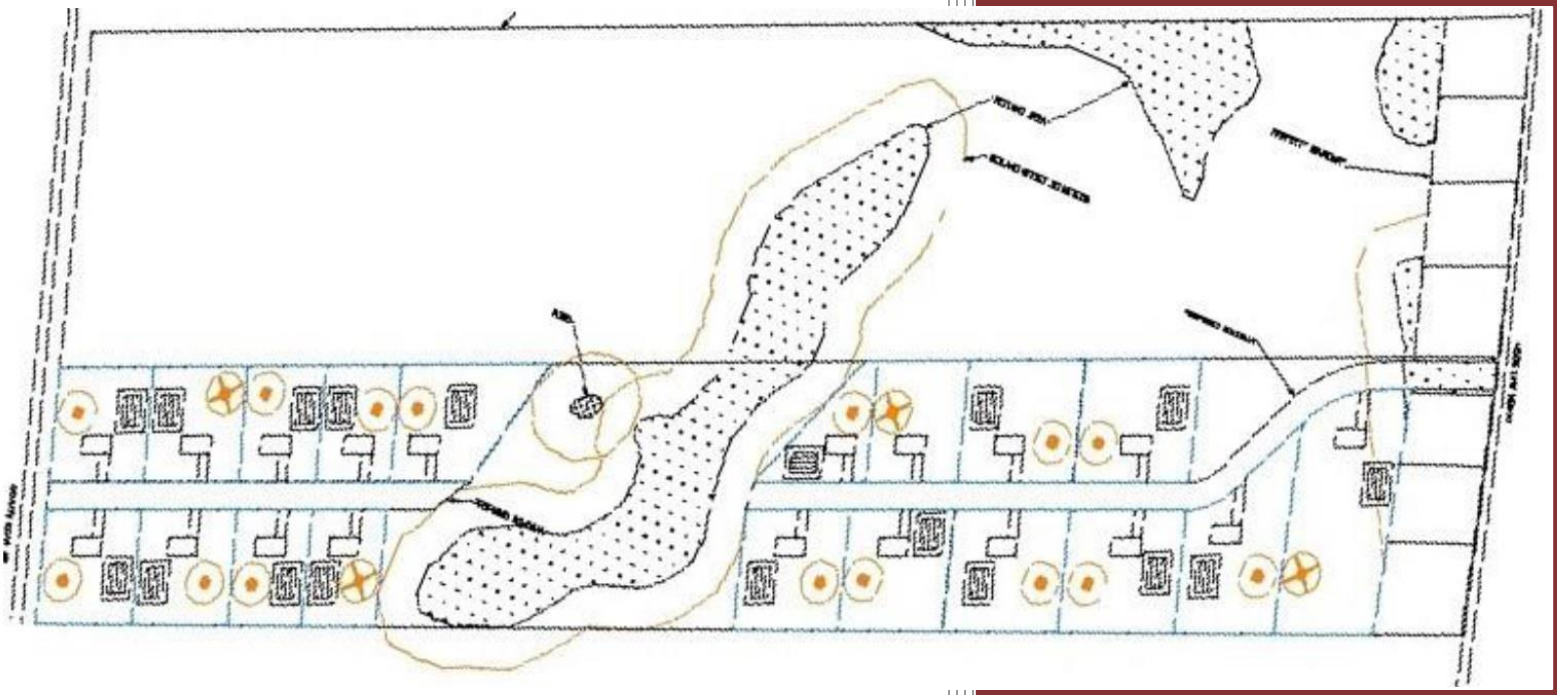
**Project No. 21-1-6814**

# 1919 Estates

## Geotechnical Report



**Terraspec Engineering Inc.**
**Geotechnical Engineers**
**973 Crawford Drive**
**Peterborough, Ontario**
**K9J 3X1**

**TABLE OF CONTENTS**



**APPENDICES**

# terraspec engineering inc.
**geotechnical engineers and materials testing**

**973 Crawford Drive**
**Peterborough, ON** **Telephone (705) 743-7880**
**K9J 3X1** **Fax (705) 743-9592**

December 06, 2021

To: Greer Galloway
Consulting Engineers
973 Crawford Drive
Peterborough, ON, K9J 3X1

**Re: Geotechnical Report,**
**Proposed Residential Subdivision, 1919 Estates**
**Location: Bobcaygeon, Ontario**
**Project Reference 21-1-6814**

**Introductory Comments**
Please accept this Report as a follow-up to the Geotechnical Report previously issued on this property under date of December 18, 2017.

