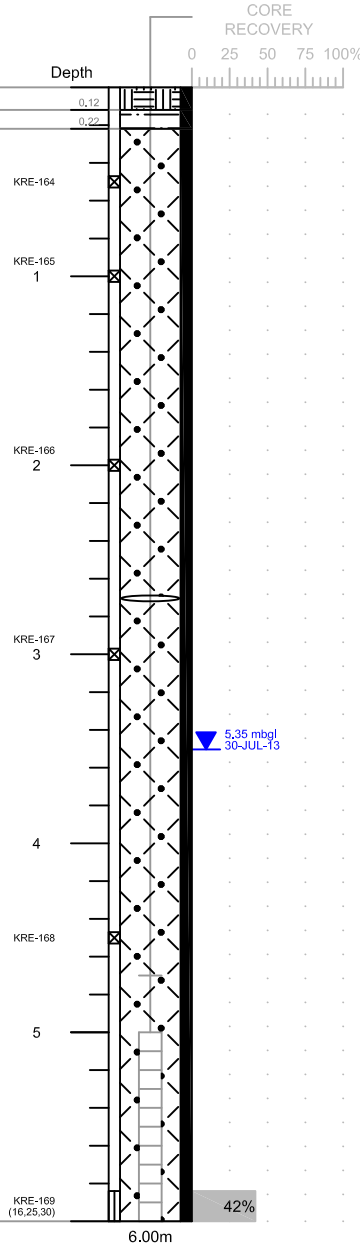
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
SILT: some sand (fine to coarse), some clay, brown, oxidized, firm, low plasticity, moist, trace Fe staining
SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-below 1.5m: low plasticity, damp to moist

-at 2.7 m: cobbles/boulders

-below 4.0 m: hard

-below 5.0 m: trace Fe staining



NOTES

- Borehole open and dry immediately after drilling (I.A.D.).
- Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
- (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
- Depths are in metres below ground level (mbgl).
- Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK / C. WU

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 11

DATE INSTALLED 2013 07 11

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-15

CHRIS CEBRYK

W1/2-11-37-4-W3M

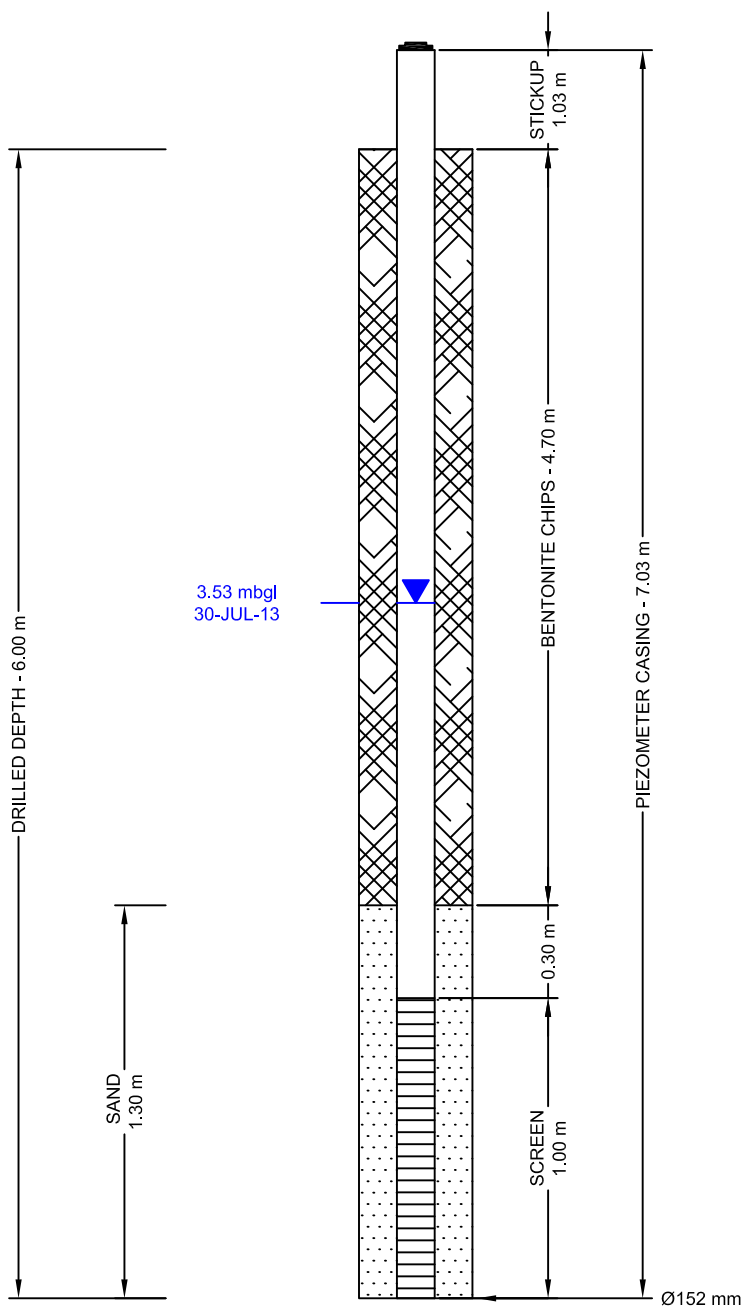
2013

5780566 N 399247 E

NAD 83 ZONE 13

SW11-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 11

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-16

CHRIS CEBRYK

W1/2-11-37-4-W3M

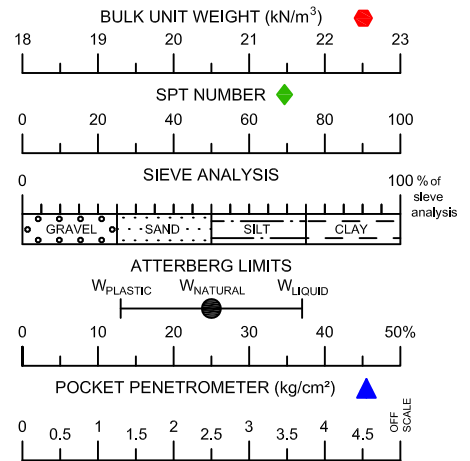
2013

5780627 N 399398 E

NAD 83 ZONE 13

SE11-11-37-04-W3

73B/1



TOPSOIL: silt, some clay, some sand (fine), dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT AND CLAY: trace sand (fine to coarse), brown, oxidized, firm, medium plasticity, moist

-below 1.5m: trace Fe staining

SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-at 2.1 m: cobbles/boulders

-at 3.66 m: cobbles/boulders

-at 5.18 m: cobbles/boulders

Depth

CORE RECOVERY

0 25 50 75 100%

KRE-170

KRE-171

1

KRE-172

(4,4,5)

KRE-173

2

KRE-174

3

KRE-175

5

KRE-176

6.00m

N=9

2.56 mbgl

30-JUL-13

00-02

62-36

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR K. EBEL, B.Sc., G.I.T.

LOGGED BY K. EBEL, B.Sc., G.I.T.

DATE DRILLED 2013 07 11

DATE INSTALLED 2013 07 11

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-16

CHRIS CEBRYK

W1/2-11-37-4-W3M

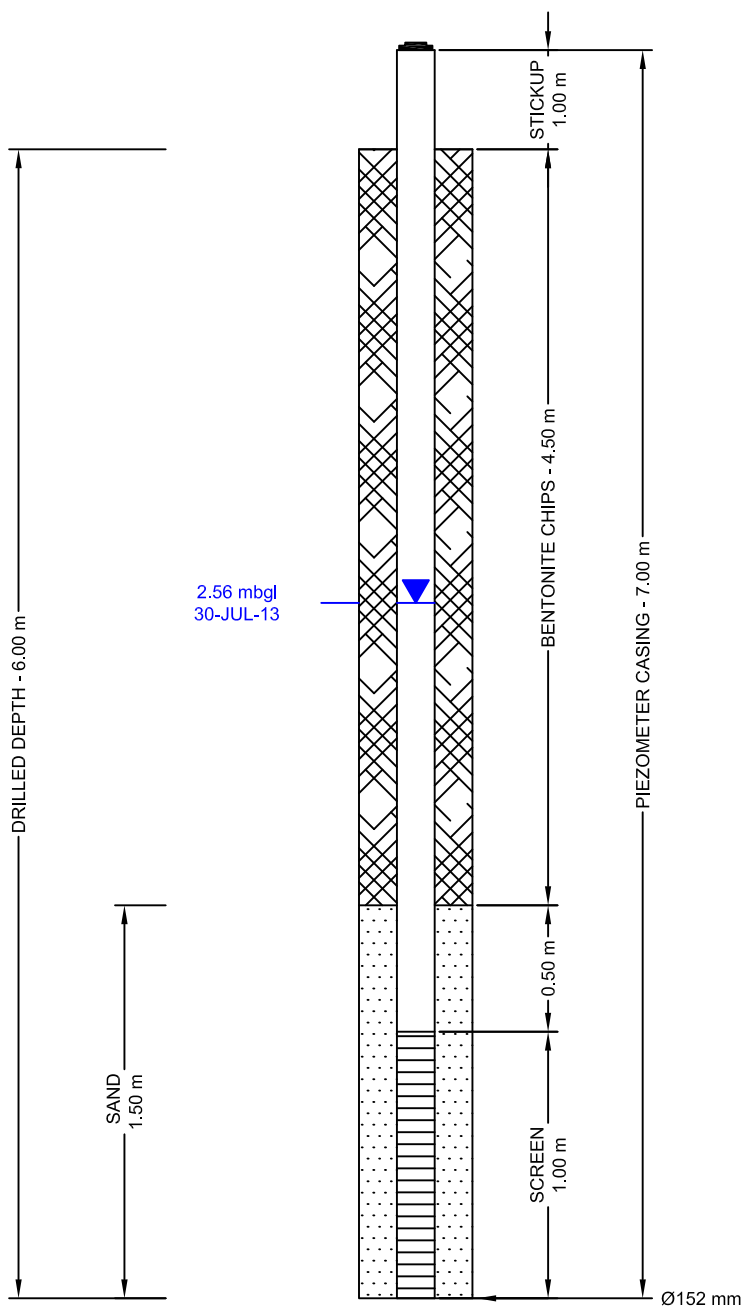
2013

5780627 N 399398 E

NAD 83 ZONE 13

SE11-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 11

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

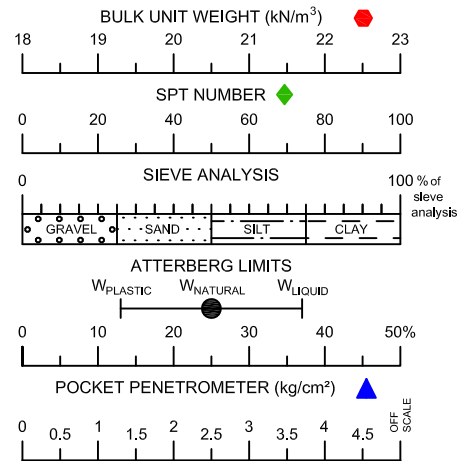
BOREHOLE 613596-17**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780393 N 398881 E

NAD 83 ZONE 13

NW05-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: some sand (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low to medium plasticity, damp, Fe staining

-below 0.4 m: moist

-below 1.0 m: very stiff

-below 2.7 m: damp to moist, crumbly

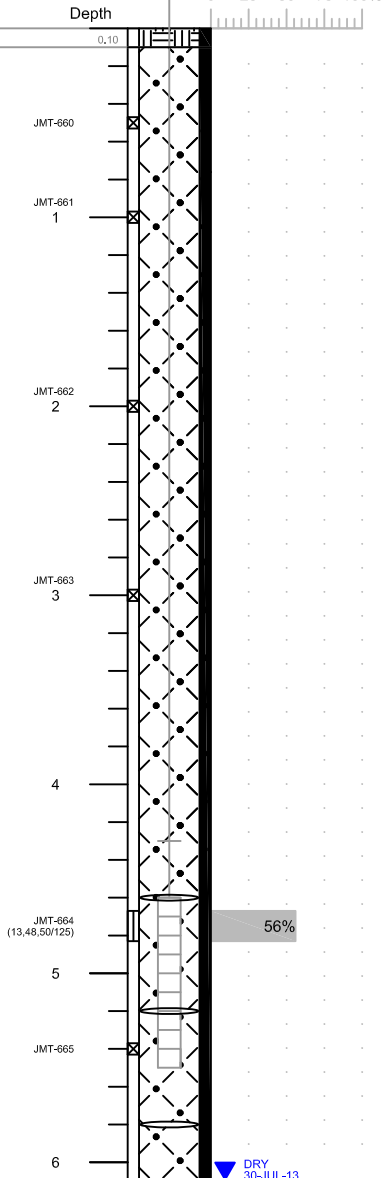
-below 3.0 m: hard

-at 4.6 m: cobbles/boulders

-below 4.6 m: trace to some gravel (fine to coarse)

-at 5.2 m: cobbles/boulders

-at 5.8 m: cobbles/boulders

**NOTES**

1. Borehole sloughed to 5.5 m (18.0 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** J. TIPMAN, B.E., E.I.T.**LOGGED BY** J. TIPMAN, B.E., E.I.T.**DATE DRILLED** 2013 07 04**DATE INSTALLED** 2013 07 04**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 19

PIEZOMETER 613596-17

CHRIS CEBRYK

W1/2-11-37-4-W3M

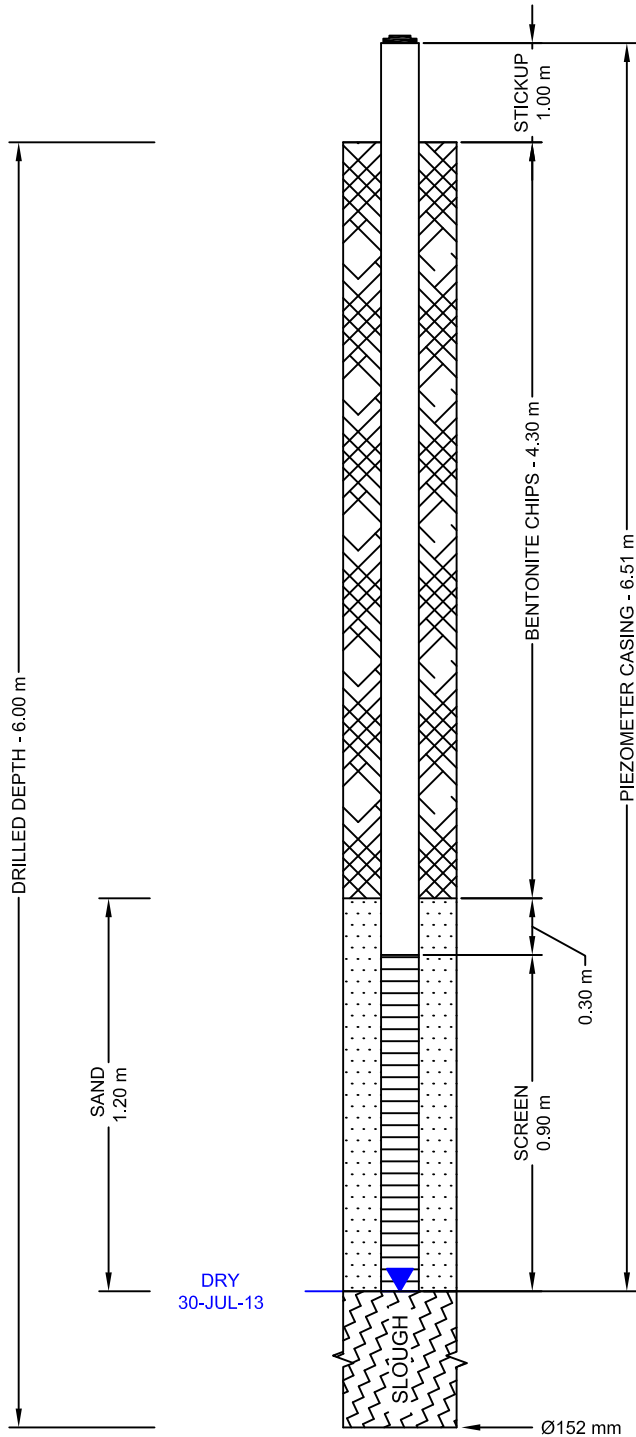
2013

5780393 N 398881 E

NAD 83 ZONE 13

NW05-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 04

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 19



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

73B/1



PIEZOMETER 613596-18

CHRIS CEBRYK

W1/2-11-37-4-W3M

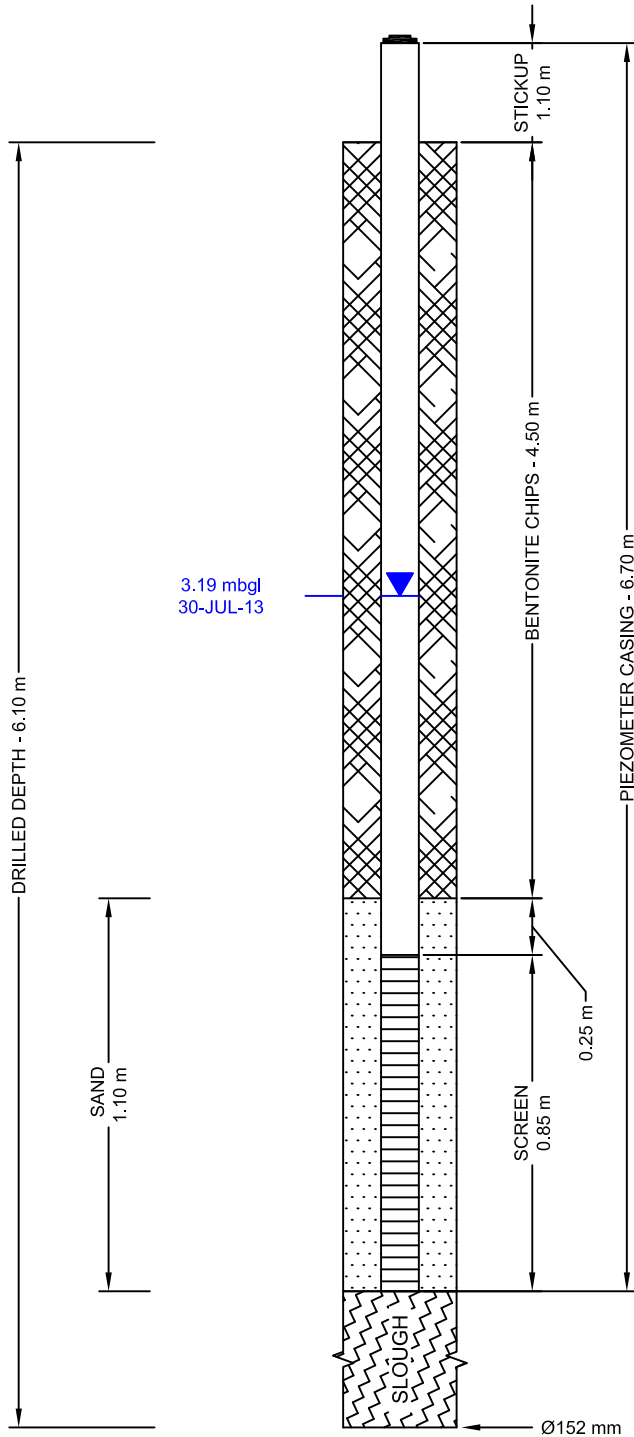
2013

5780395 N 399072 E

NAD 83 ZONE 13

NE05-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 04

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 19



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

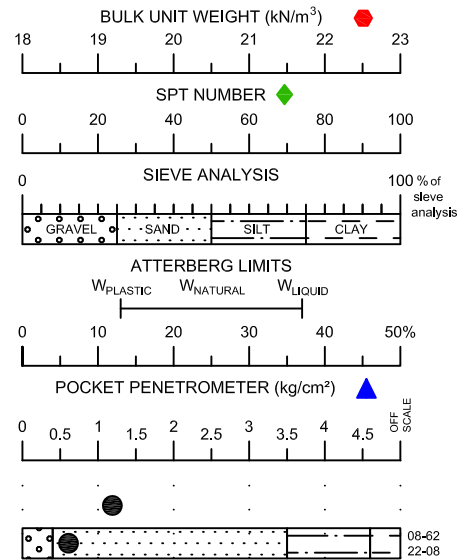
BOREHOLE 613596-19**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780445 N 399214 E

NAD 83 ZONE 13

NW06-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

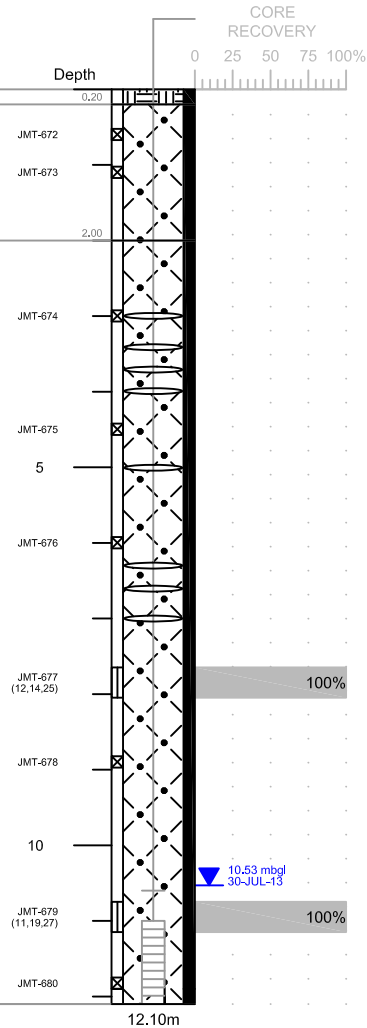
SAND TILL: (fine to coarse), silty, some gravel (fine to coarse), trace to some clay, dark brown, oxidized, compact, moist

- below 1.1 m m: trace Fe staining, moist
- at 1.6 m: cobbles/boulders

SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), dark brown, oxidized, very stiff, low plasticity, moist

- at 3.0 m: cobbles/boulders
- at 3.4 m: cobbles/boulders
- at 3.7 m: cobbles/boulders
- at 4.0 m: cobbles/boulders
- below 4.5 m: hard
- below 4.6 m: some sand, brown
- at 5.0 m: cobbles/boulders

- from 6.3 to 7.0 m: cobbles/boulders
- at 6.6 m: cobbles/boulders

**NOTES**

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**SNC • LAVALIN****CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK / C. WU**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** J. TIPMAN, B.E., E.I.T.**LOGGED BY** J. TIPMAN, B.E., E.I.T.**DATE DRILLED** 2013 07 04**DATE INSTALLED** 2013 07 04**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER**PROJECT No.** 613596**SCALE** 1:100**DATE** 2013 08 19

PIEZOMETER 613596-19

CHRIS CEBRYK

W1/2-11-37-4-W3M

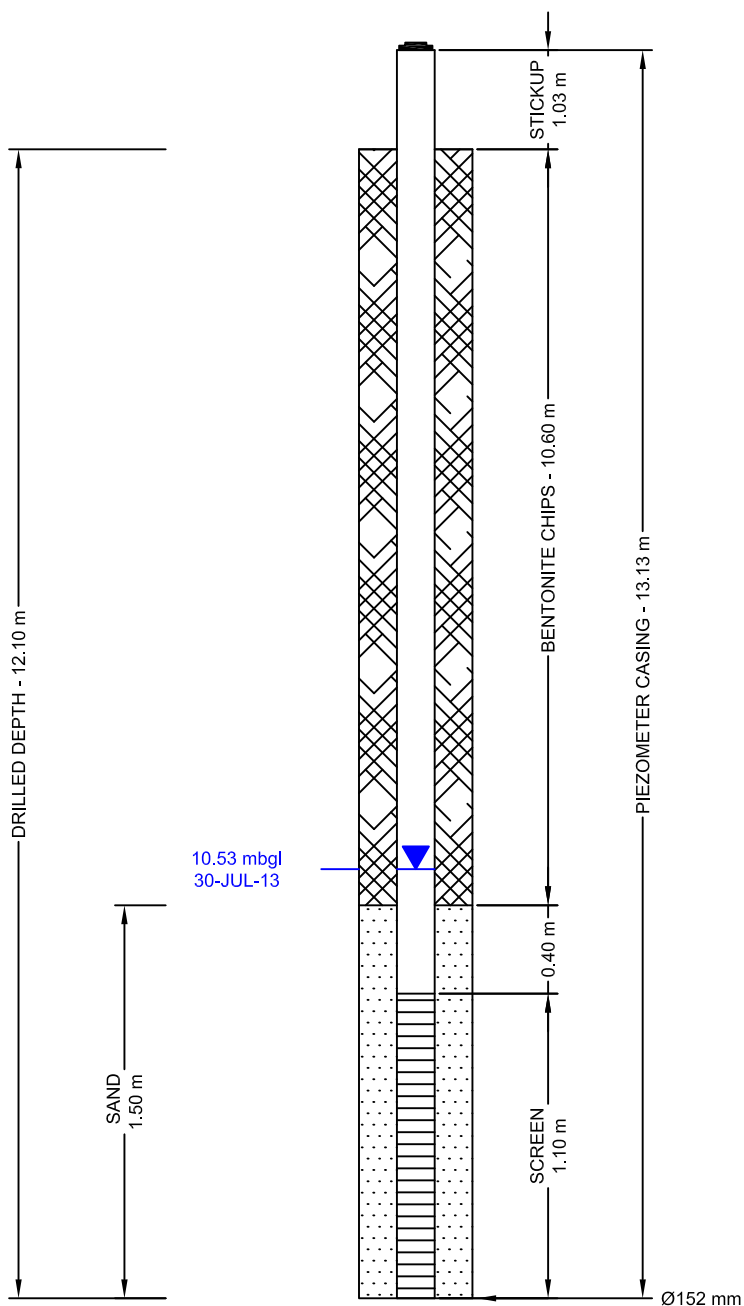
2013

5780445 N 399214 E

NAD 83 ZONE 13

NW06-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 04

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

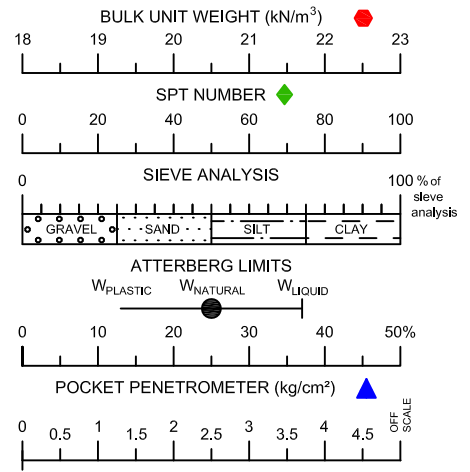
BOREHOLE 613596-20**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780090 N 399545 E

NAD 83 ZONE 13

SE06-11-37-04-W3

73B/1



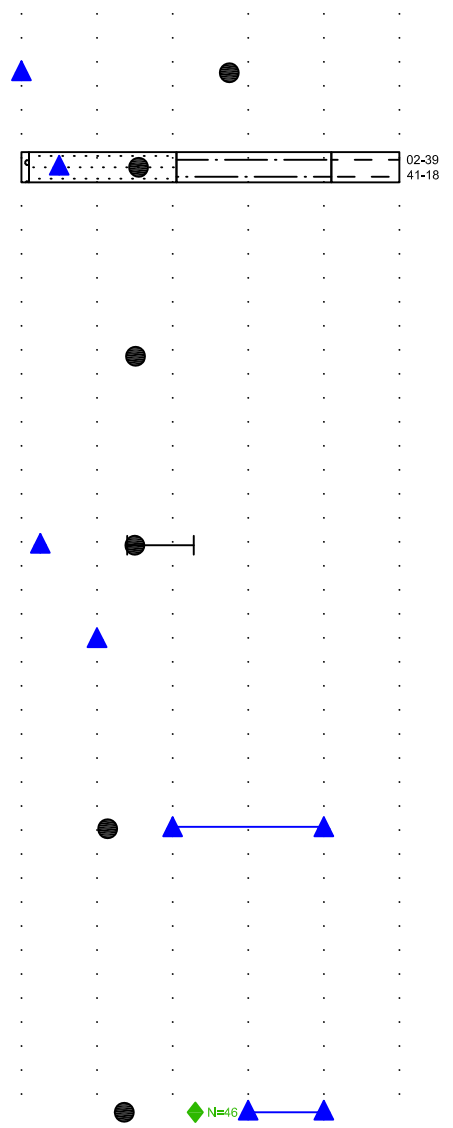
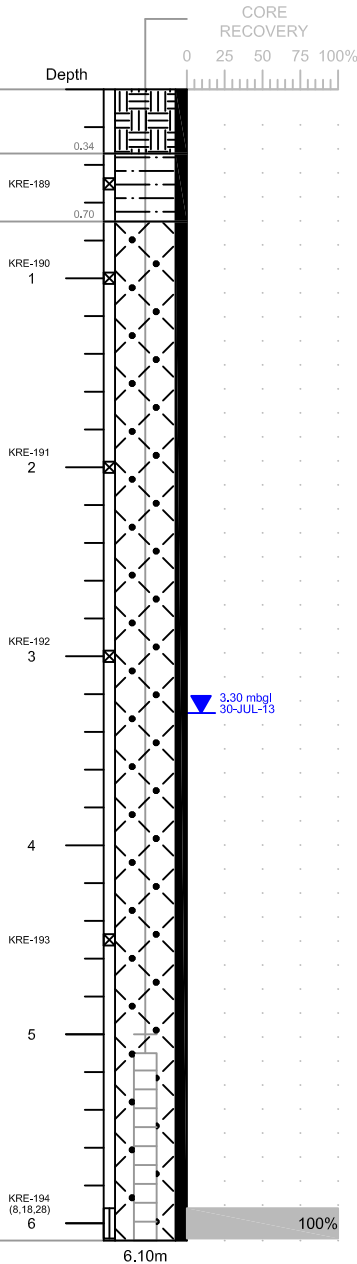
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, brown, oxidized, very soft, low plasticity, moist

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, firm, low plasticity, moist, trace Fe staining

-at 3.0 m: cobbles/boulders.
-below 3.0 m: stiff, some gravel

-below 4.5 m: very stiff

**NOTES**

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** K. EBEL, B.Sc., G.I.T.**LOGGED BY** K. EBEL, B.Sc., G.I.T.**DATE DRILLED** 2013 07 11**DATE INSTALLED** 2013 07 11**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C.WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 12

PIEZOMETER 613596-20

CHRIS CEBRYK

W1/2-11-37-4-W3M

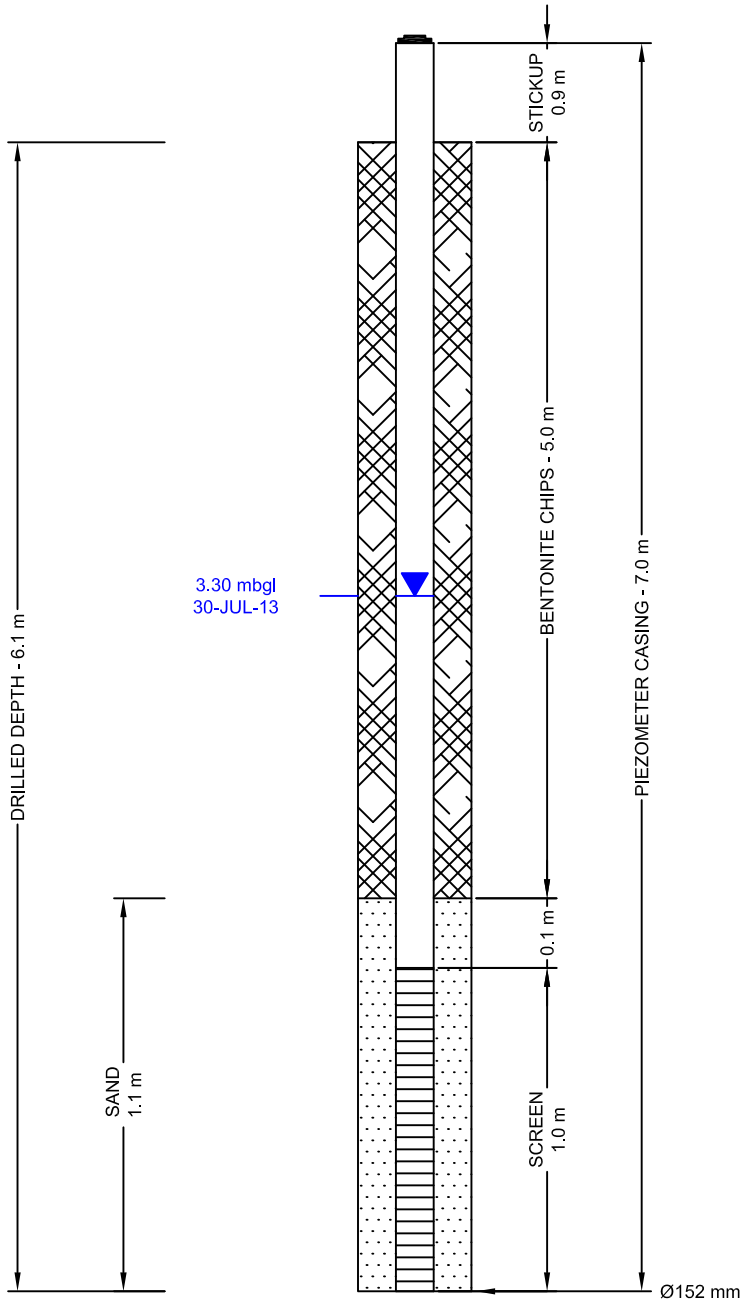
2013

5780090 N 399545 E

NAD 83 ZONE 13

SE06-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
natural ground surface, unless otherwise indicated.

