Groundwork Engineering Limited

Halfmoon Bay Subdivision

Terrain Analysis Report

Prepared for: **URSTRONG**

Prepared by: **Groundwork Engineering Limited**

Project No. **GW-21014**

Date: **16 April 2021**

Revised: **23 September 2022**

Groundwork Engineering Limited

Table of Contents

Unit 640-654 Norris Court, Kingston, ON K7P 2R9
Tel: (613)-634-1789
www.groundengineer.ca

1.0 Introduction

This report presents the results of a terrain analysis conducted at Part of Lot A, Concession South of Prince Edward Bay, Township of South Marysburgh, County of Prince Edwards, Ontario prepared in support of a request for a zoning by-law amendment. The site has an area of 20.59 hectares (ha) and will be divided into 16 lots ranging in size from 0.81 ha to 1.12 ha. The property is located on a peninsula with Prince Edward Bay to the north and Halfmoon Bay to the south.

The purpose of the terrain analysis was to review site conditions and assess suitability for onsite wastewater treatment. The sites will be serviced with drilled wells for potable water.

Field work consisting of excavation of five (5) test pits and soil sampling was undertaken by Groundwork Engineering Limited (GEL) staff in March 2021. Representative samples were submitted to third party laboratory for grain size analyses and percolation rate to confirm suitability for onsite wastewater disposal systems.

2.0 Site Topography

The lake shoreline fronting this property is heavily treed with a gentle rise towards the southwest property line, of approximately 3.5m. There is a clearing of approximately 9425m^2 on the eastern portion of the site. There is an existing wetland on the southern portion of the site, with the access road to the west and Halfmoon Bay to the east. There is a proposed single lot south of the wetland. The shoreline consists of exposed bedrock, boulders, cobble and gravel.

3.0 Field Activity – Terrain and Surficial Soils

GEL personnel were present during the excavation of five (5) test pits at strategic locations on the subject property. Excavation was completed with a tracked mini-excavator. Test pits were excavated to depths of approximately 0.38 to 0.46 m below present site grade. Test pit locations and elevations were collected by GEL with GPS survey equipment. Elevations are geodetic established using CAN-NET GNSS real-time correction network. Test pit locations were chosen to collect representative samples of the development. Since the soil stratigraphy was consistent across all test pits, excavation of test pits on all lots was not completed.

Test pit 1 was located in Lot 3 with a surface elevation of 78.26m. Overburden deposits identified in test pit 1 consisted of approximately 89mm of topsoil overlying dark brown clay and silt, trace gravel, trace sand, overlying fractured limestone. Bedrock was encountered 0.46 m below grade. No ground water infiltration was reported in test pit 1 following completion of the field work.

Unit 640-654 Norris Court, Kingston, ON K7P 2R9
Tel: (613)-634-1789
www.groundengineer.ca

Test pit 2 was located in Lot 5 with a surface elevation of 78.09m. Overburden deposits identified in test pit 2 consisted of approximately 76mm of topsoil overlying dark brown clay and silt, trace gravel, trace sand, overlying fractured limestone. Bedrock was encountered 0.46 m below grade. No ground water infiltration was reported in test pit 2 following completion of the field work.

Test pit 3 was located in Lot 9 with a surface elevation of 76.89m. Overburden deposits identified in test pit 3 consisted of approximately 89mm of topsoil overlying dark brown clay and silt, trace gravel, trace sand, overlying fractured limestone. Bedrock was encountered 0.48 m below grade. Minor ground water infiltration was reported in test pit 3 following completion of the field work.

Test pit 4 was located in Lot 11 with a surface elevation of 76.88m. Overburden deposits identified in test pit 4 consisted of approximately 89mm of topsoil overlying dark brown clay and silt, trace gravel, trace sand, overlying fractured limestone. Bedrock was encountered 0.38 m below grade. No ground water infiltration was reported in test pit 4 following completion of the field work.

Test pit 5 was located in Lot 15 with a surface elevation of 78.94m. Overburden deposits identified in test pit 5 consisted of approximately 89mm of topsoil overlying dark brown clay and silt, trace gravel, trace sand, overlying fractured limestone. Bedrock was encountered 0.38 metres below grade. No ground water infiltration was reported in test pit 5 following completion of the field work.

Test pit locations are shown on Site Plan drawing C-101 prepared by Groundwork Engineering Limited, dated April 15, 2021 (Appendix A) and test pit logs are included in Appendix B.

4.0 Surficial Drainage

The topography, soils, and gradient determine the surficial drainage. Surficial drainage will likely reflect site topography from the high point along the southwest property line across the property and towards the water.

Infiltration is expected to be poor through the silty clay overburden in the property. The percolation rate of the silty clay was determined to be greater than 50 min/cm. Percolation rate is estimated from grain size data only, in comparison to OBS 2012 SB-6. Analysis results can be found in Appendix C.

5.0 Onsite Wastewater Disposal

Test pit observations and results of grain size analyses indicate that the predominant soil type on the site is silty clay with a percolation rate of greater than 50 min/cm. The depth to bedrock is relatively shallow across the area. This area would only support a raised effluent dispersal bed.

The daily design sewage flow calculations in this assessment will be based on the assumption that the residential lots in the proposed development will each contain a single-family home with a maximum of 4 bedrooms, 3 bathrooms, with a total living area of 300m^2. Based on the O.B.C. the daily design flow sewage will be 3,000 litres.

Wastewater treatment system sizing is based on Part 8 of the Ontario Building Code (O.B.C.). A class 4 system with Filter Media bed may be used for effluent dispersal. Filter Bed sizing is based on the O.B.C. 8.7.5.

The total area required for each filter bed can be calculated with the following equations:

$$Loading\ Area = \frac{Q}{75}$$

$$Area = \frac{3000\ l/day}{75}$$

$$Area = \ 40m^2$$

$$Contact\ Area = \frac{QT}{850}$$

$$Contact\ Area = \frac{3000\ l/day * 50}{850}$$

$$Contact\ Area = \ 176.5\ m^2$$

$$Expanded\ Contact\ Area = \frac{Q}{4}$$

$$Expanded\ Contact\ Area = \frac{3000\ l/day}{4}$$

$$Expanded\ Contact\ Area = \ 750\ m^2$$

Where: Q = Daily Design Sewage Flow (3000 litres)
T = percolation time of underlying soil (50min/cm)

Unit 640-654 Norris Court, Kingston, ON K7P 2R9
Tel: (613)-634-1789
www.groundengineer.ca

Therefore, an area of approximately 176.5m^2 will be required for each filter media effluent dispersal system. With the silty clay underlying soil each system will need to be raised such that there is a minimum of 900mm between the bottom of pipe and bedrock with 4:1 side slopes and a 250mm thick sand mantle extending 15m from the end of the loading area. With the mantle included the total area required is approximately 750m^2.

6.0 Water Quality Impact Assessment

The Ministry of Environment, Conservation and Parks (MECP) Technical Guideline D-5-4 provides a methodology that assesses the potential groundwater impacts from onsite sewage systems. This guideline applies only to those areas of the province which have not been designated under Notice 3/87 as subject to MECP Guidline B-7, Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities. The individual onsite wastewater treatment systems are not classified as large subsurface sewage disposal systems and Policy D-5-4 is applicable.

Step One of the MECP D-5-4 procedure assesses lot sizes. If the proposed development has an average lot size greater than 1.0 hectare (ha) then the D-5-4 conditions have been met. The average lot size in the proposed development is 0.88 ha, which does not meet the requirements of the Step One condition.

Step Two of D-5-4 assesses system isolation. Sewage effluent must be hydrogeologically isolated from existing or potential supply aquifers. The test pits that were excavated contained between 381mm and 483mm of clay and silt, trace gravel, trace sand, with an estimated percolation rate of 50cm/min, overlying limestone bedrock. Due to the shallow overburden Step Two will not be satisfied.

Step Three of D-5-4 assesses contamination attenuation. It must be demonstrated that wastewater effluent will not cause groundwater nitrate-nitrogen concentrations to exceed 10mg/L. This maximum concentration is determined as the allowable limit in the Ontario Drinking Water Objectives. Three methods can be used to determine nitrate-nitrogen. In this case the predictive assessment for residential developments will be used.

The D-5-4 Technical Guideline provides for the Predictive Assessment. A nitrate loading of at least 40 grams/lot/day per residential dwelling shall be used. This is based on expected actual wastewater flows of 1000L/day and a minimum nitrate concentration of 40 mg/L in residential wastewater (as per MECP guidelines).

Roof tops and driveways will account for approximately 5,500m^2 to 6,500m^2 of impervious area. The area of the travelled road allowance and the wetland, were also excluded from the area calculations. The total dilution area was calculated to be 146,400 m^2. The average annual

rainfall volume was taken from the Belleville weather station since it was the closest station with available data.

The nitrate-nitrogen concentrations can be calculated using the following equations:

$$k = P\ x\ A_D\ x\ R$$
$$\mathrm{V_T} = k + \mathrm{V_S}$$
$$\mathrm{C_{PB}} = \frac{\mathrm{C_S} \times \mathrm{V_S}}{\mathrm{V_T}}$$

A_D = Dilution Area [m^2] = 146,400m^2
V_T = Total volume of water [m^3]
V_S = Annual wastewater Volume [m^3] = 1m^3/per day/per house = 5,840m^3
C_{PB} = Concentration at property boundary or water course [mg/L]
C_s = Concentration in wastewater [mg/L] = 40,000 mg/m^3
k = Yearly Volume of Infiltration [m^3/year]
P = Annual Precipitation = 0.981 [m/year]
R = Infiltration/groundwater recharge = 17.4% (Clay Loam, Urban Lawns, Table 3.1: Hydrologic Cycle Component Values, MOE Stormwater Management Planning and Design Manual, March 2003)

$$k = P\ x\ A_D\ x\ R$$

$$k = 0.981m\ x\ 146{,}400m^3\ x\ 0.174m$$

$$k = 24{,}989m^3/year$$

$$\mathrm{V_T} = 24{,}989m^3 + 5{,}840m^3$$
$$\mathrm{V_T} = 30{,}829m^3$$

$$\mathrm{C_{PB}} = \frac{40{,}000\mathrm{mg}/m^3 \times 5{,}840m^3}{30{,}829m^3}$$
$$\mathrm{C_{PB}} = 7{,}577\ mg/m^3$$
$$\mathrm{C_{PB}} = 7.58\ mg/L$$

Malroz Engineering Inc. has sampled two (2), wells for background analysis. The existing nitrate levels in both wells was less than 0.1 mg/L. Therefore, the total nitrate concentration anticipated for the development is 7.58 mg/L. This is less than the 10 mg/L Ontario Drinking Water Standard.

Based on the above calculations the nitrate-nitrogen concentration from the wastewater produced at the 16-lot residential development will have minimal affect on the groundwater.

7.0 Conclusions

The proposed lot sizes have sufficient area to support a primary and secondary location for a 750m^2 Class 4 treatment system consisting of a Filter Media effluent dispersal bed, septic tank, pump chamber and a 300m^2, 4-bedroom house.

The development can support a 16-lot proposed plan of subdivision with no risk to water quality.

Silty clay soils are prevalent across the proposed development which would limit effluent dispersal to fully raised beds with imported sandy soil.

Onsite wastewater treatment systems shall be designed, constructed, and approved by qualified personnel in accordance with the Ontario Building Code requirements. Clearance distances from controlling features such as property lines, and structures must be maintained.

Existing topography on the site leads to surface drainage conveyed by sheet flow towards the lake. Raised effluent dispersal beds should be positioned such that they do not affect surface drainage around the buildings.

Report Prepared by:

Lucas McCallum

Lucas McCallum, B. Eng., C. Tech

Report Reviewed by:

Martin Burger, M.Eng., P.Eng.

8.0 Statement of Qualifications and Limitations

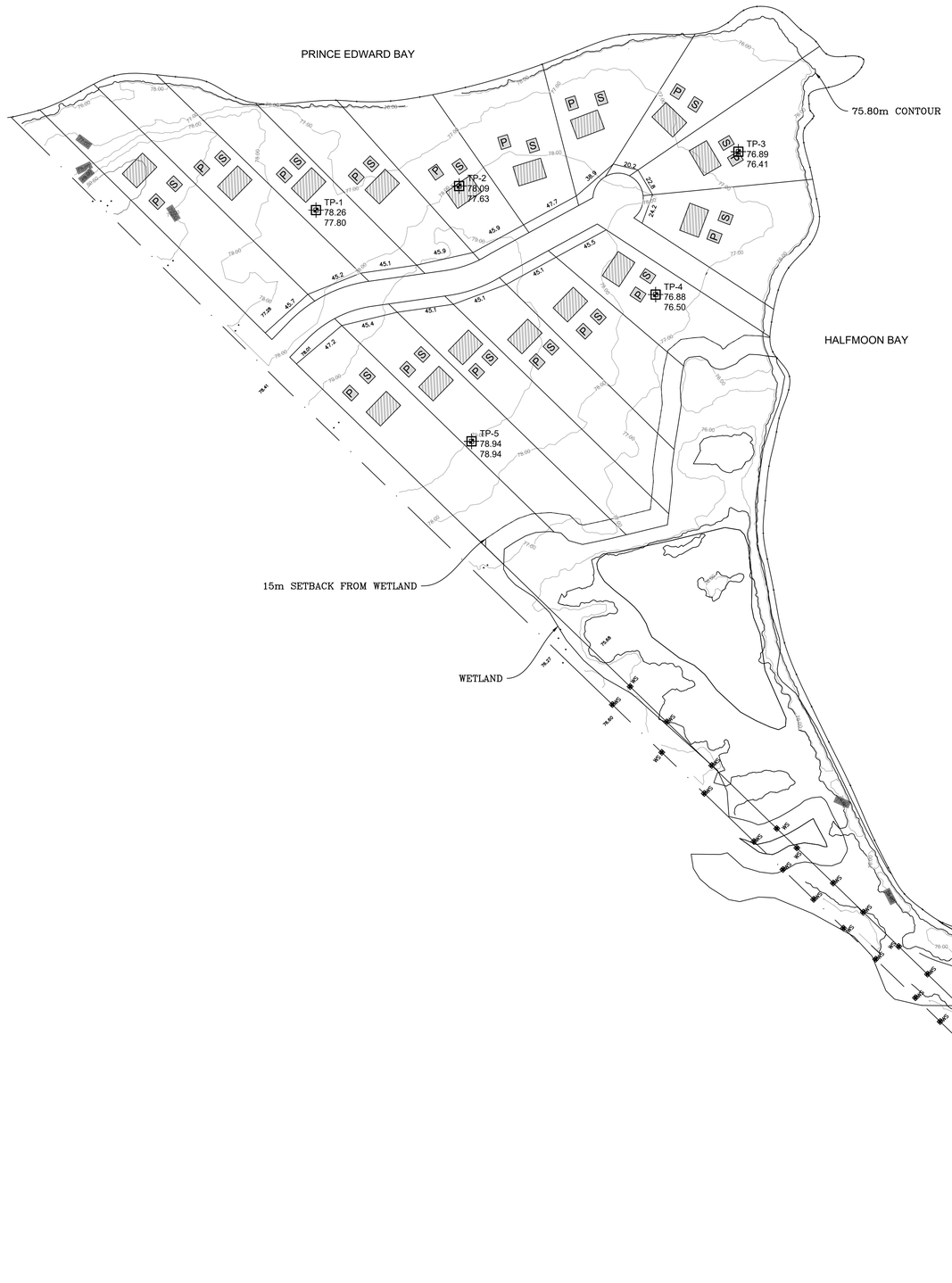
The recommendations provided in this report are based on subsurface data obtained at the specific test locations only. Boundaries between zones presented on the test pit logs are often not distinct but transitional and were interpreted. Experience indicates that the subsurface soil and groundwater conditions can vary significantly between and beyond the test pit locations. For this reason, the recommendations given in this report are subject to a field verification of the subsurface soil conditions at the time of construction.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we may be of further services to you, please do not hesitate to contact the undersigned.

Unit 640-654 Norris Court, Kingston, ON K7P 2R9
Tel: (613)-634-1789
www.groundengineer.ca

Appendix A

Site Plan

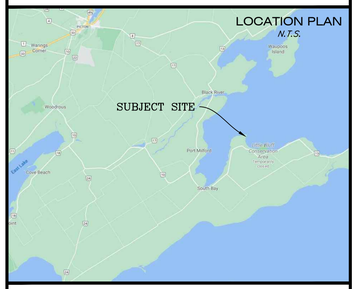


Groundwork Engineering Limited

GEOTECHNICAL • CIVIL • STORMWATER • ONSITE WASTEWATER

UNIT 640 - 654 NORRIS COURT
KINGSTON, ONTARIO
OFFICE (613) 634-1789

LOCATION PLAN
N.T.S.



LEGEND

- PROPOSED DWELLING
- TP-4 XX.XX XX.XX TEST PIT GROUND ELEV. ROCK ELEV.
- P PROPOSED PRIMARY SEPTIC AREA
- S PROPOSED SECONDARY SEPTIC AREA

LEGEND

- PROPOSED DWELLING
- PROPOSED FLOW DIRECTION
- EXISTING CONTOUR LINE
- ROCK FLOW CHECK DAM

NOTES:
- 100-YEAR FLOOD CONTOUR ELEV: 75.8m

REVISIONS

No.	Description	Date
#1	ISSUED FOR TERRAIN ANALYSIS REPORT	2021/04/16

BENCHMARK:

No.	DESCRIPTION	ELEVATION
##.	XXX	XXX.XX

LICENSED PROFESSIONAL ENGINEER
M. H. BURGER
PROVINCE OF ONTARIO

Client / Land Owner:
URSTRONG

Project:
HALFMOON BAY
PRINCE EDWARD COUNTY ONTARIO

Drawing Title:
PROPOSED SEPTIC AREAS

Drawn by: DF
Checked By: MB
Scale: 24"x36" 1:2000
Date: APRIL 9, 2021

Project Number: GW-21014
Drawing Number: C-101
SHEET 1 of 1

P:\Projects\21000\21014 – Half Moon Bay Subdivision\02 – Design\03 – Drawings\01 – Preliminary Design (Pre-Submission)\GW-21014 – Half Moon Bay.dwg
5/28/2021 8:52 AM

Appendix B

Test Pit Logs

	RECORD OF TEST PIT				
	TEST PIT No.		1		
	LOCATION		Half Moon Bay, Prince Edward County ,ON		
	Surface Elevation: 78.26			Pocket Penetrometer	
Description	Thickness (mm)	Total Depth (mm)	Elevation (m)	Depth (mm)	Readings Tons/ft2 & Kg/cm2
Topsoil (Moist)	88.90	88.90			
Dark Brown Clayey Silt, trace Gravel, Trace Sand (Moist)	368.30	457.20	78.17		
End Of Test Pit - 0.457m Bedrock Encountered No Groundwater Seepage			77.80		
Project No.	21014			Date Started:	3/8/2021
Excavation Method:	Mini Excavator			Date Completed:	3/8/2020
Logged By:	RL			Compiled By:	RL
Checked By:	MB				

	RECORD OF TEST PIT				
	TEST PIT No.		2		
	LOCATION		Half Moon Bay, Prince Edward County, ON		
	Surface Elevation: 78.09			Pocket Penetrometer	
Description	Thickness (mm)	Total Depth (mm)	Elevation (m)	Depth (mm)	Readings Tons/ft2 & Kg/cm2
Topsoil (Moist)	76.20	76.20			
Dark Brown Clayey Silt, trace Gravel, Trace Sand (Moist)	380.80	457.00	78.01		
End Of Test Pit - 0.457m Bedrock Encountered No Groundwater Seepage			77.63		
Project No.	21014			Date Started:	3/8/2021
Excavation Method:	Mini Excavator			Date Completed:	3/8/2020
Logged By:	RL			Compiled By:	RL
Checked By:	MB				

	RECORD OF TEST PIT				
	TEST PIT No.		3		
	LOCATION		Half Moon Bay, Prince Edward County, ON		
	Surface Elevation: 76.89			Pocket Penetrometer	
Description	Thickness (mm)	Total Depth (mm)	Elevation (m)	Depth (mm)	Readings Tons/ft2 & Kg/cm2
Topsoil (Moist)	88.90	88.90			
Dark Brown Clayey Silt, trace Gravel, Trace Sand (Moist)	394.10	483.00	76.80		
End Of Test Pit - 0.483m Bedrock Encountered Groundwater Seepage - 0.483m			76.41		
Project No.	21014			Date Started:	3/8/2021
Excavation Method:	Mini Excavator			Date Completed:	3/8/2020
Logged By:	RL			Compiled By:	RL
Checked By:	MB				

	RECORD OF TEST PIT				
	TEST PIT No.		4		
	LOCATION		Half Moon Bay, Prince Edward County, ON		
	Surface Elevation: 76.88			Pocket Penetrometer	
Description	Thickness (mm)	Total Depth (mm)	Elevation (m)	Depth (mm)	Readings Tons/ft2 & Kg/cm2
Topsoil (Moist)	88.90	88.90			
Dark Brown Clayey Silt, trace Gravel, Trace Sand (Moist)	292.10	381.00	76.79		
End Of Test Pit - 0.381m Bedrock Encountered No Groundwater Seepage			76.50		
Project No.	21014		Date Started:		3/8/2021
Excavation Method:	Mini Excavator		Date Completed:		3/8/2020
Logged By:	RL		Compiled By:		RL
Checked By:	MB				