The property has undergone a change of ownership, effective April 2021, from Andrew Anderson to Jeffery Homes.

The Andrew Anderson ownership had envisioned a 19 lot residential subdivision development on the south half of the property whereas the Jeffery Homes ownership proposes a 48 lot residential subdivision development on the entire property.
i.e. - 22 lots on the south part of the property, referenced hereafter as 1919 Estates, Phase 1, and
26 lots on the north part of the property, referenced as 1919 Estates, Phase 2.

The previous Geotechnical Report issued to Andrew Anderson pursuant to the south part of the property can be fully accepted as a Geotechnical Report for the Jeffery Homes proposal to develop 22 lots on the south part of the property as 1919 Estates, Phase 1. The former report is hereby edited and adjusted, as and where required, to support the Jeffery Homes Phase 1 proposal.

**General Site Data**
The project is located at 168 County Road 49, at (or near) Bobcaygeon, Ontario. The site consists mainly of undeveloped land and is still being proposed for a residential subdivision. A

Site Plan illustrating the extent and location of the property, and the proposed two phased development proposal is appended to this report.

**Investigation**

This soils investigation and resultant data pertains to only the south half of the property because that was the extent of the proposed development by the previous property owner in 2017 when this soils investigation was authorized. All of that site investigative activity and resultant data is now offered as relative information pursuant to the Jeffery Homes proposal for Phase 1 of its newly suggested 1919 Estates subdivision proposal. Ten (10) exploratory test holes were placed on site in 2017 using a track mounted excavator. All test holes are properly located and noted on the appended Site Plan.

**Soil Conditions**

The on-site soil layers are as follows:
A silty topsoil, with typical thicknesses of 200mm to 300mm,
overlying a silty sand layer containing gravel traces, which is typically compact and 600mm thick, overlying a silty sand and gravel/cobble till, in a dense condition.
Groundwater was encountered at the west end of the project at depths of 1.0m to 1.5m below the existing ground surface.
Bedrock was also encountered at the same west end of the project, at typical depths of 2.5m below the existing ground surface.

**OHSA Soil Types**

The on-site subsoils can be classified as Type 3 soils. Type 3 soils should be treated as Type 4 soils if future construction activity is required below the groundwater table.

**Laboratory Analysis**

Atterberg Limits Testing indicated all native soils are typically non-plastic.

The soil physiography at this site can be defined as till moraines, with exposed limestone plains at the northeast corner. The predominant soil type is a gravelly loam till, very stoney. The Soil Group is Brown Forest. The encountered bedrock is limestone of the Trenton Group.

## Recommendations

### 1. Cut and Fill Options

The total site elevation could be cut down (lowered) if necessary. The underlying till soils are ideal for new home building foundations, but cutting the site down will bring the foundations closer to the groundwater table which could be problematic if full basements are being proposed in the new houses.

The total site elevation could also be raised by as much as 2.0m if preferred. This is not deemed to be a necessity, but the topsoil layer is thick and would require complete removal prior to raising the site. Clean fill should be utilized to raise the site if that becomes a requirement.

The native silty sand and gravel/cobble till subsoils on site can be re-used as acceptable subgrade fill material. Any imported fill materials meeting OPSS 1010 SSM specifications, such as sand or silty sand, are also suitable fill materials.

### 2. Permeability and Erosion

The drainage of the native subsoils can be classified as medium.

The hydraulic permeability is estimated as follows:
silty sand and gravel/cobble till $k = 10^{-5}$ cm/sec. T time = 15 min/cm.

The erodibility of the native soils is rated low to moderate,
with a Wischmeier K value in the range of 0.30.

The site is generally covered with short grass and bushes.
The existing vegetation should be maintained in its undisturbed state as much as possible to provide continued resistance to ground surface erosion during the construction activities.

A standard application of rip rap placed over a Type 2 non-woven geotextile cloth can be utilized for areas requiring erosion protection measures. i.e.- pipe culvert outlets.

### 3. New House Foundations

Shallow depth footings for new houses should have minimum soil cover of 1.5m for frost protection.