SUPERVISOR K. EBEL, B.Sc., G.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 11

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-21

CHRIS CEBRYK

W1/2-11-37-4-W3M

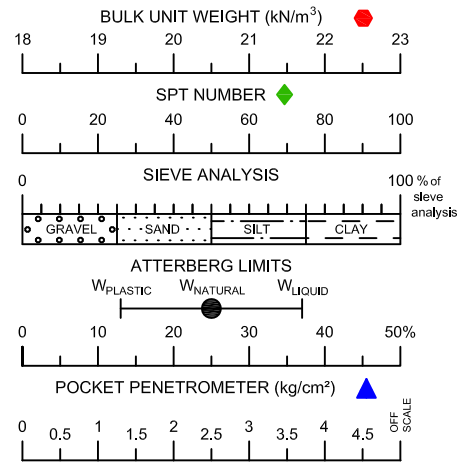
2013

5780199 N 398868 E

NAD 83 ZONE 13

SW05-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: sandy (fine), some clay, tan, oxidized, firm to stiff, low plasticity, moist

SAND: fine to coarse, silty, trace gravel (fine), trace clay, brown, oxidized, loose to compact, wet, seepage, sloughing

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, hard, low plasticity, moist

-at 5.2 m: cobbles/boulders

-at 5.8 m: cobbles/boulders

Depth

CORE RECOVERY

2.17 mbgl
30-JUL-13

50%

6.10m

NOTES

1. Borehole sloughed to 1.9 m (6.2 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl)..
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR J. TIPMAN, B.E., E.I.T.

LOGGED BY J. TIPMAN, B.E., E.I.T.

DATE DRILLED 2013 07 03

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

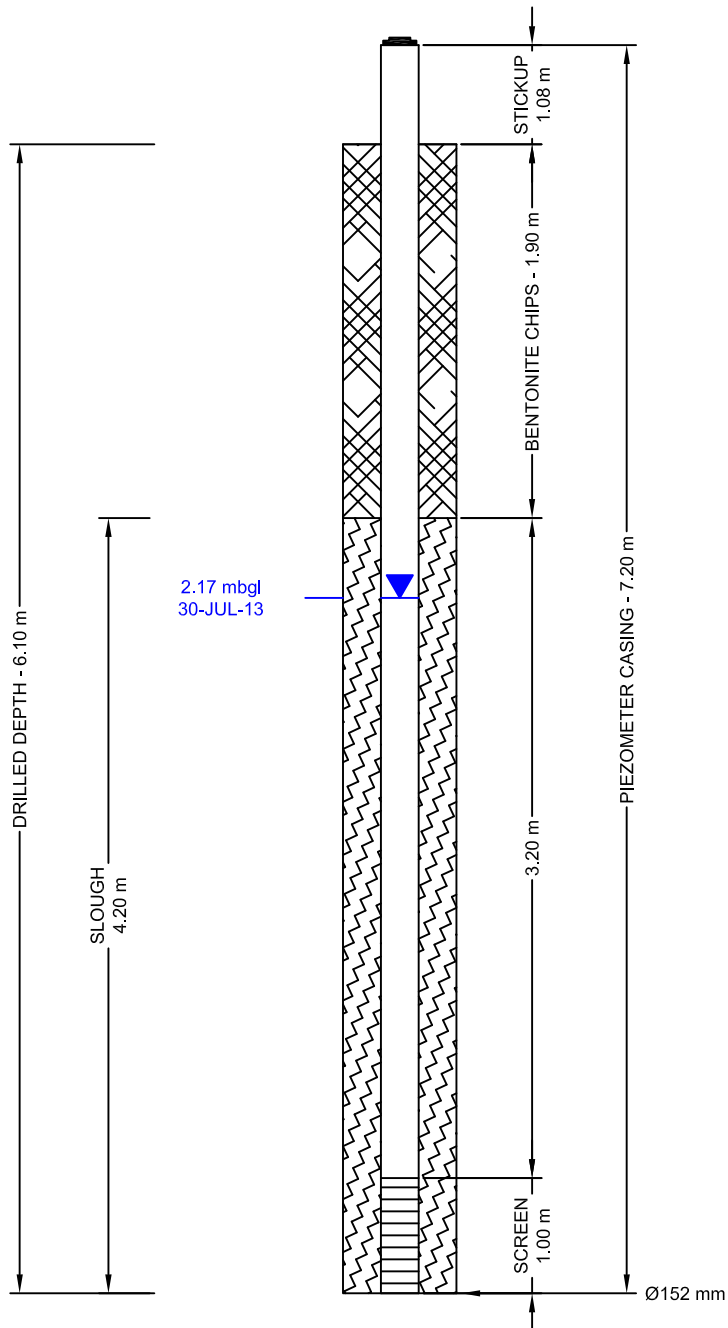
PIEZOMETER 613596-21**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780199 N 398868 E

NAD 83 ZONE 13

SW05-11-37-04-W3

73B/1

**FILTER PACK SEAL SPECIFICATIONS:**

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC

- belled couplings

NOTESAll depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.**SUPERVISOR** J. TIPMAN, B.E., E.I.T.**CONTRACTOR** BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**DATE INSTALLED** 2013 07 03**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. WU**PROJECT No.** 613596**SCALE** NOT TO SCALE**DATE** 2013 08 09**SNC • LAVALIN****CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-22

CHRIS CEBRYK

W1/2-11-37-4-W3M

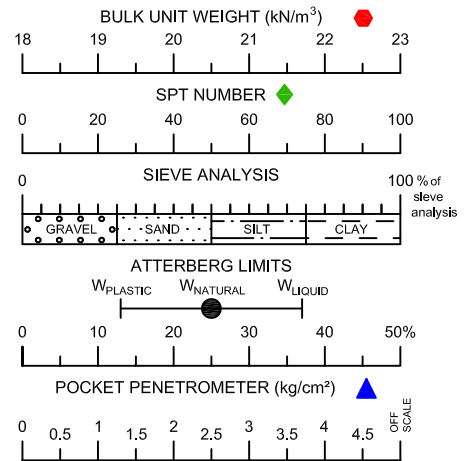
2013

5780201 N # 399067

NAD 83 ZONE 13

SE05-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine), some clay to clayey, brown, oxidized, soft, medium plasticity, moist
-below 0.5 m: tan

-below 1.5 m: stiff

-at 1.9 m: thin sand seam, seepage

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low plasticity, moist

-at 3.9 m: cobbles/boulders

-below 3.9 m: dark brown, damp to moist

-at 4.3 m: cobbles/boulders

-below 4.5 m: hard

-at 4.9 m: cobbles/boulders

-at 5.2 m: cobbles/boulders

-at 5.8 m: cobbles/boulders

Depth

CORE RECOVERY

0 25 50 75 100%

6.10m

JMT-648

JMT-649

1

JMT-650

(2,4,5)

2

JMT-651

3

4

JMT-652

5

JMT-653

6

4.70 mbgl
30-JUL-13

00-12
60-28

00-49
34-17

NOTES

- Borehole open and dry immediately after drilling (I.A.D.).
- Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
- (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
- Depths are in metres below ground level (mbgl).
- Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR J. TIPMAN, B.E., E.I.T.

LOGGED BY J. TIPMAN, B.E., E.I.T.

DATE DRILLED 2013 07 03

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. SAULNIER / C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 12

PIEZOMETER 613596-22

CHRIS CEBRYK

W1/2-11-37-4-W3M

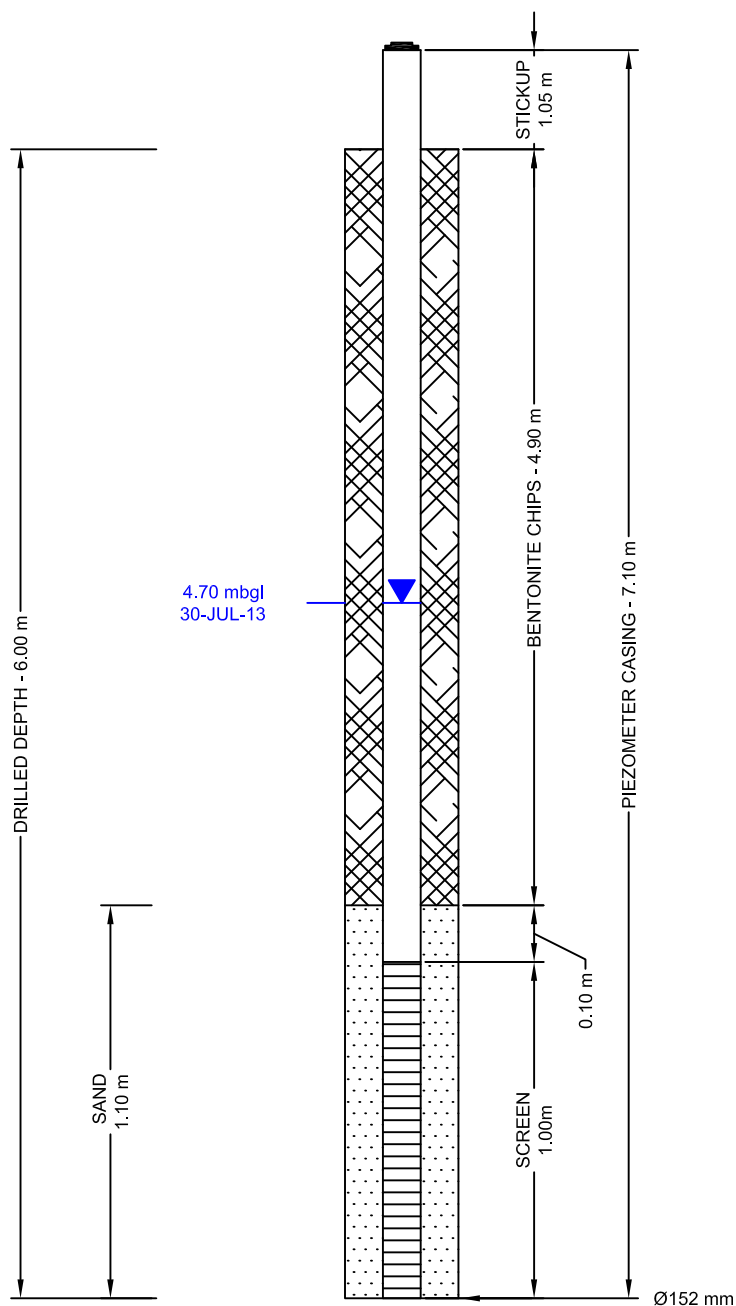
2013

5780201 N 399067 E

NAD 83 ZONE 13

SE05-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC

- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-23

CHRIS CEBRYK

W1/2-11-37-4-W3M

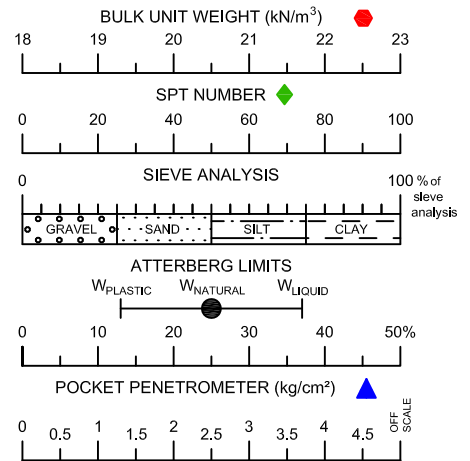
2013

5780201 N 399271 E

NAD 83 ZONE 13

SW06-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: trace to some sand (fine), clayey, tan, oxidized, soft, medium plasticity, moist

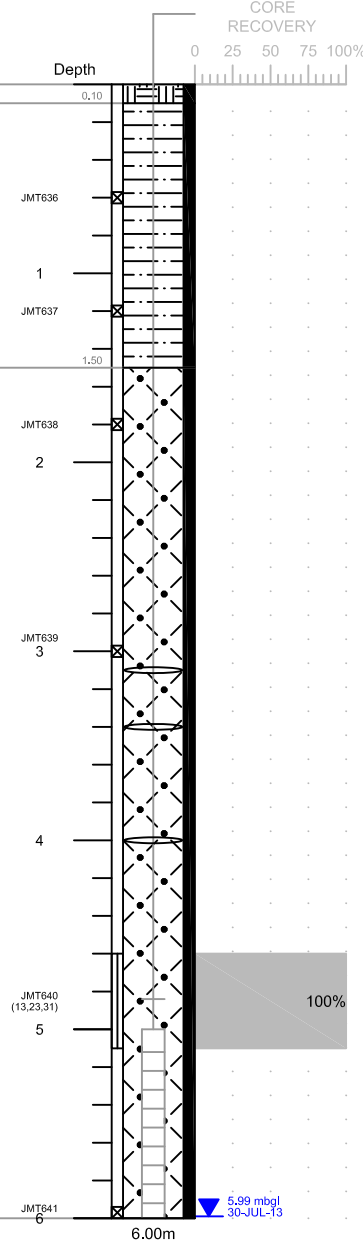
SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, firm, medium plasticity, moist

- below 3.0 m: stiff
- at 3.1 m: cobbles/boulders

- at 3.4 m: cobbles/boulders

- at 4.0 m: cobbles/boulders

- below 4.5 m: hard



NOTES

- Borehole open and dry immediately after drilling (I.A.D.).
- Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
- (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
- Depths are in metres below ground level (mbgl).
- Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

APPROVED BY

C. ZUBROWSKI, P.Eng.

DRAWN BY

C. WU

PROJECT No.

613596

SCALE

1:40

DATE

201308 12

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR J. TIPMAN, B.E., E.I.T.

LOGGED BY J. TIPMAN, B.E., E.I.T.

DATE DRILLED 2013 07 03

DATE INSTALLED 2013 07 03

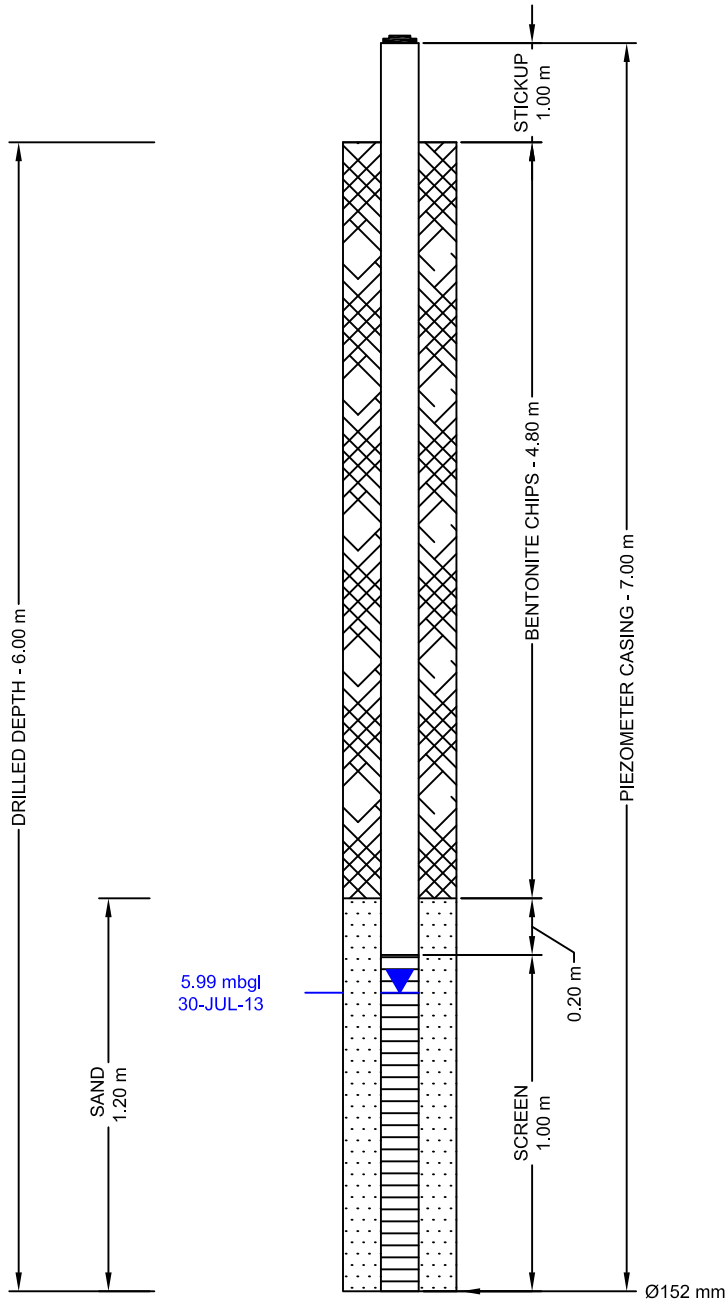
PIEZOMETER 613596-23**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5780201 N 399271 E

NAD 83 ZONE 13

SW06-11-37-04-W3

73B/1

**FILTER PACK SEAL SPECIFICATIONS:**

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

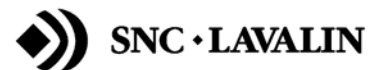
CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC

- belled couplings

NOTES

All depths are expressed in metres above or below
natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.**CONTRACTOR** BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**DATE INSTALLED** 2013 07 03**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. WU**PROJECT No.** 613596**SCALE** NOT TO SCALE **DATE** 2013 08 09**CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-24

CHRIS CEBRYK

W1/2-11-37-4-W3M

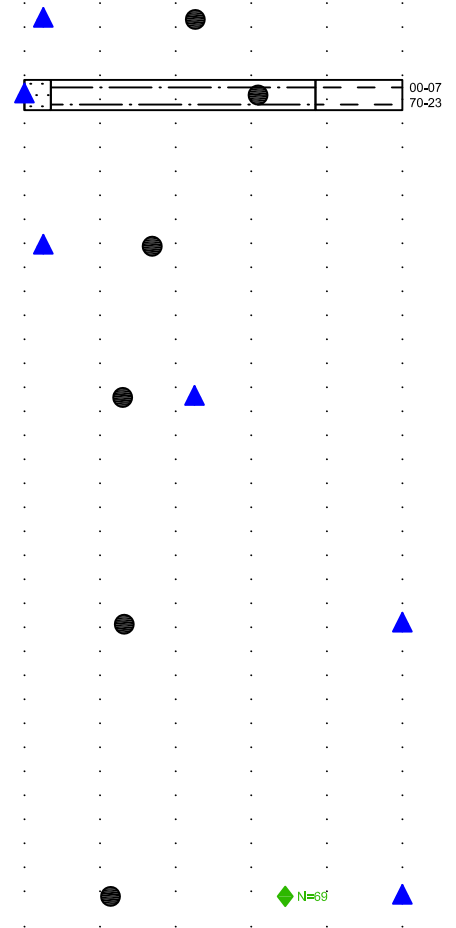
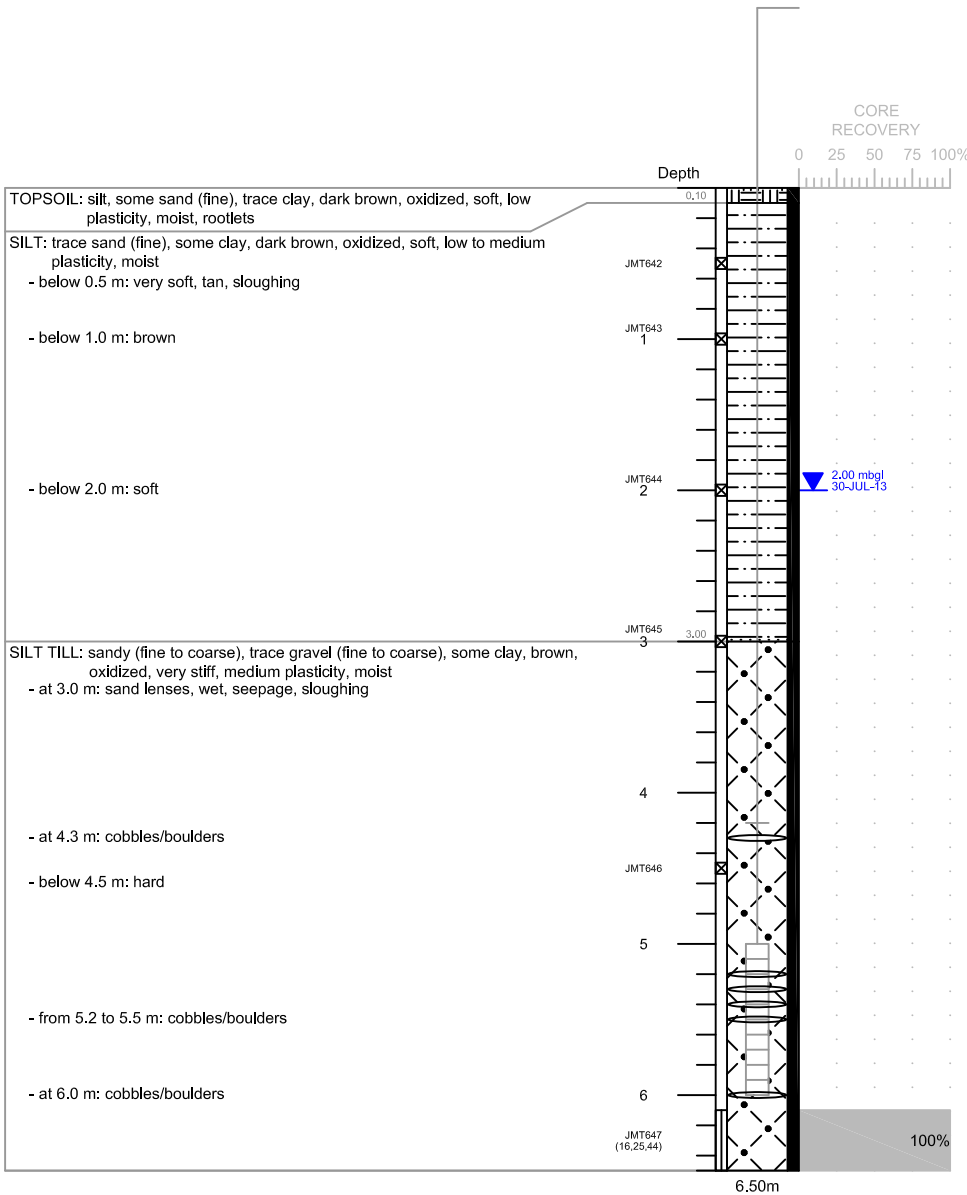
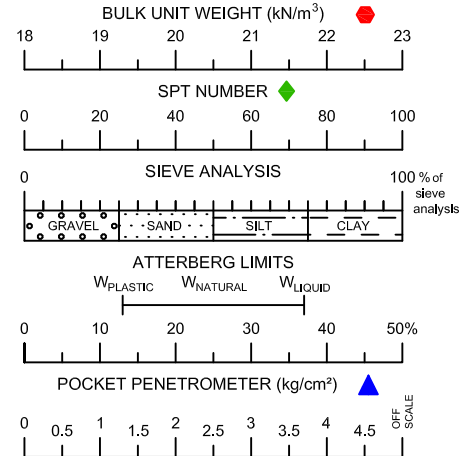
2013

5780209 N 399387 E

NAD 83 ZONE 13

SW06-11-37-04-W3

73B/1



NOTES

1. Borehole sloughed to 1.8 m (5.9 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR J. TIPMAN, B.E., E.I.T.

LOGGED BY J. TIPMAN, B.E., E.I.T.

DATE DRILLED 2013 07 03

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE 1:50

DATE 2013 08 19

PIEZOMETER 613596-24

CHRIS CEBRYK

W1/2-11-37-4-W3M

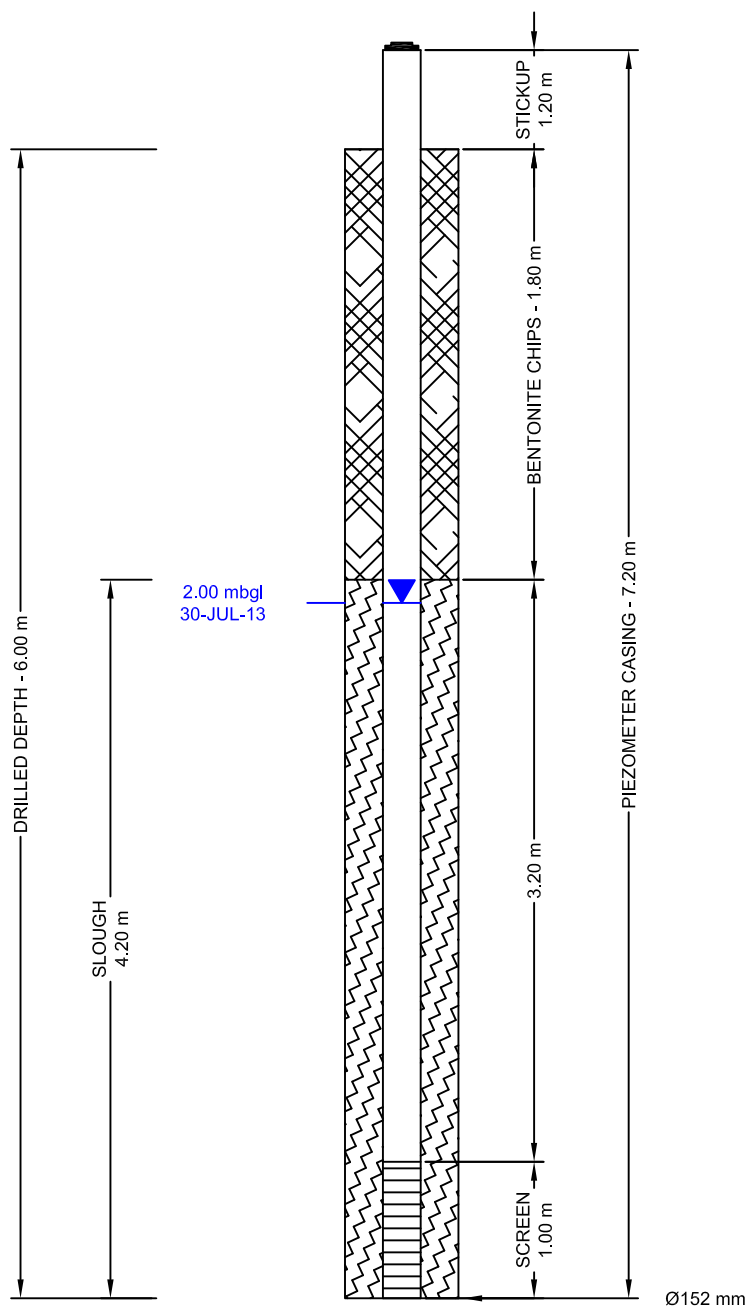
2013

5780209 N 399387 E

NAD 83 ZONE 13

SW06-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE **DATE** 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-25

CHRIS CEBRYK

W1/2-11-37-4-W3M

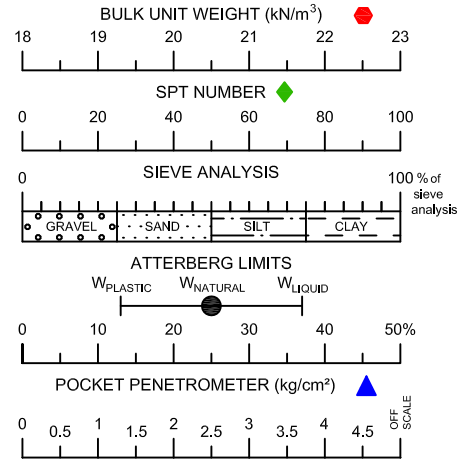
2013

5779948 N 398862 E

NAD 83 ZONE 13

NW04-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, soft, low plasticity, moist

- below 1.0 m: firm

- at 1.5 m: cobbles/boulders

- at 1.8 m: cobbles/boulders

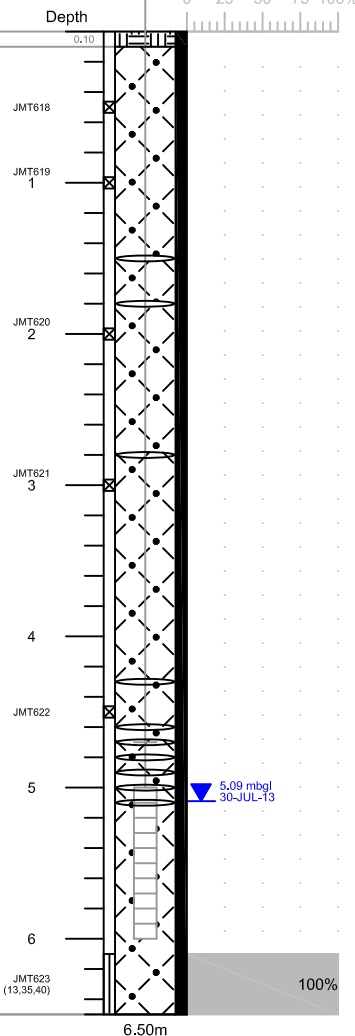
- below 2.0 m: stiff

- at 2.8 m: cobbles/boulders

- below 3.0 m: firm, Fe staining

-below 4.0 m: hard

-4.6 to 5.1 m: cobbles/boulders



03-38
37-22

N=75

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR J. TIPMAN, B.E., E.I.T.

LOGGED BY J. TIPMAN, B.E., E.I.T.

DATE DRILLED 2013 07 03

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE 1:50

DATE 2013 08 19

PIEZOMETER 613596-25

CHRIS CEBRYK

W1/2-11-37-4-W3M

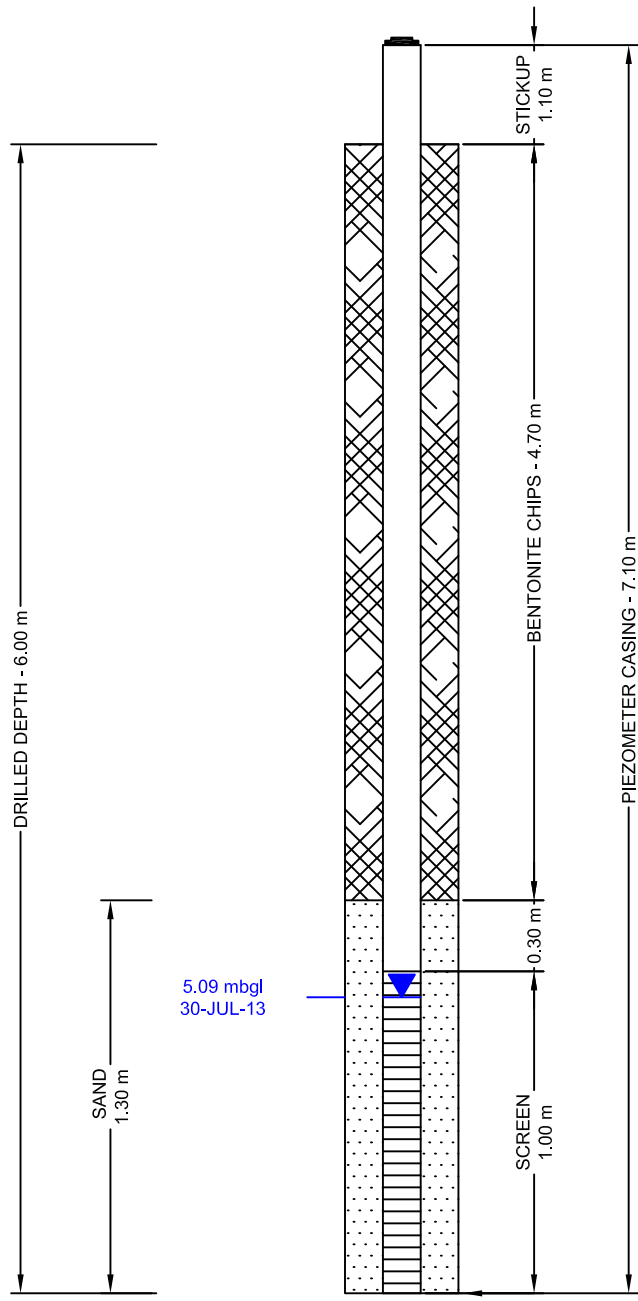
2013

5779948 N 398862 E

NAD 83 ZONE 13

NW04-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

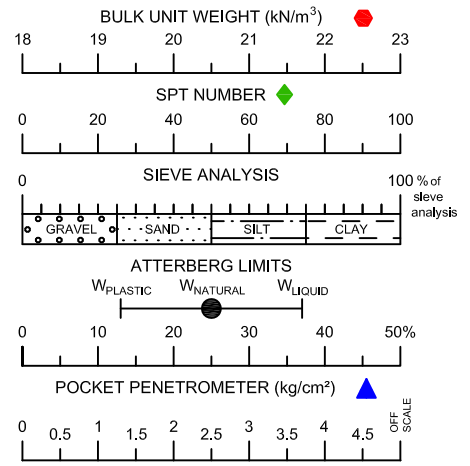
BOREHOLE 613596-26**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5779958 N 399071 E

