TERRAPEX

R-HAUZ SERVICES INC.

GEOTECHNICAL INVESTIGATION REPORT 269-281 BELL SREET SOUTH

Ottawa, Ontario

July 19, 2021

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DISTRIBUTION: **R-HAUZ SERVICES INC.** **PROJECT # CO829.00**

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1.0 INTRODUCTION

Terrapex Environmental Ltd. **(Terrapex)** was retained by R-Hauz Services Inc. (Client) to carry out a Geotechnical Investigation for the proposed 3 and 6 storey residential redevelopment (Project) located at 269-281 Bell Street South (Site) in Ottawa, Ontario.

The terms of reference for this Geotechnical Investigation were documented in the **Terrapex** proposal dated April 28, 2021. Agreement and authorization to proceed with the investigation dated June 8, 2021 was received from Ms. Sarah Craig on behalf of the Client.

Terrapex is pleased to present the results of this Geotechnical Investigation. This Geotechnical Investigation report is subject to the limitations shown in Section 8.0. The report is prepared for the sole use of the Client, and any reliance on it by any third party, is the responsibility of such third party.

This report presents the results of the investigation performed in accordance with the general terms of reference outlined above. It is understood that the Project will be performed in accordance with applicable codes and standards within its jurisdiction.

The fieldwork for the geotechnical investigation was conducted in conjunction with the Hydrogeological Investigation. The Hydrogeological Investigation report is reported under separate cover.

2.0 SITE AND PROJECT DESCRIPTION

2.1 SITE DESCRIPTION

The Site for the Project is located at the north end of Bell Street South between Plymouth Street and Orangeville Street. The Site currently consists of seven (7) two-storey single dwellings with front and back yards; it is a rectangular shaped lot with an approximate area of 1,600 m^2 with a relatively flat ground surface. There are no slopes at the Site. The location of the Site is shown on the Site Location Map attached as Figure 1 at the end of this report.

2.2 PROJECT DESCRIPTION

Our understanding of the Project is based on the information and files provided by the Client. It is understood by **Terrapex** that the Client is proposing to demolish the existing dwellings, and design and construct a new 60-unit 3 and 6-storeys building with 9 parking spaces; that will span an area of 1,100 m^2. The new building will be an above grade structure and will not contain a basement.

The following documents were provided to **Terrapex** by the Client:

- Preliminary Plans “Build Your Own Story: City of Ottawa” by R-Hauz Services Inc.; and,
- Site Plan 1 by CMV Group Architects.

3.0 SCOPE OF WORK

The scope of work for this Geotechnical Investigation included the following:

- **Terrapex** retained a private underground utility subcontractor to provide both public and private utility clearances;
- **Terrapex** retained a drilling subcontractor and drilled the following boreholes:
    - Two (2) boreholes to auger refusal; and,
    - Two (2) boreholes to auger refusal plus an additional 3 m of rock coring. Both boreholes were instrumented with monitoring wells.
- **Terrapex** supervised the drilling and logged the soil and rock conditions at the borehole locations based on the recovered soil and rock samples;
- **Terrapex** developed the two (2) monitoring wells and recorded the groundwater levels in the monitoring wells;
- **Terrapex** recorded the elevations for the boreholes;
- **Terrapex** completed geotechnical tests in our laboratory; and
- **Terrapex** prepared this Geotechnical Investigation Report based on the findings from the field investigation and laboratory testing.

4.0 FIELDWORK

The fieldwork for this investigation was carried out on July 5, 2021. It consisted of advancing four (4) boreholes labelled as BH101, MW102, BH103, and MW104. The locations of the boreholes are shown on the Borehole Location Plan attached as Figure 2 at the end of this report.

Marathon Underground performed the drilling work. The boreholes were advanced using a track mounted Geoprobe drill outfitted with continuous flight augers. Standard penetration tests (SPT) were carried out in the course of advancing the boreholes within the overburden soil to take representative samples and to measure penetration index values (N-values) to characterize the condition of the various soil materials. The number of blows of the striking hammer required to drive the split spoon sampler to 300 mm depth was recorded and these are presented on the logs as penetration index values. Advancement into the bedrock was performed by using casings and HQ double-walled wireline diamond coring methods.

Results of SPT, and descriptions of the rock cores are shown on the borehole log sheets attached in Appendix I of this report.

The monitoring wells for this investigation were developed, and groundwater level observations were recorded. The results of the groundwater level measurements in the monitoring wells are discussed in Section 6.3 of this report.

The ground surface elevations for the boreholes were recorded by **Terrapex** field staff using a laser level. The borehole elevations are related to a fire hydrant site benchmark located behind

the 275 Bell Street South property backyard with a top of spindle non-geodetic arbitrary elevation of 100.0 m.

The fieldwork for this project was carried out under the supervision of an experienced geotechnical technician who laid out the location of the boreholes in the field, arranged locates of buried services, supervised the field drilling, sampling and in situ testing, developed the monitoring wells, recorded groundwater levels and borehole elevations, and prepared the field borehole logs.

5.0 GEOTECHNICAL LABORATORY TESTS

The soil and rock core samples retained from the boreholes were properly sealed, labelled and brought to our laboratory for visual classification and laboratory testing. The results of the classification, water contents, and SPT are presented on the borehole log sheets attached in Appendix I of this report.

The laboratory testing component for this investigation consisted of the following tests:

- Moisture content on all the soil samples;
- Grain-size analyses on two (2) soil samples;
- Unconfined compressive strength and unit weight on two (2) rock core samples; and,
- One (1) corrosion package.

The result of the laboratory tests are presented in Section 6 and attached at the end of this report in Appendix II and Appendix III.

6.0 SUBSURFACE AND GROUNDWATER CONDITIONS

The subsurface soil and rock conditions encountered in the boreholes are summarized in Table 6-1 below and briefly discussed in the following subsections. Full details of the subsurface soil, rock, and groundwater conditions in the boreholes are provided on the borehole log sheets attached in Appendix I at the end of this report.

Table 6-1: Summary of Subsurface Conditions

Inferred Layer	Boreholes			
	BH101 mbgs (m)	**MW102 mbgs (m)**	**BH103 mbgs (m)**	**MW104 mbgs (m)**
FILL	0 to 1.1* (99.2 to 98.1)	0 to 1.1 (99.0 to 97.9)	0 to 2.7* (98.9 to 96.2)	0 to 2.7 (99.1 to 96.4)
Bedrock	-	1.1 to 4.0** (97.9 to 95.0)	-	2.7 to 5.7** (96.4 to 93.4)

* Practical refusal at the indicated depth

** Borehole terminated at the indicated depth

The following paragraphs present a description and commentary on the properties of the various soil and rock materials contacted in the boreholes.

It should be noted that the boundaries of soil types indicated on the borehole logs represent the materials encountered at the discrete borehole locations only. These boundaries are intended to reflect transition zones for the purpose of geotechnical design, and therefore, should not be construed as exact planes of geological change.

6.1 FILL

A layer of FILL soil was present at the surface in all the boreholes. It consisted of sand with trace gravel to gravelly, and trace organics. It was brown to grey in colour and recovered in a damp to moist condition with moisture contents ranging from 3 to 15 %. The recorded SPT N-value in the FILL ranged from 2 to 21, indicating a very loose to compact degree of compactness. The depth of the FILL in all the boreholes ranged from 1.1 to 2.7 meters below the ground surface (mbgs), corresponding to elevations 98.1 to 96.2 m. Both boreholes BH101 and BH103 were terminated in this layer due to refusal to advancement of augers.

Terrapex carried out two (2) grain size analysis on the FILL. The laboratory test result of the representative FILL samples is presented in the table below, and attached in Appendix II. Based on the grain size distribution, the tested samples can be described as gravelly sand to sand and gravel with trace to some fines.

Table 6-2: Summary of Grain Size Analyses in FILL

Sample ID	Sample Depth (mbgs)	% Gravel	% Sand	% Silt	% Clay
BH101, Sample 1	0 – 0.6	46	51	3	
BH103, Sample 3	1.5 – 2.1	22	67	11	

6.2 BEDROCK

The bedrock was cored in boreholes MW102 and MW104. It is described as limestone; strong to very strong, slightly weathered, and was of poor quality at the top, becoming of good to excellent quality with depth based on the Rock Quality Designation (RQD). The top of the rock was encountered at depths ranging from 1.1 to 2.7 mbgs, corresponding to elevations 97.9 to 96.4 m. Photographs of the rock cores are included in Appendix IV.

Both boreholes MW102 and MW104 were terminated in the rock at depths ranging from 4.0 to 5.7 mbgs, corresponding to elevations 95.0 to 93.4 m.

Terrapex completed unit weight and unconfined compressive strength tests on rock core

samples. The results of the laboratory tests on representative rock core samples are presented in the table below.

Table 6-3: Summary of Unconfined Compressive Strength on Rock Samples

Sample ID	Sample Depth (mbgs)	Unit Weight (kN/m^3)	Unconfined Compressive Strength (MPa)
MW102	1.3 – 1.5	26.8	79.9
MW104	3.2 – 3.4	26.9	57.9

6.3 GROUNDWATER

Boreholes MW102 and MW104 were both instrumented with monitoring wells. The groundwater level measurements are presented in the table below.

Table 6-4: Summary of Groundwater Conditions

Monitoring Well Location	Well Screen Details		Groundwater Observations	
	Screened Interval mbgs (m)	Screened Material	Water Level mbgs (m)	Date
MW102	2.5 – 4.0 (96.5 – 95.0)	Limestone Bedrock	2.8 (96.2)	July 15, 2021
MW104	3.2 – 5.7 (95.9 – 93.4)	Limestone Bedrock	2.6 (96.5)	July 15, 2021

It should be noted that groundwater levels are subject to seasonal fluctuations. A higher groundwater level condition will likely develop in the spring during the thaw and following significant rainfall events.

7.0 DISCUSSION AND PRELIMINARY RECOMMENDATIONS

The following discussion and preliminary recommendations are based on our current understanding of the Project. Any changes to the Project will require a review to assess the impact on the recommendations given herein. This geotechnical report is based on the factual data obtained from the boreholes advanced at the Site by **Terrapex** and are intended for use by the Client and Designers only. Contractors bidding on this project or conducting work associated with this Project should make their own interpretation of the factual data and/or carry out their own investigations.

Important factors to be considered for the design and construction of the proposed Project are expected to include the following:

- **Pre-Design Geotechnical Investigation Report:** At the time of this report, the Client had not provided **Terrapex** with the design details for this Project. It is our understanding that the Project is currently in the pre-design stages.

- **Foundations on Bedrock:** Based on the field boreholes advanced at the Site, the overburden soils consisted of FILL material overlying bedrock at approximate depths ranging from 1.1 to 2.7 mbgs. All foundations for the new building structure will need to be founded on bedrock. The recommended bearing pressure for foundations on bedrock are provided in section 7.5 of this report.

On the basis of the **Terrapex** boreholes, laboratory tests, and subsurface conditions encountered in the boreholes, the following comments and recommendations are provided.

7.1 SITE PREPARATION

7.1.1 General Grading and Interference with Existing Underground Utilities

Grading of the Site will need to be conducted in the early stages of construction. This will provide a positive control of surface water, directing it away from excavations and subgrades. Subgrades will need to be protected from surface water runoff or groundwater accumulation.

The Designers will need to review the location of proposed excavation and compare to with location of all the existing underground utilities. During construction, existing utilities that will be exposed will need to be rerouted, supported, or removed.

7.1.2 Subgrade Preparation for Footings on Rock

Subgrade preparation for footings founded on rock will involve the removal of all loose bedrock. Any pieces of rock that can be easily manipulated by conventional excavation equipment should be removed, as directed by the Geotechnical Engineer. Final subgrade surfaces should be brushed and/or air blown clean, and dry. The exposed bedrock surface should be examined and approved by the Geotechnical Engineer to confirm the competency of foundation to support the design bearing pressures.

Additional excavation of fractured rock to achieve a sound bedrock subgrade may be necessary; it is recommended that a unit price item for additional rock excavation and replacement with concrete fill be incorporated into the tender documents.

All footing subgrades must be approved by the Geotechnical Engineer.

7.2 EXCAVATIONS

The excavations for this Project are anticipated to consist of open excavations. All excavations must be carried out in accordance with the Occupational Health and Safety Act of Ontario (OHSA).

The following recommendations for excavations should be considered a supplement to, and not a replacement of the OHSA requirements.

7.2.1 Open Excavations

In the case that open excavations are used during construction, the following OHSA recommendations should be considered:

- The existing FILL on Site would be considered “Type 3 Soils” according to OHSA. “Type 3 Soils” must be sloped from its bottom with a slope having a minimum gradient of 1H:1V. Excavations into the fill soils should be relatively straightforward with conventional excavation equipment; and,

- For excavations into bedrock, there may be an upper weathered rock zone; a weathered bedrock is recommended to be treated as a “Type 2 Soil”. Sound rock would generally be self-supporting.

Bedrock excavation will require line drilling, pneumatic, or hydraulic breakers such as hoe-rams or heavy excavation equipment equipped for rock excavation. Controlled blasting techniques may also need to be used, subject to the laws and blasting restrictions that are in effect for the area. Designers are referred to the OPSS.MUNI 120 and the City of Ottawa Special Provision F-1201 specifications for the use of explosives.

Where workers must enter excavations extending deeper than 1.2 m below grade, the excavation side-walls must be suitably sloped and/or braced in accordance with OHSA and Regulations for Construction Projects.

7.2.2 Excavations Adjacent to Infrastructure

Designers and Contractors will need to review the geometry of planned excavations regarding requirements for depths and sloping. This will need to be compared to the location of existing adjacent infrastructure to ensure they are not undermined. Undermining can be prevented by ensuring that excavations do not penetrate below an imaginary line constructed outwards and downwards at a slope of 10H:7V from the toe of existing or proposed footings.

If the limitations of undermining cannot be met, then engineered shoring or underpinning systems will be required.

7.2.3 Engineered Shoring

Due to proximity of the excavation to neighbouring structures and existing infrastructure, Designers and Contractors may consider the use of Engineered Shoring systems through the overburden soils. Such systems may include soldier piles, slide rail systems, sheet piles, etc. The appropriate method should be selected by the Project Designers and Contractors, and the Engineered Shoring system will need to be designed by a Professional Engineer considering the following aspects:

- Lateral earth pressures,
- Loads from any adjacent structures, or infrastructure being retained,
- Seismic loadings,
- Freeze-thaw action on the face of the excavations,
- Expansion and contraction of shoring elements,
- Pre-stressing loads, or post tensioning loads on tie backs,
- Possible surcharge loads throughout construction (i.e., trucks, equipment, stockpiles, etc.), and
- Vibrations caused by construction methods.

The lateral pressure parameters to assist Designers and Contractors are discussed in Section 7.6.

7.2.4 Construction Dewatering

As part of this Geotechnical Investigation, **Terrapex** installed two (2) monitoring wells; the groundwater levels for the two (2) monitoring wells are provided in section 6.3.

Based on the monitoring well observations, the water levels encountered at the Site were at approximate depths of 2.6 to 2.8 mbgs, corresponding to elevations 96.5 to 96.2 m. It is anticipated that excavations for this Project will extend to depths of 2.7 mbgs and may be below the groundwater table. Groundwater seepage will occur from the FILL and should be anticipated by Contractors.

Adequate control of the groundwater at the Site can be achieved with a filtered sump pump at the base of excavation. The groundwater level must be maintained below the base of the excavation at all times.

7.3 FROST PROTECTION

The design frost depth for the City of Ottawa is 1.8 mbgs. All foundations, for unheated or isolated structures, underground utilities, which are exposed to freezing conditions within the overburden soils must be provided with a minimum of 1.8 m of soil cover for frost protection. For fully heated structures, this depth can be reduced to 1.5 m.

Where an adequate depth of soil cover cannot be provided, an equivalent insulation detail should be designed or approved by a Geotechnical Engineer; this will need to be designed or pre-approved prior to placement of any foundations or underground utilities.

If construction is to take place during the winter seasons, careful consideration should be taken to ensure exposed subgrades are not frozen. The subgrades must be protected at all times against freezing by the Contractor for the entire duration of construction, or until adequate frost protection is in place.

7.4 SEISMIC SITE CLASSIFICATION

In accordance with Ontario Building Code (OBC-2012), structures designed under Part Four of the code must be designed to resist a minimum earthquake force. The parameters for determination of the Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC-2012.

Based on the results of the field drilling, and the subsurface stratigraphy as revealed in the boreholes, **Terrapex** recommends that the building be designed to **"Site Class C"** as per table 4.1.8.4.A of the OBC-2012, and subject to the limitations of the Code.

7.5 FOUNDATIONS

The overburden soils at the site consist of loose to compact FILL, which is unsuitable for supporting the proposed building. Accordingly, it will be necessary to found the building on the bedrock.

Conventional pads and/or strip footings founded on weathered bedrock, may be dimensioned for a factored bearing capacity under Ultimate Limit State (ULS) of 1000 kPa. This includes a geotechnical resistance factor of $\Phi = 0.5$. Under Serviceability Limit States (SLS) conditions, there is no recommended bearing capacity as settlement under the ULS condition is expected to be nil.

All foundation subgrades must be reviewed and approved by the Geotechnical Engineer prior to placement of concrete.

7.6 LATERAL EARTH PRESSURES

The following soil parameters used in the determination of earth pressure acting on temporary Engineered Shoring are defined and provided below.

Table 7-1: Defined Lateral Earth Pressure Soil Parameters

Parameter	Definition	Units
Φ'	Angle of Internal Friction	degrees
γ	Bulk Density	kN/m^3
K_a	active earth pressure coefficient (Rankine)	dimensionless
K_o	at-rest earth pressure coefficient (Rankine)	dimensionless
K_p	passive earth pressure coefficient (Rankine)	dimensionless

7.6.1 Static Conditions

The appropriate un-factored static condition values for use in the design of structures subject to unbalanced earth pressures at this Site are tabulated as follows:

Table 7-2: Lateral Earth Pressure Soil Parameter Values

Soil	Parameter				
	Φ'	γ	K_a	K_p	K_0
FILL	24°	19	0.42	2.37	0.59
Bedrock	36°	26	0.26	3.85	0.41

For yielding retaining walls, the active earth pressure coefficients, K_a, is recommended to be used.

7.7 SLAB ON GRADE

It is important to note that **Terrapex** has not been provided with the design for the floor slab loadings. **Terrapex** is assuming that a typical floor slab loading of a maximum 24 kPa would be applicable. The subgrade for the floor slab will need to prepared by the Contractor and reviewed and approved by the Geotechnical Engineer prior to placement of Engineered Fill.

Subgrade preparation should include the removal of FILL and any disturbed soil. Any unsuitable subgrade areas will need to be sub-excavated and replaced with suitable Engineered Fill material compacted to 98 % of its Standard Proctor Maximum Dry Density (SPMDD).

A capillary moisture barrier consisting of a layer of 19 mm clear stone at least 200 mm thick compacted to a dense state should underlie the slab.

For design purposes and based upon a properly prepared subgrade surface covered with 200 mm of 19 mm clear stone, a typical preliminary modulus of subgrade reaction appropriate for the slab design would be approximately 30,000 kN/m^3.

7.8 ENGINEERED FILL

The following recommendations regarding construction of engineered fill should be adhered to during construction. All new fill soils which underlie slabs and in building interiors must consist of Engineered Fill in conformance with the following requirements:

- All fill, topsoil, organic materials, disturbed and weathered soils must be removed, and the exposed subgrade reviewed and approved by Geotechnical Engineer prior to any fill placement;
- The proposed fill material must be inspected and reviewed by the Geotechnical Engineer, tested for grain size and standard Proctor before being considered as Engineered Fill. Typically, OPSS 1010 “Granular B Type I” or “Granular A” material is suitable, and
- The engineered fill must be placed in lifts not exceeding 200 mm in thickness and compacted to 100 % of its SPMDD; it will need to be monitored and tested for compaction on a full-time basis by a qualified technician working under the supervision of the

Geotechnical Engineer.

7.9 PERIMETER DRAINAGE

As the new building structure will be an above grade structure with no basement level, a perimeter drainage system is not required.

7.10 EXTERIOR FOUNDATION WALL BACKFILL

The backfill for the exterior foundation wall should be a non-frost susceptible compactable material such as a sandy soil meeting the requirements of an OPSS 1010 “Granular B Type I”; other materials can be considered if they are tested and approved by the Geotechnical Engineer.

The following recommendations are to be applied for the exterior foundation wall backfill:

- The backfill materials should not be placed in a frozen condition or on a frozen subgrade;
- The backfill will need to be placed in equal stages simultaneously on both sides to avoid over compaction and distress to the walls, and lifts should not exceed 300 mm in thickness;
- For backfill that would underlie paved areas or exterior slabs-on-grade, each lift should be uniformly compacted to at least 98% of its SPMDD;
- For backfill on exteriors that would underlie landscaped areas, each lift should be uniformly compacted to at least 95% of its SPMDD, and
- Exterior grades should be sloped away from the structures, and roof drainage downspouts should be placed so that water flows away from the structure wall.

7.11 UNDERGROUND UTILITIES

7.11.1 Pipe Bedding and Cover

The following are recommendations for the service trench bedding and cover materials.

- Bedding for buried utilities should consist of an OPSS 1010 "Granular A" or "Granular B Type II" material and placed in accordance with municipal requirements;
- The cover material should be a service sand material or an OPSS 1010 "Granular A";
- Pipe bedding and backfill for flexible pipes should be undertaken in accordance with OPSD 802.010;
- The bedding and cover materials should be compacted to a minimum of 95% SPMDD. Bedding and cover details should follow the applicable governing design detail (i.e. City of Ottawa, OPSD), and
- No frozen material should be used for bedding or cover.

7.11.2 Backfill

Backfill above the cover for the underground sewers should be in accordance with the following recommendations:

- The existing FILL material may be used as backfill material with the approval of the Geotechnical Engineer. Imported suitable pit-run sandy soil material such an OPSS 1010 “Granular B Type I” would also be suitable for use as service backfill material as well;
- The backfill should be placed and compacted in uniform lift thickness compatible with the selected compaction equipment and not thicker than 300 mm. Each lift should be compacted to a minimum of 95% of its SPMDD;
- During backfilling, care should be taken to ensure the backfill proceeds in equal stages simultaneously on both sides of the pipe.

7.12 CHEMICAL CHARACTERIZATION OF SUBSURFACE SOIL

One (1) soil sample obtained from Borehole MW104 was submitted to Bureau Veritas Laboratory to assess corrosion potential to ductile iron or concrete. The test results are summarized below:

Table 7-3: Summary of Chemical Characterization

Soil Parameter	Sample ID: MW104, Sample 3
pH	7.73
Redox Potential (mV)	29.3
Resistivity (ohm-cm)	5300
Sulfide (mg/kg)	0.5
Sulphate (ug/g)	Not detected
Chloride (ug/g)	41

The American Water Works Association (AWWA) publication ‘Polyethylene Encasement for Ductile-Iron Pipe Systems’ ANSI/AWWA C105/A21.5-10 dated October 1, 2010 assigns points based on the results of the above tests. A soil or water that has a total score of ten or more points is considered corrosive to ductile iron pipe. Based on the results obtained for the sample that was submitted, the Subject Area soils are not considered to be potentially corrosive to ductile iron pipe.

The analytical results of the soil samples were compared with applicable Canadian Standards Association (CSA) A23.1-04 and are provided in the table below.

Table 7-4: Additional Requirements for Concrete Subjected to Sulphate Attack

Class of Exposure	Degree of Exposure	Water soluble Sulphate in soil sample (%)	Cementing Material to be used
S-1	Very Severe	> 2.0	HS or HSb
S-2	Severe	0.20 – 2.0	HS or HSb
S-3	Moderate	0.10 – 0.20	MS, MSb, LH, HS, or HSb

The chemical sulphate content analyses for the selected soil sample tested revealed that sulphate was not detected, as shown in Table 7-3. The results were compared with Canadian Standards Association (CSA) Standards A23.1 for sulphate attack potential on concrete structures and possesses a "negligible" risk for sulphate attack on concrete material. Accordingly, conventional GU or MS Portland cement may be used in the construction of the proposed concrete elements.

The Certificate of Analysis provided by the analytical chemical testing laboratory is found in Appendix III of this report.

7.13 PAVEMENT STRUCTURE

Subgrade preparation for any pavement structure will involve proof-rolling to identify soft spots, local anomalies, or deflections. Typically, a loaded dump truck or a heavy-duty steel drum roller is sufficient for proof rolling. All proposed subgrades will need to be inspected and approved by geotechnical staff prior to placement of granular base course material.

Any non-performing areas should be sub-excavated and replaced with an appropriate new fill soil; appropriate subgrade fill soil would be a free-draining, non-frost susceptible soil such as an OPSS 1010 “Granular B Type I”. Other material may be used with the inspection and approval by the Geotechnical Engineer.

The base and subbase courses should consist of an OPSS “Granular A” and “Granular B, Type II”, respectively. They should be placed in maximum loose lifts of 200 mm and compacted to 100 % of its SPMDD.

The table below displays the recommended minimum sections for the construction of the pavement structure for typical light duty parking stalls.

Table 7-5: Minimum Pavement Structure

Material	Layer Thickness
Light Duty Parking Stalls	
Asphalt Wearing Course (HL-3 or SP12.5B)	40 mm
Asphalt Base Course (HL8 or SP19.0B)	50 mm
Well Graded Granular Base Course (Granular ‘A’)	150 mm
Well Graded Granular Sub-Base Course (Granular ‘B’ Type II)	300 mm
Approved Subgrade by Geotechnical Engineer/Staff	

Regular maintenance will be required to achieve maximum life expectancy for any pavement structures. Generally, the asphalt pavement maintenance will involve periodic crack sealing and repair of local distress.

7.14 CONSTRUCTION INSPECTIONS AND MONITORING

The recommendations presented in this report are based on the assumption that adequate and satisfactory inspections and monitoring during construction by qualified geotechnical personnel will be provided. This will include:

- Review and approval of all subgrades by the Geotechnical Engineer;
- Laboratory testing of all proposed FILL soils;
- Full time field compaction testing of Engineered Fill soils, and part time compaction testing of backfill soils, and
- Periodic concrete testing.

8.0 LIMITATIONS

The conclusion and recommendations in this report are based on information determined at the inspection locations. Soil and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the soil investigation. The design recommendations given in this report are applicable only to the project described in the text. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made as set out in this report. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

This report was prepared for R-Hauz Services Inc. by Terrapex Environmental Ltd. The material in it reflects Terrapex Environmental Ltd. judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions which the Third Party may make based on it, are the sole responsibility of such Third Parties.

The comments given in this report on potential construction problems and possible methods are intended for the guidance of the design engineer, only. The number of inspection locations may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

Respectfully submitted,
TERRAPEX ENVIRONMENTAL LTD.

Amer Mohammad, P. Eng.	Vic Nersesian, P. Eng.
Geotechnical Project Manager	Vice President, Geotechnical Services

FIGURES

Figure 1: Site Location Map

Figure 2: Borehole Location Plan

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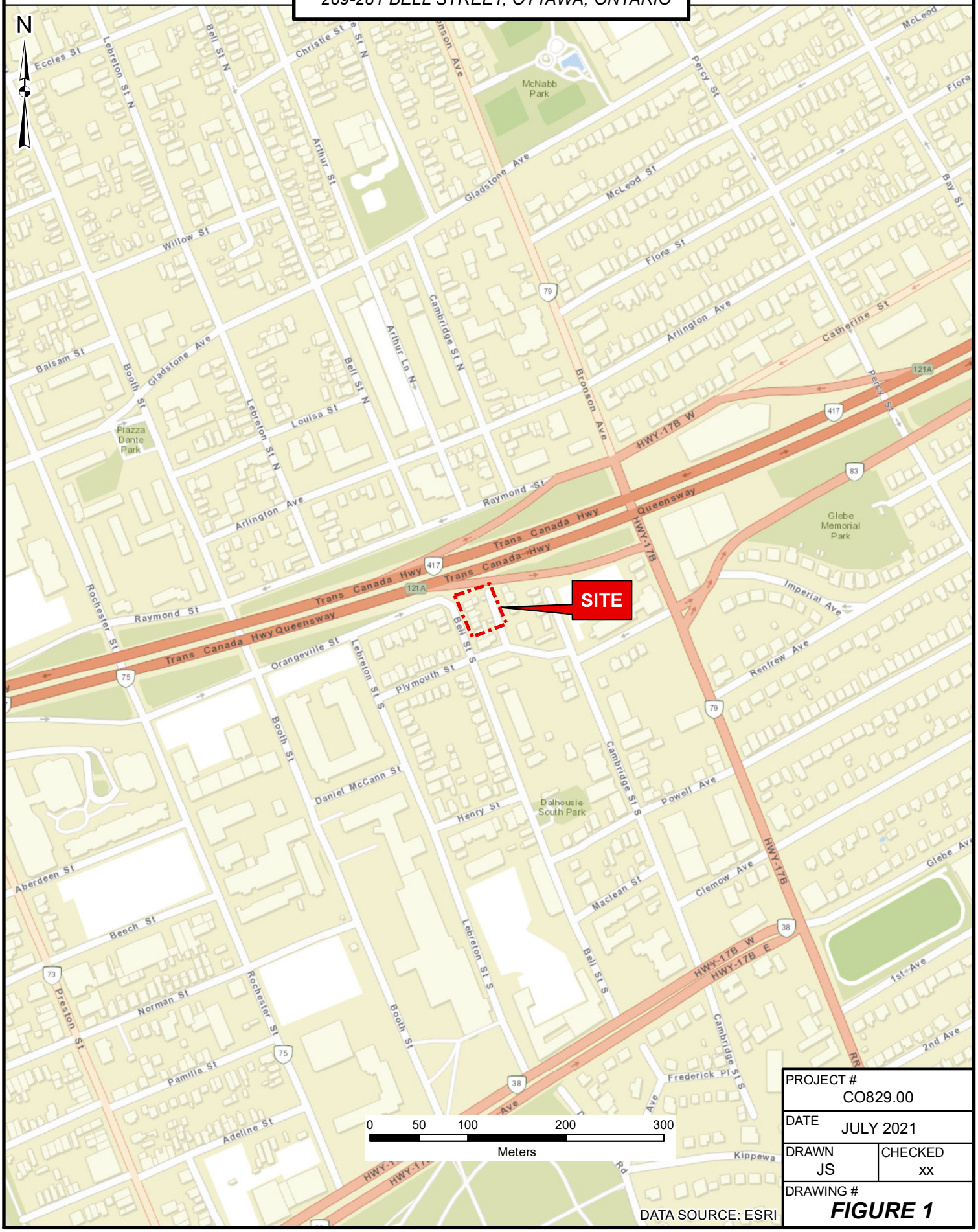
SITE LOCATION MAP

269-281 BELL STREET, OTTAWA, ONTARIO

CLIENT

R-HAUZ SERVICES INC.



DATA SOURCE: ESRI

PROJECT #	CO829.00
DATE	JULY 2021
DRAWN	JS
CHECKED	xx
DRAWING #	FIGURE 1

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TERRAPEX

BOREHOLE LOCATION PLAN

269-281 BELL STREET, OTTAWA, ONTARIO

CLIENT

R-HAUZ SERVICES INC.

PROJECT #	CO829.00
DATE	JULY 2021
DRAWN	JS
CHECKED	xx
DRAWING #	**FIGURE 2**

jserroul W:\PROJECTS\Ottawa\CO829.00 269-281 Bell Street\MXD\CO829.00_FIGURE 2 BH LOCATION PLAN.mxd

APPENDIX I
BOREHOLE LOGS

CLIENT: R-Hauz Services Inc	PROJECT NO.: CO829.00	**RECORD OF: BH101**
ADDRESS: 269-281 Bell Street South	STATION:	
CITY/PROVINCE: Ottawa, Ontario	NORTHING (m): / EASTING (m):	ELEV. (m) 99.2
CONTRACTOR: Marathon Underground	METHOD: Augering and Split Spoon Sampling	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm): / SCREEN SLOT #: / SAND TYPE:	SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● 40 80 120 160 / N-VALUE (Blows/300mm) ▲ 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL compact, damp, brown/grey gravelly sand	0	99	19	9	1						
		------ trace rootlets	0.5	98.5	50/50	5	2						
			1										
		END OF BOREHOLE Refusal to advancement of augers at 1.1 m depth											

TERRAPEX

LOGGED BY: AM/EB	DRILLING DATE: July 5, 2021
INPUT BY: JB	MONITORING DATE:
REVIEWED BY: AM	PAGE 1 OF 1

CLIENT: R-Hauz Services Inc	PROJECT NO.: CO829.00	**RECORD OF: MW102**
ADDRESS: 269-281 Bell Street South	STATION:	
CITY/PROVINCE: Ottawa, Ontario	NORTHING (m): / EASTING (m):	ELEV. (m) 99.0
CONTRACTOR: Marathon Undeground	METHOD: Augering and Split Spoon Sampling/Coring	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm): / SCREEN SLOT #: / SAND TYPE:	SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) 40 80 120 160 / N-VALUE (Blows/300mm) 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		100 mm TOPSOIL	0	99									
		FILL very loose damp, brown sand			3	13	1						
		trace gravel, trace organics	0.5	98.5									
		Refusal to advancement of augers	1	98	50/50	15	2						
		strong slightly weathered LIMESTONE	1.5	97.5									
		poor quality based on RQD	2	97			RC1						Sample RC1: TCR = 69 % SCR = 69 RQD = 37 %
			2.5	96.5									
▼			3	96									Groundwater measured at 2.8 m.
		good quality based on RQD					RC2						Sample RC2: TCR = 100 % SCR = 100 % RQD = 79 %
			3.5	95.5									
		END OF BOREHOLE											

TERRAPEX

LOGGED BY: EB	DRILLING DATE: July 5, 2021
INPUT BY: JB	MONITORING DATE: July 15, 2021
REVIEWED BY: AM	PAGE 1 OF 1

CLIENT: R-Hauz Services Inc	PROJECT NO.: CO829.00	**RECORD OF: BH103**
ADDRESS: 269-281 Bell Street South	STATION:	
CITY/PROVINCE: Ottawa, Ontario	NORTHING (m): / EASTING (m):	ELEV. (m) 98.9
CONTRACTOR: Marathon Underground	METHOD: Augering and Split Spoon Sampling	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm): / SCREEN SLOT #: / SAND TYPE:	SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) / N-VALUE (Blows/300mm)	WATER CONTENT (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL very loose damp, brown gravelly sand trace organics --- compact --- loose some gravel	0 0.5 1 1.5 2 2.5	98.5 98 97.5 97 96.5	2 21 9 50/75	7 5 6	1 2 3 4						
		END OF BOREHOLE Refusal to advancement of augers at 2.7 m depth											

TERRAPEX

LOGGED BY: EB	DRILLING DATE:
INPUT BY: JB	MONITORING DATE:
REVIEWED BY: AM	PAGE 1 OF 1

CLIENT: R-Hauz Services Inc	PROJECT NO.: CO829.00	**RECORD OF: MW104**
ADDRESS: 269-281 Bell Street South	STATION:	
CITY/PROVINCE: Ottawa, Ontario	NORTHING (m): / EASTING (m):	ELEV. (m) 99.1
CONTRACTOR: Marathon Underground	METHOD: Augering and Split Spoon Sampling/Coring	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm): / SCREEN SLOT #: / SAND TYPE:	SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

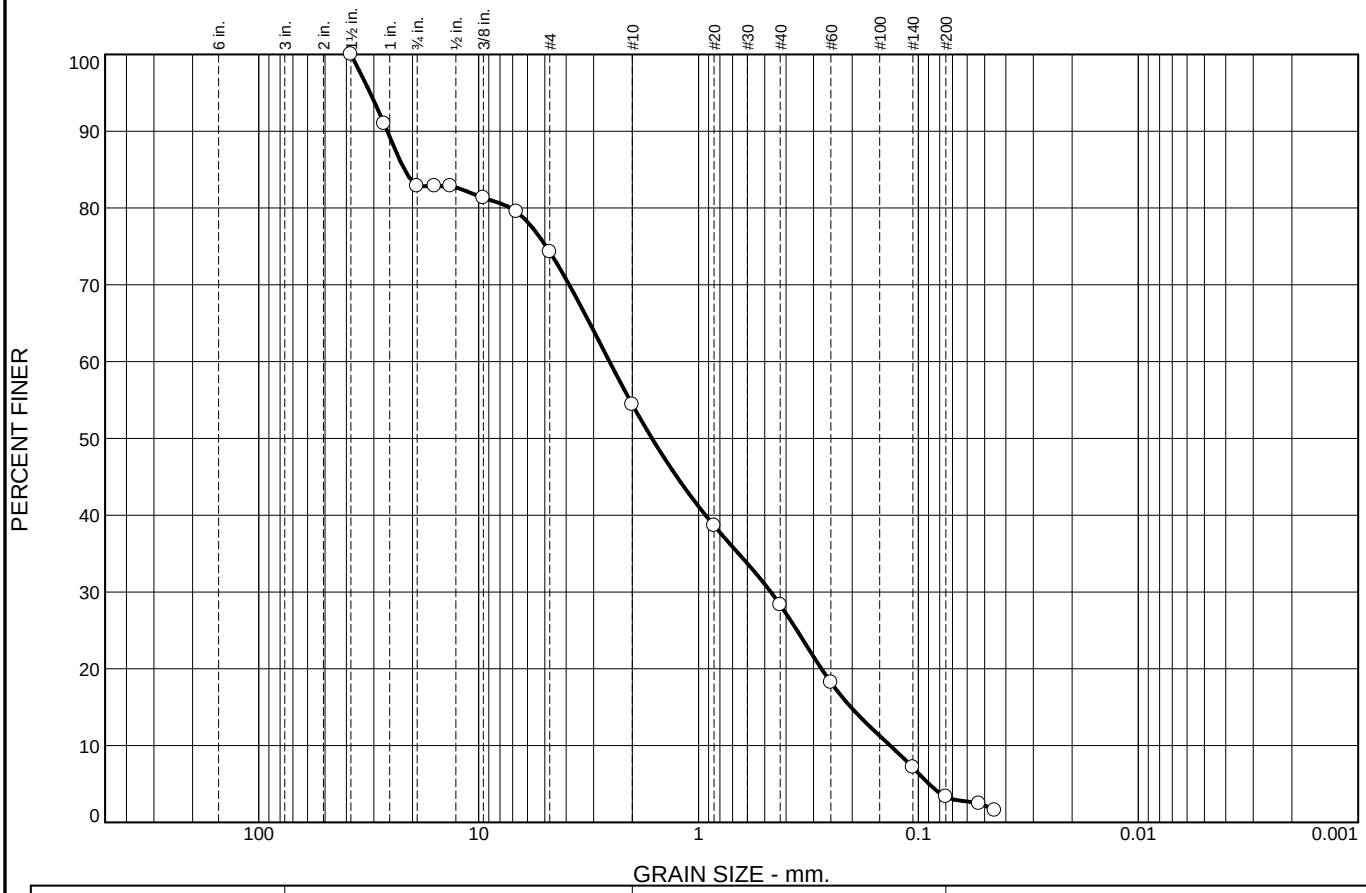
SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) / N-VALUE (Blows/300mm)	WATER CONTENT (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
FILL very loose damp, brown sand trace gravel trace organics	0	99	2	4	1						
	0.5	98.5									
	1	98	3	6	2						
moist, some gravel	1.5	97.5	4	11	3						
	2	97	50+		4						
Refusal to advancement of augers	2.5	96.5									Groundwater measured at 2.6 m.
very strong slightly weathered LIMESTONE	3	96									
poor quality based on RQD	3.5	95.5			RC1						Sample RC1: TCR = 73 % SCR = 61 % RQD = 45 %
	4	95									
excellent quality based on RQD	4.5	94.5			RC2						Sample RC2: TCR = 100 % SCR = 100 % RQD = 100 %
	5	94									
good quality based on RQD	5.5	93.5			RC3						Sample RC3: TCR = 100 % SCR = 100 % RQD = 75%
END OF BOREHOLE											

	LOGGED BY: EB	DRILLING DATE: July 5, 2021
	INPUT BY: JB	MONITORING DATE: July 15, 2021
	REVIEWED BY: AM	PAGE 1 OF 1

APPENDIX II

GEOTECHNICAL LABORATORY TEST RESULTS

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	46	26	25	3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_u
○			21.7395	2.5396	1.6282	0.4690	0.2026	0.1344	0.64	18.90

Material Description	USCS	AASHTO
○ SAND AND GRAVEL trace fines	SP	

Project No. CO829.00 **Client:** R-Hauz Services Inc.

Project: 269-281 Bell St., Ottawa, ON

○ **Sample Number:** BH101, SS1

Remarks:

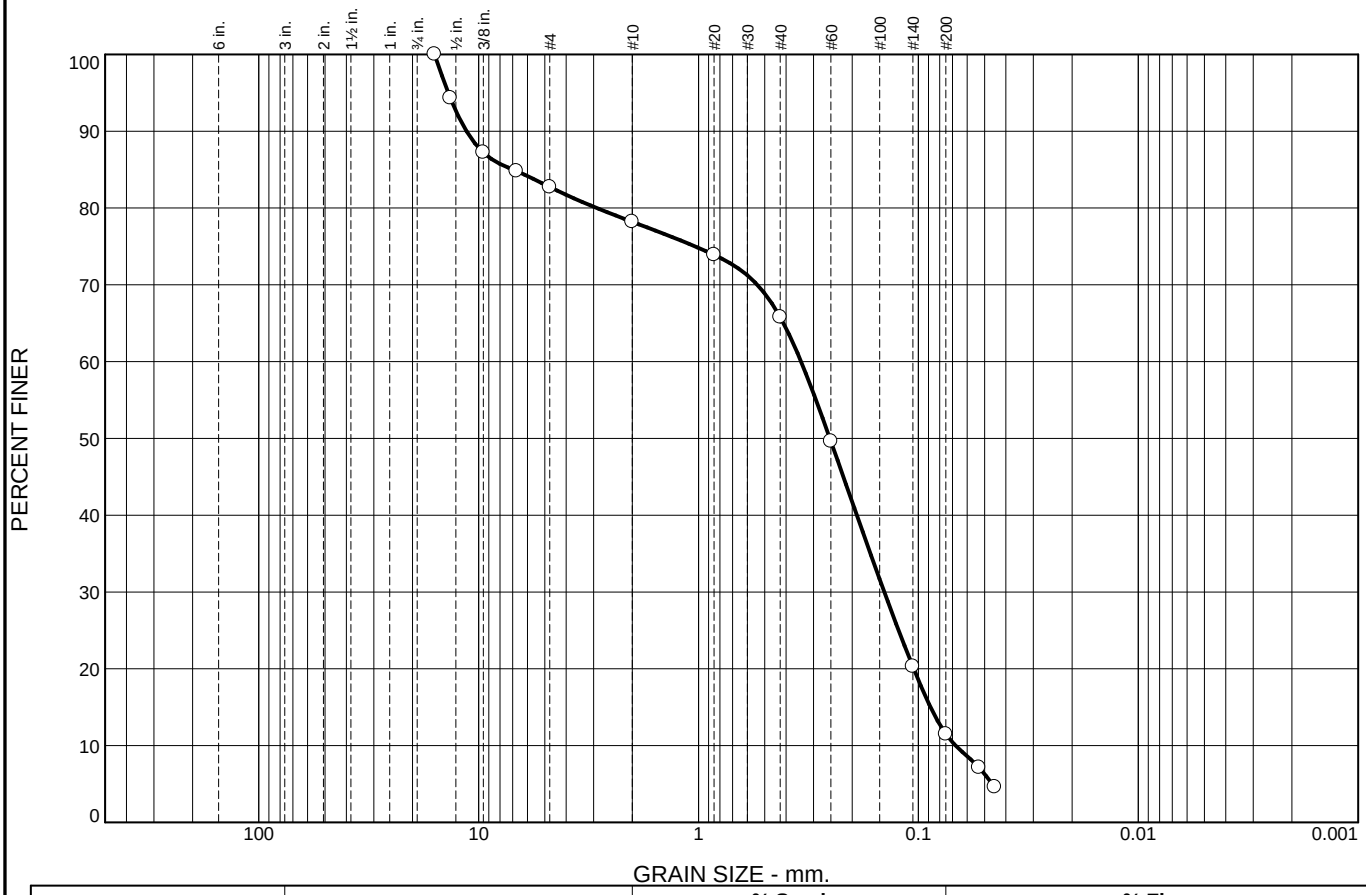
○Tested on June 14, 2021

Terrapex

Figure 1

Tested By: NT

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	22	12	55	11	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.9778	0.3418	0.2528	0.1429	0.0881	0.0678	0.88	5.04

Material Description	USCS	AASHTO
○ GRAVELLY SAND some fines		

Project No. CO829.00 **Client:** R-Hauz Services Inc.

Project: 269-281 Bell St., Ottawa, ON

○ **Sample Number:** BH103, SS3

Remarks:

○Tested on July 14, 2021

Terrapex

Figure 2

Tested By: NT

APPENDIX III

CORROSION PACKAGE TESTING

Your P.O. #: CO829.00
Your Project #: CO829.00
Site Location: 269-281 BELL ST S
Your C.O.C. #: n/a

Attention: Amer Mohammad

Terrapex Environmental Ltd
1-20 Gurdwara Rd.
Ottawa, ON
CANADA K2E 8B3

Report Date: 2021/07/19
Report #: R6725447
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1J0157
Received: 2021/07/08, 14:15

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract) (1)	1	2021/07/14	2021/07/14	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity (1)	1	2021/07/14	2021/07/14	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (2, 4)	1	N/A	2021/07/15	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (2)	1	N/A	2021/07/16	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT (1)	1	2021/07/12	2021/07/12	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil (1)	1	2021/07/09	2021/07/14	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract) (1)	1	2021/07/14	2021/07/14	CAM SOP-00464	EPA 375.4 m
Redox Potential (3, 5)	1	N/A	N/A		

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Mississauga
(2) This test was performed by Bureau Veritas Calgary via Mississauga
(3) This test was performed by Sub from Campo to Env. Testing Canada (Eurofins)
(4) Offsite analysis requires that subcontracted moisture be reported.

Your P.O. #: CO829.00
Your Project #: CO829.00
Site Location: 269-281 BELL ST S
Your C.O.C. #: n/a

Attention: Amer Mohammad

Terrapex Environmental Ltd
1-20 Gurdwara Rd.
Ottawa, ON
CANADA K2E 8B3

Report Date: 2021/07/19
Report #: R6725447
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1J0157
Received: 2021/07/08, 14:15

(5) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Katherine Szozda, Project Manager
Email: Katherine.Szozda@bureauveritas.com
Phone# (613)274-0573 Ext:7063633

==========

This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1J0157
Report Date: 2021/07/19

Terrapex Environmental Ltd
Client Project #: CO829.00
Site Location: 269-281 BELL ST S
Your P.O. #: CO829.00
Sampler Initials: EB

RESULTS OF ANALYSES OF SOIL

BV Labs ID		QAY955		
Sampling Date		2021/07/05 17:30		
COC Number		n/a		
	UNITS	**MW 104, SAMPLE 3**	**RDL**	**QC Batch**
Calculated Parameters				
Resistivity	ohm-cm	5300		7454197
Inorganics				
Soluble (20:1) Chloride (Cl-)	ug/g	41	20	7461377
Conductivity	umho/cm	188	2	7461502
Available (CaCl2) pH	pH	7.73		7457492
Soluble (20:1) Sulphate (SO4)	ug/g	ND	20	7461419
Sulphide	mg/kg	0.5 (1)	0.5	7468709
Physical Testing				
Moisture-Subcontracted	%	14	0.30	7468708

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
(1) Sample contained greater than 10% headspace at time of extraction.
Analyzed past method specified hold time

Bureau Veritas Laboratories 100 – 36 Antares Dr. Nepean, ON, K2E 7W5 Phone: 613-274-0573 Website: www.bvlabs.com

BV Labs Job #: C1J0157
Report Date: 2021/07/19

Terrapex Environmental Ltd
Client Project #: CO829.00
Site Location: 269-281 BELL ST S
Your P.O. #: CO829.00
Sampler Initials: EB

TEST SUMMARY

BV Labs ID: QAY955
Sample ID: MW 104, SAMPLE 3
Matrix: Soil

Collected: 2021/07/05
Shipped:
Received: 2021/07/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7461377	2021/07/14	2021/07/14	Alina Dobreanu
Conductivity	AT	7461502	2021/07/14	2021/07/14	Massarat Jan
Moisture (Subcontracted)	BAL	7468708	N/A	2021/07/15	Richard Ly
Sulphide in Soil	SPEC	7468709	N/A	2021/07/16	Preetleen Kathuria
pH CaCl2 EXTRACT	AT	7457492	2021/07/12	2021/07/12	Neil Dassanayake
Resistivity of Soil		7454197	2021/07/14	2021/07/14	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7461419	2021/07/14	2021/07/14	Avneet Kour Sudan
Redox Potential	COND	7469830	2021/07/19		Sara Singh

Bureau Veritas Laboratories 100 – 36 Antares Dr. Nepean, ON, K2E 7W5 Phone: 613-274-0573 Website: www.bvlabs.com

BV Labs Job #: C1J0157
Report Date: 2021/07/19

Terrapex Environmental Ltd
Client Project #: CO829.00
Site Location: 269-281 BELL ST S
Your P.O. #: CO829.00
Sampler Initials: EB

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	9.0°C

Results relate only to the items tested.

BV Labs Job #: C1J0157
Report Date: 2021/07/19

Terrapex Environmental Ltd
Client Project #: CO829.00
Site Location: 269-281 BELL ST S
Your P.O. #: CO829.00
Sampler Initials: EB

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7457492	NYS	Spiked Blank	Available (CaCl2) pH	2021/07/12		100	%	97 - 103
7457492	NYS	RPD	Available (CaCl2) pH	2021/07/12	0.14		%	N/A
7461377	ADB	Matrix Spike	Soluble (20:1) Chloride (Cl-)	2021/07/14		118	%	70 - 130
7461377	ADB	Spiked Blank	Soluble (20:1) Chloride (Cl-)	2021/07/14		103	%	70 - 130
7461377	ADB	Method Blank	Soluble (20:1) Chloride (Cl-)	2021/07/14	ND, RDL=20		ug/g	
7461377	ADB	RPD	Soluble (20:1) Chloride (Cl-)	2021/07/14	13		%	35
7461419	AKD	Matrix Spike	Soluble (20:1) Sulphate (SO4)	2021/07/14		114	%	70 - 130
7461419	AKD	Spiked Blank	Soluble (20:1) Sulphate (SO4)	2021/07/14		108	%	70 - 130
7461419	AKD	Method Blank	Soluble (20:1) Sulphate (SO4)	2021/07/14	ND, RDL=20		ug/g	
7461419	AKD	RPD	Soluble (20:1) Sulphate (SO4)	2021/07/14	NC		%	35
7461502	MJ1	Spiked Blank	Conductivity	2021/07/14		101	%	90 - 110
7461502	MJ1	Method Blank	Conductivity	2021/07/14	ND,RDL=2		umho/cm	
7461502	MJ1	RPD	Conductivity	2021/07/14	2.8		%	10
7468708	RIL	Method Blank	Moisture-Subcontracted	2021/07/15	ND, RDL=0.30		%	
7468709	PK8	Matrix Spike	Sulphide	2021/07/16		103	%	N/A
7468709	PK8	Spiked Blank	Sulphide	2021/07/16		113	%	75 - 125
7468709	PK8	Method Blank	Sulphide	2021/07/16	ND, RDL=0.5		mg/kg	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

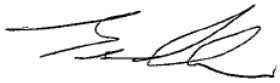
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

BV Labs Job #: C1J0157
Report Date: 2021/07/19

Terrapex Environmental Ltd
Client Project #: CO829.00
Site Location: 269-281 BELL ST S
Your P.O. #: CO829.00
Sampler Initials: EB

VALIDATION SIGNATURE PAGE

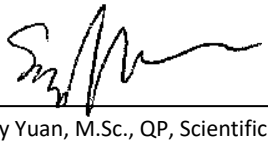
The analytical data and all QC contained in this report were reviewed and validated by:



Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Sara Singh, B.Sc, Senior Project Manager



Sandy Yuan, M.Sc., QP, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 100 – 36 Antares Dr. Nepean, ON, K2E 7W5 Phone: 613-274-0573 Website: www.bvlabs.com

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Katherine Szozda
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1957537
Date Submitted: 2021-07-13
Date Reported: 2021-07-19
Project: C1J0157
COC #: 876624

Dear Katherine Szozda:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____
Sarah Horner, Inorganics Technician

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

eurofins | Environment Testing

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Katherine Szozda
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1957537
Date Submitted: 2021-07-13
Date Reported: 2021-07-19
Project: C1J0157
COC #: 876624

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D. 1568181 Soil 2021-07-05 QAY955-MW 104 SAMPLE 3
Redox Potential	REDOX Potential		mV		293

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Katherine Szozda
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1957537
Date Submitted: 2021-07-13
Date Reported: 2021-07-19
Project: C1J0157
COC #: 876624

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 404519 **Analysis/Extraction Date** 2021-07-16 **Analyst** MW **Method** C SM2580B			
REDOX Potential	323 mV	100	

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

APPENDIX IV
ROCK CORE PHOTOGRAPHS

Borehole MW102

Borehole MW104