Spread or strip footings can be placed on the undisturbed native soils as listed below. Assuming a finished footing embedment depth of 1.5m, native soil bearing capacities will typically be available at the base of the new footings as follows:

silty sand and gravel/cobble till:
- Factored ULS bearing capacity of 300 kPa
- SLS allowable bearing capacity of 200 kPa

All new footing areas should be inspected by a licensed P.Eng. prior to placement to ensure the native subsoils are undisturbed and that minimum bearing capacities as noted above are obtained. The noted bearing capacities will be reduced where footings are being placed onto wet subgrade soils.

The licensed P.Eng. should also be consulted to set all new basement floor elevations.

## 4. Dewatering

Extensive dewatering operations during construction are not expected to be required if the footings are placed onto the silty sand and gravel/cobble till areas.

A pumping operation with standard sump pump equipment is anticipated to be sufficient for dewatering.

Care should be taken to prevent ponding and the presence of excessive rainfall during the construction operations and to control excess run-off that could lead to surface erosion problems.

The construction contract should also stipulate that the integrity of all native soil surfaces and soil bearing capacities must be preserved at all times.

Excessive on-site construction traffic will distort and soften (or weaken) the surface subgrade. Accordingly, all on-site traffic operations should be supported by creating internal traffic lanes by placing a 100mm depth of 4inch minus rock fill base material.

## 5. Seismic Parameters

The following seismic design parameters may be utilized:

Site Class C  Soil Shear Wave Average Velocity (m/s) = 360 < Vs < 760

The peak ground acceleration value for the Bobcaygeon area as per the OBC is PGA = 0.087.

## 6. Geotechnical Parameters

When calculating vertical and lateral earth pressures or other geotechnical parameters, the following unfactored coefficients may be utilized:

Native Silty Sand and Gravel/Cobble Till
phi = 35$^{o}$
Ka = 0.27; Ko = 0.43; Kp = 3.69.
Moist unit weight = 22.0 kN/m3
Coefficient of friction for the concrete/till interface = 0.55

Typical Imported Sandy Granular B Type 1 Backfill
phi = $32^o$
Ka = 0.31; Ko = 0.47; Kp = 3.25.
Moist unit weight = 22.3 kN/m3

Typical Imported Gravelly Granular B Type 1 Backfill
phi = $35^o$
Ka = 0.27; Ko = 0.43; Kp = 3.69.
Moist unit weight = 23.0 kN/m3

## 7. Subdrains

New houses having basement floor levels should be provided with subdrains consisting of perforated geotextile-wrapped pipes placed at the footing depth along the outside perimeter of the footings. The pipes should be 150mm diameter, and graded to positive outlets away from the foundation.

Backfilling operations to subdrain trenches should be completed with OPSS 1004 clear stone. Free-draining granular materials should be placed as backfill to all new foundation walls.

## 8. Concrete

The frost penetration depth at this site is 1.5m. All concrete placed within the frost penetration depth or exposed to outside extreme temperatures should consist of a 32MPa concrete mix, with 7% air entrainment.

General use (Type 10) concrete cement is suitable for this project.

## 9. Re-Use of Subsoils

The native subsoils found on site cannot be used as fill beneath structures. Any new fill required beneath new structures must be an engineered granular fill such as OPSS 1010 Granular B, Type 1.

## 10. Floor Slabs

The following minimum thickness requirements are recommended for standard slab-on-grade floors:

| | |
|---|---|
| Concrete Slabs | 127mm; (25MPa compressive strength) |
| OPSS 1010 Granular Base | 150mm |
| OPSS 1010 Granular B Type 1 subbase | 200mm |
| Over compact native subgrade soil | |

The subgrade soil surface must be proof-rolled to ensure acceptability for placement of the base and subbase materials. All deleterious soil or organics such as roots or branches must be removed from beneath the new floor area. Deleterious soils may be replaced by an acceptable subgrade fill material, or OPSS 1010 SSM.

## 11. Pipe Installation

New underground piping should follow OPSD Standards, as follows:

Soil Subgrade

| | | | |
|---|---|---|---|
| OPSD 802.010 | Flexible Pipe | - | Type 3 Earth Excavation |
| OPSD 802.031 | Rigid Pipe | - | Type 3 Earth Excavation, Class B |

Granular bedding and cover depth should be as per OPSD standards.
For normal subgrade conditions, OPSS Granular A may be utilized for pipe embedment and pipe cover material for new piping.