NAD 83 ZONE 13

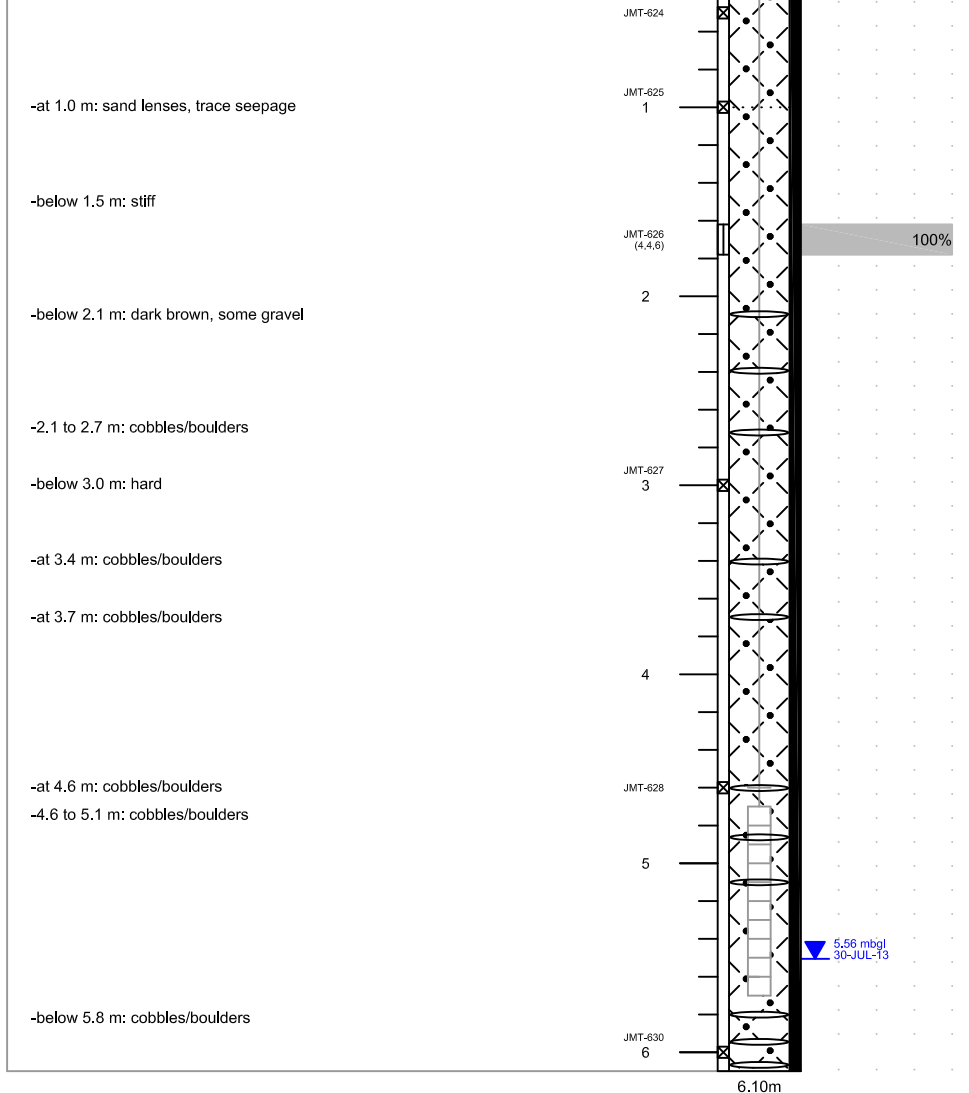
NE04-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, firm, low plasticity, moist

**NOTES**

1. Borehole sloughed to 5.7 m (18.7 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** J. TIPMAN, B.E., E.I.T.**LOGGED BY** J. TIPMAN, B.E., E.I.T.**DATE DRILLED** 2013 07 03**DATE INSTALLED** 2013 07 03**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. SAULNIER / C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 19

PIEZOMETER 613596-26

CHRIS CEBRYK

W1/2-11-37-4-W3M

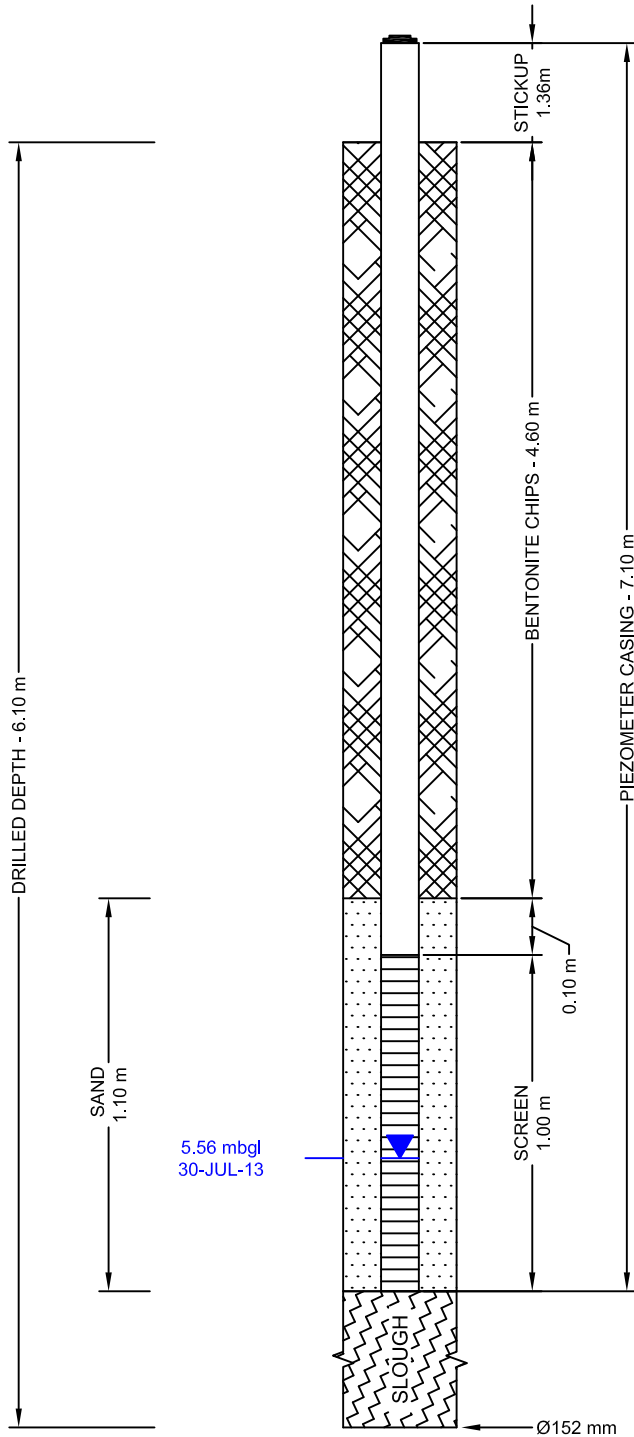
2013

5779958 N 399071 E

NAD 83 ZONE 13

NE04-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE DATE 2013 08 19



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

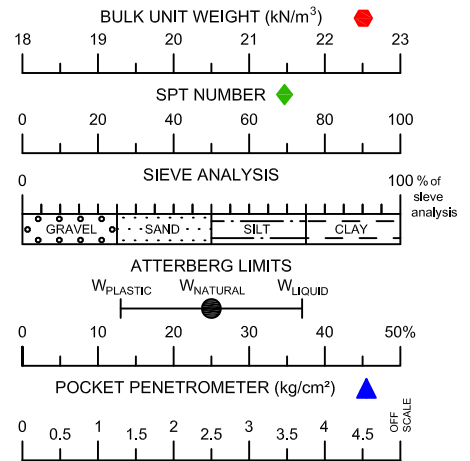
BOREHOLE 613596-27**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5779958 N 399272 E

NAD 83 ZONE 13

NW03-11-37-04-W3

73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: some sand (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, soft, low to medium plasticity, moist

- below 2.0 m: stiff

- at 2.8 m: cobbles/boulders

- below 3.1 m: hard, trace to some gravel, damp to moist

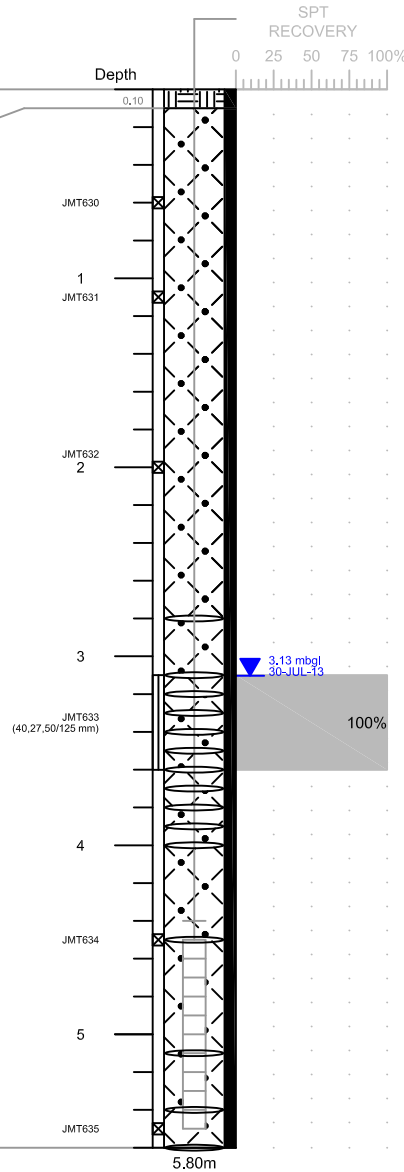
- from 3.1 to 4.0 m: cobbles/boulders

- at 4.5 m: cobbles/boulders

- at 5.1 m: cobbles/boulders

- at 5.4 m: cobbles/boulders

- at 5.6 m: cobbles/boulders

**NOTES**

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.
6. Poor auger recovery from 1.5 - 3.0 m

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

**SNC • LAVALIN****CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**ABANDONMENT** BENTONITE CHIPS**SUPERVISOR** J. TIPMAN, B.E., E.I.T.**LOGGED BY** J. TIPMAN, B.E., E.I.T.**DATE DRILLED** 2013 07 03**DATE INSTALLED** 2013 07 03**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. WU**PROJECT No.** 613596**SCALE** 1:40**DATE** 2013 08 12

PIEZOMETER 613596-27

CHRIS CEBRYK

W1/2-11-37-4-W3M

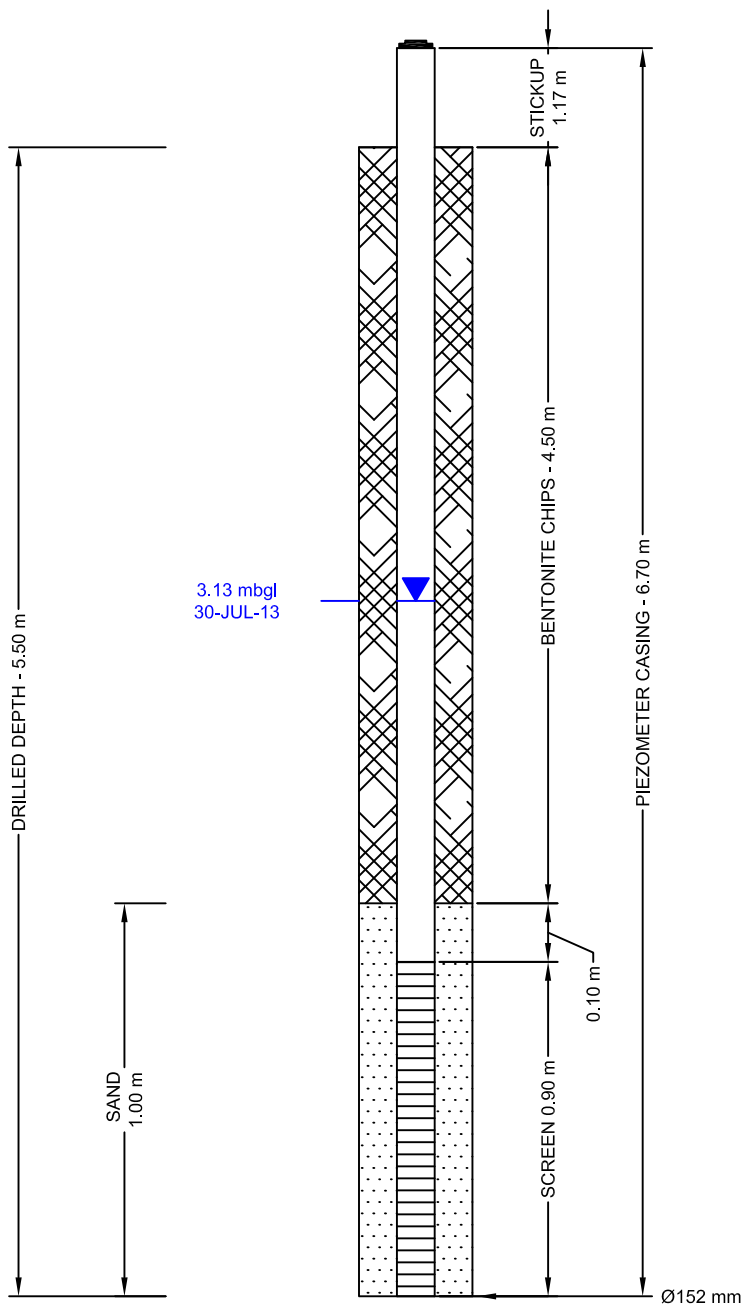
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5779958 N 399272 E

NAD 83 ZONE 13

SW04-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 02

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-29

CHRIS CEBRYK

W1/2-11-37-4-W3M

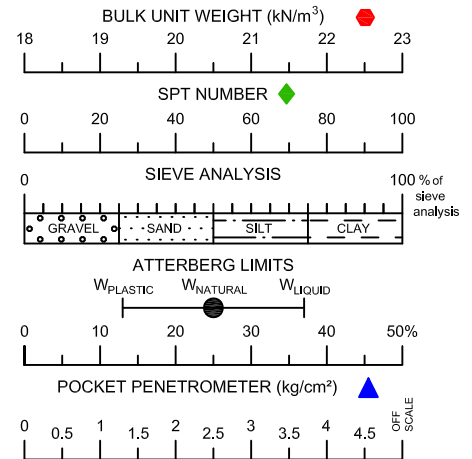
2013

5779771 N 398850 E

NAD 83 ZONE 13

SW04-11-37-04-W3

73B/1



SILT: sandy (fine), some clay, dark brown, oxidized, soft, low plasticity, moist
- below 0.2 m: brown

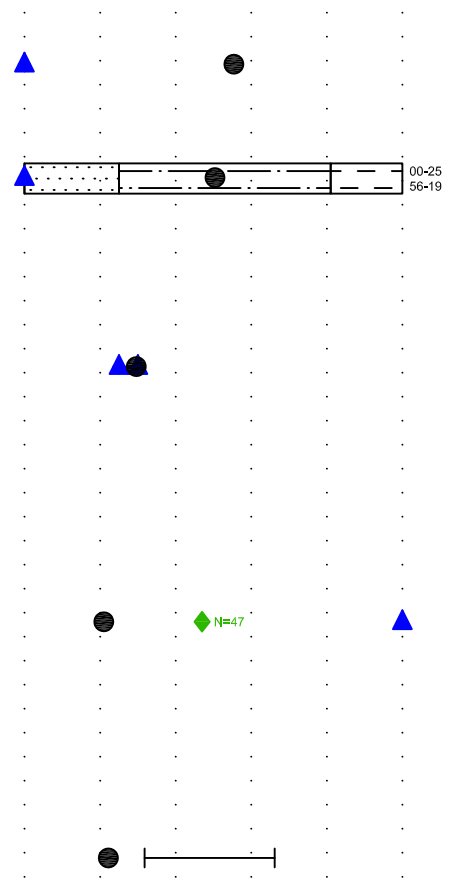
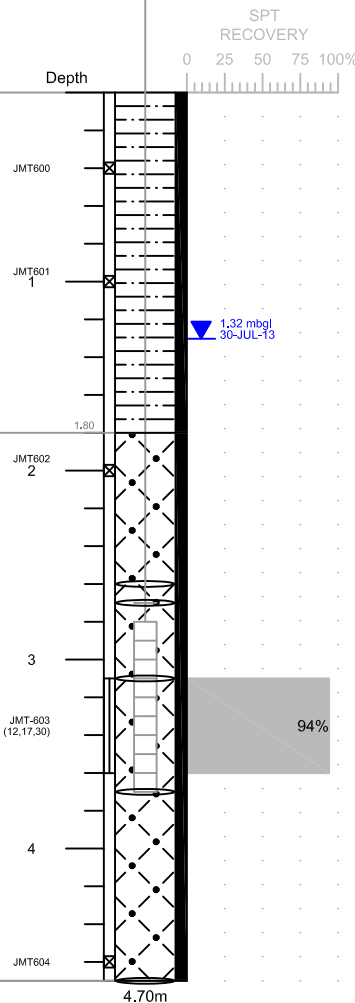
SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, stiff, medium plasticity, moist
- at 1.8 m: wet, seepage, sloughing

- at 2.6 m: cobbles/boulders
- at 2.7 m: cobbles/boulders

- below 3.1 m: hard

- at 3.7 m: cobbles/boulders

- at 4.7 m: cobbles/boulders



NOTES

- Borehole sloughed to 3.5 m (11.5 ft) immediately after drilling (I.A.D.).
- Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
- (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
- Depths are in metres below ground level (mbgl).
- Coordinates are from a handheld GPS, +/- 3 m.
- Drilling was attempted 6 times, shallow refusal during 5 attempts.
- Poor auger recovery from 3.1 - 4.6 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

APPROVED BY

C. ZUBROWSKI, P.Eng.

LOGGED BY

C. WU

PROJECT No.

613596

SCALE

1:40

DATE

2013 08 19

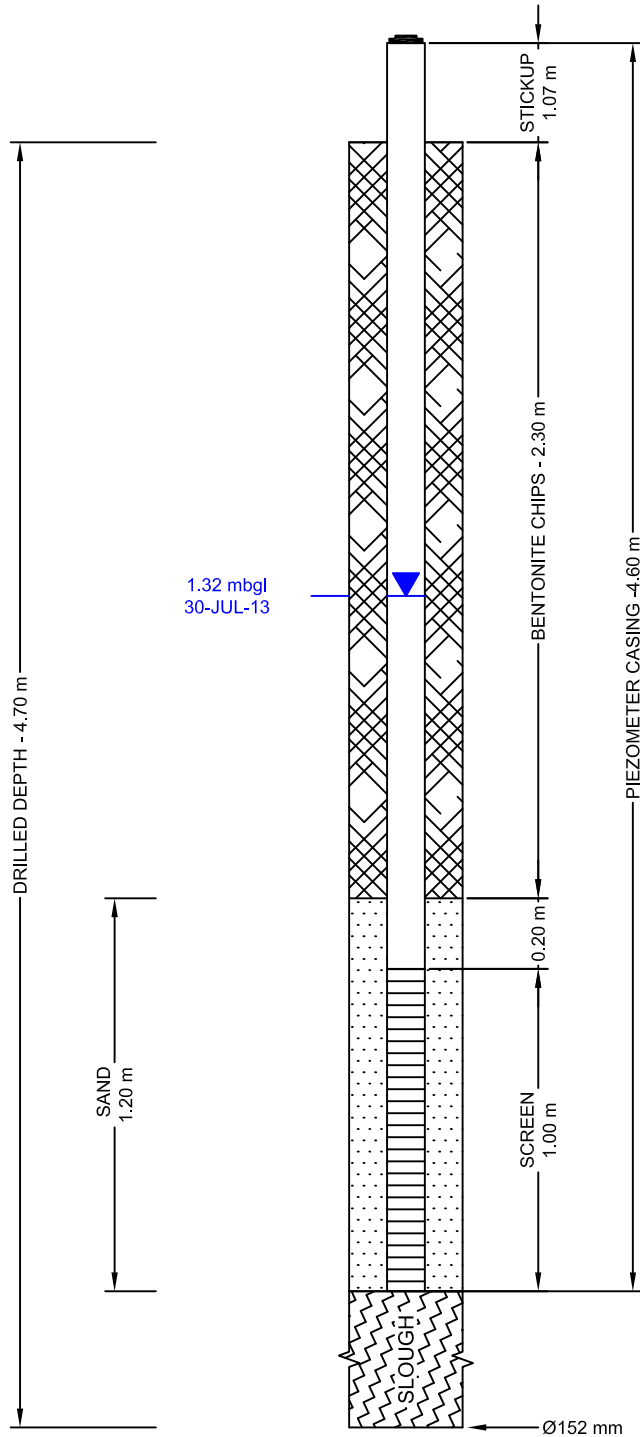
PIEZOMETER 613596-29**CHRIS CEBRYK****W1/2-11-37-4-W3M****2013**

5779771 N 398850 E

NAD 83 ZONE 13

NW03-11-37-04-W3

73B/1

**FILTER PACK SEAL SPECIFICATIONS:**

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC

- belled couplings

NOTESAll depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.**SUPERVISOR** J. TIPMAN, B.E., E.I.T.**CONTRACTOR** BOSS DRILLING**OPERATOR** C. OLEKSUIK**DRILL RIG TYPE** CME 75**DATE INSTALLED** 2013 07 02**APPROVED BY** C. ZUBROWSKI, P.Eng.**DRAWN BY** C. WU**PROJECT No.** 613596**SCALE** NOT TO SCALE **DATE** 2013 08 19**SNC • LAVALIN****CLIENT**

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

73B/1



PIEZOMETER 613596-30

CHRIS CEBRYK

W1/2-11-37-4-W3M

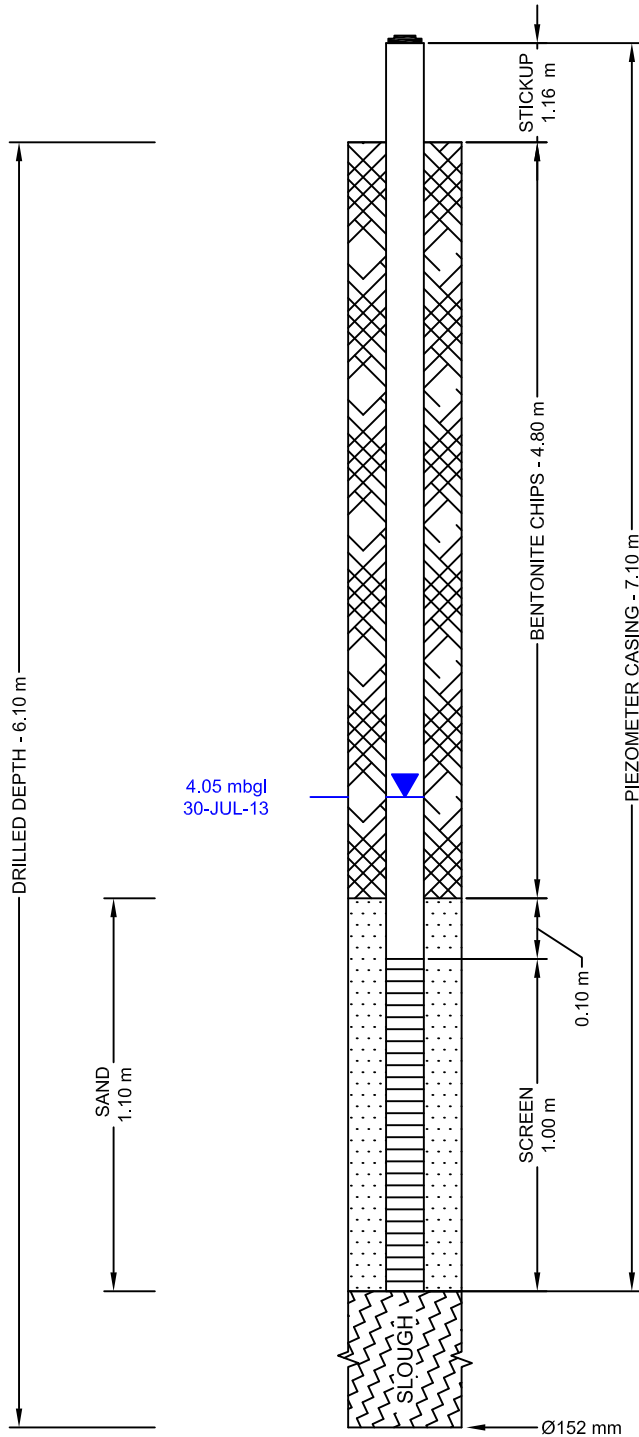
2013

5779744 N 399070 E

NAD 83 ZONE 13

SE04-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 19



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

BOREHOLE 613596-31

CHRIS CEBRYK

W1/2-11-37-4-W3M

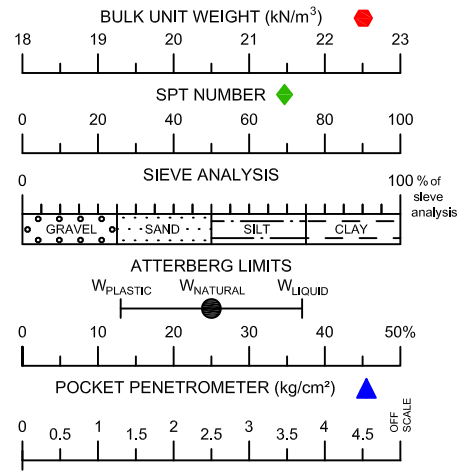
2013

5779765 N 399224 E

NAD 83 ZONE 13

SW03-11-37-04-W3

73B/1



SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, soft to firm, low plasticity, moist

-0.1 to 1.5 m: trace seepage

- below 1.0 m: firm

- at 1.5 m: cobbles/boulders

- below 3.0 m: stiff

- at 3.3 m: cobbles/boulders

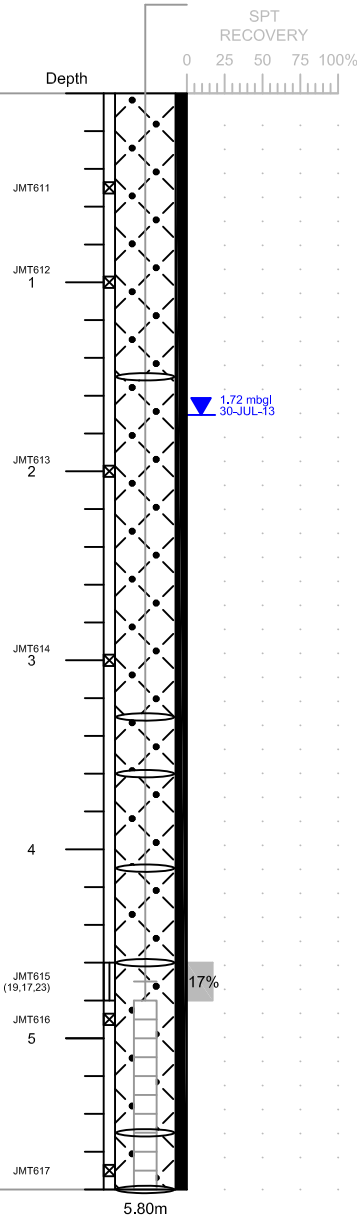
- at 3.6 m: cobbles/boulders
- below 3.6 m: dark brown, stiff, damp to moist, trace to some gravel

- at 4.1 m: cobbles/boulders

- below 4.6 m: hard, seepage

- at 5.5 m: cobbles/boulders

- at 5.8 m: cobbles/boulders



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#, #, #) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.



CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

ABANDONMENT BENTONITE CHIPS

SUPERVISOR J. TIPMAN, B.E., E.I.T.

LOGGED BY J. TIPMAN, B.E., E.I.T.

DATE DRILLED 2013 07 03

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE 1:40

DATE 2013 08 19

PIEZOMETER 613596-31

CHRIS CEBRYK

W1/2-11-37-4-W3M

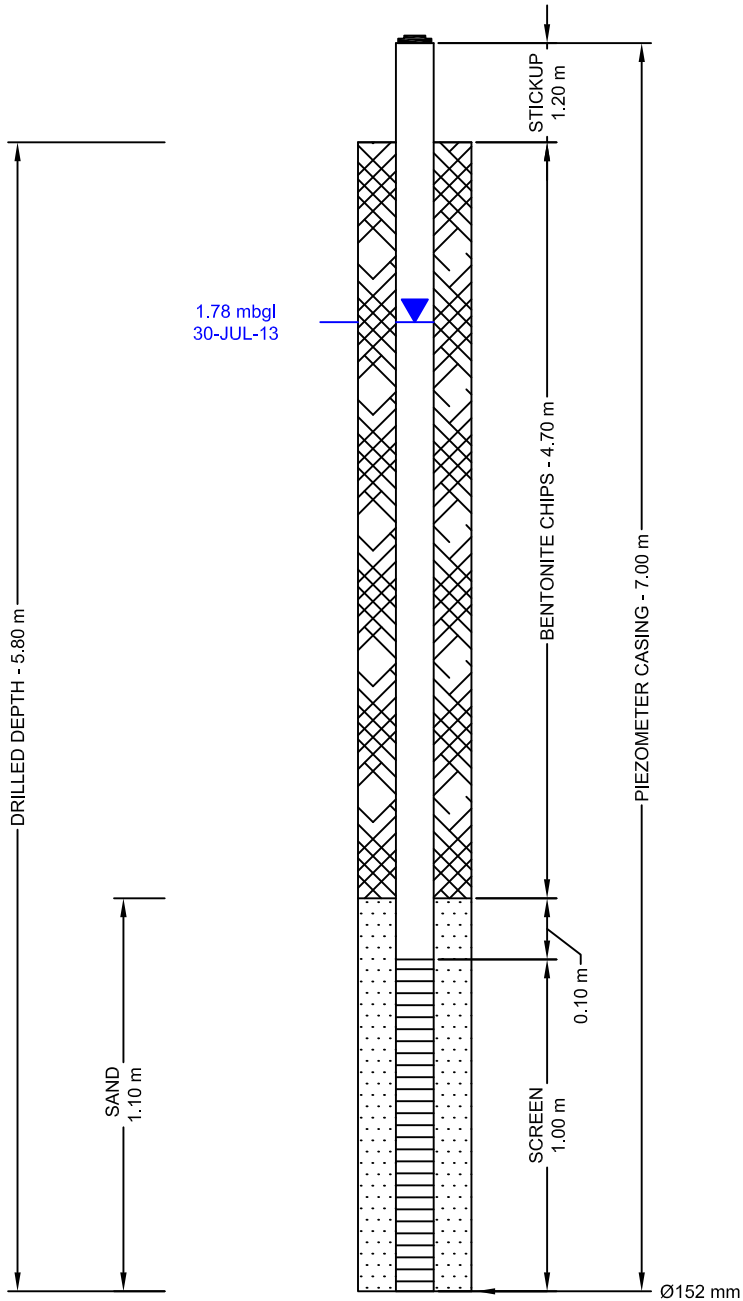
2013

5779765 N 399224 E

NAD 83 ZONE 13

SW03-11-37-04-W3

73B/1



FILTER PACK SEAL SPECIFICATIONS:

- bentonite chips

FILTER PACK SPECIFICATIONS:

- target filter sand

SCREEN SPECIFICATIONS:

- 2 inch 10 slot PVC

CASING SPECIFICATIONS:

- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below
Natural ground surface, unless otherwise indicated.

SUPERVISOR J. TIPMAN, B.E., E.I.T.

CONTRACTOR BOSS DRILLING

OPERATOR C. OLEKSUIK

DRILL RIG TYPE CME 75

DATE INSTALLED 2013 07 03

APPROVED BY C. ZUBROWSKI, P.Eng.

