APPENDIX A
Geotechnical Report

GEOTECHNICAL INVESTIGATION
PRAIRIE INDUSTRIAL PARK
NEAR MAZENOD AND CAMIEL SYS
WINNIPEG, MANITOBA

Submitted to:

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23 September 2013

AMEC File No. WX17188

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1.0 INTRODUCTION

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), were retained by Terracon Developments Ltd. (Terracon) to conduct a geotechnical investigation for the proposed Prairie Industrial project in Winnipeg, Manitoba. The location of the project is in the St Boniface Industrial park, near Mazenod and Camiel Sys and south of the Winnipeg aqueduct line.

The purpose of the investigation was to determine the soil profile at locations along the proposed roadways and underground utility lines and to provide some general geotechnical recommendations relating to construction of the these facilitites. Foundation recommendations for a proposed lift station as well as general comments relating to retention pond design and construction were also to be provided.

A Phase I Environmental Site Assessment (ESA) report, dated 11 July 2013, was also completed by AMEC for the site and was issued under separate cover.

2.0 PROPOSED DEVELOPMENT

Based on information provided by Morrison Hershfield during our May 27 site meeting, it is understood that the industrial park will have the following infrastructure;

- 2590 m of road work;
- 3210 m of water main;
- 2290 m of waste water sewers;
- 270 m of force water main;
- 650 m of land drainage sewer;
- One Lift Station; and
- One Retention Pond.

Some of the utilities will need to cross under the existing GWWD railway line as such boreholes were advanced as close as possible to the rail line as possible.

3.0 SITE CONDITIONS

The site is irregular in shape, is located to the south of the existing St. Boniface Industrial Park, and is bounded by Canadian National Railway's Symington Yards to the south, an undeveloped field followed by a railroad to the west, and an aqueduct to the north. At the time of AMEC's investigation, the site consisted mostly of an undeveloped field with several treed areas, and with a large proportion of the site covered in shallow water with rushes and reeds. The site surface is generally flat lying with the majority covered with grasses, surface vegetation such as weeds, bull rushes and moss.

The site outline and borehole location plan is provided in Appendix A, Figure 1.

4.0 FIELD INVESTIGATON

A geotechnical field investigation was conducted at the site between the dates of 11 July and 26 August 2013. The geotechnical investigation included the following boreholes;

- A total of 53 boreholes were completed along the proposed roadways (RD01 to RD53). They were advanced every 50m along the proposed road, to a depth of 2m below grade with every second borehole advanced to a depth of 6m below grade. The boreholes were generally located along the centerline of the proposed road.

- A total of four boreholes (P01 to P04) were drilled to a depth of 9 m within the proposed retention pond.

- One borehole (LS01) was advanced for the proposed lift station to a depth of 12m below present grade.

- A total of 3 boreholes (AX03, AX04 and RD27) were advanced at 2 of the 3 proposed water main aqueduct crossings to a depth of about 9m below present grade. The remaining planned crossing bore holes (AX01, AX02 and AX04 were not accessible at the time of drilling.

- Three boreholes (LDS01 to LDS04) were advanced along Mazenod road north of the aqueduct to a depth of about 6 to 7m below present grade for assessment of soil conditions along the proposed Land Drainage Sewer (LDS).

- Three boreholes (SY01 to SY03) along the property boundary between Symington yard and the site for environmental screening. These boreholes are provided for information only in this report.

All boreholes were surveyed using AMEC's survey grade GPS equipment. The majority of the boreholes were completed by Maple Leaf Drilling Ltd., under the full-time supervision of AMEC personnel. The boreholes were advanced with a track mounted drill rig equipped with 125 mm diameter solid stem augers. Some supplemental drilling of the shallow boreholes were advanced using hand augered equipment (i.e. 100mm diameter flight augers) operated by AMEC field staff. The borehole locations are shown on the Borehole Location Plan, Figure 1 in Appendix A.

All soils observed during borehole drilling were visually classified on site according to the Modified Unified Soil Classification System. Sloughing, seepage and drilling conditions, as well as any pertinent subsurface observations, were also recorded at the time of the investigation. Disturbed soil samples were taken at regular intervals from the auger cuttings. Additional sampling consisted of relatively undisturbed Shelby tube samples for the lift station foundation design at borehole LS01. Testing conducted during the field investigation consisted of pocket penetrometer tests at regular intervals in all of the boreholes.

All soil samples obtained during the field investigation were labelled, sealed in plastic bags to limit moisture loss and transported to AMEC's Winnipeg soils laboratory for further examination and testing.

All of the boreholes were backfilled with auger cuttings and a layer of bentonite on completion of drilling, after verification of short-term sloughing and seepage conditions. Excess auger cuttings were left adjacent to the boreholes.

The borehole logs are included in Appendix A and show the soil profile, results of the field and laboratory testing and comments relative to sloughing and seepage conditions encountered.

5.0 LABORATORY TESTING

Soil samples were returned to AMEC's Soils Laboratory in Winnipeg for geotechnical laboratory testing. All soil samples were visually classified. Testing included moisture contents on a large number of samples, with select samples tested for Atterberg limits and Hydrometer analysis. For all Shelby tube samples, the unconfined compressive strength was determined.

6.0 SUBSURFACE CONDITIONS

The general soil stratigraphy across the site was as follows:

- Surface Organics
- Clay Fill or Organic Clay
- Clay with Silt Layer

Surface Organics

Across the site, a layer of surface organics (moss) was present and ranged in thickness between 0.25 m and 0.75 m. The layer was generally wet and very soft at the time of the investigation. The thicker organics generally corresponded to a number of low lying wet areas.

Clay Fill

Clay fill was found beneath the surface organics in two of the boreholes, both of which were in proximity to the rail track. The clay fill was silty, high plastic, moist, firm to very stiff, and contained varying amounts of sand. The clay fill extended to depths of 0.3 m (RD53) and 1.1 m (LDS02). A single moisture content test was conducted on the fill, with a result of 24%.

Organic Clay

Below the surface organics, across approximately half of the site, a layer of organic clay was found. The organic clay was generally silty, moist, dark grey and contained traces of rootlets and organics. The layer extended to depths ranging between 50 mm and 0.45 m, averaging

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about 0.3 m. Laboratory testing of the organic clay was limited to moisture content determination and two organic contents (ASTM D2974), with the results summarized in Table 1.

Table 1: Moisture Content Summary - Organic Clay

Number of Tests	Maximum Moisture Content (%)	Minimum Moisture Content (%)	Average Moisture Content (%)	Organic Content
12	50.0	27.0	43.1	5.3 % @ RD32 – 0.3m 7.2 % @ RD26 – 0.3m

Native Clay with Silt Layer

Clay

The predominant soil encountered at the site was high plastic clay. The clay was encountered below the surficial organic soils in all boreholes and extended to the maximum depths explored (12.2 m). The clay was generally described as silty, moist, stiff, and brownish grey. Occasional thin silt laminations were present within the clay throughout the depths explored. Generally the shear strength of the clay decreased with increasing depth, becoming firm to stiff below depths of about 5 m to 6 m. Sulphate inclusions and gypsum crystals were present within the clay, typically below about 3 m. The clay became mottled brown and grey, then grey with increasing depth. Oxidation was also found within the clay, generally within the upper 7 m.

Field testing within the clay was limited to pocket penetrometers testing to assess relative undrained shear strengths. Results of the testing is summarized in Table 2. While the maximum and minimum results from pocket penetrometers testing indicate a wide range of undrained shear strengths, average undrained shear strengths were generally slightly above 100 kPa in the upper 3 m to 6 m, decreasing to about 50 to 75 kPa below 6 m.

Table 2: Pocket Penetrometer Testing in Clay

Number of Tests	Undrained Shear Strength Maximum (kPa)	Undrained Shear Strength Minimum (kPa)	Average Shear Strength (kPa)
608	420	10	103

Laboratory testing of the clay material consisted of unconfined compressive strength testing, moisture content determination, Atterberg limit testing and hydrometer grain size analyses.

Moisture content testing, which is summarized in Table 4, indicated in-situ moisture contents ranging between about 23.6% and 58.6%. Generally moisture contents were highly variable in

the upper 3 m, varying between about 23% and 55%, while below 3 m moisture contents were much more closely grouped at between about 45% and 60%.

Table 3: Moisture Content Summary - Clay

Number of Tests	Maximum Moisture Content (%)	Minimum Moisture Content (%)	Average Moisture Content (%)
255	58.6	23.6	39.3

Unconfined compressive strength testing, which is summarized in Table 4, indicated the clay to have unconfined compressive strengths of about 75 to 90 kPa throughout it's depth. Although slightly inconsistent with pocket penetrometers readings, which indicated a slight decreasing trend in strength with depth, unconfined compressive strength testing is a more accurate determination of soil strength than are field pocket penetrometers tests, which are subject to sample disturbance which is greater with depth.

Table 4: Unconfined Compressive Strength Testing in Clay

Test Data	Unconfined Compressive Strength (kPa)	Strain (%)
LS01 Sample 7 – 4.6 m to 5.2 m	88.9	3.6
LS01 Sample 10 – 7.6 m to 8.2 m	75.9	2.2
LS01 Sample 13 – 10.7m to 11.3 m	89.8	3.2

Hydrometer and Atterberg Limits tests were conducted on the clays encountered and are summarized in Table 5. For the soils tested, hydrometer and Atterberg Limits results suggest that the soil generally corresponds to a CH classification in the MUSCS. The percentage of particles was relatively consistent at 82 to 83% clay, 17 to 18% silt and no sand or gravel. Liquid limits varied from about 83% to 94% and plastic limits were from 28% to 30%.

Table 5: Hydrometer and Atterberg Limit Results - Glaciolacustrine Clay

Hydrometer and Atterberg Limit Analyses Results							
Sample Information	% Clay	% Silt	% Sand	% Gravel	Liquid Limit %	Plastic Limit %	MUSCS
RD20 Sample 4 – 1.0 m	83	17	0	0	83	30	CH
RD31 Sample 7 – 2.0 m	82	18	0	0	94	28	CH

Silt

Within the clay, a layer of silt was present in approximately half of the boreholes. The silt layer was generally low plastic, moist, soft to firm and light brown. Traces of clay were generally found within the silt. The silt layer was found at depths ranging between 0.3 m to 2.3 m, and was between 0.15 m and 1.4 m thick.

Laboratory testing of the silt material consisted of, moisture content determination, Atterberg limit testing, and hydrometer grain size analyses.

Moisture content testing, which is summarized in Table 6, indicated in-situ moisture contents ranging between about 19.7% and 42.2%. Moisture contents overall followed a slightly increasing trend with depth, however the degree of this increase was relatively small.

Table 6: Moisture Content Summary - Silt

Number of Tests	Maximum Moisture Content (%)	Minimum Moisture Content (%)	Average Moisture Content (%)
30	42.2	19.7	26.4

Hydrometer and Atterberg Limits tests were conducted on the silts encountered and are summarized in Table 7. For the soils tested, hydrometer and Atterberg Limits results suggest that the soil generally corresponds to either a CI or CL-ML classification in the MUSCS. The percentage of particles varied between 21% and 56% clay, 44% to 46%%, 0 to 22% sand and 0% to 11% gravel. Liquid limits varied from about 26% to 38% and plastic limits were the same at 18%.

Table 7: Hydrometer and Atterberg Limit Results – Silt

Hydrometer and Atterberg Limit Analyses Results							
Sample Information	**% Clay**	**% Silt**	**% Sand**	**% Gravel**	**Liquid Limit %**	**Plastic Limit %**	**MUSCS**
RD29 Sample 2 – 0.5 m	20	79	1	0	26	18	CL-ML
RD39 Sample 2 – 0.5 m	36	60	4	0	38	18	CI

6.1 SLOUGHING AND SEEPAGE CONDITIONS

The boreholes were left open for approximately 10 minutes after completion of drilling to observe short-term sloughing and seepage conditions. Some slight to moderate seepage and sloughing was noted within the upper 3 m of some of the boreholes generally from the silt or organic layers.

It should be noted that only short-term seepage and sloughing conditions were observed and that ground water levels can fluctuate annually, seasonally or as a result of construction activity.

6.2 AUGER REFUSAL

Practical auger refusal was not observed in any of the boreholes advanced at the site.

7.0 DISCUSSIONS AND RECOMMENDATIONS

7.1 LIFT STATION

7.1.1 General Evaluation

The soil conditions encountered at the Lift Station borehole location (LS01) are considered suitable for design and construction of the Lift Station. It is anticipated that the Lift Station will most likely comprise of a concrete structure supported on a clay subgrade. Based on the design embedment depth (i.e. 5m below grade) and expected light foundation loads, it is expected that the tank foundation could be designed on the basis of maintaining a *net bearing pressure* of zero (ie weight of structure is equal to or less than the weight of the soil being removed).

The following sections provide discussion and recommendations as they pertain to design and construction of the lift station, specifically: 'Ultimate' bearing pressure, lateral earth pressures for below grade walls; temporary construction dewatering requirements; and foundation concrete type.

7.1.2 Excavation Stability

7.1.2.1 Shoring

Based on the proximity of the rail line, it is envisioned that shoring or some other form of excavation support will be required to maintain excavation stability for construction of the lift station. The use of sloped excavations is likely not considered feasible to attain a base elevation of about 5m below current grade, either from the perspective of available space to construct sloped walls, nor from a short or long term stability perspective. In this regard, an open excavation would require side slopes of 2:1 or flatter, resulting in an extremely large excavation (25 m by 25 m at surface).

Currently, it is envisaged that suitable excavation support systems would consist of one of the following:

- A steel casing of sufficient diameter advanced to the required embedment using a piling rig; or
- A braced excavation box inclusive of lateral struts such that lateral support is provided to all four sides of the excavation. Due to the limited width of the excavation, the use of internal rakers would preclude work within the excavation, and as such, are not considered feasible for use as excavation support.

7.1.2.2 Lateral Earth Pressure

Given the firm to stiff consistency of the native clay overburden, the distribution of earth pressures against the walls of a braced shoring system will adopt the stress distribution illustrated in Figure B1, Appendix B. This figure should be used in sizing, and spacing of the struts.

Notwithstanding strut support requirements, the factor of safety of the braced shoring against base heave of the underlying soft normally consolidated lacustrine clay should be checked. The following expression may be used to check the factor of safety with respect to base heave, FS_b,:

$$FS_b = \frac{N_b S_u}{¥H + q_s}$$

where:
- FS_b = Factor of Safety against base heave
- N_b = Stability factor dependent upon geometry of the excavation (Assume 8.5 for a rectangular foundation with a depth to embedment ratio of 2)
- S_u = Undrained shear strength (Assume 35 kPa below base of excavation)
- γ = Bulk unit weight of the overburden (Assume 17 kN/m^3)
- H = height of wall (m)
- q_s = surcharge load (kN/m^2)

To preclude having to extend the shoring beyond the base of the excavation, a minimum factor of safety of 1.5 must be maintained. Based on a proposed excavation depth of about 5 m below current grades, FS_b is estimated to be about 2.0 assuming no surcharge loading adjacent to the excavation. Where surcharge loading adjacent to the excavation decreases the factor of safety to less than 1.5, the shoring must extend below the base of the excavation, and this office should be contacted for review and additional recommendations.

The effects of surcharge load should be applied where required. The surcharge considered should include the effects of loads from street traffic, construction equipment, and any other loads that may be transferred to the walls of the excavation during the construction period.

7.1.2.3 Construction Dewatering

Significant seepage and sloughing within the clay overburden above the anticipated excavation depth of about 5 m is not expected. Fluctuations in groundwater elevation can occur seasonally due to heavy rains and/or rises in the river level and therefore depending on when construction occurs, changes in groundwater levels may occur.

It is anticipated that where groundwater is observed within the excavation, it could be managed under normal conditions with an internal dewatering system comprised of construction sump and submersible pumps.

Primary concerns associated with using an internal dewatering system include the risk of loss of ground or washing of fines. The washing of fines and/or loss of ground could result in the siltation of collected groundwater, possibly resulting in a subsequent requirement to remove the fines (i.e. by sedimentation or filtering) prior to disposal in City storm sewers. Furthermore, the loss of ground is a serious concern where soils with potential for piping are present. Although the soils at the site are not considered particularly susceptible to piping under the anticipated excavation conditions, the loss of ground behind the shoring should be monitored, particularly where any silt layers are observed.

7.1.3 Lift Station Foundation

7.1.3.1 Ultimate Bearing Pressure

As previously discussed, it is envisaged that the outfall chamber will comprise a concrete foundation bearing on a clay subgrade at about 5 m below existing grade. Based on soil conditions encountered at the borehole location (LS01), subgrade conditions within the footprint of the lift station are expected to consist of firm to stiff native highly plastic clay. Given the soil conditions noted at the site, it is recommended that an unfactored Ultimate Limit State (ULS) bearing pressure of 300 kPa could be assumed in design of the lift station. In order to limit settlements to less than 25mm, the ‘serviceability’ limit state (SLS) should be designed for an applied bearing pressure of 90 kPa, which is roughly the weight of the soil being removed. It is cautioned however that additional settlement potential could be induced by disturbance and/or softening of the subgrade during construction.

