

July 26, 2021

Adam Sketchley, P. Eng., M.A.Sc.
Project Engineer, Principal
DesignPoint Engineering & Surveying Ltd.
Via email

Dear Adam,

**Re: Geotechnical Investigation – Proposed Wastewater Upgrade
Green Road Ext. to 1369 Hwy. 2, Lantz, NS**

This provides the findings of our geotechnical investigation for the proposed upgrade of the wastewater system generally between Green Road Extension and 1369 Highway 2 in Lantz, NS. The subsurface conditions are acceptable for the planned work but the soils are fine-grained and some care will be necessary for effective reuse of the material. This report was update to include an additional Borehole (BH8) and the end of Green Road.

MAIN FINDINGS

The subsurface conditions encountered include some fills overlying native silty clay till. No bedrock was encountered. A standpipe was installed in BH7 and groundwater was measured on January 19, 2021, at a depth of 2.2 m.

Based on our investigation, our recommendations are as follows:

- The subsurface conditions are acceptable but some care will be necessary to allow for reuse of excavated material in the roadway.
- Side slopes should be stable at 1H:1V, or an approved trench box could be used for a narrower trench.
- Dewatering should be anticipated; although seepage should be relatively minor through the clayey, native soils. In particular, the soils at Borehole 1 and 2 on Green Road Extension were wet at 2 m and 3 m during drilling, suggesting groundwater at that level.
- We anticipate that directional drilling would be used for service installation below the rail right-of-way. There is a fibre service in the right-of-way too. Monitoring of surface movements during this work will be required in addition to any other precautions needed by the rail line company.
- Geotechnical inspection and testing will be necessary during earthworks.

FIELD INVESTIGATION

The field program consisted of seven boreholes (BH1 to BH7) completed on January 10, 2021 and one borehole (BH8) completed on July 16, 2021. The borehole locations are shown in Figure A and on the appended Drawing 1.

The boreholes were conducted using a geotechnical drill rig. Representative samples were taken during the field work and the conditions at the boreholes were logged in detail. The soil conditions encountered at the site are summarized in the following paragraph and Table A.

The subsurface conditions encountered generally consist of the existing gravel road structure overlying loose silty sand with gravel fill and then native silty clay glacial till. The gravel in the existing Green Road Extension and Mader Street were 150 mm (only). The boreholes were taken to a maximum depth of 4.6 m. A standpipe was installed in BH7 and groundwater was measured on January 19, 2021 at a depth of 2.2 m. Soils at Borehole 1 and 2 were wet at 2 m and 3 m.



Figure A: Borehole Locations

Table A: Summary of Findings

Location	Elevation ¹ , m	Thickness of Fill, m	Depth to Native Soils, m	Depth to Water ² , m
BH1	13.9	1.4	1.5	2.1 ³
BH2	13.7	2.1	2.1	3.0 ³
BH3	14.4	0.6	0.6	--
BH4	15.5	0.9	0.9	--
BH5	17.8	0.9	0.9	--
BH6	21.5	0.8	0.8	--
BH7	14.8	3.6	4.0	2.2
BH8	12.0	0.9	0.9	1.8 ³

1. Geodetic Datum

2. Standpipe installed in Borehole BH7

3. Water depth based on observation of samples at the time of drilling (only).

DISCUSSION AND RECOMMENDATION

It is understood that a new wastewater line will be installed. The existing lift station may be upgraded or replaced. The site conditions are generally good but some care will need to be taken because the site material is fine-grained and will be adversely affected by moisture increase. Sumps will be necessary to dewater the excavation. A 300 mm thick layer of Type 1 Gravel should be placed at the base, or if the base is wet a layer of 25 mm clear stone could be used.

Earthworks

Earthworks for this project will involve excavation for the installation of the new service and reinstatement of the road, as required as part of the trenching.

Surface Water Control and Erosion Control

Surface water drainage controls should be provided to minimize run-off onto exposed soils. Suitable erosion and sedimentation control measures should be employed. These may include silt fences, check dams in ditches, and granular working pads.

Excavation

Excavation into the site soils will be practical with conventional earth-moving equipment.

Temporary excavation side slopes in soil should be stable at one horizontal to one vertical (1H:1V).