DRAWN BY C. WU

PROJECT No. 613596

SCALE NOT TO SCALE

DATE 2013 08 09



SNC • LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4-W3M

Appendix V

Laboratory Testing Results



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Residential Development

Project No: 613596

Tech RG

Date: 25-Jul-13

Sample #	KRE-116	KRE-117	KRE-118	KRE-119	KRE-120	KRE-121
Test Hole #	1	1	1	1	1	2
Depth	0.5	1	2	4.5	6	0.5
Tare #	ENG-110	Scout1	BenF2	Oddish4	SNC-02	Misty
Tare Mass (g)	40.47	40.20	38.15	38.93	41.55	37.98
Wet sample + tare (g)	138.83	125.22	144.42	160.32	189.82	139.40
Dry sample + tare (g)	126.29	112.49	131.23	150.17	172.84	120.34
Wt. Dry sample (g)	85.82	72.29	93.08	111.24	131.29	82.36
Water Content (%)	14.61	17.61	14.17	9.12	12.93	23.14
Sample #	KRE-122	KRE-123	KRE-124	KRE-125	KRE-126	KRE-111
Test Hole #	2	2	2	2	2	5
Depth	1	1.5	2	4.5	5.7	0.5
Tare #	Rough05	Pet1	Pika2	BenF4	AbeL3	Mao1
Tare Mass (g)	41.46	40.48	37.90	37.80	38.29	37.40
Wet sample + tare (g)	136.20	156.57	139.17	152.76	147.08	137.12
Dry sample + tare (g)	112.21	142.10	126.94	142.18	138.25	120.06
Wt. Dry sample (g)	70.75	101.62	89.04	104.38	99.96	82.66
Water Content (%)	33.91	14.24	13.74	10.14	8.83	20.64
Sample #	KRE-112	KRE-113	KRE-114	KRE-115		
Test Hole #	5	5	5	5		
Depth	1	2	4.5	5.7		
Tare #	JBond4	Pika3	AbeL5	BenF1		
Tare Mass (g)	37.04	38.20	38.88	38.34		
Wet sample + tare (g)	166.96	143.45	150.79	153.11		
Dry sample + tare (g)	154.55	130.50	136.19	142.62		
Wt. Dry sample (g)	117.51	92.30	97.31	104.28		
Water Content (%)	10.56	14.03	15.00	10.06		

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Resedential Development

Project No: 613596

Tech RG

Date: 25-Jul-13

Sample #	KRE-133	KRE-134	KRE-135	KRE-136	KRE-137	KRE-138
Test Hole #	6	6	6	6	6	6
Depth	0.5	1	2	3	4.5	5.8
Tare #	Digi25	WATCH	EHEM	JFK2	JaCol	MLK10
Tare Mass (g)	37.13	40.60	38.29	38.41	38.18	38.11
Wet sample + tare (g)	138.67	139.08	149.80	152.57	152.33	143.04
Dry sample + tare (g)	115.64	118.37	130.74	137.37	137.45	128.86
Wt. Dry sample (g)	78.51	77.77	92.45	98.96	99.27	90.75
Water Content (%)	29.33	26.63	20.62	15.36	14.99	15.63
Sample #	KRE-152	KRE-153	KRE-154	KRE-155	KRE-156	KRE-157
Test Hole #	7	7	7	7	7	7
Depth	0.5	1	2	3	4.5	5.4
Tare #	F.Sinatra	Char1	E.Hem3	JB007	Totoro1	SNC-08
Tare Mass (g)	37.40	39.16	37.01	37.56	38.33	39.81
Wet sample + tare (g)	121.93	139.33	141.44	151.96	144.35	149.34
Dry sample + tare (g)	111.02	128.72	130.91	141.25	136.09	139.12
Wt. Dry sample (g)	73.62	89.56	93.90	103.69	97.76	99.31
Water Content (%)	14.82	11.85	11.21	10.33	8.45	10.29
Sample #	KRE-183	KRE-184	KRE-185	KRE-186	KRE-187	KRE-188
Test Hole #	8	8	8	8	8	8
Depth	0.5	1	2	3	4.5	6
Tare #	Char3	N0	BiBA	NBohr9	PaulA7	E.Hem4
Tare Mass (g)	38.73	36.68	41.65	37.87	37.65	38.87
Wet sample + tare (g)	148.36	141.42	152.83	140.19	145.19	146.03
Dry sample + tare (g)	133.46	127.79	138.33	126.96	133.74	132.89
Wt. Dry sample (g)	94.73	91.11	96.68	89.09	96.09	94.02
Water Content (%)	15.73	14.96	15.00	14.85	11.92	13.98

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Resedential Development

Project No: 613596

Tech RG

Date: 25-Jul-13

Sample #	KRE-106	KRE-107	KRE-108	KRE-109	KRE-110	KRE-158
Test Hole #	9	9	9	9	9	11
Depth	0.5	1	3.05	4.5	5.7	0.5
Tare #	Oddish2	BeF5	MEAT	NBohr8	Hami1	JL10
Tare Mass (g)	38.40	38.06	41.46	38.45	38.58	39.08
Wet sample + tare (g)	149.79	133.72	159.57	159.51	152.16	151.17
Dry sample + tare (g)	137.35	122.86	151.57	150.26	145.40	132.67
Wt. Dry sample (g)	98.95	84.80	110.11	111.81	106.82	93.59
Water Content (%)	12.57	12.81	7.27	8.27	6.33	19.77
Sample #	KRE-160	KRE-161	KRE-162	KRE-163	KRE-177	KRE-178
Test Hole #	11	11	11	11	12	12
Depth	2	3	4.5	6	0.5	1
Tare #	AnFr2	DBo48	Pika5	F.Sinatra2	F.Sinatra	SQUASH
Tare Mass (g)	38.58	40.75	38.17	38.40	38.01	39.45
Wet sample + tare (g)	151.41	155.28	145.25	144.94	135.56	136.06
Dry sample + tare (g)	136.09	138.13	134.55	131.46	115.26	115.80
Wt. Dry sample (g)	97.51	97.38	96.38	93.06	77.25	76.35
Water Content (%)	15.71	17.61	11.10	14.49	26.28	26.54
Sample #	KRE-179	KRE-180	KRE-181	KRE-182		
Test Hole #	12	12	12	12		
Depth	2	3	4.5	5.9		
Tare #	E.Hem2	MIC-09	RaRaO	SNC-14		
Tare Mass (g)	38.95	40.19	40.83	41.22		
Wet sample + tare (g)	147.32	151.77	143.49	159.08		
Dry sample + tare (g)	128.11	144.48	136.12	149.47		
Wt. Dry sample (g)	89.16	104.29	95.29	108.25		
Water Content (%)	21.55	6.99	7.73	8.88		

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Resedential Development

Project No: 613596

Tech RG

Date: 25-Jul-13

Sample #	KRE-100	KRE-101	KRE-102	KRE-103	KRE-104	KRE-105
Test Hole #	13	13	13	13	13	13
Depth	0.5	1	1.5	2	4.5	5.7
Tare #	BNC	KFC-1	CheCha	MFC	Apple	Wich1
Tare Mass (g)	40.17	37.59	41.43	40.92	37.91	38.03
Wet sample + tare (g)	139.13	140.71	130.47	140.09	137.49	141.67
Dry sample + tare (g)	119.09	118.96	119.93	129.42	127.58	130.58
Wt. Dry sample (g)	78.92	81.37	78.50	88.50	89.67	92.55
Water Content (%)	25.39	26.73	13.43	12.06	11.05	11.98
Sample #	KRE-139	KRE-140	KRE-141	KRE-142	KRE-143	KRE-144
Test Hole #	14	14	14	14	14	14
Depth	0.5	1	2	3	4.5	5.7
Tare #	Oddish3	KFC-2	MIC-03	F.Sinatra	KFC-5	KFC-4
Tare Mass (g)	38.89	36.73	37.95	38.85	40.40	39.01
Wet sample + tare (g)	143.10	136.64	144.18	154.00	151.44	153.15
Dry sample + tare (g)	131.23	113.35	131.73	140.84	143.00	145.43
Wt. Dry sample (g)	92.34	76.62	93.78	101.99	102.60	106.42
Water Content (%)	12.85	30.40	13.28	12.90	8.23	7.25
Sample #	JMT-630	JMT-631	JMT-632	JMT-633	JMT-634	JMT-635
Test Hole #	27	27	27	27	27	27
Depth	0.6	1.1	2	3.1-3.6	4.5	5.5
Tare #	MFC-1	KFC-6	KFC-4	PaulA10	PaulA8	MIC-08
Tare Mass (g)	41.27	39.48	39.01	39.57	37.80	37.66
Wet sample + tare (g)	166.65	159.34	126.04	156.99	156.26	136.69
Dry sample + tare (g)	144.15	139.51	114.68	142.92	143.38	125.58
Wt. Dry sample (g)	102.88	100.03	75.67	103.35	105.58	87.92
Water Content (%)	21.87	19.82	15.01	13.61	12.20	12.64

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Resedential Development

Project No: 613596

Tech RG

Date: 25-Jul-13

Sample #	JMT-642	JMT-643	JMT-644	JMT-645	JMT-646	JMT-647
Test Hole #	24	24	24	24	24	24
Depth	0.5	1	2	3	4.5	6.1-6.5
Tare #	MK-05	JBond3	Totoro4	MIC-07	BenF3	JL9
Tare Mass (g)	37.21	38.36	38.28	38.36	38.51	37.47
Wet sample + tare (g)	142.75	130.96	138.77	141.33	138.70	146.76
Dry sample + tare (g)	123.29	109.23	124.21	129.51	127.01	135.55
Wt. Dry sample (g)	86.08	70.87	85.93	91.15	88.50	98.08
Water Content (%)	22.61	30.66	16.94	12.97	13.21	11.43
Sample #	KRE-145	KRE-147	KRE-148	KRE-149	KRE-150	KRE-151
Test Hole #	10	10	10	10	10	10
Depth	0.5	1.5	2	3	4.5	5.6
Tare #	MIC-06	MIC-04	SNC-10	Wich3	NBohr10	F.Sinatra4
Tare Mass (g)	37.99	38.21	41.10	37.66	40.50	38.24
Wet sample + tare (g)	131.97	136.06	134.71	137.31	146.01	134.44
Dry sample + tare (g)	113.28	113.59	114.69	121.80	134.72	123.72
Wt. Dry sample (g)	75.29	75.38	73.59	84.14	94.22	85.48
Water Content (%)	24.82	29.81	27.20	18.43	11.98	12.54
Sample #						
Test Hole #						
Depth						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Residential Subdivision

Project No: 613596

Tech DSR

Date: 2-Aug-13

Sample #	KRE-127	KRE-128	KRE-129	KRE-130	KRE-131	KRE-132
Test Hole #	3	3	3	3	3	3
Depth	0.5	1	2	3.05	4.5	6
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	42.50	45.86	42.50	47.64	43.67	49.76
Wet sample + tare (g)	186.97	189.12	207.29	197.86	214.77	184.56
Dry sample + tare (g)	174.31	172.54	186.76	181.58	191.92	167.74
Wt. Dry sample (g)	131.81	126.68	144.26	133.94	148.25	117.98
Water Content (%)	9.60	13.09	14.23	12.15	15.41	14.26
Sample #	KRE-164	KRE-165	KRE-166	KRE-167	KRE-168	KRE-169
Test Hole #	15	15	15	15	15	15
Depth	0.5	1	2	3	4.5	6
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	53.03	43.07	55.82	30.86	41.43	63.59
Wet sample + tare (g)	187.35	175.18	169.05	172.50	192.85	256.37
Dry sample + tare (g)	171.11	160.44	162.76	160.63	184.53	243.33
Wt. Dry sample (g)	118.08	117.37	106.94	129.77	143.10	179.74
Water Content (%)	13.75	12.56	5.88	9.15	5.81	7.25
Sample #	KRE-189	KRE-190	KRE-191	KRE-192	KRE-193	KRE-194
Test Hole #	20	20	20	20	20	20
Depth	0.5	1	2	3	4	6
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	68.85	58.13	56.73	61.70	37.91	91.37
Wet sample + tare (g)	249.62	280.60	246.93	252.59	220.22	330.60
Dry sample + tare (g)	210.68	250.74	221.99	227.74	201.62	301.89
Wt. Dry sample (g)	141.83	192.61	165.26	166.04	163.71	210.52
Water Content (%)	27.46	15.50	15.09	14.97	11.36	13.64

Comments:



SNC•LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Residential Subdivision

Project No: 613596

Tech DSR

Date: 2-Aug-13

Sample #	KRE-170	KRE-171	KRE-172	KRE-173	KRE-174	KRE-175
Test Hole #	16	16	16	16	16	16
Depth	0.5	1	1.5	2	3	4.5
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	66.29	68.05	67.99	58.36	40.82	89.30
Wet sample + tare (g)	134.57	160.90	274.76	243.52	240.63	356.98
Dry sample + tare (g)	123.20	139.07	245.68	221.54	218.45	324.94
Wt. Dry sample (g)	56.91	71.02	177.69	163.18	177.63	235.64
Water Content (%)	19.98	30.74	16.37	13.47	12.49	13.60
Sample #	KRE-176	JMT-660	JMT-661	JMT-662	JMT-663	JMT-664
Test Hole #	16	17	17	17	17	17
Depth	6	0.5	1	2	3	4.6
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	48.89	37.13	37.96	37.86	38.46	38.72
Wet sample + tare (g)	349.51	193.66	206.09	205.06	199.02	140.06
Dry sample + tare (g)	314.69	174.60	187.08	185.67	184.15	130.96
Wt. Dry sample (g)	265.80	137.47	149.12	147.81	145.69	92.24
Water Content (%)	13.10	13.86	12.75	13.12	10.21	9.87
Sample #	JMT-665	JMT-666	JMT-667	JMT-668	JMT-669	JMT-670
Test Hole #	17	18	18	18	18	18
Depth	5.4	0.5	1.2	2	3	4.5
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	37.83	38.51	37.28	37.59	39.98	38.44
Wet sample + tare (g)	185.12	163.21	215.86	188.24	207.18	238.63
Dry sample + tare (g)	173.30	135.04	183.19	163.83	185.22	217.19
Wt. Dry sample (g)	135.47	96.53	145.91	126.24	145.24	178.75
Water Content (%)	8.73	29.18	22.39	19.34	15.12	11.99

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Residential Subdivision

Project No: 613596

Tech: DSR

Date: 2-Aug-13

Sample #	JMT-671	JMT-672	JMT-673	JMT-674	JMT-675	JMT-676
Test Hole #	18	19	19	19	19	19
Depth	6.1-6.4	0.6	1.1	3	4.5	6
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	38.75	37.03	38.30	38.21	38.14	38.69
Wet sample + tare (g)	231.76	203.77	154.82	174.48	265.56	240.44
Dry sample + tare (g)	212.90	186.08	148.08	161.04	242.97	215.69
Wt. Dry sample (g)	174.15	149.05	109.78	122.83	204.83	177.00
Water Content (%)	10.83	11.87	6.14	10.94	11.03	13.98
Sample #	JMT-656	JMT-657	JMT-658	JMT-659	JMT-648	JMT-649
Test Hole #	21	21	21	21	22	22
Depth	1.9	3.3	4.4	6	0.5	1
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	38.70	38.17	41.56	41.03	40.38	38.43
Wet sample + tare (g)	204.27	147.98	220.64	274.95	251.34	233.29
Dry sample + tare (g)	182.49	137.98	205.19	251.71	198.10	188.41
Wt. Dry sample (g)	143.79	99.81	163.63	210.68	157.72	149.98
Water Content (%)	15.15	10.02	9.44	11.03	33.76	29.92
Sample #	JMT-650	JMT-651	JMT-652	JMT-653	JMT-636	JMT-637
Test Hole #	22	22	22	22	23	23
Depth	1.9	3	4.5	6	0.6	1.2
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	38.37	37.43	38.33	37.81	37.85	38.23
Wet sample + tare (g)	220.42	248.83	203.70	257.85	200.44	222.72
Dry sample + tare (g)	197.79	221.68	188.45	236.38	158.01	176.85
Wt. Dry sample (g)	159.42	184.25	150.12	198.57	120.16	138.62
Water Content (%)	14.20	14.74	10.16	10.81	35.31	33.09

Comments:



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Resedential Subdivison

Project No: 613596

Tech DSR

Date: 2-Aug-13

Sample #	JMT-677	JMT-678	JMT-679	JMT-680	JMT-654	JMT-655
Test Hole #	19	19	19	19	21	21
Depth	7.6-8.1	89.9	11.2	11.9	0.6	1.1
Tare #	WATCH	SQH	KFC-5	KFC-6	JL9	PAU
Tare Mass (g)	40.72	39.51	40.54	39.72	37.75	39.68
Wet sample + tare (g)	265.29	265.67	274.39	329.62	270.23	205.01
Dry sample + tare (g)	240.21	241.73	249.53	297.43	228.55	176.01
Wt. Dry sample (g)	199.49	202.22	208.99	257.71	190.80	136.33
Water Content (%)	12.57	11.84	11.90	12.49	21.84	21.27
Sample #						
Test Hole #						
Depth						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						
Sample #						
Test Hole #						
Depth						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						

Comments:



WATER CONTENTS

Client: Chris Cebryk
 Project: Proposed Resedential Subdivison
 Project No: 613596
 Tech: DSR
 Date: 2-Aug-13

Sample #	JMT-638	JMT-639	JMT-640	JMT-641	JMT-618	JMT-619
Test Hole #	23	23	23	23	25	25
Depth	1.8	3	5.1	6	0.5	1
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	38.92	39.07	38.35	39.00	38.41	38.33
Wet sample + tare (g)	271.79	259.75	282.47	228.96	241.13	287.63
Dry sample + tare (g)	237.14	235.74	258.13	209.56	207.40	248.84
Wt. Dry sample (g)	198.22	196.67	219.78	170.56	168.99	210.51
Water Content (%)	17.48	12.21	11.07	11.37	19.96	18.43
Sample #	JMT-620	JMT-621	JMT-622	JMT-623	JMT-624	JMT-625
Test Hole #	25	25	25	25	26	26
Depth	2	3	4.5	4.9	0.5	1
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	39.32	38.23	40.64	36.79	38.53	38.48
Wet sample + tare (g)	229.09	256.50	302.23	248.24	285.28	318.74
Dry sample + tare (g)	204.78	230.84	271.71	229.58	250.63	282.48
Wt. Dry sample (g)	165.46	192.61	231.07	192.79	212.10	244.00
Water Content (%)	14.69	13.32	13.21	9.68	16.34	14.86
Sample #	JMT-626	JMT-627	JMT-628	JMT-630	JMT-600	JMT-601
Test Hole #	26	26	26	26	29	29
Depth	1.5	3	4.6	6	0.4	1
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	39.20	40.31	38.18	38.01	38.38	38.17
Wet sample + tare (g)	294.61	215.58	183.04	221.41	280.88	270.60
Dry sample + tare (g)	246.86	195.68	167.26	202.23	228.36	223.77
Wt. Dry sample (g)	207.66	155.37	129.08	164.22	189.98	185.60
Water Content (%)	22.99	12.81	12.22	11.68	27.65	25.23

Comments: _____



SNC-LAVALIN
Environment

WATER CONTENTS

Client: Chris Cebryk

Project: Proposed Resedential Subdivison

Project No: 613596

Tech DSR

Date: 2-Aug-13

Sample #	JMT-602	JMT-603	JMT-604	JMT-604	JMT-605	JMT-606
Test Hole #	29	29	29	30	30	30
Depth	2	3.1	4.6	0.5	1	1.5-1.9
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	41.78	38.92	38.35	37.92	37.01	41.64
Wet sample + tare (g)	213.67	128.85	282.47	249.31	258.51	247.10
Dry sample + tare (g)	191.54	120.34	258.13	202.68	229.15	224.35
Wt. Dry sample (g)	149.76	81.42	219.78	164.76	192.14	182.71
Water Content (%)	14.78	10.45	11.07	28.30	15.28	12.45
Sample #	JMT-607	JMT-608	JMT-609	JMT-610	JMT-611	JMT-612
Test Hole #	30	30	30	30	31	31
Depth	2	3	4.5	6	0.5	1
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	40.88	41.29	40.26	37.89	39.12	39.36
Wet sample + tare (g)	258.76	223.51	213.36	212.35	256.98	244.52
Dry sample + tare (g)	230.99	200.55	196.08	195.80	224.02	218.60
Wt. Dry sample (g)	190.11	159.26	155.82	157.91	184.90	179.24
Water Content (%)	14.61	14.42	11.09	10.48	17.83	14.46
Sample #	JMT-613	JMT-614	JMT-615	JMT-616	JMT-617	
Test Hole #	31	31	31	31	31	
Depth	2	3	4.6	4.9	5.7	
Tare #	XBX2	N03	B16	6HH	BB7	
Tare Mass (g)	38.54	41.66	39.28	37.27	40.69	
Wet sample + tare (g)	250.49	285.88	104.08	167.14	172.27	
Dry sample + tare (g)	224.82	255.39	94.10	143.01	147.29	
Wt. Dry sample (g)	186.28	213.73	54.82	105.74	106.60	
Water Content (%)	13.78	14.27	18.21	22.82	23.43	

Comments:

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: JA
Date: 31-Jul-2013

Sample: KRE-109 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	MVP	13A	
Tare Wt, g	14.39	14.11	
Wet + Tare, g	22.24	21.08	
Dry + Tare, g	21.45	20.37	average
M%	11.2%	11.3%	11.3%

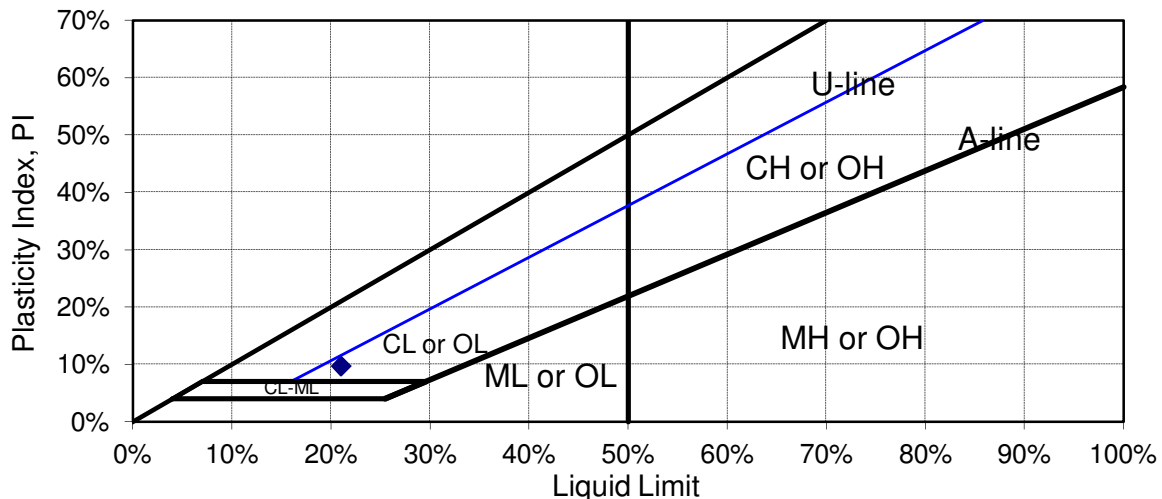
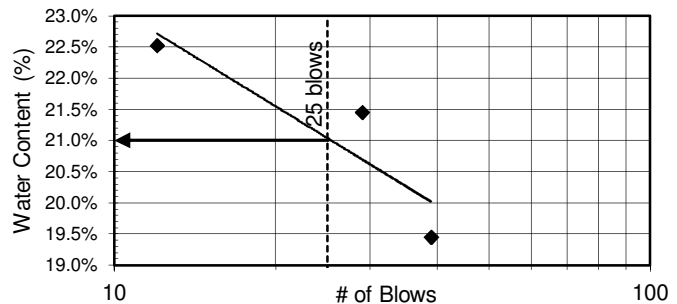
Liquid Limit (method A)

# of Blows	12	29	39
Tare #	A26	B2	A9
Tare Wt, g	12.32	14.11	12.77
Wet + tare, g	22.60	28.83	24.93
Dry + tare, g	20.71	26.23	22.95
Water content	22.5%	21.5%	19.4%

SUMMARY

Plastic Limit: 11.3%
Liquid Limit: 21.0%
Plasticity Index: 9.7%
Classification: CL

Natural Water Content: 8.3%



Comments: -

The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: JA
Date: 28-Jul-2013

Sample: KRE-117 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	40A	52A	
Tare Wt, g	13.13	12.77	
Wet + Tare, g	19.78	21.10	
Dry + Tare, g	18.99	20.08	average
M%	13.5%	14.0%	13.7%

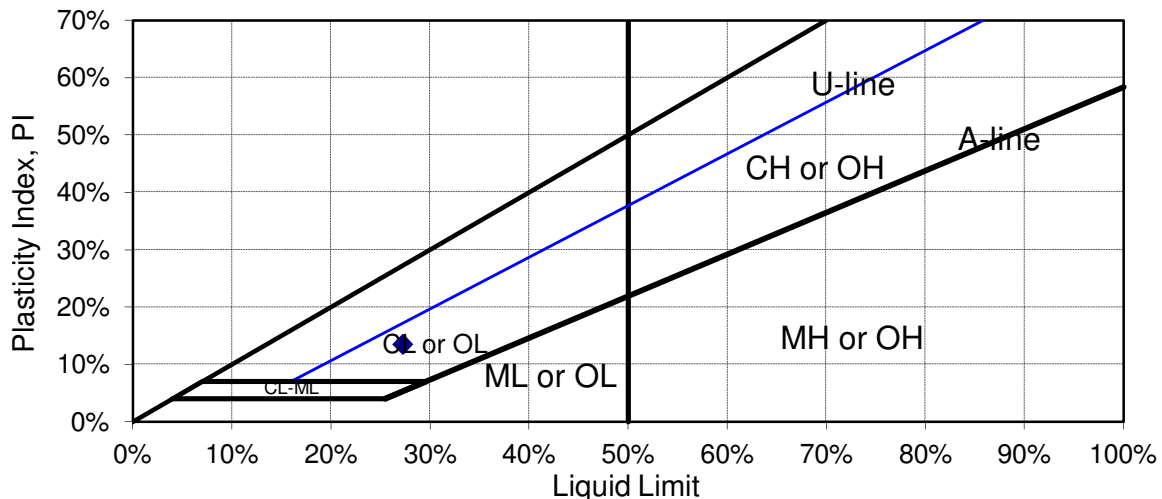
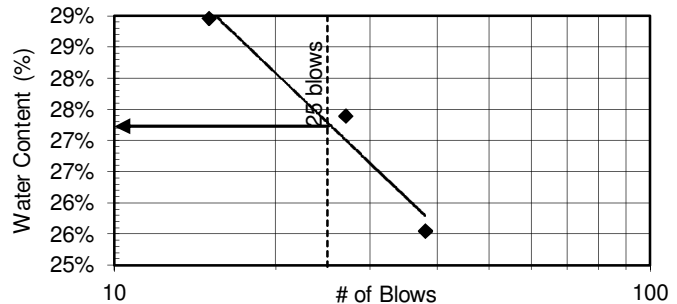
Liquid Limit (method A)

# of Blows	15	27	38
Tare #	29A	Z5	B2
Tare Wt, g	14.18	13.98	14.10
Wet + tare, g	23.13	21.42	21.52
Dry + tare, g	21.12	19.82	20.01
Water content	29.0%	27.4%	25.5%

SUMMARY

Plastic Limit: 13.7%
Liquid Limit: 27.2%
Plasticity Index: 13.5%
Classification: CL

Natural Water Content: 17.6%



Comments: -

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Subdivison
Project #: 613596
Technician: JA
Date: 1-Aug-2013

Sample: KRE-132 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	21A	37A	
Tare Wt, g	14.4	13.97	
Wet + Tare, g	23.75	21.85	
Dry + Tare, g	22.50	20.80	average
M%	15.4%	15.4%	15.4%

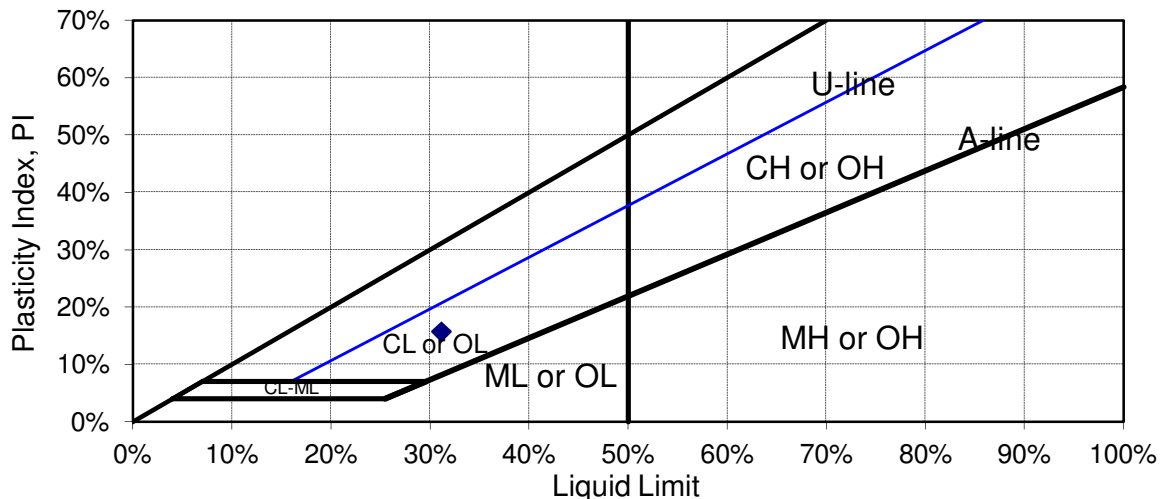
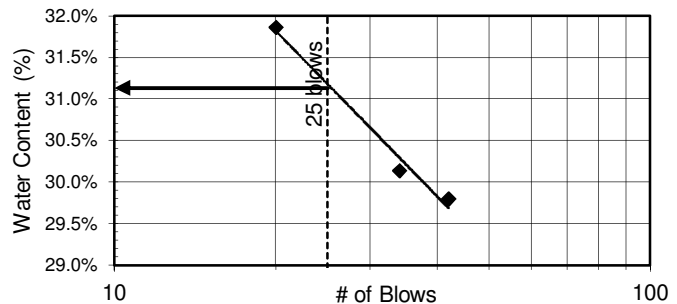
Liquid Limit (method A)

# of Blows	20	34	42
Tare #	TRN	63A	31A
Tare Wt, g	13.86	14.08	14.21
Wet + tare, g	23.13	26.30	24.62
Dry + tare, g	20.89	23.47	22.23
Water content	31.9%	30.1%	29.8%

SUMMARY

Plastic Limit: 15.4%
Liquid Limit: 31.1%
Plasticity Index: 15.7%
Classification: CL

Natural Water Content: -



Comments: -

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Subdivison
Project #: 613596
Technician: RG
Date: 2-Aug-2013

Sample: KRE-170 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	Z1	55A	
Tare Wt, g	14.38	14.05	
Wet + Tare, g	21.58	20.78	
Dry + Tare, g	20.23	19.51	average
M%	23.1%	23.3%	23.2%

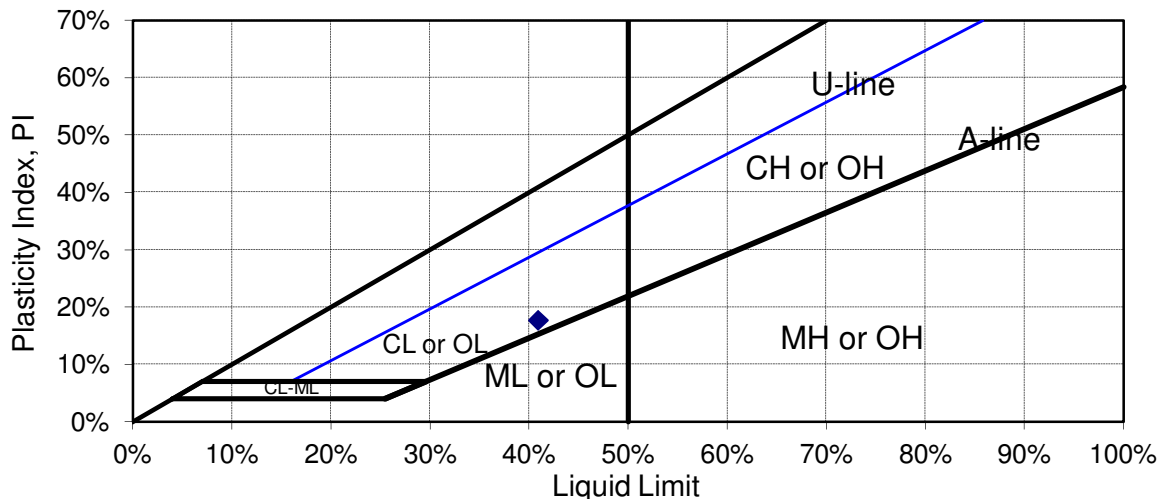
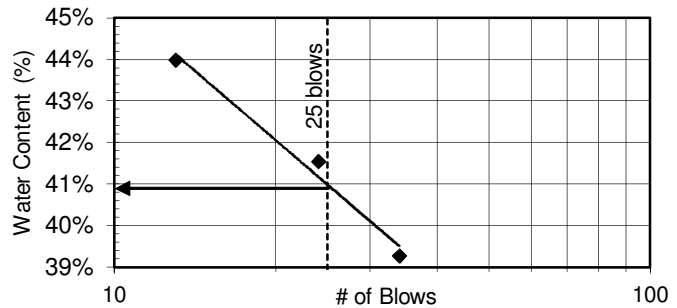
Liquid Limit (method A)

# of Blows	13	24	34
Tare #	A26	T6	47A
Tare Wt, g	12.33	14.06	14.27
Wet + tare, g	22.87	22.68	24.27
Dry + tare, g	19.65	20.15	21.45
Water content	44.0%	41.5%	39.3%

SUMMARY

Plastic Limit: 23.2%
Liquid Limit: 40.9%
Plasticity Index: 17.7%
Classification: CL

Natural Water Content: -



Comments: -

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: RG
Date: 29-Jul-2013

Sample: KRE-178 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	A19	T7M	
Tare Wt, g	14.19	14.44	
Wet + Tare, g	21.25	19.47	
Dry + Tare, g	20.31	18.87	average
M%	15.4%	13.5%	14.5%

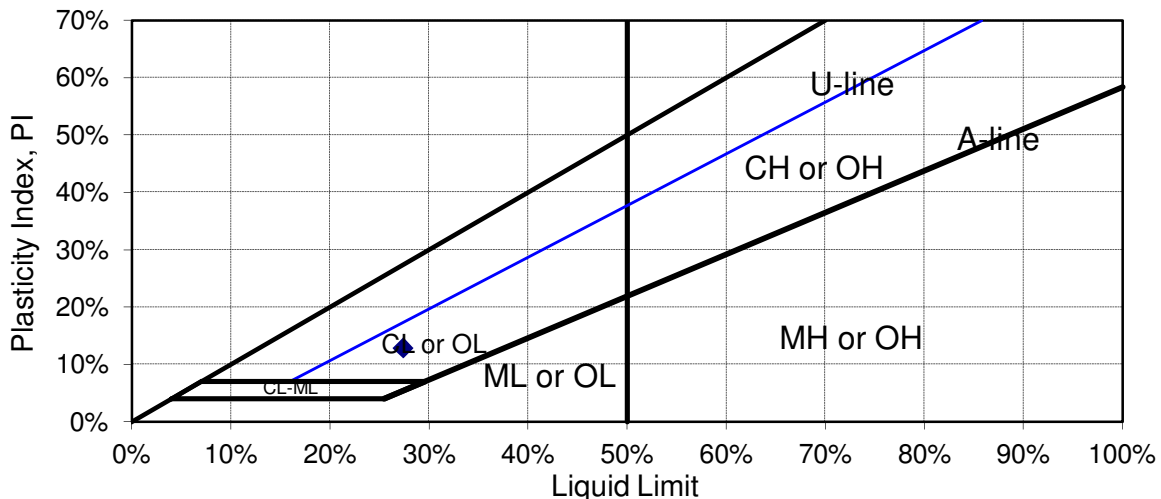
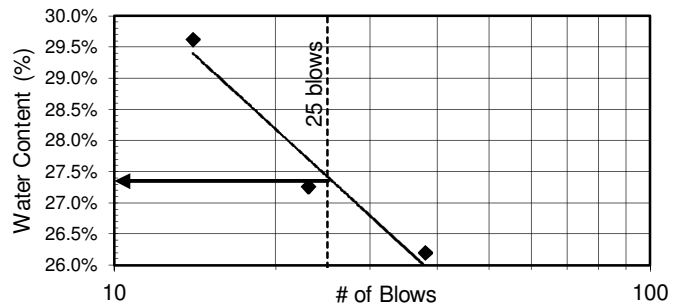
Liquid Limit (method A)

# of Blows	14	23	38
Tare #	A24	27A	B3
Tare Wt, g	12.71	14.18	13.92
Wet + tare, g	25.05	26.13	24.95
Dry + tare, g	22.23	23.57	22.66
Water content	29.6%	27.3%	26.2%

SUMMARY

Plastic Limit: 14.5%
Liquid Limit: 27.4%
Plasticity Index: 12.9%
Classification: CL

Natural Water Content: 26.5%



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: RG
Date: 29-Jul-2013

Sample: KRE-186 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	A26	47A	
Tare Wt, g	12.31	14.28	
Wet + Tare, g	18.86	21.53	
Dry + Tare, g	18.08	20.67	average
M%	13.5%	13.5%	13.5%