For wet subgrade conditions, a crushed rock should be utilized for pipe bedding and coverings, such as OPSS 1010 Granular B Type 2 with 100% passing the 50mm sieve, or Clear Stone.

Frost protection for underground piping should be utilized as per OPSD standards, with a frost treatment depth of k = 1.5m:

| | |
|---|---|
| OPSD 803.030 | Frost Penetration Line Below Bedding Grade |
| OPSD 803.031 | Frost Penetration Line Above Bedding Grade |

## 12. Pavement Design

At all new roadway locations, all organic soils must be removed from the subgrade materials. Earth grading and crossfall must comply with OPSD 200.01 to prevent ponding of water on the soil subgrade, and to provide effective drainage of the new pavement structure.

Proof-rolling of the subgrade soil must be undertaken to ensure it is acceptable for placement of the new granular subbase and base materials.

The following minimum pavement design as per OPSS 1150 specification is recommended for new pavement:

| | |
|---|---|
| HL3 Surface Course | 40mm |
| HL8 Binder Course | 50mm |
| OPSS 1010 Granular A base | 150mm |
| OPSS 1010 Granular B Type 1 | 300mm |

SuperPave hot mix as per OPSS 1151 can be substituted for OPSS 1150, if desired.

The hot mix substrates should be tack coated with asphalt cement having a minimum rating of PGAC 58 -34 prior to placing the surface course as per OPSS.PROV 308.

The construction contract should stipulate that all hot mix paving operations must be carried

out in accordance with OPSS 310 specifications, and that the surface course should be delayed until the new house construction program is complete. This will provide for a better finished product, and allows time to repair any defects in the Binder Course caused by the house construction program.

**13. Compaction Requirements**

All native soil and granular fill compaction requirements for the project should conform with OPSS 501, Subsection 501.08.02 - Method A, utilizing soil placement in maximum 300mm lifts and a compaction standard of 100% of Standard Proctor Maximum Dry Density.

**Statement of Limitations**

This report is intended for the guidance of the project design team.

From a construction viewpoint, contractors must make their own assessment of the soil and groundwater conditions, and how those issues might affect their proposed construction operations, techniques, and schedules.

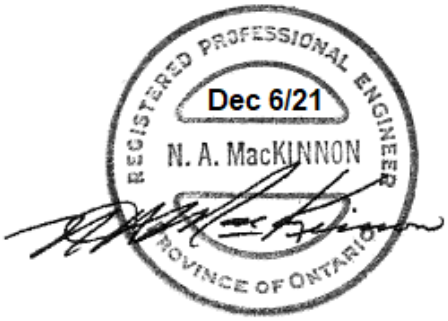
The recommendations in this report are based on information and data acquired at the test holes and from the laboratory analysis. Soils and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations and conditions may become apparent during construction that could not be detected or anticipated at the time of the soils investigation. If that occurs and appears to be detrimental to the construction program, a Terraspec representative should be contacted and recalled to the site for further consultation, testing, and analysis.

Terraspec should also be retained during the construction program to ensure that all subgrade preparation requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in test holes. In cases where any of our recommendations are not followed, the company's responsibility is limited to interpreting the information from the test hole data.

This report is applicable only to this project, being constructed substantially in accordance with the details of alignment and elevations as quoted in the report.

~ ~ ~

**TERRASPEC ENGINEERING INC.**
**GEOTECHNICAL ENGINEERS**




Shane Galloway, B.A.
Manager

N.A. MacKinnon, P.Eng.
Senior Engineer

**Test Hole Data**
**1919 Estates Phase 1**

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**Notes**

1. Soil types, strata, and groundwater conditions have been established only at test hole locations.
2. Soils are described according to the MTO Soils Classification System and OPSD 100.06.
3. Dimensions are in millimetres up to 1 metre, then in metres thereafter.