The bearing surface of the lift station should be excavated in a manner to minimize disturbance of the subgrade. Further, the bearing surface should be trimmed free of softened or loose soil, protected against swelling and desiccation, kept free of water, and protected from any other detrimental environmental effects. The total elapsed time between the time foundation excavation is complete and the reinforcement steel and foundation concrete is placed should be kept to a minimum.

7.1.3.2 Buoyancy

Based on an assumed groundwater level at the site, the lift station will be subject to uplift due to buoyancy. For design purposes, the buoyancy force may be estimated assuming a groundwater table located at about 2 m below grade. This assumes that there is no sub-drainage system installed around the lift station. This also assumes that the upper pprtion of the lift station, as a minimum, will be backfilled with clay.

Resistance to buoyancy will be provided by the dead weight of the lift station and soil friction along the exterior sidewalls of the lift station. The available side friction resistance along the perimeter walls of the lift station will depend upon the construction method and/or backfill used along the perimeter of the structure. If the dead weight of the lift station is insufficient to resist buoyancy forces, AMEC can provide a recommended friction value for along the perimeter of the structure once final construction and backfill details are known.

7.1.3.3 Lateral Earth Pressures on Lift Station Walls

The permanent walls of the lift station will be required to resist lateral earth pressures and hydrostatic pressure from the surrounding soil and groundwater. Provided that the backfill placed against the wall is lightly compacted, the lateral soil pressure (*p*) distribution may be assumed to be trapezoidal in shape and increase linearly with depth as illustrated on Figure B2, Appendix B.

Lightly to moderately compacted backfill typically corresponds to soils placed and compacted to between 93 percent and 95 percent of standard Proctor maximum dry density (SPMDD). Settlements under the self weight of such compacted backfill is dependent on the soil type used, however usually do not exceed 2 percent of the fill height. In cases where the backfill is well to highly compacted, the additional lateral pressures induced on the wall by compaction must also be considered in the design of the below grade walls. AMEC can provide lateral earth pressure distributions for highly compactive backfill upon request.

It is anticipated that a braced excavation will be formed against the face of the excavation, and as such, limited relaxation of the retained soils will occur. As such, the use of the ‘at-rest’ lateral earth pressure coefficient K_o in the design of unyielding lift station walls is recommended. Outlined below in Table 8 are assumed design values for the ‘at rest’ lateral earth pressure coefficient as well as bulk unit weight of native highly plastic clay:

Table 8: Lateral Earth Pressure Coefficients and Total Unit Weights for Light to Moderately Compacted Soil

Soil Type	Angle of Internal Friction, ¤ (°)	'at-rest' Earth Pressure, K_o	Total Unit Weight, ¥= (kN/m^3)
Highly Plastic Clay	18	0.69	17
Granular	30	0.50	20

The earth pressure coefficient outlined in Table 8 is unfactored, and does not include any factor of safety.

It is recommended that a cap of clay, concrete or asphalt be placed at the ground surface adjacent to the foundation walls to reduce the migration of surface water into the underlying granular backfill materials. If a clay cap is used, a minimum thickness of approximately 0.5 m is recommended.

7.1.4 Frost Considerations

Based on local experience, an average annual frost penetration depth of 2.4 m is expected at the site. With respect to the potential for adfreeze and frost heave of the lift station, the base of the lift station will be located well below the depth of frost penetration at a depth of about 5m below grade. As such, the risk of frost uplift of lift station is considered low to negligible.

However, notwithstanding the above, the lift station will be required to extend through the zone of frost penetration. Portions of the lift station located within the depth of frost penetration must be structurally designed to resist increased lateral pressures induced by frost. In the case of unyielding walls exposed to frost penetration above the groundwater table, it is recommended that $K_o = 1.0$, be used to account for lateral frost pressures[1] .

7.2 SITE GRADING & ROADWAYS

Prior to rough site grading, fill areas and areas providing subgrade support (i.e. grade supported slab footprints, pavement areas, etc.) should be cleared of trees, stumps, brush, ground plants, and matted vegetation. Trees, brush, stumps, roots, etc. should be removed from site. Furthermore, organic topsoil, mineral soils with an organic content greater than about 6 to 7 percent (i.e. the surface organics noted on the logs as "moss"), and other deleterious material should be stripped and stockpiled outside of the footprint of cut and fill areas and areas providing subgrade support. Low organic mineral soils such as the organic clay noted below the surface organics (moss layer) containing less than 6 to 7 percent organic by weight may be considered relatively unaffected by the organic content from a subgrade suitability standpoint, and may be left in place in pavement areas, but should be removed from within building footprints to preclude any requirement for the installation of a methane extraction system within crawlspaces. Stockpiled topsoil and organic material may be re-used for landscaping only.

[1] As per Canadian Foundation Engineering Manual, 3rd Edition, P. 429, an earth pressure coefficient K=1 should be used in combination with insulation for highly frost susceptible soils.

Based on the borehole information, the exposed subgrade following site clearing and stripping of unsuitable materials is expected to consist of highly plastic clay, organic clays with less than 6 percent by organic content or potentially a shallow soft and wet silt layer. Typically, prior to the placement of any fill to achieve subgrade design elevations or final surface grades, exposed cohesive subgrades are scarified, moisture conditioned to within two to three percent of optimum moisture content (OMC), and compacted to at least 95 percent of standard Proctor maximum dry density (SPMDD). However, in the case of areas having wet silts at or just below subgrade, which are highly susceptible to disturbance (i.e. rutting, spreading, etc.) under concentrated loads, compaction of the natural subgrade may not be possible. This should be assessed at the time of construction.

It is understood that most of the roads constructed at the site will be raised well above the current grades. Accordingly, the construction and performance of asphalt and concrete pavements at this site will likely not be impacted in a significant way by the silt layers noted in the boreholes. In this regard, raising of site grades should provide an overall benefit to long term performance. Conversely, if there are areas where grades are at or below the current site grades, additional construction complications are likely to result and appropriate methods for dealing with the silt will be required. Given the thickness of the silt identified during the investigation, complete removal would likely not be cost effective and therefore other means of limiting the impact of the silt should be considered. Traditionally in the Winnipeg area, silts exposed at or near the subgrade elevation are sub-excavated to about 300 to 400mm below the design subgrade elevation and backfilled with 100 to 150mm crushed limestone rock placed on a geotextile fabric.

It is understood that standard Winnipeg road designs are to be utilized. Where requested, AMEC can provide site specific pavement designs, based on anticipated traffic loadings and design life.

7.3 PONDS

It is understood that a retention pond will be constructed as part of the industrial park. Four boreholes were advanced within the pond areas and the soils conditions generally consisted of native high plastic clay with 3 of 4 holes having a silt layer noted in the upper 1 to 2m. It is understood that the standard City of Winnipeg retention pond design (consisting of a 7H:1V slope below and above the summer water level) will be adopted. This City of Winnipeg design is understood to have been used successfully at numerous locations in the city and therefore represents an appropriate target level of stability (standard of practice) for the proposed retention pond.

Given the soil conditions noted (i.e. high plastic clay), typical excavation techniques are considered appropriate. Regardless of the slope design used in the pond area, special attention should be paid to any silt layers encountered during construction. Silt layers above the normal water level should be daylighted in the pond slopes with an appropriate filter (granular of synthetic) to drain groundwater carried in the silt layer and avoid the accumulation of

groundwater pressures which can cause stability concerns. Under no circumstances should the silt layer be capped with clay where it intersects the slope.

7.4 PIPING

Underground service utilities are commonly installed in the Winnipeg area using trenching methods. On that basis, typical construction methods are considered appropriate for the installation of underground utilities.

Standard excavation of trenches is considered suitable at this location for purposes of installing underground services and piping, provided that trench excavations will be less than about 3 m in depth. Trench excavations should include minimum slopes of 1:1. Alternatively, trench walls can be cut vertical or near vertical provided that a trench cage is used to protect down hole workers. As a minimum, all trench excavations should comply with the requirements of the Manitoba Workplace Safety and Health Act and Guidelines, and the Workers Compensation Board. The trenching work should be undertaken by experienced contractors and should also be closely supervised by knowledgeable safety personnel. Trench excavations which experience unusual difficulties should be brought to the immediate attention of the geotechnical consultant so that remedial work can be undertaken.

The trench should be cut to a width a minimum of 0.6 m plus the pipe diameter to accommodate placement and compaction of granular bedding material. Bedding material at least 0.3 m thick placed above and below the pipes should be used to provide suitable load distribution. The bedding material should be nominally compacted to a maximum of 95% of standard Proctor maximum dry density (SPMDD). Excessive compaction of the bedding material should be avoided to prevent damage to the utilities.

It is understood that the the pipes will need to be protected from freezing conditions, which may be accomplished by providing a sufficient thickness of cover material (soil or granular), utilizing insulated and heat traced pipes or by providing a sufficient thickness of synthetic insulation. About 2.4 m of soil cover is generally sufficient in the Winnipeg area.

7.4.1 Backfill

Fill used to backfill trench excavations should be compacted to a standard that is in keeping with the performance requirements of the finished area. If the area is not planned for an end use (such as for landscaping, staging areas, etc.), a minimum compaction standard and common fill materials could be considered. For finished areas that require a higher level of performance (such as roadways) a compaction level in the order of about 95 to 98% of SPMDD is recommended. As well, select fill materials should be used and in this regard, the native excavated soils are not recommended for such areas, as they can be difficult to compact within confined areas. Trench backfill should consist of materials consistent with the City of Winnipeg Standard Construction specification for underground works.

7.5 FOUNDATION CONCRETE TYPE

Where concrete elements outlined in this report and all other concrete in contact with the local soil will be subjected in service to weathering, sulphate attack, a corrosive environment, or saturated conditions, the concrete should be designed, specified, and constructed in accordance with concrete exposure classifications outlined in CSA standard A23.1-09, Concrete Materials and Methods of Concrete Construction. In addition, all concrete must be supplied in accordance with current Manitoba and National Building Code requirements.

Based on AMEC's experience in Winnipeg, water soluble sulphate concentrations in the soil are typically in the range of 0.2% to 2.0%. As such, the degree of sulphate exposure at the site may be considered as 'severe' in accordance with current CSA standards, and the use of sulphate resistance cement (Type HS or HSb) is recommended for concrete in contact with the local soil. Furthermore, air entrainment should be incorporated into any concrete elements that are exposed to freeze-thaw to enhance its durability.

It should be recognized that there may be structural and other considerations, which may necessitate additional requirements for subsurface concrete mix design.

8.0 TESTING AND MONITORING

All engineering design recommendations presented in this report are based on the assumption that an adequate level of testing and monitoring will be provided during construction and that all construction will be carried out by a suitably qualified contractor experienced in foundation and earthworks construction. An adequate level of testing and monitoring is considered to be:

- for excavations:
  - monitor the groundwater conditions prior to construction.
  - evaluate the excavation base after completion of excavation to assess the basal stability and seepage conditions for dewatering assessment
  - monitor the installation of sheet piles
  - monitor vertical and horizontal shoring movements
- for foundations:
  - design review and review of the bearing surface prior to placement of concrete.
- for concrete construction:
  - testing of plastic and hardened concrete in accordance with CSA A23.1-09 and A23.2-09.
  - review of concrete supplier's mix designs for conformance with prescribed and/or performance concrete specifications.

AMEC requests the opportunity to review the design drawings and the installation of the lift station to confirm that the geotechnical recommendations have been correctly interpreted. AMEC further requests the opportunity to review the soil and groundwater conditions encountered as excavation proceed so that the assumptions made in preparing this report can either be confirmed, or so that recommendations provided in this report can be modified to reflect such different conditions as are encountered.

The contractor should be advised that it is anticipated that the geotechnical engineer will not be on site on a full-time basis. Therefore, the timely reporting by contractor staff of unusual events such as, but not limited to, loss of ground, changes in soil behaviour, movements of roadway surfaces and shoring, and changes in dewatering volumes will be very important in ensuring a suitably rapid response to potentially serious circumstances.

AMEC would be pleased to provide any further information that may be needed during design and to advise on the geotechnical aspects of specifications for inclusion in contract documents.

9.0 CLOSURE

The findings and recommendations presented herein for design of the proposed Lift Station and development are based on a geotechnical evaluation of the findings in the geotechnical boreholes drilled at the site. If conditions are encountered that appear to be different from those shown in the borehole log and described in this report, or if the assumptions stated herein are not in keeping with the design, AMEC should be notified and given the opportunity to review the current recommendations in light of any new findings. Recommendations presented herein may not be valid if an adequate level of inspection is not provided during construction, or if relevant building code requirements are not met.

Soil conditions, by their nature, can be highly variable across a construction site. The placement of fill during and prior to construction activities on a site can contribute to variable soil conditions. A contingency amount should be included in the construction budget to allow for the possibility of variations in soil conditions, which may result in modification of the design, and/or changes in construction procedures.

This report has been prepared for the exclusive use of Terracon Developments, and their design agents, for specific application to the development described within this report. The data and recommendations provided herein should not be used for any other purpose, or by any other parties, without review and written advice from AMEC.

The findings and recommendations of this report have been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty is made, either expressed or implied.

Respectfully submitted,

AMEC Environmental & Infrastructure
a division of AMEC Americas Limited

Trevor Gluck, P. Eng.
Senior Geotechnical Engineer

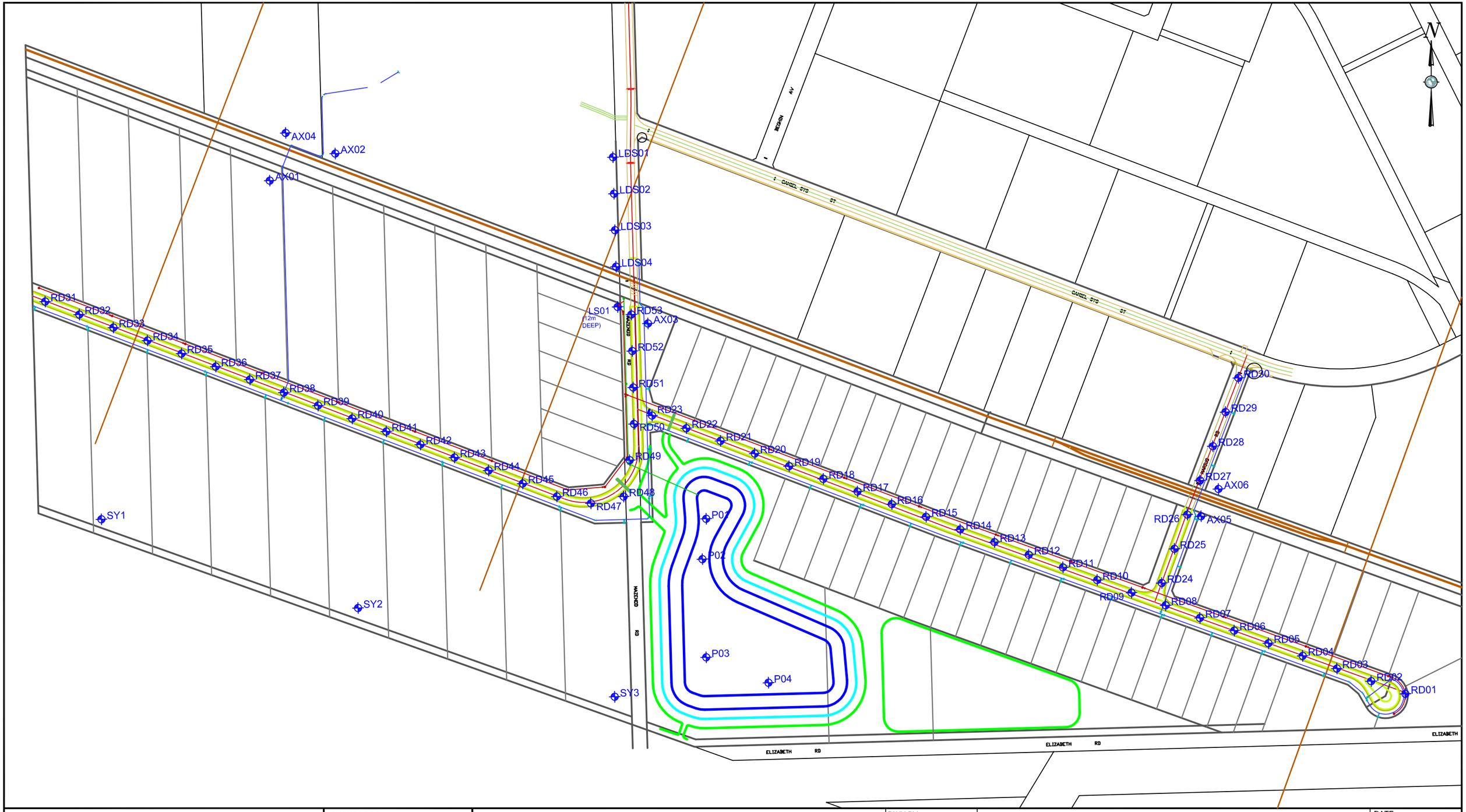
Reviewed By:
Harley Pankratz, P. Eng.
VP: Eastern Prairies/Northern Alberta

PROVINCE OF MANITOBA
T. R.
GLUCK
Member
22305
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
AMEC Environment & Infrastructure, a
Division of AMEC Americas Limited
No. 555 Date: SEPT 23/13

APPENDIX A

SITE PLAN
&
BOREHOLE LOGS



NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT No. WX17188 DATED JULY 2013.