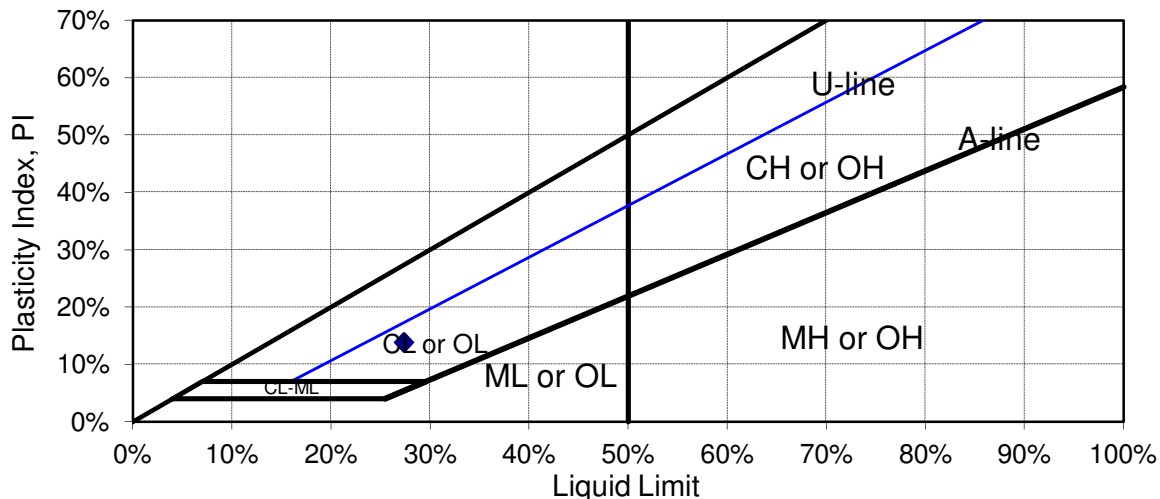
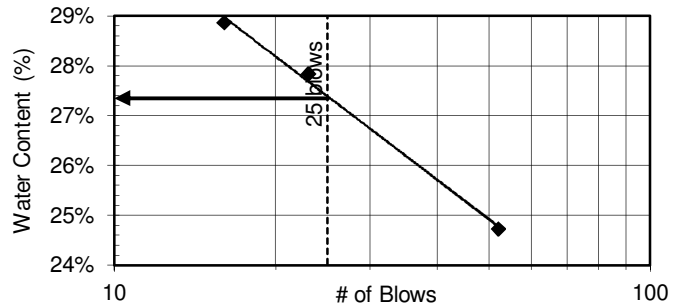
Liquid Limit (method A)

# of Blows	16	23	52
Tare #	38A	31A	TLL
Tare Wt, g	14.20	14.20	14.01
Wet + tare, g	22.28	27.47	24.40
Dry + tare, g	20.47	24.58	22.34
Water content	28.9%	27.8%	24.7%

SUMMARY

Plastic Limit: 13.5%
Liquid Limit: 27.4%
Plasticity Index: 13.9%
Classification: CL

Natural Water Content: 19.9%



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Subdivison
Project #: 613596
Technician: JA
Date: 1-Aug-2013

Sample: KRE-192 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	T9B	A31	
Tare Wt, g	14.04	13.42	
Wet + Tare, g	23.33	21.86	
Dry + Tare, g	22.20	20.82	average
M%	13.8%	14.1%	14.0%

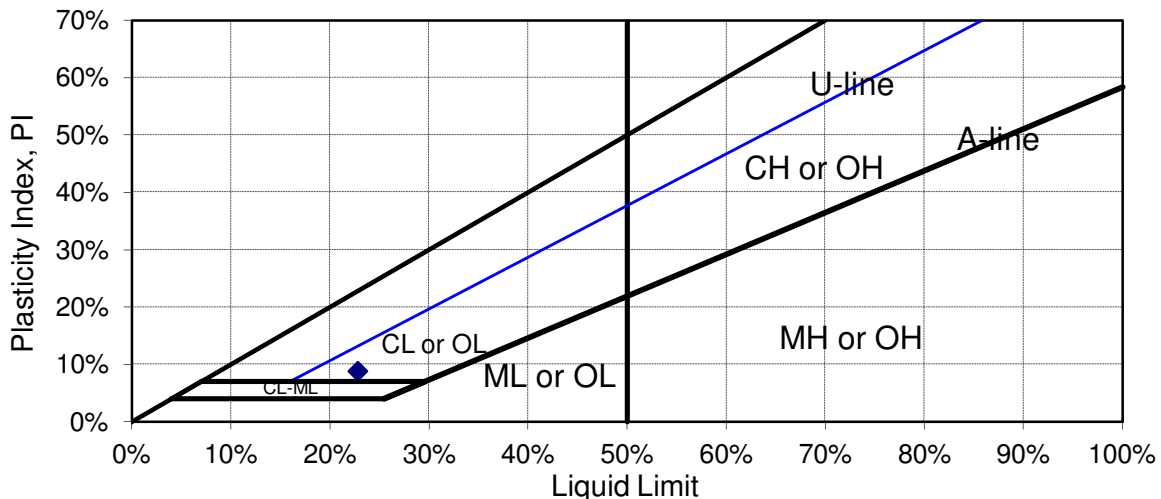
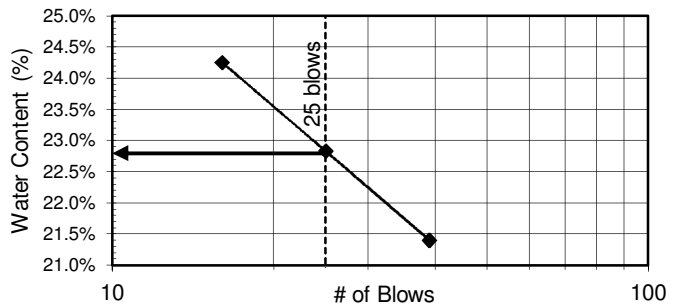
Liquid Limit (method A)

# of Blows	16	25	39
Tare #	1A	54A	38A
Tare Wt, g	14.10	14.54	14.22
Wet + tare, g	23.27	23.90	23.92
Dry + tare, g	21.48	22.16	22.21
Water content	24.3%	22.8%	21.4%

SUMMARY

Plastic Limit: 14.0%
Liquid Limit: 22.8%
Plasticity Index: 8.8%
Classification: CL

Natural Water Content: -



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Subdivison
Project #: 613596
Technician: RG
Date: 1-Aug-2013

Sample: JMT-604 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	B3	9A	
Tare Wt, g	13.9	14.31	
Wet + Tare, g	19.88	21.20	
Dry + Tare, g	19.06	20.25	average
M%	15.9%	16.0%	15.9%

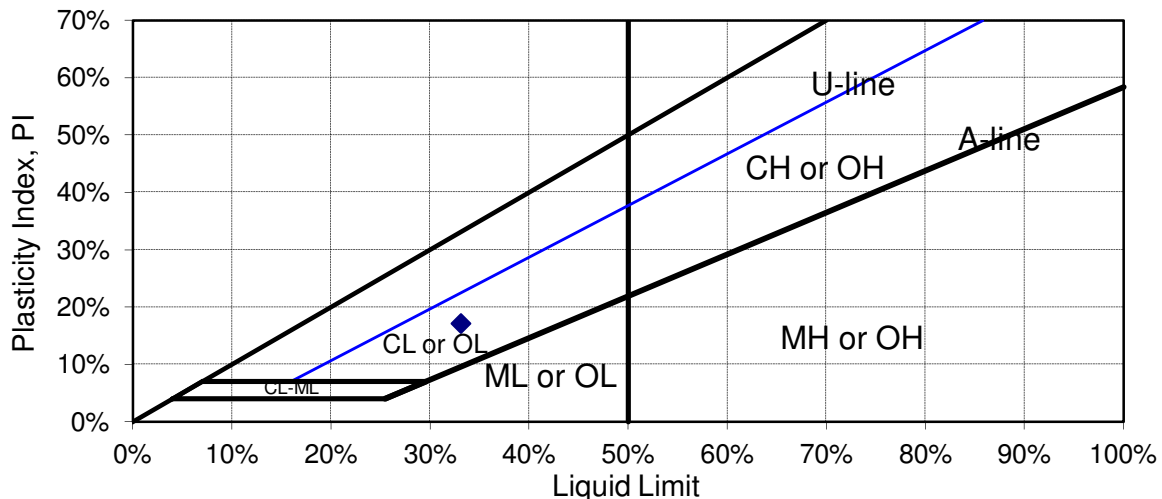
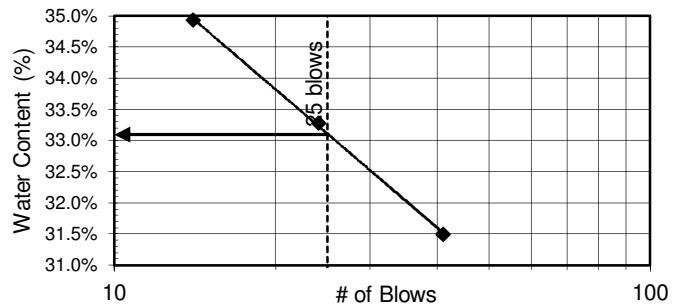
Liquid Limit (method A)

# of Blows	14	24	41
Tare #	B7	T8A	MDH
Tare Wt, g	14.26	14.44	14.57
Wet + tare, g	24.65	23.17	24.13
Dry + tare, g	21.96	20.99	21.84
Water content	34.9%	33.3%	31.5%

SUMMARY

Plastic Limit: 15.9%
Liquid Limit: 33.1%
Plasticity Index: 17.2%
Classification: CL

Natural Water Content: -



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: RG
Date: 1-Aug-2013

Sample: JMT-612 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	46A	13A	
Tare Wt, g	13.38	14.13	
Wet + Tare, g	19.86	19.36	
Dry + Tare, g	19.21	18.80	average
M%	11.1%	12.0%	11.6%

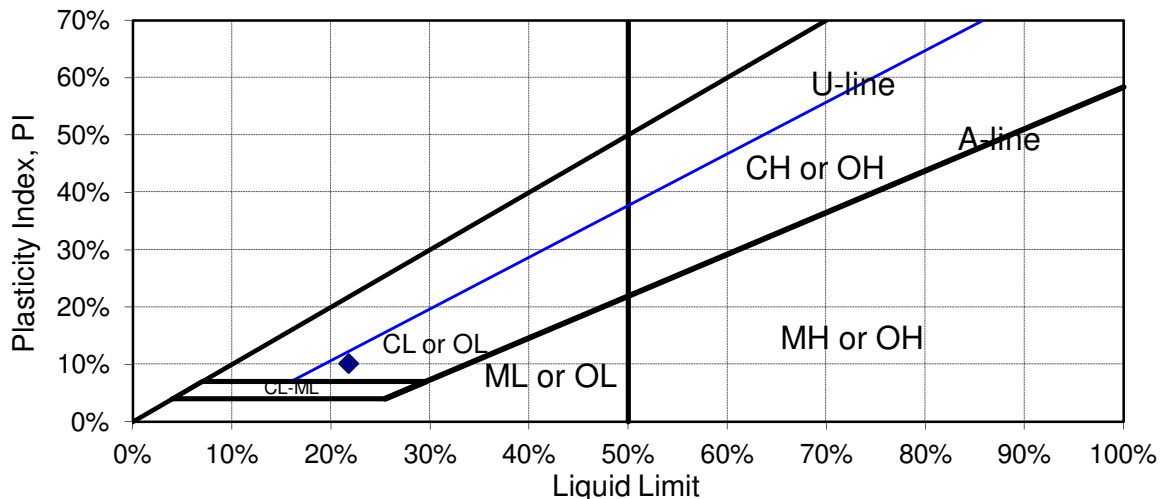
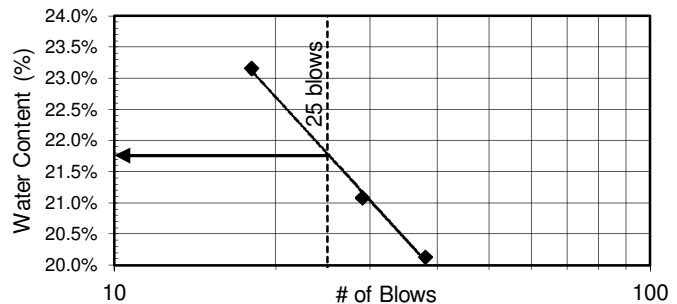
Liquid Limit (method A)

# of Blows	18	29	38
Tare #	2J	C3	69A
Tare Wt, g	14.20	14.02	14.21
Wet + tare, g	21.06	22.29	21.49
Dry + tare, g	19.77	20.85	20.27
Water content	23.2%	21.1%	20.1%

SUMMARY

Plastic Limit: 11.6%
Liquid Limit: 21.8%
Plasticity Index: 10.2%
Classification: CL

Natural Water Content: -



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: RG
Date: 1-Aug-2013

Sample: JMT-621 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	a19	YN	
Tare Wt, g	12.93	14.25	
Wet + Tare, g	18.67	21.06	
Dry + Tare, g	18.02	20.29	average
M%	12.8%	12.7%	12.8%

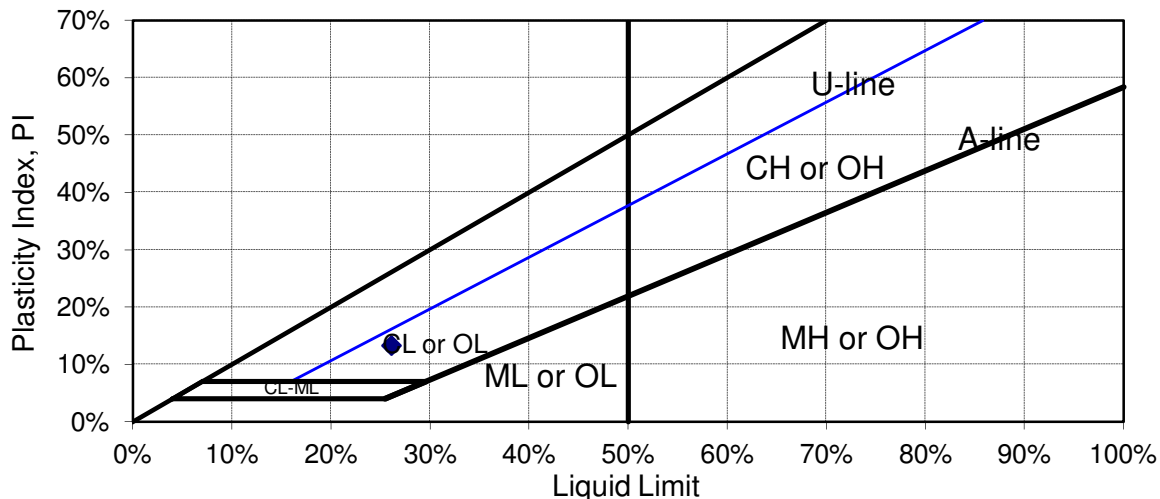
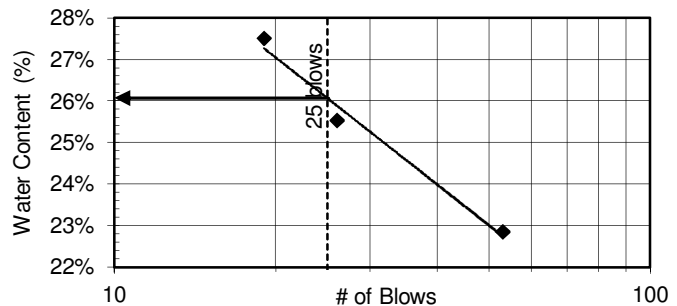
Liquid Limit (method A)

# of Blows	19	26	53
Tare #	6A	A17	21A
Tare Wt, g	13.81	12.32	13.10
Wet + tare, g	23.96	23.43	25.57
Dry + tare, g	21.77	21.17	23.25
Water content	27.5%	25.5%	22.9%

SUMMARY

Plastic Limit: 12.8%
Liquid Limit: 26.1%
Plasticity Index: 13.3%
Classification: CL

Natural Water Content: -



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: JA
Date: 28-Jul-2013

Sample: JMT-632 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	40A	52A	
Tare Wt, g	14.27	13.87	
Wet + Tare, g	20.03	21.99	
Dry + Tare, g	19.34	20.95	average
M%	13.6%	14.7%	14.1%

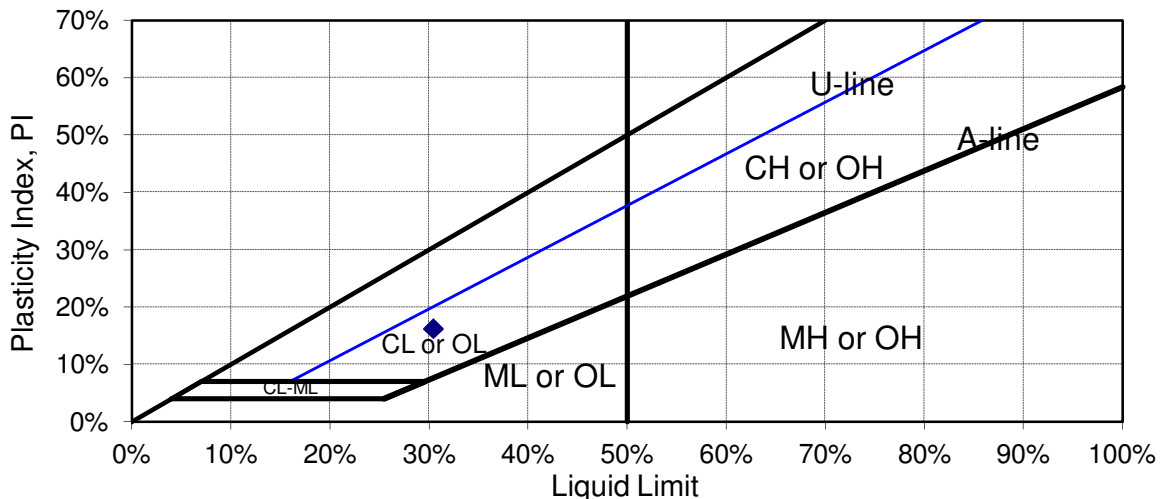
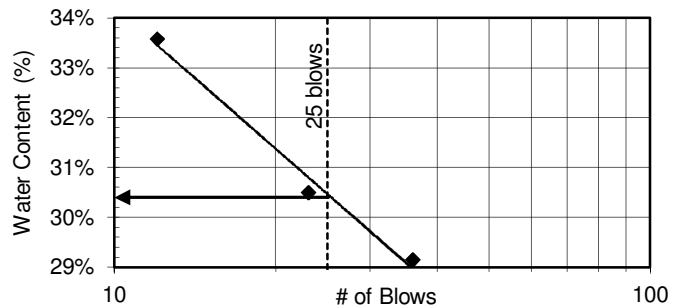
Liquid Limit (method A)

# of Blows	12	23	36
Tare #	MCA	65a	B7
Tare Wt, g	14.53	14.16	14.27
Wet + tare, g	23.52	21.99	21.58
Dry + tare, g	21.26	20.16	19.93
Water content	33.6%	30.5%	29.2%

SUMMARY

Plastic Limit: 14.1%
Liquid Limit: 30.4%
Plasticity Index: 16.3%
Classification: CL

Natural Water Content: 15.1%



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Subdivison
Project #: 613596
Technician: RG
Date: 1-Aug-2013

Sample: JMT-641 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	T10	TRN	
Tare Wt, g	14.45	13.86	
Wet + Tare, g	21.41	21.76	
Dry + Tare, g	20.62	20.85	average
M%	12.8%	13.0%	12.9%

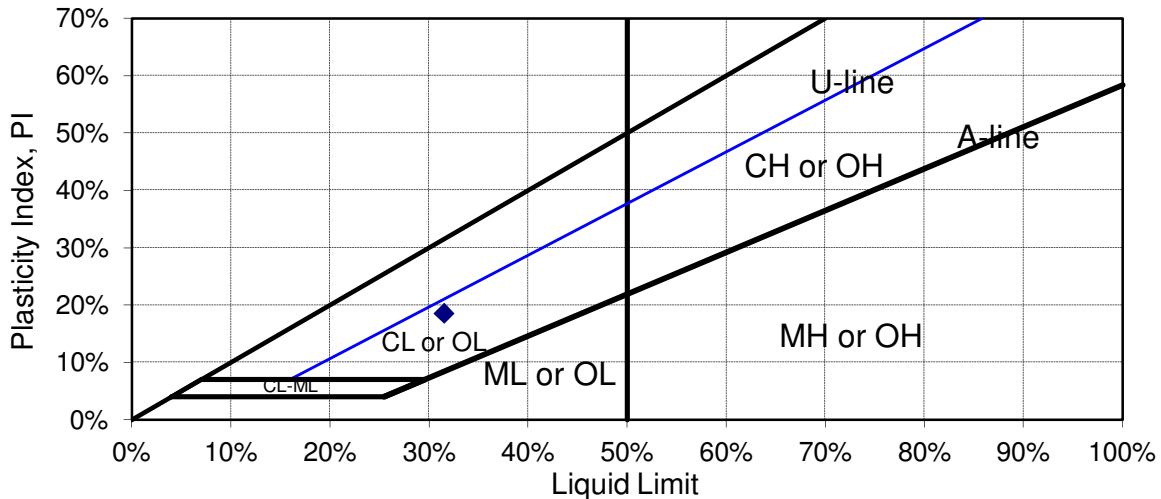
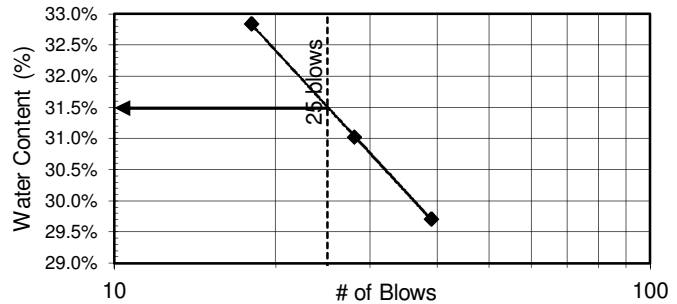
Liquid Limit (method A)

# of Blows	18	28	39
Tare #	2J	54A	9A
Tare Wt, g	14.18	14.52	14.31
Wet + tare, g	20.49	20.39	20.16
Dry + tare, g	18.93	19.00	18.82
Water content	32.8%	31.0%	29.7%

SUMMARY

Plastic Limit: 12.9%
Liquid Limit: 31.5%
Plasticity Index: 18.6%
Classification: CL

Natural Water Content: -



Comments: -

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Subdivison
Project No: 613596
Technician: JA
Date: 1-Aug-2013

Sample: JMT-656 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g			
Wet + Tare, g			
Dry + Tare, g			
M%			

average

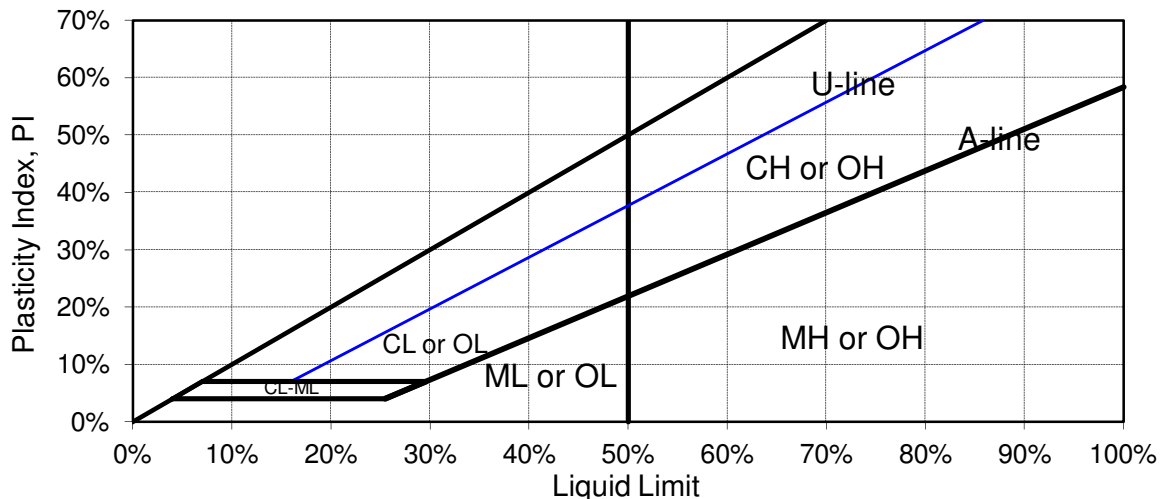
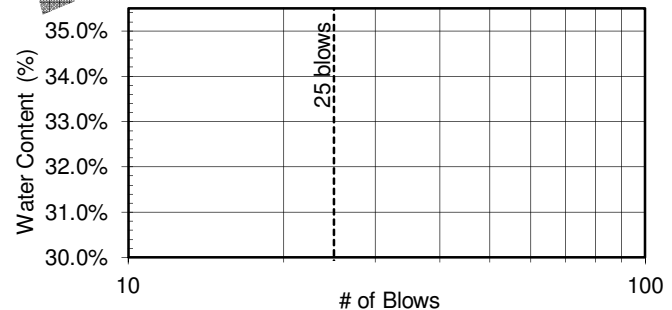
Liquid Limit (method A)

# of Blows				
Tare #				
Tare Wt, g				
Wet + tare, g				
Dry + tare, g				
Water content				

SUMMARY

Plastic Limit: _____
Liquid Limit: _____
Plasticity Index: _____
Classification: _____

Natural Water Content: N/A



Comments: Non-Plastic

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)



SNC-LAVALIN
Environment

Client: Chris Cebryk
Project: Proposed Resedential Development
Project #: 613596
Technician: RG
Date: 1-Aug-2013

Sample: JMT-661 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	T10	66A	
Tare Wt, g	14.45	14.49	
Wet + Tare, g	21.05	21.10	
Dry + Tare, g	20.24	20.21	average
M%	14.0%	15.6%	14.8%

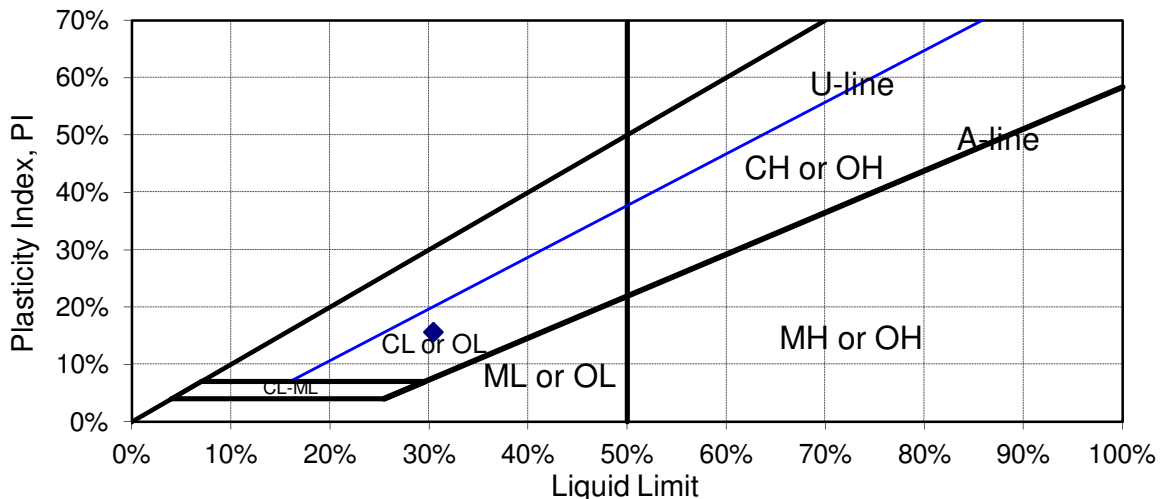
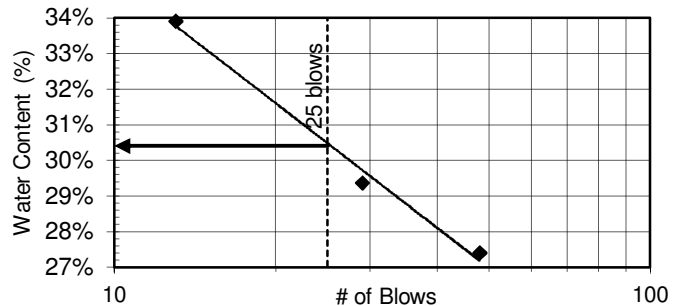
Liquid Limit (method A)

# of Blows	13	29	48
Tare #	R2	A18	A35
Tare Wt, g	14.21	13.09	12.67
Wet + tare, g	25.78	24.63	23.13
Dry + tare, g	22.85	22.01	20.88
Water content	33.9%	29.4%	27.4%

SUMMARY

Plastic Limit: 14.8%
Liquid Limit: 30.4%
Plasticity Index: 15.6%
Classification: CL

Natural Water Content: -



Comments: -

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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	99	
# 4	4.75	99	
# 10	2.00	98	
# 20	0.850	97	
# 40	0.425	96	
# 60	0.250	94	
# 100	0.150	92	
# 200	0.075	84	
Hydrometer Analysis		0.0565	79.9
		0.0429	62.0
Dispersing agent:		0.0317	49.8
Sodium Hexametaphosphate		0.0231	39.9
		0.0166	35.3
Dosage of dispersing agent:		0.0122	31.7
40 g/L		0.0088	25.5
		0.0063	24.6
		0.0042	23.6
		0.0032	21.2
		0.0022	21.0
		0.0013	18.2



SNC•LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Subdivison

MDH Job No:

613596

SAMPLE:

KRE-101

DATE:

1-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

1

% SAND

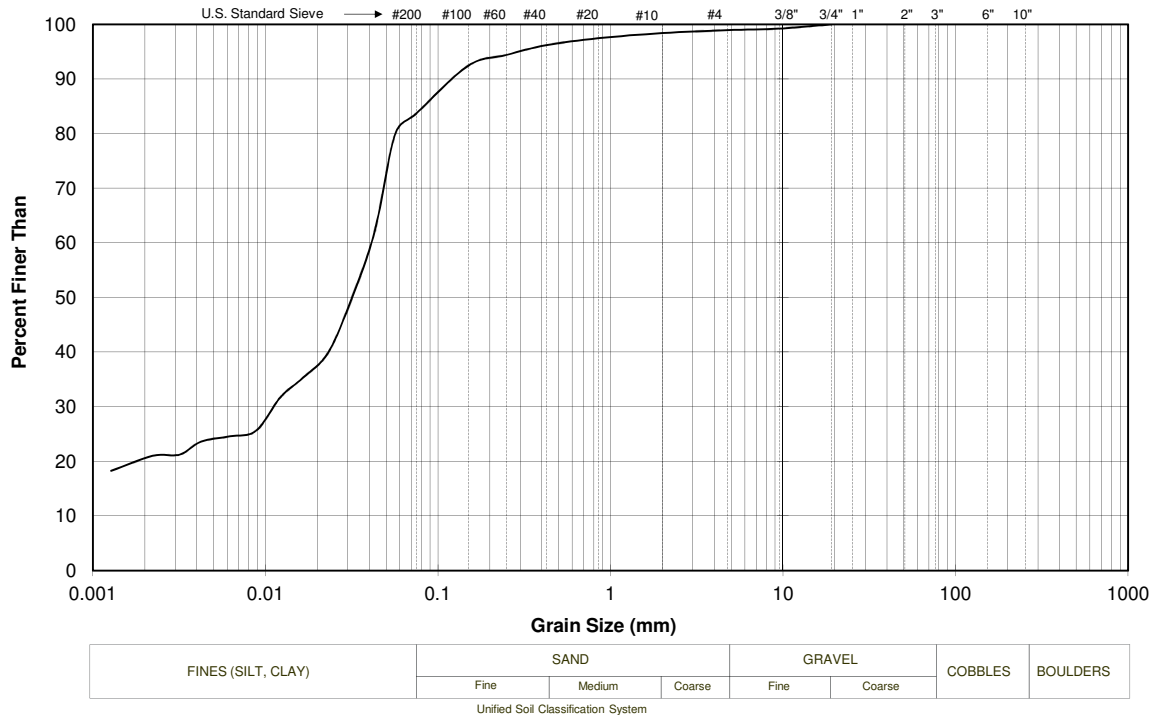
15

% FINES (SILT, CLAY)

84

COMMENTS:

