APPENDIX A – SOILS INVESTIGATION REPORT

Cockburn and Calrossie Combined Sewer Relief Works Geotechnical Investigations

FINAL REV 1

KGS Group 11-0107-18
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1.0 INTRODUCTION

1.1 GENERAL BACKGROUND

KGS Group was retained by the City of Winnipeg Water and Waste Department to perform geotechnical investigations to facilitate the design and construction of the proposed trunk sewer along Rockman Street and Byng Place. The proposed trunk sewer project is part of the Cockburn/Calrossie Combined Sewer Relief Works currently being undertaken by the City of Winnipeg.

It is our understanding that the trunk storm sewer will be 1200 mm in diameter, approximately 1 km in length and would conveying water from the storm retention pond at Parker Pond to the Calrossie Outfall, located near Toiler's Park on the Red River. It is further understood that trenchless construction methods will be employed for the installation of the proposed trunk sewer pipe.

The purpose of our investigation was to identify the subsurface soil and groundwater conditions along the route of the proposed works. This report contains detailed description of the geotechnical investigations program performed by KGS Group, our findings and geotechnical design recommendations for the proposed trunk storm sewer.

1.2 PREVIOUS SITE INVESTIGATIONS

KGS Group was retained by the City of Winnipeg to complete geotechnical investigations program for the repair and rehabilitation of the Calrossie Outfall (RR-37B) located within Toiler's Park on the Red River. The drilling and soil sampling program was completed on October 4, 2013. Two test holes, approximately 12 m and 15 m in depth, were drilled within the park.

The stratigraphy encountered at the test hole locations during the 2013 site investigation generally consisted of a thin layer of fill over an extensive layer of high plasticity silty clay of lacustrine origin overlying till. The top of the till layer was at approximately El. 217.1 m± to 217.5 m±. The groundwater level measured within the till layer was at approximately El. 227.0 m± and exhibited a slight downward gradient from the clay to the underlying till.

1.3 SCOPE OF THE 2014 INVESTIGATION PROGRAM

Test hole Drilling and Soil Sampling – Approval for the drilling program was issued to KGS Group on February 27, 2014 and the drilling of the ten test holes was completed between March 24 and March 27, 2014. Approximate locations of the test holes are shown in Figure 1 and a summary of the locations is presented in Table 1.

The primary objective of the drilling program was to determine the stratigraphy and engineering properties of the subsurface materials along the alignment of the proposed trunk storm sewer. The information obtained from the site investigations will be used to facilitate the design and construction of the various components of the trunk storm sewer including the excavation of the launch and reception shafts.

The drill rig was provided and operated by Maple Leaf Enterprises, while KGS Group directed and provided continuous on-site supervision throughout the exploration program. The test holes were drilled with a truck mounted drill rig and split spoon samples were obtained within the deposits at several locations. Soil samples were collected from auger flights at 1.5 m intervals and at any change in soil stratigraphy within overburden materials.

Strength index testing was performed on the soil samples using a field Torvane to estimate the undrained shear strength. All test holes were backfilled with soil cuttings and American National Standards Institute (ANSI) approved environmental friendly bentonite grout mixture. The holes within the pavement structure were restored using ready-mixed concrete.

Instrumentation Program – Three (3) pneumatic piezometers were installed within the silt till and one (1) within the silty clay. Table 2 summarizes the piezometric instrumentation monitoring to date.