**Abbreviations**

| | | | | | |
|---|---|---|---|---|---|
| asph | - | asphalt | & | - | and |
| blds | - | boulders | w | - | with |
| blk | - | black | so | - | some |
| br | - | brown | tr | - | trace |
| BR | - | bedrock | | | |
| cl | - | clay(ey) | S | - | soil sample |
| cob | - | cobbles | Su | - | vane shear strength (kPa) |
| conc | - | concrete | | | |
| cr | - | crushed | | | |
| f | - | fine | | | |
| gr | - | gravel(ly) | | | |
| gry | - | grey | | | |
| med | - | medium | | | |
| NFP | - | no further progress | | | |
| org | - | organics | | | |
| RF | - | rock fill | | | |
| sa | - | sand(y) | | | |
| si | - | silt(y) | | | |
| tps | - | topsoil | | | |

**TH #1**

| | | | |
|---|---|---|---|
| 0 | - | 150 | br si tps |
| 150 | - | 600 | br si sa & gr -moist, compact |
| 600 | - | 3.10 | lt br si sa & gr/cob -wet, compact |

-perched water at 910mm
-water accumulated to a 2.44m depth in the test hole

**TH #2**

| | | | |
|---|---|---|---|
| 0 | - | 240 | br si tps |
| 240 | - | 610 | br si sa tr gr -moist, compact |
| 610 | - | 2.30 | lt br si sa & gr/cob -moist, compact S1 at 1.3m |
| 2.30 | - | NFP, flat limestone BR, sound | |

-perched water at 1.6m

**TH #3**

| | | | |
|---|---|---|---|
| 0 | - | 200 | br si tps |
| 200 | - | 560 | br si sa tr gr -moist, compact |
| 560 | - | 1.71 | lt br si sa & gr tr cob -moist, compactS2 at 1.6m |
| 1.71 | - | 2.10 | flat shale/limestone fragments -dry, dense |
| 2.10 | - | 2.50 | gry gr & sa -moist, very dense |
| 2.50 | | | NFP, flat limestone BR, sound |

-slight perched water at 1.1

**TH #4**

| | | | |
|---|---|---|---|
| 0 | - | 180 | br si tps |
| 180 | - | 530 | br si sa tr gr -dry, compact |
| 530 | - | 2.10 | lt br si sa & gr/cob -moist, dense |
| 2.10 | - | 3.66 | lt br si sa & gr/cob w limestone fragments -moist, dense S3 at 2.1m |

-limestone fragments up to 350mm diameter
-water not encountered

**TH #5**

| | | | |
|---|---|---|---|
| 0 | - | 110 | br si tps |
| 110 | - | 3.66 | lt br si sa & gr/cob -moist, dense S4 at 610mm |

-some boulders after 650mm

| | | |
|---|---|---|
| 3.66 | | NFP, dense boulders |

-water not encountered

**TH #6**

| | | | | |
|---|---|---|---|---|
| 0 | - | 300 | br si tps | |
| 300 | - | 800 | br si sa tr gr -moist, compact | |
| 800 | - | 1.80 | lt br si cl sa & gr/cob -moist, dense | |
| 1.80 | - | 3.20 | gry si sa & gr -moist, very dense | S5 at 1.9m |

-water not encountered

**TH #7**

| | | | | |
|---|---|---|---|---|
| 0 | - | 280 | br si tps | |
| 280 | - | 610 | br si sa tr gr -moist, compact | |
| 610 | - | 3.66 | gry/br si sa & gr/cob -moist, dense | |

-some limestone fragments after 3m
-water not encountered

**TH #8**

| | | | | |
|---|---|---|---|---|
| 0 | - | 280 | br si tps | |
| 280 | - | 760 | br si sa -moist, compact | S6 at 600mm |
| 760 | - | 3.35 | gry/br si sa & gr/cob so blds -moist, dense | |
| 3.35 | | | NFP, dense boulders | |

-water not encountered

**TH #9**

| | | | | |
|---|---|---|---|---|
| 0 | - | 270 | br si tps | |
| 270 | - | 630 | br si sa -moist, compact | |
| 630 | - | 3.66 | gry/br si sa & gr/cob tr blds -moist, dense | S7 at 1.5m |

-water not encountered

**TH #10**

| | | | | |
|---|---|---|---|---|
| 0 | - | 200 | br si tps | |
| 200 | - | 3.66 | br si sa & gr/cob so blds -moist, dense | |

