

June 10, 2019

**Mr. Chris Boudreau, P. Eng.**  
**Strum Consulting Ltd.**  
Via email

Dear Mr. Boudreau,

**Re: Geotechnical Investigation – Proposed Road, Mount Uniacke Business Park  
Mount Uniacke, NS**

This provides the findings of our geotechnical investigation for the proposed road in the Mount Uniacke Business Park on James Boyle Drive in Mount Uniacke, NS. Bedrock was encountered at shallow depths between 0.0 m to 1.2 m from existing grades. Blasting or hydraulic breaking may be needed depending on design grades. Recommendations are provided herein for road design and earthworks for the proposed development.

#### **MAIN FINDINGS**

The subsurface conditions encountered include rootmat and topsoil overlying native soil and/or bedrock. Native soil was encountered in four test pits (TP5, TP8, TP9, and TP10) at depths of 0.3 m to 0.6 m. Bedrock was encountered in all test pits at depths of 0.0 m to 1.2 m. No groundwater was encountered during testing pit excavation.

Based on our investigation, our recommendations are as follows:

- The subsurface conditions are generally favourable, but bedrock is very shallow and bedrock excavation will be necessary if that are any cuts to achieve design subgrade elevations. Bedrock excavation is typically a more costly item. The bedrock on the site is slate of the Halifax Formation, which many times is found to be a sulphide bearing materials, which is a regulated material under the NS Environment Act. The results from the test pits show that the bedrock is not a sulphide bearing material. However, additional sulphide sulphur testing should be conducted if there are cuts of more than 0.5 m into bedrock. If the bedrock in deeper cuts (if any) is not a sulphide bearing materials, then excavated slate material could be considered for reuse as subgrade fill. Some sorting or processing of the material may be necessary to allow for reuse.
- Geotechnical inspection and testing will be necessary during earthworks.

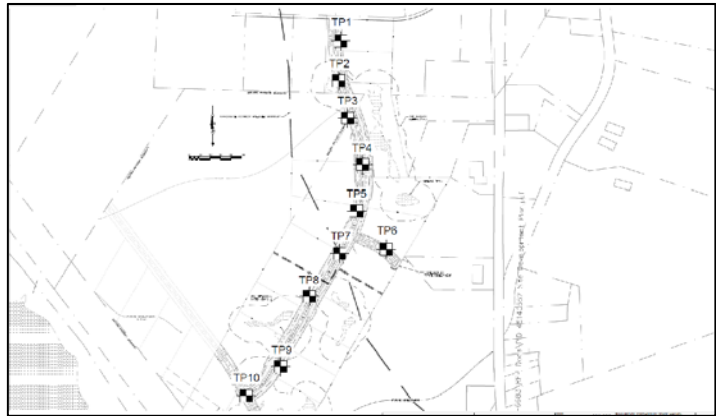
## FIELD INVESTIGATION

The field program consisted of ten test pits (TP1 to TP10) completed on May 30, 2019. The test pit locations are shown in Figure A and on the appended Drawing 1.

The test pits were conducted using an excavator. Representative samples were taken during the field work and the conditions at the test pits 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 rootmat and topsoil overlying native soil and/or bedrock. Native soil was encountered in four test pits at depths of 0.3 m to 0.6 m. Bedrock was encountered in all test pits at depths of 0.0 m to 1.2 m. No groundwater was encountered.

Three (3) bedrock samples were collected and submitted to Dalhousie Minerals Engineering Centre for sulphide sulphur testing. The results show non-detectable sulphide sulphur in all three samples. The results are shown in the appended report.



**Figure A: Test Pit Locations**

**Table A: Summary of Findings**

<b>Location</b>	<b>Elevation<sup>1</sup>, m</b>	<b>Thickness of Rootmat/Topsoil, m</b>	<b>Depth to Native Soil, m</b>	<b>Depth to Bedrock, m</b>	<b>Depth of Test Pit, m</b>
TP1	161.3	0.3	--	0.3	0.3
TP2	159.4	0.3	--	0.3	0.3
TP3	157.7	0.1	--	0.1	0.1
TP4	157.7	0.2	--	0.2	0.2
TP5	156.6	0.6	0.6	1.2	1.5
TP6	152.4	0.0	--	0.0	0.0
TP7	153.6	0.0	--	0.0	0.0
TP8	148.7	0.4	0.4	0.6	0.7
TP9	143.1	0.6	0.6	1.1	1.1
TP10	137.5	0.3	0.3	0.4	0.4

1. Geodetic Datum

## DISCUSSION AND RECOMMENDATION

It is understood that a new road and is proposed for the site. The site conditions are generally good with rootmat/topsoil and/or native soil overlying bedrock. Bedrock outcrops were frequently encountered throughout the site.