FIGURE 1
TEST HOLE LOCATIONS

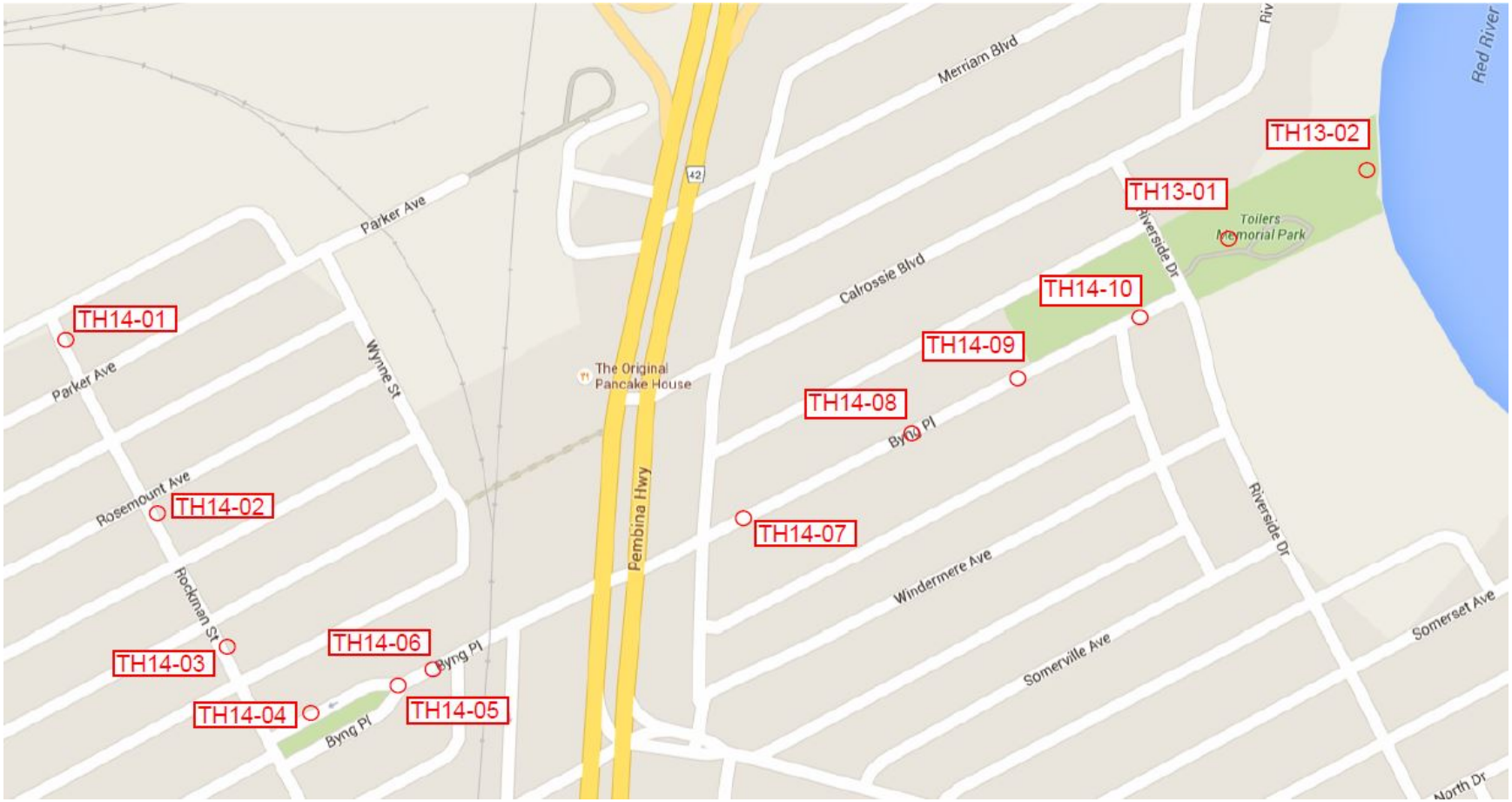

TABLE 1
SUMMARY OF TEST HOLE LOCATIONS

Test hole ID	Locations	Northing (m)	Easting (m)	Approx. Ground Surface Elevation (m)	Approx. Borehole Depth (m)
TH14-01	East Side of Rockman Street between Parker and Heatherdale	5523638	632442	231.94	13.74
TH14-02	East Side of Rockman South of Rosemount	5523524	632500	231.81	12.19
TH14-03	East Side of Rockman South of Edderton	5523444	632546	231.77	12.65
TH14-04	North Side of Byng East of Rockman	5523398	632592	231.84	14.08
TH14-05	East End of Byng Island	5523416	632649	232.65	12.19
TH14-06	South Side of Byng West of Train Tracks	5523431	632674	232.93	14.33
TH14-07	In Front of 952 Byng	5523524	632864	232.46	14.94
TH14-08	In Front of 934 Byng	5523576	632961	232.00	12.65
TH14-09	In Front of 920 Byng	5523621	633036	231.97	12.19
TH14-10	South Side of Byng West of Riverside	5523664	633109	231.72	14.78

2.0 SITE STRATIGRAPHY

In general, the stratigraphy at the site consisted of a layer of asphalt concrete above sand and gravel fill materials (pavement structure). Beneath the pavement structure is an extensive deposit of high plastic silty clay underlined by glacial silt till deposit. Details regarding the subsurface conditions are provided on the test hole log records contained in Appendix A.

2.1 PAVEMENT STRUCTURE

The proposed site has an overlying asphalt concrete surface with a thickness that ranged from 50 to 100 mm±. The road base material beneath the asphalt concrete consisted of approximately 200 to 250 mm± thick compacted sand and gravel fill material.

2.2 SILTY CLAY (CH)

An extensive layer of highly plastic silty clay was encountered immediately beneath the pavement structure at the majority of the test holes drilled. The upper layer of the lacustrine clay deposit was oxidized and brown in colour becoming grey around elevation El 227 m±. The clay was moist, firm and became softer with depth. Approximately 0.2 to 0.4 m± thick silt lenses were encountered in a number of the test holes at a depth of 0.9 to 2.5 m± below the ground surface. Silt inclusions and trace amounts of sand and gravel were encountered occasionally throughout the deposit.

The undrained shear strength, as estimated from the field Torvane, ranged from 50 kPa near the top of the deposit and decreased to 20 kPa near the bottom, with average shear strength of 32.8 kPa±. The average thickness of the silty clay layer is approximately 12.2 m±. Standard penetration testing within the deposit recorded “N” values ranging from 3.5 to 4.9, with an average of 4.2 blows/0.3 m±.

Previous laboratory testing conducted at Toilers Park indicated that the moisture content of the clay deposit ranged from 32 to 58%. Atterberg limit tests and grain size analyses were conducted on three samples of the silty clay. The plastic limits ranged from 15 to 22%, the liquid limits ranged from 52 to 74%, and the plasticity index (PI) ranged from 37 to 54%. The samples

were found to be comprised of 3 to 6% gravel, 6 to 14% sand, 24 to 35% silt, and 49 to 62% clay.

2.3 TILL

Till was encountered below the silty clay at a depth that ranged from 12.4 to 13.1 m± below the existing ground surface which correspond to a geodetic level of EL. 219.0 to 220.5 m±. The till was found to be light grey in colour, damp, soft to dense in consistency, of low plasticity, and contained trace amounts of clay, fine to coarse grained sand, and fine to coarse grained gravel. Standard penetration test "N" values in the till varied from 10 to >50 blows/0.3 m with most of the SPT values being greater than 40 blows.