CLIENT LOGO

CLIENT:
TERRACON DEVELOPMENTS

AMEC Environment & Infrastructure
440 DOVERCOURT DRIVE
WINNIPEG, MANITOBA R3Y 1N4
PHONE: 204.488.2997 FAX:204.489.8261

DWN BY:	MD
CHK'D BY:	RB
DATUM:	NAD83
PROJECTION:	UTM Zone 14 U
SCALE:	AS SHOWN

GEOTECHNICAL INVESTIGATION
PROPOSED PRAIRIE INDUSTRIAL PARK
NEAR MAZENOD AND CAMIEL SYS
WINNIPEG, MANITOBA

TEST HOLE LOCATION PLAN

DATE:	SEPTEMBER 2013
PROJECT NO:	WX17188
REV. NO.:	A
FIGURE No.	FIGURE 1

P:\Jobs\17100's\17180's\17188 – Terracon – St Boniface Industrial park\Geotech\Drawings\Current\WX17188 – REVISED.dwg – FIG 1 – Sep. 20, 2013 2:35pm – anthony.lospe

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **AX03**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, trace rootlets, trace organics, high plastic, moist, firm, grey		1			
		CH			2			
1								1
			SILT - trace clay, low plastic, moist, soft, tan to light brown		3			
		ML						
			- very moist below 1.7m					
			CLAY - silty, high plastic, moist, firm - stiff, greyish brown, occasional oxidation and occasional silt inclusions					
2					4			2
3					5			3
		CH						
4					6			4
5								5
6					7			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

17188 - TERRACON - ST BONIFACE INDUSTRIAL PARK.GPJ 13/09/24 09:15 AM (GEOTECHNICAL REVISED)

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AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: AL	COMPLETION DEPTH: 6.1 m
REVIEWED BY: RB	COMPLETION DATE: August 21, 2013
Figure No. 2	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **AX05**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace rootlets to 0.3m, high plastic, moist, stiff, brownish grey, occasional silt inclusions		2			
1			- greyish brown below 0.8m					1
					3			
2					4			2
			- firm, brown, occasional sulphate inclusions below 2.3m					
3					5			3
			- trace sand, occasional to frequent sulphate inclusions at 3.1m					
4								4
					6			
		CH	- firm to stiff, greyish brown below 4.6m					
5								5
6					7			6
			- firm, occasional to frequent silt inclusions ~3mm dia. below 6.1m					
7								7
					8			
			- soft to firm, dark greyish brown below 7.6m					
8								8
			- grey to dark grey below 8.5m					
9					9			9
			TEST HOLE TERMINATED AT 9.1m BELOW EXISTING GRADE					
10			NOTES: Very slight squeezing was observed below 8.5m during drilling. No seepage was encountered during drilling. Test hole remained open to 8.5m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					10
11								

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LOGGED BY: AL	COMPLETION DEPTH: 9.1 m
REVIEWED BY: RB	COMPLETION DATE: July 12, 2013
Figure No. 3	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **LDS01**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, trace rootlets, high plastic, moist, stiff to very stiff, grey to dark grey, occasional oxidation inclusions		1			
					2			
1			- trace fine grained sand, stiff, grey below 0.8m					1
					3			
			- brown, stiff to firm below 1.5m - frequent silt lenses approximately 20mm thick from 1.5m to 1.7m					
2					4			2
			- firm below 2.3m					
3		CH	- occasional sulphate inclusions below 3m		5			3
4								4
					6			
			- dark greyish brown below 4.6m					
5								5
6					7			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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Winnipeg, Manitoba

LOGGED BY: AL	COMPLETION DEPTH: 6.1 m
REVIEWED BY: RB	COMPLETION DATE: August 26, 2013
Figure No. 4	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **LDS02**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY (FILL) - silty, some sand, high plastic, moist, very stiff, dark greyish brown		1			
		CH	- grey, trace wood debris, frequent grey silt inclusions, hard below 0.6m		2			
1			CLAY - silty, trace rootlets, high plastic, moist, very stiff, dark greyish brown, occasional sulphate inclusions		3			1
2			- frequent silt lenses approximately 20mm thick, firm, brown from 2.1m to 2.3m		4			2
3			- greyish brown, occasional oxidation inclusions below 3m		5			3
		CH						
4								4
			- dark greyish brown below 4.6m		6			
5								5
			- grey to dark grey, soft, occasional to frequent sulphate inclusions below 5.5m					
6					7			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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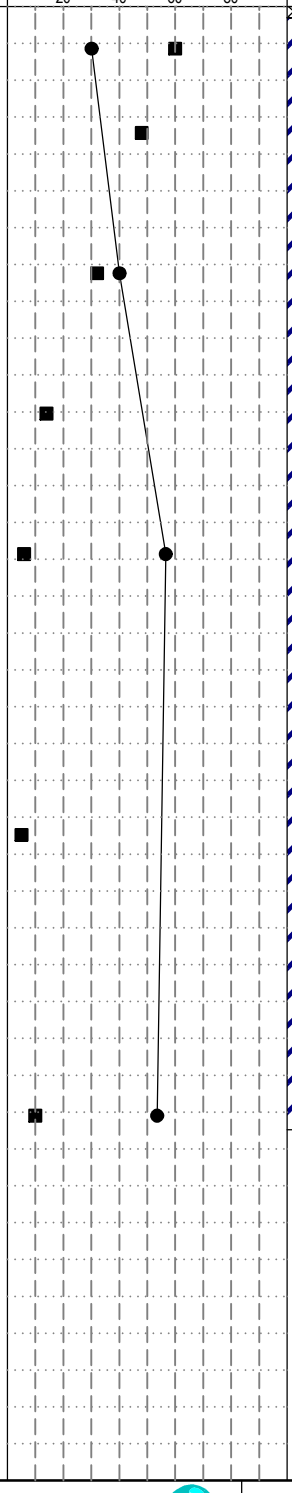
LOGGED BY: AL	COMPLETION DEPTH: 6.1 m
REVIEWED BY: RB	COMPLETION DATE: August 26, 2013
Figure No. 5	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **LDS03**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
			CLAY - silty, trace fine grained sand, high plastic, moist, very stiff, greyish brown, occasional oxidation inclusions		1			
					2			
1								1
			- brown, stiff, occasional sulphate inclusions below 1.5m		3			
2								2
			- occasional sulphate lenses approximately 20mm thick, brown, firm from 2.1m to 2.3m		4			
3		CH			5			3
			- occasional to frequent sulphate and oxidation inclusions, soft below 3m					
4								4
					6			
			- occasional oxidation and sulphate inclusions below 4.6m					
5								5
6					7			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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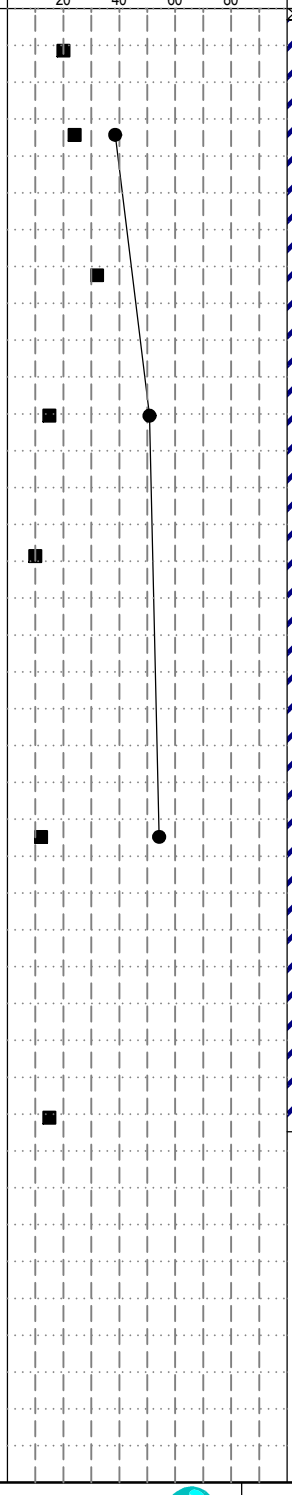
REVIEWED BY: RB	COMPLETION DATE: August 26, 2013
Figure No. 6	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **LDS04**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional oxidation inclusions		1			
					2			
1								1
					3			
			- brown, occasional sulphate and silt inclusions below 1.5m					
2								2
			- firm below 2.3m		4			
3		CH	- occasional to frequent sulphate, firm below 3m		5			3
4								4
			- dark greyish brown below 4.6m		6			
5								5
6					7			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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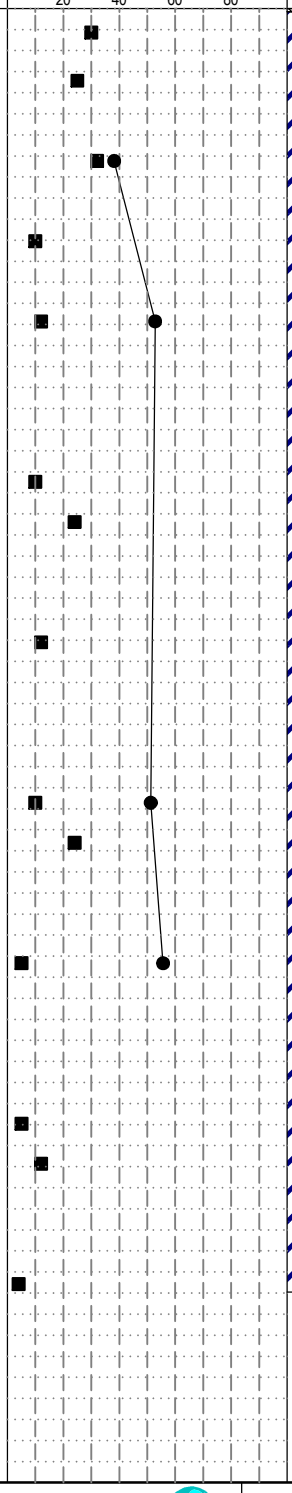
LOGGED BY: AL	COMPLETION DEPTH: 6.1 m
REVIEWED BY: RB	COMPLETION DATE: August 26, 2013
Figure No. 7	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **LS01**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
			CLAY - silty, trace rootlets, trace organics high plastic, moist, stiff, grey, occasional oxidation inclusions		2			
1			- no rootlets and organics, greyish brown below 0.8m					1
					3			
2					4			2
			- firm to stiff, brown below 2.3m					
3					5			3
4					6			4
					7		Unconfined Compressive Strength @4.6m: 88.9 kPa @ 3.6% Strain	
5			- grey, stiff below 5.1m					5
6		CH	- firm below 6.1m		8			6
7					9			7
					10		Unconfined Compressive Strength @4.6m: 75.9 kPa @ 2.2% Strain	
8								8
9			- soft to firm below 9.1m		11			9
10								10
					12			
11					13		Unconfined Compressive Strength @4.6m: 89.8 kPa @ 3.2% Strain	11
12					14			12
			TEST HOLE TERMINATED AT 12.1m BELOW EXISTING GRADE					
13			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 12.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					13
14								

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LOGGED BY: AL	COMPLETION DEPTH: 12.2 m
REVIEWED BY: RB	COMPLETION DATE: August 21, 2013
Figure No. 8	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **P01**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		CH	CLAY -silty, trace organics, trace rootlets, high plastic, moist, firm, mottled grey and dark grey		2			
1			- stiff, greyish brown, frequent silt inclusions, no organics and no rootlets below 0.8m		3			1
		ML	SILT - trace clay, low plastic, moist, firm to soft, tan-brown, occasional oxide inclusions below 0.9m		4			
2			CLAY - silty, high plastic, moist, stiff to very stiff, brown, occasional to frequent silt inclusions, occasional oxide inclusions		5			2
			- firm, occasional silty inclusions below 2.3m					
3					6			3
4								4
					7			
5		CH						5
6					8			6
			- soft, grey below 6.4m					
7								7
					9			
8								8
9					10			9
			TEST HOLE TERMINATED AT 9.1m BELOW EXISTING GRADE					
10			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 9.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					10
11								

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LOGGED BY: AL	COMPLETION DEPTH: 9.1 m
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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **P02**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		CH	CLAY -silty, high plastic, moist, stiff, mottled grey and dark grey		1			
		ML	SILT - trace clay, low plastic, moist, soft, tan-brown		2			
1			CLAY -silty, high plastic, moist, stiff to very stiff, greyish brown, occasional oxide inclusions, occasional sulfate inclusions		3			1
2					4			2
3			- firm to stiff, brown below 3.0m		5			3
4					6			4
5		CH	- occasional silt inclusions below 4.6m		7			5
6			- soft, grey below 6.4m		8			6
7								7
8					9			8
9			TEST HOLE TERMINATED AT 9.1m BELOW EXISTING GRADE					9
10			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 9.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					10
11								