Material selected for reuse will have to be properly stockpiled at an off-site location. Only selected drier material should be considered for reuse.

Dewatering of Excavations

With proper surface water controls, dewatering of excavations through the use of ditches and swales draining to sumps would be practical. Discharge will have to meet environmental guidelines.

Fill Placement and Compaction

Fill required for trench backfill above the pipe bedding should consist of the following:

- selected, drier excavated material, or
- imported, quarried gravel or well-graded rockfill with a maximum particle size of 200 mm.

The lift thickness used during placement of fills must be compatible with the compaction equipment and the material type to ensure the specified density throughout. The lift thickness should not exceed 300 mm.

Backfill for the lift station should consist of well-graded, granular material such as NSTIR Type 2 Gravel.

Fill materials should be compacted to the following percentage of maximum Standard Proctor dry density:

- | | |
|----------------------------------|------|
| • Base and subbase gravels | 100% |
| • Fill within 300 mm of subgrade | 98% |
| • Fill below 300 mm of subgrade | 95% |
| • Landscaped areas | 93% |

Slopes and Toe Drainage

Although not expected, permanent fill slopes should be 2H:1V, or lower. Although not expected, permanent cut slopes should be stable at 2H:1V for slope heights of less than 2 m. Cut slopes of greater heights will require a 300 mm thick granular blanket or deep rooting vegetation to reinforce the slope or a 3H:1V slope. A toe drain or swale should be provided for drainage at the base of cut slopes.

Inspection and Testing

It is recommended that inspection of fill placement in roadway area be conducted by experienced geotechnical personnel prior to placement of fill.

Roadway Areas

For reinstatement of trenches within the roadway, the subgrade should be proof-rolled. Any soft or wet material should be replaced with approved, granular material. The pavement structure should meet NSTIR standard details.

All aggregate should meet the NSTIR Standard Specifications. The gravels should be compacted to 100% of Standard Proctor maximum dry density. Asphalt should be compacted to 92.5% Marshall Method theoretical maximum density.

Please contact us if you have any questions.

Regards,



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APPENDIX A

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting good vegetative growth
<i>Peat</i>	- fibrous aggregate of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- any materials below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- >75 mm
<i>Seam</i>	- 2 mm to 75 mm
<i>Parting</i>	- < 2 mm
<i>Well Graded</i>	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes
<i>Uniformly Graded</i>	- predominantly of one grain size

Terminology describing soils on the basis of grain size and plasticity is based on the Unified Soil Classification System (USCS) (ASTM D-2488). The classification excludes particles larger than 76 mm (3 inches). This system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	Greater than 20%

The standard terminology to describe cohesionless soils includes the compactness (formerly "relative density"), as determined by laboratory test or by the Standard Penetration Test 'N' – value.

Relative Density	'N' Value	Compactness %
<i>Very Loose</i>	<4	<15
<i>Loose</i>	4-10	15-35
<i>Compact</i>	10-30	35-65
<i>Dense</i>	30-50	65-85
<i>Very Dense</i>	>50	>85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests, or occasionally by standard penetration tests.

Consistency	Undrained Shear Strength (Su)		'N' Value
	Kips/sq.ft.	KPa	
<i>Very Soft</i>	< 0.25	< 12.5	< 2
<i>Soft</i>	0.25 – 0.5	12.5 – 25	2 – 4
<i>Firm</i>	0.5 – 1.0	25 – 50	4 – 8
<i>Stiff</i>	1.0 – 2.0	50 – 100	8 – 15
<i>Very Stiff</i>	2.0 – 4.0	100 – 200	15 – 30
<i>Hard</i>	> 4.0	> 200	> 30

ROCK DESCRIPTION

Rock Quality Designation (RQD)

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on N-size (45 mm) core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from in situ fractures.