<



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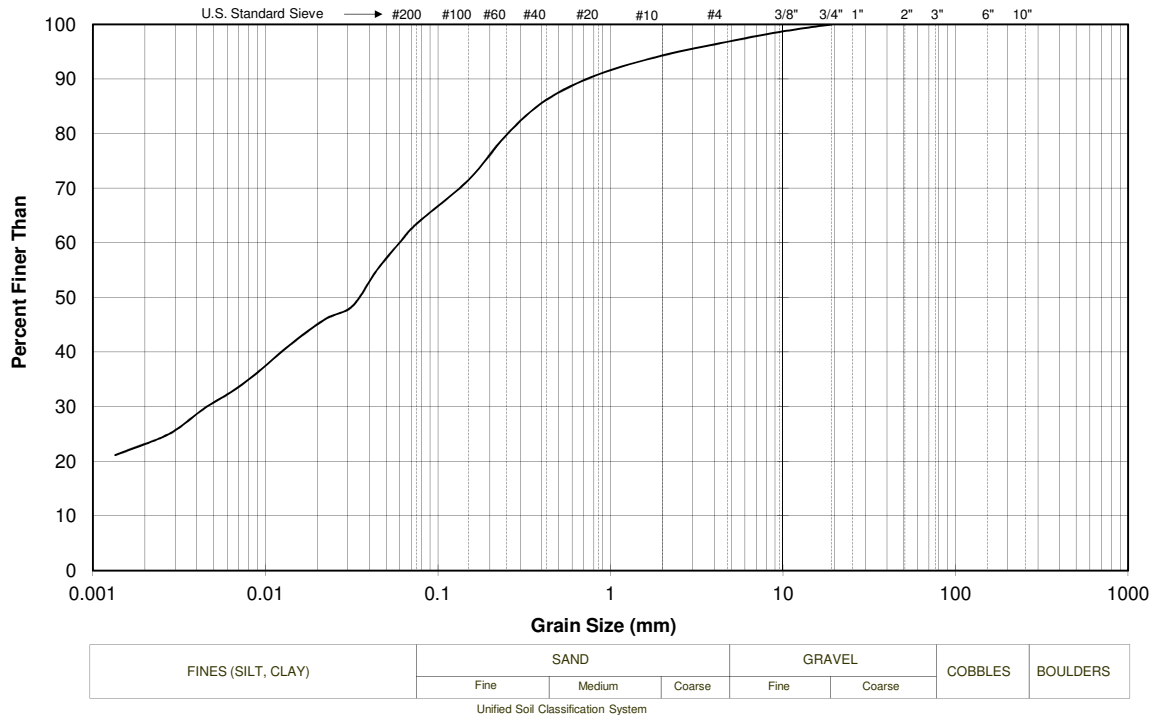
PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	99	
# 4	4.75	97	
# 10	2.00	94	
# 20	0.850	91	
# 40	0.425	86	
# 60	0.250	80	
# 100	0.150	71	
# 200	0.075	63	

		SNC•LAVALIN Environment	
CLIENT:	Chris Cebryk		
PROJECT:	Proposed Resedential Development		
MDH Job No:	613596		
SAMPLE:	KRE-107		
DATE:	30-Jul-13		
PARTICLE SIZE DISTRIBUTION SUMMARY			
% GRAVEL	3		
% SAND	34		
% FINES (SILT, CLAY)	63		
COMMENTS:			

Hydrometer Analysis	0.0612	60.3
	0.0442	55.0
Dispersing agent:	0.0320	48.4
<i>Sodium Hexametaphosphate</i>	0.0228	46.2
	0.0163	43.1
Dosage of dispersing agent:	0.0121	39.7
<i>40 g/L</i>	0.0086	35.8
	0.0062	32.5
	0.0044	29.7
	0.0032	26.1
	0.0025	24.2
	0.0013	21.1



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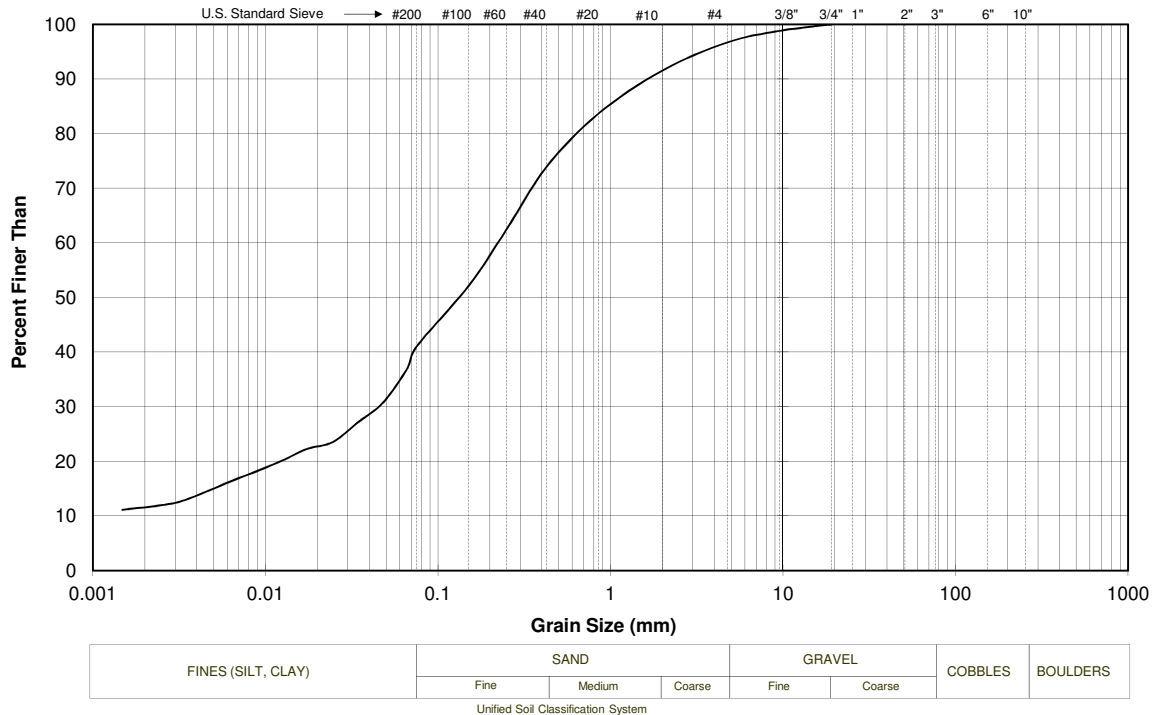
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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC•LAVALIN Environment	
	Sieve	Diameter (mm) % Finer		
	3"	76.2 100	CLIENT: Chris Cebryk	
	2"	50.8 100	PROJECT: Proposed Resedential Development	
	1"	25.4 100	MDH Job No: 613596	
	3/4"	19.1 100	SAMPLE: KRE-112	
	3/8"	9.5 99	DATE: 30-Jul-13	
	# 4	4.75 97	PARTICLE SIZE DISTRIBUTION SUMMARY	
	# 10	2.00 92		
	# 20	0.850 84	% GRAVEL 3	
	# 40	0.425 74	% SAND 56	
	# 60	0.250 62	% FINES (SILT, CLAY) 41	
	# 100	0.150 52	COMMENTS:	
	# 200	0.075 41		
Hydrometer Analysis		0.0664 37.0		
		0.0480 30.7		
Dispersing agent:		0.0344 27.1		
<i>Sodium Hexametaphosphate</i>		0.0246 23.5		
		0.0175 22.2		
Dosage of dispersing agent:		0.0128 20.3		
40 g/L		0.0091 18.3		
		0.0065 16.5		
		0.0046 14.5		
		0.0033 12.7		
		0.0025 11.9		
		0.0015 11.1		



The testing services reported here have been performed in accordance with accepted local industry standards.

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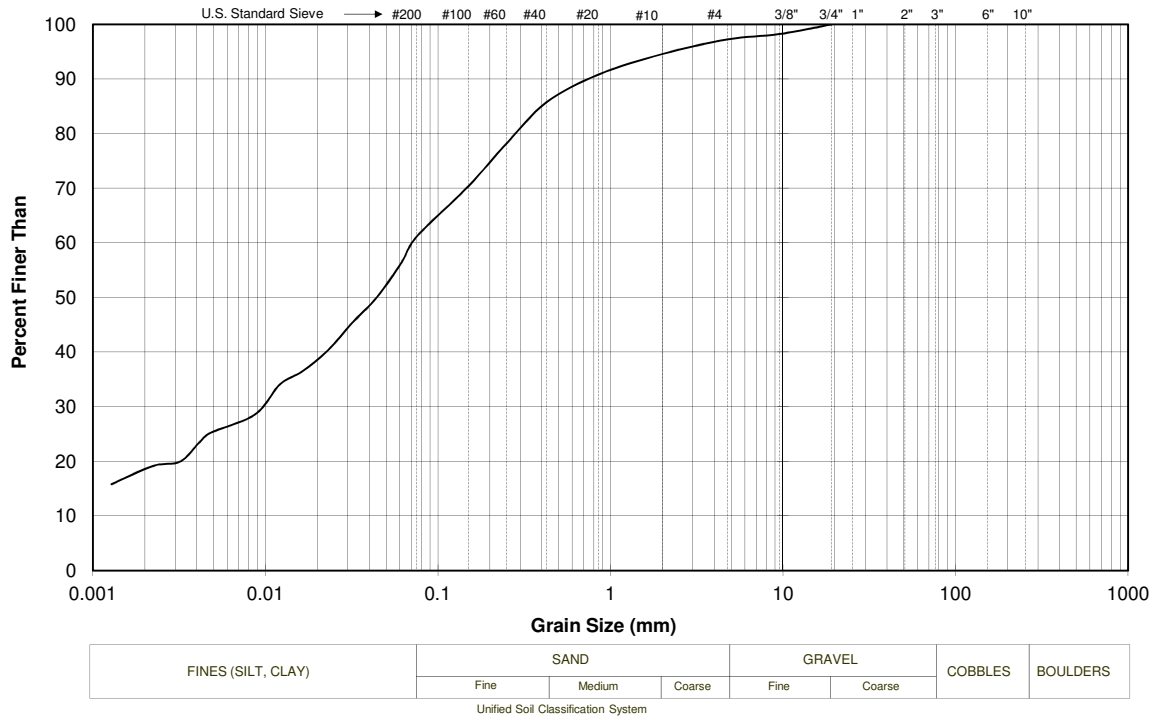
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment	
	Sieve	Diameter (mm) % Finer		
	3"	76.2 100	CLIENT: Chris Cebryk	
	2"	50.8 100	PROJECT: Proposed Resedential Subdivison	
	1"	25.4 100	MDH Job No: 613596	
	3/4"	19.1 100	SAMPLE: KRE-117	
	3/8"	9.5 98	DATE: 1-Aug-13	
	# 4	4.75 97	PARTICLE SIZE DISTRIBUTION SUMMARY	
	# 10	2.00 95		
	# 20	0.850 91	% GRAVEL 3	
	# 40	0.425 86	% SAND 36	
	# 60	0.250 78	% FINES (SILT, CLAY) 61	
	# 100	0.150 70	COMMENTS:	
	# 200	0.075 61		
Hydrometer Analysis		0.0612 56.3		
		0.0443 50.1		
Dispersing agent:		0.0319 45.4		
<i>Sodium Hexametaphosphate</i>		0.0229 40.3		
		0.0164 36.5		
Dosage of dispersing agent:		0.0121 34.0		
<i>40 g/L</i>		0.0087 28.6		
		0.0048 25.2		
		0.0041 23.3		
		0.0032 19.9		
		0.0022 19.1		
		0.0013 15.8		



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This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis		Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	99
	3/8"	9.5	99
	# 4	4.75	99
	# 10	2.00	99
	# 20	0.850	99
	# 40	0.425	99
	# 60	0.250	99
	# 100	0.150	99
	# 200	0.075	97
Hydrometer Analysis		0.0540	95.4
		0.0391	90.4
Dispersing agent:		0.0280	87.3
<i>Sodium Hexametaphosphate</i>		0.0200	84.7
		0.0145	79.8
Dosage of dispersing agent:		0.0104	71.1
<i>40 g/L</i>		0.0080	61.2
		0.0058	53.1
		0.0042	47.0
		0.0030	41.2
		0.0022	37.9
		0.0013	32.5



SNC•LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Development

Project No:

613596

SAMPLE:

KRE-122

DATE:

26-Jul-13

PARTICLE SIZE DISTRIBUTION SUMMARY

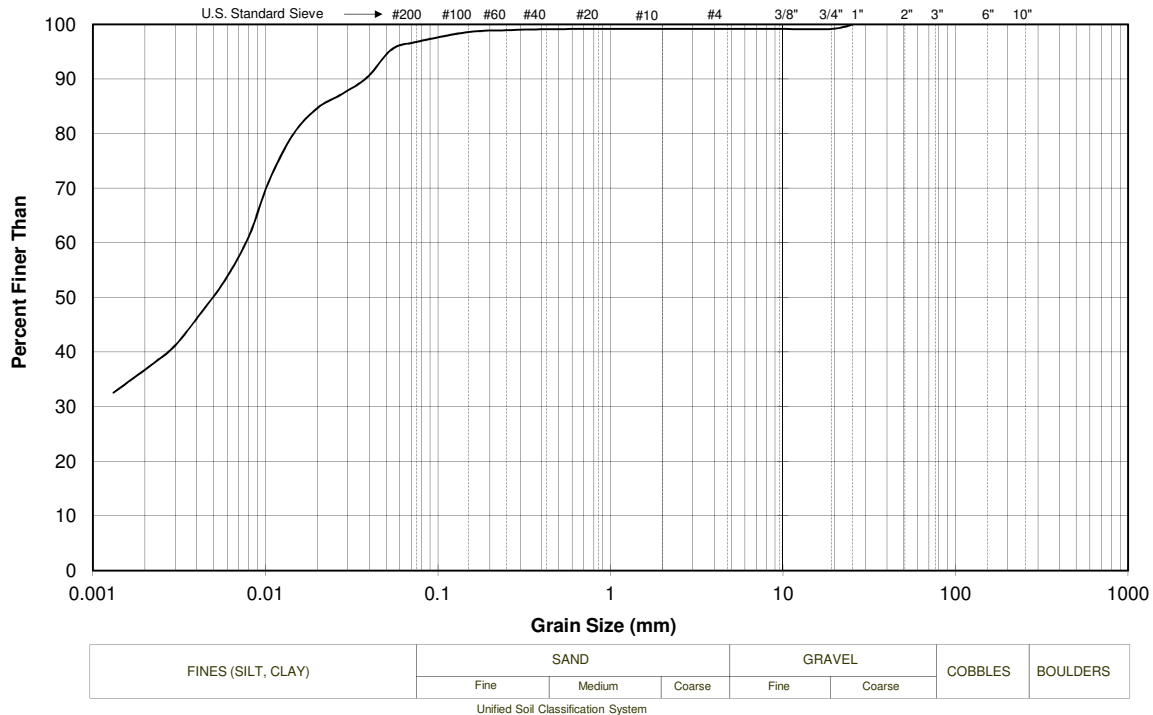
% GRAVEL1

% SAND2

% FINES (SILT, CLAY)97

COMMENTS:

<



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This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis		Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	97
	# 4	4.75	94
	# 10	2.00	85
	# 20	0.850	81
	# 40	0.425	75
	# 60	0.250	68
	# 100	0.150	60
	# 200	0.075	50
Hydrometer Analysis		0.0640	44.3
		0.0460	40.4
Dispersing agent:		0.0331	36.0
<i>Sodium Hexametaphosphate</i>		0.0237	32.4
		0.0169	29.9
Dosage of dispersing agent:		0.0125	27.3
<i>40 g/L</i>		0.0089	24.1
		0.0064	22.4
		0.0045	20.0
		0.0032	18.8
		0.0024	17.9
		0.0011	17.0



SNC-LAVALIN
Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Subdivison

Project No:

613596

SAMPLE:

KRE-128

DATE:

2-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

6

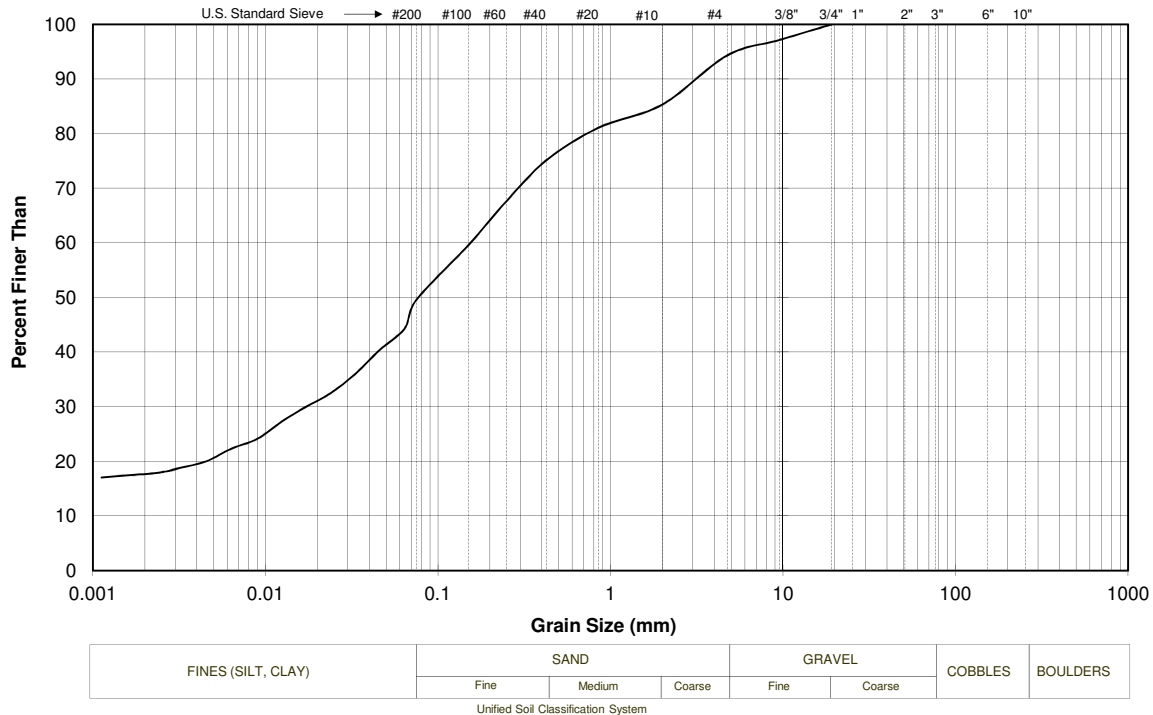
% SAND

44

% FINES (SILT, CLAY)

50

COMMENTS:



The testing services reported here have been performed in accordance with accepted local industry standards.

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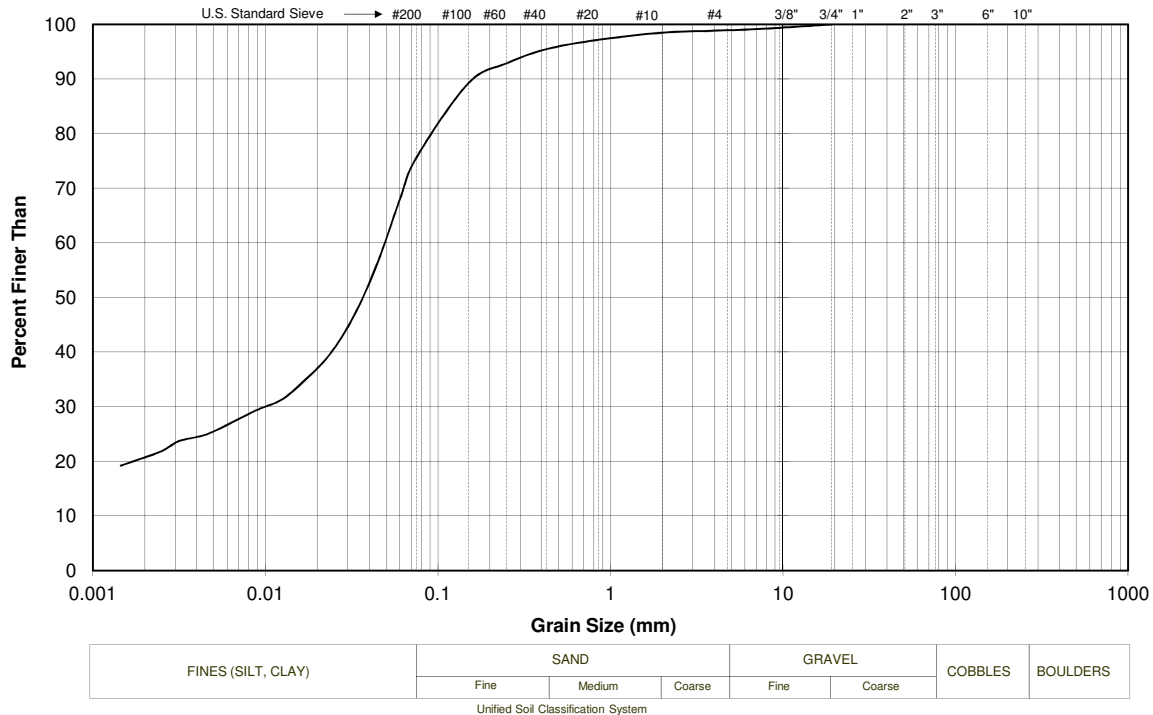
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment	
	Sieve	Diameter (mm) % Finer		
	3"	76.2 100	CLIENT: Chris Cebryk	
	2"	50.8 100	PROJECT: Proposed Resedential Development	
	1"	25.4 100	Project No: 613596	
	3/4"	19.1 100	SAMPLE: KRE-134	
	3/8"	9.5 99	DATE: 30-Jul-13	
	# 4	4.75 99	PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL 1 % SAND 23 % FINES (SILT, CLAY) 76	
	# 10	2.00 98		
	# 20	0.850 97	COMMENTS: 	
	# 40	0.425 95		
	# 60	0.250 93		
	# 100	0.150 89		
	# 200	0.075 76		
Hydrometer Analysis		0.0600 67.8		
		0.0443 56.1		
Dispersing agent:		0.0324 46.5		
<i>Sodium Hexametaphosphate</i>		0.0235 39.5		
		0.0169 34.8		
Dosage of dispersing agent:		0.0124 31.3		
40 g/L		0.0089 29.3		
		0.0063 27.0		
		0.0045 24.8		
		0.0032 23.7		
		0.0024 21.7		
		0.0014 19.2		



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	100	
# 4	4.75	100	
# 10	2.00	94	
# 20	0.850	93	
# 40	0.425	93	
# 60	0.250	93	
# 100	0.150	92	
# 200	0.075	90	
Hydrometer Analysis		0.0545	87.7
		0.0388	86.1
Dispersing agent:		0.0279	82.5
Sodium Hexametaphosphate		0.0198	81.7
		0.0143	77.9
Dosage of dispersing agent:		0.0107	72.0
40 g/L		0.0078	64.8
		0.0057	57.5
		0.0041	51.3
		0.0029	46.7
		0.0023	43.7
		0.0014	38.0



SNC•LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Development

MDH Job No:

613596

SAMPLE:

KRE-140

DATE:

30-Jul-13

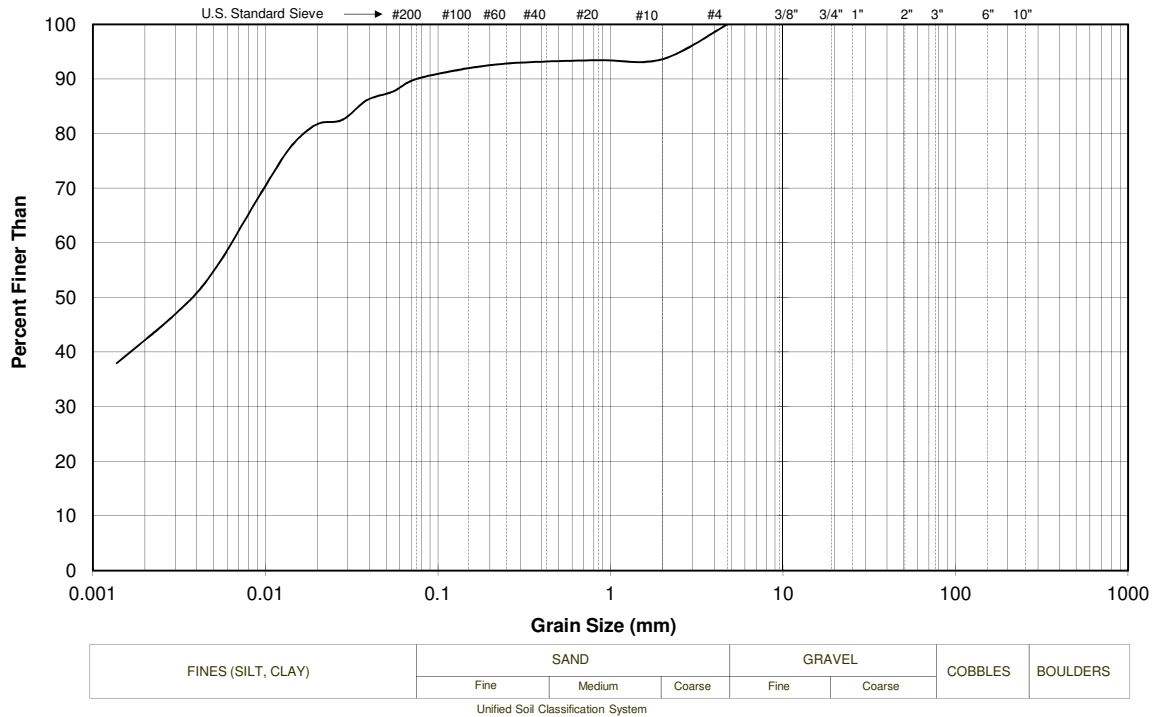
PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

% SAND10

% FINES (SILT, CLAY)90

COMMENTS:

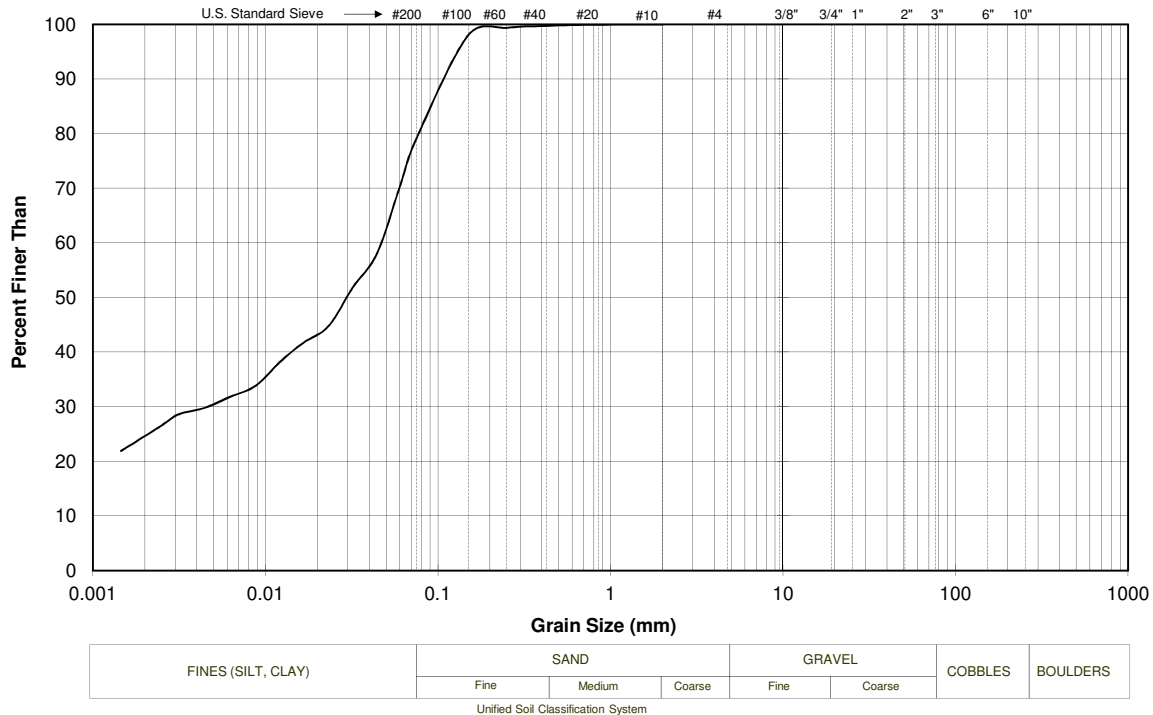


The testing services reported here have been performed in accordance with accepted local industry standards.
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 Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC•LAVALIN Environment	
Sieve	Diameter (mm)	% Finer		
3"	76.2	100	CLIENT: Chris Cebryk	
2"	50.8	100	PROJECT: Proposed Resedential Subdivison	
1"	25.4	100	Project No: 613596	
3/4"	19.1	100	SAMPLE: KRE-146	
3/8"	9.5	100	DATE: 1-Aug-13	
# 4	4.75	100	PARTICLE SIZE DISTRIBUTION SUMMARY	
# 10	2.00	100	% GRAVEL	
# 20	0.850	100	% SAND 21	
# 40	0.425	100	% FINES (SILT, CLAY) 79	
# 60	0.250	99		
# 100	0.150	98		
# 200	0.075	79		
Hydrometer Analysis		0.0600	70.2	COMMENTS:
		0.0443	58.1	
Dispersing agent:		0.0320	51.8	
<i>Sodium Hexametaphosphate</i>		0.0232	44.7	
		0.0166	41.7	
Dosage of dispersing agent:		0.0122	38.2	
<i>40 g/L</i>		0.0088	33.8	
		0.0062	31.8	
		0.0044	29.7	
		0.0031	28.5	
		0.0025	26.5	
		0.0015	21.9	



The testing services reported here have been performed in accordance with accepted local industry standards.

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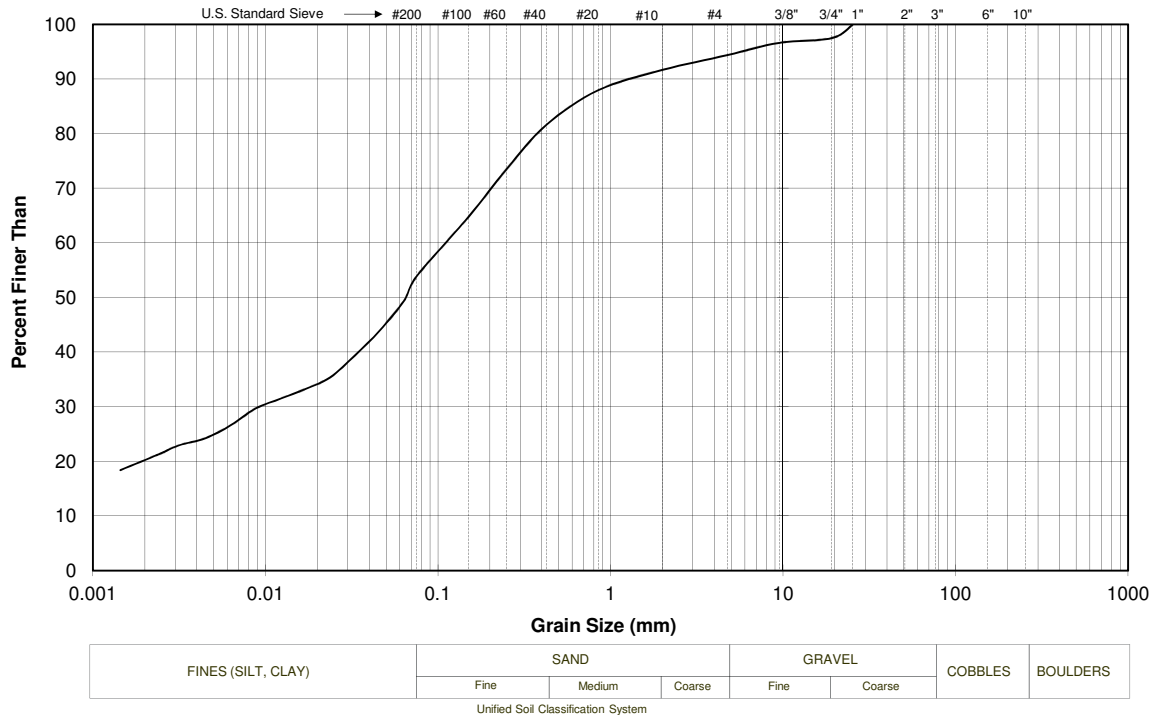
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC•LAVALIN Environment	
Sieve	Diameter (mm)	% Finer		
3"	76.2	100	CLIENT: Chris Cebryk PROJECT: Proposed Resedential Development MDH Job No: 613596 SAMPLE: KRE-153 DATE: 30-Jul-13 PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL6 % SAND40 % FINES (SILT, CLAY)54 COMMENTS: <	



The testing services reported here have been performed in accordance with accepted local industry standards.