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Figure No. 10	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **P03**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
			CLAY - silty, high plastic, moist, stiff, greyish brown		2			
1								1
			- occasional silt inclusions, occasional sulfate inclusions below 1.5m		3			
2								2
			- occasional oxide inclusions below 2.3m		4			
3								3
			- firm, brown below 3.0m		5			
4								4
		CH	- occasional to frequent oxide inclusions below 4.6m		6			
5								5
6					7			6
			- grey, soft, no oxide inclusions below 6.7m					
7								7
8					8			8
9					9			9
			TEST HOLE TERMINATED AT 9.1m BELOW EXISTING GRADE					
10			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 9.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					10
11								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **P04**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		CH	CLAY - silty, trace rootlets, trace organics, medium plastic, moist, very stiff, dark brownish grey		2			
1			- greyish brown, occasional sulfate inclusions below 0.8m		3			1
		ML	SILT - trace clay, low plastic, damp, friable, crumbly, light brown to tan, occasional sulfate and occasional oxide inclusions		4			
			CLAY - silty, high plastic, moist, very stiff, greyish brown, occasional sulfate and occasional silt inclusions		5			
2			- frequent silt layers (~25mm thick), firm to stiff, brown between 1.5m and 1.m		6			2
			- stiff, brown, frequent silty and frequent sulfate inclusions below 2.3m					
3					7			3
			- firm, occasional silt and occasional sulfate, and occasional oxidation inclusions below 3.0m					
4								4
					8			
			- no sulfate inclusions below 4.6m					
5		CH						5
6					9			6
7			- grey, soft below 7.0m					7
					10			
8								8
9					11			9
			TEST HOLE TERMINATED AT 9.1m BELOW EXISTING GRADE					
10			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 9.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					10
11								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD01**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace organics to 0.3m, high plastic, moist, firm to stiff, dark greyish brown		2			
			- stiff, greyish brown below 0.6m		3			
1					4			1
			- occasional silt lenses ~25mm thick between 1.2m to 1.5m		5			
					6			
2					7			2
3		CH			8			3
4					9			4
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD02**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, stiff, greyish brown		2			
					3			
1					4			1
			- brown, occasional silt inclusions below 1.2m		5			
		CH			6			
2					7			2
3			- firm below 3m		8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD03**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace rootlets to 0.3m, high plastic, moist, stiff, dark grey to black		2			
					3			
1		CH			4			1
					5			
					6			
			- some silt and clay lenses ~15mm thick at 1.8m					
2		ML	SILT - trace clay, low plastic, moist to very moist, firm, tan-brown, occasional oxidation inclusions		7			2
			CLAY - silty, high plastic, moist, firm to stiff, greyish brown					
3					8			3
4		CH						4
			- occasional silt inclusions below 4.6m		9			
5								5
6			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE		10			6
			NOTES:					
			- no sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD04**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics and rootlets to 0.6m, high plastic, moist, stiff, grey to dark grey		2			
		CH			3			
1					4			1
			SILT - some clay, low to medium plastic, moist, firm, tan-brown		5			
		ML			6			
			- moist to very moist, firm to soft below 1.8m					
2			CLAY - silty, high plastic, moist, stiff, greyish brown		7			2
		CH						
3					8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD05**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		2			
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, stiff, dark grey to black		3			
1					4			1
					5			
					6			
2					7			2
3		CH			8			3
4					9			4
5								5
6			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE		10			6
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD06**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		2			
			CLAY - silty, trace rootlets to 0.3m, high plastic, moist, stiff, dark grey to black		3			
1			- greyish brown, occasional sulphate inclusions below 0.6m		4			1
			- stiff, brown below 0.9m		5			
		CH			6			
2					7			2
3			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE		8			3
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD07**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace rootlets to 0.3m, high plastic, moist, stiff, dark grey		2			
			- dark greyish brown below 0.6m		3			
1					4			1
					5			
			- brown, occasional sulphate inclusions below 1.5m		6			
2					7			2
			- firm below 2.1m					
3		CH	- occasional to frequent sulphate inclusions at 3.1m		8			3
4								4
			- occasional sulphate inclusions below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD08**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, stiff, mottled dark grey and brown		2			
			- greyish brown below 0.6m		3			
1					4			1
					5			
		CH	- brown below 1.5m		6			
			- occasional silt lenses ~20mm thick at 1.8m		7			
2								2
3					8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD09**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace rootlets to 0.3m, high plastic, moist, firm, light grey to grey, frequent silt lenses ~10mm thick		2			
			- soft to firm, greyish brown below 0.6m		3			
1			- stiff, frequent silt lenses ~25mm thick below 0.9m		4			1
			- brown, occasional oxidation inclusions below 1.2m		5			
					6			
2					7			2
			- firm, mottled grey and brown below 2.1m					
3		CH	- greyish brown below 3.1m		8			3
4								4
					9			
5								5
6			- soft to firm, dark greyish brown below 5.9m		10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD10**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		CH	CLAY - silty, trace rootlets to 0.3m, high plastic, moist, firm, greyish brown, occasional oxidation inclusions		2			
					3			
1			- stiff below 0.9m - firm to stiff, frequent silt inclusions below 1.1m		4			1
		ML	SILT - trace clay, low plastic, very moist to wet, soft, tan-brown		5			
			CLAY - silty, high plastic, moist, firm to stiff, greyish brown		6			
2					7			2
		CH						
3			- firm, brownish grey below 2.9m		8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE NOTES: - No sloughing was encountered during drilling. Slight seepage was observed below 1.7m below grade during drilling. Test hole remained open to 3.1m and water level was measured at 1.7m below grade upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD11**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics, high plastic, moist, firm, greyish brown		2			
		CH	- brown below 0.6m		3			
1			- stiff below 0.9m		4			1
			- occasional oxidation below 1.2m					
			SILT - trace clay, low plastic, moist, soft to firm, tan-brown, occasional sulphate and oxidation inclusions		5			
		ML			6			
2			- very moist to wet, soft below 1.8m					2
			CLAY - silty, high plastic, moist, firm to stiff, tan-brown, frequent silt inclusions		7			
3			- firm, greyish brown below 3.1m		8			3
4		CH						4
			- soft to firm, grey below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing was encountered during drilling. Slight seepage was observed below 1.8m below grade during drilling. Test hole remained open to 6.1m and water level was measured at 5.9m below grade upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD12**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, firm, greyish brown		2			
					3			
1			- firm to stiff below 0.9m					1
		CH	- stiff, brown below 1.2m		4			
					5			
			- occasional sulphate and oxidation inclusions below 1.5m		6			
			- occasional to frequent oxidation and silt inclusions below 1.8m		7			
2								2
		ML	SILT - trace clay, low plastic, very moist to wet, soft, tan-brown		8			
		CH	CLAY - silty, high plastic, moist, firm, brown to tan, frequent silt inclusions		9			
3			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					3
			NOTES:					
			- No sloughing was encountered during drilling. Slight seepage was observed below 2.6m below grade during drilling. Test hole remained open to 3.1m and water level was measured at 2.9m below grade upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD13**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organic to 0.3m, high plastic, moist, firm, grey to dark grey		2			
			- mottled grey and brown below 0.6m		3			
1		CH	- stiff, brown below 0.9m		4			1
					5			
			- occasional oxidation and sulphate inclusions below 1.5m		6			
			- firm below 1.8m					
2		ML	SILT - trace clay, low plastic, moist to very moist, soft, tan-brown		7			2
			CLAY - silty, high plastic, moist, firm to stiff, greyish brown, occasional silt inclusions					
3					8			3
4		CH						4
			- firm, dark greyish brown below 4.6m		9			
5								5
6			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE		10			6
			NOTES: - Very slight sloughing was encountered below 2.4m below grade during drilling. Moderate seepage was observed below 2.4m below grade during drilling. Test hole remained open to 5.8m and water level was measured at 3.1m below grade upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD14**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, firm, grey to dark grey		2			
			- greyish brown, occasional oxidation inclusions below 0.6m		3			
1		CH	- firm to stiff below 0.9m		4			1
			- stiff below 1.2m		5			
			- brown below 1.5m					
		ML	SILT - some clay, low to medium plastic, moist, firm, tan-brown		6			
2			CLAY - silty, high plastic, moist, stiff, tan-brown, occasional silt and oxidation inclusions		7			2
		CH						
			- firm to stiff, greyish brown below 2.7m		8			
3			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					3
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD15**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		CH	CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, stiff, grey to dark grey		2			
					3			
1			- greyish brown, occasional oxidation inclusions below 0.9m					1
		ML	SILT - some clay, low plastic, moist, firm, tan-brown		4			
			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional silt inclusions		5			
					6			
			- stiff to very stiff below 1.8m					
2					7			2
			- firm to stiff, dark greyish brown below 2.1m					
3					8			3
			- abundant silt lenses ~20mm thick, moist to very moist at 3.1m					
		CH						
4								4
					9			
			- firm below 4.6m					
5								5
6			- grey to dark grey below 5.9m		10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD16**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH CH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		ML	CLAY - silty, trace sand, high plastic, moist, soft to firm, mottled tan and grey, frequent silt inclusions		2			
			SILT - clayey, low to medium plastic, moist, soft to firm, tan-brown		3			
1			CLAY - silty, high plastic, moist, stiff, greyish brown, frequent silt inclusions		4			1
			- occasional silt inclusions below 1.2m		5			
			- frequent silt lenses ~5mm thick at 1.5m		6			
2		CH	- brown, occasional oxidation inclusions below 1.8m		7			2
3			- firm, greyish brown below 2.9m		8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD17**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace organics lenses ~5mm thick to 0.3m, high plastic, moist, firm to stiff, mottled brown to dark grey		2			
			- some organics at 0.6m		3			
1			- stiff, brown below 0.9m		4			1
			- greyish brown below 1.2m		5			
					6			
2			- occasional sulphate inclusions below 1.8m		7			2
3		CH	- firm, dark greyish brown below 3.1m		8			3
4								4
					9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD18**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics to 0.3m, high plastic, moist, firm to stiff, grey to dark grey		2			
			- brown, occasional oxidation inclusions below 0.6m		3			
1		CH	- stiff below 0.9m		4			1
			- very stiff, occasional to frequent oxidation inclusions below 1.5m		5			
			- mottled tan and brown, occasional to frequent sulphate and oxidation inclusions below 1.8m		6			
2								2
		ML	SILT - trace clay, low plastic, moist, soft to firm, tan-brown, occasional oxidation inclusions		7			
		CH	CLAY - silty, high plastic, moist, stiff, greyish brown					
3					8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing was encountered during drilling. Slight seepage was observed below 1.7m below grade during drilling. Test hole remained open to 3.1m and water level was measured at 1.7m below grade upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD19**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, some organics to 0.3m, high plastic, moist, firm, dark grey to brown		2			
			- stiff, greyish brown below 0.6m		3			
1					4			1
			- brown below 1.2m		5			
			- brown to light brown, occasional silt inclusions below 1.5m		6			
2					7			2
3		CH	- firm, greyish brown below 3.1m		8			3
4								4
			- grey, occasional sulphate inclusions below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD20**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace organics to 0.3m, high plastic, moist, stiff, greyish brown, occasional oxidation inclusions - occasional rootlets to 0.8m		2 3			
1			30 83		4		Hydrometer Analysis Results @ "1.1m": Gravel= 0.0% Sand= 0.5% Silt= 16.5% Clay= 83.0%	1
		CH	- brown, occasional sulphate and oxidation inclusions below 1.5m - occasional to frequent silt lenses ~10mm thick between 1.5m to 1.7m		5 6 7			
2								2
3			- firm below 2.7m		8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD21**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace organics to 0.3m, high plastic, moist, stiff, dark grey to grey, occasional oxidation inclusions		2			
			- occasional silt inclusions below 0.6m		3			
1			- greyish brown below 0.9m		4			1
					5			
			- brown below 1.5m		6			
2					7			2
3		CH	- firm below 3.1m		8			3
4					9			4
			- greyish brown below 4.6m					
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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Figure No. 33	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD22**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		CH	CLAY - silty, trace organics to 0.3m, high plastic, moist, stiff, dark greyish brown, occasional rootlets and oxidation inclusions		2			
		ML	SILT - some clay, low to medium plastic, moist, firm, mottled grey and brown		3			
1			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional silt inclusions		4			1
					5			
			- stiff to very stiff below 1.5m		6			
2		CH	- firm to stiff below 2.1m		7			2
3					8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
4			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					4
5								5
6								6
7								7
8								

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Figure No. 34	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD23**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH CH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		2			
			CLAY - silty, some organics, trace rootlets to 0.3m, high plastic, moist, stiff, grey to dark grey		3			
			SILT - trace clay, low plastic, moist, firm, tan-brown		4			
1		ML	- soft to firm below 0.6m					1
			- moist to very moist, soft below 0.9m		5			
			- light grey to tan-brown, occasional oxidation inclusions below 1.2m		6			
			CLAY - silty, high plastic, moist, stiff, greyish brown		7			
2					8			2
			- firm to stiff below 2.1m					
3					9			3
		CH						
4					10			4
			- firm, occasional sulphate inclusions below 4.6m					
5								5
6					11			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD24**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, high plastic, moist, stiff, grey		1			
		CH			2			
					3			
1			- greyish brown, occasional sulphate inclusions below 0.9m					1
		ML	SILT - trace clay, low plastic, moist to very moist, soft, tan-brown		4			
			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional sulphate and silt inclusions		5			
					6			
2			- very stiff, brown below 1.8m					2
					7			
		CH	- stiff, frequent silt lenses ~25mm thick between 2.1m and 2.3m					
3			- grey below 2.9m		8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing was encountered during drilling. Very slight seepage was observed below 1.4m below grade during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD25**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey					
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, firm, dark greyish brown		2			
			- stiff, brown, occasional silt inclusions below 0.6m		3			
1					4			1
					5			
					6			
2					7			2
			- firm, greyish brown, occasional oxidation inclusions below 2.1m					
3		CH			8			3
4								4
					9			
			- soft to firm below 4.6m					
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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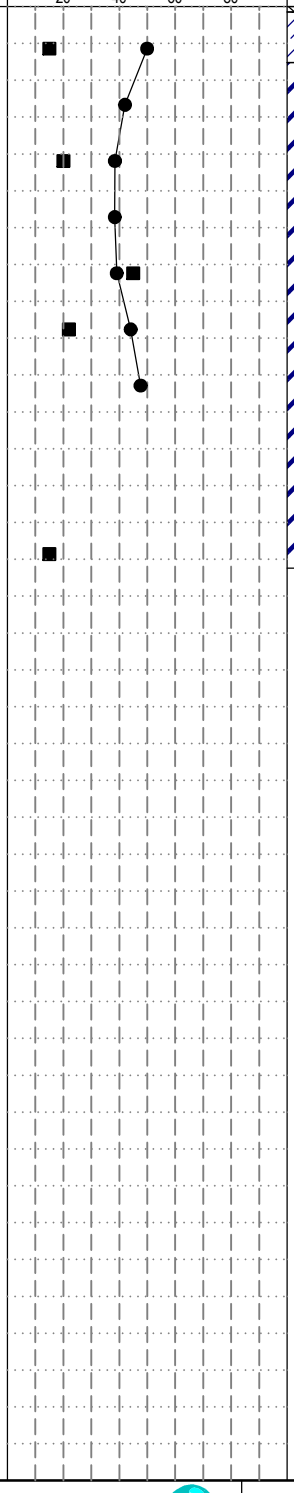
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD26**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, high plastic, greyish brown, frequent rootlets		1			
			CLAY - silty, high plastic, moist, stiff, greyish brown		2			
					3			
1			- mottled brown below 0.9m					1
			- brown, occasional silt inclusions below 1.0m		4			
			- stiff to very stiff below 1.2m		5			
		CH			6			
2					7			2
			- frequent silt inclusions below 2.4m					
3			- silt lamination at 2.9m		8			3
			- firm below 2.9m					
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD27**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~38mm thick					0
			CLAY - silty, trace fine grained sand, high plastic, moist, very stiff, greyish brown		1			
					2			
					3			
1			- stiff below 0.9m		4			1
			- occasional sulphate inclusions below 1.2m		5			
			- brown, occasional silt inclusions below 1.5m		6			
2					7			2
3		CH	- firm, dark greyish brown below 3m		8			3
4								4
			- soft to firm below 4.6m		9			
5			- grey below 5.5m					5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing and seepage encountered upon completion of drilling. Test hole remained open to 6.10m below grade upon completion. Test hole was backfilled with auger cuttings.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD28**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, high plastic, moist, firm to stiff, brown, frequent rootlets		1			
			- dark grey between 0.5m and 0.6m		2			
			- brownish grey below 0.6m		3			
1					4			1
			- brown below 1.2m		5			
		CH	- stiff to very stiff below 1.5m		6			
			- occasional silt inclusions below 1.8m		7			
2								2
3			- firm below 2.9m		8			3
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD29**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~38mm thick					0
		CH	CLAY - silty, high plastic, moist, stiff, mottled grey and tan, stiff, frequent lenses approximately 20mm thick		1			
			SILT - trace clay, low plastic, moist to very moist, soft to firm, tan-brown, occasional oxidation inclusions		2		Hydrometer Analysis Results @ "0.5m": Gravel= 0.0% Sand= 1.6% Silt= 78.5% Clay= 19.9%	
1		ML	- occasional clay lenses approximately 15mm thick, soft to firm below 0.9m		3			1
					4			
		CH	CLAY - silty, high plastic, moist, stiff, greyish brown, occasional silt inclusions		5			
		ML	SILT - trace clay, low plastic, moist, firm, tan-brown					
			CLAY - silty, high plastic, moist, stiff, greyish brown, frequent silt inclusions		6			
2			- firm, occasional sulphate and oxidation inclusions below 2.1m		7			2
3					8			3
4		CH						4
					9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
7			NOTES: - No sloughing and seepage encountered upon completion of drilling. Test hole remained open to 6.10m below grade upon completion. Test hole was backfilled with auger cuttings.					7
8								

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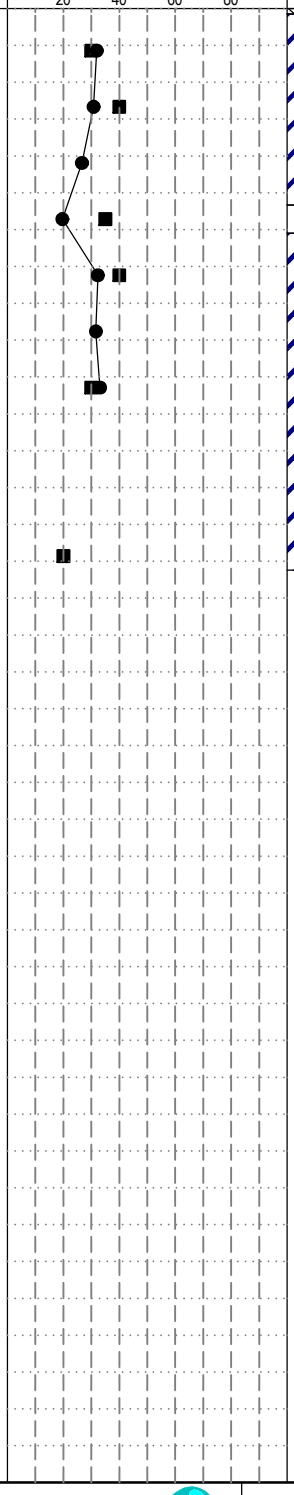
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD30**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, high plastic, moist, firm, brown, frequent silt inclusions, frequent rootlets		1			
		CH	- stiff to very stiff, dark grey, frequent rootlets between 0.5m and 0.6m		2			
			- firm, greyish brown, occasional rootlets at 1m		3			
1		ML	SILT - trace clay, low plastic, stiff, damp to moist, tan-brown		4			1
			CLAY - silty, high plastic, moist, stiff to very stiff, mottled brown, frequent silt inclusions		5			
					6			
2			- frequent silt layers (~40mm thick) below 1.8m		7			2
		CH						
3					8			3
			TEST HOLE TERMINATED 3.0m BELOW GRADE NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD31**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

