February 21, 2019 File: 2018-4227

Urban Star Horse Creek Development Ltd.
10555 48 St SE Unit 105
Calgary, AB T2C 2B7

Attention: Mr. Jorie McKenzie, PL (Eng), PMP

Re: Geotechnical Investigation
Urban Star Horse Creek Development
Rocky View County, Alberta

1.0 INTRODUCTION

As requested, a geotechnical investigation was conducted by E2K Engineering Ltd. (E2K) at the above noted site known as Urban Star Horse Creek Development. The objective of the investigation was to determine the soil and groundwater conditions and to identify geological/geotechnical constraints which may ultimately affect the proposed development.

The scope of work consisted of drilling 36 boreholes across the site, soil sampling, laboratory testing, and the evaluation of the results for the proposed residential development. The location of the boreholes is shown on Figure 2. The scope of work also included a slope stability assessment analysis which will be provided under separate cover. The results of CBR tests and recommendations for preliminary pavement sections will be provided as an addendum to this report.

It is understood that preparation of a conceptual scheme for this site is underway. According to the information provided to us at the time of this report, the proposed development will consist of a fully serviced residential development of approximately 280 acres.

The proposed development is anticipated to consist of residential buildings, roadways, pathways, stormwater facilities, deep water/sanitary services, and parking lots. The proposed development is shown on Figure 1.

2.0 SITE DESCRIPTION

The site is located at NE-29-26-4-W5M and SE-32-26-04-W5M, northwest of Cochrane, adjacent to Range Road 44, and south of Weedon Trail in Rocky View County.

The investigated area is approximately 1500 m x 650 m and is bound by Range Road 44 to the east, private properties to the north, and an escarpment along the west and south sides. The escarpment overlooks Weedon Trail to the west and south.

According to the available drawings, the maximum elevation difference across the site is approximately 50 m with a critical slope of 15% to 45%. The site slopes down towards the west and south. The drainage pattern at this site is towards the west and south, where the escarpment is located.

A driveway provides access from Range Road 44 to a residence located in the middle of the site, and the rest of the site is undeveloped. Two high pressure and low pressure gas lines owned by Plains Midstream and Cochrane Gas Co-Op run along the east side of the site.

The site was comprised of several fenced fields at the time of the investigation, and was covered with snow.

Based on our survey of the boreholes, the elevation variation across the portion of the site investigated was approximately 14 m. The east portion of the site is relatively flat with an approximate slope of 5% down towards the west.

3.0 DETAILS OF THE INVESTIGATION

The geotechnical investigation consisted of drilling 36 boreholes across the site to depths ranging from 2.4 m to 8.8 m below ground surface. The drilling was performed on January 23 to 28, 2019 utilizing a track-mounted drill rig owned and operated by All Service Drilling Inc. of Airdrie, Alberta. The borehole location plan is shown on Figure 2.

The subsurface soil conditions encountered were continuously logged using the Modified Unified Soil Classification System which includes soil types, depths, moisture contents and soil descriptions. Disturbed grab soil samples were obtained at regular intervals from the auger and SPT samples were collected using a split spoon sampler. Pocket penetrometer readings were taken on disturbed samples of cohesive soils during drilling.

A standpipe was installed in all of the boreholes for future groundwater table measurement to depths ranging from 1.9 m to 7.4 m. Following drilling, all boreholes were backfilled to the surface with drill cuttings and sealed with bentonite chips at the top. The locations of the boreholes were recorded with a handheld GNSS receiver using the latitude and longitude in the Universal Transverse Mercator System. The borehole logs are appended at the end of this report.

The obtained soil samples were tested in the E2K geotechnical laboratory. The laboratory testing program included visual classifications and moisture content determination for all samples. Atterberg Limit testing was carried out on five (5) selected soil samples. Hydrometer analysis was conducted on five (5) selected samples. Ten (10) samples were tested for water soluble sulphate concentration to determine the type of concrete that will be

required during construction. The results of the laboratory program are presented on the borehole logs.

4.0 SUBSURFACE CONDITIONS

Below is a summary of the subsurface conditions encountered at the borehole locations which were drilled on site:

4.1 SOIL STRATIGRAPHY

The general soil profile at the borehole locations consisted of topsoil overlaying clay till over bedrock which extended to the final depth explored in all of the boreholes. Bedrock consisting of siltstone was encountered at all borehole locations. Detailed description of soils encountered is provided on the borehole logs and is discussed in the following sections. Variations in the thickness and condition of soil materials identified could be encountered between the boreholes and in areas of the site not investigated.

Topsoil

Silty to clayey topsoil was encountered at the surface in all boreholes. The thickness of the topsoil ranged from 100 to 200 mm.

Clay Till

Clay Till material was encountered beneath the topsoil. The clay till layer was described as silty, containing some gravel to gravelly, trace sand to sandy, low to medium plastic, containing trace amount of oxides, light brown to brown in color, and dry to moist.

The clay deposits are typically “till-like”. These glacial deposits have been heavily pre-consolidated in their geological history. The excellent bearing and deformation properties of the glacial deposits have been verified by numerous structures founded on or within these deposits.

Occasional non to low plastic wet silt layers or pockets may be present between the base of the gravel and the top of the underlying clay till or within the till.

The clay is generally in a moist condition; however, saturated sand and silt lenses or layers are present throughout the deposit. Rafted bedrock pieces are also common within this deposit, although they were not encountered in our investigations.

It should be noted, that the clay till is of heterogenous character of all particle sizes ranging from gravel to clay and the composition of the soil matrix substantially varies. It is possible to encounter cobbles and boulders within the till deposits.

Moisture content tests performed on the samples taken within clay till material ranged from 4.4% to 24.6%, indicative of damp to very moist in-situ moisture content.

The SPTs performed in the clay till layer resulted in blow counts ranging from 19 to over 50, indicative of stiff to hard condition.

Pocket penetrometer readings taken within the clay layer also had a wide range between 50 kPa and 225 kPa, indicative of a stiff to hard cohesive material.

Five (5) Atterberg Limits tests were performed on selected samples within this layer, which are shown in the following table:

Summary of Atterberg Limit Test (Clay Layer)				
Borehole No.	**Depth (m)**	**Liquid Limit (%)**	**Plastic Limit (%)**	**Plasticity**
BH-01	1.5	36	15	Medium
BH-15	3.1	35	17	Medium
BH-21	1.5	46	25	Medium
BH-28	3.1	37	15	Medium
BH-35	1.5	40	16	Medium

The results indicate a cohesive soil of medium plasticity.

Five (5) hydrometer tests were conducted on disturbed samples in order to assess the grain size distribution of the clay. The results of the tests are summarized in the table below.

Summary of Hydrometer Tests					
Borehole	**Depth (m)**	**Clay Content (%)**	**Silt Content (%)**	**Sand Content (%)**	**Gravel Content (%)**
BH-01	1.5	23	60	17	0
BH-15	3.1	32	50	18	0
BH-21	1.5	27	58	15	0
BH-28	3.1	22	50	23	5
BH-35	1.5	24	51	18	7

The result indicates that the material primarily consists of silty clay. It should be noted that even though the material consists primarily of silt, the material behaves as a cohesive material. The details are shown on the borehole logs.

Bedrock

Bedrock was encountered at the location of all boreholes underneath the clay till deposits at depths ranging from 0.6 to 4.0 m below existing grade and extended to the final depth of the investigation, where practical auger refusal was met. The bedrock was described as weathered and weak siltstone that was light brown in color and dry. It should be noted that the bedrock elevation decreased as we moved towards the west portion of the investigated area of the site, where the escarpment is located.

Moisture content tests performed on the samples taken within the bedrock material ranged from 4.0% to 20.2%, indicative of dry to damp in-situ moisture content.

4.2 GROUNDWATER CONDITIONS

During drilling, seepage or saturated conditions was not encountered. A standpipe was installed in all boreholes and groundwater monitoring was also performed by E2K personnel on January 29, February 4, and February 11, 1 day, 7 days and 14 days after drilling, respectively. The groundwater depths in these standpipes are provided below.