### Earthworks

Earthworks for this project will involve excavations of rootmat and topsoil to native soil and/or bedrock, and cuts and fills depending on design grades.

#### Surface Water Control and Erosion Control

Prior to excavations, surface water drainage controls should be provided on the up-gradient (north) side of the site 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. Bedrock removal may require blasting or rock breaking, depending on design grades. Some ripping of the bedrock surface may be possible with a large dozer but the this may be limited.

Temporary excavation side slopes in soil should be stable at one horizontal to one vertical (1H:1V). Bedrock slopes can be cut 1H:4V, pending review at the time of construction.

#### Dewatering of Excavations

With proper surface water controls, dewatering of excavations through the use of ditches and swales draining to sumps would be practical.

#### Fill Placement and Compaction

Fill required for road subgrade should consist of the following:

- selected excavation site soil or bedrock with a maximum particle size of 200 mm, 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 approximately 200 mm for backfilling of foundations and services.

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 driveway/parking subgrade | 98%  |
| • Fill below 300 mm of driveway/parking subgrade  | 95%  |
| • Landscaped areas                                | 93%  |

### Slopes and Toe Drainage

Permanent fill slopes should be 2H:1V, or lower. 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 all traffic bearing surfaces be conducted by experienced geotechnical personnel prior to placement of fill. Inspection and testing is also recommended during site grading and backfilling operations.

### **Road Structure**

The road areas should be cut to subgrade elevation and proof-rolled. Any soft or wet material should be replaced with approved, granular material. The slate bedrock may actually breakdown into a finer material if there is repeated construction trucking directly on the material. This should be avoided or the contractor should replace such material with approved granular fill.

The following pavement structure from the Specifications for Subdivision Road would be acceptable. The use of a geotextile should be considered depending on design elevations and the time of year of construction.

Material	Thicknesses
Asphalt, Mix Type C-HF Mix Type B-HF	40 mm 100 mm
Type 1 Gravel Type 2 Gravel	150 mm 450 mm

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

If there are any unpaved yard areas, a geotextile (such as Terratrack 400) could be added at subgrade level for strength and separation.

Please contact us if you have any questions.

Regards,



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Senior Geotechnical Engineer  
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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>	

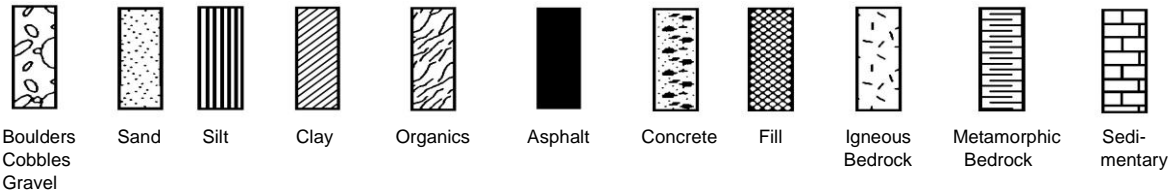
Strength Classification	Uniaxial Compressive Strength (MPa)
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing weathering:

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

## STRATA PLOT

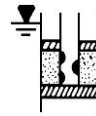
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



## 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 <sub>s</sub>	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 <sub>u</sub>	Unconfined compression
		I <sub>p</sub>	Point Load Index (I <sub>p</sub> on Borehole Records equals I <sub>p</sub> (50); the index corrected to a reference diameter of 50 mm)
		MSV	Laboratory Miniature Shear Vane



## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS





Water Level Date: --

Test Pit: 1

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0	   	Ground Surface	161.3				
		ROOTMAT/TOPSOIL					
			161.0				
		End of Test Pit at 0.3 m - REFUSAL ON BEDROCK - no groundwater encountered					
1							
2							
3							
4							
5							

## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS




Water Level Date: --

Test Pit: 2

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0	  	Ground Surface	159.4		RS	1	
		ROOTMAT/TOPSOIL					
		End of Test Pit at 0.3 m - REFUSAL ON BEDROCK - no groundwater encountered	159.1				
1							
2							
3							
4							
5							



## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS



Water Level Date: --

Test Pit: 3

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	157.7				
		ROOTMAT	157.6				
		End of Test Pit at 0.1 m - REFUSAL ON BEDROCK - no groundwater encountered					
1							
2							
3							
4							
5							



## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS

Water Level Date: --

Test Pit: 4

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	157.7				
		ROOTMAT/TOPSOIL	157.5				
		End of Test Pit at 0.2 m - REFUSAL ON BEDROCK - no groundwater encountered					
1							
2							
3							
4							
5							

## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS

Water Level Date: --

Test Pit: 5

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	156.6				
		ROOTMAT/TOPSOIL					
			156.0				
		TILL: Compact to dense light brown to brown silty sand with gravel - occasional cobble					
1			155.4				
		WEATHERED BEDROCK					
			155.1				
		End of Test Pit at 1.5 m - REFUSAL ON BEDROCK - no groundwater encountered			RS	1	
2							
3							
4							
5							



## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS

Water Level Date: --

Test Pit: 6

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	152.4				
		BEDROCK OUTCROP					
		End of Test Pit at 0.0 m - REFUSAL ON BEDROCK					
		- no groundwater encountered					
1							
2							
3							
4							
5							



## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS

Water Level Date: --

Test Pit: 7

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	153.6				
		BEDROCK OUTCROP End of Test Pit at 0.0 m - REFUSAL ON BEDROCK - no groundwater encountered					
1							
2							
3							
4							
5							

## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS

Water Level Date: --

Test Pit: 8

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	148.7				
		ROOTMAT/TOPSOIL					
			148.3				
		TILL: Compact to dense light brown to brown silty sand with gravel - occasional cobble	148.1				
		WEATHERED BEDROCK	148.0				
		End of Test Pit at 0.7 m - REFUSAL ON BEDROCK - no groundwater encountered					
1							
2							
3							
4							
5							

## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS

Water Level Date: --

Test Pit: 9

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0		Ground Surface	143.1				
		ROOTMAT/TOPSOIL					
			142.5				
		TILL: Compact grey silty sand with gravel					
1			142.0		GS	1	
		End of Test Pit at 1.1 m - REFUSAL ON BEDROCK - no groundwater encountered					
2							
3							
4							
5							

## TEST PIT RECORD

Project Name: Mount Uniacke Business Park

Project No.: 093-008

Client: Strum Consulting

Location: Mount Uniacke, NS





Water Level Date: --

Test Pit: 10

Sheet: 1 of 1

Date Drilled: May 30, 2019

Datum: Geodetic

SUBSURFACE PROFILE				SAMPLE			Comments
Depth (m)	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Water Level (m)	Type	Number	
0	   	Ground Surface	137.5				
		ROOTMAT/TOPSOIL					
			137.2				
		TILL: Compact greyish brown to brown silty sand with gravel	137.1				
		End of Test Pit at 0.4 m - REFUSAL ON BEDROCK - no groundwater encountered			RS	1	
1							
2							
3							
4							
5							



Photograph 1: A view of the site looking east. May 30, 2019.



Photograph 2: A view of the site looking south. May 30, 2019.



Photograph 3: A view of the site looking south/southeast. May 30, 2019.



Photograph 4: A view of the site looking west. May 30, 2019.



Photograph 5: Excavating test pit 1. May 30, 2019.



Photograph 6: Test pit 1. May 30, 2019.



Photograph 7: Test pit 2. May 30, 2019.



Photograph 8: Test pit 3. May 30, 2019.



Photograph 9: Test pit 4. May 30, 2019.



Photograph 10: Test pit 5. May 30, 2019.



Photograph 11: Test pit 8. May 30, 2019.



Photograph 12: Test pit 9. May 30, 2019.



Photograph 13: Test pit 10. May 30, 2019.

06-Jun-19

BME - Bruce MacNeil Engineering  
61 Bluewater Road  
Bedford, NS  
B4B 1G8  
Atten: Michael Sanford

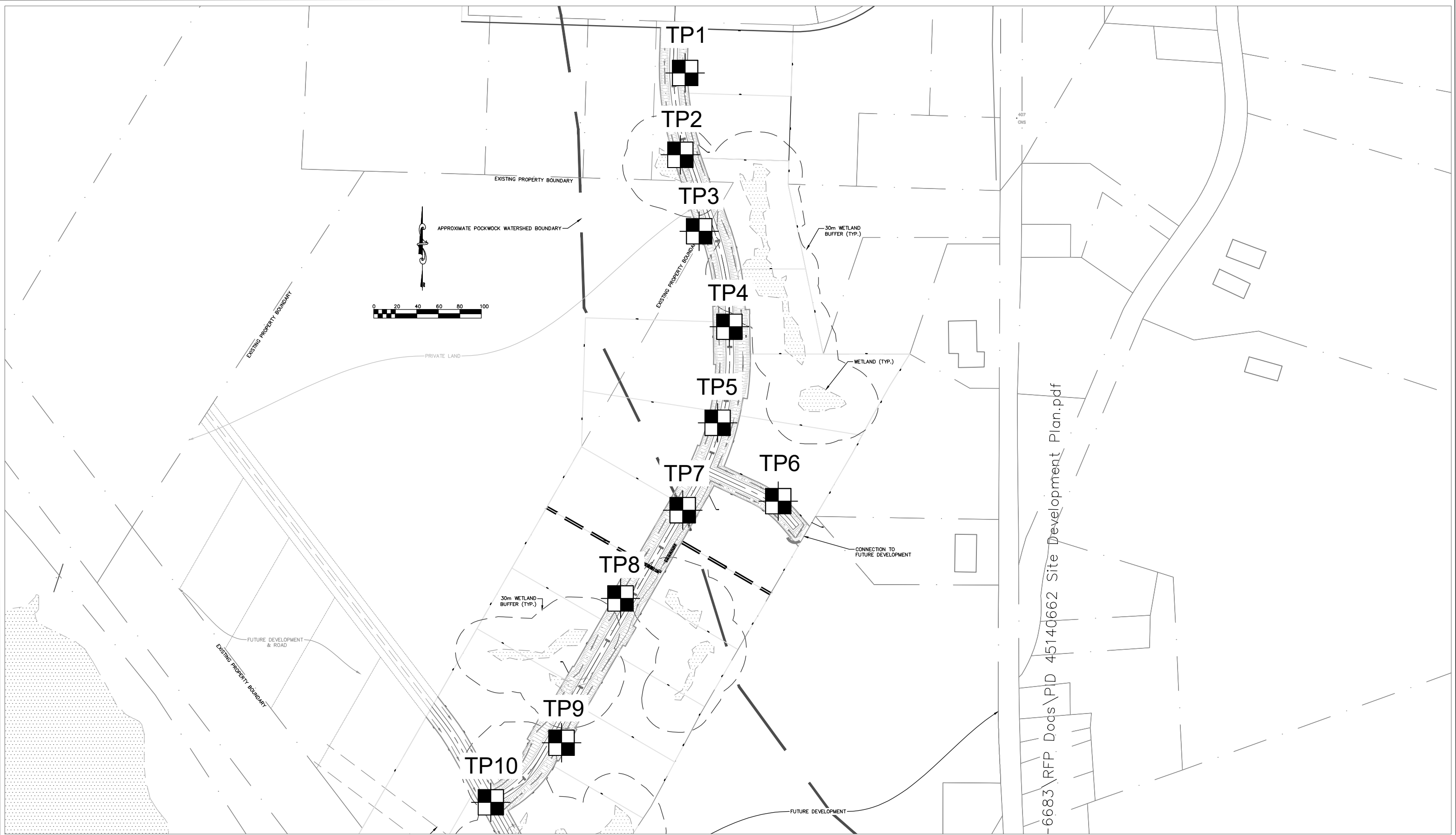
**RUSH**

Re: Results of analysis on submitted samples.  
PN#

Sample	Wt. %		kg/t
	S(Total)	S(Sulphide)	Acid Prod. Potential
BME Engineering - TP2	<0.001	NR	<0.03
BME Engineering - TP5	<0.001	NR	<0.03
BME Engineering - TP8	<0.001	NR	<0.03

Refer. Sample	Wt. % S (Total)
KZK-1 (0.80% S)	0.800

Daniel Chevalier, MASc  
Manager, Minerals Engineering Centre



**BME** Engineering Ltd.

61 Bluewater Road  
Bedford, NS  
B4B 1G8

Mount Uniacke Business Park

Test Pit Locations

James Boyle Drive  
Mount Uniacke, NS

JOB #:	093-008
SCALE:	1:5000
DATE:	30-MAY-19
DRAWN BY:	AH
CHECKED BY:	RBM

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1  
REV: 0