28 94

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, trace rootlets, high plastic, moist, firm to stiff, grey to dark grey		1			
			- no rootlets, stiff, occasional silt inclusions below 0.6m		2			
			- greyish brown, occasional sulphate inclusions below 0.9m		3			
1			- 75mm thick silt layer at 1.2m		4			1
			- brown below 1.5m		5			
			- occasional oxidation inclusions below 1.8m		6			
2			- firm to stiff below 2.1m		7		Hydrometer Analysis Results @ "2.0m": Gravel= 0.0% Sand= 0.2% Silt= 18.2% Clay= 81.6%	2
3		CH	- firm, brown to light brown below 3m		8			3
4								4
			- occasional sulphate inclusions below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing and seepage encountered upon completion of drilling. Test hole remained open to 6.10m below grade upon completion. Test hole was backfilled with auger cuttings.					
7								7
8								

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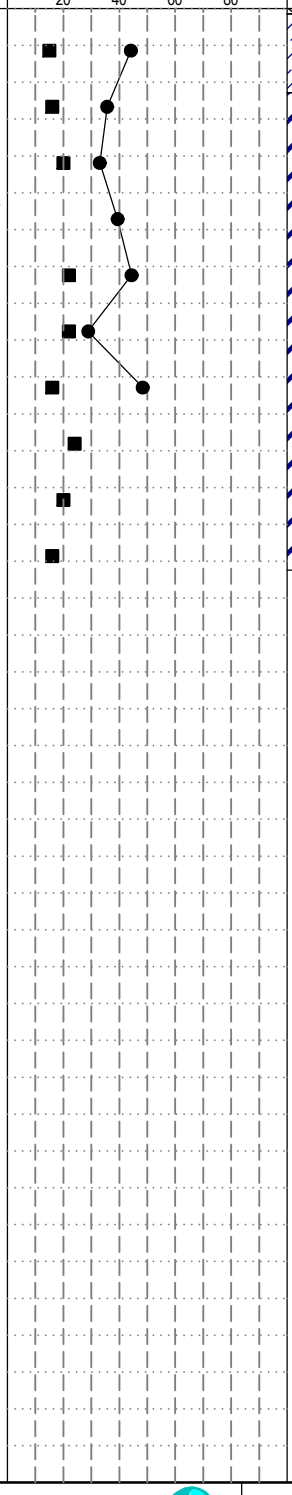
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD32**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, high plastic, moist, firm, dark grey		1			
			CLAY - silty, high plastic, moist, firm to stiff, grey, occasional rootlets		2			
			- brown below 0.6m		3			
1 ▼			- frequent silt layers (~10mm thick) to 1.4m		4			1 ▼
			- mottled brown, occasional to frequent silt layers to 1.8m		5			
		CH	- light brown below 1.7m		6			
2			- occasional sulphate inclusions at 2.0m		7			2
					8			
			- and silt between 2.6m and 2.7m		9			
			- frequent silt inclusions at 2.7m					
3			- dark brown below 2.9m		10			3
			TEST HOLE TERMINATED AT 3.0m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing observed, moderate seepage encountered at 1.0m below grade. Test hole remained open to 3.0m below grade and depth to water at 1.0m below grade upon completion. Test hole was backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD33**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
			CLAY - silty, trace rootlets and organics, high plastic, moist, soft, grey to dark grey, occasional oxidation inclusions		1			
					2			
			- greyish brown, firm, no organics and rootlets below 0.6m		3			
1			- firm to stiff, occasional oxidation inclusions below 0.9m		4			1
			- brown, stiff below 1.2m		5			
					6			
2					7			2
			- firm below 2.1m					
3		CH			8			3
4								4
					9			
			- occasional sulphate and silt inclusions, soft to firm below 4.6m					
5								5
			- soft below 5.8m					
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing and seepage encountered upon completion of drilling. Test hole remained open to 6.10m below grade upon completion. Test hole was backfilled with auger cuttings.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD34**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~38mm thick					0
		OH	ORGANIC CLAY - silty, high plastic,moist, soft to firm, dark grey to black, frequent rootlets		1			
			CLAY - silty, high plastic, moist, firm to stiff, grey, occasional rootlets		2			
1		CH			3			1
			- abundant silt lamination		4			
			SILT - some clay, wet, soft, tan-brown		5			
					6			
2		ML	- firm, occasional oxide inclusions below 1.8m		7			2
					8			
			CLAY - silty, high plastic, damp, very stiff, brown					
			- very stiff below 2.6m		9			
3		CH						3
			- stiff below 2.9m		10			
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES:					
			- No sloughing was encountered during drilling. Significant seepage observed from surface of grade. Test hole remained open to 3.0m and was filled with water to top of grade. Test hole was back filled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD35**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
			CLAY - silty, trace organics and rootlets, high plastic, moist, firm, greyish brown, occasional oxidation inclusions		1			
					2			
			- no organics and rootlets, stiff below 0.6m		3			
1		CH						1
			- brown below 1.2m		4			
			- occasional silt inclusions, brown to light brown below 1.5m		5			
					6			
2		ML	SILT - trace clay, low plastic, moist to very moist, soft, tan-brown, occasional oxidation inclusions		7			2
			CLAY - silty, high plastic, moist, firm to stiff, greyish brown, occasional oxidation and silt inclusions					
3					8			3
4		CH						4
			- firm, grey below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED 6.1m BELOW GRADE NOTES: - No sloughing was encountered during drilling. Very slight seepage below 5.2m. Test hole remained open to 6.1m and was filled with water to top of grade. Test hole was back filled with auger cuttings.					
7								7
8								

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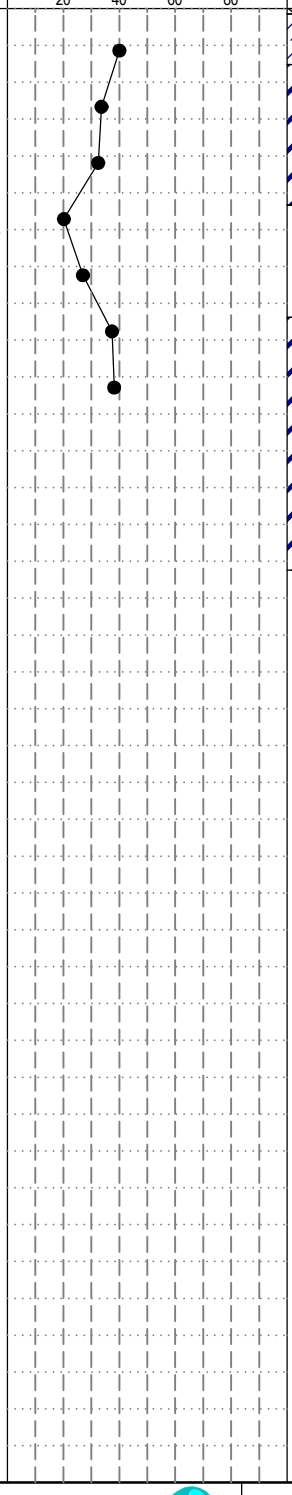
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD36**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, high plastic, moist, firm, dark grey		1			
			CLAY - silty, high plastic, moist, stiff, grey, frequent silt inclusions (~2mm thick)		2			
		CH			3			
1			SILT - some clay, some sand, trace gravel, moist, soft, tan-brown		4			1
		ML	- trace sand, frequent clay lamination below 1.4m		5			
			CLAY - silty, high plastic, moist, stiff, light brown to brown, occasional silt inclusions (~10mm thick)		6			
2			- occasional sulfate inclusions below 2.1m		7			2
		CH			8			
					9			
3					10			3
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES:					
			- No sloughing observed during drilling. Moderate seepage observed 1.2m below grade. Test hole remained open to 3.0m and depth to water upon completion was 1.2m below grade. Test hole backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD37**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~35mm thick					0
		CH	CLAY - silty, trace rootlets and organics, high plastic, damp to moist, very stiff, dark grey, occasional oxidation inclusions		1			
					2			
			- dark grey to grey, stiff, moist, occasional silt inclusions below 0.6m		3			
1		ML	SILT - trace clay, low plastic, moist, soft to firm, tan-brown, occasional clay inclusions		4			1
			- soft, moist to very moist below 1.2m		5			
			CLAY - silty, high plastic, moist, very stiff, brown		6			
2					7			2
			- stiff, occasional oxidation and silt inclusions below 2.1m					
3					8			3
			- greyish brown, firm below 3m					
4		CH						4
					9			
			- occasional sulphate inclusions below 4.6m					
5								5
6					10			6
			TEST HOLE TERMINATED 6.1m BELOW GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD38**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
		CH	CLAY - silty, trace organic rootlets, high plastic, moist, firm, dark grey to grey, occasional sulphate inclusions		1			
			- stiff, grey, no organics, occasional silt inclusions below 0.6m		2			
1			SILT - trace clay, low plastic, moist, soft to firm, tan-brown		3			1
		ML	- tan, occasional grey clay streak approximately 3mm thick below 1.2m		4			
			- moist to very moist, soft below 1.5m		5			
2			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional oxidation inclusions		6			2
		CH	- firm to stiff, dark greyish brown below 2.1m		7			
3					8			3
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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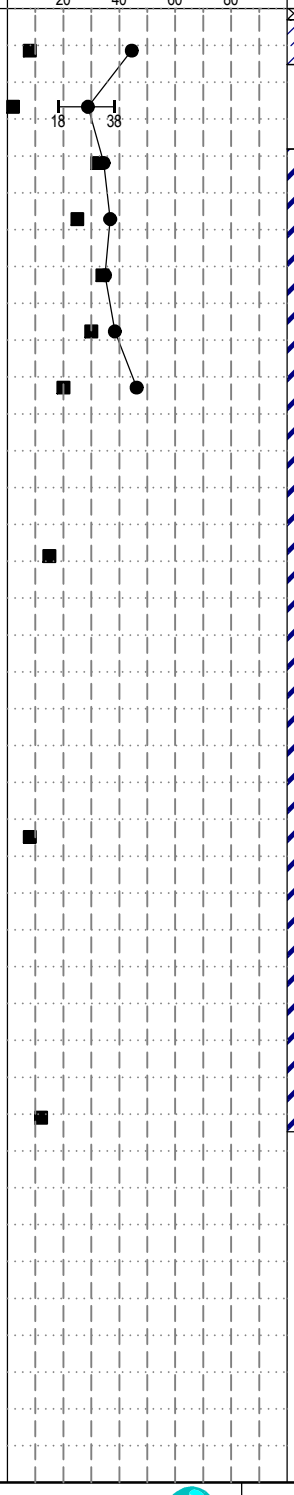
PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD39**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets, trace organics, high plastic, moist, soft, dark grey to black		1			
		ML	SILT - trace clay, occasional rootlets, occasional organics, low plastic, moist, very soft, tan-brown		2		Hydrometer Analysis Results @ "0.5m": Gravel= 0.0% Sand= 3.8% Silt= 60.0% Clay= 36.2%	
1			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional oxide inclusions		3			1
					4			
					5			
					6			
2			- occasional silt inclusions below 1.8m		7			2
			- firm, brown below 2.1m					
3					8			3
		CH						
4								4
					9			
			- soft, occasional silt inclusions below 4.6m					
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD40**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~ 75mm thick					0
		OH	ORGANIC CLAY - silty, high plastic, moist, firm, dark grey, occasional layers of rootlets (~5mm thick)		1			
			CLAY - silty, high plastic, moist, firm, grey to dark grey		2			
			- firm to stiff below 0.8m		3			
1			- brownish grey below 1.0m		4			1
					5			
		CH			6			
2					7			2
			- firm, occasional silt inclusions below 2.3m		8			
					9			
			- brown below 2.7m		10			
3			TEST HOLE TERMINATED AT 3.0m BELOW EXISTING GRADE NOTES: - No sloughing was encountered during drilling. Significant seepage observed from surface of grade. Test hole remained open to 3.0m and was filled with water to top of grade. Test hole was back filled with auger cuttings.					3
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD41**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~50mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and trace organics, high plastic, moist, soft, dark grey to grey		1			
					2			
		ML	SILT - trace clay, low plastic, moist to very moist, soft, tan-brown, occasional clay lenses (~3mm thick)		3			
1			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional silt lenses (~10mm thick), stiff, below 2.1m		4			1
					5			
					6			
2					7			2
3			- firm below 3.0m		8			3
		CH						
4								4
			- no silt lenses below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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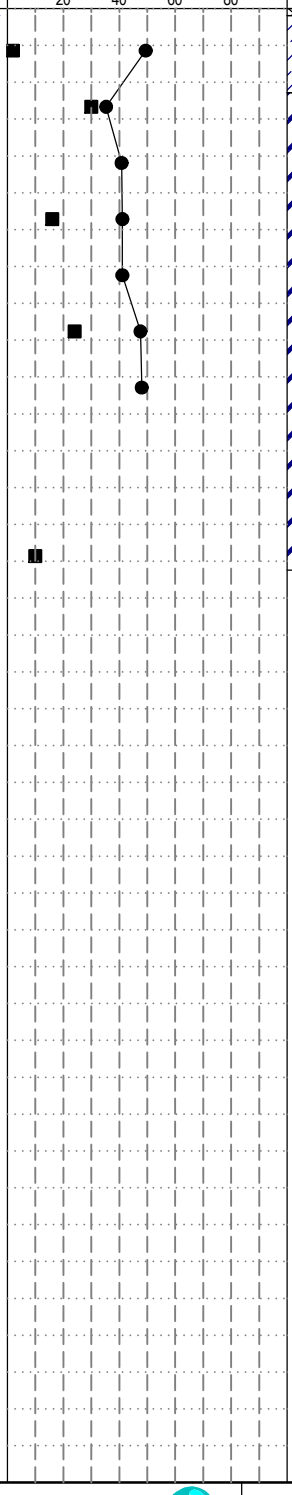
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD42**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~38mm					0
		OH	ORGANIC CLAY - silty, medium to high plastic, moist, firm, dark grey, abundant rootlets, occasional silt layers (~7mm thick)		1			
			CLAY - silty, high plastic, moist, stiff, brownish grey, frequent rootlets		2			
1					3			1
					4			
					5			
			- brown below 1.5m					
		CH			6			
2			- abundant silt lamination and frequent silt inclusions between 1.9m and 2.0m		7			2
3					8			3
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES:					
			- No sloughing was encountered during drilling. Significant seepage observed 40mm below grade from surface. Test hole remained open to 3.0m below grade, and filled with water to a depth of 40mm below grade. Test hole backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD43**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, trace rootlets and trace organics, high plastic, moist, firm, greyish brown		1			
					2			
			- stiff, no rootlets and organics below 0.6m					
		CH			3			
1								1
					4			
			- occasional silt and occasional silt inclusions below 1.2m					
		ML	SILT - trace clay, low plastic, moist, soft, tan-brown, occasional oxidation inclusions		5			
					6			
2			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional silt inclusions		7			2
			- firm to stiff, brown below 2.1m					
3					8			3
			- firm to soft below 3m					
		CH						
4								4
					9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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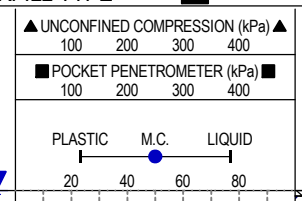
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD44**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORANICS (Moss) - ~25mm thick					0
			CLAY - silty, high plastic, moist, soft, grey, frequent rootlets		1			
					2			
			- firm to stiff below 0.3m		3			
1					4			1
					5			
		CH			6			
			- occasional sulphate inclusions below 1.8m		7			
2								2
			- firm below 2.3m		8			
					9			
			- frequent oxide inclusions at 2.7m		10			
3			TEST HOLE TERMINATED 3.0m BELOW GRADE					3
			NOTES:					
			- Trace sloughing was encountered 0.15m below grade. Significant seepage was encountered at grade. Test hole remained open to 3.0m and was filled with water to top of grade. Test hole was back filled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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REVIEWED BY: RB	COMPLETION DATE: July 23, 2013
Figure No. 56	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD45**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, trace rootlets, trace organics, high plastic, moist, firm, greyish brown		1			
					2			
			- dark greyish brown, firm to stiff, trace to some rootlets and organics, occasional silt inclusions below 0.6m		3			
1			- stiff below 0.9m					1
					4			
			- brown, occasional sulfate inclusions, no rootlets and organics below 1.2m		5			
					6			
2			- firm to stiff below 1.8m		7			2
3		CH	- firm below 3.0m		8			3
4								4
					9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 12.1m BELOW EXISTING GRADE					
			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 12.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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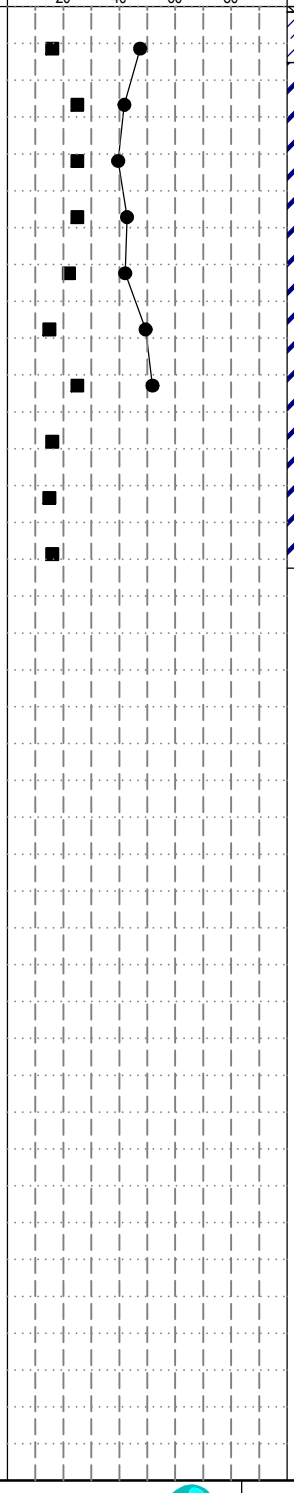
REVIEWED BY: RB	COMPLETION DATE: August 21, 2013
Figure No. 57	Page 1 of 1

PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD46**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick		1			0
		OH	ORGANIC CLAY - silty, high plastic, moist, firm to stiff, dark grey, frequent rootlets					
			CLAY - silty, high plastic, moist, stiff, grey, abundant silt inclusions		2			
			- brown below 0.3m		3			
1					4			1
			- occasional sulphate inclusions below 1.2m		5			
		CH			6			
2					7			2
			- firm, brownish grey below 2.1m		8			
					9			
3					10			3
			TEST HOLE TERMINATED 3.0m BELOW GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD47**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	CLAY - silty, trace rootlets, high plastic, moist, stiff, dark grey to black		1			
					2			
		CH	CLAY - silty, high plastic, moist, stiff, dark greyish to brown, occasional organics		3			
1		ML	SILT - trace clay, low plastic, moist, firm to stiff, light brown, occasional grey clay inclusions		4			1
			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional sulfate and occasional silt inclusions		5			
			- brown below 1.7m		6			
2			- firm to stiff below 1.8m		7			2
3					8			3
		CH						
4								4
			- firm to stiff below 4.6m		9			
5								5
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES: No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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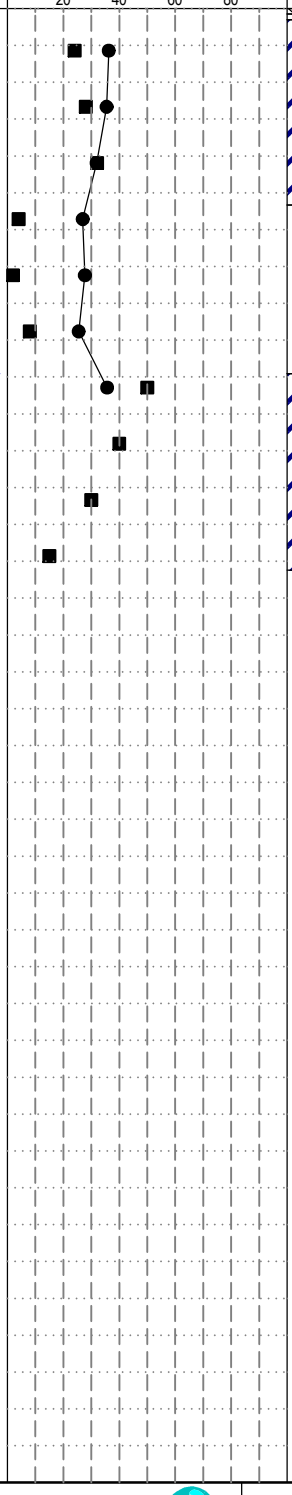
PROJECT: Prairie Industrial Park	DRILLED BY: AMEC	BORE HOLE NO: **RD48**
CLIENT: Terracon Developments		PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: Hand Auger	ELEVATION:

SAMPLE TYPE: Shelby Tube | No Recovery | SPT (N) | Grab Sample | Split-Pen | Core

BACKFILL TYPE: Bentonite | Pea Gravel | Drill Cuttings | Grout | Slough | Sand



Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick				
		OH	ORGANIC CLAY - silty, high plastic, moist, stiff, dark grey		1		
		CH	CLAY - silty, high plastic, moist, stiff, brownish grey - trace rootlets below 0.6m - occasional silt lamination below 0.9m		2 3		
1		ML	SILT - trace clay, low plastic, moist, soft, tan brown		4 5 6		
2		CH	CLAY - silty, high plastic, moist, very stiff, greyish brown, trace rootlets -occasional silt inclusions below 2.1m - stiff below 2.7m		7 8 9 10		
3			TEST HOLE TERMINATED 3.0m BELOW GRADE NOTES: - Trace sloughing encountered between 1.2m to 1.3m. Slight seepage observed from 1.2m to 1.3m. Test hole remained open to 3.0m below grade prior to backfilling. Depth to water was 2.0m below grade. Test hole back filled with auger cuttings.				

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD49**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		CH	CLAY - silty, trace organics to 0.3m, high plastic, moist, stiff to very stiff, grey to dark grey		2			
			- stiff, greyish brown below 0.6m		3			
1			- firm below 0.9m					1
		ML	SILT - trace clay, low platic, moist, soft, tan-brown, occasional clay inclusions		4			
					5			
			- moist to very moist below 1.5m					
			CLAY - silty, high plastic, moist, stiff, greyish brown, occasional silt inclusions		6			
2					7			2
			- occasional silt lenses ~20mm thick below 2.1m					
3					8			3
			- abundant silt lenses ~40mm thick between 3.1m to 3.2m					
		CH						
4								4
					9			
			- soft, grey to dark grey below 4.6m					
5								5
6			- occasional oxidation inclusions below 5.9m		10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD50**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH CH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, soft to firm, dark grey		2			
		ML	SILT - trace clay, low plastic, moist, soft, tan-brown, occasional clay lenses ~10mm thick		3			
1			CLAY - silty, high plastic, moist, very stiff, greyish brown, frequent silt lenses ~15mm thick		4			1
					5			
			- light greyish brown, occasional silt inclusions below 1.5m		6			
2			- stiff, greyish brown below 1.8m					2
		CH	- firm below 2.1m		7			
3					8			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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REVIEWED BY: RB	COMPLETION DATE: July 12, 2013
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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD51**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		CH	CLAY - silty, trace organics and rootlets to 0.3m, high plastic, moist, stiff, grey to dark grey, occasional sulphate inclusions		2			
			- greyish brown, occasional silt lenses ~5mm thick below 0.6m		3			
1			- firm, occasional oxidation inclusions below 0.9m					1
		ML	SILT - trace clay, low platic, moist, soft, tan-brown, occasional oxidation inclusions		4			
					5			
			- moist to very moist below 1.5m					
			CLAY - silty, high plastic, moist, stiff, brown, occasional silt inclusions		6			
2					7			2
			- firm, abundant silt lenses ~25mm thick between 2.1m and 2.3m					
3					8			3
			- stiff, greyish brown, occasional sulphate inclusions below 3.1m					
		CH						
4								4
					9			
			- firm, dark greyish brown below 4.6m					
5								5
			- soft to firm, grey below 5.5m					
6					10			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- Slight to moderate sloughing and moderate seepage was encountered 1.1m below grade during drilling. Test hole remained open to 1.2m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD52**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
			CLAY - silty, trace sand, gravel and rootlets to 0.3m, high plastic, moist, firm to stiff, dark grey to brown		2			
			- stiff, grey to dark grey below 0.6m		3			
1			- dark greyish brown, occasional oxidation inclusions below 0.9m		4			1
					5			
		CH			6			
2			- greyish brown, frequent silt lenses ~15mm thick below 1.8m		7			2
			- abundant silt inclusions between 2.3m to 2.6m		8			
3					9			3
			TEST HOLE TERMINATED AT 3.1m BELOW EXISTING GRADE					
			NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **RD53**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
		OH	ORGANIC CLAY - silty, trace rootlets and organics, moist, dark grey		1			
		CH	CLAY (FILL) - silty, some sand to sandy, trace gravel and rootlets, high plastic, moist, firm, dark greyish brown		2			
			CLAY - silty, trace organics and rootlets to 0.5m, high plastic, moist, stiff, grey to dark grey, occasional sulphate inclusions		3			
1			- dark greyish brown below 0.9m		4			1
					5			
			- greyish brown below 1.5m		6			
			- brown, occasional silt inclusions below 1.8m		7			
2					8			2
			- firm, abundant silt lenses ~25mm thick at 2.4m					
3					9			3
		CH						
4								4
					10			
			- occasional to frequent silt inclusions below 4.6m					
5								5
			- soft, grey below 5.5m					
6					11			6
			TEST HOLE TERMINATED AT 6.1m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 6.1m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **SY01**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, high plastic, moist, stiff, greyish brown		1			
1		CH			2			1
			SILT - trace clay, low plastic, moist, soft, tan-brown, occasional oxidation inclusions		3			
		ML						
2			CLAY - silty, high plastic, moist, firm, greyish brown, occasional sulphate and silt inclusions		4			2
		CH						
3			TEST HOLE TERMINATED AT 3.0m BELOW EXISTING GRADE NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.		5			3
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **SY02**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

▲ UNCONFINED COMPRESSION (kPa) ▲ 100 200 300 400

■ POCKET PENETROMETER (kPa) ■ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, high plastic, moist, stiff to very stiff, grey, occasional oxidation and sulphate inclusions, trace rootlets		1			
			- grey to dark grey, stiff below 0.8m		2			
1								1
		CH	- brown, occasional sulphate inclusions, no rootlets below 1.5m		3			
2								2
			- firm below 2.3m - greyish brown below 2.4m		4			
3					5			3
			TEST HOLE TERMINATED AT 3.0m BELOW EXISTING GRADE NOTES: - No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

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PROJECT: Prairie Industrial Park	DRILLED BY: Maple Leaf Drilling Ltd.	BORE HOLE NO: **SY03**
CLIENT: Terracon Developments	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17188
LOCATION: Winnipeg, Manitoba	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION:

SAMPLE TYPE: Shelby Tube; No Recovery; SPT (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Drill Cuttings; Grout; Slough; Sand

Depth (m)	SOIL SYMBOL	MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS	Depth (m)
0		OR	SURFACE ORGANICS (Moss) - ~25mm thick					0
			CLAY - silty, trace coarse grained sand, high plastic, moist, stiff to very stiff, greyish brown		1			
					2			
1			- stiff, occasional silt inclusions below 0.8m					1
					3			
		CH	- brown, occasional sulphate inclusions below 1.5m					
2								2
					4			
			- greyish brown below 2.3m					
			- firm below 2.7m					
3					5			3
			TEST HOLE TERMINATED AT 3.0m BELOW EXISTING GRADE					
			NOTES:					
			- No sloughing or seepage was encountered during drilling. Test hole remained open to 3.0m and was dry upon completion of drilling. Test hole was backfilled with auger cuttings and bentonite.					
4								4
5								5
6								6
7								7
8								

17188 - TERRACON - ST BONIFACE INDUSTRIAL PARK.GPJ 13/09/24 09:16 AM (GEOTECHNICAL REVISED)

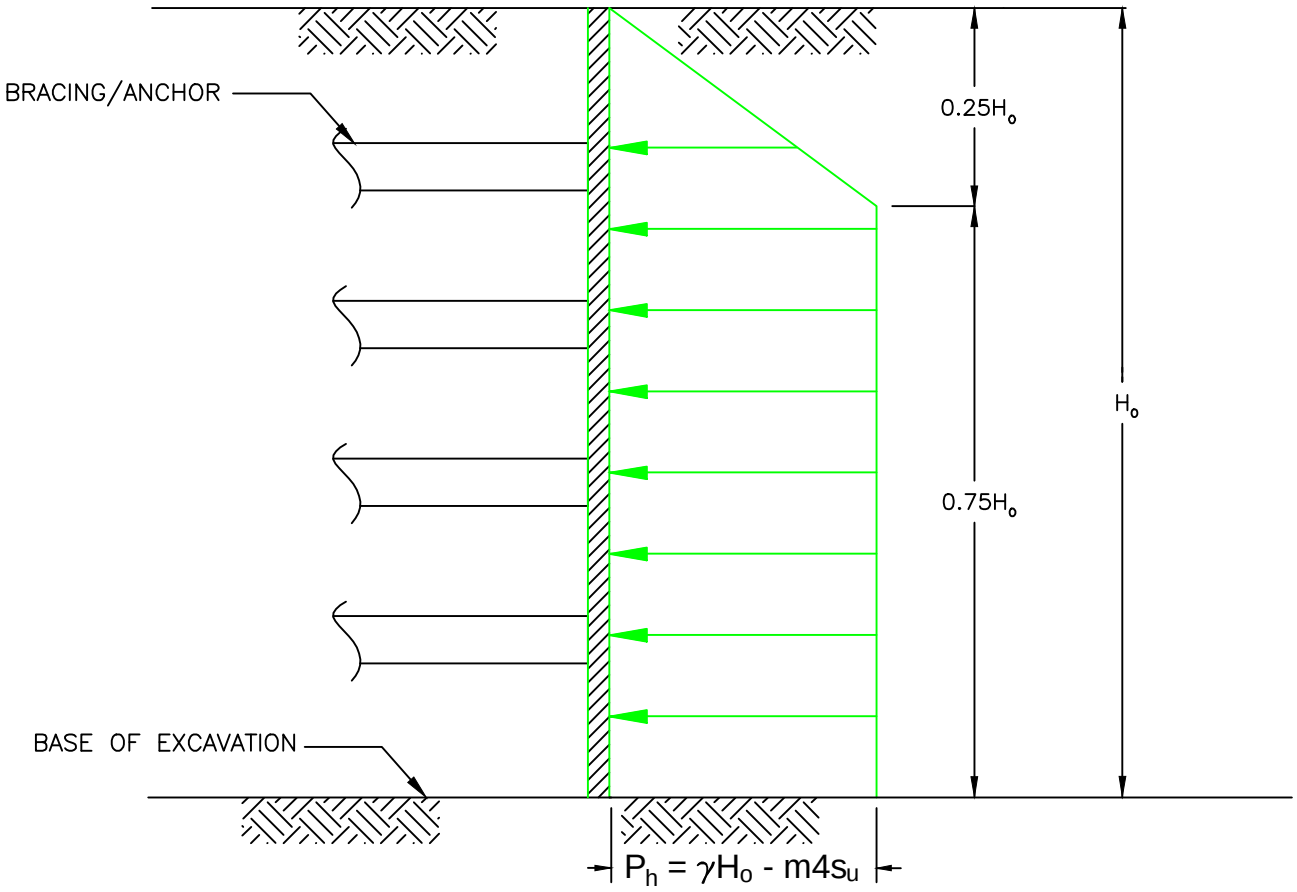
amec

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: AL	COMPLETION DEPTH: 3 m
REVIEWED BY: RB	COMPLETION DATE: August 26, 2013
Figure No. 68	Page 1 of 1

APPENDIX B

LATERAL EARTH PRESSURES



WHERE: P_h = DESIGN LATERAL PRESSURE MAGNITUDE (kPa)

γ = BULK UNIT WEIGHT OF SOIL (ASSUME $\gamma = 17 kN/m^3$)

H_o = EMBEDMENT DEPTH OF WALL BELOW GRADE (m)

m = 0.4 FOR SOFT, NORMALLY CONSOLIDATED CLAY

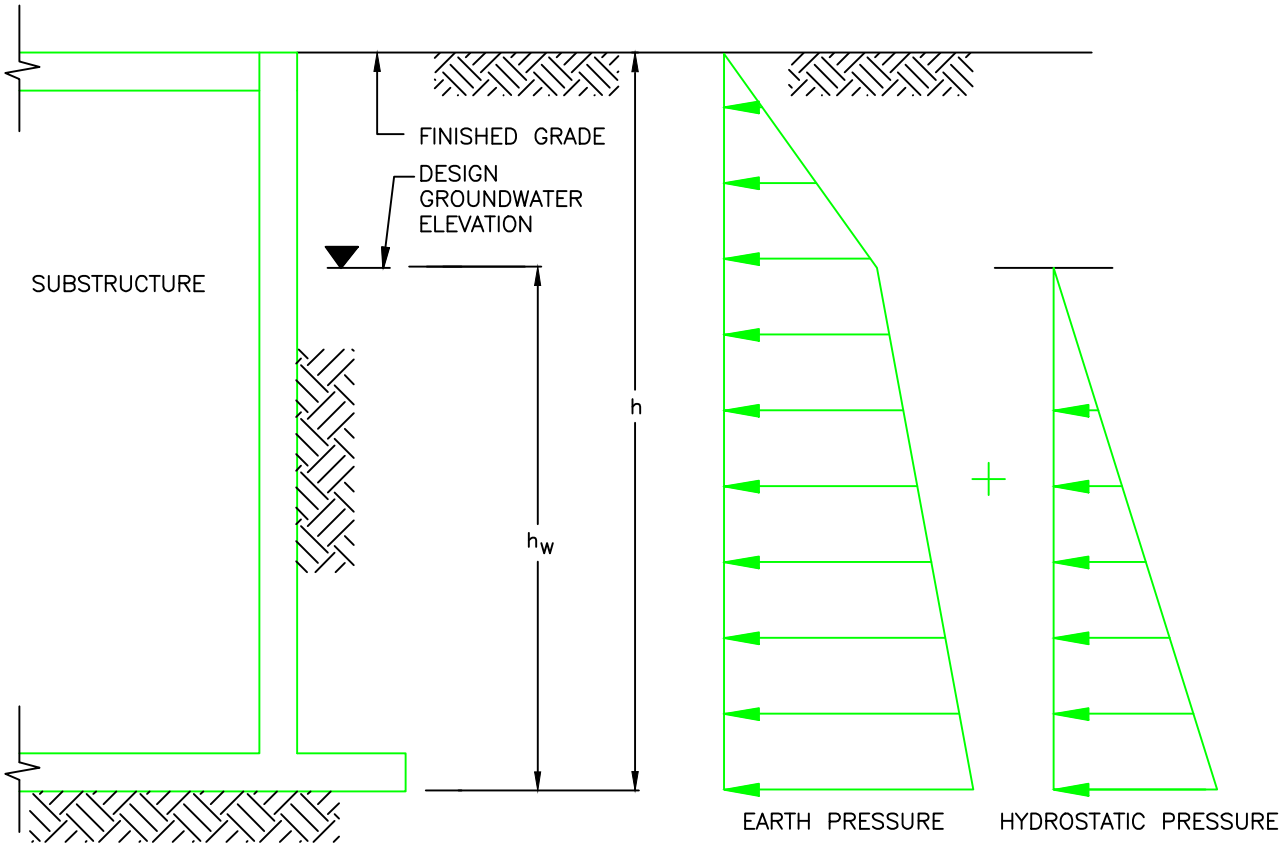
S_U = UNDRAINED SHEAR STRENGTH (ASSUME 35 kPa)