Laboratory testing conducted on till samples obtained from the test holes drilled within Toilers Park indicated that the moisture content of the till ranged from 9 to 16%.

2.4 GROUND WATER CONDITIONS

As mentioned above, four (4) two pneumatic piezometers were installed as part of the 2014 site investigation program. The instruments were installed in test holes TH14-01, TH14-05, TH14-07, and TH14-10.

Groundwater measurements were taken on May 1, 2014 from the piezometers installed in March 2014 and summarized in Table 2.

TABLE 2
TYPICAL GROUNDWATER MEASUREMENTS

Piezometer	Tip Elevation (m)	May 1, 2014 Groundwater Level Reading (m)	Jan 15, 2015 Groundwater Level Reading (m)
TH14-01	218.22	218.22(1)	218.22(1)
TH14-05	220.46	228.69	228.55
TH14-07	217.52	226.66	Note 2
TH14-10	216.94	216.94(1)	216.94(1)

Notes:
1. No return flow from pneumatic piezometer. Piezometer likely damaged.
2. Vehicle parked over top of the instrument.

3.0 DESIGN AND CONSTRUCTION CONSIDERATIONS

3.1 TRENCHLESS PIPE INSTALLATION METHODS

The two most viable trenchless pipe installation methods suitable for the proposed work and readily available locally for installing large diameter sewer line are Microtunnelling and Auger/Thrust Boring.

3.1.1 Microtunneling

Microtunneling is a remotely-controlled, guided, pipe-jacking operation that provides continuous support to the excavation face by applying mechanical or fluid pressure to balance groundwater and earth pressures. Support at the excavation face is a key feature of microtunneling, distinguishing it from traditional open-shield pipe-jacking. Microtunnel Boring Machines (MTBMs) have been used extensive and successfully to install gravity flow sewer lines requiring precise line and grade in weak clay soil deposits

Microtunneling installation technique requires a jacking shaft from which the pipe installation starts and a reception shaft at the opposite end of the pipeline to retrieve the MTBM which would be used to excavate underground along the pipe alignment. The MTBM is pushed into the earth by hydraulic jacks mounted and aligned in the jacking shaft. The jacks are then retracted and the slurry lines and control cables are disconnected. The pipe or casing to be installed is lowered into the shaft and inserted between the jacking frame and the MTBM or previously jacked pipe. Slurry lines and power and control cable connections are made, and the pipe and MTBM are advanced another drive stroke. This process is repeated until the MTBM reaches the reception shaft. Upon drive completion, the MTBM and trailing equipment are retrieved and all equipment removed from the pipeline.

MTBMs have a rotating cutting head to excavate the ground material; the spoil is transported through conveyor system back to the jacking/lunching shaft. The cutting head is turned by a hydraulic or electric motor while a pressurized slurry mixing chamber behind the cutter head maintain face stability. MTBMs are capable of independently counter-balancing earth and hydrostatic pressures. Earth pressure is counter-balanced by careful control of advance rates

and excavation rates of spoil materials. Groundwater pressure is counter-balanced by using pressurized slurry in the soil-mixing chamber of the MTBM.

Large diameter sewer line with drive lengths up to 120 m have been successfully achieved in the Winnipeg area using MTBMs.

3.1.2 Auger/Thrust Boring

Auger boring is ideal for installing pipe in relatively soft stable ground conditions such as clay located above the water table. The soil within the pipe is retained during auger boring to reduce the likelihood of ground settlement from excavation, making auger boring a popular installation method for installing utilities under railroads, highways, and levies where potential settlement is a concern.

The auger boring process uses an auger boring machine to rotate an auger placed within the pipe and fitted to a cutter head at the front of the pipe. The rotating cutter head, which is slightly larger in diameter than the pipe, excavates the soil in front of the pipe. The soil is transported back to the launching where it is removed by hand or machine. The auger boring machine advances along a track, which is aligned to drive the casing pipe on the designed grade. Once the machine reaches the end of the track arrangement, the auger chain is disconnected from the machine and the machine is moved back to the original starting point on the track where a new casing pipe segment and auger chain is connected to the machine and to the existing chain/cutter head. The excavation and thrust process is repeated until the project is completed. The auger chain is then withdrawn from the casing pipe and the pipe is cleaned of all remaining soil and ready to use.

3.2 CONSIDERATIONS FOR PIPE INSTALLATION AT CN RAIL CROSSING

Construction of the section of the pipe installation that will be installed beneath the existing CN Rail line shall be completed using one of the trenchless method described in Section 3.1 and must comply with the following specification and standards.

(i) A guide to the Pipe and Wire Process- water/Sewer Pipeline by CN Rail (August 2009)

(ii) Pipeline Crossing Specifications by CN Rail

(iii) Transport Canada standard, "*TC E-10 Standards Respecting Pipeline Crossings Under Railways".*

(iv) *Safety Guidelines for Contractors and Non-CN Personnel, May 2004*

3.2.1 Settlement and Construction Monitoring

The depth of cover above the proposed pipe line beneath the CN Rail line is approximately 8.72m (28.5 ft), this significant thickness of insitu clay above the proposed pipe makes the risk of settlement of the rail tracks negligible. The installation of the sewer using either of the trenchless installation technique outlined above should not result in any adverse effect to CN operations or property. Nevertheless, it is recommended that the railway be monitored for movement/settlement during the installation of the new sewer pipe as follows:

(i) A baseline survey of the railway should be conducted and submitted to CN prior to the installation of the sewer lines. The baseline survey should include the top of rail elevation at intervals of 3.05 m (10 feet) along the track and extending a minimum of 10 m beyond the extent of the proposed work.

(ii) During construction, periodic survey monitoring of the rails must be carried out and submitted to CN. The required frequency of survey monitoring and reporting will be provided by CN in writing. Survey data will be reviewed to determine if settlement of any track defects have occurred.

3.2.2 Emergency Response Plan

In the unlikely event that the survey monitoring data indicates a defect that is "Near Urgent" or within 1/8 inch (3.175 mm) of an Urgent defect then CN may carry out required maintenance of the track at the expense of the City to restore the track to the same or better condition as was established in the baseline survey. In all cases CN will have the right to carry out maintenance of the track upon completion of the works and during any agreed to warranty period to restore the track at the expense of City to the same or better condition as was established in the baseline survey.

If an urgent or near urgent defect is detected, an on-site meeting should be conducted between all parties including Contractor, Consultant, City and CN to determine the cause of the defect and remedial action. A remedial action plan will be developed and implemented. The remedial may include pressure injected grout to fill any potential voids to prevent future settlement. As aforementioned, the risk that such a problem will occur with the proposed trenchless installation method is negligible given the plastic nature of the subsurface clay material and the significant depth of cover above the pipe.

3.3 EXCAVATIONS

It is anticipated that excavations will be required to facilitate the construction of the proposed trunk storm sewer. All excavation work should be performed in accordance with the Workplace Safety and Health Act and Part 26 of the Manitoba Workplace Safety and Health Regulation, M.R. 217/2006.

Construction excavation details are not available at the time of preparation of this report. Preliminary guidance for temporary excavations is provided on Table 3.

TABLE 3
PRELIMINARY GUIDANCE FOR TEMPORARY EXCAVATIONS

Height of Excavation (m)	Recommended Side Slope
0 –1.5	1H : 1V
1.5 –3.0	1.5H : 1V
3.0 – 5.0	2H : 1V
5.0 – 6.5	3H : 1V

If excavation is to be performed adjacent to the existing roadway or infrastructure, temporary shoring or bracing will be required. Suitable options include steel piling and timber lagging or driven steel sheet piling. Any excavation deeper than 1.5 m should be reviewed and designed prior to construction by an experienced professional engineer with an expertise in geotechnical engineering. The shoring design should account for all applicable surcharge loads. Opening and voids behind shoring lagging or sheet piles should be backfilled with free draining granular materials.

Due to the highly variable silt content of the upper clays, the soil may be susceptible to sloughing from wetting and mechanical disturbance. It is recommended that the side slopes of all open excavations be covered with water proof material to prevent saturation of the soil and all surface runoff should be directed away from the excavations. All surcharge loads such as stockpiled soil, equipment, etc. should be kept a minimum of 10 m away from the edge of excavations.

During the site investigations there was no significant water infiltration into the test holes, however, there may be the potential of localized groundwater inflows into excavations below the water table, which may require temporary pumping as well as potential shoring. Design of the above measures depends on the size, depth and extent of the excavation.

3.4 GROUND MOVEMENT

Excavation support systems should be designed to control ground movement/subsidence around the perimeter of the excavation. The magnitude of ground movement could be affected by the procedure and workmanship applied during construction. Potential settlement of the ground surface adjacent to temporary shoring system should be recognized and accounted for in the design. Any resulting movement/settlement around the perimeter of the excavation must be kept within acceptable limit as specified in the contract document.

The excavation and shoring system should be designed by a professional engineer with extensive relevant experienced and the works must be inspected and certified by the same professional engineer to verify that the temporary structure has been installed according to the design.

3.5 BASE HEAVE

The stability of the bottom of the excavation could be comprised if the high plastic clay is overstressed and allowed to shear. The base of excavation and shoring should be designed to achieve a minimum factor of safety of 2.0 with respect to base heave.

3.6 CARE AND CONTROL OF WATER

The base of the excavations may to be below the groundwater level during construction. In order to maintain safe working conditions in the excavation and to protect against instability of the excavation base, the water should not allowed to accumulate anywhere within the excavations or to within 0.5 m below the lowest point within the excavation. Therefore, it will be important to have an effective drainage and sump pump system below the base of excavation, and to maintain a firm, dry working surface. The drainage system should be designed to efficiently collect groundwater seepage and surface water drainage within the excavation so it can be pumped out and treated. Surface run-off resulting from rainfall should be controlled and prevented from entering into the excavation.

3.7 LATERAL EARTH PRESSURES

For design purposes the soils may be assigned active, at-rest and passive lateral earth pressure coefficients as shown in Table 4.

TABLE 4
LATERAL EARTH PRESSURE COEFFICIENTS

Backfill Material	ϕ'	K_a	K_0	K_p
Clay Till	25°	0.41	0.58	2.46
Native Clay	18°	0.53	0.69	1.89
Well Graded Compacted Granular	35°	0.27	0.43	3.69

3.8 FROST PENETRATION

The expected depth of frost penetration has been estimated assuming a design freezing index of 2680^{0}C days, taken as the coldest winter over a ten (10) year period. The estimated maximum depth of frost penetration is 2.5 m assuming no insulation cover.

4.0 CLOSURE

The geotechnical investigation conducted by KGS Group describes the underlying soil and groundwater conditions along Rockman Street and Byng Place at the test hole locations. This report presents the geotechnical engineer's best judgment of the subsurface and ground conditions anticipated to be encountered at the project site during construction. In order to develop the design, it was necessary to interpolate between the test holes that were drilled at the site. While the actual conditions encountered in the field are expected to be within the range of conditions discussed in this document, the spatial variability of subsurface and groundwater conditions that would be encountered at the site may be more complex than the simplified interpretation presented in this report.

To facilitate project design, certain assumptions were made with respect to the construction methods and on the level of workmanship that can reasonably be expected for the construction of a large diameter trunk sewer project. It should be noted that the Contractor's selected equipment, means, methods, and workmanship will influence the behaviour and performance of the subsurface soils encountered at the site.

Full time inspection by qualified geotechnical personnel is recommended during construction to ensure that design intent is achieved and to address any issue that may arise due to variability in soils condition.

5.0 STATEMENT OF LIMITATIONS

5.1 THIRD PARTY USE OF REPORT

This report has been prepared for the City of Winnipeg to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

5.2 GEOTECHNICAL INVESTIGATION STATEMENT OF LIMITATION

The geotechnical investigation findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations are based on the results of field and laboratory investigations, combined with an interpolation of soil and groundwater conditions found at and within the depth of the test holes drilled by KGS Group at this site. If conditions encountered during construction appear to be different from those shown by the test holes drilled by KGS Group or if the assumptions stated herein are not in keeping with the design, this office should be notified in order that the recommendations can be reviewed and modified if necessary.

APPENDIX A

TEST HOLE LOG RECORD

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-01**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Rockman Street
LOCATION East Side of Rockman Between Parker and Heatherdale
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **231.94 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **24/03/2014**
UTM (m) N **5,523,636**
E **632,440**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL / %
231.8				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.							
231	1	5		**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules. - Increased silt content between 0.30 and 0.91 m. - Black between 0.91 and 1.07 m.				S1			
230	2			- Frozen above 1.98 m.				S2			
229	3	10						S3	100	▲5 ▲6 ▲7	
228	4							S4			
		15		- Grey below 4.57 m.				S5	100	▲4 ▲4 ▲7	
227	5										
226	6	20		- Trace medium to coarse grained sand between 6.25 and 6.55 m. - Piece of coarse grained gravel (30 mm Ø) at 6.40 m. - Increased silt nodules (~2-10 mm Ø) below 6.40 m.				S6		▲3 ▲4 ▲5	
225	7										
		25						S7	100	▲5 ▲5 ▲7	
224	8			- Trace coarse grained sand, trace fine grained gravel below 8.31 m.							
223	9	30		- Soft below 8.84 m.				S8	100	▲2 ▲2 ▲3	
222				- Piece of coarse grained gravel (30 mm Ø) at 9.60 m. - Piece of coarse grained gravel (30 mm Ø) at 9.83 m.							

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\BYNG PLACE\BYNG DRILLING.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-01**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆
221	11	35					S	S9	100	▲2 ▲3 ▲3	
220	12	40									
219.5				**SILT TILL** - Tan, moist, dense to very dense, low plasticity, fine to coarse grained sand, trace fine to coarse grained gravel.			S	S10	100	▲2 ▲2 ▲3	
219	13			- Damp, dense below 13.41 m.							
218.2		45				13.6	S	S11			
218	14			**REFUSAL AT 13.74 m**		13.7			100	▲10 *Refused 25mm into first set	
				Notes: 1. Test hole remained open to the bottom after drilling. 2. Approximately 0.9 m of water in test hole after drilling. 3. Installed pneumatic piezometer (PN 035740) at 13.72 m below grade and installed a flush mount cover. 4. Backfilled test hole with bentonite grout mixture from 13.74 m to grade. 5. SPT bouncing on suspected gravel or cobble.		13.7				
217	15	50									
216	16										
		55									
215	17										
214	18	60									
213	19										
		65									
212	20										
211	21	70									

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\BYNG PLACE\BYNG DRILLING.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-02**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Rockman Street
LOCATION East Side of Rockman South of Rosemount
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **231.81 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **24/03/2014**
UTM (m) N **5,523,518** E **632,502**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL / %
231.7				**CONCRETE**					
231.3				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
231	1	5		**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules.		S1			
230	2			-Frozen above 2.13 m.					
229	3	10				S2	100	▲4 ▲4 ▲6	
228	4					S3			
227	5	15		- Grey below 4.88 m.		S4	94	▲4 ▲5 ▲7	
226	6	20				S5	100	▲3 ▲4 ▲5	
225	7			- Piece of fine grained gravel (10 mm Ø) at 6.50 m.					
224	8	25		- Increased silt nodules (~3-10 mm Ø) below 7.92 m.		S6	100	▲2 ▲3 ▲5	
223	9	30				S7	100	▲4 ▲4 ▲5	
222									

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\BYNG PLACE\BYNG DRILLING.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH14-02

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
221	11	35				S8	100	▲ 3 3 4	◆
220	12	40		- Soft below 11.68 m.		S9			◆
219.6				**END OF TEST HOLE AT 12.19 m**					
219	13	45		Notes: 1. Test hole remained open and dry to bottom after drilling. 2. Backfilled test hole with bentonite chips from 12.19 to 11.58 m, auger cuttings from 11.58 to 1.22 m, bentonite chips from 1.22 to 0.30 m and concrete from 0.30 m to grade.					
218	14								
217	15	50							
216	16								
215	17	55							
214	18	60							
213	19								
212	20	65							
211	21	70							
210									

SAMPLE TYPE Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\BYNG PLACE\BYNG DRILLING.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-03**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Rockman Street
LOCATION East Side of Rockman South of Edderton
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. 11-0107-18
GROUND ELEV. 231.77 m
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 26/03/2014
UTM (m) N 5,523,441
E 632,545

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
231.7				**CONCRETE**					
231.5				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
231	1			**CLAYEY SILT** - Tan, moist, firm, intermediate to high plasticity, trace medium grained sand.		S1			
230.2		5		**SILTY CLAY** - Brown, moist, firm, high plasticity, trace silt nodules.					
230	2			- Frozen above 1.83 m.					
229	3	10				S2			
						S3	100	▲4 ▲4 ▲4	
228	4			- Grey below 3.40 m.		S4			
227	5	15		- Reduced silt nodules below 4.57 m.					
226	6	20				S5	100	▲3 ▲4 ▲5	
225	7			- Increased silt content between 6.25 and 6.71 m.					
224	8	25				S6			
223	9	30		- Increased moisture content with depth below 9.14 m.		S7	100	▲4 ▲4 ▲4	
222									

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH14-03

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
221	11	35				S8			
220	12	40							
219.4						S9	100	▲ 2 ▲ 3 ▲ 3	
219.1				**SILT TILL** - Light grey, moist, dense to very dense, low plasticity, fine to coarse grained sand, trace fine grained gravel.					
219	13	45		**END OF TEST HOLE AT 12.65 m**					
218	14								
217	15	50							
216	16								
215	17	55							
214	18	60							
213	19								
212	20	65							
211	21								
210		70							

Notes:
1. Test hole remained open and dry to the bottom after drilling.
2. Backfilled test hole with bentonite chips from 12.65 to 11.58 m, auger cuttings from 11.58 to 0.91 m, bentonite chips from 0.91 m to 0.30 m and concrete from 0.30 m to grade.

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-04**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION North Side of Byng East of Rockman
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **231.84 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **26/03/2014**
UTM (m) N **5,523,392** E **632,587**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
231.7				**CONCRETE**					
231.5				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
231	1	5		**SILTY CLAY** - Brownish black, moist, firm to stiff, high plasticity, trace medium to coarse grained sand.					
				- Brown below 1.52 m.		S1			
230	2					S2			
229.7				- Frozen above 1.98 m.					
229.6				**SILT** - Tan, moist, soft, low plasticity.					
				SILTY CLAY - Brown, moist, firm to stiff, high plasticity, trace silt nodules.					
229	3	10		- Firm below 3.05 m.					
				- Mottled grey and brown below 3.20 m.		S3			
228	4								
		15				S4	100	▲4 ▲4 ▲5	
227	5			- Grey below 4.98 m.					
226	6	20				S5			
225	7								
		25				S6	83	▲4 ▲3 ▲5	
224	8								
223	9	30							
				- Soft below 9.30 m.		S7			
222				- Piece of coarse grained gravel (~40 mm Ø) at 9.45 m.					

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH14-04

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
221	11	35		- Trace fine to coarse grained sand below 10.67 m.	S	S8	100	▲ 2, 3, 4	
220	12	40							
219.0	13	45		**SILT TILL** - Light grey, moist, dense to very dense, low plasticity, fine to coarse grained sand, trace fine to coarse grained gravel.	S	S9			
218					S	S10			
217.8	14			- Dense below 14.02 m.			100	▲ 50 *See Note 4	
				END OF TEST HOLE AT 14.08 m					
217	15	50							
216	16								
215	17	55							
214	18	60							
213	19								
212	20	65							
211	21	70							

Notes:
1. Test hole remained open to the bottom after drilling.
2. Approximately 0.3 m of water in test hole after drilling.
3. Backfilled test hole with bentonite chips from 14.08 to 12.80 m, auger cuttings from 12.80 to 0.91 m, bentonite chips from 0.91 m to 0.30 m and concrete from 0.30 m to grade.
4. SPT refused 64 mm into first set.

SAMPLE TYPE Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-05**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION East End of Byng Island
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **232.65 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **26/03/2014**
UTM (m) N **5,523,415** E **632,650**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆
232.6				**CONCRETE**							
232.3				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.							
232	1	5		**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules.							
231	2			- Frozen above 1.98 m.				S1			
230	3	10		- Mottled brown/grey below 3.05 m.				S2			
229	4							S3	100	4, 3, 5	
228	5	15						S4	89	4, 5, 6	
227	6	20		- Grey below 6.40 m.				S5	100	3, 4, 6	
226	7			- Piece of coarse grained gravel (~25 mm Ø) at 7.21 m. - Trace fine grained gravel below 7.32 m.							
225	8	25		- Piece of coarse grained gravel (~40 mm Ø) at 7.68 m.				S6	100	3, 2, 4	
224	9	30		- Reduced silt nodules below 9.14 m.				S7	100	4, 5, 5	
223											