Static Groundwater Depth Below Surrounding Grade				
Borehole	**Ground Elevations (masl)**	**January 29, 2019 (m)**	**February 4, 2019 (m)**	**February 11, 2019 (m)**
BH-01	1314.54	Dry	Dry	Dry
BH-02	1311.51	Dry	Dry	Dry
BH-03	-	Dry	Dry	Dry
BH-04	-	Dry	Dry	Dry
BH-05	1312.11	Dry	Dry	Dry
BH-06	1310.54	Dry	Dry	Dry
BH-07	-	Dry	Dry	Dry
BH-08	-	Dry	Dry	Dry
BH-09	1315.34	Dry	Dry	Dry
BH-10	1309.74	Dry	Dry	Dry
BH-11	-	Dry	Dry	Dry
BH-12	-	Dry	Dry	Dry

Static Groundwater Depth Below Surrounding Grade (Cnt'd)				
Borehole	**Ground Elevations (masl)**	**January 29, 2019 (m)**	**February 4, 2019 (m)**	**February 11, 2019 (m)**
BH-13	1311.23	Dry	Dry	Dry
BH-14	-	Dry	Dry	Dry
BH-15	1302.90	Dry	Dry	Dry
BH-17	1308.23	Dry	Dry	Dry
BH-16	-	Dry	Dry	Dry
BH-18	1305.85	Dry	Dry	Dry
BH-19	-	Dry	Dry	Dry
BH-20	-	Dry	Dry	Dry
BH-21	1301.18	Dry	Dry	Dry
BH-22	1303.67	Dry	Dry	Dry
BH-23	1304.40	Dry	Dry	Dry
BH-24	1307.06	Dry	Dry	Dry
BH-25	1308.61	Dry	Dry	Dry
BH-26	1307.11	Dry	Dry	Dry
BH-27	1305.32	Dry	Dry	Dry
BH-28	1309.89	Dry	Dry	Dry
BH-29	1309.46	Dry	Dry	Dry
BH-30	1308.21	Dry	Dry	Dry
BH-31	1311.44	Dry	Dry	Dry
BH-32	1309.31	Dry	Dry	Dry
BH-33	1309.20	Dry	Dry	Dry
BH-34	1310.04	Dry	Dry	Dry
BH-35	1307.85	Dry	Dry	Dry
BH-36	1307.89	Dry	Dry	Dry

It should be noted that the groundwater may significantly vary with seasonal conditions including, precipitation, temperature, site drainage characteristics, etc. Further groundwater measurements will be made once per month for the next six months and the summary of the groundwater monitoring program as well as the elevations of boreholes which are not provided above will be provided.

Seasonal variations in groundwater levels are likely to be experienced, with higher levels occurring following periods of prolonged rainfall or spring thaw. With normal seasonal

variations, fluctuations in groundwater levels are typically estimated to be in a range of ±0.5 to 1 m.

5.0 COMMENTS AND RECOMMENDATIONS

It is understood that the proposed development will consist of residential buildings with one level of basement/parkade, driveways, pathways and parking lots.

Geotechnical recommendations have been provided based on the proposed structures as understood at the time of this report preparation. These recommendations may require revision if the project details are altered at a later stage of the project design.

Based on the results of the investigation, the testing carried out, and our understanding of the proposed development, we submit the following comments and recommendations:

5.1 Site Preparation

At the time of investigation, the site was undeveloped and covered with snow. It is understood that the existing house located in the middle of the site will be demolished and removed from the site. All existing foundations and pavements should be demolished and removed from the site along with the debris. Any vegetation, topsoil, disturbed or organic soil and unsuitable fill materials should be stripped away from any portions of the site where engineered fill is needed to bring the subject site to final grade. Erosion and sediment transport control measures are to be taken at all times, throughout construction and after completion of the project.

5.2 Site Suitability

Overall, considering the soil and groundwater conditions encountered in our geotechnical investigation, the site is considered to be suitable for the proposed development.

Since the investigated portion of the site is relatively flat and flush with Range Road 44, it is anticipated that only minor grading is required for this site. Areas of the site requiring subgrade support (ie, Roads, Sidewalks, Lanes, etc) should be inspected for bearing capacity at the time of construction. The exposed subgrade should be proof-rolled to identify any localized soft areas within the site. These soft areas should then be sub-excavated and replaced with a material approved by E2K. This will allow for an evenly prepared subgrade at the time of construction, and reduce the risk of any differential settlement resulting from poorly compacted fills.

Clay soils are known to experience swelling and shrinkage when exposed to variances in moisture content. Therefore, bearing surfaces and areas deemed to be structurally loaded are

not permitted to desiccate during construction as some swell pressures will develop at the time of rehydration or at the time of concrete placement. It should be noted that variations of the above noted conditions may be encountered between boreholes and in areas of the site not investigated.

5.3 Site Grading and Drainage

Based on our survey of the boreholes, the elevation variation within the investigated portion of the site was approximately 14 m.

At the time of this investigation, a grading plan was not available. For the purpose of this report, it was anticipated that the site will be graded in a way that no significant fills will be required. Should this not be the case, E2K should be given the opportunity to re-evaluate the recommendations within the report.

The finished grades in the vicinity of the buildings, and perimeter pavement areas should be sloped away from the foundation elements of the building. The upper 0.5 m of backfill around the proposed structures should consist of compacted clay to act as a seal against the ingress of surface runoff. The clay should extend a distance of 3 m from the structure and should be graded at a minimum slope of 2 percent away from the buildings in landscaped areas, and 1.5 percent in paved areas.

Site grading should also be provided in paved areas, both during and following construction, such that water is rapidly shed from the surface of the parking area to a positive drainage system. Water should not be allowed to pond on, or be adjacent to, the proposed pavement areas. Backfill placed against the structures should provide positive drainage away from the structure. This positive drainage must be maintained for the life of the structure. Based on our observations, it is anticipated that a major surface grading will also be required to allow for positive drainage away from the proposed structures and paving areas.

5.4 Weeping Tile

It is not expected that development on this site will cause groundwater to rise to within foundation depths. For this reason, weeping tile systems would not be required to control groundwater around proposed structures, however, weeping tile is generally recommended regardless to promote dry foundation conditions in the event of poor surface drainage, prolonged precipitation or flooding conditions. Weeping tiles typically consist of 100 mm perforated pipes running along the exterior side of the peripheral wall footings. These pipes should be installed in a layer of drainage gravel and graded to a sump or the sewer network.

5.5 Slab-On-Grade

Loose or soft areas should be removed from beneath slab areas. The potential of any heave or peripheral movements can be reduced by implementing proper surface drainage measures around the exterior of the slab, and by limiting potential sources of external water beneath the floor slab.

Small vertical movements are inevitable for a grade-supported floor slab due to settlement of fill and consolidation of soft or loose native soils. Slabs should be allowed to float on the subgrade and be tied into the foundation walls or grade beams only at doorways. To further reduce the potential effects of vertical slab movement, the following design provisions should be implemented to allow the slab to move independently of the structural components of the building:

- Partition and non-bearing walls should **not** be rigidly connected to bearing walls or columns.
- Slabs should be allowed to float on the subgrade and be tied into the foundation walls or grade beams only at doorways.
- Concrete slabs should be reinforced and articulated at regular intervals to provide for controlled cracking.
- The installation of buried water supply lines beneath the floor slab should be avoided wherever possible. Waste water lines beneath the floor slabs should consist of PVC pressure pipe with welded joints.
- Positive site drainage should be provided away from the proposed building footprint.
- Frost should not be allowed to penetrate beneath the floor slab just prior to, during or after construction.

5.6 Foundation System

For the proposed buildings with a basement level/underground parking, shallow foundations can be used.

5.6.1 Shallow Foundations

It is assumed that any basement/underground parking will be heated. The basement will have footings to an approximate depth of 3.5 m. If any unheated structures are proposed, footings will need to be placed to a minimum depth of 2.2 m in order to minimize frost related movements.

Based on the soil condition and SPT values obtained across the site, the shallow foundations will likely be founded in silty clay till material.

In the native silty clay till material, an allowable bearing capacity of 150 kPa may be used for shallow foundations founded at a depth ranging from 1.5 m to 3.5 m below existing grade.

Foundation excavations should not be exposed to rain, snow, freezing temperatures and/or ponded water prior to footing construction. Although seepage is not expected in foundation excavations at this site, if this occurs within the footing excavation, the base should be graded to a low point and groundwater must be removed prior to casting the footing.

If the construction of the foundations is taking place during winter conditions, steps should be taken to insulate and heat the foundation system, as well as to protect it from the elements to prevent frost from developing underneath the footings. If frost develops underneath the footings, substantial foundation movement is to be expected.

The bearing surface of footings is to be inspected by a geotechnical engineer to verify that the required bearing support is attained.

Due to the shallow bedrock elevation in some areas of the site, caution should be made in the construction of footings of buildings which are founded on different materials as excessive differential settlement may occur. The footings should be sized to achieve less than 25 mm of total settlement. The minimum footing width should be 0.6 m.

5.6.2 Lateral Earth Pressure on the Walls

Lateral earth pressures for foundation walls can be calculated using the following equation and the parameters provided below.

$$P_o = K_o (\gamma_b H + q)$$

Where:

P_o = Lateral earth pressure at rest condition where no movements of walls occur at a given depth (kPa).

K_o = Coefficient of earth pressure at rest condition; use 0.5 for backfill material assumed to consist of the **silty clay** till and **clayey silt** native soils found on site.

γ_b = Bulk unit weight of soil for backfill; for **stiff to very stiff silty clay** and **clayey silt**, use 19 kN/m^3.

H = Depth below final grade (m).

q = Any surcharge pressure at ground level.

If drainage is not provided, allowance should be made for hydrostatic pressures. In addition, the hydrostatic pressure due to water should be applied.

$$P_w = \gamma_w H_w$$

Where:

P_w = Hydrostatic pressure (kPa).

γ_w = Unit weight of water (9.8 kN/m^3).

H_w = Depth below top of water table (m).

The above noted expression assumes native material compacted to approximately 95% of Standard Proctor maximum dry density and horizontal ground behind the basement wall. If the ground surface slopes upwards away from the wall, design wall pressures should be re-evaluated.

5.7 Swell Potential

Clay soils are known to experience swelling and shrinkage when exposed to variances in moisture content. Medium plastic cohesive soils were encountered at the estimated footing depths. The in-situ moisture content of this material was observed to be nearly at its corresponding plastic limit. The potential for swelling in these shallow soils is considered to be moderate, when exposed to varying moisture contents. However, in order to minimize the risk of the footings to heave if supported on swelling soil conditions, following recommendations should be followed:

- When preparing the clay subgrade at the foundation elevation, it is **critical to avoid excessive drying** as rehydration of the clay subgrade may result in swelling pressures at the base of the shallow foundation system.

- The clay subgrade should be maintained at a moisture content of a minimum of 2% wet of the material's optimum moisture content.

- It is strongly recommended that prior to pouring concrete for the foundation system; a detailed moisture content analysis should be performed on the exposed foundation

subgrade soils, ensuring that the material is of adequate moisture content. Performing these index tests at the foundation elevation will allow for construction personnel to adequately pre-hydrate the subgrade soils, reducing movements from swelling of the foundation soils upon potential rehydration.

- The potential for swelling can be reduced by implementing proper surface drainage measures around the exterior of the foundation and limiting potential sources of external water infiltrating beneath the footings.

5.8 Frost Protection and Penetration

Based on the 1 in 25-year return period winter, the depth of frost penetration in the Cochrane area is approximately 2.2 m assuming no snow cover and a soil profile consisting of native silty clay material with typical moisture contents of 15%. In the case of granular backfill soils with an average moisture content of 10%, the expected depth of frost penetration would be about 3.1 m for the same return period.

If it is deemed necessary to reduce the frost related forces acting on the structures, one option would be to install insulation adjacent to frost walls. For an unheated building, the insulation should be 80 mm thick and extend 2.44 m out from all edges of the slab. Insulation extending out from the slab should be placed at a depth of 300 mm below final grade and should be installed on top of 300 mm of clean granular fill. Multiple layers of insulation should be used to achieve the required thickness, if possible. Consecutive layers of insulation should be staggered to cover gaps between insulation boards and further reduce frost heave effects.

5.9 Underground Services

The burial depths for water lines should be established on the basis of the 25-year return period with an added embedment depth as a safety margin since the trench backfill may not consist entirely of clay. Where the water lines will be covered with primarily clay backfill, the minimum burial depth should be taken as 2.75 m and increased to 3.2 m where granular backfill is used. These burial depths should comply with City Standards, which are 2.75 m in a clay soil and 3.05 m in a granular soil. In settlement sensitive areas such as structurally loaded zones, compacted granular backfill materials must be used only.

For installation of utilities across the subject site, we do not anticipate any difficulty regarding pipe support while using conventional methods. To prevent the migration of fines into the bedding gravel, the installation of plugs consisting of compacted clay or lean concrete is recommended at frequent intervals around the pipe and manholes. In addition, weepers should be connected into the storm system upstream of the plugs. This will reduce water flow through the bedding gravel and minimize migration of fine grained soils. In some cases, a non-woven geotextile filter fabric may be required to separate fine grained silt and

sand from bedding gravel. E2K can provide further recommendations for plug frequency and filter fabric requirements upon request.

5.10 Excavations and Shoring

Excavations are expected to be required for utility trenches and underground parking. Based on the boreholes advanced at the site, these excavations will be completed primarily within silty clay soils. Conventional temporary open excavations with cut slopes are considered to be appropriate for short term utility trench excavations to depths of approximately 3.2 m below grade.

Temporary excavations should be designed and excavated in strict compliance with rules and regulations of Alberta Occupational Health and Safety Act (OH & S). The contractor is solely responsible for protecting excavation by shoring, sloping, benching and/or other means as required to maintain the stability of both the excavation sides and the bottom.

Temporary excavations shallower than 1.5 m should be cut at a slope no steeper than 1H (Horizontal):1V (vertical). For excavations extending below 1.5 m depth, temporary slopes could be cut at an inclination of 2H:1V. If this is not a viable option, other methods of stabilizing the excavation should be sought (such as shotcrete, shoring, etc.), which are to be designed by a qualified geotechnical engineer only. E2K can provide the design parameters for shoring if requested by the client.

Stockpiles of material, excavated soil and wheel loads should be kept away from the excavation crest by a distance equal to the depth of the excavation. It is recommended to have a geotechnical engineer inspect excavations for safety and stability.
The degree of stability of excavation walls typically decreases with time and therefore construction should be directed at minimizing the length of time that excavations remain open.

5.11 Trench Backfill

In areas where backfilled service trenches coincide with areas that subgrade support is required, the backfill should consist of an engineered fill and placed according to Section 5.1. It should be expected that settlement of new or replaced fill will occur due to “self-weight”, particularly where thick fills are placed. For granular fill soils compacted to a minimum of 100 percent of the Standard Proctor maximum dry density, the fill settlement is expected to be 0.5 percent or less of the fill height. For clay fill compacted to 98 percent of the Standard Proctor maximum dry density, the fill settlement is expected to be in the range of 0.5 to 1 percent of the fill height, with the majority of the settlement occurring during the first freeze thaw cycle. In settlement sensitive areas such as structurally loaded zones, compacted granular backfill materials must be used only.

In areas where trench backfill coincide with pavement or foundation structures, construction of these elements should be delayed as much as practical following completion of the trench backfill, allowing for settlement of the fill soils to occur.

In landscaped areas or other areas not requiring subgrade support, the degree of compaction and fill type would be less critical. In these areas, generally all inorganic soils from the excavation could be re-used as backfill for trenches and the degree of compaction could be reduced. However, it should be recognized that poorly compacted fill soils would be subject to higher degrees of post construction settlement and could disrupt the desired surface drainage scheme. Where the backfill is placed at 90 to 95 percent Standard Proctor maximum dry density, the settlement in the backfill is estimated to be in the order of 2 to 4 percent of the fill thickness.

5.12 Requirements for Foundation Concrete

To determine the potential of sulphate attack on any concrete in contact with soils at the site, ten (10) soil samples were taken from boreholes to test for water-soluble sulphate concentrations. The results of the chemical tests are summarized in the following table.

Summary of Water-Soluble Sulphate Concentration

Borehole No.	Depth (m)	Sulphate Concentration (%)	Degree of Exposure
BH-01	1.5	0.047	Negligible
BH-04	3.1	0.044	Negligible
BH-09	3.1	0.061	Negligible
BH-15	3.1	0.020	Negligible
BH-20	3.1	0.033	Negligible
BH-21	1.5	0.044	Negligible
BH-26	1.5	0.016	Negligible
BH-28	3.1	0.016	Negligible
BH-34	3.1	0.016	Negligible
BH-35	1.5	0.024	Negligible

The sulphate content revealed a “negligible” potential for sulphate attack. Therefore as per CSA guidelines, all concrete in contact with soils on this site may be made using CSA Type GU (General Use) Portland cement. Any imported soils should be tested to determine water

soluble sulphate concentration and associated sulphate exposure classification. The maximum water cement ratio should be 0.5 and an air entrainment agent is recommended for improved workability and durability.

6.0 SEISMIC CLASSIFICATION OF THE SITE

Seismic design for various structures is based on the 2014 Alberta Building Code (ABC). The primary objective of the ABC earthquake resistant design requirements is to protect the life and safety of the public in response to strong ground shaking. Structures designed in conformance to the code may undergo structural damage but should not collapse as a result of the ground shaking.

The 2014 ABC seismic design procedures are based on ground motion parameters (e.g. peak ground acceleration, (PGA) and spectral acceleration, Sa values) having a 2% probability of exceedance in 50 years; ie. the 2,475-year return period earthquake event. Based on the results of the E2K field investigation, it is appropriate to classify the ground conditions at the subject site as a Class D site, in accordance with the 2014 ABC.

Liquefaction of the clay till and silt material at this site is not of substantial concern in the event of significant seismic activity.

7.0 LIMITATIONS

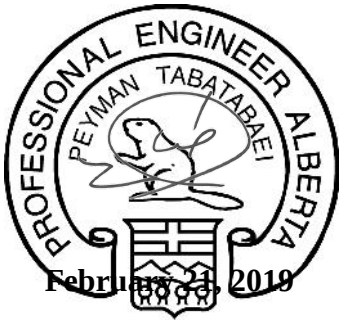
Recommendations made within this report are based on the interpreted findings encountered within the 36 boreholes drilled. It should be noted that natural conditions are innately variable particularly in glacial deposits and glacially modified areas. Should conditions other than those reported herein, be identified at any stage of development, E2K should be notified and given the opportunity to re-evaluate current information, if required.

This report has been prepared with accepted soil and foundation engineering practices for the project specified in Section 1.0 of this report. No other warranty is expressed or implied.

8.0 CLOSURE

We trust the information contained herein meets your present requirements. Should you require inspection services, or further information regarding the geotechnical aspects of this project, please do not hesitate to contact our office.

Yours truly,
E2K Engineering Ltd.
APEGA Permit to Practice: P9582



Peyman Tabatabaei, P.Eng.
Project Geotechnical Engineer

Attachments: Figure 1: Proposed Development
Figure 2: Borehole Locations
Borehole Logs
Explanation of Terms and Symbols

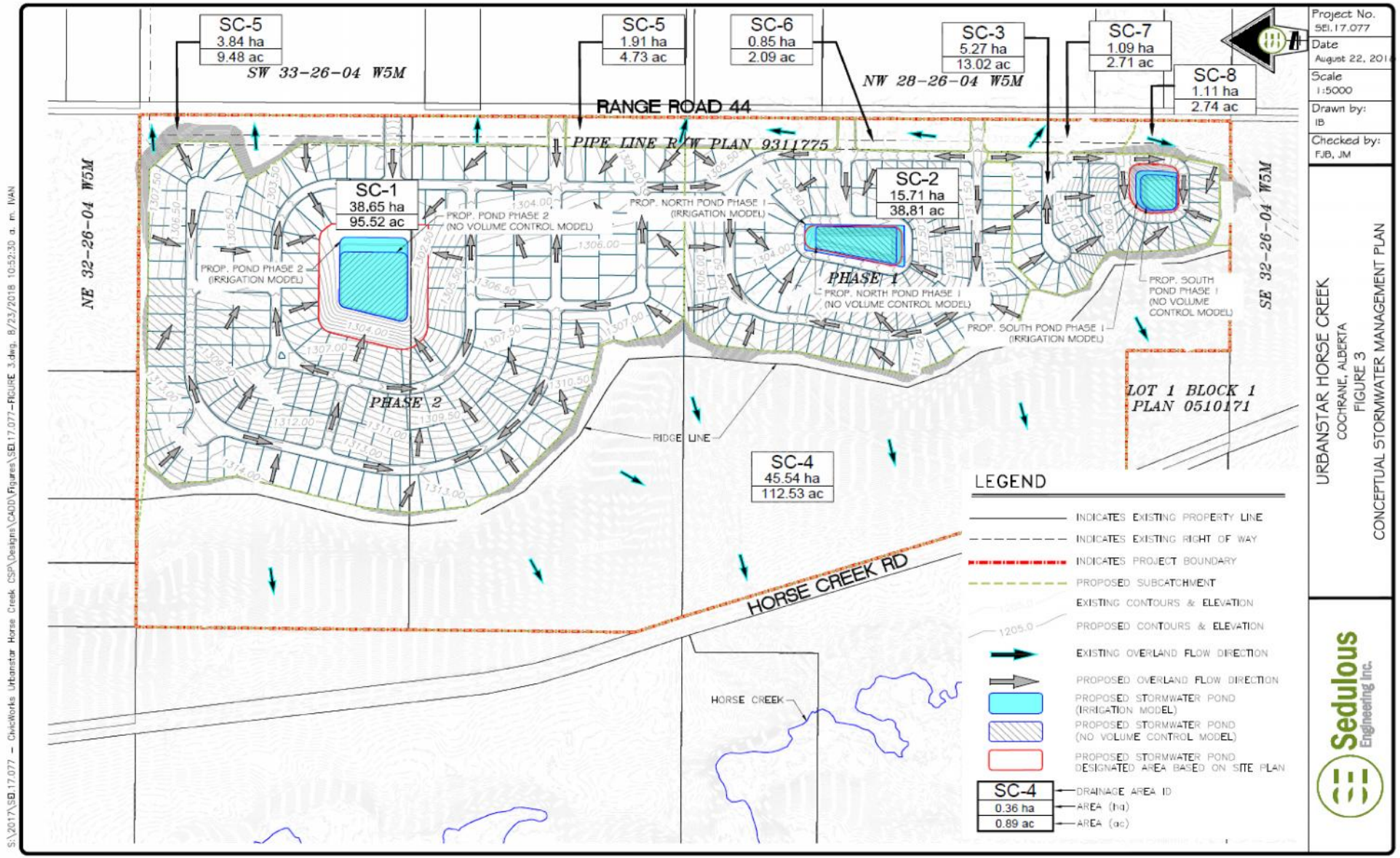


Figure 1 - Proposed Development

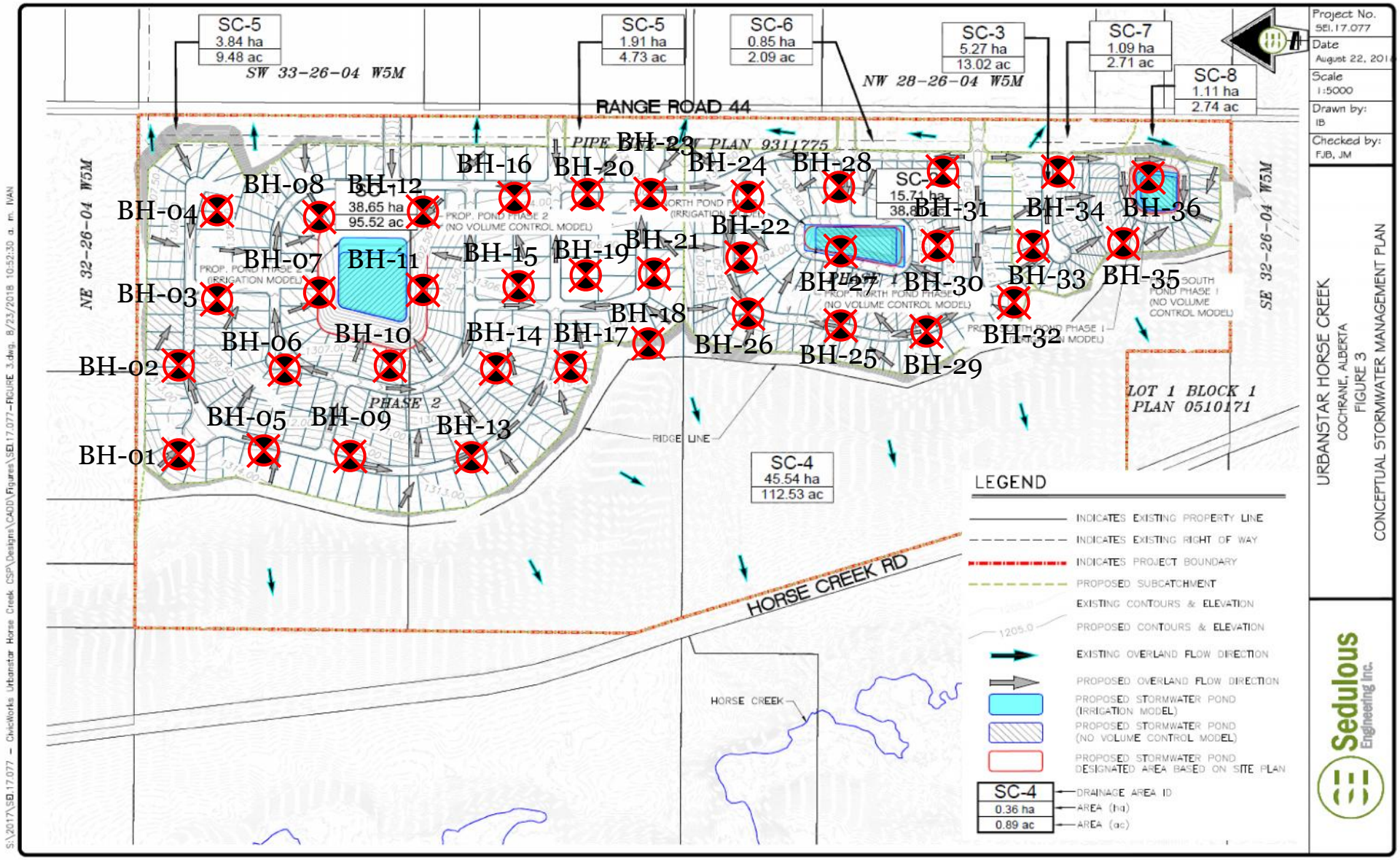


Figure 2 - Borehole Locations

Approximate Borehole Location

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-01**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681993.88 EASTING: 672827.07	ELEVATION: 1314.54m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA
0		TOPSOIL						
		CLAY(Till), silty, some gravel, trace sand, low to medium plastic, damp, brown, trace oxides		S1		9.3		
1								
				SPT1	8-12-19	11.9		Clay: 23% Silt: 60% Sand: 17% SO4=0.047% (Neg.) REC = 95%
2		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		7.1		
3								
				S3		13.5		
4								
5								
				S4		8.7		
6								
7				S5		6.5		
		End of Hole at 7.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 6.33 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.						
8								
9								
9.3								

SLOTTED PIEZOMETER

LOGGED BY: HL	COMPLETION DEPTH: 7.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-02**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681982.11 EASTING: 672967.68	ELEVATION: 1311.51m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some grave, trace sand, low to medium plastic, brown, damp, hard, trace oxides		S1		5.9	50			
1										1
				SPT1	10-11-20	11.6		REC = 95%		
2										2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		9.6				
3										3
				S3		6.3				
4										4
		End of Hole at 4.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.47 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
5										5
6										6
6.3										6.3

LOGGED BY: HL	COMPLETION DEPTH: 4.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-03**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC – M.C. – LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some sand to sandy, some gravel, low to medium plastic, light brown, damp, very stiff		S1		7.1				
1										1
		CLAY (Till), silty, some gravel, trace sand, low to medium plastic, brown, damp, very stiff, trace oxides		SPT1	2-11-16	11.3		REC = 90%		
2				S2		7.4				2
		BEDROCK, siltstone, weathered, weak, light brown, dry								
3										3
				S3		5.4				
4		End of Hole at 4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.21 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								4
5										5
6										6

LOGGED BY: HL	COMPLETION DEPTH: 4.00 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-04**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (100 200 300 400) / BLOW COUNT (20 40 60 80) / UNCONF. SHEAR STR. (kPa) (100 200 300 400) / 0.5 x POCKETPEN. (kPa) (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel to gravelly, trace sand, low to medium plastic, brown, damp, very stiff, trace oxides		S1		10.4	125			
1										1
		CLAY and SILT (Till), some sand to sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard		SPT1	4-13-13	8.6		REC = 80%		
2				S2		5.2				2
				SPT2	13-28-50(3)	6.4	>>	SO4=0.044% (Neg.) REC = 80%		
3										3
		BEDROCK, siltstone, weathered, weak, light brown, dry		S3		5.7				
4										4
5				S4		8.2				5
		End of Hole at 5.5 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.79 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
6										6
7										7
7.5										7.5

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

e2k engineering ltd.

LOGGED BY: HL	COMPLETION DEPTH: 5.50 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-05**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681805.09 EASTING: 672874.22	ELEVATION: 1312.11m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel, some sand, low to medium plastic, brown, damp, very stiff, trace oxides		S1		8.6				
1										1
				SPT1	4-12-13	8.8	■	REC = 80%		
2										2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		9.9	100			
3										3
				S3		11.3	75			
4										4
		End of Hole at 4.6 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.94 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
5										5
6										6
6.7										6.7

LOGGED BY: HL	COMPLETION DEPTH: 4.70 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-06**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681799.14 EASTING: 673005.57	ELEVATION: 1310.54m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel, trace sand, low to medium plastic, brown, damp, hard, trace oxides								
1				S1		10.8	75			1
			SPT	SPT1	14-15-18	10.1		REC = 20%		
2				S2		13.6	200			2
3		BEDROCK, siltstone, weathered, weak, light brown, dry	SPT	SPT2	15-50(6)	20.2	>>	REC = 50%		3
4				S3		6.5				4
		End of Hole at 4.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.54 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
5										5
6										6
6.3										6.3

LOGGED BY: HL	COMPLETION DEPTH: 4.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/20/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-07**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some sand to sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, very stiff		S1		8.3				
1										1
		CLAY (Till), silty, some gravel, trace sand, low to medium plastic, brown, damp, hard, trace oxides		SPT1	2-7-12	12.7	■	REC = 85%		
2										2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		7.8				
3							125			3
				S3		4.6				
4		End of Hole at 3.8 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.2 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								4
5										5
5.7										5.7

LOGGED BY: HL	COMPLETION DEPTH: 3.70 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-08**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC – M.C. – LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (100 200 300 400) / BLOW COUNT (20 40 60 80) / UNCONF. SHEAR STR. (kPa) (100 200 300 400) / 0.5 x POCKETPEN. (kPa) (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel, some sand, low to medium plastic, brown, damp, hard, trace oxides								
1				S1		9.6				1
			SPT	SPT1	6-15-50(3)	12.2		>> REC = 20%		
2				S2		6.3				2
		BEDROCK, siltstone, weathered, weak, light brown, dry								
3										3
				S3		6.3				
4		End of Hole at 4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.45 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								4
5										5
6										6

LOGGED BY: HL	COMPLETION DEPTH: 4.00 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/21/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-09**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681642.21 EASTING: 677847.17	ELEVATION: 1315.34m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (100 200 300 400) / BLOW COUNT (20 40 60 80) / UNCONF. SHEAR STR. (kPa) (100 200 300 400) / 0.5 x POCKETPEN. (kPa) (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, very stiff		S1		4.4				
1										1
				SPT1	15-15-9	5	■	REC = 40%		
2										2
				S2		5.7	150			
3		CLAY (Till), silty, some gravel, some sand, low to medium plastic, brown, damp, very stiff, trace oxides		SPT2	7-7-14	7.5	■	SO4=0.061% (Neg.) REC = 50%		3
				S3		13.8				
4		BEDROCK, siltstone, weathered, weak, light brown, dry								4
5				S4		8.4				5
6										6
7				S5		9				7
8										8
				S6		6.6				
9		End of Hole at 8.8 m due to practical auger refusal. Dry upon completion. Standpipe installed to 7.41 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								9
10										10
10.8										10.8

LOGGED BY: HL	COMPLETION DEPTH: 8.80 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-10**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681632.33 EASTING: 673029.74	ELEVATION: 1309.74m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some gravel, trace sand, low to medium plastic, light brown, damp, hard								
1				S1		8.2				1
		BEDROCK, siltstone, weathered, weak, light brown, dry								
2				S2		5.8	125			2
3				S3		5.9				3
		End of Hole at 3.8 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
4										4
5										5
5.7										5.7

LOGGED BY: HL	COMPLETION DEPTH: 3.70 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-11**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some sand, some gravel, low to medium plastic, light brown, damp, hard		S1		9.4				
1			SPT	SPT1	11-13-19	10.4	■	REC = 50%		1
		CLAY (Till), silty, some gravel to gravelly, trace sand, low to medium plastic, brown, damp, hard, trace oxides								
2				S2		10.9				2
		BEDROCK, siltstone, competent, light brown, dry								
3		End of Hole at 3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 2.5 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								3
4										4
5										5

LOGGED BY: HL	COMPLETION DEPTH: 3.00 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-12**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and SILT (Till), sandy, some gravel, low to medium plastic, light brown, damp, hard								
				S1		10.4				
1										1
				SPT1	8-15-16	10.6	■	REC = 50%		
2										2
				S2		5.2				
		BEDROCK, siltstone, weathered, weak, light brown, dry								
3										3
				S3		12.7				
4										4
		End of Hole at 4.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.46 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
5										5
6										6
6.3										6.3

LOGGED BY: HL	COMPLETION DEPTH: 4.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-13**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681485.33 EASTING: 672894.27	ELEVATION: 1311.23m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some sand to sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard		S1		6.8				
1										1
				SPT1	9-10-21	14		REC = 95%		
2										2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		9.9				
3										3
				S3		9.6				
4										4
5										5
				S4		6.2				
6										6
				S5		9.2				
7		End of Hole at 7.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 6.34 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								7
8										8
9										9
9.3										9.3

LOGGED BY: HL	COMPLETION DEPTH: 7.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-14**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	VANE SHEAR (kPa) 100 200 300 400; BLOW COUNT 20 40 60 80; UNCONF. SHEAR STR. (kPa) 100 200 300 400; 0.5 x POCKETPEN. (kPa) 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some sand to sandy, trace gravel, low to medium plastic, light brown, damp, hard		S1		8.1				
1										1
				SPT1	10-13-19	10.1	■	REC = 90%		
2		BEDROCK, siltstone, weathered, weak, light brown, dry - becomes competent		S2		5.4				2
		End of Hole at 2.4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 1.98 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
3										3
4										4
4.4										4.4

LOGGED BY: HL	COMPLETION DEPTH: 2.40 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-15**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681456.06 EASTING: 673148.19	ELEVATION: 1302.90m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL				PLASTIC M.C. LIQUID (20 40 60 80)	(100 200 300 400)			0
		CLAY (Till), silty, trace sand, low to medium plastic, brown, damp, hard, trace oxides								
				S1		24.6	225			
1										1
								REC = 60%		
				SPT1	3-9-11	14.3				
2										2
		- trace gravel		S2		12.3				
								Clay: 32% Silt: 50% Sand: 18% SO4=0.020% (Neg.)		
3				SPT2	1-3-14	13.2		REC = 70%		3
		BEDROCK, siltstone, competent, light brown, dry								
		End of Hole at 3.7 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.2 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.		S3		9.1				
4										4
5										5
5.7										5.7

LOGGED BY: HL	COMPLETION DEPTH: 3.70 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-16**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC M.C. LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400 ■ BLOW COUNT ■ 20 40 60 80 ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400 ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	DEPTH (m)
0		TOPSOIL							0
		CLAY and SILT (Till), some sand to sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard							
1				S1		8.8			1
		BEDROCK, siltstone, weathered, weak, light brown, dry							
2				S2		11.7			2
3									3
				S3		5.8			
4									4
		End of Hole at 4.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.62 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.							
5									5
6									6
6.3									6.3

LOGGED BY: HL	COMPLETION DEPTH: 4.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/28/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-17**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681374.21 EASTING: 672954.5	ELEVATION: 1308.23m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC — M.C. — LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, low to medium plastic, light brown, damp, hard								
1		BEDROCK, siltstone, weathered, weak, light brown, dry		S1		6				1
2				S2		7.3				2
3										3
4				S3		9.9				4
5				S4		6.4				5
		End of Hole at 5.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.34 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								
6										6
7										7
7.2										7.2

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

LOGGED BY: HL	COMPLETION DEPTH: 5.20 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
	Page 1 of 1

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-18**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681315.06 EASTING: 673094.07	ELEVATION: 1305.85m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC – M.C. – LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), some sand, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard		S1		9 9				
1										1
			SPT	SPT1	1-11-24	42 4	■	REC = 95%		
2										2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		4				
3										3
				S3		7				
4		End of Hole at 4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 2.85 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								4
5										5
6										6

LOGGED BY: HL	COMPLETION DEPTH: 4.00 m
REVIEWED BY: PT	COMPLETION DATE: 1/25/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-19**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC – M.C. – LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard								
1				S1		5.8				1
				SPT1	50(3)	13.6		REC = 5%		
2		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		11.5				2
3										3
4				S3		5.3				4
				S4						
5		End of Hole at 5.2 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.55 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 4, 2019.								5
6										6
6.9										6.9

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/21/19

LOGGED BY: HL	COMPLETION DEPTH: 4.90 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
	Page 1 of 1

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-20**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC M.C. LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, trace to some sand, some gravel, low to medium plastic, very stiff, light brown, damp		S1		19				
1										1
		- becomes gravelly						REC = 90%		
				SPT1	6-11-14	12.2				
2										2
				S2		11.5	225			
								SO4=0.033% (Neg.)		
3								REC = 95%		3
		BEDROCK, Siltstone, weathered, weak, light brown, dry		SPT2	6-26-40	11.8				
				S3		7.8	175			
4										4
				SPT3	50(4)	10.9		REC = 10%		
5				S4		7.7				5
6		End of Hole at 6.1 m due to practical auger refusal. Dry upon completion. Standpipe installed to 5.61 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								6
7										7
7.8										7.8

LOGGED BY: HL	COMPLETION DEPTH: 5.80 m
REVIEWED BY: PT	COMPLETION DATE: 1/23/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-21**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681191.25 EASTING: 673147.69	ELEVATION: 1301.18m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm
0		TOPSOIL			
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1	
1					
		BEDROCK, siltstone, weathered, weak, light brown, dry		SPT1	8-13-25
2				S2	
3					
				S3	
4					
5		End of Hole at 4.6 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.82 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.			
6					
6.6					

ATTERBERG LIMITS & MOISTURE CONTENT: PLASTIC | M.C. | LIQUID (20 40 60 80)

▲ VANE SHEAR (kPa) ▲ (100 200 300 400)

■ BLOW COUNT ■ (20 40 60 80)

◆ UNCONF. SHEAR STR. (kPa) ◆ (100 200 300 400)

● 0.5 x POCKETPEN. (kPa) ● (100 200 300 400)

9.5 (S1)

13.7 (SPT1)

9.8 (S2)

4.5 (S3)

OTHER DATA:

Clay: 27%
Silt: 58%
Sand: 15%
SO4=0.044%
(Neg.)
REC = 75%

SLOTTED PIEZOMETER

DEPTH (m)

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

	LOGGED BY: HL	COMPLETION DEPTH: 4.60 m
	REVIEWED BY: PT	COMPLETION DATE: 1/24/19
		Page 1 of 1

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-22**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681203.63 EASTING: 673208.91	ELEVATION: 1303.67m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC M.C. LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard		S1		8.3				
1										1
				SPT1	6-18-20	9.8		REC = 65%		
2		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		5.7				2
3										3
				S3		9				
4										4
5				S4		7				5
6										6
		End of Hole at 6.1 m due to practical auger refusal. Dry upon completion. Standpipe installed to 5.02 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
7										7
8										8
8.1										8.1

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

	LOGGED BY: HL	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: PT	COMPLETION DATE: 1/24/19
		Page 1 of 1

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-23**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681206.77 EASTING: 673278.01	ELEVATION: 1304.40m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC M.C. LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard								
1				S1		8.6				1
								REC = 80%		
			SPT	SPT1	16-20-26	9.2	■			
2										2
		CLAY (Till), silty, some gravel, some sand, low to medium plastic, brown, damp, hard, trace oxides		S2		12.9	1.75			
3		BEDROCK, siltstone, weathered, weak, light brown, dry								3
				S3		5.8				
4										4
		End of Hole at 4.6 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.4 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
5										5
6										6
6.6										6.6

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

e2k engineering ltd.

LOGGED BY: HL	COMPLETION DEPTH: 4.60 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-24**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681054.4 EASTING: 673418.03	ELEVATION: 1307.06m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC – M.C. – LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel to gravelly, trace sand, low to medium plastic, light brown, damp, hard		S1		9.2				
1										1
				SPT1	6-15-15	9.1		REC = 90%		
2				S2		11.3	200			2
		BEDROCK, siltstone, weathered, weak, light brown, dry		SPT2	15-50(6)	10.9	>>	REC = 70%		
3										3
				S3		5.3				
4										4
		End of Hole at 4.6 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.68 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
5										5
6										6
6.3										6.3

LOGGED BY: HL	COMPLETION DEPTH: 4.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/23/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/20/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-25**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680925.27 EASTING: 673123.62	ELEVATION: 1308.61m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1		9.8				
1										1
			SPT	SPT1	20-22-20	9.4		REC = 35%		
2										2
				S2		9.9				
		BEDROCK, siltstone, weathered, weak, light brown, dry								
3										3
				S3		8.4				
4		End of Hole at 4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 3.08 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								4
5										5
6										6

LOGGED BY: HL	COMPLETION DEPTH: 4.00 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/20/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-26**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5681043.16 EASTING: 673209.83	ELEVATION: 1307.11m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low to medium plastic, light brown, damp, hard		S1		7.8				
1										1
								SO4=0.016% (Neg.)		
		BEDROCK, siltstone, weathered, weak, light brown, dry	SPT1		17-50(5)	9.1	>>■	REC = 50%		
2										2
		becomes competent		S2		3.8				
		End of Hole at 2.4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 2.03 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
3										3
4										4
4.4										4.4

LOGGED BY: HL	COMPLETION DEPTH: 2.40 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-27**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: EASTING:	ELEVATION: 1305.32m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC M.C. LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (100 200 300 400) / BLOW COUNT (20 40 60 80) / UNCONF. SHEAR STR. (kPa) (100 200 300 400) / 0.5 x POCKETPEN. (kPa) (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1		5.8				
1										1
			SPT1	10-25-25		9.1		REC = 60%		
2				S2		5				2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S3		4.1				
3										3
		End of Hole at 3.4 m due to practical auger refusal. Dry upon completion. Standpipe installed to 2.84 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
4										4
5										5
5.4										5.4

LOGGED BY: HL	COMPLETION DEPTH: 3.40 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-28**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680914.03 EASTING: 673420.67	ELEVATION: 1309.89m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	VANE SHEAR (kPa) 100 200 300 400 / BLOW COUNT 20 40 60 80 / UNCONF. SHEAR STR. (kPa) 100 200 300 400 / 0.5 x POCKETPEN. (kPa) 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, gravelly, some sand, low to medium plastic, brown, damp, hard		S1		7.3				
1										1
			SPT	SPT1	6-23-25	8.8		REC = 60%		
2										2
				S2		8				
3								Clay: 22% Silt: 50% Sand: 23% SO4=0.016% (Neg.) REC = 80%		3
		BEDROCK, siltstone, weathered, weak, light brown, dry	SPT	SPT2	5-25-29	9.1				
				S3		6.2				
4										4
5				S4		7				5
6		End of Hole at 6 m due to practical auger refusal. Dry upon completion. Standpipe installed to 5.72 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								6
7										7
7.9										7.9

LOGGED BY: HL	COMPLETION DEPTH: 5.90 m
REVIEWED BY: PT	COMPLETION DATE: 1/23/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-29**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680770.66 EASTING: 673173.28	ELEVATION: 1309.46m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (kPa) 100 200 300 400; BLOW COUNT 20 40 60 80; UNCONF. SHEAR STR. (kPa) 100 200 300 400; 0.5 x POCKETPEN. (kPa) 100 200 300 400	OTHER DATA	SLOPE INDICATOR	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard								
1				S1		8.8				1
			SPT	SPT1	50(5)	11.7		REC = 10%		
2		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		7.1				2
3										3
4				S3		7				4
5										5
				S4		7.5				
6										6
7		End of Hole at 7 m due to practical auger refusal. Dry upon completion. Standpipe installed to 6.38 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.		S5		5.5				7
8										8
9										9

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

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LOGGED BY: HL	COMPLETION DEPTH: 7.00 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-30**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680805.72 EASTING: 673275.5	ELEVATION: 1308.21m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (kPa) 100 200 300 400; BLOW COUNT 20 40 60 80; UNCONF. SHEAR STR. (kPa) 100 200 300 400; 0.5 x POCKETPEN. (kPa) 100 200 300 400	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1		11.2				
1										1
		CLAY (Till), silty, some gravel to gravelly, trace sand, low to medium plastic, brown, damp, hard		SPT1	8-22-29	10.7		REC = 60%		
2										2
				S2		10.1	225			
3		BEDROCK, siltstone, weathered, weak, light brown, dry								3
				S3		6.9				
4										4
5				S4		10.9				5
6		End of Hole at 5.8 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.63 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								6
7										7
7.8										7.8

LOGGED BY: HL	COMPLETION DEPTH: 5.80 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-31**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680752.8 EASTING: 673430.81	ELEVATION: 1311.44m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOTTED PIEZOMETER	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel to gravelly, trace sand, low to medium plastic, brown, damp, very stiff								
				S1		8.1	175			
1										1
				SPT1	6-12-12	11.7	■	REC = 70%		
2										2
				S2		11.2	125			
3				SPT2	50(6)	9.6		REC = 20%		3
		BEDROCK, siltstone, weathered, weak, light brown, dry								
				S3		6.7				
4										4
5				S4		5.6				5
		End of Hole at 5.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.43 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
6										6
7										7
7.2										7.2

LOGGED BY: HL	COMPLETION DEPTH: 5.20 m
REVIEWED BY: PT	COMPLETION DATE: 1/23/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/20/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-32**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680666.74 EASTING: 673223.44	ELEVATION: 1309.31m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOPE INDICATOR	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1		8.8				
1										1
				SPT1	7-16-19	10	■	REC = 85%		
2		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		10.1				2
3										3
4				S3		8.4				4
5										5
				S4		7.9				
6										6
7				S5		6.9				7
		End of Hole at 7.3 m due to practical auger refusal. Dry upon completion. Standpipe installed to 6.58 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
8										8
9										9
9.3										9.3

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

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LOGGED BY: HL	COMPLETION DEPTH: 7.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-33**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680663.11 EASTING: 673323.87	ELEVATION: 1309.20m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	VANE SHEAR (kPa) / BLOW COUNT / UNCONF. SHEAR STR. (kPa) / 0.5 x POCKETPEN. (kPa)	OTHER DATA	SLOPE INDICATOR	DEPTH (m)
0		TOPSOIL								0
		CLAY (Till), silty, some gravel, some sand, medium plastic, brown, damp, hard, trace oxides		S1		22.6	175			
1										1
			SPT	SPT1	10-16-20	11.9		REC = 98%		
2				S2		12.5	200			2
			SPT	SPT2	12-10-9	13.4		REC = 98%		
3										3
		BEDROCK, siltstone, weathered, weak, light brown, dry		S3		15.4	200			
4										4
5				S4		11.4				5
		End of Hole at 5.5 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.68 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
6										6
7										7
7.5										7.5