NOTES:

1. LATERAL PRESSURE DUE TO SURCHARGE LOAD AT THE SURFACE MUST BE ADDED TO THE ABOVE PRESSURE DIAGRAM.

P:\JOBS\17100'S\17180'S\17188 – TERRACON – ST BONIFACE INDUSTRIAL PARK\GEOTECH\DRAWINGS\WX16347 – FIG 3.DWG

CLIENT: **TERRACON DEVELOPMENTS**	DWN BY: AL	PROJECT: GEOTECHNICAL INVESTIGATION PRAIRIE INDUSTRIAL PARK NEAR MAZENOD AND CAMIEL SYS WINNIPEG, MANITOBA	DATE: SEPTEMBER 2013
	CHK'D BY: TG		PROJECT No.: wx17188
	DATUM: -		REV. No.: B
amec 440 DOVERCOURT DRIVE WINNIPEG, MANITOBA R3Y 1N4 PHONE: 204.488.2997 FAX:204.489.8261	PROJECTION: -	TITLE: LATERAL EARTH PRESSURE DISTRIBUTION FOR TEMPORARY BRACED EXCAVATIONS IN SOFT, NORMALLY CONSOLIDATED CLAY	FIGURE No.: FIGURE B1
	SCALE: NOT TO SCALE		



RECOMMENDED PRESSURE DISTRIBUTION

$$P_h = K\gamma(h-h_w) + K\gamma' h_w + \gamma_W h_w$$

WHERE: P_h = LATERAL EARTH PRESSURE (kPa)

γ = UNIT WEIGHT OF SOIL (SEE TEXT OF REPORT)

γ' = BUOYANT UNIT WEIGHT OF SOIL (SEE TEXT OF REPORT)

γ_w = UNIT WEIGHT OF WATER (USE γ_w=9.8 kN/m^3)

h = HEIGHT OF WALL FROM FINISHED GRADE TO BASE OF WALL (m)

h_w = HEIGHT OF GROUNDWATER TABLE ABOVE BASE OF WALL (m)

K = LATERAL EARTH PRESSURE COEFFICIENT (K_o – SEE REPORT TEXT)

NOTES:

1. SEE TEXT OF REPORT FOR UNIT WEIGHTS AND LATERAL EARTH PRESSURE COEFFICIENTS.
2. A HYDROSTATIC COMPONENT NEED ONLY BE INCLUDED WHERE A PERCHED GROUND WATER TABLE WERE TO OCCUR WITHIN THE LEVEL OF SUB–STRUCTURE IN COMBINATION WITH NO SUB–DRAINAGE.

CLIENT: **TERRACON DEVELOPMENTS**	DWN BY: AL	PROJECT: **GEOTECHNICAL INVESTIGATION PRAIRIE INDUSTRIAL PARK NEAR MAZENOD AND CAMIEL SYS WINNIPEG, MANITOBA**	DATE: SEPTEMBER2013
	CHK'D BY: TG		PROJECT No.: WX17188
amec 440 DOVERCOURT DRIVE WINNIPEG, MANITOBA R3Y 1N4 PHONE: 204.488.2997 FAX:204.489.8261	DATUM: -		REV. No.: B
	PROJECTION: -	TITLE: LATERAL EARTH PRESSURES ON PERMANENT GATE CHAMBER WALLS	FIGURE No.: FIGURE B2
	SCALE: NOT TO SCALE		

P:\Jobs\16300's\16340's\16347 UofM Sifton Road Outfall\drawings\WX16347 – FIG 4.DWG

Stantec Consulting Ltd.
500–311 Portage Avenue, Winnipeg MB R3B 2B9

November 24, 2015
File: 116809351

Attention: Maqbool Hussain
500 – 311 Portage Avenue
Winnipeg, MB R3B 2B9

Dear Mr. Hussain,

Reference: St. Boniface Industrial Lift Station

Stantec was retained to perform a geotechnical investigation to evaluate the existing soils conditions and provide foundation recommendations for the proposed St. Boniface Industrial Lift Station located in Winnipeg, Manitoba. The purpose of the geotechnical investigation was to determine subsurface conditions and provide foundation recommendations. In addition to the foundation review, a slope stability analysis of proposed excavations was also performed in order to determine the maximum side slopes during excavation for the tanks.

Outlined below is a description of the proposed lift station, a summary of the geotechnical investigation, foundation recommendations and the results of the slope stability analysis.

1.0 PROPOSED LIFT STATION

The project site is located within the St. Boniface Industrial Park, just east of Mazenod Road as shown on Figure 1 in Appendix B. The proposed works at this site consists of the design and construction of the St. Boniface Industrial Lift Station. The currently proposed Lift Station consists of the following:

- Two discrete 3 m diameter by 10 m deep tanks. To facilitate a connection of the tanks near the tank base, it is likely that the tanks will be installed by mass excavation, and would be founded on a common concrete slab;
- A heated building will be constructed overtop one of the tanks

2.0 GEOTECHNICAL INVESTIGATION

The geotechnical drilling and sampling program was performed on November 19, 2015, with drilling services provided by Maple Leaf Drilling Ltd. and continuous Stantec supervision. The drilling was performed using a track mounted Mobile B37X drill rig. One testhole was drilled at this site, with the location shown on Figure 1 in Appendix B. The testhole was drilled approximately 15 m south of the proposed lift station location. Partially frozen/wet conditions created poor rig access and therefore the testhole was drilled at the closest feasible location to the proposed lift station (photograph included within Appendix B). The drilling program consisted of advancing 125 mm solid stem augers through the native overburden materials to power auger refusal. Overburden soil samples were retrieved directly off the auger flights at approximately 0.75 to 1.5 m intervals. Attempts were also made to advance 35 mm inside diameter split spoon samples in cohesionless samples to obtain Standard Penetration Test (SPT) “N” values. All samples were visually inspected in the field for material types and consistency.

Field torvanes were performed on all cohesive samples to estimate clay material undrained shear strength.

INVESTIGATION RESULTS

The overall stratigraphic conditions of the site have been based upon the investigation results obtained during the field drilling program and are outlined below.

Based upon testhole TH1, the stratigraphy consisted of a surficial layer of topsoil overlying native silty clay overlying silt till. A description of the soil stratigraphy is given below, with the detailed testhole log included in Appendix C. Also included in Appendix C are the symbols and terms used on borehole and test pit records.

Organics/Topsoil

A surface layer of organic/topsoil material was encountered from ground surface. The topsoil was black in colour, moist and was approximately 150 mm thick.

Native Silty Clay

Native silty clay was encountered underlying the upper organic/topsoil material. The silty clay material was black to brown in colour and moist. The thickness of the silty clay layer was observed to be 17.2 m. The undrained shear strength of the silty clay layer ranged from 22 to 92 kPa (average of 45 kPa), classifying this material as soft to stiff in consistency.

Silt Till

A layer of silt till was observed underlying the native silty clay material. The till was layer was first encountered at a depth of 17.35 m below grade, with auger refusal occurring at a depth of 18.1 m below grade within the till layer. The till was brown to tan in colour, moist, non-plastic, with sand, with fine gravel. One standard penetration tests (SPT) was completed within the till layer which resulted in SPT refusal consisting of 50 blows for 75 mm of penetration.

Groundwater and Soil Sloughing Conditions

Minor groundwater seepage was observed at an approximate depth of 1 m below ground surface. Upon completion of the testhole, the groundwater was observed at a depth of 9.5 m. This measured water level within the testhole at completion of drilling should not be considered the long term groundwater level in the area. The actual groundwater level will vary by season/precipitation, but may be conservatively assumed at 2 m below existing grade. Soil sloughing was observed within the silt till layer at a depth of 17.1 m below ground surface.

3.0 FOUNDATION REVIEW AND RECOMMENDATIONS

Based upon the results of the geotechnical investigation, a foundation review has been performed for both the proposed tank slab and the proposed heated structure.

Tank Slab

The individual tanks or tank slab may be founded directly on the native silty clay at 10 m depth.

Bearing capacity at 10 m depth may be taken as the bearing capacity at ULS at 10 m depth, plus the total weight of soil removed for each tank, minus the weight of the tank and any water or sewage within the tank.

For design purposes, a bearing capacity at the underside of the tanks may be taken as 300 kPa (at ULS and SLS), minus the weight of the tanks and its contents (i.e. water, sewage, etc).

The empty tanks would have a buoyant force of 700 kN (not including the weight of the tank, and assuming a groundwater level at surface to represent the worst case scenario). Assuming the tank remains empty, the buoyant force would be resisted by friction along the sidewalls of the tank. This frictional resistance would be dependent on the tank installation methodology, and whether the sidewalls of the tank are in contact with native clay or granular backfill. Assuming native clay contact, the uplift shaft resistance may be taken as 1100 kN at ULS. Assuming granular backfill is in contact with the tank sidewalls (and GWL at 2 m below ground surface), the uplift shaft resistance is 1000 kN at ULS. Based upon the above, it would therefore appear that buoyancy failure is not a concern for the proposed tanks.

Building Foundation

The foundation for the proposed building is dependent on the tank installation methodology. If the tanks can be installed without the need for mass excavation (i.e. soil removal via auger and tanks lowered into place), the building foundation could likely be cast-in-place concrete friction piles. Our current understanding of the tank installation consists of a mass excavation with the excavation material (i.e. native clay) used to backfill the excavation once the tank installation is complete. The recompaction of the native clay to the in-situ density is not considered practical, and some long term settlement of the recompacted material is likely. Settlement of the recompacted material would induce downdrag forces on friction piles, and therefore friction piles are not recommended.

The proposed building foundation should therefore consist of driven end bearing piles that are driven to refusal in the underlying till. The surface of the till layer was encountered at a depth of 17.4 m below ground surface, with pile end and bearing refusal likely at approximately 18 m depth below existing grade.

The driven piles may consist of either precast concrete piles or steel piles. Pile capacities at ultimate limit states (ULS) are provided for driven precast concrete piles and driven steel piles in Table 1 and Table 2 below, respectively. For design purposes, the pile capacity at Serviceability Limit State (SLS) may be taken as the ULS capacity. The unfactored downdrag force along the upper 10 m of the pile length has been included in the tables below.

Table 1- Driven Precast Concrete Pile Capacity

Pile Diameter	Pile Capacity at ULS	Unfactored Downdrag Force	Refusal Criteria
305 mm	550 kN	350 kN	5 Blows/ 25 mm
356 mm	750 kN	400 kN	8 Blows/ 25 mm
400 mm	1000 kN	450 kN	12 Blows/25 mm

The refusal criteria indicated in the above table should be achieved at least 3 times for the final resistance. The hammer should be capable of delivering a minimum rated energy of 40 kJ/Blow. Pre-boring to a depth of approximately 3 m should be considered for all driven piles to enhance pile alignment and reduce vibration levels during pile driving. The prebored hole diameter should be slightly larger than the nominal pile diameter. All piles should be driven continuously to their required depth once driving is initiated. Pile heave for piles within 5 pile diameters of each other should be monitored and redriving should be done where pile heave occurs. Pile spacing should not be less than 2.5 pile diameters, measured center to center. Precast concrete piles driven to practical refusal will develop the majority of their capacity from toe resistance, and therefore, a reduction in pile capacity is generally not required for group action. If pile groups are required for the proposed additions, we should be contacted to review the requirement for a group reduction factor.

Table 2- Driven Steel Pile Capacity

Pile Size	Pile Capacity at ULS	Unfactored Downdrag Force	Refusal Criteria
HP310x110	1200 kN	300 kN	20 Blows/ 25 mm

Recommendations for design and installation of steel H piles are provided below.

1. Pile spacing within pile groups should be a minimum of 2.5 pile diameters measured centre to centre. Provided that pile heave is monitored and piles are redriven when pile heave is observed, no reduction in pile capacity is required due to group action. Redriving of all piles in groups should be specified along with the requirement to monitor pile heave.

2. Prior to the pile installation, the piles should be inspected to confirm that the material specifications are satisfied. As a minimum, steel H-piles should meet the requirements of CAN/CSA-G40.20/G40.21, Grade 350 W. The piles should be free from protrusions, which could create voids in the soil around the pile during driving.

3. The piles should be fitted with a driving shoe to help minimize damage to the end of the pile during the driving process. The driving shoe should not extent beyond the outside face of the pile to prevent disturbance of the soils adjacent to the pile as it is being driven.

4. The maximum compression and tension stresses developed within any pile during installation (commonly referred to as the driving stresses) should be limited to 0.9 F_y.

5. The piles should be driven to practical refusal with a diesel hammer having a minimum rated energy of 50 kJ per blow. Practical pile refusal can generally be considered to be three consecutive sets of 20 blows per 25 mm of pile penetration.

6. Monitoring of the pile installation by an experienced inspector is recommended to verify that the piles are installed in accordance with design assumptions and the driving criteria are satisfied. For each pile, a complete driving record in terms of the number of blows per 300 mm of penetration should be recorded.

Because of the potential settlement of the recompacted clay material, the building floor should be supported by a structural slab.

4.0 STABILITY REVIEW OF TANK EXCAVATION

As stated previously, it is our current understanding that the proposed tanks will be installed using a mass excavation that is 10 m deep. A slope stability review has been performed to identify the maximum side slopes that can be utilized during the excavation. The slope stability analysis was performed using the software SLOPE\W, developed by Geoslope International Inc. The computer model investigates a large number of potential failure surfaces and depending on the method of analysis used can present the results in the form of contours of computed factors of safety against sliding.

The stability of a slope is typically generalized as a ratio of the forces that drive the failure divided by the forces that resist failure. The unitless fraction is called a Factor of Safety (FS). Factors of Safety that are unity (1.0) or less indicate that driving forces exceed resisting forces and from a geotechnical engineering perspective the slip has failed or is highly unstable.

As per the Canadian Foundation Engineering Manual (CFEM), temporary excavations in clay material should be reviewed using undrained strength parameters. The temporary excavation side slope geometry should be such that a minimum overall slip surface Factor of Safety (FS) of 1. 5 be maintained for this site.

The slope stability review has consisted of evaluating the FS for the critical overall slip surface for assumed excavation side slopes of 1H:1V, 2H:1V, and 3H:1V. For the analysis, as undrained shear strength of 45 KPa has been used for the native clay material. The results of the slope stability analysis are included in Appendix D. As shown, a temporary excavation side slope of **2H:1V** is required to meet the target of FS of 1.5.

5.0 ANCILLARY ISSUES

The following is a summary of recommendations related to the temporary excavation.

- As material is excavated, it should be stockpiled no closer than 20 m from the edge of the excavation. The height of the stockpile should be a maximum of 5 m.
- During the temporary excavation, there should be no need for significant dewatering, as groundwater infiltration is expected to be minimal. Any surface or groundwater infiltration into the excavation should be pumped to an appropriate discharge point.
- The analysis for the side slope stability has assumed a temporary condition. As such, the time that the excavation remains open should be minimized, and no longer than 3 weeks.
- When the excavated material is placed back in the excavation, it should be placed in lifts not exceeding 200 mm and be compacted to a minimum of 97% the materials Standard Proctor Maximum Dry Density (SPMDD) within 4% of the optimum moisture content.

60. CLOSURE

This report has been prepared for the sole benefit of St. Boniface Industrial Lift Station and its agents, and may not be used by any third party without the express written consent of Stantec Consulting Ltd.