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-05**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
222	11	35					S8		100	▲2 ▲4 ▲4	◆
221	12	40					S9				◆
220.5				**END OF TEST HOLE AT 12.19 m**		12.0 12.2					
220	13	45		Notes: 1. Test hole remained open and dry to the bottom after drilling. 2. Installed pneumatic piezometer (PN 035741) at 12.19 m below grade and installed a flush mount cover. 3. Backfilled test hole with bentonite grout mixture from 12.19 m to grade.							
219	14										
218	15	50									
217	16										
216		55									
215	17										
214	18	60									
213	19										
212	20	65									
211	21	70									

SAMPLE TYPE ⊓ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	**C. FRIESEN**	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-06**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION South Side of Byng West of Train Tracks
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. 11-0107-18
GROUND ELEV. 232.93 m
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 28/03/2014
UTM (m) N 5,523,428
E 632,677

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆
232.9				**CONCRETE**					
232.6				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
				SILTY CLAY - Brown, moist, firm to stiff, high plasticity, trace silt nodules.					
232	1								
		5			Auger Grab	S1			
231	2								
230.6				- Frozen above 2.29 m.					
230.5				**SILT** - Tan, moist, firm, low plasticity.	Auger Grab	S2			
230	3			**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules.					
		10		- Mottled brown/grey below 3.05 m.	Split Spoon	S3	100	▲ 3 4 5	
229	4								
		15			Auger Grab	S4			
228	5								
227	6								
		20			Split Spoon	S5	100	▲ 3 4 5	
				- Piece of coarse grained gravel (~30 mm Ø) at 6.43 m.					
226	7			- Grey below 6.71 m.					
				- Piece of coarse grained gravel (~20 mm Ø) at 7.32 m.					
		25			Auger Grab	S6			
225	8								
224	9								
		30			Split Spoon	S7	100	▲ 3 4 5	
223									

Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆: 20 40 60 80

PL MC LL
%
20 40 60 80

SAMPLE TYPE: Auger Grab; Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-06**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
	11	35		- Reduced silt nodules between 10.67 and 12.50 m.		S8			
222									
221	12	40				S9	100	▲ 2 ▲ 3 ▲ 3	
220.3				**SILT TILL** - Light grey, moist, dense to very dense, low plasticity, fine to coarse grained sand, trace fine to coarse grained gravel.					
220	13								
		45				S10			
219	14					S11			
218.6				- Damp below 14.33 m.			100	▲ 40 *See Note 4	
				REFUSAL AT 14.36 m					
218	15	50							
217	16								
		55							
216	17								
215	18	60							
214	19								
		65							
213	20								
212	21	70							

Notes:
1. Test hole remained open to the bottom after drilling.
2. Approximately 0.3 m of water in test hole after drilling.
3. Backfilled test hole with bentonite chips from 14.36 to 14.02 m, auger cuttings from 14.02 to 0.91 m, bentonite chips from 0.91 m to 0.30 m and concrete from 0.30 m to grade.
4. SPT refused 25 mm into first set.

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-07**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION In Front of 952 Byng
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **232.46 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **27/03/2014**
UTM (m) N **5,523,522** E **632,864**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆
232.4			**CONCRETE**					
232.2			**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
232	1	5	**SILTY CLAY** - Brown, moist, stiff, high plasticity, trace medium to coarse grained sand.	S1				
231								
230.6	2		- Frozen above 1.83 m.	S2				
230.2			**SILT** - Tan, moist, soft, low plasticity.					
230	3	10	**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules.	S3		56	▲4 ▲4 ▲5	
229								
228	4	15	- Mottled brown/grey below 4.27 m.	S4		72	▲4 ▲4 ▲6	
227	5		- Trace fine grained gravel at 4.88 m.					
226	6	20		S5		94	▲3 ▲3 ▲4	
225	7	25	- Increased silt content between 6.81 and 6.91 m. - Grey below 7.16 m.	S6		100	▲4 ▲4 ▲5	
224	8		- Trace coarse grained sand below 7.70 m.					
223	9	30	- Soft below 9.60 m.	S7		100	▲2 ▲3 ▲4	

SAMPLE TYPE ▨ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH14-07

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
222	11	35									
221	12	40									
220				- Trace medium to coarse grained sand, trace fine grained gravel below 12.34 m.			S8	S8	100	▲2 ▲2 ▲4	
219.4	13			**SILT TILL** - Light grey, moist, dense to very dense, low plasticity, some fine to coarse grained sand, trace fine grained gravel.			S9	S9	89	▲2 ▲2 ▲4	
219		45									
218	14			- Damp below 14.63 m.			S10	S10	89	▲4 ▲6 ▲5	
217.5	15	50		**AUGER REFUSAL AT 14.94 m**		14.8 14.9	S11	S11			
217				Notes: 1. Test hole remained open and dry to the bottom after drilling. 2. Installed pneumatic piezometer (PN 035743) at 14.94 m below grade and installed a flush mount cover. 3. Backfilled test hole with bentonite grout mixture from 14.94 m to grade.							
216	16										
215	17	55									
214	18	60									
213	19										
212	20	65									
211	21	70									

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-08**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION In Front of 934 Byng
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **232.00 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **28/03/2014**
UTM (m) N **5,523,578**
E **632,964**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆
231.9				**CONCRETE**					
231.7				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
231.2				**CLAYEY SILT** - Brown, moist, stiff, intermediate to high plasticity, trace coarse grained sand.					
231.1				**SILT** - Tan, moist, firm, low plasticity.					
231	1			**CLAYEY SILT** - Brown, moist, firm to stiff, intermediate plasticity.		S1			
		5							
230	2			- Frozen above 1.83 m.					
229.7				**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules.		S2			
229	3	10		- Mottled brown/grey below 3.05 m.		S3	89	▲4 ▲6 ▲6	
228	4								
		15		- Grey below 4.57 m.		S4			
227	5								
226	6	20		- Reduced silt nodules below 6.10 m.		S5	100	▲3 ▲3 ▲5	
225	7								
		25							
224	8					S6			
223	9	30				S7	100	▲4 ▲4 ▲5	

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH14-08

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
				- Trace medium to coarse grained sand below 10.52 m.					
221	11	35		- Soft below 10.82 m.		S8			
220	12	40				S9	100	▲ 3 ▲ 2 ▲ 4	
219.4				**END OF TEST HOLE AT 12.65 m**					
219	13			Notes: 1. Test hole remained open and dry to the bottom after drilling. 2. Backfilled test hole with bentonite chips from 12.65 to 12.19 m, auger cuttings from 12.19 to 0.91 m, bentonite chips from 0.91 m to 0.30 m and concrete from 0.30 m to grade.					
218	14	45							
217	15	50							
216	16	55							
215	17								
214	18	60							
213	19	65							
212	20								
211	21	70							

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-09**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION In Front of 920 Byng
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **231.97 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **27/03/2014**
UTM (m) N **5,523,621**
E **633,036**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆
231.9				**CONCRETE**					
231.7				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.					
231	1			**CLAYEY SILT** - Brown, moist, firm to stiff, intermediate plasticity, trace medium to coarse grained sand.					
230.4		5		**SILTY CLAY** - Brown, moist, firm to stiff, high plasticity, trace silt nodules.		S1			
230	2			- Frozen above 2.13 m. - Mottled brown/grey, firm below 2.29 m.		S2			
229	3	10		- Increased silt content between 3.35 and 4.11 m.					
228	4								
227	5	15		- Grey below 4.88 m.		S3	100	▲3 ▲4 ▲5	
226	6	20							
225	7					S4			
224	8	25				S5	100	▲2 ▲3 ▲4	
223	9	30		- Trace coarse grained sand below 9.30 m.		S6			
222									

SAMPLE TYPE Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH14-09

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
221	11	35		- Soft below 10.36 m.	S	7	100	▲ 2 2 3	◆ ◆ ◆ ◆ ◆
220	12	40							
219.8				**END OF TEST HOLE AT 12.19 m**					
219	13	45							
218	14								
217	15	50							
216	16								
215	17	55							
214	18	60							
213	19								
212	20	65							
211	21	70							

Notes:
1. Test hole remained open and dry to the bottom after drilling.
2. Backfilled test hole with bentonite chips from 12.19 to 11.89 m, auger cuttings from 11.89 to 0.91 m, bentonite chips from 0.91 m to 0.30 m and concrete from 0.30 m to grade.

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\BYNG PLACE\BYNG DRILLING.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-10**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT COCKBURN & CALROSSIE SEWER RELIEF
SITE Byng Place
LOCATION South Side of Byng West of Riverside
DRILLING METHOD 125 mm ø Solid Stem Auger

JOB NO. **11-0107-18**
GROUND ELEV. **231.72 m**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **27/03/2014**
UTM (m) N **5,523,659** E **633,112**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL / %
231.6				**CONCRETE**							
231.4				**SAND & GRAVEL FILL** - Brown, damp, compact, medium to coarse grained sand, fine grained gravel, trace coarse grained gravel.							
231	1	5		**SILTY CLAY** - Dark brown, moist, firm to stiff, high plasticity, trace medium to coarse grained sand.			S1				
230	2			- Frozen above 1.98 m.							
229	3	10		- Trace silt nodules below 3.05 m.			S2		100	4, 5, 6	
228	4	15		- Brownish grey below 4.57 m.			S3		100	4, 5, 7	
227	5										
226	6	20					S4		100	4, 3, 5	
225	7										
224	8	25					S5		100	3, 3, 6	
223				- Piece of coarse grained gravel (20 mm Ø) at 8.38 m.							
222	9	30		- Piece of coarse grained gravel (25 mm Ø) at 9.35 m. - Piece of coarse grained gravel (35 mm Ø) at 9.68 m. - Soft below 9.75 m.			S6		100	5, 7, 9	

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH14-10**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
221	11	35					S7		100	▲2 ▲2 ▲4	
220	12	40		- Increased silt nodules (~3-8 mm Ø) below 12.19 m.			S8		100	▲2 ▲3 ▲4	
219	13	45		**SILT TILL** - Light grey, moist, dense to very dense, low plasticity, trace fine to coarse grained sand, trace fine grained gravel.			S9		100	▲2 ▲5 ▲4	
218	14			- Damp below 14.17 m.			S10				
217	15	50		**AUGER REFUSAL AT 14.78 m**		14.6 14.8					
216	16	55		Notes: 1. Test hole remained open and dry to the bottom after drilling. 2. Installed pneumatic piezometer (PN 035742) at 14.78 m below grade and installed a flush mount cover. 3. Backfilled test hole with bentonite grout mixture from 14.78 m to grade.							
215	17										
214	18	60									
213	19										
212	20	65									
211	21	70									
210											

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	C. FRIESEN	DAA	26/10/15

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