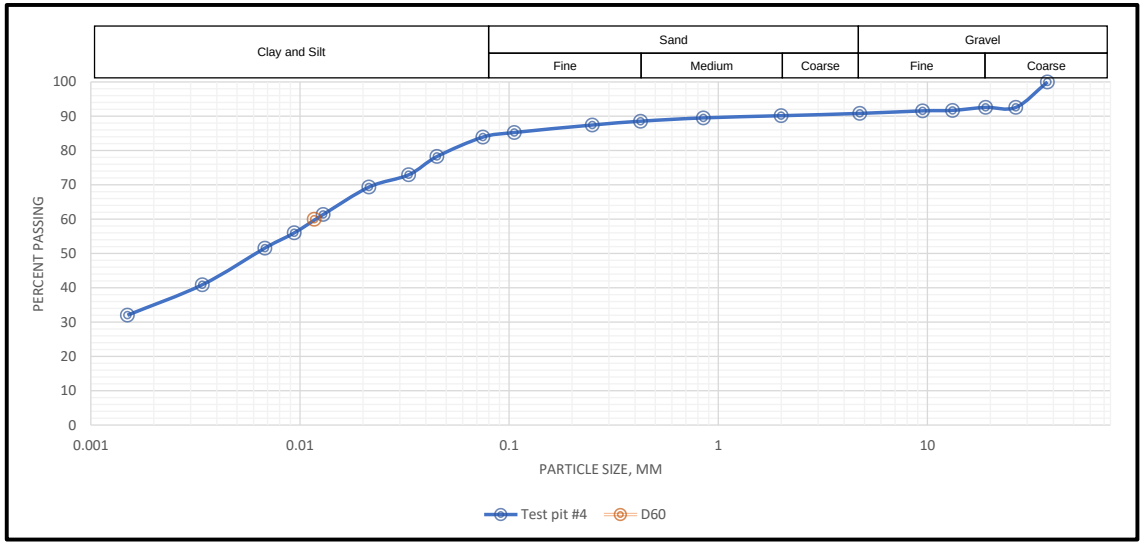
	RECORD OF TEST PIT				
	TEST PIT No.		5		
	LOCATION		Half Moon Bay, Prince Edward County, ON		
	Surface Elevation: 78.94			Pocket Penetrometer	
Description	Thickness (mm)	Total Depth (mm)	Elevation (m)	Depth (mm)	Readings Tons/ft2 & Kg/cm2
Topsoil (Moist)	88.90	88.90			
Dark Brown Clayey Silt, trace Gravel, Trace Sand (Moist)	292.10	381.00	78.85		
End Of Test Pit - 0.381m Bedrock Encountered No Groundwater Seepage			78.56		
Project No.	21014		Date Started:		3/8/2021
Excavation Method:	Mini Excavator		Date Completed:		3/8/2020
Logged By:	RL		Compiled By:		RL
Checked By:	MB				

Appendix C

Grain Size Analysis

Malroz Engineering Inc. Laboratory
745 Development Drive Unit 4B
Kingston, ON, K7M 4W6

Particle Size Analysis (LS-702)



Clay (%)	Silt (%)	Sand (%)	Gravel (%)
35	49	7	9
CLAY AND SILT, trace gravel, trace sand			

Lab No.: 0141A
Client Ref.: 21014
Client: Groundwork Engineering Ltd.
Location : Half Moon Bay Subdivsion
Coefficient of Uniformity, Cu: -

Tested: JS
Date: 2021-03-15
Depth: 15"
Sample ID: Test pit #4
Effective size, D10 (mm): -

Notes: Estimated T-time: over 50 min/cm (unacceptable)
T-time is estimated from grain size data only, in comparison to OBC 2012 SB-6, and based solely on the sample as received.

Validated:

Date: 2021-03-16

Supplementary Data:

Volume of bulb, V_B (cm^3)	57	Specific Gravity, GS (assumed):	2.7
Length of Bulb, L_2 (cm)	13.60	Dispersing Agent (g/L):	40
Scale Dimension, h_s (cm/Div.)	0.18	Area of Cylinder, A (cm^2)	28.3
Maximum Particle Size (mm):	26.5	0' to Top of Bulb, L_1 (cm)	11.0