-frequent limestone boulders after 1.8m
-water not encountered

**Laboratory Test Data**
**1919 Estates, Phase 1**

| **Soil Sample** | **1** | **2** | **3** | **4** | |
|---|---|---|---|---|---|
| **Sieve** | **% Passing** | | | | |
| 37.5mm | 100 | 100 | 100 | 100 | grain size |
| 26.5mm | 85.4 | 90.9 | 84.2 | 94.1 | |
| 19.0mm | 73.2 | 79.2 | 80.7 | 92.1 | |
| 13.2mm | 64.4 | 72.9 | 71.5 | 81.4 | |
| 9.50mm | 55.3 | 65.3 | 61.2 | 70.0 | |
| 4.75mm | 46.5 | 52.8 | 48.3 | 52.0 | |
| 2.36mm | 41.9 | 45.2 | 42.4 | 47.0 | |
| 1.18mm | 37.7 | 38.0 | 35.8 | 40.3 | |
| 600um | 34.1 | 31.4 | 30.4 | 34.8 | |
| 300um | 30.3 | 25.5 | 25.7 | 29.8 | |
| 150um | 25.5 | 19.7 | 20.8 | 24.0 | |
| 75um | 21.9 | 15.8 | 17.2 | 19.7 | |
| %gravel | 53.5 | 47.2 | 51.7 | 48.0 | gravel content |
| %sand | 24.6 | 37.0 | 31.1 | 32.3 | sand content |
| ASTM | GM | GM | GM | GM | soil classification |
| frost rating | Low | Low | Low | Low | susceptibility to frost heave |
| LL | 34.0 | 17.1 | 21.0 | 27.0 | liquid limit |
| PL | 21.7 | 16.3 | 18.8 | 18.1 | plastic limit |
| PI | 12.3 | 0.8 | 2.2 | 8.9 | plastic index |
| W | 38.4 | 11.7 | 9.2 | 13.3 | field moisture content |