RQD	ROCK QUALITY
90 – 100	Excellent, intact, very sound
75 – 90	Good, massive, moderately jointed or sound
50 – 75	Fair, blocky and seamy, fractured
25 – 50	Poor, shattered and very seamy or blocky, severely fractured
0 – 25	Very poor, crushed, very severely fractured

Terminology describing rock mass:

Spacing (mm)	Bedding, Laminations, Bands	Discontinuities
2000 – 6000	<i>Very Thick</i>	<i>Very Wide</i>
600 – 2000	<i>Thick</i>	<i>Wide</i>
200 – 600	<i>Medium</i>	<i>Moderate</i>
60 – 200	<i>Thin</i>	<i>Close</i>
20 – 60	<i>Very Thin</i>	<i>Very Close</i>
< 20	<i>Laminated</i>	<i>Extremely Close</i>
< 6	<i>Thinly Laminated</i>	

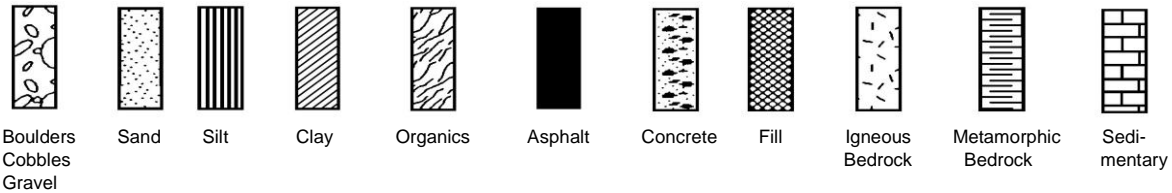
Strength Classification	Uniaxial Compressive Strength (MPa)
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing weathering:

- Slight* - Weathering limited to the surface of major discontinuities. Typically iron stained.
- Moderate* - Weathering extends throughout rock mass. Rock is not friable.
- High* - Weathering extends throughout rock mass. Rock is friable.

STRATA PLOT

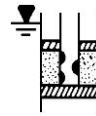
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT



Borehole or
Standpipe



Piezometer

SAMPLE TYPE AND/OR FIELD TESTS

SS	Split Spoon Sample (obtained by performing the Standard Penetration Test)	AS	Auger Sample
		BS	Bulk Sample
		WS	Wash Sample
ST	Shelby Tube or Thin Wall Tube	HQ, NQ, BQ, etc.	Rock Core Samples (obtained with the use of standard size diamond drilling bits)
PS	Piston sample		
DC	Dynamic Cone Penetration		
FSV	Field Shear Vane		

N- VALUE

Numbers in this column are the results of the SPT (Standard Penetration Test): the number of blows of a 140 pound (64kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and 'N' values cannot be presented, the abbreviation SSR (Split Spoon Refusal) will appear in place of a numerical value.

OTHER TESTS

Symbols in this column indicate that the following laboratory tests have been carried out and the results are presented separately.

S	Sieve analysis	H	Hydrometer analysis
G _s	Specific gravity of soil particles	□	Unit weight
k	Permeability	C	Consolidation
↓	Single packer permeability test; test interval from depth shown to bottom of borehole	CD	Consolidated drained triaxial
I	Double packer permeability test; Test interval as indicated	CU	Consolidated undrained triaxial with pore pressure measurements
○↓	Falling head permeability; using casing	UU	Unconsolidated undrained triaxial
▽↓	Falling head permeability test using well point or piezometer	DS	Direct shear
		Q _u	Unconfined compression
		I _p	Point Load Index (I _p on Borehole Records equals I _p (50); the index corrected to a reference diameter of 50 mm)
		MSV	Laboratory Miniature Shear Vane

[illegible]

BOREHOLE RECORD

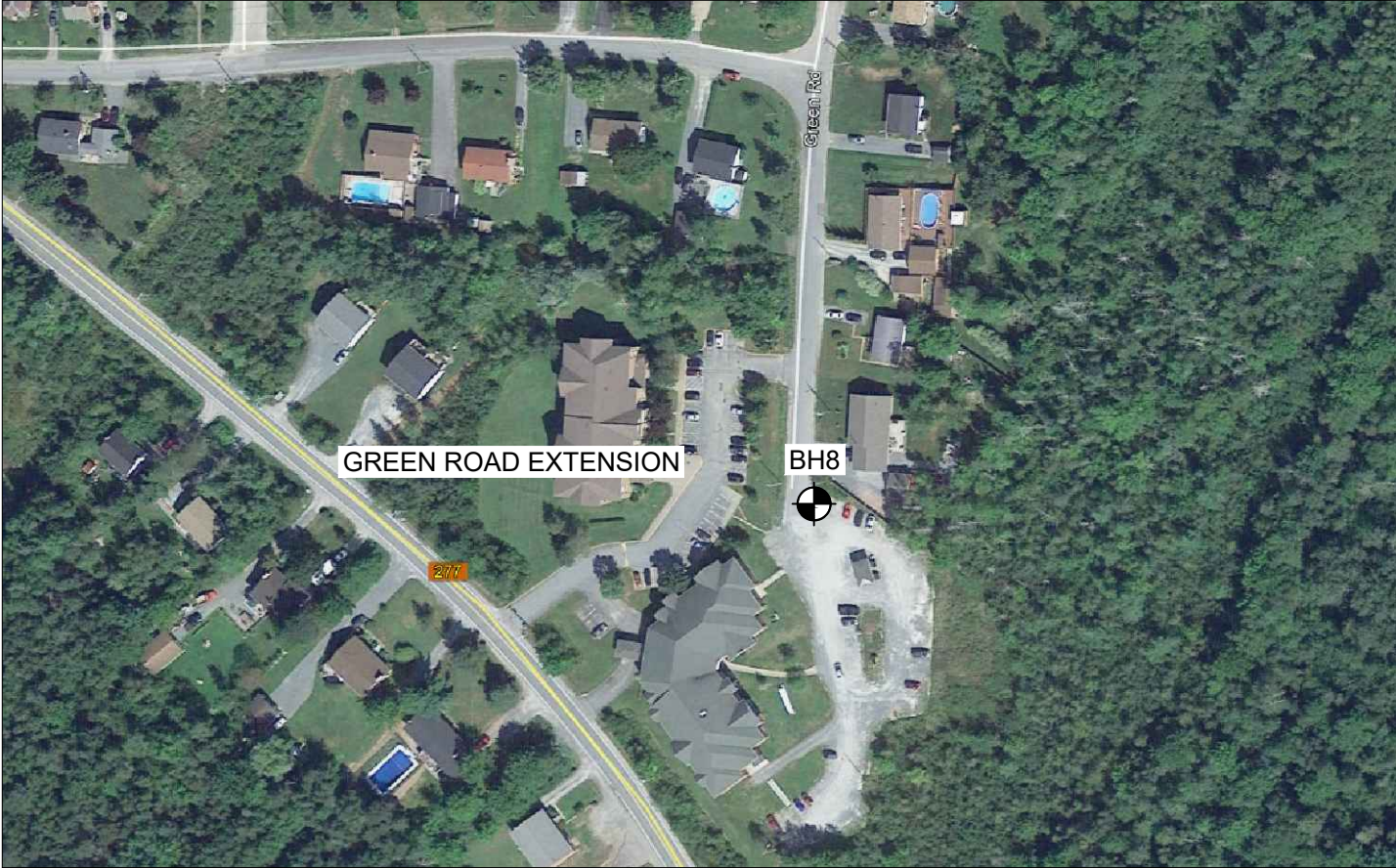
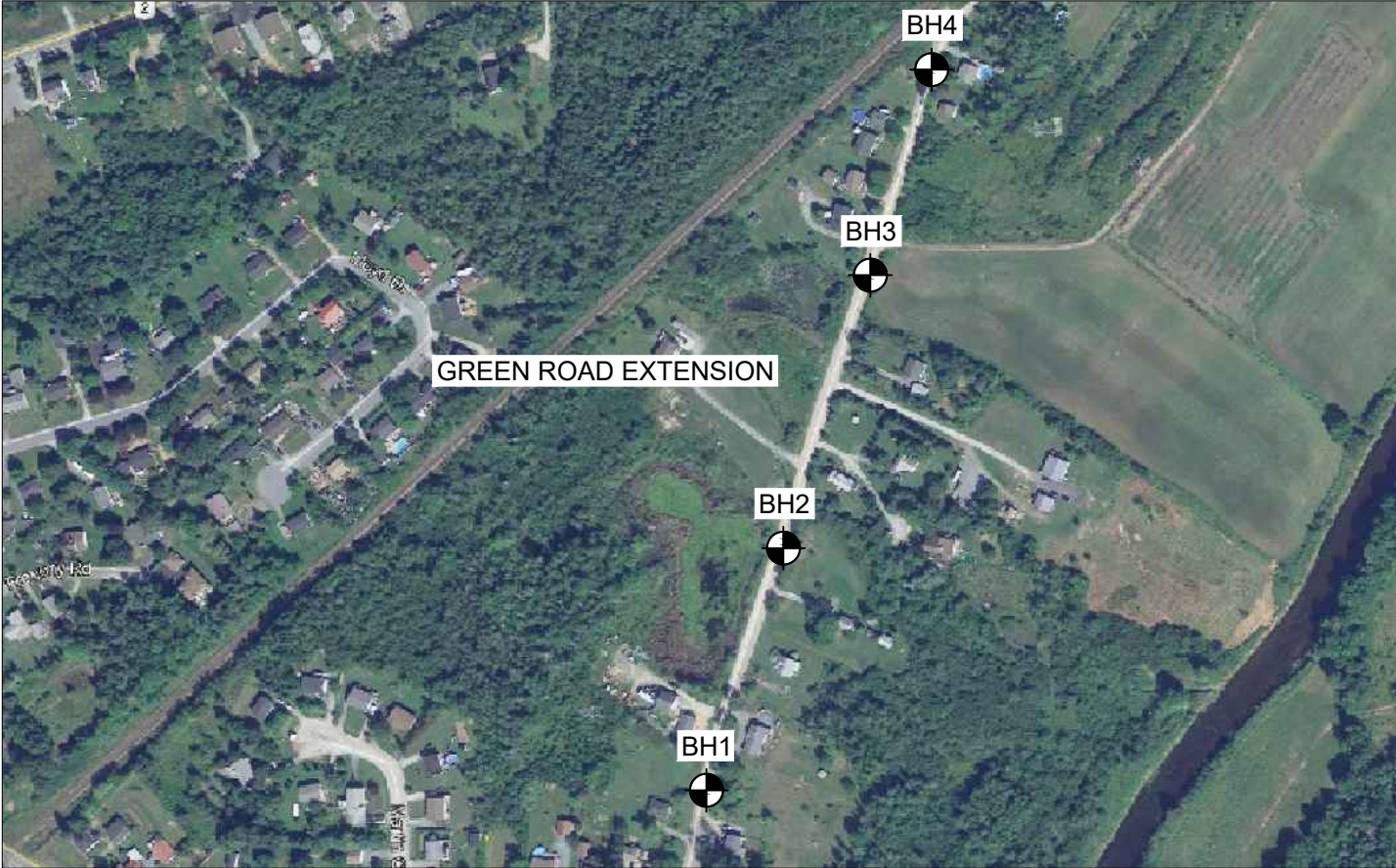
BOREHOLE RECORD

BOREHOLE RECORD



Borehole No.: 6
Sheet 1 of 1
Date Drilled: January 10, 2021
Datum: Geodetic

BOREHOLE RECORD

Borehole No.: 8
Sheet 1 of 1
Date Drilled: July 16, 2021
Datum: Geodetic



LEGEND

-  BH1 - BH7 BME Boreholes (January 2021)
-  BH8 BME Boreholes (July 2021)

BME Engineering Ltd. <small>61 Bluewater Road Bedford, NS B4B 1G8</small>	Lantz Wastewater Upgrades		JOB #:	154-009	DOCUMENTS PREPARED BY BRUCE MACNEIL ENGINEERING LTD. ARE TO BE USED ONLY FOR THE SPECIFIC PROJECT AND SPECIFIC USE FOR WHICH THEY WERE PREPARED. ANY EXTENSION OF USE TO OTHER PROJECTS, BY OWNER, OR ANY OTHER PARTY, WITHOUT THE EXPRESSED, WRITTEN AUTHORIZATION OF BRUCE MACNEIL ENGINEERING LTD. IS DONE AT THE USER'S OWN RISK. IF USED IN A WAY OTHER THAN WHAT WAS SPECIFICALLY INTENDED, THE OWNER WILL HOLD BRUCE MACNEIL ENGINEERING LTD. HARMLESS FROM ALL CLAIMS AND LOSSES.	1
	Borehole Locations		SCALE:	NTS		
	Lantz, NS		DATE:	21-JULY-2021		
			DRAWN BY:	AH		
			CHECKED BY:	RBM	REV:	0