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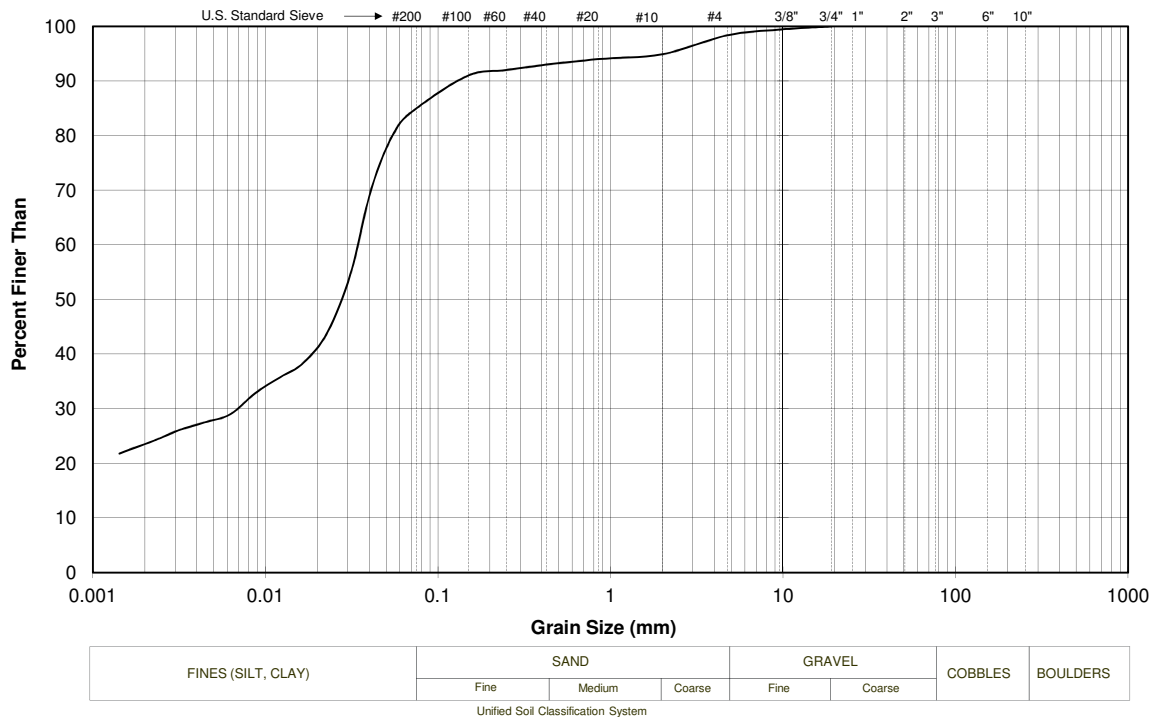
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment	
	Sieve	Diameter (mm) % Finer		
	3"	76.2 100	CLIENT: Chris Cebryk	
	2"	50.8 100	PROJECT: Proposed Resedential Subdivison	
	1"	25.4 100	Project No: 613596	
	3/4"	19.1 100	SAMPLE: KRE-159	
	3/8"	9.5 99	DATE: 1-Aug-13	
	# 4	4.75 98	PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL 2 % SAND 15 % FINES (SILT, CLAY) 83	
	# 10	2.00 95		
	# 20	0.850 95	COMMENTS: 	
	# 40	0.425 94		
	# 60	0.250 93		
	# 100	0.150 92		
	# 200	0.075 83		
Hydrometer Analysis		0.0556 80.5		
		0.0412 70.4		
Dispersing agent:		0.0311 54.7		
<i>Sodium Hexametaphosphate</i>		0.0229 44.0		
		0.0165 38.3		
Dosage of dispersing agent:		0.0122 35.8		
<i>40 g/L</i>		0.0087 32.8		
		0.0062 28.9		
		0.0044 27.5		
		0.0031 26.0		
		0.0024 24.4		
		0.0014 21.8		



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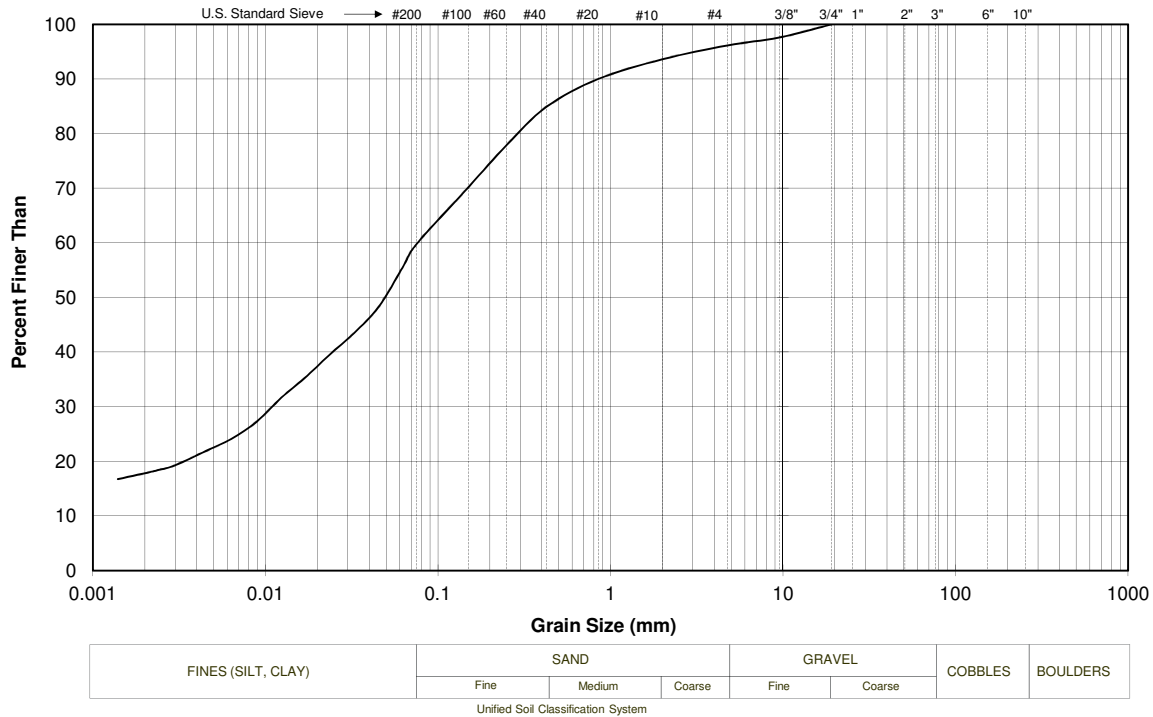
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment	
	Sieve	Diameter (mm) % Finer		
	3"	76.2 100	CLIENT: Chris Cebryk	
	2"	50.8 100	PROJECT: Proposed Residential Subdivision	
	1"	25.4 100	MDH Job No: 613596	
	3/4"	19.1 100	SAMPLE: KRE-165	
	3/8"	9.5 98	DATE: 6-Aug-13	
	# 4	4.75 96	PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL 4 % SAND 36 % FINES (SILT, CLAY) 60	
	# 10	2.00 94		
	# 20	0.850 90	COMMENTS: 	
	# 40	0.425 85		
	# 60	0.250 78		
	# 100	0.150 70		
	# 200	0.075 60		
Hydrometer Analysis		0.0623 55.4		
		0.0453 48.2		
Dispersing agent:		0.0326 43.5		
<i>Sodium Hexametaphosphate</i>		0.0234 39.4		
		0.0168 35.2		
Dosage of dispersing agent:		0.0124 31.6		
<i>40 g/L</i>		0.0089 27.2		
		0.0063 24.1		
		0.0045 21.9		
		0.0030 19.3		
		0.0023 18.3		
		0.0014 16.7		



The testing services reported here have been performed in accordance with accepted local industry standards.

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis		Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	100
	# 40	0.425	100
	# 60	0.250	100
	# 100	0.150	99
	# 200	0.075	98
Hydrometer Analysis		0.0530	97.0
		0.0382	93.3
Dispersing agent:		0.0272	91.3
Sodium Hexametaphosphate		0.0195	88.5
		0.0142	81.8
Dosage of dispersing agent:		0.0108	73.3
40 g/L		0.0080	61.6
		0.0059	51.5
		0.0042	44.0
		0.0027	39.4
		0.0021	37.0
		0.0013	33.5



SNC-LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Residential Subdivision

Project No:

613596

SAMPLE:

KRE-171

DATE:

6-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

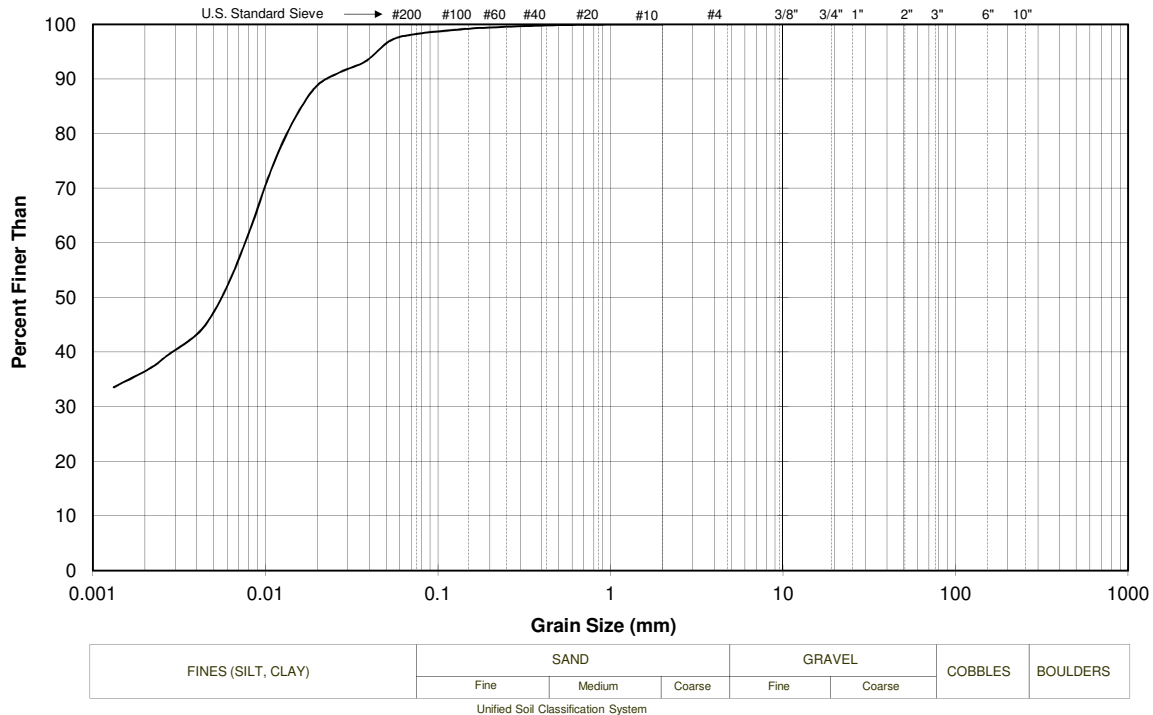
% GRAVEL

% SAND2

% FINES (SILT, CLAY)98

COMMENTS:

<



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

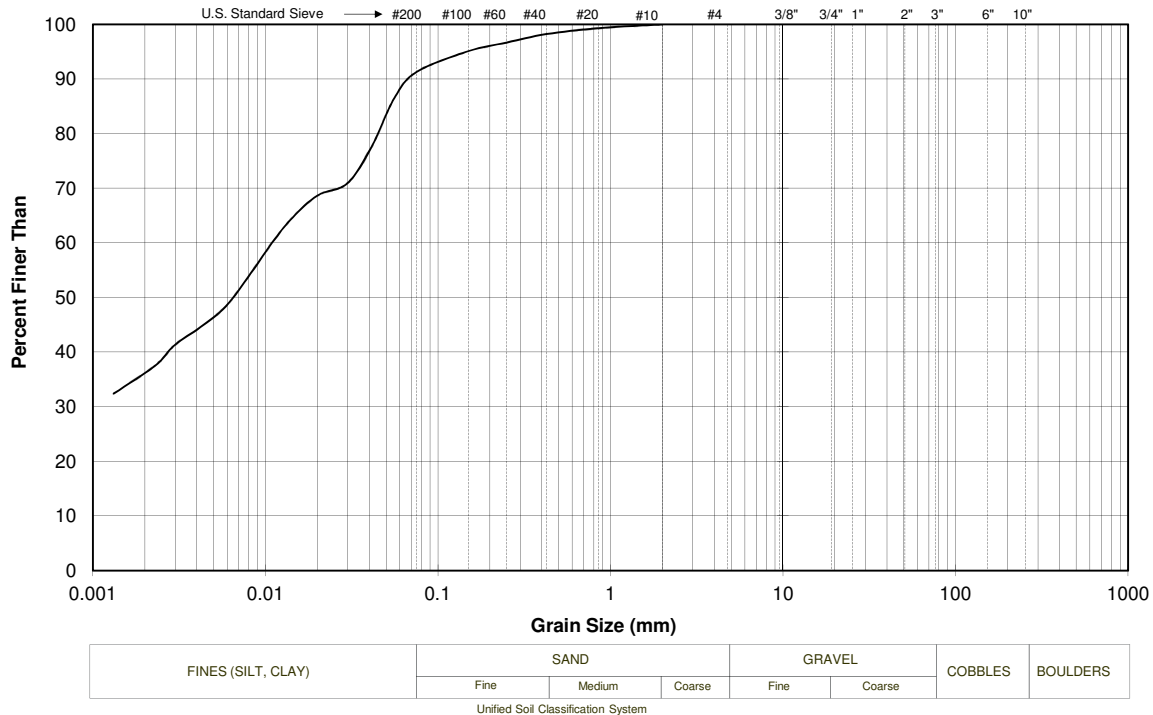
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis				 SNC•LAVALIN Environment		
Sieve	Diameter (mm)	% Finer				
3"	76.2	100	CLIENT: Chris Cebryk PROJECT: Proposed Resedential Development MDH Job No: 613596 SAMPLE: KRE-178 DATE: 26-Jul-13 PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL % SAND9 % FINES (SILT, CLAY)91 COMMENTS:			
2"	50.8	100				
1"	25.4	100				
3/4"	19.1	100				
3/8"	9.5	100				
# 4	4.75	100				
# 10	2.00	100				
# 20	0.850	99				
# 40	0.425	98				
# 60	0.250	97				
# 100	0.150	95				
# 200	0.075	91				
Hydrometer Analysis		0.0559				86.5
		0.0411				77.5
Dispersing agent:		0.0298				70.9
Sodium Hexametaphosphate		0.0201				68.7
		0.0144				64.7
Dosage of dispersing agent:		0.0113				60.7
40 g/L		0.0082	54.4			
		0.0059	48.4			
		0.0042	44.6			
		0.0030	41.3			
		0.0023	37.4			
		0.0013	32.4			



The testing services reported here have been performed in accordance with accepted local industry standards.

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

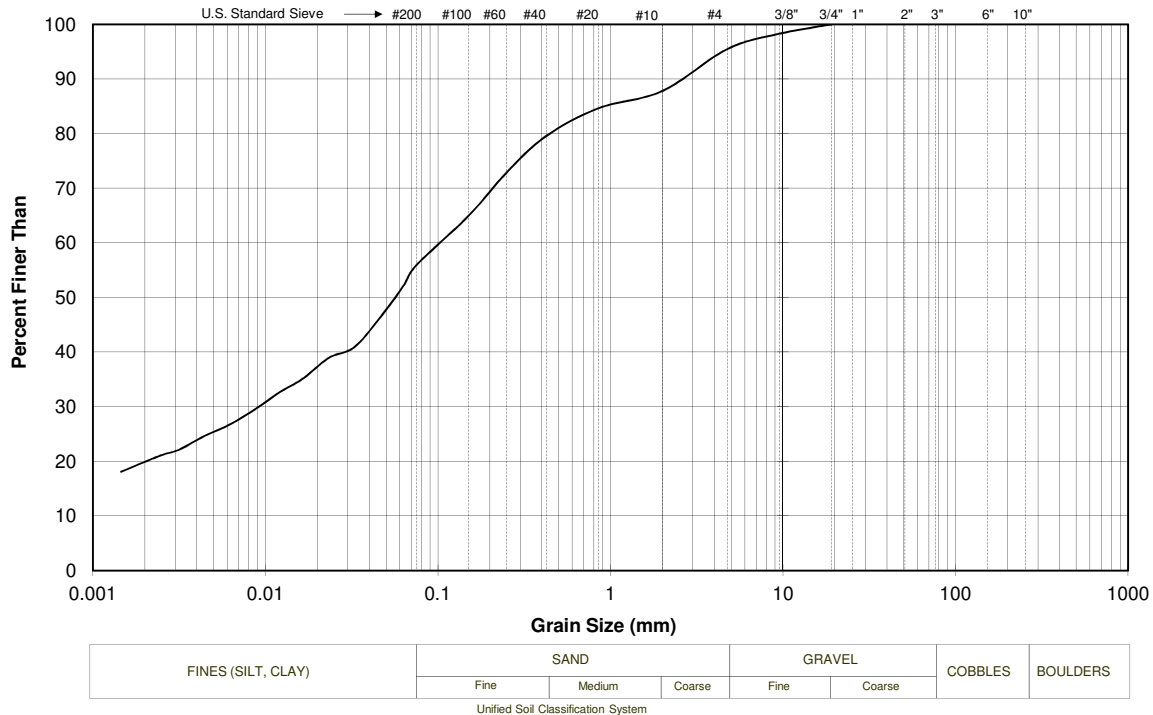
(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	98	
# 4	4.75	95	
# 10	2.00	88	
# 20	0.850	85	
# 40	0.425	80	
# 60	0.250	73	
# 100	0.150	65	
# 200	0.075	56	

		SNC•LAVALIN Environment	
CLIENT:	Chris Cebryk		
PROJECT:	Proposed Resedential Subdivison		
MDH Job No:	613596		
SAMPLE:	KRE-184		
DATE:	1-Aug-13		
PARTICLE SIZE DISTRIBUTION SUMMARY			
% GRAVEL	5		
% SAND	39		
% FINES (SILT, CLAY)	56		

Hydrometer Analysis	0.0625	51.9
	0.0452	45.9
Dispersing agent:	0.0326	40.8
<i>Sodium Hexametaphosphate</i>	0.0232	38.9
	0.0166	35.2
Dosage of dispersing agent:	0.0123	32.7
<i>40 g/L</i>	0.0088	29.6
	0.0063	26.7
	0.0045	24.6
	0.0032	22.1
	0.0025	21.0
	0.0015	18.1

COMMENTS:



The testing services reported here have been performed in accordance with accepted local industry standards.

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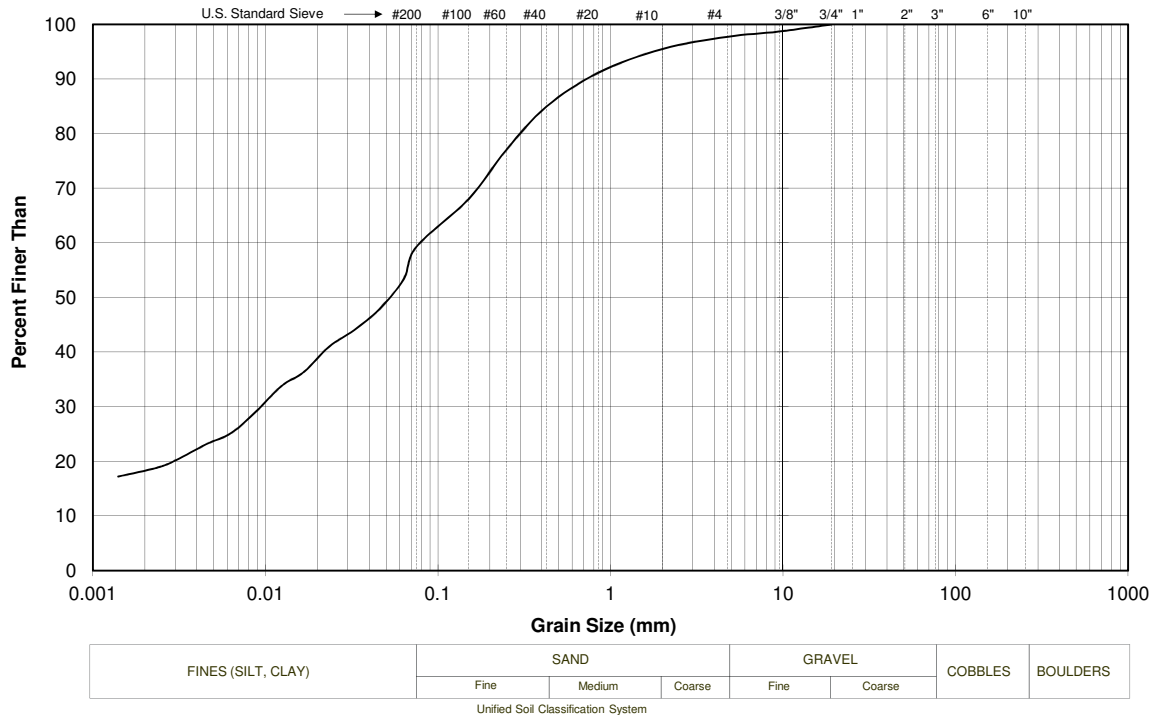
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	99	
# 4	4.75	98	
# 10	2.00	95	
# 20	0.850	91	
# 40	0.425	85	
# 60	0.250	77	
# 100	0.150	68	
# 200	0.075	59	
Hydrometer Analysis			CLIENT: Chris Cebryk
			PROJECT: Proposed Residential Subdivision
			Project No: 613596
			SAMPLE: KRE-190
			DATE: 6-Aug-13
			PARTICLE SIZE DISTRIBUTION SUMMARY
			% GRAVEL 2
			% SAND 39
			% FINES (SILT, CLAY) 59
			COMMENTS:



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

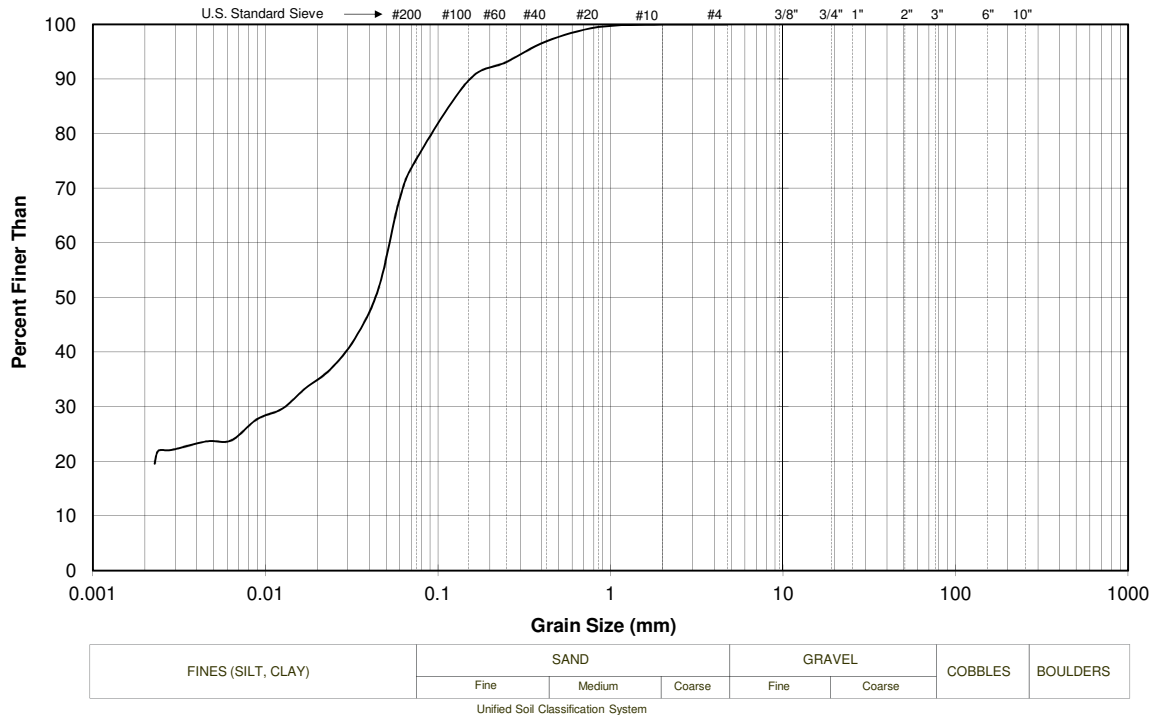
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC•LAVALIN Environment	
Sieve	Diameter (mm)	% Finer		
3"	76.2	100	CLIENT: Chris Cebryk PROJECT: Proposed Residential Subdivision Project No: 613596 SAMPLE: JMT-601 DATE: 6-Aug-13 PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL % SAND 25 % FINES (SILT, CLAY) 75 COMMENTS: 	
2"	50.8	100		
1"	25.4	100		
3/4"	19.1	100		
3/8"	9.5	100		
# 4	4.75	100		
# 10	2.00	100		
# 20	0.850	99		
# 40	0.425	97		
# 60	0.250	93		
# 100	0.150	90		
# 200	0.075	75		
Hydrometer Analysis				
	0.0600	68.0		
	0.0451	51.5		
Dispersing agent:	0.0329	42.4		
<i>Sodium Hexametaphosphate</i>	0.0237	36.8		
	0.0170	33.3		
Dosage of dispersing agent:	0.0125	29.6		
<i>40 g/L</i>	0.0089	27.7		
	0.0063	23.8		
	0.0045	23.6		
	0.0028	22.0		
	0.0024	21.9		
	0.0023	19.5		



The testing services reported here have been performed in accordance with accepted local industry standards.

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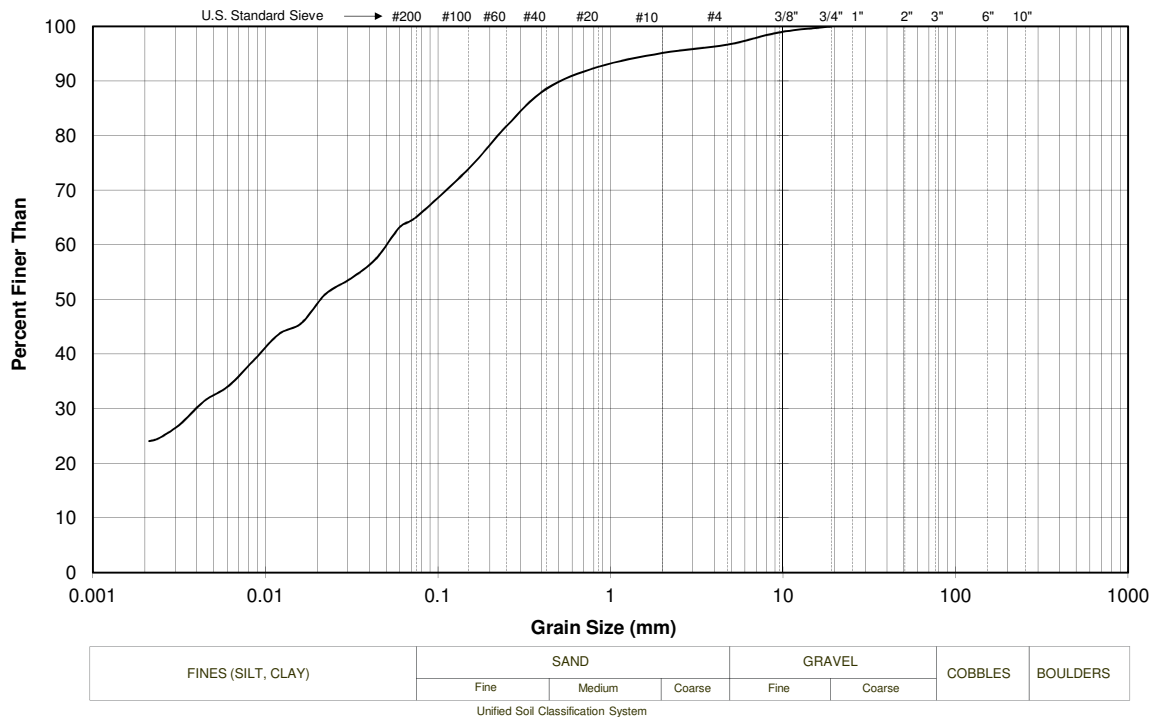
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis				 SNC•LAVALIN Environment	
Sieve	Diameter (mm)	% Finer			
3"	76.2	100	CLIENT: Chris Cebryk PROJECT: Proposed Resedential Subdivison MDH Job No: 613596 SAMPLE: JMT-605 DATE: 2-Aug-13 PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL3 % SAND32 % FINES (SILT, CLAY)65 COMMENTS:		



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis		Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	98
	3/8"	9.5	97
	# 4	4.75	94
	# 10	2.00	90
	# 20	0.850	85
	# 40	0.425	78
	# 60	0.250	69
	# 100	0.150	59
	# 200	0.075	47
Hydrometer Analysis		0.0649	42.7
		0.0469	36.9
Dispersing agent:		0.0335	33.9
<i>Sodium Hexametaphosphate</i>		0.0240	30.5
		0.0172	26.8
Dosage of dispersing agent:		0.0126	25.2
<i>40 g/L</i>		0.0090	21.6
		0.0064	18.8
		0.0046	16.3
		0.0031	15.0
		0.0024	14.4
		0.0014	12.7



SNC-LAVALIN
Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Residential Subdivision

Project No:

613596

SAMPLE:

JMT-612

DATE:

6-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

6

% SAND

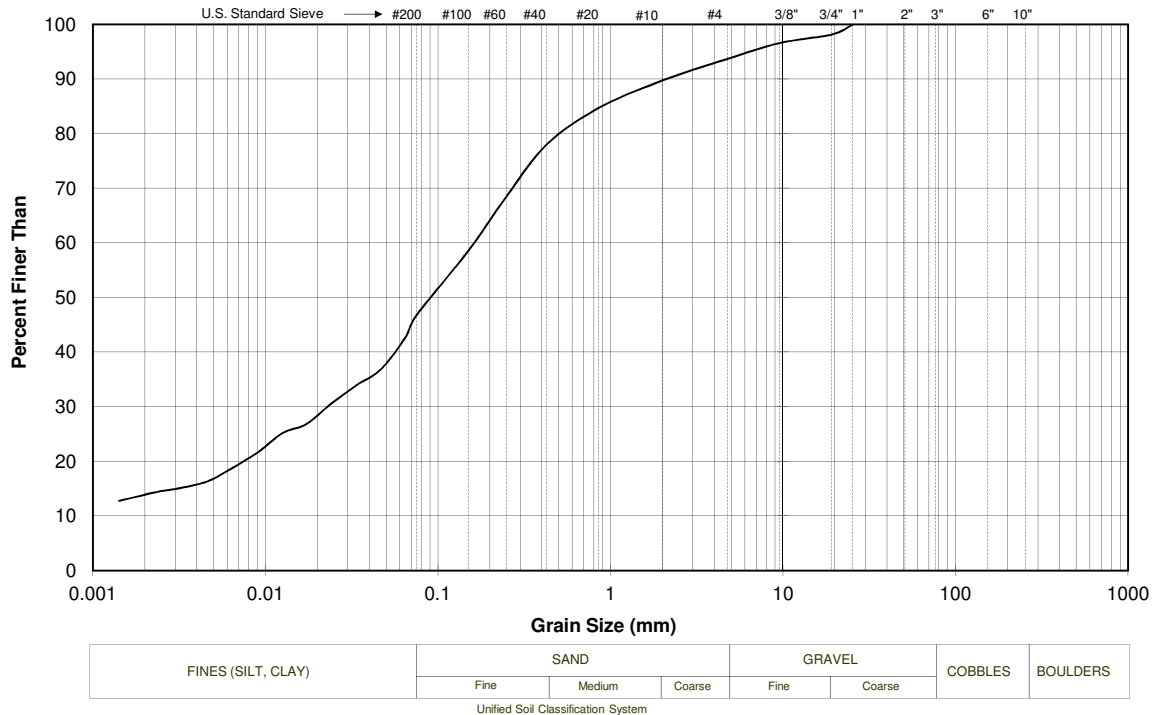
47

% FINES (SILT, CLAY)

47

COMMENTS:

</



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	98	
# 4	4.75	97	
# 10	2.00	95	
# 20	0.850	91	
# 40	0.425	85	
# 60	0.250	77	
# 100	0.150	69	
# 200	0.075	59	
Hydrometer Analysis		0.0627	55.1
		0.0459	45.8
Dispersing agent:		0.0329	42.0
Sodium Hexametaphosphate		0.0234	39.8
		0.0168	35.2
Dosage of dispersing agent:		0.0124	32.5
40 g/L		0.0078	28.6
		0.0063	27.2
		0.0044	25.6
		0.0032	24.0
		0.0024	22.8
		0.0022	21.7



SNC•LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Subdivison

MDH Job No:

613596

SAMPLE:

JMT-619

DATE:

2-Aug-13

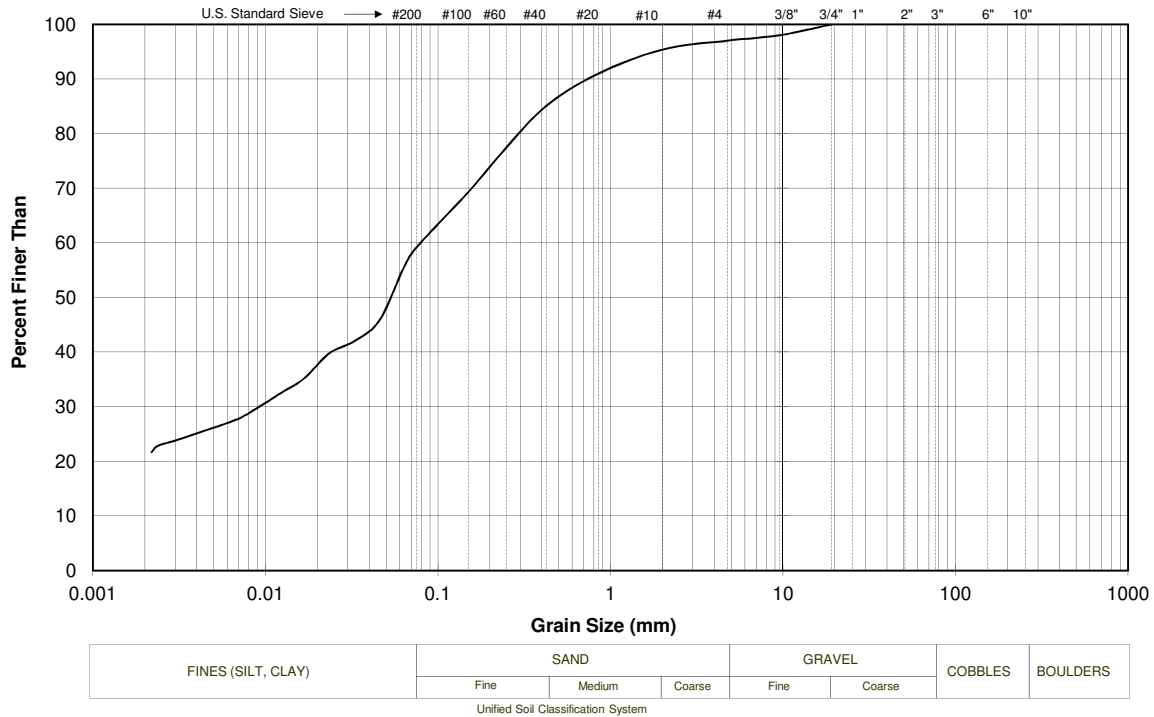
PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL3

% SAND38

% FINES (SILT, CLAY)59

COMMENTS:



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 Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis		Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	94
	# 40	0.425	84
	# 60	0.250	72
	# 100	0.150	61
	# 200	0.075	51
Hydrometer Analysis		0.0649	47.6
		0.0474	37.9
Dispersing agent:		0.0339	33.9
<i>Sodium Hexametaphosphate</i>		0.0241	31.8
		0.0172	30.0
Dosage of dispersing agent:		0.0126	27.6
<i>40 g/L</i>		0.0090	24.0
		0.0064	21.7
		0.0046	18.9
		0.0030	17.1
		0.0023	17.4
		0.0014	15.7



SNC-LAVALIN
Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Residential Subdivision

Project No:

613596

SAMPLE:

JMT-625

DATE:

6-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

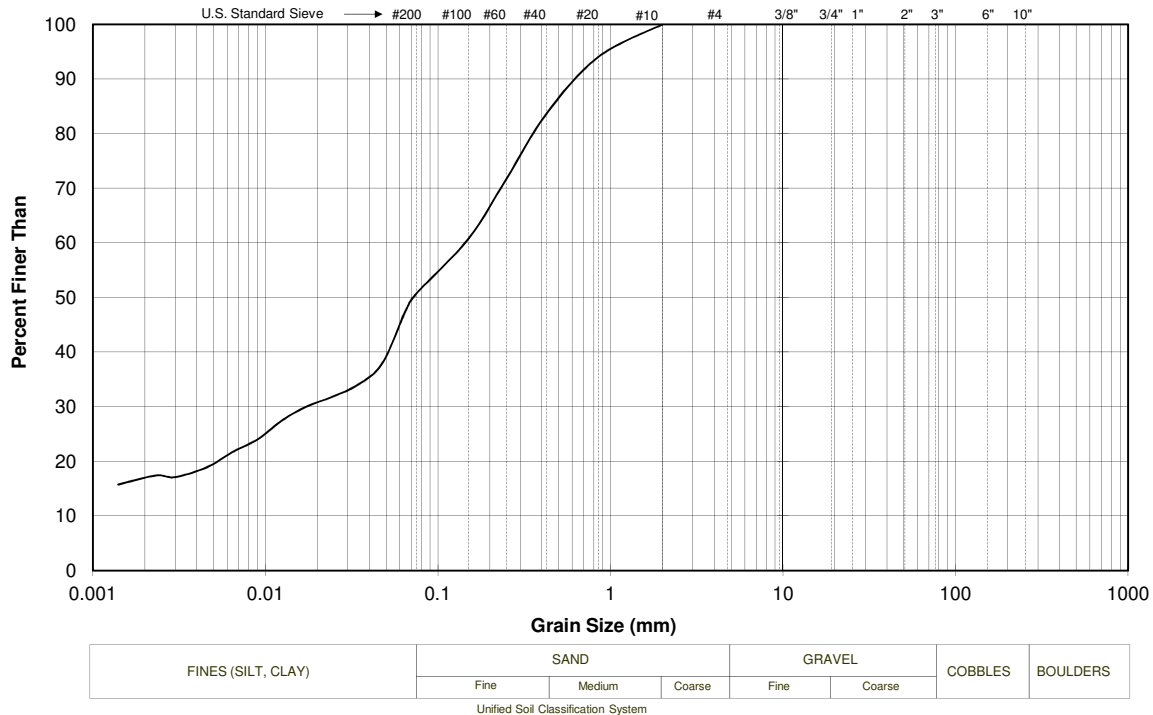
% GRAVEL

% SAND49

% FINES (SILT, CLAY)51

COMMENTS:

<



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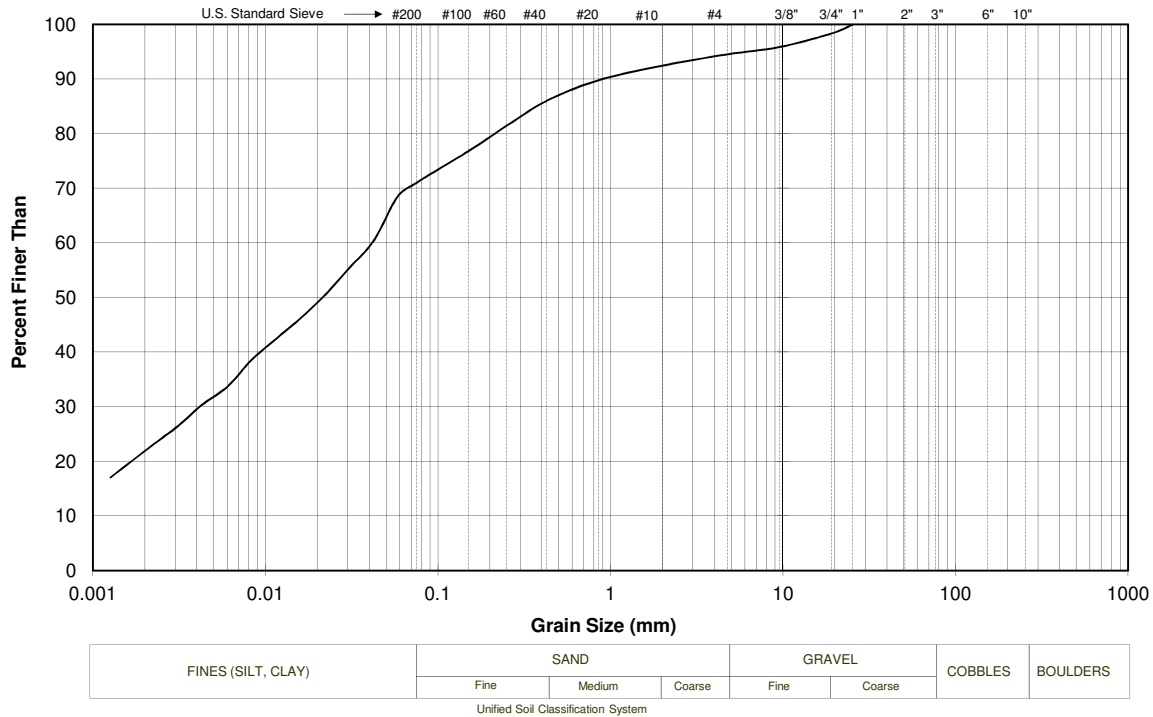
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis				
	Sieve	Diameter (mm) % Finer		
	3"	76.2 100	CLIENT: Chris Cebryk	
	2"	50.8 100	PROJECT: Proposed Resedential Subdivison	
	1"	25.4 100	MDH Job No: 613596	
	3/4"	19.1 98	SAMPLE: JMT-631	
	3/8"	9.5 96	DATE: 1-Aug-13	
	# 4	4.75 95	PARTICLE SIZE DISTRIBUTION SUMMARY	
	# 10	2.00 92		
	# 20	0.850 90	% GRAVEL 5	
	# 40	0.425 86	% SAND 24	
	# 60	0.250 81	% FINES (SILT, CLAY) 71	
	# 100	0.150 77	COMMENTS:	
	# 200	0.075 71		
Hydrometer Analysis		0.0581 68.3		
		0.0425 60.4		
Dispersing agent:		0.0306 55.4		
<i>Sodium Hexametaphosphate</i>		0.0221 50.4		
		0.0158 46.1		
Dosage of dispersing agent:		0.0117 42.6		
40 g/L		0.0084 38.7		
		0.0060 33.7		
		0.0043 30.3		
		0.0031 26.2		
		0.0022 22.9		
		0.0013 17.0		



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	100	
# 4	4.75	100	
# 10	2.00	100	
# 20	0.850	99	
# 40	0.425	98	
# 60	0.250	97	
# 100	0.150	95	
# 200	0.075	91	
Hydrometer Analysis		0.0556	87.4
		0.0402	82.0
Dispersing agent:		0.0290	77.6
Sodium Hexametaphosphate		0.0208	74.5
		0.0150	68.9
Dosage of dispersing agent:		0.0113	61.8
40 g/L		0.0082	53.7
		0.0060	46.1
		0.0043	40.0
		0.0030	36.4
		0.0023	32.6
		0.0021	32.0



SNC•LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Subdivison

MDH Job No:

613596

SAMPLE:

JMT-637

DATE:

2-Aug-13

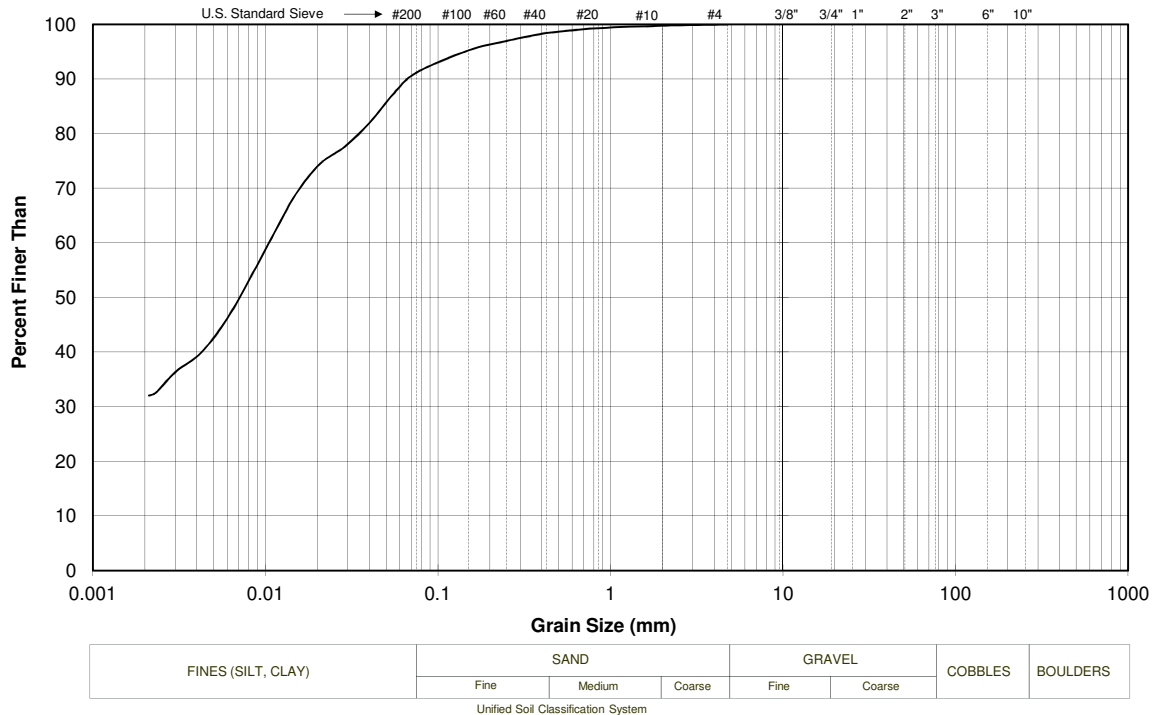
PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

% SAND9

% FINES (SILT, CLAY)91

COMMENTS:



The testing services reported here have been performed in accordance with accepted local industry standards.

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	100	
# 4	4.75	100	
# 10	2.00	100	
# 20	0.850	100	
# 40	0.425	100	
# 60	0.250	99	
# 100	0.150	99	
# 200	0.075	93	
Hydrometer Analysis		0.0571	81.7
		0.0429	66.8
Dispersing agent:		0.0320	51.9
Sodium Hexametaphosphate		0.0231	45.5
		0.0167	39.5
Dosage of dispersing agent:		0.0123	35.8
40 g/L		0.0088	32.0
		0.0063	30.0
		0.0045	27.9
		0.0031	26.6
		0.0025	24.2
		0.0015	21.0



SNC•LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Development

MDH Job No:

613596

SAMPLE:

JMT-643

DATE:

31-Jul-13

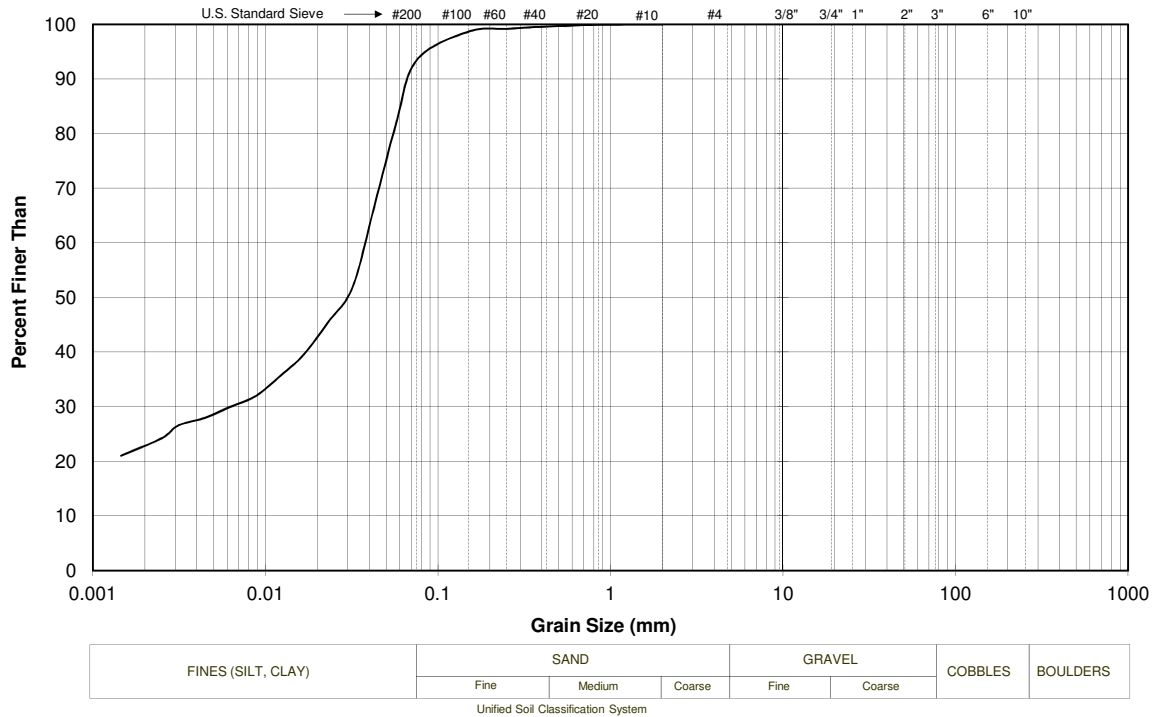
PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

% SAND7

% FINES (SILT, CLAY)93

COMMENTS:



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 Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	100	
# 4	4.75	100	
# 10	2.00	100	
# 20	0.850	99	
# 40	0.425	97	
# 60	0.250	95	
# 100	0.150	92	
# 200	0.075	88	
Hydrometer Analysis		0.0558	84.9
		0.0403	80.0
Dispersing agent:		0.0289	76.4
Sodium Hexametaphosphate		0.0208	72.6
		0.0151	65.6
Dosage of dispersing agent:		0.0113	58.1
40 g/L		0.0083	47.7
		0.0060	39.7
		0.0044	34.0
		0.0031	30.6
		0.0024	28.8
		0.0021	27.9



SNC-LAVALIN

Environment

CLIENT:

Chris Cebryk

PROJECT:

Proposed Resedential Subdivison

Project No:

613596

SAMPLE:

JMT-649

DATE:

2-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL

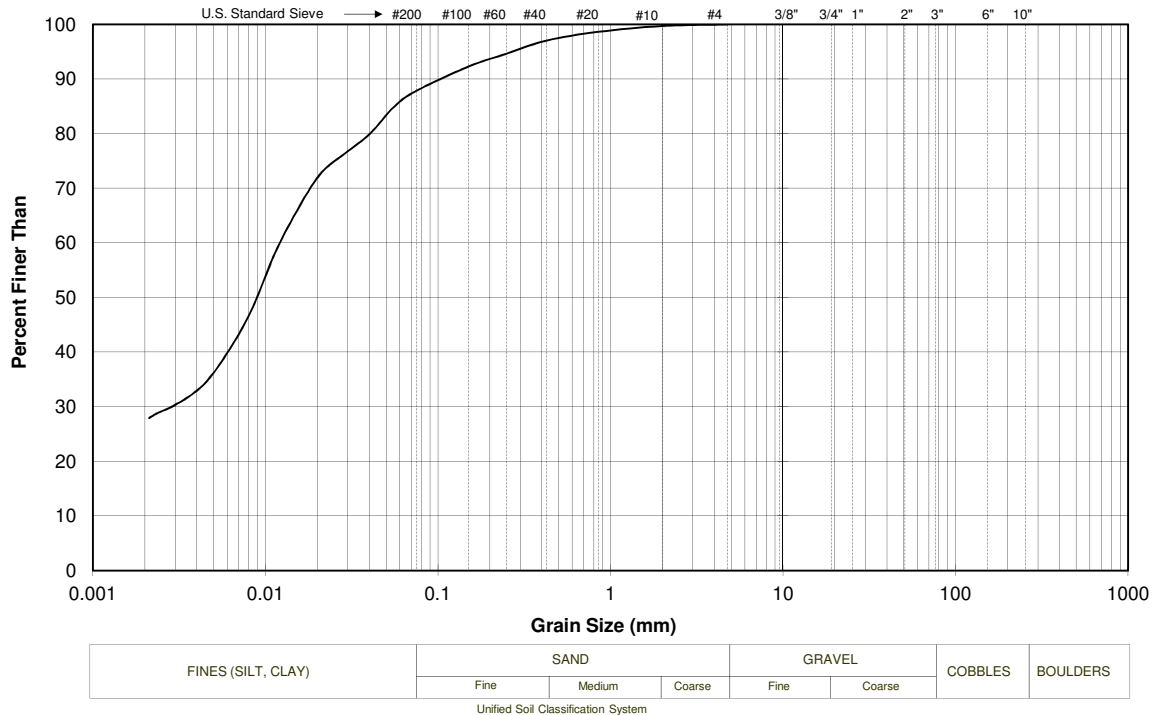
% SAND

% FINES (SILT, CLAY)

12

88

COMMENTS:



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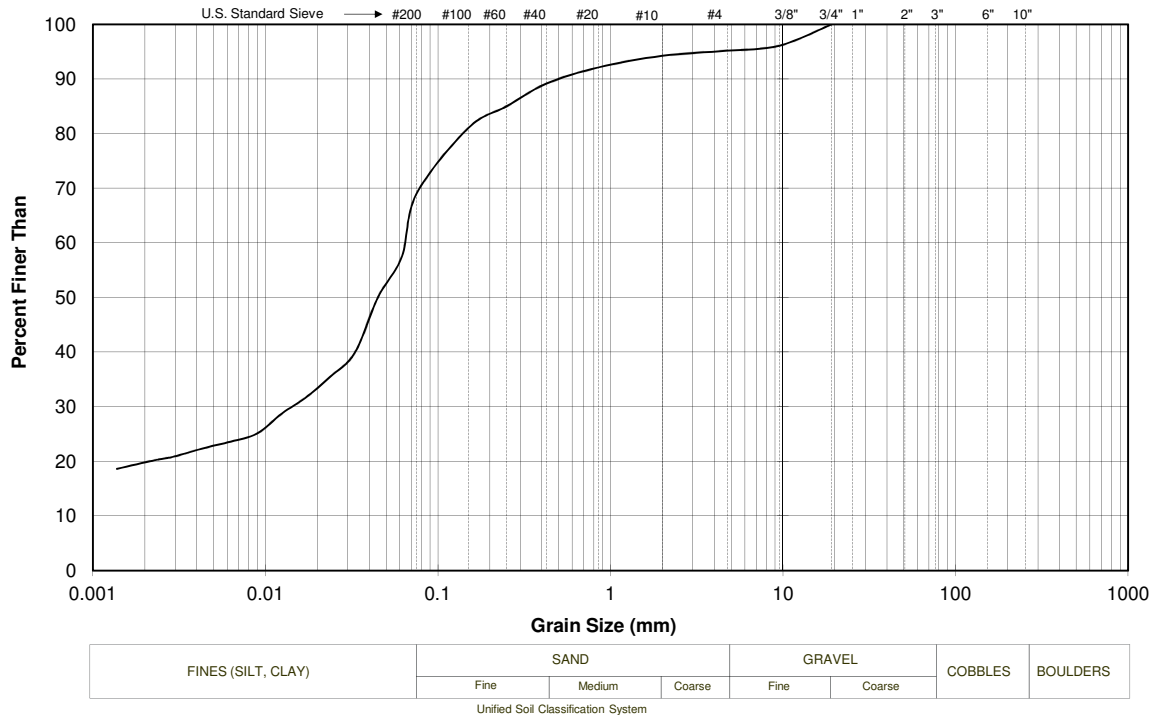
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment	
Sieve	Diameter (mm)	% Finer		
3"	76.2	100	CLIENT: Chris Cebryk	
2"	50.8	100	PROJECT: Proposed Residential Subdivision	
1"	25.4	100	MDH Job No: 613596	
3/4"	19.1	100	SAMPLE: JMT-655	
3/8"	9.5	96	DATE: 6-Aug-13	
# 4	4.75	95	PARTICLE SIZE DISTRIBUTION SUMMARY % GRAVEL 5 % SAND 26 % FINES (SILT, CLAY) 69	
# 10	2.00	94		
# 20	0.850	92		
# 40	0.425	89		
# 60	0.250	85		
# 100	0.150	81		
# 200	0.075	69		
Hydrometer Analysis		0.0618	57.5	COMMENTS: <



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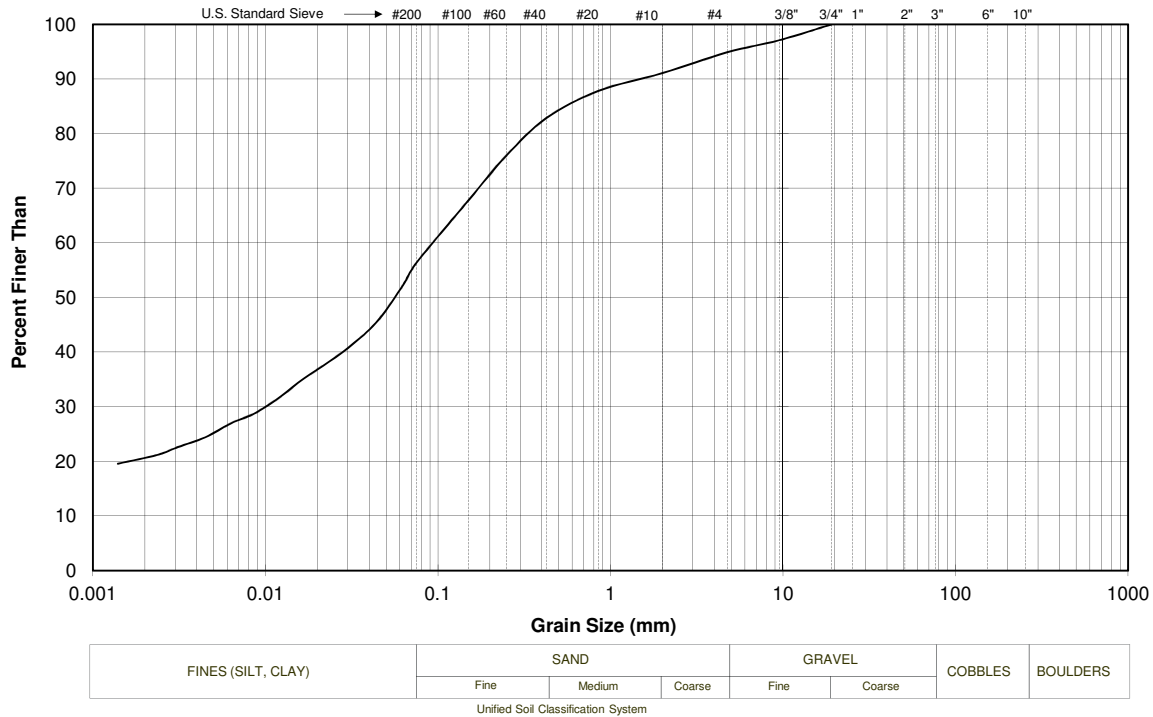
Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			
Sieve	Diameter (mm)	% Finer	
3"	76.2	100	
2"	50.8	100	
1"	25.4	100	
3/4"	19.1	100	
3/8"	9.5	97	
# 4	4.75	95	
# 10	2.00	91	
# 20	0.850	88	
# 40	0.425	83	
# 60	0.250	76	
# 100	0.150	68	
# 200	0.075	56	
Hydrometer Analysis		0.0627	52.2
		0.0454	45.9
Dispersing agent:		0.0327	41.6
Sodium Hexametaphosphate		0.0234	38.2
		0.0167	35.2
Dosage of dispersing agent:		0.0123	31.9
40 g/L		0.0088	28.9
		0.0063	26.9
		0.0045	24.4
		0.0031	22.6
		0.0024	21.1
		0.0014	19.5

		SNC-LAVALIN Environment	
CLIENT:	Chris Cebryk		
PROJECT:	Proposed Residential Subdivision		
MDH Job No:	613596		
SAMPLE:	JMT-661		
DATE:	6-Aug-13		
PARTICLE SIZE DISTRIBUTION SUMMARY			
% GRAVEL	5		
% SAND	39		
% FINES (SILT, CLAY)	56		
COMMENTS:			

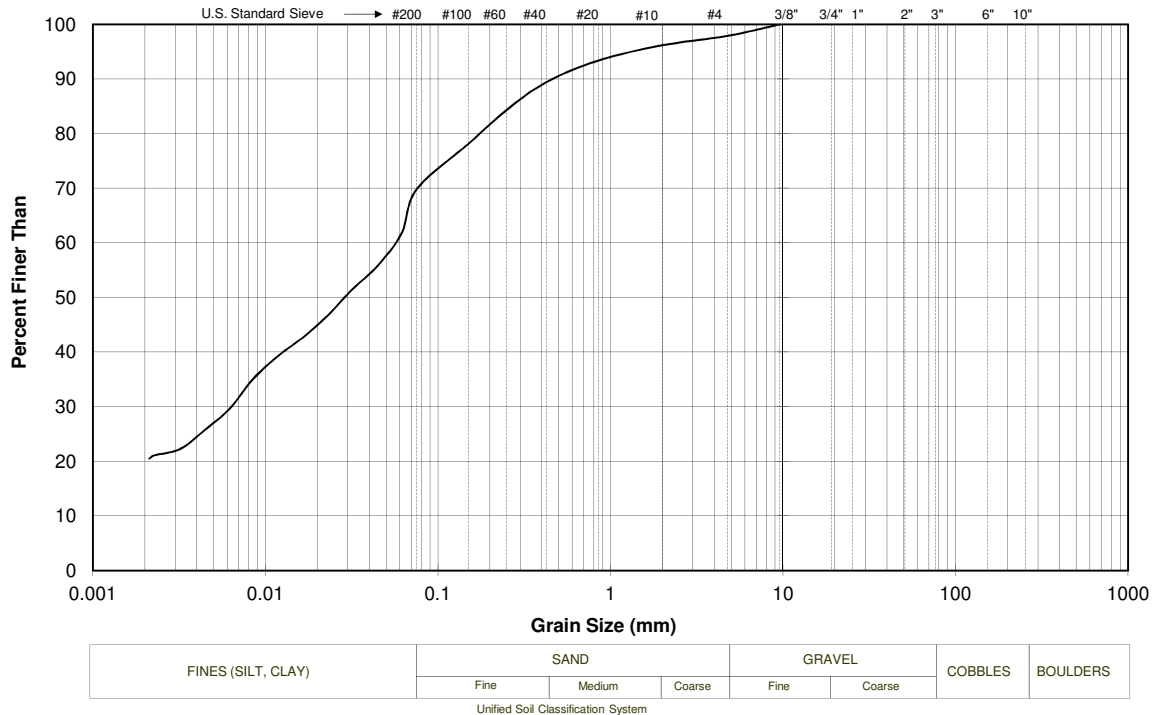


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 Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC•LAVALIN Environment	
Sieve	Diameter (mm)	% Finer		
3"	76.2	100	CLIENT: Chris Cebryk	
2"	50.8	100	PROJECT: Proposed Resedential Subdivison	
1"	25.4	100	MDH Job No: 613596	
3/4"	19.1	100	SAMPLE: JMT-667	
3/8"	9.5	100	DATE: 2-Aug-13	
# 4	4.75	98	PARTICLE SIZE DISTRIBUTION SUMMARY	
# 10	2.00	96		
# 20	0.850	93	% GRAVEL	
# 40	0.425	89	% SAND	
# 60	0.250	84	% FINES (SILT, CLAY)	
# 100	0.150	78		
# 200	0.075	70		
Hydrometer Analysis			COMMENTS:	
	0.0613	61.7		
	0.0444	55.7		
Dispersing agent:	0.0319	51.5		
<i>Sodium Hexametaphosphate</i>	0.0229	46.7		
	0.0164	42.6		
Dosage of dispersing agent:	0.0121	39.6		
40 g/L	0.0086	35.3		
	0.0062	29.5		
	0.0044	25.7		
	0.0032	22.2		
	0.0023	21.1		
	0.0021	20.5		



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

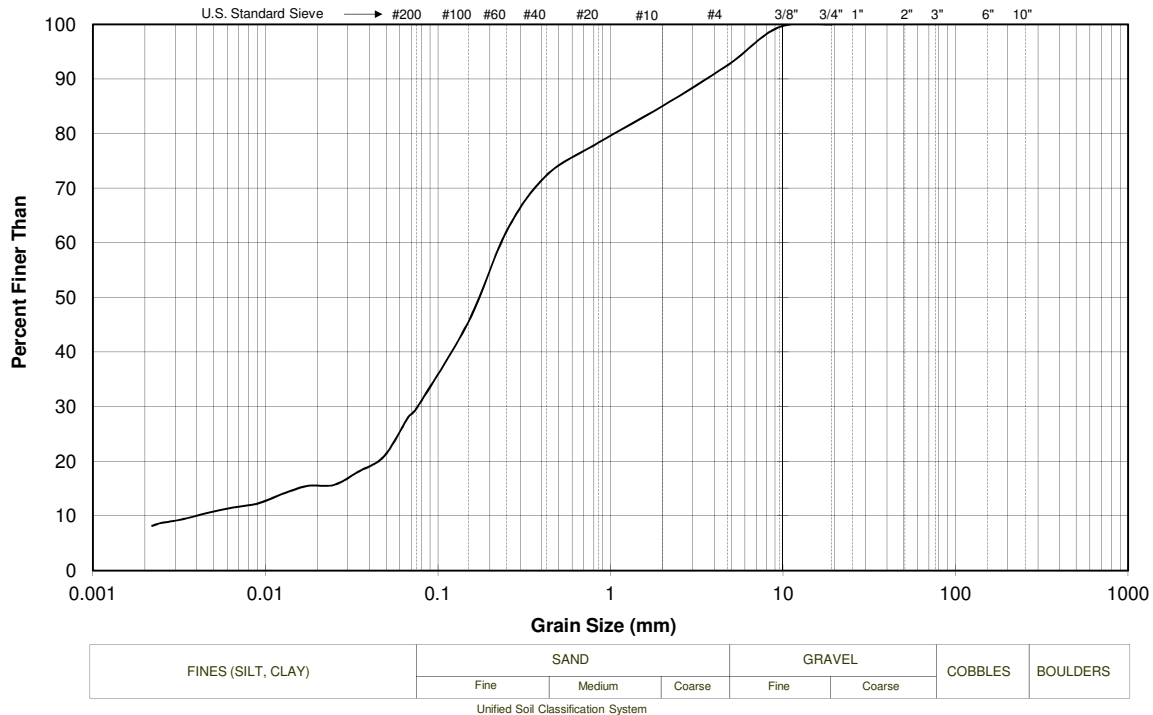
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis			 SNC-LAVALIN Environment	
Sieve	Diameter (mm)	% Finer		
3"	76.2	100	CLIENT: Chris Cebryk	
2"	50.8	100	PROJECT: Proposed Resedential Subdivison	
1"	25.4	100	Project No: 613596	
3/4"	19.1	100	SAMPLE: JMT-673	
3/8"	9.5	100	DATE: 2-Aug-13	
# 4	4.75	92	PARTICLE SIZE DISTRIBUTION SUMMARY	
# 10	2.00	85		
# 20	0.850	78	% GRAVEL	
# 40	0.425	72	% SAND	
# 60	0.250	62	% FINES (SILT, CLAY)	
# 100	0.150	46		
# 200	0.075	30		
Hydrometer Analysis			COMMENTS:	
	0.0673	28.1		
	0.0488	21.0		
Dispersing agent:	0.0349	18.2		
Sodium Hexametaphosphate	0.0249	15.7		
	0.0176	15.5		
Dosage of dispersing agent:	0.0129	14.2		
40 g/L	0.0092	12.4		
	0.0065	11.5		
	0.0046	10.5		
	0.0033	9.4		
	0.0025	8.7		
	0.0022	8.2		



The testing services reported here have been performed in accordance with accepted local industry standards.

The results presented are for the sole use of the designated client only.

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.



SNC-LAVALIN
Environment

WATER CONTENTS & BULK DENSITIES

Client: Chris Cebryk

Project: Proposed Residential Development

MDH # 613596

Tech: RG

Date: 25-Jul-13

Sample #	KRE-187-SPT	KRE-120-SPT	JMT-633	KRE-108-SPT	KRE-180-SPT	
Borehole						
Tare #	SAP-06	Unicorn	CE-2	M	CE-6	
Tare Mass (g)	30.92	30.98	30.86	30.89	31.02	
Wet sample + tare (g)	117.42	124.44	127.04	126.18	118.97	
Dry sample + tare (g)	108.83	113.77	117.02	119.50	112.86	
Wt. Dry sample (g)	77.91	82.79	86.16	88.61	81.84	
Water Content (%)	11.03	12.89	11.63	7.54	7.47	
Bulk Density						
Sample #	KRE-187-SPT	KRE-120-SPT	JMT-633	KRE-108-SPT	KRE-180-SPT	
Mass of sample in air (g):	114.64	192.16	170.03	89.74	180.39	
Mass of sample + wax in air (g):	118.33	195.37	175.18	93.00	185.89	
Mass of sample + wax in water (g):	63.82	108.82	94.21	50.30	103.63	
Wet density (kg/m ³):	2276	2317	2262	2299	2371	
Dry density (kg/m ³):	2050	2052	2026	2138	2206	
Sample #						
Borehole						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						
Bulk Density						
Sample #						
Mass of sample in air (g):						
Mass of sample + wax in air (g):						
Mass of sample + wax in water (g):						
Wet density (kg/m ³):						
Dry density (kg/m ³):						
Comments:						