Any use, which a third party makes of this report, is the responsibility of such third party. Use of this report is subject to the Statement of General Conditions provided in **Appendix A**. It is the responsibility of St. Boniface Lift Station who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design or construction

We trust the above information meets with your present requirements. Should you have any questions or require further information, please contact us. This report has been prepared by Rhett Bonham, B.Sc, E.I.T. and reviewed by Thomas Crilly P.Eng.

We appreciate the opportunity to assist you in this project.

Regards,

STANTEC CONSULTING LTD.

PROVINCE OF MANITOBA
TNC
T.N.
CRILLY
MEMBER
10064
NOV 24/15
REGISTERED PROFESSIONAL ENGINEER

Tom Crilly, M.Sc., P.Eng.
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APEGM
Certificate of Authorization
Stantec Consulting Ltd.
No. 1301

Attached:

Appendix A	Statement of General Conditions
Appendix B	Site Location
Appendix C	Testhole Log
Appendix D	Slope Stability Review

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APPENDIX A
STATEMENT OF GENERAL CONDITIONS

November 24, 2015
Maqbool Hussain

Appendix A: Statement of Terms and Conditions

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec's present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec will not be responsible to any party for damages incurred as a result of failing to notify Stantec that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present

APPENDIX B
SITE LOCATION

Figure 1


Waters Dr
Begonia Ave
Paquin Rd
St Boniface Industrial Park
Mazenod Rd
Approx TH Location
Gamebird Sys St
Google earth
© 2015 Google
N
300 m

Photo 1: View of frozen/wet area, looking northwest – November 19, 2015

Photo 2: View of drilling operation – November 19, 2015

APPENDIX C
TESTHOLE LOG

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.

Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

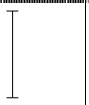
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

TH1 TESTHOLE RECORD

CLIENT City of Winnipeg PROJECT No. 116809351
PROJECT St. Boniface Lift Station DATUM NORTHING 5526671
LOCATION St. Boniface, Winnipeg, MB ELEVATION TBD m EASTING 640168
DRILLING DATE November 19, 2015 DRILLING CO. Maple Leaf DRILLING METHOD Clay Auger

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	MOISTURE CONTENT (%)
0	TP		Topsoil			
			Silty Clay - Black, moist, high plasticity, firm to stiff, some oxidization - trace organics at 0.3 m - tan to light brown, soft below 0.5 m - soft below 0.8 m - minor seepage at 1 m - stiff below 1.2 m	GS		
1				GS		
2				GS		
3			- light brown to dark brown below 3 m			
4				GS		
5						
6						
7				GS		
8						
9	CL ML		- firm below 9.2 m	GS		
10						

Insitu Shear Vane (kPa) Torvane on Grab Samples (kPa)
Pocket Penetrometer (kPa)
50kPa 100kPa 150kPa 200kPa
W_P W W_L Moisture Content & Atterberg Limits
Standard Penetration Test, blows/0.3m
10 20 30 40 50 60 70 80 90

DEPTH (ft): 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34

Sample Type: GS - Grab Sample SPT - Standard Penetration Test
ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: KDB
Reviewed by:

Stantec

TH1 TESTHOLE RECORD

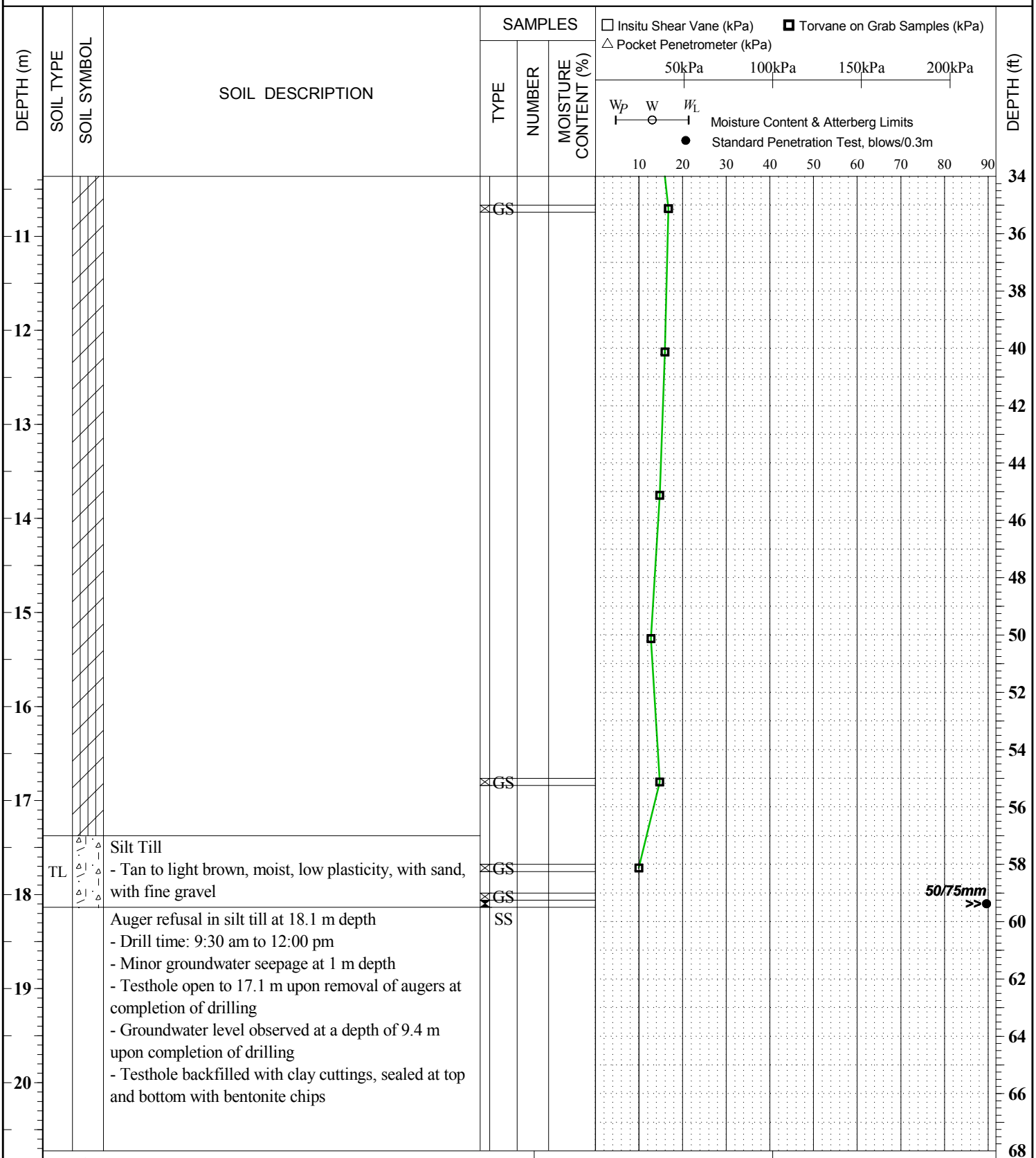
cont'd

CLIENT City of Winnipeg — PROJECT No. 116809351

PROJECT St. Boniface Lift Station — DATUM — NORTHING 5526671

LOCATION St. Boniface, Winnipeg, MB — ELEVATION TBD m — EASTING 640168

DRILLING DATE November 19, 2015 DRILLING CO. Maple Leaf — DRILLING METHOD Clay Auger



Sample Type: GS - Grab Sample SPT - Standard Penetration Test ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test

Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: KDB

Reviewed by:

Stantec

APPENDIX D
SLOPE STABILITY REVIEW

Name: Silty Clay (TSA) Model: Undrained (Phi=0) Unit Weight: 18 kN/m³ Cohesion': 45 kPa
Name: Silt Till (TSA) Model: Undrained (Phi=0) Unit Weight: 20 kN/m³ Cohesion': 100 kPa

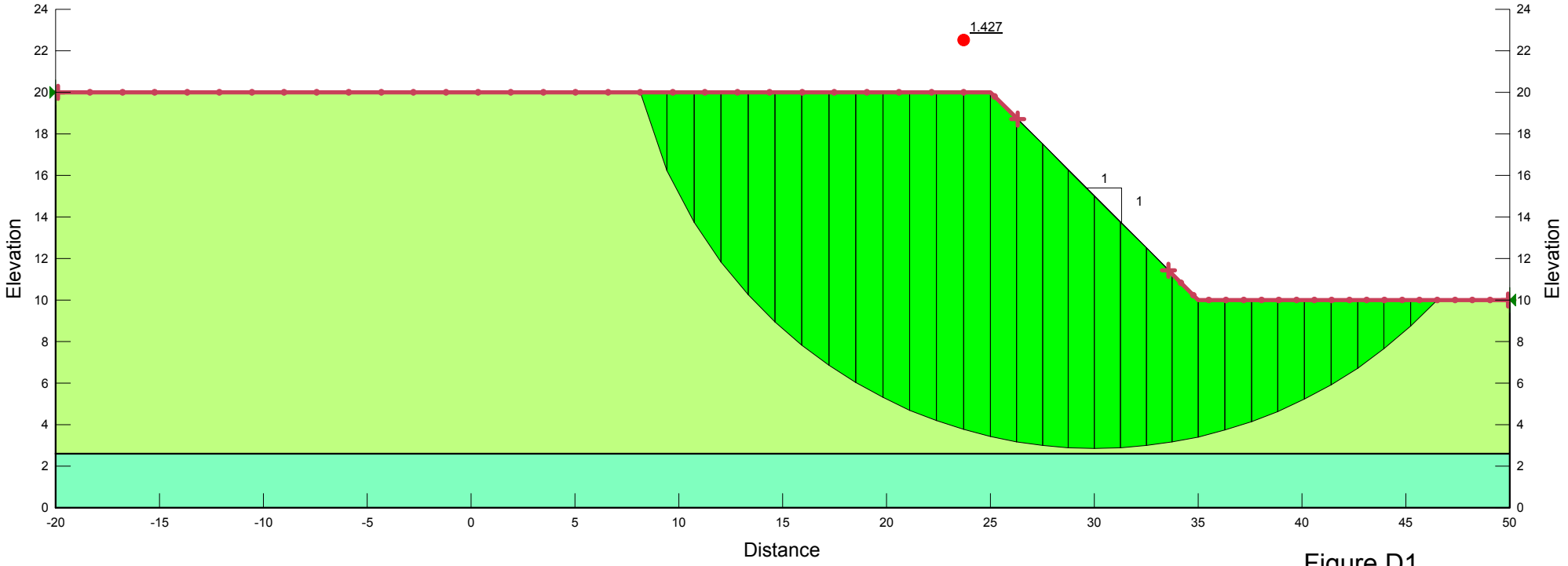


Figure D1

Name: Silty Clay (TSA) Model: Undrained (Phi=0) Unit Weight: 18 kN/m³ Cohesion': 45 kPa
Name: Silt Till (TSA) Model: Undrained (Phi=0) Unit Weight: 20 kN/m³ Cohesion': 100 kPa

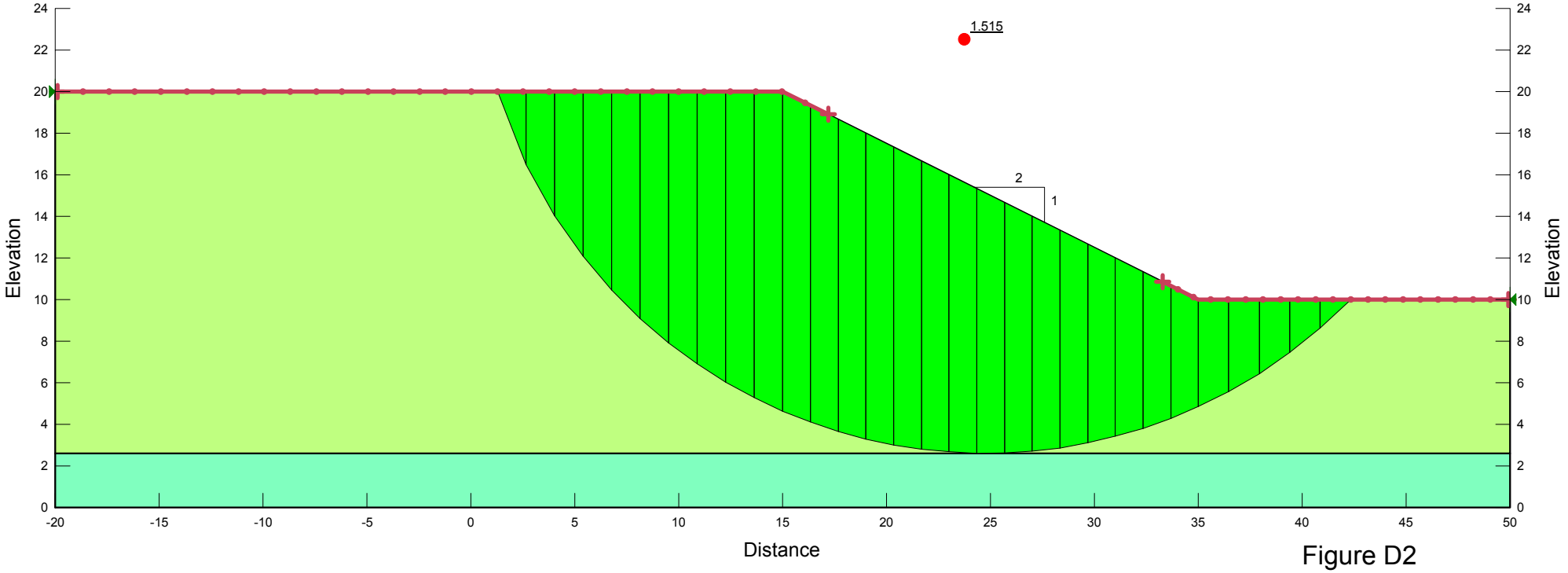


Figure D2

Name: Silty Clay (TSA) Model: Undrained (Phi=0) Unit Weight: 18 kN/m³ Cohesion': 45 kPa
Name: Silt Till (TSA) Model: Undrained (Phi=0) Unit Weight: 20 kN/m³ Cohesion': 100 kPa

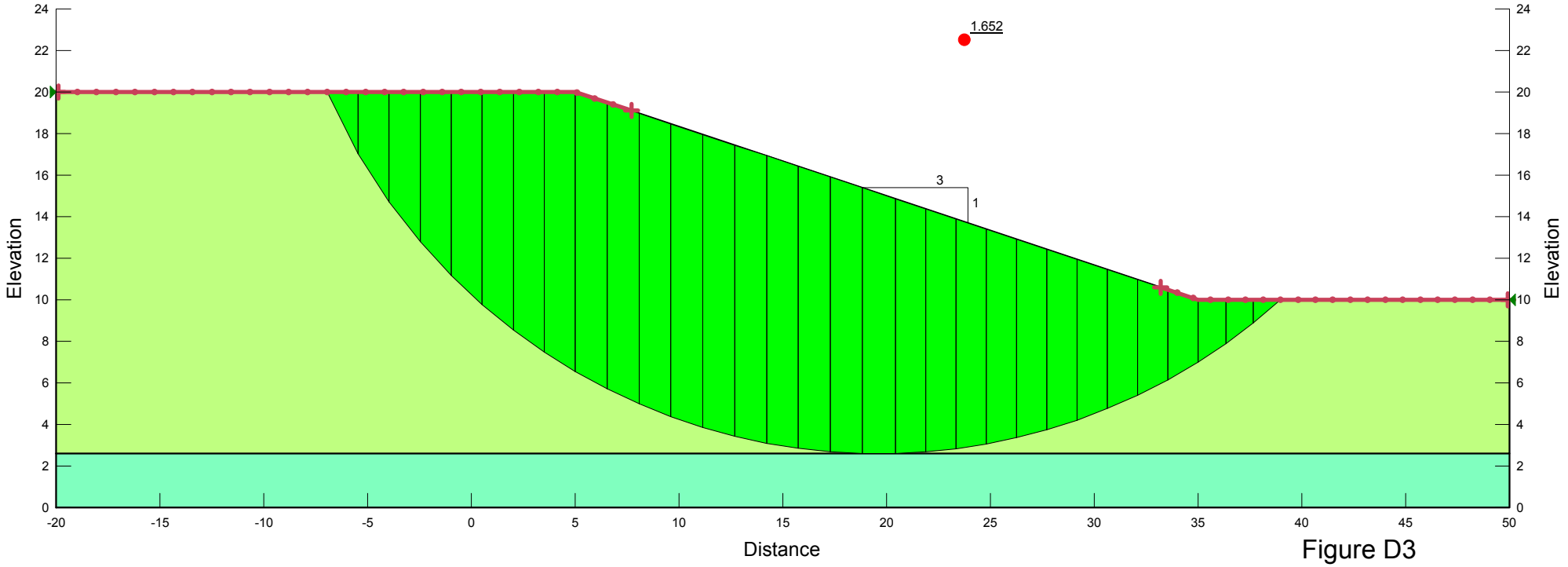


Figure D3