LOGGED BY: HL	COMPLETION DEPTH: 5.50 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-34**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680643.7 EASTING: 673431.95	ELEVATION: 1310.04m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC — M.C. — LIQUID; 20 40 60 80)	VANE SHEAR (kPa) (100 200 300 400) / BLOW COUNT (20 40 60 80) / UNCONF. SHEAR STR. (kPa) (100 200 300 400) / 0.5 x POCKETPEN. (kPa) (100 200 300 400)	OTHER DATA	SLOPE INDICATOR	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1		8.3				
1										1
		CLAY (Till), silty, some gravel, some sand, low to medium plastic, brown, damp, hard		SPT1	12-22-30	10.2		REC = 70%		
2				S2		10.4	225			2
3		BEDROCK, siltstone, weathered, weak, light brown, dry		SPT2	21-31-42	13.4		SO4=0.016% (Neg.) REC = 95%		3
				S3		5.3				
4										4
5				S4		5.4				5
6		End of Hole at 6.1 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.7 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								6
7										7
7.3										7.3

LOGGED BY: HL	COMPLETION DEPTH: 5.30 m
REVIEWED BY: PT	COMPLETION DATE: 1/23/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-35**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680544.23 EASTING: 673314.94	ELEVATION: 1307.85m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOPE INDICATOR	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard, trace oxides		S1		13.1				
1										1
				SPT1	10-18-22	7.4		Clay: 24% Silt: 51% Sand: 18% Gravel: 7% SO4=0.024% (Neg.) REC = 90%		
2										2
		BEDROCK, siltstone, weathered, weak, light brown, dry		S2		5.1				
3										3
				S3		5.6				
4										4
5										5
				S4		10.8				
6										6
				S5		6.9				
7		End of Hole at 7 m due to practical auger refusal. Dry upon completion. Standpipe installed to 6.12 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								7
8										8
9										9
9.2										9.2

GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

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LOGGED BY: HL	COMPLETION DEPTH: 7.20 m
REVIEWED BY: PT	COMPLETION DATE: 1/24/19
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PROJECT NAME: Horse Creek Road	LOCATION: See Figure 1	BOREHOLE NO: **BH-36**
CLIENT: Urban Star Ltd.	DRILL TYPE: Solid Stem Auger	E2K PROJECT NO: 2018-4227
	NORTHING: 5680567.49 EASTING: 673428.98	ELEVATION: 1307.89m

SAMPLE TYPE: CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT BLOWS /300 mm	ATTERBERG LIMITS & MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	▲ VANE SHEAR (kPa) ▲ 100 200 300 400; ■ BLOW COUNT ■ 20 40 60 80; ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400; ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	SLOPE INDICATOR	DEPTH (m)
0		TOPSOIL								0
		CLAY and Silt (Till), sandy, some gravel, trace cobbles, low plastic, light brown, damp, hard		S1		7.9				
1										1
				SPT1	12-28-31	9.6	■	REC = 80%		
2				S2		10	225			2
3		BEDROCK, siltstone, weathered, weak, light brown, dry		SPT2	50(5)	7.6		REC = 20%		3
				S3		11.4				
4										4
5				S4		5.8				5
		End of Hole at 5.5 m due to practical auger refusal. Dry upon completion. Standpipe installed to 4.97 m. Hole backfilled with drill cuttings and a bentonite cap. Dry on February 1, 2019.								
6										6
7										7
7.3										7.3

LOGGED BY: HL	COMPLETION DEPTH: 5.20 m
REVIEWED BY: PT	COMPLETION DATE: 1/23/19
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GEOTECHNICAL LOG JAN 23, 2019.GPJ AB_TRANS.GPJ 2/19/19

EXPLANATION OF TERMS AND SYMBOLS

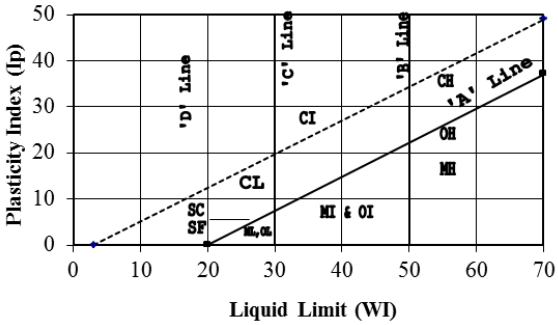
The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described below. It should be noted that materials, boundaries, and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site.

SOIL DESCRIPTIONS

The soils in the borehole logs have been described using the Modified Unified Soil Classification System in conjunction with description guidelines from the Canadian Foundation Engineering Manual 4th Edition.

Secondary Constituents	
Descriptor	Percentage by Weight
And	> 35%
y/ey	20 – 35%
Some	10 – 20%
Trace	< 10%

Plasticity Chart



Consistency of Cohesive Soils		
Classification	Undrained Shear Strength (kPa)	"N" Blow Count
Very Soft	< 12	< 2
Soft	12 – 25	2 – 4
Firm	25 – 50	4 – 8
Stiff	50 – 100	8 – 15
Very Stiff	100 – 200	15 – 30
Hard	> 200	> 30

Relative Density of Non-Cohesive Soils	
Classification	SPT – N
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	> 50

SYMBOLS

Asphalt	High Plasticity Clay	Intermediate Plasticity Clay	Low Plasticity Clay	Fill	Poorly Graded Gravel	Well Graded Gravel	High Plasticity Silt	Intermediate Plasticity Silt
Low Plasticity Silt	Low Plasticity Organics	Clayey Sand	Silty Sand	Poorly Graded Sand	Well Graded Sand	Shale	Sandstone	Measured water level

MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

Major Division			Symbol	Description	Criteria	
Coarse Grained Soils	Gravel (More than half coarse grains larger than 4.75 mm)	Clean Gravel (little or no fines)	GW	Well graded gravels, little or no fines	$C_u = \frac{D_{60}}{D_{10}} > 4 \;\; C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \; to \; 3$	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting above criteria	
		Gravel with fines	GM	Silty gravels, gravel-sand-silt mixtures	Fines content > 12%	Atterberg Limit below "A" Line, $w_p < 4$
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg Limit above "A" Line, $w_p > 7$
	Sand (More than half of coarse grains smaller than 4.75 mm)	Clean Sand (little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}} > 6 \; C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \; to \; 3$	
			SP	Poorly graded sands, little or no fines	Not meeting above criteria	
		Sand with fines	SM	Silty sand, sand-silt mixtures	Fines content > 12%	Atterberg Limit below "A" Line, $w_p < 4$
			SC	Clayey sand, sand-clay mixtures		Atterberg Limit above "A" Line, $w_p > 7$
Fine Grained Soils	Silts (Below "A" line, negligible organic content)	$W_L < 50$	ML	Inorganic silts and very fine sands, rock flour, silty sands with low plasticity	See plasticity chart	
		$W_L > 50$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils		
	Clays (Above "A" line, negligible organic content)	$W_L < 30$	CL	Inorganic clays of low plasticity, gravelly, sandy, or silty clays, lean clays		
		$30 < W_L < 50$	CI	Inorganic clays of medium plasticity, silty clays		
		$W_L > 50$	CH	Inorganic clays of high plasticity, fat clays		
	Organic silts and clays (Below "A" line	$W_L < 50$	OL	Organic silts and organic silty clays of low plasticity		
		$W_L > 50$	OH	Organic clays of high plasticity		
Highly Organic Soils			Pt	Peat and other highly organic soils	Strong colour or odour, often fibrous texture	

- The soil of each stratum is described using the Unified Soil Classification System modified slightly so that an inorganic clay of "medium plasticity" is recognized
- "REC" denotes percentage sample recovery
- SPT "N" values represent the number of blows by a 63.6 kg hammer dropped 760 mm to drive a 50 mm diameter open sampler a distance of 300 mm after an initial penetration of 150 mm