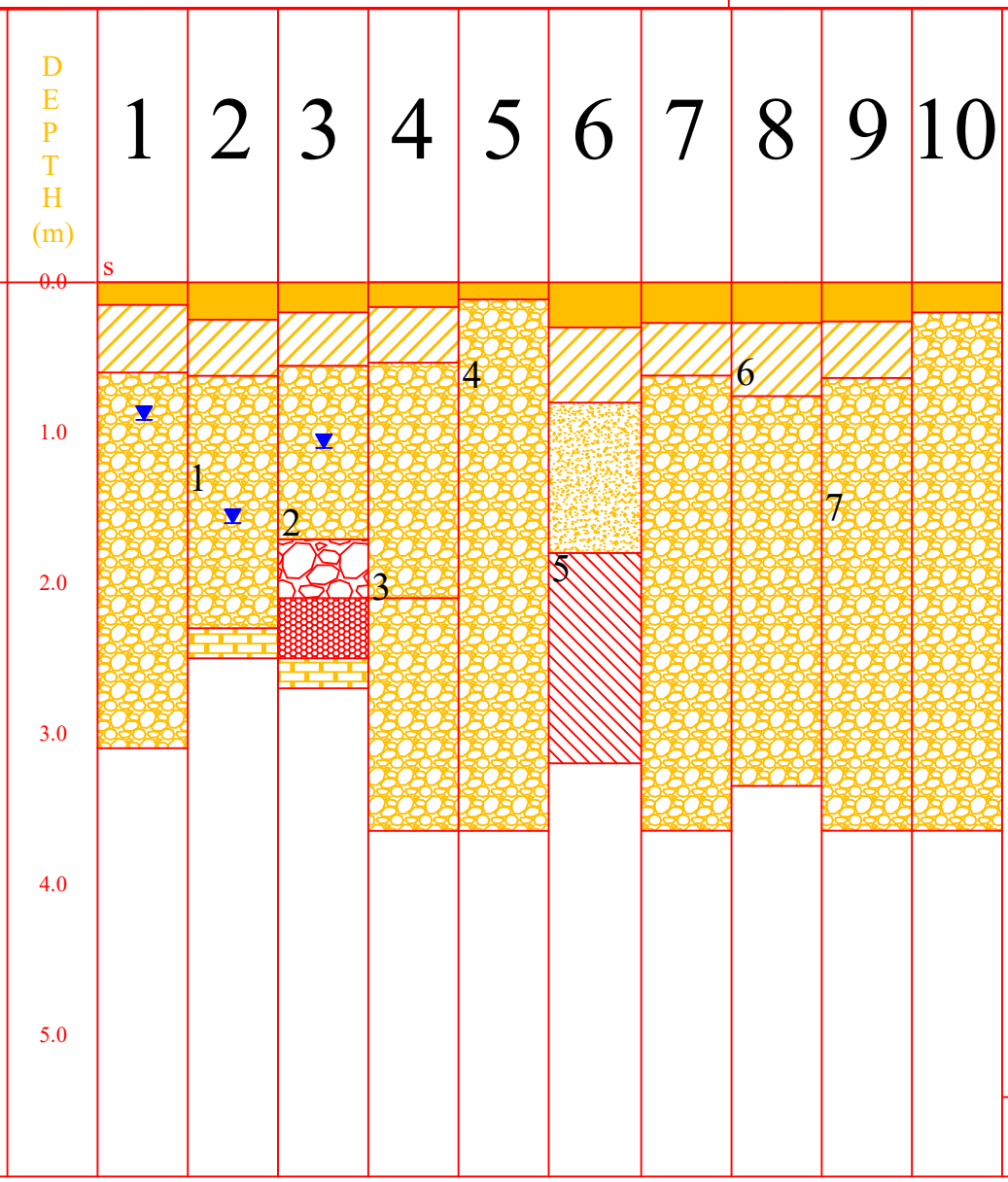
| **Soil Sample** | **5** | **6** | **7** | |
|---|---|---|---|---|
| **Sieve** | **% Passing** | | | |
| 53.0mm | 100 | 100 | 100 | grain size |
| 37.5mm | 92.7 | 100 | 97.5 | |
| 26.5mm | 89.7 | 100 | 89.4 | |
| 19.0mm | 69.2 | 100 | 83.1 | |
| 13.2mm | 55.3 | 100 | 72.6 | |
| 9.50mm | 44.5 | 100 | 65.2 | |
| 4.75mm | 35.8 | 100 | 49.4 | |
| 2.36mm | 31.2 | 99.2 | 42.2 | |
| 1.18mm | 26.0 | 95.8 | 34.4 | |
| 600um | 21.8 | 89.0 | 27.8 | |
| 300um | 18.4 | 79.0 | 22.5 | |
| 150um | 15.3 | 66.8 | 17.6 | |
| 75um | 13.1 | 58.0 | 14.4 | |
| %gravel | 64.2 | 0.0 | 50.6 | gravel content |
| %sand | 22.7 | 42.0 | 35.0 | sand content |
| ASTM | GM | ML | GM | soil classification |
| frost rating | Low | Med | Low | susceptibility to frost heave |
| LL | 20.0 | 15.4 | 22.8 | liquid limit |
| PL | 15.1 | 14.9 | 20.8 | plastic limit |
| PI | 4.9 | 0.5 | 2.0 | plastic index |
| W | 9.5 | 30.3 | 10.2 | field moisture content |

# TEST HOLE LOG DATA

PROJECT No.: 21-1-6814
CLIENT: Greer Galloway
PROJECT: 1919 Estates, Phase 1
DATE: November 14, 2017

SOIL DATA
METHOD: Excavator
s = sample

▼ encountered water elevation




LEGEND

- silty topsoil
- silty sand trace gravel
- silty clay sand & gravel/cobble
- silty sand & gravel/cobble
- gravel & sand
- silty sand & gravel
- shale/limestone fragments
- bedrock

Terraspec


GREER GALLOWAY
CONSULTING ENGINEERS

LEGEND:

- WETLAND AREA
- WETLAND OFFSET 30m
- POND
- ROAD
- HYDRO
- BELL

DRAWING:

# 1919 Estates

TOPOGRAPHIC PLAN

PROJECT:

SUBDIVISION DEVELOPMENT

| NO. | REVISION | DATE |
|---|---|---|
| 05 | | |
| 04 | | |
| 03 | | |
| 02 | | |
| 01 | CONCEPTUAL DESIGN | 2017 |

DESIGNED BY: TL
DRAWN BY: TL
REVIEWED BY: ISO
APPROVED BY: ISO
PROJECT DATE: AUGJST 2017
SCALE: SCALE 1:1750
PROJECT NO.: 16-1-6801
DRAWING NO.: