THE CITY OF WINNIPEG

PEMBINA TRAILS COLLEGIATE

VOCATIONAL WING

WINNIPEG, MANITOBA

TENDER NO. 954-2023B

APPENDICIES

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PEMBINA TRAILS SCHOOL DIVISION

Waverley West Schools Geotechnical Investigation – Additional Services – Phase 2

Final:
Rev. 0

KGS Group Project:
20-1522-002

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for Pembina Trails School Division in accordance with the agreement between KGS Group and Pembina Trails School Division (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by Pembina Trails School Division and unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group's work.

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Geotechnical Investigation Statement of Limitations

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 the site at the time of drilling. 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, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

1.0 INTRODUCTION

Kontzamanis Graumann Smith MacMillan Inc. (KGS Group) was retained by Pembina Trails School Division as the geotechnical consultant for additional exploration services for the new schools to be constructed in Waverley West located on Cadboro Road in Winnipeg, Manitoba. The additional services included site investigations to accommodate changes in the building locations to validate the foundation assessment and pavement surfacing recommendations provided in the report submitted in February 2019 and March 2020.

1.1 Project Understanding

The project site is located mostly on the south side of Cadboro Road as well as a small area north of Cadboro Road, approximately 0.7 km (0.4 mi) west of Waverley Street. The site has historically been used as farmland with no previous development across the site. Ground surface across the site is relatively flat. From aerial images and visual inspection during the previous two (2) investigation programs developed for this site, there are low lying areas and drainage swales that traverse the east end of the property.

It is KGS Group's understanding that this report will serve for the final layout of two (2) new school buildings and a daycare building. The site has an approximate area of 14.0 acres south of Cadboro Road and 5.0 acres north of Cadboro Road. Based on the information provided in the previous assignment performed by KGS Group (18-1517-001 and 20-1522-001), the elementary school building is anticipated to be a two-storey 7,944 m^2 (85,507 ft^2) school with capacity for 800 students. The high school building is anticipated to be a three-storey 11,748 m^2 (126,452 ft^2) school for a capacity of 1,000 students and have the capacity to expand to accommodate an additional 200 students in the future. A standalone daycare building will be located on the west side of the site. The future additions may include classrooms, shops and other facilities. Foundation loads and possible basement or crawlspace considerations are not currently available for the proposed buildings.

In addition, the proposed facility will also include hard and soft surface play areas, sports fields, loading areas for school buses and delivery trucks, walking pathways, landscape planting, light standards, property fencing, site drainage, and final topsoil and seeding.

This report summarizes the results of the additional investigations completed in December 2020 and presents a comparison with the conditions and design recommendations summarized in the report submitted in February 2019 and March 2020.

1.2 Scope of Services

The scope of these services for the updated layout included a site investigation program and review of the previously reported foundation assessment and pavement surfacing recommendations. The scope of services was completed in accordance with KGS Group's proposal dated December 3, 2020. The geotechnical engineering services included the following:

Utilities Locate and Site Clearances – KGS Group reviewed the utility clearances completed for the previous study, and requested updated ones for this investigation program, to identify and locate public underground and overhead utilities. KGS Group laid out the test holes to avoid utilities and other services.

Geotechnical Investigation – An on-site drilling program was completed to investigate the subsurface and groundwater conditions at the proposed site. The drilling program consisted of a total of six (6) additional deep test holes, three (3) within the footprint of each of the new school building locations. The test holes were advanced to power auger refusal in the underlying till and were completed under the direction of KGS personnel. Four (4) shallow test holes were also completed in the parking areas and roadways and advanced to depths of 3.0 m (10 ft). Drilling services were provided by Paddock Drilling Ltd. of Winnipeg, Manitoba with continuous KGS Group supervision. Details of the investigation program is presented in Section 2.0 of this report.

Geotechnical Assessment Report – This geotechnical design report was prepared to summarize the field investigations, and to present the validity of the previous geotechnical foundation assessments recommendations and any further recommendations for the proposed development, including:

- Detailed test hole logs of encountered stratigraphy incorporating field observations, soil classification, estimated depth of groundwater, and a plan showing the location of all test holes.
- General description of regional geology.
- Verification of the applicability of the Geotechnical Foundation Report prepared by KGS Group for Qualico Communities in February 2019 (project number: 18-1517-001) and for Pembina Trails School Division in March 2020 (project number: 20-1522-001), confirming the recommended foundation types, design capacities, expected settlement and general recommendations. The previous reports have been included in Appendices A and B, respectively.
- Advise on any new recommendations.

2.0 INVESTIGATION PROGRAM

2.1 Test Hole Drilling and Sampling Program

A drilling and sampling program was completed from December 15 to 16, 2020 with drilling services provided by Paddock Drilling Ltd. of Brandon, Manitoba with continuous KGS Group supervision. The drilling and sampling program consisted of ten (10) test holes distributed over the site, as shown on Figure 1, following the suggestions proposed in by the client. The locations of the test holes drilled for the previous studies are also shown on Figure 1.

Six (6) test holes were advanced to power auger or Standard Penetration Test (SPT) refusal and four (4) test holes were advanced to a depth of 3.0 m (10 ft) below grade. All test holes were completed using a track mounted Mobile B48 drill rig equipped with 125 mm diameter solid stem continuous flight augers. The locations of the test holes are provided on Table 1, with the UTM coordinates.

Representative disturbed soil samples were obtained in all test holes at 1.5 m (5 ft) intervals, or at any change in soil strata. Soil samples were collected directly off the auger flights and visually classified in the field in accordance with the modified Unified Soil Classification System (USCS). Clay samples were field tested with a field Torvane to evaluate consistency and estimate the undrained shear strength. SPTs were performed in the till to determine the relative in-situ density.

Upon completion of the drilling, each test hole was examined for indications of sloughing and seepage. All test holes were backfilled with soil cuttings and bentonite chips to surface. Detailed summary soil logs incorporating all field observations and laboratory testing are provided in Appendix C.

FIGURE 1: TEST HOLE LOCATIONS

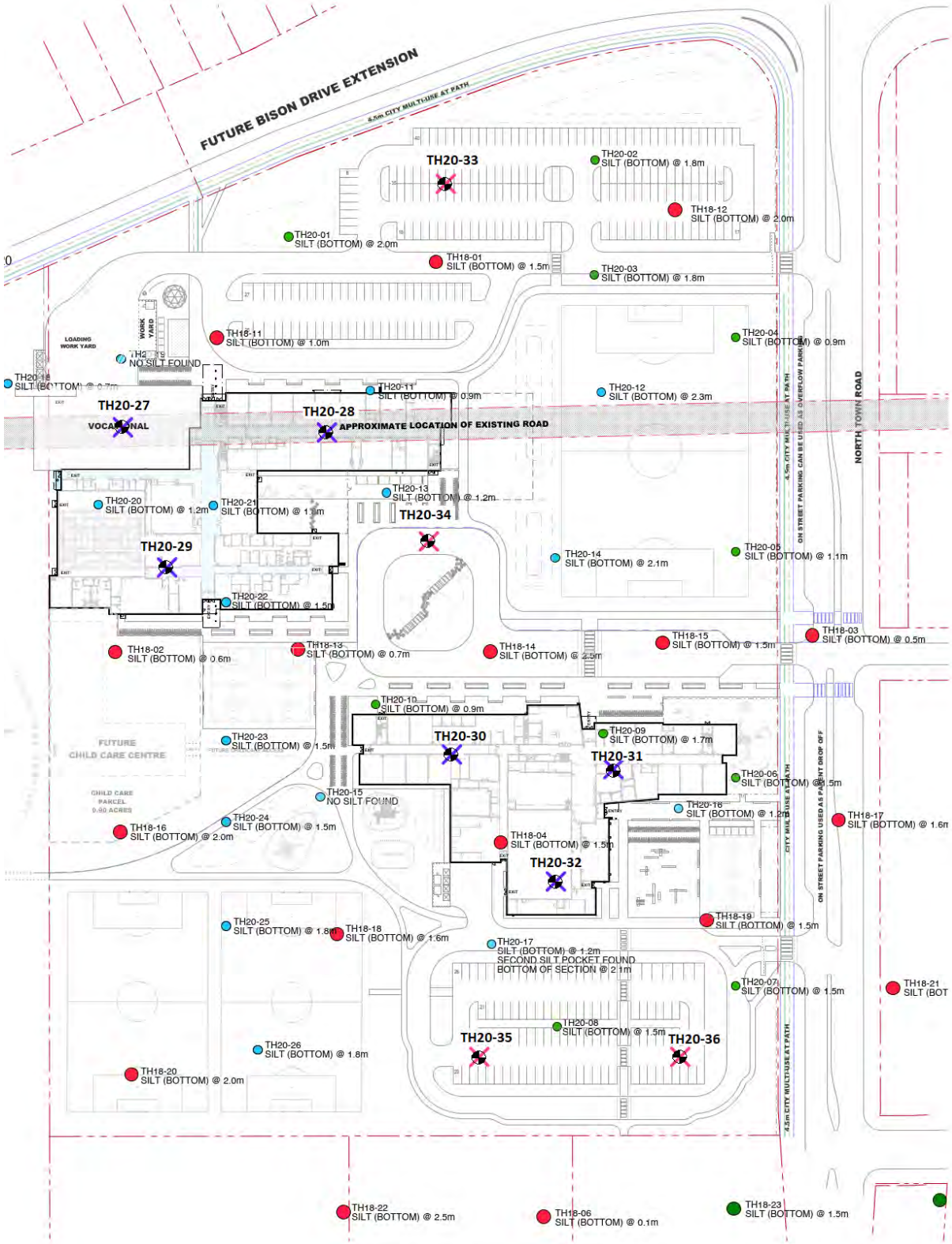

TABLE 1: APPROXIMATE TEST HOLE COORDINATES

Test Hole ID	Approximate UTM Coordinates		Structure	Test Hole Depth (m)
	Northing (m)	Easting (m)		
TH20-27	5,517,788	630,594	Vocational	18.0
TH20-28	5,517,822	630,653	High School – Northeast	15.6
TH20-29	5,517,750	630,633	High School – Southwest	15.5
TH20-30	5,517,747	630,740	Elementary School	15.6
TH20-31	5,517,762	630,794	Elementary School	16.8
TH20-32	5,517,728	630,793	Elementary School	15.4
TH20-33	5,517,908	630,647	North Parking lot	3.0
TH20-34	5,517,796	630,701	Entry Plaza Drop-Off	3.0
TH20-35	5,517,654	630,808	South Parking lot	3.0
TH20-36	5,517,683	630,857	South Parking lot	3.0

3.0 INVESTIGATION RESULTS

3.1 Regional Geology

The geology in Winnipeg, in general terms, consists of glaciolacustrine clay deposits over till, consistent with the findings of the drilled material at the location of the Waverley West Schools. Additional information on the regional geology can be found in the Geological Engineering Report for Urban Development of Winnipeg, from the University of Manitoba.

3.2 Stratigraphy

A total of ten (10) test holes (TH20-27 to TH20-36) were drilled during this additional study at the proposed site for the new school buildings in Waverley West, Winnipeg, Manitoba. As aforementioned, the stratigraphy at the site was consistent with the regional geology and has been interpreted by KGS Group to consist of a layer of topsoil and organic (black) clay overlying high plasticity clay with a silt layer near surface, underlain by a layer of glacial till over suspected bedrock. Power auger or SPT refusal occurred between 15.4 and 18 m below existing ground surface within the silt till.

A description of the findings is included in the following paragraphs. These results are compatible to the findings of the previous study submitted in February 2019 and March 2020.

Topsoil – Topsoil was observed at ground surface in all the test holes except TH20-27 and TH20-28. The topsoil was black in colour and frozen. The approximate thickness of the topsoil layer ranged between 0.1 to 0.15 m.

Fill – Gravel fill was encountered at ground surface in test holes TH20-27 and TH20-28. The gravel fill was brown in colour, and frozen. The approximate thickness of the gravel fill was 0.3 m (1.0 ft).

Clay fill was encountered below the gravel fill in TH20-27 and TH20-28. The clay fill was brown in colour, frozen, contained some coarse grained sand, trace medium grained sand, and trace fine grained gravel. The approximate thickness of the clay fill ranged from 0.1 to 0.3 m (0.5 to 1 ft).

Organic Clay (OH) – Organic clay was observed below topsoil in test holes TH20-30, TH20-31, TH20-34 to TH20-36. The organic clay was frozen and contained some organics and trace rootlets. The organic clay was non-frozen, moist, stiff and of low plasticity below 0.3 m below ground surface. The approximate thickness of the organic clay layer ranged from 0.1 to 0.5 m and had an average thickness of 0.5 m. These findings are compatible with the results from the previous study.

Silt (ML) – Silt was observed in all test holes except TH20-29 within the organic clay or clay layers. The silt layer was encountered at a depth ranging from 0.3 to 1.2 m (1 to 4 ft) below existing ground surface. The silt layer had a variable thickness ranging from 0.1 to 0.7 m (0.3 to 2.5 ft). The silt was generally light brown in colour, damp to moist, soft and non-plastic.

Silty Clay (CL-ML) – Silty clay was encountered in all test holes except TH20-28, TH20-34 and TH20-36 at depths ranging from 0.1 to 1.3 m (0.3 to 4.3 ft). The silty clay was generally brown in colour, moist, stiff in

consistency, of low plasticity, contained some silt, and trace medium to coarse grained sand. The approximate thickness of the silty clay layer ranged from 0.2 to 0.8 m (0.6 to 2.5 ft).

Clay (CH) – Clay of high plasticity was encountered below the silt or silty clay in all test holes at depths ranging from 0.7 to 2.1 m (2.5 to 7 ft) below existing ground surface. The clay was generally mottled brown to grey in colour, damp to moist, firm to stiff in consistency, of high plasticity and contained trace silt nodules. With depth, the clay became grey in colour, wet and soft. Occasional trace silt inclusions and trace oxidation were observed. The undrained shear strength of the clay, as estimated by the field Torvane, varied throughout the strata from 15 kPa to greater than 90 kPa, generally decreasing with depth.

Clay Till – Clay till was encountered in two (2) of the deep test holes (TH20-27 and TH20-32) below the clay layer at a depth ranging from 13.3 to 13.4 m (43.7 to 44 ft), with a thickness ranging from 0.6 to 1.8 m (2.7 to 6 ft). The clay till was grey in colour, moist, soft, of intermediate to high plasticity, and contained fine to coarse grained sand. The undrained shear strength of the clay till, as estimated by the field Torvane, varied throughout the strata from 10 to 25 kPa, generally decreasing with depth.

Silt Till – Silt till was encountered in all the refusal test holes (TH20-27 to TH20-32) below the clay (or the clay till) at a depth ranging from 13.5 to 15.2 m (44.5 to 50 ft) below existing ground surface. The silt till was light brown in colour, damp moist, compact to dense, contained some to with fine to medium grained sand, trace coarse grained sand, and trace fine to coarse grained gravel.

3.3 Surface Water Conditions

Due to the snow cover at the time of this study, no further observation could be made regarding surface water conditions. Recommendations given in the previous report, submitted in February 2019, regarding to manage surface water should be considered.

3.4 Groundwater Conditions

Seepage and sloughing conditions were variable across the site. In general, seepage and sloughing were not observed in shallow test holes that were advanced up to 3.0 m depth. This is likely due to the low permeability of the clay in the area and short duration (15 to 30 minutes) required to advance the shallow test holes. Sloughing occurred in all the deep test holes that were drilled to refusal in till.

Groundwater infiltration was noted in test holes at depths ranging from of 10.4 to 15.2 m (34 to 50 ft) below ground surface in four (4) of the deep test holes.

Based on previous experience, groundwater levels will fluctuate seasonally and following precipitation events, hence the actual water level at the time of construction could differ from those reported herein.

3.5 Potential Difficult Ground Conditions

During the site investigation, groundwater infiltration and squeezing/sloughing was variable across the site. The groundwater inflows and subsequent sloughing in these areas should be dealt with during construction by the means deemed necessary by the foundation installation contractor.

In KGS Group's experience, sporadic and irregular zones of cobbles, boulders and/or granular layers have been frequently encountered in till deposits such as those encountered at this site. These zones can and should be expected to be water bearing, which may cause difficulties when advancing pile excavations into till. The cobbles and boulders would need to be removed when encountered within foundation excavations. Contractors should anticipate that sleeves may be required for cast-in-place pile excavations advanced below a depth of 8 m below ground surface or below the water table.

4.0 COMPARISON WITH PREVIOUS STUDIES

After review of the reports from February 2019 and March 2020 and the results of this investigation, KGS Group determined that the stratigraphy encountered was similar across the site. The refusal (power auger or SPT) depths from this investigation are generally similar to the February 2019 and March 2020 investigations completed across the site.

In general, groundwater infiltration and test hole sloughing and squeezing were consistent with the findings from the previous investigations.

Based on the findings of this investigation, it has been determined by KGS Group that the design parameters and recommendations for foundations, slab-on-grade floors and pavement sections from the 2019 report "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey" remain valid and should be used going forward.

The anticipated embedment depths for the driven prestressed precast concrete piles still include the range reported in 2019, varying from 14.5 to 21.7 m. In this present investigation, the anticipated driven pile embedment lengths range from 15.4 up to 18 m, therefore, within the limits presented in the 2019 report. Pile lengths are expected to vary considerably across the site. Please refer to the 2019 report "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site consultant for Geotechnical Survey" for further design values and recommendations.

5.0 CONCLUSIONS

- In general, the stratigraphy at the site is consistent with the previous findings and has been interpreted by KGS Group to consist of topsoil, organic clay and silt overlying high plasticity clay underlain by clay and silt till. Solid stem power auger or SPT refusal occurred in the silt till at depths ranging from 15.4 to 18.0 m below existing ground surface.
- Observed seepage and sloughing conditions were variable across the site. In general, seepage and sloughing were not observed in shallow test holes advanced up to 3.0 m, but sloughing occurred in all deep test holes, drilled to refusal. Groundwater infiltration varied between depths of 10.4 to 15.2 m (34 to 50 ft) below ground surface. It is anticipated that groundwater inflows and sloughing will have to be dealt with during construction by the means deemed necessary by the foundation installation contractor.
- In KGS Group's experience, sporadic and irregular zones of cobbles, boulders and/or granular layers have been frequently encountered in till deposits such as those at this site. These zones can and should be expected to be water bearing, which may cause difficulties when advancing pile excavations or end-bearing piles into till. The cobbles and boulders would need to be removed when encountered in foundation excavations. Contractors should anticipate that sleeving may be required when excavating cast-in-place piles.
- Recommendations for suitable foundation options and design values reported in 2019 in "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey" remain valid. It includes cast-in-place friction or end-bearing concrete piles and driven prestressed precast end-bearing concrete piles into dense till.
- Recommendations for other structures reported in 2019 in "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey" remain valid. It includes slab-on-grade floors and pavement sections.

6.0 RECOMMENDATIONS

Based on our assessment, the following recommendations are made:

- Any reference to the foundation considerations and other structures should be made to the 2019 report "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey", as design values and recommendations remain valid.
- Full-time inspection by experienced geotechnical personnel should be completed throughout construction of foundations to ensure that the design capacities indicated in this report are achieved. Detailed construction records should also be kept by qualified personnel throughout construction.

APPENDIX A

2019 KGS Group Report –
Two Design-Build Schools –
Waverley West, Winnipeg, Manitoba
– Site Consultant for Geotechnical
Survey

KGS GROUP
CONSULTING ENGINEERS

QUALICO communities

QUALICO COMMUNITIES

TWO DESIGN-BUILD SCHOOLS
WAVERLEY WEST, WINNIPEG, MANITOBA
SITE CONSULTANT FOR GEOTECHNICAL SURVEY

FINAL

KGS Group 18-1517-001
February 2019

SUBMITTED BY:

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1.0 INTRODUCTION

KGS Group, was contracted by Qualico Communities for professional engineering services as the Geotechnical Site Consultant for the Two Design-Build Schools in Waverley West located on Cadboro Road in Winnipeg, Manitoba. The site consultant services included a site investigation program, foundation assessment and pavement design for the design of the K-8 and 9-12 schools.

1.1 PROJECT UNDERSTANDING

The project site is located mostly on the south side of Cadboro Road as well as a small area north of Cadboro Road, approximately 0.7 km (0.4 mi) west of Waverley Street. The site has historically been used as farm land with no previous development across the site. Ground surface across the site is flat. From aerial images, there are low lying areas and drainage swales that traverse the east end of the property.

It is KGS Group's understanding that Qualico Communities is proposing an alternate development site for the design and construction of the proposed two (2) new school buildings. The proposed site has an approximate area of 36.7 acres south of Cadboro Road and 6.4 acres north of Cadboro Road. The first school building is anticipated to be a two-storey 7,944 m^2 (85,507 ft^2) school for a capacity for 800 students. The second school building is anticipated to be a three-storey 11,748 m^2 (126452 ft^2) school for a capacity of 1,000 students and 104 seat child care, and have the capacity to expand to accommodate an additional 200 students in the future. The future additions may include classrooms, shops and other facilities. Foundation loads and possible basement or crawlspace considerations are not available for the proposed schools at this time.

In addition to the school buildings, the proposed site will also include hard and soft surface play areas, sports fields, loading areas for school buses and delivery trucks, walking pathways, landscape planting, light standards, property fencing, site drainage and final topping and seeding.

This report summarizes the results of the field investigations, and presents preliminary geotechnical considerations and conclusions based on those same field investigations.

1.2 SCOPE OF WORK

The site consultant services for the two (2) Waverley West design build schools consisted of a site investigation program, foundation assessment and pavement design. The scope of work was in accordance with KGS Group's proposal, dated October 12th, 2018. The geotechnical engineering services included the following:

Utilities Locate and Site Clearances – KGS Group reviewed the utility clearances completed by Qualico Communities prior to drilling including identification and location of public underground and overhead utilities. KGS Group laid out the test holes to avoid utilities and other services.

Investigation Program – An on-site drilling program was completed to investigate the subsurface and groundwater conditions at the proposed site. The drilling program consisted of advancing a total of thirty-two (32) test holes. Ten (10) test holes were advanced to power auger refusal and twenty-two (22) test holes were advanced to 4.6 m below grade. Drilling services were provided by Paddock Drilling Ltd. with continuous KGS Group supervision.

Diagnostic Laboratory Testing – Diagnostic laboratory tests including moisture content, Atterberg limits and grain size analyses were performed on select soil samples to determine the relevant engineering properties of the foundation soils.

Geotechnical Assessment Report – A geotechnical design report was prepared to summarize the field investigations, geotechnical assessments and recommendations for the development including:

- Detailed test hole logs of site stratigraphy incorporating field observations, soil classification, laboratory test results and estimated depth of groundwater.
- General description of regional geology.
- Recommendations for both heated/unheated structures and uplift.

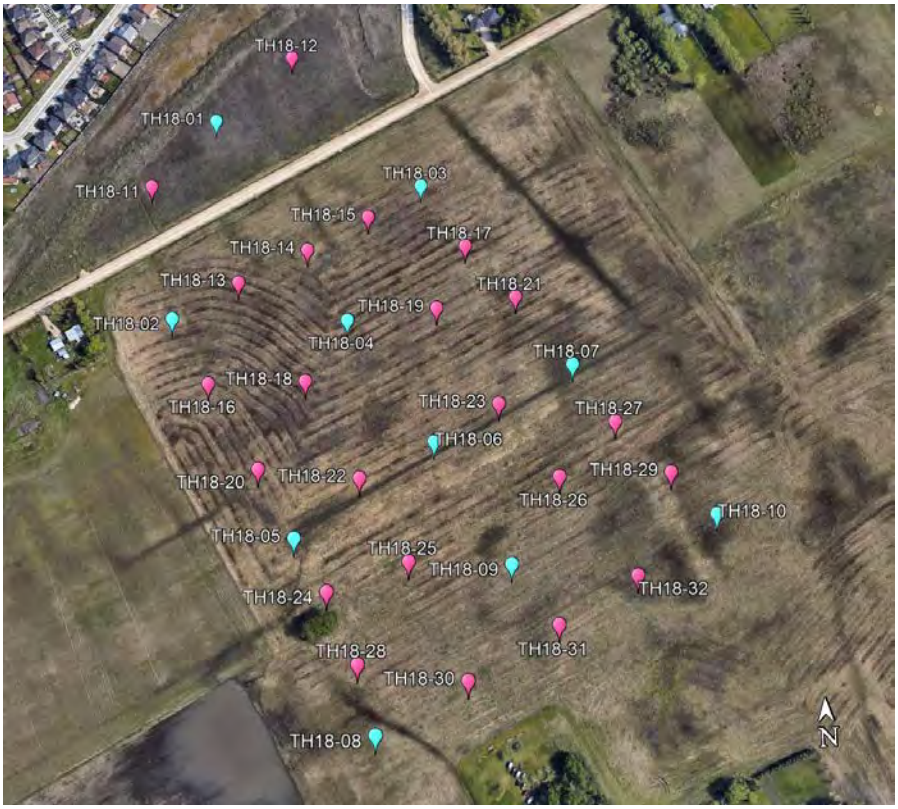
- Recommendations for both shallow and deep foundations, slabs, excavations, shoring, walls and other structures including Ultimate Limit States (ULS) bearing capacity and skin friction values in accordance with the 2010 National Building Code of Canada.
- Recommended foundation type and design capacities.
- Estimated total and differential settlement for the proposed foundation system.
- General recommendations for excavations, subsurface drainage, perimeter drainage, under-floor drainage and dewatering.
- Recommendations for slab-on-grade construction and site/subgrade preparation including backfill, parking requirements, depth/type of fill and compaction.
- Suitability of excavated material as backfill.
- Recommendations for pavements, driveways and exterior walks including surface drainage recommendations.
- Soil sulphate conditions for determining foundation concrete sulphate resistance classification requirements.
- Recommended foundation factors for seismic design. Seismic Hazard Analysis will be completed using Good Engineering Practice (GEP).
- Site seismic classification.
- Soil classification for proposed site location.
- Estimates of freeze – thaw susceptibility and evaluation of potential soil expansion and its effect on slabs at-grade. Recommended frost protection depth.
- Considerations for impact on foundation work/construction adjacent to existing buildings/roadways.
- Water conditions and flow rates for drainage, including effect of weather.
- Advise on any special construction difficulties or irregularities that may be encountered.

2.0 INVESTIGATION PROGRAM

2.1 TEST HOLE DRILLING AND SAMPLING PROGRAM

A drilling and sampling program was completed from October 25th to 29th, 2018 with drilling services provided by Paddock Drilling Ltd. of Brandon, Manitoba with continuous KGS Group supervision. The drilling and sampling program consisted of thirty-two (32) test holes with twenty (20) test holes evenly distributed over the central two-thirds of the site and twelve (12) test holes on the outer one-third of the site, as shown on Figure 1. Ten (10) test holes were advanced to practical auger refusal while the remaining twenty-two (22) test holes were advanced to 4.6 m below grade. All test holes were completed using a track mounted Acker MP5-T drill rig equipped with 125 mm diameter solid stem continuous flight augers. The locations of the test holes are shown on Figure 1 with the surveyed UTM coordinates for the test holes provided on Table 1. Cyan markers indicate refusal test holes and magenta markers indicate shallow test holes.

FIGURE 1
TEST HOLE LOCATIONS



Representative disturbed soil samples were obtained in all test holes at 1.5 m (5 ft) intervals, or at any change in soil strata. Soil samples were collected directly off the auger flights and visually classified in the field in accordance with the modified Unified Soil Classification System (USCS). Clay samples were field tested with a Field Torvane to evaluate consistency and estimate the undrained shear strength. Standard Penetration Tests (SPTs) were performed in the till to determine the relative in-situ density.

Upon completion of the drilling, each test hole was examined for indications of sloughing and seepage. All test holes were backfilled with soil cuttings and bentonite chips to surface. Detailed summary soil logs incorporating all field observations and stratigraphic profiles are provided in Appendix A.

TABLE 1
APPROXIMATE TEST HOLE COORDINATES

Test Hole ID	Approximate UTM Coordinates		Test Hole Ground Elevation (m)	Test Hole Depth (m)
	Northing (m)	Easting (m)		
TH18-01	5517888	630662.4	232.44	15.3
TH18-02	5517718	630631.3	232.70	15.2
TH18-03	5517826	630830.1	232.37	15.2
TH18-04	5517713	630769.5	232.60	15.4
TH18-05	5517541	630729.3	232.41	14.1
TH18-06	5517613	630836.6	232.52	15.4
TH18-07	5517672	630946.7	232.27	15.6
TH18-08	5517395	630789.9	232.69	15.6
TH18-09	5517517	630894.6	232.49	15.6
TH18-10	5517551	631051.6	232.16	16.4
TH18-11	5517831	630611.2	232.59	4.6
TH18-12	5517944	630723.7	232.39	4.6
TH18-13	5517747	630682.7	232.53	4.6
TH18-14	5517773	630738.1	232.56	4.6
TH18-15	5517800	630786.5	232.48	4.6
TH18-16	5517664	630661.5	232.64	4.6
TH18-17	5517773	630865	232.47	4.6
TH18-18	5517664	630737	232.55	4.6
TH18-19	5517721	630840.6	232.46	4.6
TH18-20	5517595	630701.3	232.70	4.6
TH18-21	5517729	630903.5	232.29	4.6
TH18-22	5517586	630778.7	232.31	4.6
TH18-23	5517642	630887.9	232.35	4.6
TH18-24	5517500	630753.5	232.85	4.6
TH18-25	5517521	630815.8	232.62	4.6
TH18-26	5517583	630932.7	232.27	4.6
TH18-27	5517625	630978.4	232.38	4.6
TH18-28	5517446	630776.9	232.66	4.6
TH18-29	5517584	631019.4	232.25	4.6
TH18-30	5517432	630858.9	232.77	4.6
TH18-31	5517471	630927.6	232.45	4.6
TH18-32	5517506	630989.4	232.26	4.6

2.2 LABORATORY TESTING

A diagnostic laboratory testing program was performed on select representative soil samples to determine the relevant engineering properties of the subsurface soils relative to the foundation design. Diagnostic testing included: twenty-three (23) moisture content tests, two (2) Atterberg limit analyses and two (2) particle size analyses. Laboratory testing was completed at a Standards Council of Canada accredited soil testing laboratory in Winnipeg, Manitoba in accordance with ASTM Standards.

3.0 INVESTIGATION RESULTS

3.1 REGIONAL GEOLOGY

During the last glacial advance and retreat, Winnipeg's glacial till was laid down by ice masses. Glaciolacustrine deposits suspended in glacial lakes confined by ice masses settled to overlie the tills. Additional information on the regional geology can be found in Geological Engineering Report for Urban Development of Winnipeg, University of Manitoba.

Winnipeg geology consisted of carbonate sedimentary bedrock overlaying Precambrian era granite and gneiss. The sedimentary rock consists of limestone, dolomite and shale to a lesser extent. Local geological maps indicate karst topography caused from dissolution of the soluble rock, and a heavily fractured upper bedrock layer. The karst topography is typically infilled with mixtures of silt, sand and gravel till material.

3.2 SITE STRATIGRAPHY

A total of thirty-two (32) test holes were drilled at the proposed site for two (2) new school buildings in Waverley West, Winnipeg, Manitoba. In general, the stratigraphy at the site was consistent and has been interpreted by KGS Group to consist of a layer of topsoil and organic clay overlying high plasticity fat clay with a clayey silt layer near surface, the upper deposits are underlain by a layer of glacial till over suspected bedrock.

The clayey silt layer was encountered in twenty-five (25) test holes between 0.2 m and 3.5 m below ground surface and was on average 0.7 m thick. Silt till was encountered in all the refusal test holes (TH18-01 to TH18-10) at a depth of 12.5 m to 14.9 m below existing ground surface. Power auger refusal occurred between 14.1 m to 16.4 m below existing ground surface within the silt till.

Topsoil

Topsoil was observed at ground surface in all the test holes. The topsoil was black in colour, dry, loose and contained with organics. The approximate thickness of the topsoil layer ranged from 0.1 m to 0.6 m and had an average thickness of 0.3 m.

Organic Clay

Organic clay was observed at ground surface in all the test holes. The organic clay was black in colour, dry, stiff in consistency, of high plasticity and contained some organics. The approximate thickness of the organic clay layer ranged from 0.2 m to 1.7 m and had an average thickness of 0.7 m. The moisture content in the organic clay was 27.1% as measured in one (1) sample.

Fat Clay (CH)

Fat clay was encountered below the organic clay or topsoil at a depth ranging from 0.1 m to 2.0 m below existing ground surface. The fat clay was brown in colour, damp to moist, firm to stiff in consistency and of high plasticity. With depth, the fat clay became grey in colour, wet and soft. The undrained shear strength of the fat clay, as estimated by the Field Torvane, varied throughout the strata from 5 kPa to greater than 100 kPa, generally decreasing with depth. The moisture content in the fat clay varied between 26.5% and 63.4% as measured in seventeen (17) samples. Atterberg testing completed on two (2) samples at a depth of 8.2 m below grade measured an average Liquid Limit of 82%, Plastic Limit of 23%, and a Plasticity Index of 59%, classifying the soil as a high plasticity clay. Particle Size Analysis on two (2) samples at a depth of 8.2 m measured an average particle distribution of 0.0% Gravel, 3.4% Sand, 28.1% Silt and 68.6% Clay.

Clayey Silt

Clayey silt was observed in twenty-five (25) test holes within the organic clay or silty clay layers. The clayey silt layer was encountered at a depth ranging from 0.2 m (TH18-03, TH18-10 and TH18-27) to 3.5 m (TH18-30) below existing ground surface. The clayey silt layer had a variable thickness ranging from 0.1 m to 1.7 m with an average thickness of 0.7 m. The clayey silt was

generally light brown in colour, dry and compact in consistency. The moisture content in the clayey silt was 18.3% as measured in one (1) sample.

Silt Till

Silt till was encountered in all the refusal test holes below the silty clay at a depth ranging from 12.7 m to 13.4 m below existing ground surface. The silt till was light grey in colour, moist, compact to dense with fine to coarse grained sand and fine to coarse grained gravel. The moisture content in the silt till varied between 9.3% and 12.0% as measured in four (4) samples.

3.3 SURFACE WATER CONDITIONS

The site is relatively flat with notable low lying areas that appear to pond water during wet seasons. It appears that a drainage swale runs along the eastern limit of the site. A portion of the new buildings may lie within the existing swale; and the north portion of the swale will transect any pavement areas on the east. Detailed site plans were not available at the time of this report. The final design and building locations should incorporate surface water management, and maintaining positive drainage away from structures, slabs and pavements. This is critical to the performance of a structure over time.

3.4 GROUNDWATER CONDITIONS

Observed seepage and sloughing conditions were highly variable throughout the drilling investigation. In general, seepage and sloughing was not observed in shallow test holes that were advanced to 4.6 m depth. This is likely due to the low permeability of the clay in the area and short duration (15 to 30 minutes) required to advance the shallow test holes. Sloughing occurred in all the deep test holes that were drilled to refusal. Groundwater infiltration varied between depths of 7.9 m to 13.4 m below ground surface within the refusal test holes.

One (1) pneumatic piezometer and one (1) Casagrande tipped standpipe piezometer was installed in TH18-06 within the clay and silt till at 9.2 m and 15.4 m below grade respectively.

Table 2 summarizes the piezometric monitoring completed to date during the short monitoring period. In general, the groundwater at the site is interpreted to have recorded groundwater

levels at Elev. 230.07 m± in the silty clay and a lower groundwater level at Elev. 225.66 m± in the silt till. Based on these groundwater levels there is a downward gradient in the silty clay. Piezometers were monitored once approximately two (2) weeks after installation. Piezometers should be monitored again prior to the start of the detailed design to identify any changes in the piezometeric elevations.

TABLE 2
PIEZOMETRIC MONITORING DATA

Test Hole:	**TH18-06**	
Ground Elevation (m):	**232.52**	
Piezometer Type:	**Standpipe**	**Pneumatic**
Piezometer No.:	**-**	**PN 037137**
Top of Pipe Elevation (m):	**233.44**	
Tip Elevation (m):		**223.32**
Monitoring Zone:	**Till**	**Silty Clay**
Date	**Piezometric Elevation (m)**	
November 8th, 2018	225.6	230.07

Based on previous experience, groundwater levels will fluctuate seasonally and following precipitation events, hence the actual water level at the time of construction could differ from those reported herein.

3.5 POTENTIAL DIFFICULT GROUND CONDITIONS

During the test hole drilling investigation, groundwater infiltration and test hole squeezing/sloughing was highly variable throughout the site. The groundwater inflows and subsequent sloughing in these areas will have to be dealt with during construction by the means deemed necessary by the foundation installation contractor.

In KGS Group's experience, sporadic and irregular zones of cobbles, boulders and/or granular layers have been frequently encountered within till deposits such as those at this site. These zones can and should be expected to be water bearing, which may cause difficulties when advancing bored piles or caissons through the till. The cobbles and boulders would need to be

removed when encountered within foundation excavations. Contractors should anticipate that sleeves may be required for any bored piles advanced below a depth of 8 m below ground surface or below the water table.

4.0 FOUNDATION CONSIDERATIONS

KGS Group recommends a deep foundation for the two (2) proposed Waverley West school buildings. The soils in Winnipeg are comprised of soft compressible silt, overlying clay that has a potential to swell when it dries and is rewetted. The resulting total and differential movements from consolidation or swelling of the subsurface soils, is typically unacceptable for most structures supported on a shallow foundation. To alleviate issues and reduce the risk of damaging differential movements, a deep foundation system is preferred to support structures at this site. Suitable deep foundation types for consideration include driven pre-stressed pre-cast concrete piles or end-bearing cast-in-place piles. Shallow cast-in-place friction piles may be considered for structures tolerant of some movement.

4.1 LIMIT STATE DESIGN

The foundation considerations described in this report follow the Limit States Design (LSD) guidelines. Limit States Design (LSD) requires consideration of two (2) main loading states: Ultimate Limit States (ULS) and Serviceability Limit States (SLS). The Ultimate Limit States (ULS) are primarily concerned with collapse mechanisms of the structure and safety, and the Serviceability Limits States (SLS) present conditions or mechanisms that restrict or constrain the intended use, function or occupancy of the structure under expected service or working loads. For pile foundation design, each loading state prescribes Geotechnical Resistance Factors (Φ) that are based upon the method used to evaluate pile capacity to obtain the Factored Ultimate Limit State (ULS) pile capacity values. The SLS resistance values shown in the tables below are anticipated to limit foundation settlement to 25 mm or less.

The estimated unfactored ULS values provided in Table 3, 4 and 5 represent the nominal (ultimate) geotechnical resistance, R_n. A Geotechnical Resistance Factor (Φ) of 0.4 should be applied to determine the factored geotechnical resistance as presented in in the following equation:

$$\Phi R_n \geq \Sigma \alpha_i S_{ni}$$

where:

Φ – geotechnical resistance factor

R_n – nominal (ultimate) geotechnical resistance

$\Sigma \alpha_i S_{ni}$ – summation of the factored overall load effects for a given load combination

4.2 STRAIGHT SHAFT CAST-IN-PLACE CONCRETE FRICTION PILES

Straight shaft cast-in-place concrete piles may be used to support the light foundation loads. For design purposes, the upper 3.0 m of pile length below final ground elevation of piles potentially exposed to frost should be neglected when determining pile capacities. For piles not exposed to frost the upper 2.0 m of pile length below final grade should be neglected. It should be noted that this applies to piles installed in the native silty clay only, and that fill or organic material should be assumed to provide no support.

Friction piles may be designed based upon the estimated Ultimate Limit State (ULS) and Serviceability Limit State (SLS) skin friction values provided on Table 3. Piles that are designed to be friction piles should be designed to resist the load by shaft resistance only. The contribution from end bearing should be ignored in the pile capacity calculations.

TABLE 3
ESTIMATED SKIN FRICTION RESISTANCE FOR LIMIT STATES DESIGN

	Depth Below Finished Subgrade (m)	Serviceability Limit State, SLS (kPa)	Unfactored Ultimate Limit State, ULS (kPa)
Unit Shaft Resistance	0 to 2.5	–	–
	2.5 to 7	10	30
	7 to 11	8	25

4.3 STRAIGHT SHAFT CAST-IN-PLACE CONCRETE END BEARING PILES

Cast-in-place concrete end bearing piles may be used to support heavy foundation loads or where differential settlement is unacceptable. To resist tensile pile uplift due to frost action

and/or swelling of the clay, all piles should have reinforcing steel designed by an experienced structural engineer.

The estimated average factored end bearing Ultimate Limit State (ULS) and Serviceability Limit State (SLS) end bearing values are provided below on Table 4.

TABLE 4
ESTIMATED END BEARING RESISTANCES FOR LIMIT STATES DESIGN

End Bearing Material	Serviceability Limit State, SLS (kPa)	Unfactored Ultimate Limit State, ULS (kPa)
Dense Till	500	800

4.4 DRIVEN PRESTRESSED PRECAST CONCRETE PILES

The proposed school buildings could be supported on driven precast concrete piles bearing on the underlying till where differential settlement is unacceptable. Below are the estimated factored Ultimate Limit State (ULS) and Serviceability Limit State (SLS) pile loading capacities when driven to practical refusal with diesel hammers having a rated energy per blow of not less than 40,000 Joules. The final penetration resistance indicated on the table should be achieved for three (3) consecutive sets for the final resistance. The estimated unfactored values for Limit States Design (LSD) of the driven prestressed precast concrete piles are provided in Table 5.

TABLE 5
DRIVEN PRESTRESSED PRECAST CONCRETE PILES FOR LIMIT STATES DESIGN

Pile Diameter	Serviceability Limit State (SLS) Values (kN)	Ultimate Limit State (ULS) Values (kN)	Final Refusal Criteria (Blows Per 25 mm)[Note 1]
300 mm	445	1,400	5
350 mm	625	1,960	8
400 mm	800	2,400	12

Notes:
1. If higher energies or other types of hammers are used, they should be evaluated to ensure that piles are not overstressed and suitable refusal criteria to be determined.

It is expected the pile tip elevations may vary considerably (several meters) in depth. The actual depth of pile penetration will depend on localized till conditions and the presence of cobbles and boulders. Power auger refusal occurred between 14.1 m to 16.4 m in ten (10) test holes, below existing ground surface in the silt till. Based on the geotechnical investigation, it is anticipated that driven piles will be embedded approximately 14.1 m to 16.4 m below ground surface. Piles can typically be cast in lengths ranging from 10 m to 22 m; however, pile lengths exceeding 18 m require special handling in order to prevent cracking of the piles. The final selection of driven prestressed precast concrete pile lengths will be the responsibility of the piling contractor using the available test hole information provided in this report.

Pre-boring approximately 5 m below grade should allow for standing of the piles, enhance pile plumbness/alignment, reduce potential ground heave in large pile groups and reduce vibrations induced on the adjacent buildings. Vibration monitoring of the adjacent buildings should be completed during pile driving. Additional pre-boring will be required if monitored vibrations are above acceptable levels, as determined by the structural engineer.

If significant squeezing or sloughing of the bore hole occurs during pre-boring then the pre-boring depth may be reduced accordingly. All piles should be spaced a minimum of three-pile diameters apart and all piles driven within five-pile diameters should be monitored for heave. If heave occurs, these piles should be re-driven to refusal. Careful attention will be required during driving, especially as the pile tip approaches the dense till, to ensure practical refusal has been achieved, there is no uplift on adjacent piles, and to avoid pile breakage.

Reduction in pile load carrying capacity due to group action is not necessary for the precast concrete piles when driven to practical refusal, since the pile design relies mainly on the base-resistance developed at the tip. The design capacity of a pile group is the sum of the allowable capacity of the individual piles.

It should be assumed by the designers that the tensile strength of these precast piles is minimal and they have little capacity to resist bending.

4.5 ADDITIONAL CONSIDERATIONS FOR PILE FOUNDATIONS

Additional considerations for the design and construction for pile foundations are provided below:

(a) The spacing between adjacent piles should be a minimum of three-pile diameters, as measured from center to center.

(b) In addition to piles acting individually, friction piles can act as a group when closely spaced, less than three-pile diameters apart. Group action occurs when the soil between adjacent piles is dragged down and shaft resistance develops around the perimeter of the group only. If it is necessary to space piles closer than three-pile diameters apart, the capacity of these piles acting as a group will need to be evaluated once final geometry and spacing of the piles is known.

(c) To minimize the potential for uplift due to frost action and/or swelling of the clay, all piles should have a minimum embedded length of 8 m.

(d) To resist tensile pile uplift due to frost action and/or swelling of the clay, all piles should have full depth reinforcing steel designed by an experienced structural engineer.

(e) The potential exists for squeezing of the bore hole during the installation of the cast-in-place concrete piles at this site. Full-length steel sleeves should be maintained on site and utilized as required during construction to maintain the pile shaft and base in a clean dry state.

(f) When seepage is encountered, which cannot be controlled by sleeves during piling, removal of the water from the pile holes prior to pouring concrete or placing concrete by tremie methods may be required. At all times during removal of the steel sleeve, a head of concrete shall be maintained sufficiently above the sleeve bottom to limit sloughing and seepage into the pile hole from the adjacent ground.

(g) The reinforcement and concrete should be placed immediately following the drilling of each pile to prevent disturbance to the foundation soil during subsequent construction activity. Where this is not possible on the day of drilling, the pile hole should be refilled and later redrilled, once concrete is ready to place.

(h) For end bearing piles on competent till, the elevation of the base of the pile must be selected so that it is at least 500 mm into the competent underlying till to ensure that the desired capacity can be developed.

(i) Full time inspection by experienced geotechnical personnel should be completed throughout construction of foundations to ensure that the design capacities indicated in this report are achieved. Detailed construction records should also be kept by qualified personnel throughout construction.

(j) All concrete piles should utilize CSA Type 50 sulphate resistant cement.

(k) A minimum of 150 mm thick void space should be provided beneath all structural elements including pile caps and grade beams to accommodate the expansive nature of the underlying soil.

(l) Detailed construction records and full time inspection by experienced geotechnical personnel is recommended throughout construction of foundations to ensure that the design capacities indicated in this report are achieved. Inspection of the bearing surface by experienced geotechnical personnel is required to ensure that the specified bearing capacity is achieved.

(m) Where Pile Driving Analysis (PDA) testing is undertaken on a minimum of 5% of the piles driven at the site, an increased geotechnical resistance factor of 0.5 may be utilized on the pile resistance as determined by CAPWAP and field results. A geotechnical resistance factor of 0.6 could be utilized if a static load test is undertaken on a minimum of two (2) piles at the site.

(n) If either PDA testing or static load testing is undertaken, they should be completed under the supervision of an experienced geotechnical engineer and KGS Group should review the results of any testing and pile capacities.

4.6 POTENTIAL SETTLEMENT OF PILED FOUNDATIONS

Given that the existing clay on site is of high plasticity, the potential for uplift on piled foundations is classified as high. Potential movement should be reviewed during detailed design to ensure that potential settlement is within the acceptable limits. Poly wrapped sono-tubes should be installed through the upper clay layer to mitigate potential uplift on piles.

For end bearing cast-in-place piles and driven prestressed precast concrete piles that develop capacity on the basis of end bearing on dense till, settlement is expected to occur elastically. The magnitude of the settlement will depend on the magnitude and intensity of the loading, pile diameter and spacing, etc. Therefore, potential settlements of the pile types considered in this report should be reviewed during detailed design to ensure potential settlement is within the acceptable limits of the proposed development.

5.0 DESIGN CONSIDERATIONS FOR OTHER STRUCTURES

5.1 SLAB-ON-GRADE FLOOR

The slab-on-grade floor founded on the native silty clay may be assigned a factored bearing capacity of 100 kPa. The following should be considered for this alternative:

- Sub-excavate the surficial topsoil and organic clay to the native silty clay.
- Proof roll and compact the subgrade with a heavy drum roller. Proof rolling and compaction of the subgrade should be completed under the supervision of an experienced geotechnical engineer to identify unstable or unsuitable areas. If any soft spots are encountered they should be sub-excavated 600 mm and backfilled with compacted granular fill to 98% Standard Proctor Dry Density (SPMDD).
- A non-woven geotextile fabric should be placed as a separator between the subgrade and compacted granular fill.
- A minimum 150 mm thick layer of granular base and 300 mm thick layer of sub-base should be placed immediately below the foundation. All granular should be placed in maximum 150 mm thick lifts and compacted to 98% SPMDD.
- The granular fill should be well-graded free-draining and include organic-free and non-frozen aggregate. Sieve analysis and compaction testing of the granular base and subgrade materials should be conducted by qualified geotechnical personnel to ensure that the materials supplied and percent compactions are in accordance with design specifications.
- The final ground elevation around the perimeter of the building structures should be sloped away at a minimum 5% grade for a distance of 2 m away from the building. Beyond 2 m, the final ground elevation should be sloped at 2% away from the building. The final ground elevations should be sloped away from the building structures to protect against surface water ponding and compensate for future loss of grade that may result from potential settlement.
- All mechanical services and piping that would be buried within the engineered fill should be designed to accommodate potential ground movement. Exterior grade supported concrete slabs (including sidewalks) will be subjected to seasonal vertical movements related to frost. Connection and tie-in details between the exterior concrete slabs and rigid structures element should account for this potential frost jacking.
- To minimize the potential for frost heave on the concrete footing and slab-on-grade, consideration should be given to the use of rigid synthetic insulation on the face of the foundation and extending outward laterally. A 100 mm thick rigid board extruded polystyrene extended out at least 2 m beyond the edge of the footing can be used. The insulation should be placed on at least 450 mm compacted granular backfill

The footings for unheated structures should be buried at least 2.5 m below existing grade and a thicker insulation rigid insulation of at least 100 mm is recommended.

Seasonal movement, differential settlement and potential cracking of the concrete slab may occur over time with grade supported slabs. This alternative should be selected only if some movement and differential settlement is acceptable. Differential settlements of 50 mm to 100 mm do routinely occur for floor slabs poured directly on grade. Where this is deemed unacceptable a structural slab supported on intermediate piles should be utilized.

5.2 PAVEMENT SECTION

On the basis of the soil conditions encountered during drilling and subject to inspection by qualified geotechnical personnel, the asphalt and concrete pavement structure for lightly loaded roadways and parking lots can be designed on the basis of the values provided in Table 6 and 7.

TABLE 6
ASPHALT PAVEMENT SECTION

Pavement Structure	Thickness	% Compaction
Light Duty Section		
Asphaltic Concrete	100 mm	98% Marshall
Base Course (20 mm crushed limestone)	100 mm	100% Std Proctor
Sub-base (50 mm crushed limestone)	300 mm	100% Std Proctor
Subgrade	- Proof-rolled with heavy sheepsfoot roller - Place non-woven geotextile	
Heavy Duty Section		
Asphaltic Concrete	100 mm	98% Marshall
Base Course (20 mm crushed limestone)	200 mm	100% Std Proctor
Sub-base (50 mm crushed limestone)	300 mm	100% Std Proctor
Subgrade	- Proof-rolled with heavy sheepsfoot roller - Place non-woven geotextile	

TABLE 7
PORTLAND CEMENT CONCRETE PAVEMENT SECTION

Light Duty Pavement Structure	Thickness	% Compaction
Continuously Reinforced Portland Cement Concrete	200 mm	N/A
Base Course (20 mm crushed limestone)	75 mm	100% SPMDD
Sub-base (50 mm crushed limestone)	250 mm	100% SPMDD
Subgrade	- Proof-rolled with heavy sheepsfoot roller - Place non-woven geotextile - Place geogrid, as required	

The subgrade should be sub-excavated to the design elevation and proof-rolled using a heavy sheepsfoot roller to achieve a minimum compaction of 98% Standard Proctor Maximum Dry Density (SPMDD). The subgrade should be inspected by qualified geotechnical personnel prior to the placement of the overlying granular base. Areas that exhibit unsuitable deflection or unsuitable soils such as organic matter, silts or soft clays should be sub-excavated as directed by the geotechnical personnel and replaced with compacted granular subbase to 100% SPMDD. Non-woven geotextile fabric should be placed as a separator between the clay subgrade and compacted granular fill. Depending final grading of the pavement, the pavement designer should review the requirement for excavation of the clayey silt layer, or inclusion of a geogrid in the pavement design.

The granular base course and subbase materials should be well-graded and free-draining include organic-free, non-frozen, aggregate conforming to standard specifications. Sieve analysis and compaction testing of the granular base and subgrade materials should be conducted by qualified geotechnical personnel to ensure that the materials supplied and percent compactions are in accordance with design specifications.

For the hot mix asphaltic concrete, gradation analysis of the aggregates compaction testing and Marshall testing should be undertaken. This will provide data to confirm that the asphaltic concrete pavement complies with the project specification.

Slab-on-grade concrete pads can be utilized for isolated areas where larger static wheel loads may exist, including delivery/loading dock and garbage pickup areas. Exterior grade supported

concrete slabs (including sidewalks) will be subjected to seasonal vertical movements related to frost action and varying seasonal groundwater conditions. Connection and tie-in details between the exterior concrete slabs and rigid structures element such as grade beams, pile caps or interior slabs should account for this potential vertical movement. To minimize the frost heave movements, consideration should be given to the use of rigid synthetic insulation, extending outward laterally (2 m (min) length and 100 mm (min) thickness) and beneath the structure.

5.3 EXTERIOR SIDEWALKS

Based on the soil conditions encountered during the site investigation and the City of Winnipeg Standard Construction Specifications, the asphalt and concrete pavement structure for exterior sidewalks and hard surfaces can be designed on the basis of the section provided in Table 8 and 9 below.

TABLE 8
EXTERIOR CONCRETE SIDEWALK SECTIONS

Pavement Structure	Thickness	% Compaction
Residential		
Concrete (reinforcing can be omitted)	100 mm	N/A
Sub-base (20 mm crushed limestone)	75 mm	100% Std Proctor
Crossing in or adjacent to industrial or commercial zone		
Concrete with reinforcing	150 mm	N/A
Base (20 mm crushed granular)	75 mm	100% Std Proctor
Sub-base (50 mm crushed limestone)	150 mm	100% Std Proctor

TABLE 9
EXTERIOR ASPHALT SIDEWALK AND HARD SURFACE SECTIONS

Pavement Structure	Thickness	% Compaction
Asphaltic Concrete	75 mm	98% Marshall
Base Course (20 mm crushed limestone)	75 mm	100% Std Proctor
Sub-base (50 mm crushed limestone)	150 mm	100% Std Proctor

Sidewalk construction should be performed in accordance with City of Winnipeg Standard Construction Specification CW 3325 – Portland Cement Concrete Sidewalk.

5.4 LATERAL EARTH PRESSURE

For design purposes the soils may be assigned active, passive and at-rest lateral earth pressure coefficients as shown in Table 10.

TABLE 10
LATERAL EARTH PRESSURE COEFFICIENTS

Material	γ (kN/m^3)	ϕ'	K_a	K_p	K_o
Silty Clay	17.5	20°	0.49	2.04	0.66
Till	18	30°	0.33	3.00	0.50
Well–Graded Granular Fill	18.5	35°	0.27	3.69	0.43

6.0 OTHER DESIGN CRITERIA

6.1 TEMPORARY CONSTRUCTION EXCAVATIONS AND SHORING

Construction excavation details are not available at the time of preparation of this report. Any excavation deeper than 1.5 m (5 ft) should be reviewed and designed prior to construction by an experienced professional engineer with an expertise in geotechnical engineering.

Due to the clayey silt layer, the upper clay may be susceptible to sloughing from wetting and mechanical disturbance. All open excavation side slopes should be covered to prevent saturation of the soil and all surface runoff should be directed away from excavations. All surcharge loads such as stockpiled soil, equipment, etc. should be kept a minimum of 10 m away from the edge of excavations. All excavations should be carried out in accordance with applicable Workplace Health and Safety rules and regulations.

During the site investigation significant water infiltration was encountered in a number of test holes. Therefore, potential localized groundwater inflows into an excavation below the water table are likely, which may require temporary pumping as well as potential shoring. Design of the above measures depends on the location, size, depth and extent of the excavation. If excavation is to be performed adjacent to the existing streets or infrastructure, temporary shoring or bracing will be required. Suitable options include steel piling and timber lagging or driven steel sheet piling.

6.2 SEISMIC CLASSIFICATION

Based on the results of the test hole drilling program and KGS Group's knowledge of the local geology in the Winnipeg area, the proposed site can assume Site Class E Classification for seismic site response as per Table 4.1.8.4.A. in NBCC 2010.

6.3 FROST PENETRATION

The depth of frost penetration will vary depending on air temperature, ground cover, the type of any fill material used during development and other factors. Surficial soils at this site consisted of silty clay.

The expected depth of frost penetration has been estimated assuming a design freezing index of 2680°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 bare ground and no insulation cover. The clay soils can heave upon freezing and that consideration must be considered in the foundation design. Good site drainage must also be maintained after development.

Well graded granular materials should be utilized as structural backfill material as well graded granular materials are less susceptible to the effects of frost heave than fine grained silt and clay materials. Polystyrene insulation can be used as a thermal insulator to minimize any effects that frost could potentially have on foundations or slabs.

The depth of burial (minimum 2.5 m) of water lines or other lines that cannot be allowed to freeze should consider local practice. Shallow lines can be protected using a heat trace or closed cell extruded polystyrene insulation. The amount and extent of insulation required will be dependent on several factors including the thermal regime around the pipe, the depth of burial, surface conditions, and fluid temperature, if present.

6.4 SITE SURFACE DRAINAGE

The final ground elevation around the perimeter of the building structures should be sloped away at a minimum 5% grade for a distance of 2 m away from the building. Beyond 2 m, the final ground elevation should be sloped at 2% away from the building. The final ground elevations should be sloped away from the building structures to protect against surface water ponding and compensate for future loss of grade that may result from potential settlement. Downspouts should be positively directed away from structures and extend beyond the backfill zone.

6.5 SITE SUBSURFACE DRAINAGE

A permanent subdrain system should be installed around the exterior of below grade walls and below grade floor slabs to collect groundwater and direct it into a central high capacity sump pit(s). Internal drainage should also be given consideration, with a perforated weeping tile wrapped with a filter sock in a granular (pea gravel or crushed rock) trench directing flows to a central sump pit. Interior weeping tile trenches should be located a minimum of 300 mm below the underside of the prepared subgrade elevation for the slab. All granular fill placed within the weeping tile trench should be free draining. Exterior weeping tile trenches should be capped a minimum 0.6 m thick cohesive soil (clay). The ground surface should also be positively graded to promote surface runoff away from pavements and structures.

6.6 GROUNDWATER CONTROL

Based on the observed groundwater condition during field investigation program, the groundwater level was observed during drilling at depths ranging from 7.9 m to 13.4 m below existing grade in the refusal test holes. Groundwater elevations will vary seasonally and annually and actual levels at the site during construction may differ from those identified in this report. During site investigations, a silt layer was encountered in twenty-five (25) test holes between 0.2 m and 3.5 m below existing grade. There is a potential of localized groundwater inflows into an excavation through this silt layer, which may require temporary pumping, and may require trenching or flattening of temporary excavation slopes. Design of the above measures depends on the size, depth and extent of the excavation as well as groundwater conditions at the time of construction.

6.7 TYPE OF CEMENT FOR CONCRETE MIX

The degree of exposure of concrete in contact with soils to sulphate attack is classified in CAN/CSAA23.1-M94 (Concrete Materials and Methods of Concrete Construction) as moderate (S-3), severe (S-2) or very severe (S-1). All concrete should be made with high sulphate-resistant cement (HS or HSb), and all cast-in-place piles and pile caps should have a minimum specified 28 day compressive strength of 35 MPa and class of exposure of S-1 corresponding to very severe sulphate attack. A maximum water to cement ratio of 0.40 should

be specified in accordance with Table 2, CSA A23.1-04 for concrete with very severe sulphate exposure (S1). Concrete which may be exposed to freezing and thawing should be adequately air entrained to improve freeze-thaw durability in accordance with Table 4, CSA A23.1-04.

7.0 CONCLUSIONS

- In general, the stratigraphy at the site is fairly consistent and has been interpreted by KGS Group to consist of topsoil and organic clay overlying high plasticity silty clay underlain by silt till and suspected bedrock. Solid stem power auger refusal occurred in the silt till at depths ranging from 14.1 m to 16.4 m below existing ground surface.

- Observed seepage and sloughing conditions were highly variable throughout the drilling investigation. In general, seepage and sloughing was not observed in shallow test holes that were advanced to 4.6 m. Sloughing occurred in all the deep test holes that were drilled to refusal. Groundwater infiltration varied between depths of 7.9 m to 13.4 m below ground surface.

- During the test hole drilling investigation, groundwater infiltration and test hole squeezing was highly variable throughout the proposed site. The groundwater inflows and subsequent sloughing in these areas will have to be dealt with during construction by the means deemed necessary by the foundation installation contractor.

- In KGS Group's experience, sporadic and irregular zones of cobbles, boulders and/or granular layers have been frequently encountered within till deposits such as those at this site. These zones can and should be expected to be water bearing, which may cause difficulties when advancing bored piles or end bearing piles through the till. The cobbles and boulders would need to be removed when encountered within foundation excavations. Contractors should anticipate that sleeving may be required for any bored piles.

- Suitable foundation types include cast-in-place friction or end bearing concrete piles and driven prestressed precast end bearing concrete piles on dense till or bedrock.

- The expected depth of frost penetration has been estimated assuming a design freezing index of 2680^{o}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.

- The proposed site can assume Site Class E Classification for seismic site response as per Table 4.1.8.4.A. in NBCC 2010.

8.0 RECOMMENDATIONS

Based on our assessment the following recommendations are made:

- Shallow foundations are not recommended. Shallow footing foundations bearing directly on either fill or native overburden clay will not perform satisfactorily due to the expansive nature of the clay and the potential differential settlements that would occur as a result.
- The silty clay may be assigned an unfactored ULS skin friction of 30 kPa between 2.5 m and 7 m below existing ground surface and 25 kPa between 7 m and 11 m.
- Cast-in-place piles founded on dense till can be assigned an unfactored Ultimate Limit State (ULS) end bearing capacity of 800 kPa. For cast-in-place piles end bearing on dense till, the elevation of the base of the pile must be selected so that it is at least 500 mm into the dense underlying till to ensure that the desired capacity can be developed.
- Prestressed precast concrete piles driven to practical refusal can be assigned unfactored ULS end bearing capacities of 1400 kN, 1960 kN and 2400 kN for pile diameters of 300 mm, 350 mm and 400 mm, respectively.
- Cast-in-place concrete end bearing piles should have steel reinforcement designed by a structural engineer.
- For piles exposed to frost, the upper 3 m should be neglected throughout the depth of frost penetration for design purposes. Where piles are not exposed to frost, i.e. interior piles, the upper 2.0 m of the pile should be neglected in the design.
- A minimum of 150 mm void space should be constructed under all structural elements including pile caps, grade beams and structural floor slabs to accommodate the expansive nature of the underlying soil.
- It is recommended that all concrete in contact with native soils use sulfate resistance cement CSA Type HS.
- Full-time inspection by experienced geotechnical personnel should be completed throughout construction of foundations to ensure that the design capacities indicated in this report are achieved. Detailed construction records should also be kept by qualified personnel throughout construction.

9.0 STATEMENT OF LIMITATIONS

9.1 THIRD PARTY USE OF REPORT

This report has been prepared for Qualico Communities 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. This report has been prepared for the Client 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.

9.2 GEOTECHNICAL INVESTIGATION STATEMENT OF LIMITATIONS

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

2018 TEST HOLE LOGS
LABORATORY TEST RESULTS

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-01**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - North Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.44**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,888**
E **630,662**

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 / %
232.3				**TOPSOIL** - Black, dry, loose, with organics.					
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.					
231.7						S1			
	1			**SILT** - Light brown, dry, compact.					
						S2			
230.9		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
	2					S3			
230				- Silt layer at 2.13 m.					
	3	10		- Mottled brown below 2.90 m.					
229						S4			
	4								
228		15							
	5					S5			
227									
	6	20							
226									
	7					S6			
225		25		- Grey, moist below 7.62 m.					
	8								
224						S7			
	9	30							
223									

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-01

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 %
222	11	35				S8			
221	12	40				S9			
220									
219.8	13	45		**CLAY TILL** - Light grey, wet, soft, low plasticity, some fine to coarse grained sand, some fine to coarse grained gravel.		S10			
219									
218.3	14								
218				**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.		S11			
217.1	15	50		- 50 blows for 2" in the first SPT set.		S12	10	▲50	
217				**POWER AUGER REFUSAL AT 15.29 m**					
216	16	55							
215	17								
214	18	60							
213	19	65							
212	20								
211	21	70							

Notes:
1. Hole open to 14.17 m below grade after completion of drilling.
2. Water was at observed at 13.41 m after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-02**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.70**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,718**
E **630,631**

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 %
232.2				**TOPSOIL** - Black, dry, loose, with organics.					
232.1				**SILT** - Light brown, dry, compact.		S1			
232				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
	1					S2			
		5							
231									
	2								
230						S3			
	3	10		- Mottled brown below 2.90 m.					
229						S4			
	4								
		15							
228									
	5					S5			
227									
	6	20							
226									
	7					S6			
		25							
225									
	8					S7			
				- Grey, moist below 8.38 m.					
224									
	9	30							
223						S8			

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-02

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
222	11	35					
221	12	40			S9		
220	13			- Increase in fine to coarse grained gravel below 12.80 m.			
219.0		45			S10		
219	14			**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.	S11		
218	15				S12		
217.4		50		- 50 blows for 3.5" in the first SPT set.	S13	15	
217	16			**POWER AUGER REFUSAL AT 15.33 m**			
216	17	55					
215	18	60					
214	19						
213	20	65					
212	21						
211		70					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

Notes:
1. Hole open to 13.24 m below grade after completion of drilling.
2. Water was at observed at 11.15 m after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-03**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.37**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,826**
E **630,830**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.2				**TOPSOIL** - Black, dry, loose, with organics.			
232				**SILT** - Light brown, dry, compact.			
231.9				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
	1					S1	
		5				S2	
231	2			- Silt layer between 2.13 m and 2.29 m.			
230				- Mottled brown below 2.44 m.		S3	
	3	10					
229							
	4					S4	
228		15					
	5					S5	
227							
	6	20					
226							
	7					S6	
225		25					
	8						
224						S7	
	9	30					
223				- Grey, moist below 9.45 m.			
						S8	

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-03

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
222							
	11	35					
221					S	S9	
	12	40					
220							
219.9				- Increase in fine to coarse grained gravel below 12.50 m.			
				CLAY TILL - Light grey, wet, soft, low plasticity, some fine to coarse grained sand, some fine to coarse grained gravel.			
	13				S	S10	
219		45					
	14				S	S11	
218.2				- Clay layer between 14.02 m and 14.17 m.			
218				**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.			
	15			- Auger refusing at 14.94 m.			
217.2		50		- 50 blows for 3.5" in the second SPT set.	S	S12	25
217				**POWER AUGER REFUSAL AT 15.18 m**			
	16			Notes: 1. Hole open to 12.19 m below grade after completion of drilling. 2. Water was at observed at 10.06 m after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
216							
		55					
	17						
215							
	18	60					
214							
	19						
213		65					
	20						
212							
	21	70					
211							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60
20 ▲ 50 ▲

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
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-04**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.60**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,713**
E **630,770**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.3				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
231.7	1			**SILT** - Light brown, dry, compact.		S2	
231.1		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
231	2						
230						S3	
	3	10		- Mottled brown below 3.05 m.			
229							
	4					S4	
228		15		- Grey, damp-moist below 4.28 m.			
	5					S5	
227							
	6	20					
226							
	7					S6	
225		25					
	8					S7	
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-04

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 %
222	11	35		- Wet, very soft below 10.67 m.		S8			
						S9			
221	12	40							
220	13								
219.2						S10			
219		45		**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.					
	14					S11			
218									
	15	50							
217.2				- 50 blows for 4.75" in the first SPT set.		S12	10	▲ 50	
217				**POWER AUGER REFUSAL AT 15.36 m**					
	16			Notes: 1. Hole open to 10.05 m below grade after completion of drilling. 2. Water was at observed at 8.23 m after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
216		55							
	17								
215									
	18	60							
214									
	19								
213		65							
	20								
212									
	21	70							
211									

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-05**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.41**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,541**
E **630,729**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.3				**TOPSOIL** - Black, dry, loose, with organics.			
232				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
231.6						S1	
	1			**SILT** - Light brown, dry, compact.		S2	
231							
230.9		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
	2			- Mottled brown below 1.68 m.			
230						S3	
	3	10				S4	
229						S5	
	4						
228		15		- Grey, damp-moist below 4.27 m.			
	5						
227						S6	
	6	20					
226							
	7					S7	
225		25					
	8					S8	
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-05

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 %
222						S9			◆ 20 40 60 80
	11	35							
221						S10			◆
	12	40							
220									◆
	13								
219						S11			
218.6		45						▲16	
	14			**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.		S12	100	▲19	
218.3				- 40 blows for 6" in the third SPT set.				▲40	
218				**POWER AUGER REFUSAL AT 14.12 m**					
	15	50							
217									
	16								
216									
		55							
	17								
215									
	18	60							
214									
	19								
213									
		65							
	20								
212									
	21								
211		70							

Notes:
1. Hole open to 9.14 m below grade after completion of drilling.
2. Water was at observed at 7.92 m after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-06**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.52**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/25/2018**
UTM (m) N **5,517,613**
E **630,837**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZO. 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 / %
232.4				**TOPSOIL** - Black, dry, loose, with organics.						20 40 60	20 40 60 80
232				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.							
	1							S1			
231		5									
	2							S2			
230											
	3	10		- Mottled brown below 3.05 m.							
229											
	4							S3			
228		15									
	5							S4			
227											
	6	20									
226				- Grey, damp-moist below 6.86 m.							
	7							S5			
225		25									
	8							S6			
224											
	9	30			PN	9.2 9.3					
223											

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR **Paddock Drilling Ltd.**
INSPECTOR **J. WONG**
APPROVED D. ANDERSON
DATE 2/12/19

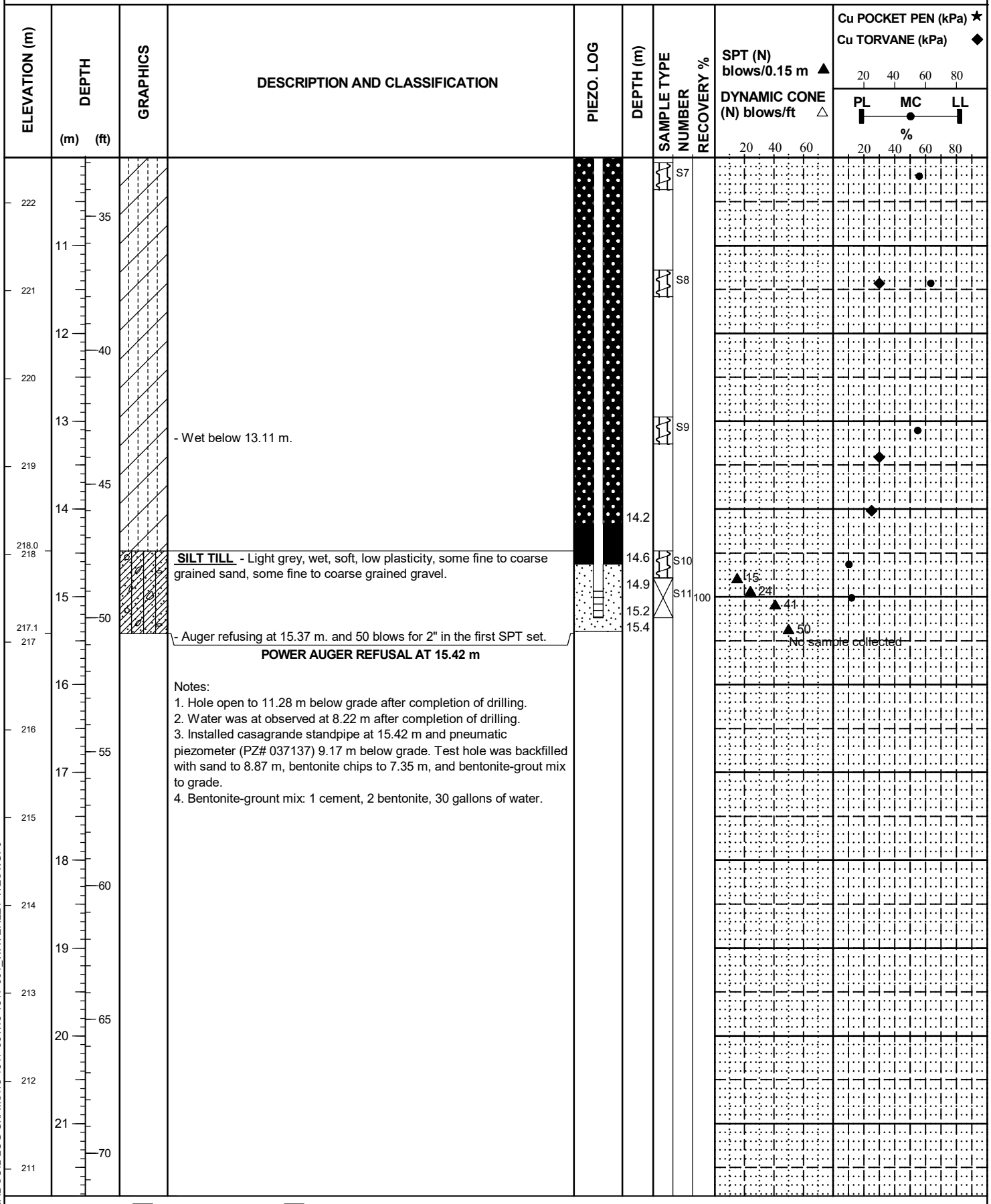
GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-06**



Notes:
1. Hole open to 11.28 m below grade after completion of drilling.
2. Water was at observed at 8.22 m after completion of drilling.
3. Installed casagrande standpipe at 15.42 m and pneumatic piezometer (PZ# 037137) 9.17 m below grade. Test hole was backfilled with sand to 8.87 m, bentonite chips to 7.35 m, and bentonite-grout mix to grade.
4. Bentonite-grout mix: 1 cement, 2 bentonite, 30 gallons of water.

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-07**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.27**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/25/2018**
UTM (m) N **5,517,672**
E **630,947**

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 %
232				**TOPSOIL** - Black, dry, loose, with organics.					
231.7									
	1			**SILT** - Light brown, dry, compact.		S1			
						S2			
231									
230.7		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
	2								
230						S3			
	3	10		- Mottled brown below 2.59 m.					
229									
	4					S4			
228		15							
	5			- Increasing silt below 4.88 m.					
227						S5			
	6	20							
226						S6			
	7			- Grey below 7.01 m.					
225		25							
	8								
224						S7			
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-07

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 %
222	11	35				S8			
221	11					S9			
	12	40							
220									
	13			- Increase in fine to coarse grained gravel below 13.11 m.		S10			
219		45							
	14								
218						S11			
217.3	15			**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.					
217		50							
216.6				- 50 blows for 0.25" in the second SPT set.		S12		▲8 ▲50	
	16			**POWER AUGER REFUSAL AT 15.70 m**					
216									
		55							
	17								
215									
	18	60							
214									
	19								
213		65							
	20								
212									
	21	70							
211									

Notes:
1. Hole open to 12.80 m below grade after completion of drilling.
2. Water was at observed at 12.50 m after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-08**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.69**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/25/2018**
UTM (m) N **5,517,395**
E **630,790**

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 %
232.5				**TOPSOIL** - Black, dry, loose, with organics.					
232.0				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1			
	1	5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S2			
231	2					S3			
230		10		- Mottled brown below 2.74 m.					
	3								
229						S4			
	4	15							
228									
	5					S5			
227									
	6	20							
226									
	7			- Grey below 7.16 m.		S6			
225		25							
	8					S7			
224									
	9	30							
223						S8			

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-08**

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 %
222	11	35						20 40 60	20 40 60 80
221	12	40		- Increase in fine to coarse grained gravel below 11.58 m.		S9			
220.2				**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.					
220	13					S10			
219		45							
218	14					S11			
217.1	15	50				S12	65	▲12 ▲28 ▲50	
217				- 50 blows for 4" in the third SPT set.					
	16			**POWER AUGER REFUSAL AT 15.57 m**					
216		55							
	17								
215									
	18	60							
214									
	19								
213		65							
	20								
212									
	21	70							
211									

Notes:
1. Hole open to 14.33 m below grade after completion of drilling.
2. Water was at observed at 13.41 m after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-09**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.45**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/25/2018**
UTM (m) N **5,517,471**
E **630,928**

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 △ (20 40 60)	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ (20 40 60 80)	PL MC LL % (20 40 60 80)
232										
231.8				**TOPSOIL** - Black, dry, loose, with organics.						
	1			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S1			◆	
231		5								
	2					S2			◆	
230				- Mottled brown below 2.74 m.						
	3	10								
229									◆	
	4					S3				
228		15								
	5									
227				- Grey below 5.49 m.		S4			◆	
	6	20								
226										
	7					S5			◆	
225		25								
	8					S6			◆	
224										
	9	30								
223										

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-09

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 %
222	11	35				S7			
						S8			
221	12	40							◆
220	13			- Increasing in medium grained gravel below 13.11 m.		S9			
219		45							
218.1	14								
218				**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.		S10			
	15	50		- 50 blows for 4" in the first SPT set.		S11	33	▲ 50	
217						S12			
216.8				**POWER AUGER REFUSAL AT 15.65 m**					
216	16			Notes: 1. Hole open to 11.89 m below grade after completion of drilling. 2. Water was at observed at 9.75 m after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
		55							
215	17								
	18	60							
214									
	19								
213		65							
	20								
212									
	21	70							
211									

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-10**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.16**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/25/2018**
UTM (m) N **5,517,551**
E **631,052**

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 %
232.0	0	0		**TOPSOIL** - Black, dry, loose, with organics.					
				SILT - Light brown, dry, compact.					
231.4						S1			
				SILTY CLAY - Brown, damp-moist, firm, high plasticity.					
231	1	5				S2			
230	2					S3			
				- Mottled brown below 2.44 m.					
229	3	10							
228	4					S4			
		15		- Grey below 4.57 m.					
227	5					S5			
226	6	20							
225	7					S6			
		25							
224	8					S7			
223	9	30							

SAMPLE TYPE ☒ Split Spoon

CONTRACTOR **Paddock Drilling Ltd.**
INSPECTOR **J. WONG**
APPROVED D. ANDERSON
DATE 2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH18-10

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 %
222	11	35				S8			
221	12	40				S9			
220	13	45				S10			
219	14			- Increase in fine to coarse grained gravel below 13.41 m.					
218									
217.8				**SILT TILL** - Light grey, moist, dense, low plasticity, with fine grained to coarse grained sand, with fine grained to coarse grained gravel.		S11			
217	15	50				S12	100	1, 1, 7	
216	16					S13	10	50	
215.8				- 50 blows for 3.5" in the first SPT set.		S14			
				POWER AUGER REFUSAL AT 16.40 m					
215	17	55							
214	18	60							
213	19	65							
212	20								
211	21	70							

Notes:
1. Hole open to 10.36 m below grade after completion of drilling.
2. Water was at observed at 7.92 m after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-11**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - North Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.59**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,831**
E **630,611**

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 / %
232.1				**TOPSOIL** - Black, dry, loose, with organics.					
232.0				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.					
				SILT - Light brown, dry, compact.		S1			
231.5	1			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S2			
231		5							
	2					S3			
230									
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			
228.0		15		**TESTHOLE END AT 4.57 m**					
228	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-12**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - North Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.39**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,944**
E **630,724**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.2				**TOPSOIL** - Black, dry, loose, with organics.			
232				**SILTY CLAY** - Brown, dry-moist, firm, high plasticity.			
	1					S1	
						S2	
231							
230.9		5		**SILT** - Light brown, dry, compact.		S3	
230.4	2			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
230						S4	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S5	
228							
227.8		15		**TESTHOLE END AT 4.57 m**			
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-13**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.53**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,747**
E **630,683**

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 %
232.2				**TOPSOIL** - Black, dry, loose, with organics.					
232				**SILT** - Light brown, dry, compact.					
231.8						S1			
	1			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S2			
231		5							
	2								
230						S3			
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			
228.0		15		**TESTHOLE END AT 4.57 m**					
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-14**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.56**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,773**
E **630,738**

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 %
232.3				**TOPSOIL** - Black, dry, loose, with organics.					
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.					
231.8						S1			◆
	1			**SILT** - Light brown, dry, compact.					
		5				S2			
231									
	2								
230.1									
230				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S3			◆
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			◆
228.0		15							
228				**TESTHOLE END AT 4.57 m**					
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-15**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.48**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,800**
E **630,787**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.3				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
231.9				**SILT** - Light brown, dry, compact.			
	1					S2	
231.0		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
230	2					S3	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S4	
228.0		15		**TESTHOLE END AT 4.57 m**			
	5						
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

Notes:
1. Hole open to 4.57 m below grade after completion of drilling.
2. No water was observed after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-16**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.64**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,664**
E **630,661**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.5				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.			
	1					S1	
231		5					
230.8				**SILT** - Light brown, dry, compact.			
230.6	2			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S2	
230							
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S3	
228.1		15					
228				**TESTHOLE END AT 4.57 m**			
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-17**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.46**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/26/2018**
UTM (m) N **5,517,773**
E **630,865**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.3				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.			
231.6	1					S1	
		5		**SILT** - Light brown, dry, compact.		S2	
231							
230.8	2			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
230						S3	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S4	
228							
227.9		15		**TESTHOLE END AT 4.57 m**			
	5						
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

Notes:
1. Hole open to 4.57 m below grade after completion of drilling.
2. No water was observed after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-18**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.64**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,664**
E **630,661**

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 %
232.4				**TOPSOIL** - Black, dry, loose, with organics.					
232	1			**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.					
						S1			◆ >1(
231.0		5				S2			
	2			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					◆
230									
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S3			◆
228.1		15		**TESTHOLE END AT 4.57 m**					
228	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR **Paddock Drilling Ltd.**
INSPECTOR **J. WONG**
APPROVED D. ANDERSON
DATE 2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-19**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.46**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,721**
E **630,841**

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 / %
232.0				**TOPSOIL** - Black, dry, loose, with organics.					
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.					
	1					S1			
231.2				**SILT** - Light brown, dry, compact.		S2			
231.0		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
	2					S3			
230									
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			
228									
227.9		15		**TESTHOLE END AT 4.57 m**					
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-20**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.70**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,595**
E **630,701**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.3				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
231.6	1			**SILT** - Light brown, dry, compact.		S2	
231		5					
230.7	2			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S3	
230							
	3	10		- Mottled brown below 3.1 m.			
229						S4	
	4						
228.1		15		**TESTHOLE END AT 4.57 m**			
228	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-21**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.29**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,729**
E **630,904**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232				**TOPSOIL** - Black, dry, loose, with organics.			
231.7							
231.4				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
	1			**SILT** - Light brown, dry, compact.			
231		5		- Increase in clay at 1.22 m.		S2	
230.2	2			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
230						S3	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S4	
228							
227.7		15		**TESTHOLE END AT 4.57 m**			
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-22**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.31**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,586**
E **630,779**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232							
231.9				**TOPSOIL** - Black, dry, loose, with organics.			
				ORGANIC CLAY - Black, dry, stiff, high plasticity, some organics.		S1	
231.2	1			**SILTY CLAY** - Brown, dry-moist, firm, high plasticity.		S2	
231		5				S4	
230.5				**SILT** - Light brown, dry, compact.			
	2					S3	
230							
229.9				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S5	
228							
227.7		15		**TESTHOLE END AT 4.57 m**			
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-23**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.35**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,642**
E **630,888**

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 %
232.0				**TOPSOIL** - Black, dry, loose, with organics.					
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1			
231.7				**SILT** - Light brown, dry, compact.					
	1			- Increase in clay at 1.07 m.		S2			
231									
230.8		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
	2								
230						S3			
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			
228									
227.8		15		**TESTHOLE END AT 4.57 m**					
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225									
		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-24**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.85**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,500**
E **630,754**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.5				**TOPSOIL** - Black, dry, loose, with organics.			
232.1				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
232	1			**SILT** - Light brown, dry, compact.		S2	
231.5		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
231	2						
230	3	10		- Mottled brown below 3.1 m.		S3	
229	4					S4	
228.3		15		**TESTHOLE END AT 4.57 m**			
228	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227	6	20					
226	7						
		25					
225	8						
224	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-25**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.62**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,521**
E **630,816**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.4				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
231.7	1			**SILT** - Light brown, dry, compact.		S2	
231.4				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
231		5		- Silt layer at 1.52 m and 1.83 m.			
230	2					S3	
229	3	10		- Mottled brown below 3.1 m.			
228.1	4					S4	
228		15		**TESTHOLE END AT 4.57 m**			
227	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
226	6	20					
225	7	25					
224	8						
223	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-26**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.27**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,583**
E **630,933**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.1				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1	
231.5				**SILT** - Light brown, dry, compact.			
231.2	1			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.		S2	
231		5					
	2						
230						S3	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S4	
228							
227.7		15		**TESTHOLE END AT 4.57 m**			
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-27**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.38**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,625**
E **630,978**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.1				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.			
	1					S1	
231							
230.9		5		**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.			
	2						
230						S2	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S3	
228							
227.8		15		**TESTHOLE END AT 4.57 m**			
	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.			
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-28**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.66**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,446**
E **630,777**

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 %
232.5				**TOPSOIL** - Black, dry, loose, with organics.					
232.1				**SILT** - Light brown, dry, compact.		S1			
232	1			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
		5				S2			>1(
231	2								
						S3			
230	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			
228.1		15		**TESTHOLE END AT 4.57 m**					
228	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

SAMPLE TYPE Auger Grab

CONTRACTOR **Paddock Drilling Ltd.**
INSPECTOR **J. WONG**
APPROVED D. ANDERSON
DATE 2/12/19

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-29**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.25**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,584**
E **631,019**

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 %
232				**TOPSOIL** - Black, dry, loose, with organics.					
231.8				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
231	1	5				S1			
230	2					S2			
229	3	10		- Mottled brown below 3.1 m.					
228	4					S3			
227.7		15		**TESTHOLE END AT 4.57 m**					
227	5			Notes: 1. Hole open to 4.57 m below grade after completion of drilling. 2. No water was observed after completion of drilling. 3. Backfilled with auger cuttings and bentonite chips to grade.					
226	6	20							
225	7	25							
224	8								
223	9	30							

SAMPLE TYPE Auger Grab

CONTRACTOR **Paddock Drilling Ltd.**
INSPECTOR **J. WONG**
APPROVED D. ANDERSON
DATE 2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-30**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.77**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,432**
E **630,859**

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 %
232.5				**TOPSOIL** - Black, dry, loose, with organics.					
232.2				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.		S1			
232	1			**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
		5				S2			
230.9	2			**SILT** - Light brown, dry, compact.					
230						S3			
	3	10							
229.3				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
229	4					S4			
228.2		15		**TESTHOLE END AT 4.57 m**					
228	5								
227	6	20							
226	7								
		25							
225	8								
224	9	30							
223									

Notes:
1. Hole open to 4.57 m below grade after completion of drilling.
2. No water was observed after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-31**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.45**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,471**
E **630,928**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.3				**TOPSOIL** - Black, dry, loose, with organics.			
232				**ORGANIC CLAY** - Black, dry, stiff, high plasticity, some organics.			
231.8							
				SILT - Light brown, dry, compact.		S1	
231.4	1						
				SILTY CLAY - Brown, damp-moist, firm, high plasticity.		S2	
231		5					
	2						
230						S3	
	3	10		- Mottled brown below 3.1 m.			
229							
	4					S4	
228							
227.9		15		**TESTHOLE END AT 4.57 m**			
	5						
227							
	6	20					
226							
	7						
225		25					
	8						
224							
	9	30					
223							

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

Notes:
1. Hole open to 4.57 m below grade after completion of drilling.
2. No water was observed after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

GEOTECHNICAL-SOIL LOG U:\FMS\18-1517-001\18-1517-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH18-32**

CLIENT

PROJECT Waverley West School Geo. Investigation

SITE 2 Design-Build Schools in Waverley West

LOCATION Cadboro Road - South Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. **18-1517-001**
GROUND ELEV. **232.26**
TOP OF CASING ELEV.
WATER ELEV.
DATE DRILLED **10/29/2018**
UTM (m) N **5,517,506**
E **630,989**

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 / %
232.1				**TOPSOIL** - Black, dry, loose, with organics.					
232				**CLAYEY SILT** - Brown, dry-damp, compact-firm, intermediate to high plasticity.					
232.0				**SILTY CLAY** - Brown, damp-moist, firm, high plasticity.					
						S1			
	1					S2			
231		5							
	2								
230						S3			
	3	10		- Mottled brown below 3.1 m.					
229									
	4					S4			
228									
227.7		15		**TESTHOLE END AT 4.57 m**					
	5								
227									
	6	20							
226									
	7								
225		25							
	8								
224									
	9	30							
223									

Notes:
1. Hole open to 4.57 m below grade after completion of drilling.
2. No water was observed after completion of drilling.
3. Backfilled with auger cuttings and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	J. WONG	D. ANDERSON	2/12/19

KGS GROUP

CONSULTING ENGINEERS

APPENDIX B

2020 KGS Group Report – Waverley West Schools Geotechnical Investigation – Extra Services

PEMBINA TRAILS SCHOOL DIVISION

WAVERLEY WEST SCHOOLS GEOTECHNICAL INVESTIGATION – EXTRA SERVICES

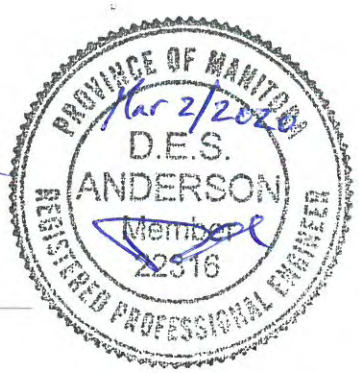
Final:
Rev. 0

KGS Group Project:
20-1522-001

Date:
March 2, 2020

PREPARED BY:

David Anderson, M.Sc., P.Eng.
Senior Geotechnical Engineer



APPROVED BY:

Taunya Ernst, B.Sc., P.Eng., P.E., P.G.
Senior Geotechnical Engineer

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for Pembina Trails School Division in accordance with the agreement between KGS Group and Pembina Trails School Division (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by Pembina Trails School Division and unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group's work.

Third Party Use of Report

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.

Geotechnical Investigation Statement of Limitations

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 the site at the time of drilling. 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, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

1.0 INTRODUCTION

Kontzamanis Graumann Smith MacMillan Inc. (KGS Group) was retained by Pembina Trails School Division for additional professional engineering services as the geotechnical consultant for the schools in Waverley West located on Cadboro Road in Winnipeg, Manitoba. The site consultant services included a new site investigation program to accommodate changes to the original project, and validation of the foundation assessment and pavement design provided in the report submitted in February 2019.

1.1 Project Understanding

The project site is located mostly on the south side of Cadboro Road as well as a small area north of Cadboro Road, approximately 0.7 km (0.4 mi) west of Waverley Street. The site has historically been used as farm land with no previous development across the site. Ground surface across the site is flat. From aerial images and visual inspection during the two (2) ground investigation programs developed for this site, there are low lying areas and drainage swales that traverse the east end of the property.

It is KGS Group's understanding that this report will serve for the final layout of the site for the construction of two (2) proposed new school buildings and a daycare building. The site has an approximate area of 14.0 acres south of Cadboro Road and 5.0 acres north of Cadboro Road. Based on the information provided in the previous assignment performed by KGS Group (18-1517-001), the elementary school building is anticipated to be a two-storey 7,944 m^2 (85,507 ft^2) school with capacity for 800 students. The high school building is anticipated to be a three-storey 11,748 m^2 (126,452 ft^2) school for a capacity of 1,000 students and have the capacity to expand to accommodate an additional 200 students in the future. A standalone daycare building will be located on the west side of the site. The future additions may include classrooms, shops and other facilities. Foundation loads and possible basement or crawlspace considerations are not currently available for the proposed buildings.

In addition, the proposed facility will also include hard and soft surface play areas, sports fields, loading areas for school buses and delivery trucks, walking pathways, landscape planting, light standards, property fencing, site drainage and final topping and seeding.

This report summarizes the results of the additional investigations completed in January 2020, and presents a comparison with the conditions and design recommendations summarized in the report submitted in February 2019.

1.2 Scope of Work

The current site consultant services for the updated project of the Waverley West design build schools consisted of a site investigation program, and review of the previously reported foundation assessment and pavement design. The scope of work was in accordance with KGS Group's proposal, dated December 20, 2019. The geotechnical engineering services included the following:

Utilities Locate and Site Clearances – KGS Group reviewed the utility clearances completed for the previous study, and requested updated ones for this investigation program, to identify and locate public underground and overhead utilities. KGS Group laid out the test holes to avoid utilities and other services.

Geotechnical Investigation Program – An on-site drilling program was completed to investigate the subsurface and groundwater conditions at the proposed site. The drilling program consisted of advancing a total of twenty-six (26) test holes. Sixteen (16) test holes were advanced to power auger or Standard Penetration Test (SPT) refusal and ten (10) test holes were advanced between 3.0 and 4.6 m (10 and 15 ft) below grade, using solid stem auger. Drilling services were provided by Paddock Drilling Ltd. of Winnipeg, Manitoba with continuous KGS Group supervision. Details of the investigation program is presented in Item 2.0 of this report.

Laboratory Testing – Laboratory tests included moisture contents and Atterberg limits on selected soil samples for correlation to relevant engineering properties of the subgrade and foundation soils. A total of 144 samples were tested.

Geotechnical Assessment Report – This geotechnical design report was prepared to summarize the field investigations, and to present the validity of the previous geotechnical foundation assessments recommendations and any further recommendations for the proposed development, including:

- Detailed test hole logs of encountered stratigraphy incorporating field observations, soil classification, laboratory test results, estimated depth of groundwater, and a plan showing the location of all test holes.
- General description of regional geology.
- Verification of the applicability of the Geotechnical Foundation Report delivered by KGS Group to Qualico Communities in February 2019 (project number: 18-1517-001), confirming the recommended foundation types, design capacities, expected settlement and general recommendations.
- Advise on any new recommendations.

2.0 INVESTIGATION PROGRAM

2.1 Test Hole Drilling and Sampling Program

A drilling and sampling program was completed from January 16 to 22, 2020 with drilling services provided by Paddock Drilling Ltd. of Brandon, Manitoba with continuous KGS Group supervision. The drilling and sampling program consisted of twenty-six (26) test holes distributed over the site, as shown on Figure 1, following the suggestions proposed in by the client. The locations of the test holes drilled for the previous study are also shown on Figure 1.

Sixteen (16) test holes were advanced to power auger or SPT refusal and ten (10) test holes were advanced to a depth between 3.0 and 4.6 m (10 and 15 ft) below grade. All test holes were completed using a track mounted Mobile B48 drill rig equipped with 125 mm diameter solid stem continuous flight augers. The exact locations of the test holes are provided on Table 1, with the surveyed UTM coordinates.

Representative disturbed soil samples were obtained in all test holes at 1.5 m (5 ft) intervals, or at any change in soil strata. Soil samples were collected directly off the auger flights and visually classified in the field in accordance with the modified Unified Soil Classification System (USCS). Clay samples were field tested with a field Torvane to evaluate consistency and estimate the undrained shear strength. Standard Penetration Test's were performed in the till to determine the relative in-situ density.

Upon completion of the drilling, each test hole was examined for indications of sloughing and seepage. All test holes were backfilled with soil cuttings and bentonite chips to surface. Detailed summary soil logs incorporating all field observations and laboratory testing are provided in Appendix A.

2.2 Laboratory Testing

Laboratory testing was performed on select representative soil samples for correlation to relevant engineering properties of the subsurface soils relative to the foundation design. Laboratory tests included: 142 moisture content tests and two (2) Atterberg limit analyses. Laboratory testing was completed at a Canadian Council of Independent Laboratories (CCiL) certified soil testing laboratory in Winnipeg, Manitoba in general accordance with ASTM Standards. Results of moisture content are included on the test hole logs and Atterberg limit results are also included in Appendix A.

FIGURE 1 - TEST HOLE LOCATIONS

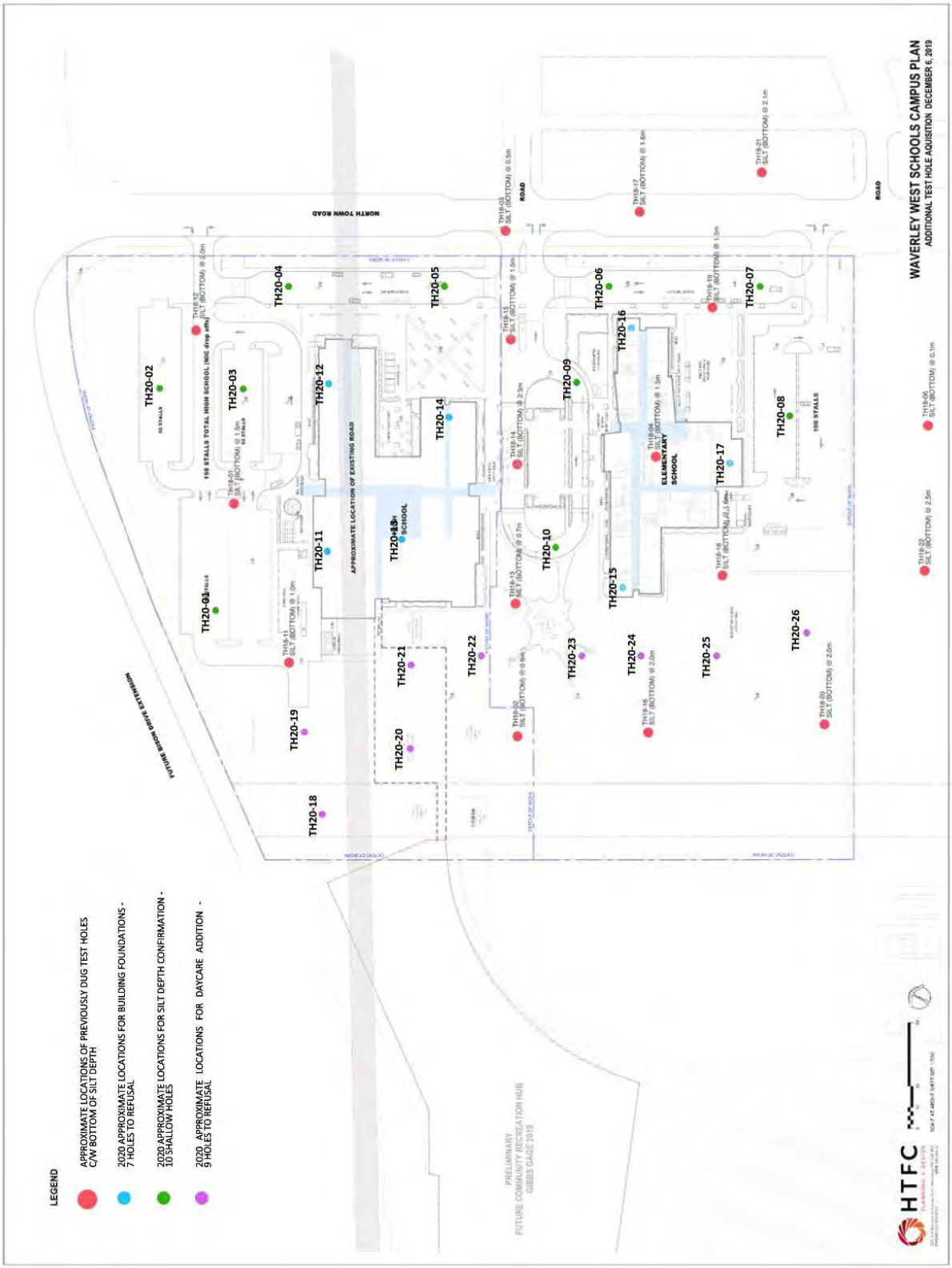

TABLE 1: APPROXIMATE TEST HOLE COORDINATES

Test Hole ID	Approximate UTM Coordinates		Structure	Test Hole Depth (m)
	Northing (m)	Easting (m)		
TH20-01	5,517,873	630,611	Parking lot	3.0
TH20-02	5,517,950	630,690	Parking lot	4.6
TH20-03	5,517,913	630,707	Parking lot	3.0
TH20-04	5,517,913	630,760	Parent Drop-Off	3.0
TH20-05	5,517,841	630,793	Parent Drop-Off	3.0
TH20-06	5,517,774	630,827	Parent Drop-Off	3.0
TH20-07	5,517,709	630,856	Parent Drop-Off	3.0
TH20-08	5,517,672	630,812	Parking lot	3.0
TH20-09	5,517,765	630,782	Entry Plaza Drop-Off	3.0
TH20-10	5,517,743	630,713	Entry Plaza Drop-Off	3.0
TH20-11	5,517,840	630,660	High School	15.3
TH20-12	5,517,877	630,728	High School	15.5
TH20-13	5,517,812	630,681	High School	15.3
TH20-14	5,517,812	630,740	High School	15.1
TH20-15	5,517,702	630,711	Elementary School	14.9
TH20-16	5,517,753	630,814	Elementary School	15.5
TH20-17	5,517,687	630,779	Elementary School	17.1
TH20-18	5,517,788	630,560	Daycare Addition	19.5
TH20-19	5,517,810	630,585	Daycare Addition	18.4
TH20-20	5,517,762	630,601	Daycare Addition	17.4
TH20-21	5,517,780	630,634	Daycare Addition	18.6
TH20-22	5,517,749	630,654	Daycare Addition	14.9
TH20-23	5,517,711	630,677	Daycare Addition	14.9
TH20-24	5,517,687	630,691	Daycare Addition	14.9
TH20-25	5,517,655	630,704	Daycare Addition	14.9
TH20-26	5,517,620	630,730	Daycare Addition	15.1

3.0 INVESTIGATION RESULTS

3.1 Regional Geology

The geology in Winnipeg, in general terms, consists of glaciolacustrine clay deposits over till, consistent with the findings of the drilled material at the location of the Waverley West Schools. Additional information on the regional geology can be found in the Geological Engineering Report for Urban Development of Winnipeg, from the University of Manitoba.

3.2 Site Stratigraphy

A total of twenty-six (26) test holes were drilled during this additional study at the proposed site for the new school buildings in Waverley West, Winnipeg, Manitoba. As aforementioned, the stratigraphy at the site was consistent with the regional geology and has been interpreted by KGS Group to consist of a layer of topsoil and organic (black) clay overlying high plasticity clay with a silt layer near surface, underlain by a layer of glacial till over suspected bedrock. Power auger or SPT refusal occurred between 14.9 and 19.5 m below existing ground surface within the silt till.

A description of the findings is included in the following paragraphs. These results are compatible to the findings of the previous study submitted in February 2019.

Topsoil – Topsoil was observed at ground surface in all the test holes. The topsoil was black in colour and frozen. The approximate thickness of the topsoil layer was 0.1 m. This is thinner than the results from the previous study, most likely because it is harder to identify the top layers when the surface is frozen and covered in snow.

Organic Clay (OH) – Organic clay was observed at ground surface in all the test holes. The organic clay was dry, frozen and contained some organics and trace rootlets. Occasional silt inclusions and change in colour to brown or grey were observed in some test holes. The approximate thickness of the black clay layer ranged from 0.1 to 0.9 m and had an average thickness of 0.5 m. These findings are thinner than the results from the previous study, most likely because it is harder to identify the top layers when the surface is frozen and covered in snow. The moisture content in the black clay varied between 27 and 41%, with an average of 31% as measured in six (6) samples.

Silt (ML) – Silt was observed in twenty-four (24) test holes within the organic clay or clay layers. In two (2) test holes (TH20-02 and TH20-17), the silt layer was present twice near the surface, divided by the clay layer. The silt layer was encountered at a depth ranging from 0.2 (TH20-16) to 2.7 m (TH20-12) below existing ground surface. The silt layer had a variable thickness ranging from 0.2 to 1.3 m. The silt was generally light brown in colour, dry and compact in consistency. The moisture content in the silt varied between 18 and 33%, with an average of 24% as measured in twenty-four (24) samples.

Clay (CH) – Clay of high plasticity was encountered below the organic clay at a depth ranging from 0.6 to 1.5 m below existing ground surface. The clay was generally mottled brown to grey in colour, damp to moist, firm to stiff in consistency. With depth, the clay became grey in colour, wet and soft. Occasional trace silt inclusions and trace oxidation were observed. The undrained shear strength of the clay, as estimated by the

field Torvane, varied throughout the strata from 15 kPa to greater than 90 kPa, generally decreasing with depth. The moisture content in the clay varied between 31 and 59% with an average of 48% as measured in seventy-nine (79) samples. Atterberg limit tests completed in two (2) samples at a depth of 8.4 m below grade measured an average liquid limit of 79, plastic limit of 23, and a plasticity index of 56, classifying the soil as a high plasticity clay.

Clay Till – Clay till was encountered in nine (9) of the deep test holes below the clay layer at a depth ranging from 12.8 to 13.7 m, with a thickness ranging from 0.6 to 2.0 m. The clay till was light grey in colour, moist to wet, with some sand and gravel inclusions. The moisture content in the clay till varied between 17 and 39% with an average of 30% as measured in eight (8) samples.

Silt Till – Silt till was encountered in all the refusal test holes (TH20-11 to TH20-26) below the clay (or the clay till) at a depth ranging from 13.4 to 16.0 m below existing ground surface. The silt till was light brown in colour, with some sand and gravel inclusions. The observed moisture varied throughout the test holes, some being dry or dry to moist and some being moist to wet. Laboratory testing indicated that the moisture content in the silt till varied between 7 and 28% with an average of 13% as measured in twenty-five (25) samples.

3.3 Surface Water Conditions

Due to the snow cover at the time of this study, no further observation could be made regarding surface water conditions. Recommendations given in the previous report, submitted in February 2019, regarding to manage surface water should be considered.

3.4 Groundwater Conditions

Seepage and sloughing conditions were variable across the site. In general, seepage and sloughing were not observed in shallow test holes that were advanced up to 4.6 m depth. This is likely due to the low permeability of the clay in the area and short duration (15 to 30 minutes) required to advance the shallow test holes. Sloughing occurred in all the deep test holes that were drilled to refusal in till.

Groundwater infiltration was noted in test holes at depths ranging from of 7.4 to 14.6 m below ground surface in ten (10) of the deep test holes. These test holes are in the eastern and western portion of the land, very close to Cadboro Road, as well as at the central portion of the southern area of the land, as shown on Figure 2.

One (1) pneumatic piezometer and one (1) Casagrande tipped standpipe piezometer were installed for the study reported in February 2019, in TH18-06 (also shown on Figure 2), in the clay and silt till at depths of 9.2 and 15.4 m below grade, respectively. New readings were taken for this study on January 29, 2020, and a summary of the piezometric monitoring findings to date is presented on Table 2.

In general, the groundwater at the site is interpreted to have recorded levels ranging from Elev. ±229.92 to 230.07 m in the silty clay and a lower groundwater level ranging from Elev. ±225.66 to 226.02 m in the silt till. Based on these groundwater levels there is a downward gradient in the silty clay.

FIGURE 2 – OBSERVED WATER LEVELS

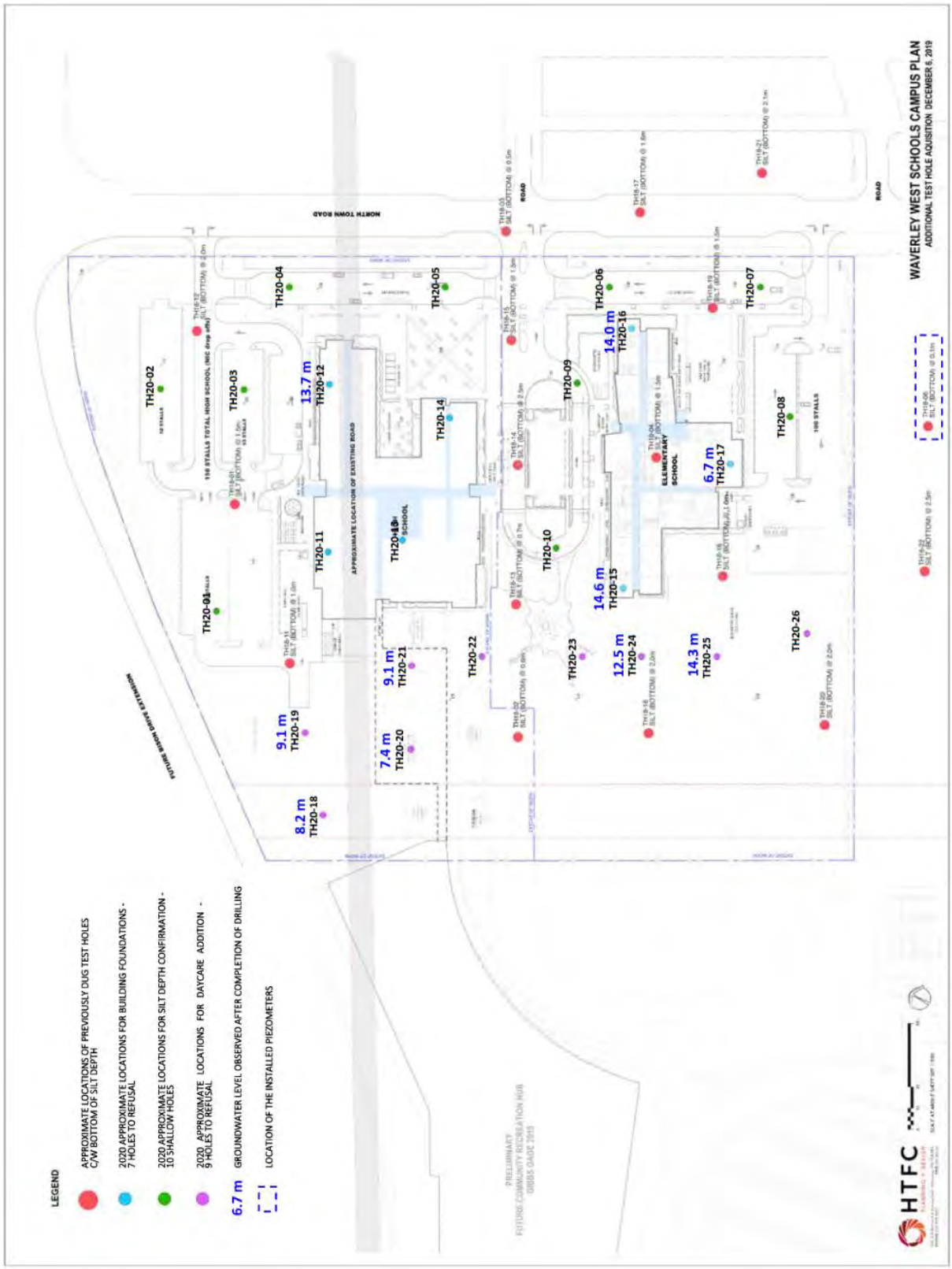

TABLE 2: PIEZOMETRIC MONITORING DATA

Test Hole	TH18-06	
Ground Elevation (m)	232.52	
Piezometer Type	Standpipe	Pneumatic
Piezometer No.	-	PN 037137
Top of Pipe Elevation (m)	233.44	-
Tip Elevation (m)	217.10	223.32
Monitoring Zone	Till	Silty Clay
Date	Piezometric Elevation (m)	
November 8, 2018	225.66	230.07
January 29, 2020	226.02	229.92

Based on previous experience, groundwater levels will fluctuate seasonally and following precipitation events, hence the actual water level at the time of construction could differ from those reported herein.

3.5 Potential Difficult Ground Conditions

During the site investigation, groundwater infiltration and squeezing/sloughing was variable across the site. The groundwater inflows and subsequent sloughing in these areas should be dealt with during construction by the means deemed necessary by the foundation installation contractor.

In KGS Group's experience, sporadic and irregular zones of cobbles, boulders and/or granular layers have been frequently encountered in till deposits such as those encountered at this site. These zones can and should be expected to be water bearing, which may cause difficulties when advancing pile excavations into till. The cobbles and boulders would need to be removed when encountered within foundation excavations. Contractors should anticipate that sleeves may be required for cast-in-place pile excavations advanced below a depth of 8 m below ground surface or below the water table.

4.0 COMPARISON WITH PREVIOUS STUDY

After review of the 2018/2019 investigations and the results of this investigation, KGS Group determined that the stratigraphy encountered was similar across the site. It was observed that in test holes TH20-17, TH20-18, TH20-20 and TH20-21, a 100 to 150 mm thick sandy layer existed within the silt till at depths ranging from 15.2 to 17.4 m. Based upon these additional investigations, the silt layer was found to range in thickness from 0.2 to 2.7 m thick.

The refusal (power auger or SPT) depths from this investigation are generally similar across the site; however, it should be noted that test holes TH20-17 to TH20-21, located on the northwestern portion of the site, encountered deeper refusal depths than previously indicated in the 2018/2019 investigation for the same area, ranging from 17.1 to 19.5 m, which is up to 3 m deeper than the previous study.

In general, groundwater infiltration and test hole sloughing and squeezing were consistent with the findings from the previous investigation. The groundwater monitoring results were also similar from the previous reading in 2018.

Based on the findings of this investigation, it has been determined by KGS Group that the design parameters and recommendations for foundations, slab-on-grade floors and pavement sections from the 2019 report "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey" remain valid and should be used going forward.

The anticipated embedment depths for the Driven Prestressed Precast Concrete Piles still includes the range reported in 2019, varying from 14.5 to 21.7 m. In this present investigation, the anticipated driven pile embedment lengths range from 14.9 up to 19.5 m, therefore, within the limits presented in the 2019 report. Pile lengths are expected to vary considerably across the site. Please refer to the 2019 report "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site consultant for Geotechnical Survey" for further design values and recommendations.

5.0 CONCLUSIONS

- In general, the stratigraphy at the site is consistent with the previous findings and has been interpreted by KGS Group to consist of topsoil and organic clay overlying high plasticity clay underlain by clay and silt till. Solid stem power auger or SPT refusal occurred in the silt till at depths ranging from 14.9 to 19.5 m below existing ground surface.
- Observed seepage and sloughing conditions were variable across the site. In general, seepage and sloughing were not observed in shallow test holes advanced up to 4.6 m, but sloughing occurred in all deep test holes, drilled to refusal. Groundwater infiltration varied between depths of 7.4 to 14.6 m below ground surface. It is anticipated that groundwater inflows and sloughing will have to be dealt with during construction by the means deemed necessary by the foundation installation contractor.
- In KGS Group's experience, sporadic and irregular zones of cobbles, boulders and/or granular layers have been frequently encountered in till deposits such as those at this site. These zones can and should be expected to be water bearing, which may cause difficulties when advancing pile excavations or end-bearing piles into till. The cobbles and boulders would need to be removed when encountered in foundation excavations. Contractors should anticipate that sleeving may be required when excavating cast-in-place piles.
- Recommendations for suitable foundation options and design values reported in 2019 in "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey" remain valid. It includes cast-in-place friction or end-bearing concrete piles and driven prestressed precast end-bearing concrete piles into dense till.
- Recommendations for other structures reported in 2019 in "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey" remain valid. It includes slab-on-grade floors and pavement sections.

6.0 RECOMMENDATIONS

Based on our assessment, the following recommendations are made:

- Any reference to the foundation considerations and other structures should be made to the 2019 report "Two Design-Build Schools – Waverley West, Winnipeg, Manitoba – Site Consultant for Geotechnical Survey", as design values and recommendations remain valid.
- Full-time inspection by experienced geotechnical personnel should be completed throughout construction of foundations to ensure that the design capacities indicated in this report are achieved. Detailed construction records should also be kept by qualified personnel throughout construction.

APPENDIX A

Laboratory Test Results

Test Hole Logs

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-01**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, West Parking Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, MOBILE B48 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/16/2020**
UTM (m) N **5,517,873**
E **630,611**

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 %
	0			**TOPSOIL** - Black, frozen.					
				ORGANIC CLAY (OH) - Black, frozen, some organics, trace rootlets.					
				- Brown, moist, stiff, high plasticity below 0.6 m.					
	1					S1			◆ >90
		5		**SILT (ML)** - Brown, moist, soft, low plasticity.		S2			●
	2			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.					● ◆
						S3			
	3	10		**END OF TEST HOLE AT 3.0 m**					
	4	15							
	5								
	6	20							
	7	25							
	8								
	9	30							

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-02**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, North Parking Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, MOBILE B48 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/16/2020**
UTM (m) N **5,517,950**
E **630,690**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Brown, frozen, some silt inclusions, trace organics, trace rootlets.			
	1			- Moist, stiff, high plasticity below 0.9 m.		S1	
		5		**SILT (ML)** - Brown, moist, soft, low plasticity.		S2	
	2			**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace silt inclusions.			
				- Silt pocket at 2.4 m (100 to 150 mm thick). - Mottled brown and grey below 2.6 m.		S3	
	3	10		- Firm below 3.4 m.			
	4						
		15		**END OF TEST HOLE AT 4.6 m**			
	5			Notes: 1. Test hole remained open to 4.6 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.			
	6	20					
	7	25					
	8						
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>80
>80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-03**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, South Parking Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, MOBILE B48 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/16/2020**
UTM (m) N **5,517,913**
E **630,707**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Brown, frozen, trace organics, trace rootlets.			
						S1	
				- Moist, stiff, high plasticity, increased silt below 0.8 m.			
	1			**SILT (ML)** - Brown, moist, soft, low plasticity.			
		5				S2	
	2			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
						S3	
	3	10		**END OF TEST HOLE AT 3.0 m**			
	4	15					
	5						
	6	20					
	7	25					
	8						
	9	30					

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-04**

CLIENT PEMBINA TRAILS SCHOOL DIVISION
PROJECT Waverley West School Geo. Investigation - Extra Services
SITE Waverley West, Cadboro Rd.
LOCATION North End Lot, Parent Drop-Off
DRILLING METHOD 125 mm ø Solid Stem Auger, MOBILE B48 Track Mounted Drill Rig

JOB NO. 20-1522-001
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 1/16/2020
UTM (m) N 5,517,913
E 630,760

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0			**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black and grey, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
				- Moist, soft, low plasticity below 0.6 m.		S1	
	1			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
		5					
	2					S2	
	3	10		**END OF TEST HOLE AT 3.0 m**			
	4						
		15					
	5						
	6	20					
	7						
		25					
	8						
	9	30					

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-05**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Parent Drop-Off

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,841**
E **630,793**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0			**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black and grey, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.		S1	
						S2	
	1			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
		5					
	2					S3	
				- Silt pocket at 2.4 m (100 to 150 mm thick).			
	3	10		**END OF TEST HOLE AT 3.0 m**			

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80
>80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-06**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Parent Drop-Off

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,774**
E **630,827**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black and grey, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
				- Moist, soft, low plasticity below 0.6 m.			
	1			- Increased clay below 1.1 m.		S1	
		5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
	2					S2	
	3	10		**END OF TEST HOLE AT 3.0 m**			
	4						
		15					
	5						
	6	20					
	7						
		25					
	8						
	9	30					

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80
>85

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-07**

CLIENT PEMBINA TRAILS SCHOOL DIVISION
PROJECT Waverley West School Geo. Investigation - Extra Services
SITE Waverley West, Cadboro Rd.
LOCATION South End Lot, Parent Drop-Off
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. 20-1522-001
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 1/21/2020
UTM (m) N 5,517,709
E 630,856

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 %
	0			**TOPSOIL** - Black, frozen.					
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.					
				SILT (ML) - Brown, frozen.					
	1			- Moist, soft, low plasticity below 0.9 m.		S1			
		5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.					
	2			- Silt pocket at 2.4 m (100 to 150 mm thick).					
				- Firm below 2.7 m.		S2			
	3	10		**END OF TEST HOLE AT 3.0 m**					
	4								
		15							
	5								
	6	20							
	7								
		25							
	8								
	9	30							

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-08**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, South Parking Lot

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,672**
E **630,812**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.			
	1			- Moist, high plasticity below 0.9 m.		S1	
				SILT (ML) - Brown, moist, soft, low plasticity.		S2	
		5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
	2					S3	
				- Silt pocket at 2.6 m (100 to 150 mm thick).			
	3	10		**END OF TEST HOLE AT 3.0 m**			
	4	15					
	5						
	6	20					
	7	25					
	8						
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-09**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, East Side Entry Plaza Drop-Off Loop

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,765**
E **630,782**

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 %
	0	0		**TOPSOIL** - Black, frozen.					
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.					
				- Brown below 0.6 m.		S1			
	1	5		**SILT (ML)** - Brown, moist, soft, low plasticity.		S2			
	2			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions, trace gypsum inclusions.		S3			
				- Silt pocket at 2.6 m (100 to 150 mm thick).					
	3	10		**END OF TEST HOLE AT 3.0 m**					
	4	15							
	5								
	6	20							
	7	25							
	8								
	9	30							

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-10**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, West Side Entry Plaza Drop-Off Loop

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,743**
E **630,713**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0			**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.		S1	
	1			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.		S2	
		5					
	2			- Silt pocket at 2.1 m (100 to 150 mm thick).		S3	
	3	10		**END OF TEST HOLE AT 3.0 m**			
	4	15					
	5						
	6	20					
	7	25					
	8						
	9	30					

Notes:
1. Test hole remained open to 3.0 m upon completion of drilling.
2. No water infiltration observed after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80
>80

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-11**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, Northwest High School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/17/2020**
UTM (m) N **5,517,840**
E **630,660**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
				- Moist, soft, low plasticity below 0.6 m.		S1	
1				**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity.			
		5					
2						S2	
				- Trace silt inclusions, trace oxidation below 2.4 m.			
				- Firm below 2.7 m.			
3		10					
4						S3	
		15					
5						S4	
6		20					
				- Soft below 6.4 m.			
7				- Grey below 7.0 m.		S5	
		25					
8						S6	
9		30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-11

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 %
	11	35		- Trace medium to coarse sand below 10.4 m.		S7			
						S8			
	12	40		- Increased silt inclusions below 12.5 m.					
	13					S9			
		45							
	14			**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.					
				- Harder drilling below 14.5 m.		S10			
	15	50		- Very dense below 15.2 m.		S11	100	▲ 50	
				SPT REFUSAL AT 15.3 m					
	16			Notes: 1. Test hole remained open to 15.2 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
		55							
	17								
	18	60							
	19								
		65							
	20								
	21	70							

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-12**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, Northeast High School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/17/2020**
UTM (m) N **5,517,877**
E **630,728**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.			
	1	5		- Black and brown, moist, high plasticity, some silt below 0.8 m.		S1	
	2			**SILT (ML)** - Brown, moist, soft, low plasticity, trace clay, trace medium to coarse grained sand.		S2	
	3	10		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
				- Firm below 3.4 m.		S3	
	4	15					
	5					S4	
	6	20		- Soft below 6.4 m.			
				- Grey below 6.7 m.		S5	
	7	25					
	8					S6	
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-12

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 %
	11	35				S7			
	12	40				S8			
	13			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.					
▼	14	45				S9			
	15	50		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S10			
				- Very dense below 15.2 m.		S11	100	▲38 ▲50	
				SPT REFUSAL AT 15.5 m					
	16			Notes: 1. Test hole remained open to 14.6 m upon completion of drilling. 2. Groundwater observed at 13.7 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
	17	55							
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-13**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Central-West High School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/20/2020**
UTM (m) N **5,517,812**
E **630,681**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
				- Moist, soft, low plasticity below 0.8 m.		S1	
	1			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
		5					
	2					S2	
				- Silt pocket at 2.7 m (100 to 150 mm thick).			
	3	10		- Firm below 3.4 m.			
	4					S3	
		15					
	5					S4	
	6	20		- Grey below 6.4 m.			
	7					S5	
		25		- Soft to firm below 7.3 m.			
	8					S6	
	9	30		- Soft below 8.8 m.			

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>80
>80

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-13

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 %
	11	35		- Increased silt inclusions, trace medium to coarse grained sand below 10.4 m.		S7			
	12	40				S8			
	13			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.					
	14	45				S9			
	15			**SILT TILL** - Light brown, dry, some to with fine to coarse grained sand, some fine gravel.		S10			
		50		- Near power auger refusal at 15.1 m. - Very dense below 15.2 m.		S11	100	▲ 50	
				SPT REFUSAL AT 15.3 m					
	16			Notes: 1. Test hole remained open to 14.0 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
	17	55							
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-14**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Southeast High School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/20/2020**
UTM (m) N **5,517,812**
E **630,740**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.			
	1			- Moist, stiff, high plasticity below 0.8 m.		S1	
		5		**SILT (ML)** - Brown, moist, soft, low plasticity.			
	2					S2	
				CLAY (CH) - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.		S3	
	3	10					
	4					S4	
		15					
	5			- Firm below 4.9 m.			
				- Grey below 5.5 m.		S5	
	6	20					
				- Soft below 6.4 m.			
	7					S6	
		25					
	8						
						S7	
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>70
>80

SAMPLE TYPE Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-14

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 %
	11	35		- Trace medium to coarse grained sand below 11.0 m.		S8			
						S9			
	12	40							
	13			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.		S10			
		45		**SILT TILL** - Light brown, dry, some to with fine to coarse grained sand, some fine gravel.					
	14					S11			
	15					S12	100	▲ 50	
		50		**POWER AUGER REFUSAL AT 15.1 m**					
	16			Notes: 1. Test hole remained open to 14.3 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
		55							
	17								
	18	60							
	19								
		65							
	20								
	21	70							

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-15**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Northwest Elementary School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,702**
E **630,711**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.			
				- Brown below 0.3 m.			
				- Increased silt between 0.6 and 0.9 m.			
	1			**CLAY (CH)** - Black and brown, moist, stiff, high plasticity.		S1	
		5		- Mottled brown and grey, trace silt inclusions, trace gypsum inclusions below 1.5 m.			
	2			- Silt pocket at 1.8 m (100 to 150 mm thick).		S2	
	3	10					
	4					S3	
		15					
	5			- Firm below 4.9 m.		S4	
	6	20					
	7			- Grey below 7.0 m.		S5	
		25					
	8			- Soft below 7.9 m.		S6	
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-15**

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 %
	11	35				S7		20 40 60	20 40 60 80
	12	40		- Trace medium to coarse grained sand, trace fine gravel below 12.5 m.		S8			
	13	45				S9			
▼	14			**SILT TILL** - Light brown, dry, some to with fine to coarse grained sand, some fine gravel.		S10			
	15	50				S11	50	▲ 50	
				POWER AUGER REFUSAL AT 14.9 m					
	16	55		Notes: 1. Test hole remained open to 14.6 m upon completion of drilling. 2. Groundwater observed at 14.6 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
	17								
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-16**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Northeast Elementary School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/22/2020**
UTM (m) N **5,517,753**
E **630,814**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
	1			- Moist, soft, low plasticity below 0.9 m.		S1	
		5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
	2					S2	
				- Silt pocket at 2.4 m (100 to 150 mm thick).			
	3	10					
	4					S3	
		15		- Firm below 4.3 m.			
	5			- Grey below 5.2 m.		S4	
	6	20					
	7					S5	
		25					
	8					S6	
	9	30		- Soft below 9.4 m.			

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>80
>80

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-16

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 %
	11	35		- Trace to some silt inclusions, trace medium to coarse grained sand below 10.1 m.		S7			
	12	40				S8			
	13			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.		S9			
▼	14	45		**SILT TILL** - Light brown, dry, some to with fine to coarse grained sand, some fine gravel.		S10			
	15	50				S11	100	▲ 50	
				SPT REFUSAL AT 15.5 m					
	16			Notes: 1. Test hole remained open to 14.6 m upon completion of drilling. 2. Groundwater observed at 14.0 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
	17	55							
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-17**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, South End Elementary School

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/22/2020**
UTM (m) N **5,517,687**
E **630,779**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
	1			- Moist, soft, low plasticity below 0.9 m.		S1	
		5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
	2			**SILT (ML)** - Brown, moist, soft, low plasticity.		S2	
				CLAY (CH) - Mottled brown and grey, moist, stiff, high plasticity.		S3	
	3	10					
				- Silt pocket at 3.7 m (100 to 150 mm thick).		S4	
	4			- Trace silt inclusions, trace oxidation below 4.0 m.			
		15					
	5			- Firm below 4.9 m.			
				- Grey below 5.2 m.		S5	
▼	6	20					
						S6	
	7						
		25		- Silt pocket at 7.8 m (100 mm thick).			
	8						
				- Trace coarse sand below 8.5 m.		S7	
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-17**

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 %
	11	35		- Trace to some silt inclusions, trace medium to coarse grained sand below 10.1 m.		S8			
				- Soft, trace to some silt inclusions below 11.0 m.		S9			
	12	40							
	13					S10			
		45		**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.					
	14			- Increased fine gravel below 14.0 m.		S11			
	15	50							
				SILT TILL - Light brown, dry, some to with fine to coarse grained sand, some fine gravel.					
	16					S12			
		55		- Fine to medium coarse grained sand seam at 16.8 m (100 mm thick).					
	17			- Some to with fine grained sand, no fine gravel.		S13	100	▲20 ▲46 ▲50	
				SPT REFUSAL AT 17.1 m					
	18	60		Notes: 1. Test hole remained open to 16.2 m upon completion of drilling. 2. Groundwater observed at 6.7 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips to grade.					
	19								
	20	65							
	21	70							

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-18**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, Northwest Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, MOBILE B48 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/17/2020**
UTM (m) N **5,517,788**
E **630,560**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.		S1	
				SILT (ML) - Brown, moist, soft, low plasticity, some clay.		S2	
				CLAY (CH) - Mottled brown and grey, moist, stiff, high plasticity.			
	1	5					
	2			- Trace silt inclusions, trace oxidation below 2.4 m.		S3	
	3	10		- Firm below 3.4 m.			
	4					S4	
		15					
	5			- Grey below 5.5 m.		S5	
	6	20		- Soft below 6.4 m.			
	7					S6	
		25					
▼	8					S7	
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>80

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-18

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 %
	11	35				S8			
	12	40				S9			
	13			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.		S10			
	14	45							
	15	50		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S11			
						S12	78	▲17 ▲30 ▲30	
	16								
	17	55		- Increased sand below 16.8 m.					
				- Soft between 17.4 and 18.9 m.					
	18	60							
	19					S13			
	20	65		**POWER AUGER REFUSAL AT 19.5 m**					
	21	70							

Notes:
1. Test hole remained open to 8.2 m upon completion of drilling. Measuring tape possibly sticking to side walls.
2. Groundwater observed at 8.2 m after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips to grade.

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-19**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION North End Lot, Northeast Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, MOBILE B48 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/16/2020**
UTM (m) N **5,517,810**
E **630,585**

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 / %
				TOPSOIL - Black, frozen.					
				CLAY (CH) - Black and brown, frozen, trace organics, trace rootlets.					
						S1			
	1			- Brown, moist, stiff, high plasticity below 0.9 m.					
		5				S2			
	2								
				- Silt pocket at 2.3 m (100 mm thick).		S3			
				- Mottled brown and grey, trace silt inclusions below 2.4 m.					
	3	10				S4			
						S5			
	4								
		15							
	5								
						S6			
				- Grey below 5.5 m.					
				- Firm below 5.8 m.					
	6	20							
						S7			
	7								
		25							
	8					S8			
▼	9	30		- Soft below 9.4 m.					

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-19

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 %
	11	35				S9		20 40 60	20 40 60 80
	12	40				S10			
	13	45				S11			
	14					S12			
	15	50		**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.		S13			
	16	55		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S14		14	
	17					S15	78	22 27	
	18	60				S16			
				POWER AUGER REFUSAL AT 18.4 m		S17	100	46 50	
	19	65		Notes: 1. Test hole remained open to 17.7 m upon completion of drilling. 2. Groundwater observed at 9.1 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
	20	70							
	21								

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-20**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Central-North Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/20/2020**
UTM (m) N **5,517,762**
E **630,601**

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 %
	0			**TOPSOIL** - Black, frozen.				20 40 60	20 40 60 80
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.					
				SILT (ML) - Brown, frozen.		S1			
	1			- Moist, soft, low plasticity below 0.8 m.					
				CLAY (CH) - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.					
		5							
	2					S2			>70
		10							
	3			- Trace oxidation below 3.4 m.					
						S3			
	4	15							
	5					S4			
				- Firm to stiff below 5.8 m.					
	6	20							
				- Grey below 6.7 m.		S5			
▼	7	25							
	8			- Soft below 7.9 m.		S6			
	9	30							

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

GEOTECHNICAL-SOIL LOG U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-20**

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 %
	11	35				S7			
	12	40				S8			
	13								
		45				S9			
	14			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.					
				SILT TILL - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S10			
	15	50				S11	67	16, 17, 21	
	16					S12			
		55				S13	100	13, 34, 55	
	17			- Sand seam at 17.4 m (150 mm thick).					
				POWER AUGER REFUSAL AT 17.4 m					
	18	60							
	19								
		65							
	20								
	21	70							

Notes:
1. Test hole remained open to 15.5 m upon completion of drilling.
2. Groundwater observed at 7.4 m after completion of drilling.
3. Test hole backfilled with cutting and bentonite chips.

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-21**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Northeast Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/20/2020**
UTM (m) N **5,517,780**
E **630,634**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0	0		**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.			
				- Brown, moist, high plasticity below 0.8 m.		S1	
	1			**SILT (ML)** - Brown, moist, soft, low plasticity.		S2	
		5					
	2			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.		S3	
	3	10		- Firm below 2.3 m. - Silt pocket at 2.3 m (100 mm thick).			
	4					S4	
		15					
	5						
						S5	
	6	20		- Grey below 6.1 m. - Soft below 6.4 m.			
	7					S6	
		25					
	8						
						S7	
▼	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

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
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-21

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 %
	11	35				S8			
	12	40				S9			
	13	45				S10			
	14								
	15	50		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S11		15	
				- Fine to medium grained sand seam at 15.2 m (100 mm thick).		S12		27, 24	
	16					S13			
		55						40	
	17					S14		29, 53	
	18	60		**POWER AUGER REFUSAL AT 18.6 m**					
	19			Notes: 1. Test hole remained open to 16.8 m upon completion of drilling. 2. Groundwater observed at 9.1 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
	20	65							
	21	70							

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-22**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Northeast/Central Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,749**
E **630,654**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
	0			**TOPSOIL** - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.		S1	
				SILT (ML) - Brown, moist, soft, low plasticity.		S2	
	1	5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.			
	2					S3	
	3	10					
	4					S4	
		15		- Trace gypsum inclusions below 4.6 m.			
	5					S5	
	6	20		- Firm below 5.8 m.			
				- Grey below 6.7 m.		S6	
	7	25					
	8			- Soft below 7.9 m.		S7	
	9	30					

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>80

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-22**

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 %
	11	35		- Trace coarse sand below 11.3 m.		S8			
	12	40				S9			
	13			- Increased silt inclusions, trace fine gravel below 12.8 m.		S10			
		45		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.					
	14					S11			
	15	50		**POWER AUGER REFUSAL AT 14.9 m**		S12	86	▲ 50	
				Notes: 1. Test hole remained open to 14.6 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
	16								
		55							
	17								
	18	60							
	19								
		65							
	20								
	21	70							

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-23**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Southeast/Central Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,711**
E **630,677**

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) ◆ / PL MC LL / %
	0			**TOPSOIL** - Black, frozen.				20 40 60	20 40 60 80
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.					
	1			**SILT (ML)** - Brown, moist, soft, low plasticity.					
		5				S1			
				CLAY (CH) - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.					>80
	2			- Some silt inclusions between 2.0 and 2.3 m.		S2			
	3	10		- Firm, trace oxidation below 3.4 m.		S3			
	4								
		15							
	5			- Grey below 4.9 m.		S4			
	6	20		- Soft to firm below 6.4 m.					
	7					S5			
		25							
	8								
						S6			
	9	30							

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH20-23

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 %
	11	35		- Soft below 10.4 m.		S7			
	12	40				S8			
	13			- Increased silt inclusions, trace coarse sand below 12.8 m.		S9			
	14	45		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S10			
	15	50		**POWER AUGER REFUSAL AT 14.9 m**		S11	36	▲ 50	
	16			Notes: 1. Test hole remained open to 14.0 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
	17	55							
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ▣ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-24**

CLIENT PEMBINA TRAILS SCHOOL DIVISION
PROJECT Waverley West School Geo. Investigation - Extra Services
SITE Waverley West, Cadboro Rd.
LOCATION South End Lot, Southeast/Central Daycare
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/21/2020**
UTM (m) N **5,517,687**
E **630,691**

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 %
	0			**TOPSOIL** - Black, frozen.				20 40 60	20 40 60 80
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.		S1			
				SILT (ML) - Brown, frozen.					
	1			- Moist, soft, low plasticity below 0.9 m.		S2			
		5		**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation.					
	2					S3			
	3	10							
	4					S4			
		15							
	5			- Firm below 4.9 m.		S5			
	6	20		- Grey below 5.8 m.					
	7					S6			
		25							
	8					S7			
	9	30		- Soft below 9.4 m.					

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-24**

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 %
	11	35				S8		20 40 60	20 40 60 80
	12	40				S9			
	13			**CLAY TILL** - Light grey, moist to wet, soft, some fine to coarse grained sand, trace fine gravel.		S10			
	14	45		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S11			
	15	50				S12	100	▲55	
				POWER AUGER REFUSAL AT 14.9 m					
	16			Notes: 1. Test hole remained open to 14.0 m upon completion of drilling. 2. Groundwater observed at 12.5 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
	17	55							
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-25**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Southeast End Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/22/2020**
UTM (m) N **5,517,655**
E **630,704**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
				TOPSOIL - Black, frozen.			
				ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.			
				SILT (ML) - Brown, frozen.			
	1			- Moist, soft, low plasticity below 0.9 m.		S1	
		5				S2	
	2			**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation.			
						S3	
	3	10		- Trace gypsum inclusions below 3.0 m.			
	4					S4	
		15					
	5					S5	
				- Grey below 5.5 m.			
				- Firm to stiff below 5.8 m.			
	6	20					
	7					S6	
		25					
	8			- Firm below 7.9 m.			
						S7	
	9	30		- Trace coarse sand below 9.4 m.			

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

>90

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-25**

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 %
	11	35				S8		20 40 60	20 40 60 80
	12	40		- Increased silt inclusions, trace fine gravel below 12.2 m.		S9			
	13	45		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.		S10			
▼	14	45				S11			
	15	50				S12	75	▲55	
				POWER AUGER REFUSAL AT 15.0 m					
	16	55		Notes: 1. Test hole remained open to 14.6 m upon completion of drilling. 2. Groundwater observed at 14.3 m after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
	17								
	18	60							
	19								
	20	65							
	21	70							

SAMPLE TYPE ⊡ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-26**

CLIENT PEMBINA TRAILS SCHOOL DIVISION

PROJECT Waverley West School Geo. Investigation - Extra Services

SITE Waverley West, Cadboro Rd.

LOCATION South End Lot, Southeast End Daycare

DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Track Mounted Drill Rig

JOB NO. **20-1522-001**
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **1/22/2020**
UTM (m) N **5,517,620**
E **630,730**

ELEVATION (m) | DEPTH (m) (ft) | GRAPHICS | DESCRIPTION AND CLASSIFICATION | SAMPLE TYPE | NUMBER | RECOVERY %

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

TOPSOIL - Black, frozen.

ORGANIC CLAY (OH) - Black and brown, frozen, trace organics, trace rootlets.

- Brown, moist, stiff, high plasticity below 0.6 m.

S1

SILT (ML) - Brown, moist, soft, low plasticity.

S2

CLAY (CH) - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions.

- Silt pocket at 2.1 m (100 mm thick).

S3

S4

- Firm below 4.3 m.

S5

- Grey below 6.1 m.

S6

- Soft to firm below 7.3 m.

S7

Depth (m)	Depth (ft)
1	5
2	10
3	15
4	20
5	25
6	30
7	
8	
9	

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH20-26**

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 %
	11	35		- Increased silt inclusions, trace medium to coarse grained sand below 11.0 m.		S8			
				- Silt pocket at 11.6 m (150 mm thick).		S9			
	12	40		- Increased silt inclusions, trace fine gravel below 12.2 m.					
	13					S10			
		45		**SILT TILL** - Light brown, dry to moist, some to with fine to coarse grained sand, some fine gravel.					
	14					S11			
	15					S12	100	▲55	
		50		**POWER AUGER REFUSAL AT 15.2 m**					
	16			Notes: 1. Test hole remained open to 14.9 m upon completion of drilling. 2. No water infiltration observed after completion of drilling. 3. Test hole backfilled with cutting and bentonite chips.					
		55							
	17								
	18	60							
	19								
		65							
	20								
	21	70							

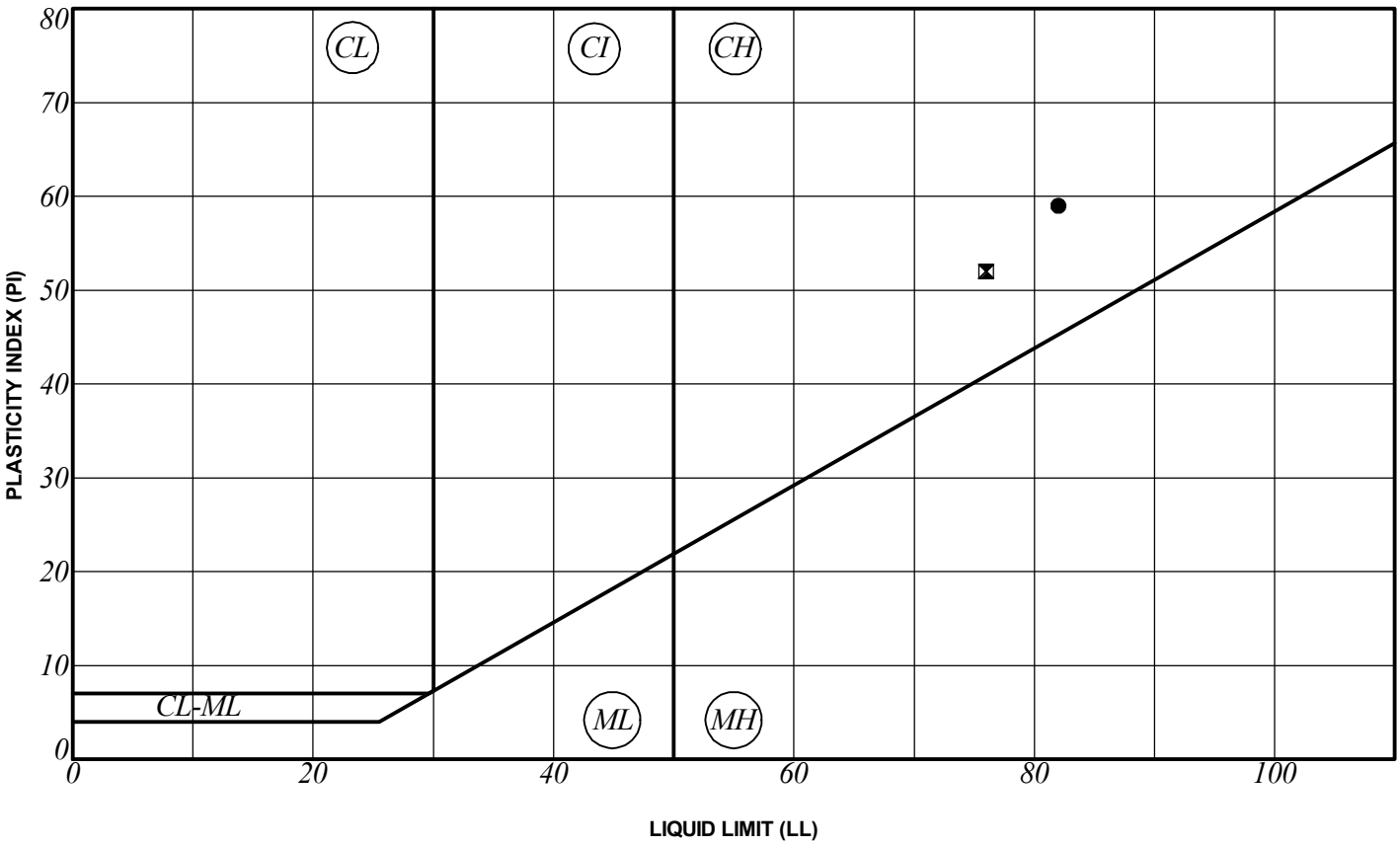
SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △: 20 40 60

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
Paddock Drilling Ltd.	N.BRAY	TE	2/19/20



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH20-12	8.4	S6	82	23	59				47.0	CH
⊠	TH20-20	8.4	S6	76	24	52				44.5	CH

Notes:
ML - Low Plasticity Silt
MH - High Plasticity Silt
CL-ML - Silty Clay
CL - Low Plasticity Clay
CI - Intermediate Plasticity Clay
CH - High Plasticity Clay
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
MC - Moisture Content
NP - Non-Plastic

KGS GROUP

PEMBINA TRAILS SCHOOL DIVISION

Waverley West School Geo. Investigation - Extra Services

A-LINE PLOT

February 2020	Figure A1	Page 1 of 1

A-LINE PLOT U:\FMS\20-1522-001\20-1522-001_WAVERLEY WEST.GPJ

KGS
GROUP

Experience in Action

APPENDIX C

December 2020 Test Hole Logs

KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-27

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/16/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,788
DESCRIPTION	Vocational Structure		E 630,594
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 18.0 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
			GRAVEL FILL - Brown, frozen, mix of sand and gravel.						
			CLAY FILL - Brown, frozen, some coarse grained sand, trace medium grained sand, trace fine grained gravel.						
1			**CLAY (CH)** - Dark brown, frozen, trace black colour. - Moist, stiff, high plasticity below 0.8 m.			S1			
	5		**SILT (ML)** - Light brown, moist, soft, non-plastic.			S2			
			SILTY CLAY (CL-ML) - Brown, moist, stiff, low plasticity, some silt, trace medium to coarse grained sand.			S3			
2			**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace silt nodules.						
						S4			
3	10		- Mottled brown/grey below 3.0 m.						
4						S5			
	15								
5			- Firm below 5.2 m.						
6	20					S6			
7			- Increased silt content from 7.0 m to 7.3 m.			S7			
	25		- Grey below 7.6 m.						
8									
9	30					S8			

PL MC LL
Cu TORVANE (kPa) ◆
Cu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS ▽ **During Drilling** 16.76 m on 12/16/2020

CONTRACTOR **Paddock Drilling**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-27

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
	35					S9			
11			- Trace coarse grained sand below 11.0 m.						
						S10			
12	40		- No sand below 12.2 m.						
13			- Trace medium to coarse grained sand below 13.1 m.						
	45		**CLAY TILL** - Dark grey, moist, soft, intermediate to high plasticity, trace fine to coarse grained sand.			S11			
14			- Decreased sand content below 14.3 m.						
15			- Trace silt till pockets, trace fine grained gravel below 14.9 m.			S12			
	50		**SILT TILL** - Light grey, damp, dense, some fine to coarse grained sand, trace fine to coarse grained gravel.						
16						S13			
			- Moist, compact below 16.5 m.						
	55		- Moist to wet, some to with medium to coarse grained sand below 16.8 m.	▽		S14	31	6 4 4	8
17			- Hard drilling below 17.5 m.			S15			
18			Notes: 1. End of test hole at 18.0 m. 2. Auger refusal encountered in till at a depth of 18.0 m. 3. Test hole backfilled with auger cuttings and bentonite chips.						
	60								
19									
	65								
20									
21	70								

PL MC LL
Cu TORVANE (kPA) ◆
Cu POCKET PEN (kPA) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS ▽ **During Drilling** 16.76 m on 12/16/2020

CONTRACTOR **Paddock Drilling**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-28

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/16/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,822
DESCRIPTION	High School - Northeast		E 630,653
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 15.6 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER
			GRAVEL FILL - Brown, frozen.			
			CLAY FILL - Black, frozen.			
			- Not frozen, moist, stiff.			S1
			SILT (ML) - Light brown, damp, non-plastic.			
1						S2
	5		**CLAY (CH)** - Brown, moist, stiff, high plasticity.			
2			- Trace silt nodules below 2.1 m.			S3
			- Some silt nodules from 2.6 m to 2.8 m.			
3	10		- Mottled brown/grey, firm below 3.0 m.			
4						S4
	15					
5						
6	20					S5
			- Grey below 6.4 m.			
7						S6
	25		- Reduced silt nodules below 7.6 m.			
8						
9	30					S7

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** 15.24 m on 12/16/2020

CONTRACTOR **Paddock Drilling**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-28

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER
			- Trace to some silt nodules below 11.6 m.			S8
11	35					
			- Trace fine to medium grained sand below 12.2 m.			S9
12	40					
13						S10
	45					
14						
			SILT TILL - Light brown, damp, dense, some fine to coarse grained sand, trace fine to coarse grained sand.	▼		S11
15	50					
			Notes: 1. End of test hole at 15.6 m. 2. Auger refusal encountered in till at a depth of 15.6 m. 3. Test hole caved to 15.2 m upon completion of drilling. 4. Test hole backfilled with auger cuttings and bentonite chips.			
16						
	55					
17						
18	60					
19						
	65					
20						
21	70					

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** 15.24 m on 12/16/2020

CONTRACTOR
Paddock Drilling

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-29

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/15/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,750
DESCRIPTION	High School - Southwest		E 630,633
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 15.5 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE
			TOPSOIL.					
			SILTY CLAY (CL-ML) - Brown, low plasticity, frozen, trace rootlets.					
			- Not frozen, moist, crumbly below 0.3 m.					
1			**CLAY (CH)** - Brown, moist, firm, high plasticity.			S1		
	5		- Trace silt nodules below 1.5 m.					
2						S2		
3	10		- Mottled grey/brown below 3.0 m.					
			- Stiff below 3.4 m.					
4			- Trace oxidation below 4.0 m.					
			- Firm below 4.3 m.			S3		
	15							
5								
			- Grey, no oxidation below 5.5 m.			S4		
6	20							
7			- Soft below 7.0 m.			S5		
	25							
8								
9	30					S6		

PL MC LL
Cu TORVANE (kPA) ◆
Cu POCKET PEN (kPA) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** 14.63 m on 12/15/2020

CONTRACTOR **Paddock Drilling**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 12/22/2020

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TEST HOLE LOG

HOLE NO.
TH20-29

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE
			- Trace medium to oarse grained sand, trace fine grained gravel below 13.0 m.			S7		
						S8		
						S9		
			SILT TILL (TILL) - Light grey, moist, compact, some fine to coarse grained sand, trace fine grained gravel.					
			- Damp, dense below 14.5 m.	▼		S10		
						S11	50/ 100mm	+100
			Notes: 1. End of test hole at 15.5 m. 2. Auger refusal encountered in till at a depth of 15.5 m. 3. Test hole caved to 14.9 m upon completion of drilling. 4. Test hole backfilled with auger cuttings and bentonite chips.					

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

>>▲

WATER LEVELS ▼ **Upon Completion of Drilling** 14.63 m on 12/15/2020

CONTRACTOR
Paddock Drilling

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-30

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/15/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,747
DESCRIPTION	West Side of Elementary School		E 630,740
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 15.6 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE
			TOPSOIL - Black, frozen, with rootlets.					
			ORGANIC CLAY (OH) - Black, frozen, some organics, with rootlets.					
			SILTY CLAY (CL-ML) - Light brown, damp, low plasticity, powdery/crumbely.			S1		
			SILT (ML) - Light brown, damp, soft, non-plastic.			S2		
1	5		**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace silt nodules.					
2						S3		
			- Some silt nodules from 2.6 m to 2.8 m.			S4		
3	10		- Mottled grey/brown below 3.0 m.					
			- Trace medium grained sand pockets from 3.5 m to 3.7 m.					
4						S5		
5	15							
6	20		- Grey, soft below 6.1 m.			S6		
7						S7		
8	25		- Hole squeezing at 7.6 m.					
						S8		
9	30							

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** 10.44 m on 12/15/2020

CONTRACTOR **Paddock Drilling**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-30

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE	PL MC LL; Cu TORVANE (kPa) ◆; Cu POCKET PEN (kPa) ★; SPT (N) BLOWS/0.30 m ▲ (20 40 60 80)
11	35			▼		S9			◆
12	40		- Firm below 12.2 m. - Some silt inclusions, trace fine to medium grained sand below 12.6 m.			S10			◆
13						S11			
14	45		**SILT TILL** - Light grey, moist, compact, some to with fine to coarse grained sand, trace fine grained gravel. - Dense, damp below 14.6 m.						
15						S12	4 11		
16	50					S13	50/ 80mm	+100	>>▲
17	55		Notes: 1. End of test hole at 15.6 m. 2. Auger refusal encountered in till at a depth of 15.6 m. 3. Test hole caved to 14.7 m upon completion of drilling. 4. Test hole backfilled with auger cuttings and bentonite chips.						
18									
19	60								
20	65								
21	70								

WATER LEVELS ▼ **Upon Completion of Drilling** 10.44 m on 12/15/2020

CONTRACTOR
Paddock Drilling

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-31

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/15/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,762
DESCRIPTION	East Side of Elementary School		E 630,794
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 16.8 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
			TOPSOIL - Black, frozen, trace rootlets.						
			ORGANIC CLAY (OH) - Black, frozen, some organics, with rootlets.						
			SILT (ML) - Light brown, damp, soft, non-plastic.			S1			
			SILTY CLAY (CL-ML) - Brown, moist, stiff, low to intermediate plasticity, trace silt nodules, crumbly.			S2			
1	5		**CLAY (CH)** - Brown, moist, stiff, high plasticity.						
2			- Some silt nodules from 2.0 m to 2.1 m. - Mottled brown/grey below 2.1 m.						
			- Firm below 2.4 m.			S3			
3	10								
4			- Grey below 4.3 m.			S4			
	15								
5									
6	20					S5			
7									
	25					S6			
8									
9	30					S7			
			- Trace medium to coarse frained sand below 9.4 m.						

PL MC LL
Cu TORVANE (kPA) ◆
Cu POCKET PEN (kPA) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
During Drilling 12.19 m on 12/15/2020
Upon Completion of Drilling 14.63 m on 12/15/2020

CONTRACTOR
Paddock Drilling

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-31

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
	35					S8			
11									
	40			▽		S9			
12									
	45					S10			
13									
			SILT TILL - Light grey, damp, dense, some fine to coarse grained sand, trace fine grained gravel.	▼					
14									
	50					S11			
15						S12	67	9 20 13	33
			- Hard below 16.5 m.						
16	55					S13			
			Notes: 1. End of test hole at 16.8 m. 2. Auger refusal encountered in till at a depth of 16.8 m. 3. Test hole caved to 16.2 m upon completion of drilling. 4. Test hole backfilled with auger cuttings and bentonite chips.						
17									
18	60								
19									
	65								
20									
21									
	70								

PL MC LL
Cu TORVANE (kPA) ◆
Cu POCKET PEN (kPA) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
▽ **During Drilling** 12.19 m on 12/15/2020
▼ **Upon Completion of Drilling** 14.63 m on 12/15/2020

CONTRACTOR
Paddock Drilling

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
12/22/2020

KGS_LOG_U:\FMS\20-1522-002\WAVERLEY WEST SCHOOL.GPJ

KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-32

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/16/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,728
DESCRIPTION	South Side of Elementary School		E 630,793
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 15.4 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE
			TOPSOIL - Black, frozen, trace rootlets.					
			SILTY CLAY (CL-ML) - Brown, frozen.					
			- Not frozen, damp, stiff, low to intermediate plasticity, trace silt nodules, crumbly.			S1		
			SILT (ML) - Light brown, damp, soft, non-plastic.					
1	5					S2		
			CLAY (CH) - Brown, moist, stiff, high plasticity, trace silt nodules.					
2			- Some silt nodules below 2.4 m.					
						S3		
3	10		- Mottled brown/grey below 3.0 m.					
4						S4		
	15		- Firm below 4.6 m.					
5								
						S5		
6	20							
			- Grey, reduced silt nodules below 6.7 m.					
7						S6		
	25							
8			- Soft below 7.9 m.					
						S7		
9	30							

PL MC LL
Cu TORVANE (kPA) ◆
Cu POCKET PEN (kPA) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** 10.36 m on 12/16/2020

CONTRACTOR **Paddock Drilling**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-32

DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER	BLOWS/0.15 m	N-VALUE	PL MC LL; Cu TORVANE (kPA) ◆; Cu POCKET PEN (kPA) ★; SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
35 11		- Silt pockets at 10.3 m. - Trace coarse grained sand below 10.4 m.	▼		S8			◆ ◆
40 12					S9			◆ ◆
13		- Trace medium to coarse grained sand, fine grained gravel below 12.8 m.						
45 14		**CLAY TILL** - Light grey, moist, soft, low to intermediate plasticity, some fine to medium grained sand.			S10			◆
15		**SILT TILL** - Light brown, moist, compact, some to with fine to medium grained sand, trace coarse grained sand, trace fine to coarse grained gravel. - Damp, dense below 14.9 m.						
50					S11	50/ 140mm	+100	>> ▲
16		Notes: 1. End of test hole at 15.4 m. 2. Auger refusal encountered in till at a depth of 15.4 m. 3. Test hole caved to 14.6 m upon completion of drilling. 4. Test hole backfilled with auger cuttings and bentonite chips.						
55 17								
18								
60								
19								
65 20								
21								
70								

WATER LEVELS ▼ **Upon Completion of Drilling** 10.36 m on 12/16/2020

CONTRACTOR **Paddock Drilling**

INSPECTOR **C. FRIESEN**

APPROVED T. ERNST

DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-33

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/16/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,908
DESCRIPTION	North Parking Lot		E 630,647
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 3.0 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER
			TOPSOIL - Black, frozen.			
			SILTY CLAY (CL-ML) - Dark brown, frozen, trace rootlets, trace silt nodules.			
			SILT (ML) - Light brown, damp, soft, non-plastic.			S1
1			**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace silt nodules.			S2
	5					
2			- Some silt nodules from 2.2 m to 2.4 m.			
			- Trace gypsum nodules below 2.7 m.			S3
3	10					
4						
	15					
5						
6	20					
7						
	25					
8						
9	30					

Notes:
1. End of test hole at 3.0 m.
2. Test hole remained open to 3.0 m upon completion of drilling.
3. Test hole backfilled with auger cuttings and bentonite chips.

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** on 12/16/2020 None Encountered

CONTRACTOR **Paddock Drilling**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 12/22/2020

KGS_LOG_U:\FMS\20-1522-002\WAVERLEY WEST SCHOOL.GPJ

KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-34

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/15/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,796
DESCRIPTION	Entry Plaza Drop-Off		E 630,701
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 3.0 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER
			TOPSOIL - Black, frozen.			
			ORGANIC CLAY (OH) - Black, frozen, some organics, trace rootlets.			
			- Moist, stiff, low plasticity below 0.3 m.			
			SILT (ML) - Light brown, damp, non-plastic.			
1	5		**CLAY (CH)** - Brown, moist, stiff, intermediate to high plasticity, trace silt nodules, crumbly.			S1
						S2
2			- Mottled grey/brown, high plasticity below 1.7 m.			
			- Firm below 2.3 m.			
3	10					S3
4	15					
5						
6	20					
7	25					
8						
9	30					

Notes:
1. End of test hole at 3.0 m.
2. Test hole remained open to 3.0 m upon completion of drilling.
3. Test hole backfilled with auger cuttings and bentonite chips.

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** on 12/15/2020 None Encountered

CONTRACTOR **Paddock Drilling**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-35

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/16/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,654
DESCRIPTION	South Parking Lot		E 630,808
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 3.0 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER
			TOPSOIL - Black, frozen, trace rootlets.			
			ORGANIC CLAY (OH) - Black, frozen, some organics, trace rootlets. - Not frozen, moist, stiff.			
			SILT (ML) - Light brown, damp, soft, non-plastic.			
1			**SILTY CLAY (CL-ML)** - Brown, moist, stiff, low plasticity. - Crumbly below 0.7 m.			S1
			CLAY (CH) - Brown, moist, stiff, high plasticity, trace silt nodules.			S2
	5					
2			- Some silt nodules from 2.0 m to 2.1 m.			S3
3						S4
	10					
4						
	15					
5						
6						
	20					
7						
	25					
8						
9						
	30					

Notes:
1. End of test hole at 3.0 m.
2. Test hole remained open to 3.0 m upon completion of drilling.
3. Test hole backfilled with auger cuttings and bentonite chips.

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** on 12/16/2020 None Encountered

CONTRACTOR **Paddock Drilling**

INSPECTOR **C. FRIESEN**

APPROVED T. ERNST

DATE 12/22/2020

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH20-36

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT	**Waverley West Schools Geotechnical Investigation - Phase 2**	**DATE DRILLED**	12/16/2020
LOCATION	Winnipeg, Manitoba	**UTM (m)**	N 5,517,683
DESCRIPTION	South Parking Lot		E 630,857
DRILL RIG / HAMMER	Mobile B48 Truck Mounted Drill Rig with Auto-Hammer		
METHOD(S)	0.0 m to 3.0 m: 125 mm ø SSA		

DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	SAMPLE TYPE	NUMBER
			TOPSOIL - Black, frozen.			
			ORGANIC CLAY (OH) - Black, frozen, some organics, trace rootlets. - Not frozen, moist, stiff, low plasticity, with organics below 0.3 m.			S1
			SILT - Light brown, damp, soft, non-plastic.			S2
1	5		**CLAY** - Brown, moist, stiff, intermediate to high plasticity, trace silt nodules.			
2			- Some silt nodules from 2.1 m to 2.1 m.			
			- Firm below 2.7 m.			S3
3	10		Notes: 1. End of test hole at 3.0 m. 2. Test hole remained open to 3.0 m upon completion of drilling. 3. Test hole backfilled with auger cuttings and bentonite chips.			
4	15					
5						
6	20					
7						
	25					
8						
9	30					

PL MC LL

Cu TORVANE (kPA) ◆

Cu POCKET PEN (kPA) ★

SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS ▼ **Upon Completion of Drilling** on 12/16/2020 None Encountered

CONTRACTOR
Paddock Drilling

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
12/22/2020

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KEY TO SYMBOLS

LITHOLOGIC SYMBOLS


Clay (CH, high plasticity)


Silty Clay (CL-ML)


Fill (made ground)


Silt (ML)


Silt Till


Organic Clay (OH)


Till (mix of gravel, sand, clay and silt)


Topsoil

SAMPLER SYMBOLS


Auger Grab


SPT Split Spoon

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - Liquid Limit
PL - Plastic Limit
PI - Plastic Index
MC - Moisture Content
DD - Dry Density
NP - Non-Plastic
-200 - Percent Passing No. 200 Sieve
TV - Torvane (kPa)
PP - Pocket Penetrometer (kPa)
PSA - Particle Size Analysis
TOC - Top Of Casing

PN - Pneumatic Piezometer
VW - Vibrating Wire Piezometer
PID - Photoionization Detector
ppm - Parts Per Million
▽ Water Level During Drilling
▼ Water Level Upon Completion of Drilling
▼ Water Level Remeasured/Static

CLIENT	**PEMBINA TRAILS SCHOOL DIVISION**	**PROJECT NO.**	20-1522-002
PROJECT NAME	Waverley West Schools Geotechnical Investigation - Phase 2	**LOCATION**	Winnipeg, Manitoba

KGS
GROUP

Experience in Action