August 14, 2022 (Revision 1)

Fernbrook Homes (Parkside) Limited
2220 Highway 7, Unit 5
Concord, ON
L4K 1W7

Attn: Danny Salvatore

RE: Geotechnical Update Report for Proposed Residential Development
70 Pioneer Trail, Barrie, Ontario
Project No. 2101696

INTRODUCTION

GEI Consultants (GEI) was retained by Fernbrook Homes (Parkside) Limited to provide an updated geotechnical letter report in support of the proposed residential development to be constructed at 70 Pioneer Trial in Barrie, Ontario.

This revision of the report (Revision 1, dated August 14, 2022) is being provided to reflect the most up to date site plan drawing and to provide revised borehole elevations.

The property of 70 Pioneer Trail is irregular in shape and is approximately 2.5 hectares in size. The property is generally bounded on all sides by vacant forested land, with Pioneer Trail located at the southwestern corner of the property and Lake Simcoe located at the northeastern corner of the property. The property is currently vacant but historically contained a single-family dwelling.

GEI was provided with the following site plan drawing for review: *"Common Element Condominium, Part of Lot 16, Concession 13, Geographic Township of Innisfil now in the City of Barrie"*, Proj. No. FER-15101, dated January 24 ,2022, by The Jones Consulting Group. Based on this drawing, it is proposed to extend Pioneer Trail into the property and construct a total of 18 residential lots. It is expected that the properties will be municipally serviced with sewer and water. The site is relatively flat so there is not expected to be significant grading to accommodate the proposed development. There is a minimum 30 metre buffer beyond the top of slope adjacent to Lake Simcoe near the northeastern corner of the property.

GEI was provided with the following existing geotechnical reports that were previously prepared for the property:

- *"Geotechnical Investigation, Proposed Residential Development, 70 Pioneer Trail, City of Barrie, Ontario",* File No. 31-15-2003, dated September 13, 2016, by Terraprobe Inc.
- *"Assessment of Groundwater Levels, February 2015 to August 2016 Monitoring, Proposed Residential Development, 70 Pioneer Trail, City of Barrie, Ontario",* File No. 31-15-2003, dated September 13, 2016, by Terraprobe Inc.
- *"Development Setback and Slope Stability Requirements, Residential Development, 70 Pioneer Trail, Barrie, Ontario",* File No. 31-15-2003, dated September 13, 2016, by Terraprobe Inc.

Based on our review of the above noted reports, the soils underlying the site generally consist of a compact to dense sand deposit, with a very stiff to hard clayey silt deposit noted at depth in some boreholes. In general, the groundwater table is on the order of 1 to 2 metres below grade within the western half of the site and on the order of 3 to 5 metres below grade within the eastern half of the site. The reports contain geotechnical engineering recommendations regarding foundations, slab-on-grade construction, excavations, bedding and backfill, lateral earth pressures, pavement design thickness, stormwater management facilities and slope stability development setbacks.

It is understood that a pre-consultation meeting was recently conducted for this development. Comments that pertain to the geotechnical and hydrogeological requirements at this site that were provided by various regulatory agencies are as follows:

- Pre-Consultation Required Reports Checklist, Site Plan Control, dated December 3, 2020, by City of Barrie:
    - Both a geotechnical report, hazards lands/slope and soil stability report, and a hydrogeological study are required.
- Planning Act Application – Pre-Consultation, dated November 26, 2020, by Lake Simcoe Region Conservation Authority:
    - Geotechnical/Soils Report and a hydrogeological analysis including a water balance are required.
- Memorandum, dated November 20, 2020, by City of Barrie:
    - States: *"A geotechnical/hydrogeological report will be required upon site plan submission in support of this development. This report shall include a pavement structure recommendation, address ground water levels as they relate to any servicing and building foundations, and address soils as they may relate to any potential "Low Impact Development" initiatives."*

It is understood that another consultant will be reviewing and preparing a hydrogeological report in support of the proposed development, and GEI's scope of work relates only to the geotechnical aspects of the project. It was requested that GEI provide a letter report which provides a review of the geotechnical reports already completed for the property and provide commentary on any updates that may be required, as well as the applicability of the reports as they relate to the most recent development scheme.

REVIEW OF EXISTING GEOTECHNICAL RECCOMENDATIONS

In the following section the existing geotechnical recommendations provided within Sections 6.1 to 6.10 of "*Geotechnical Investigation, Proposed Residential Development, 70 Pioneer Trail, City of Barrie, Ontario*", File No. 31-15-2003, dated September 13, 2016, by Terraprobe Inc. (hereinafter referred to as Geotechnical Report) were reviewed and relevant commentary, alterations and/or additional recommendations, if any, were provided. Any additional recommendations should be read in conjunction with the Geotechnical Report and be incorporated into the final design and construction of the development.

A copy of the Geotechnical Report is attached to this letter report as Enclosure 1. The following sections refer to the relevant section number of the Geotechnical Report in brackets for consistency.

GEI was provided with updated ground surface elevations on August 8, 2022 for each borehole location by Jones Consulting Group. Jones Consulting Group noted that the elevations associated with the boreholes from the Terraprobe study seemed erroneous and conducted this survey to confirm the exact borehole elevations. It is understood that no site grading has occurred since the Terraprobe study. A summary of the previous and revised borehole ground surface elevations that are being used are as follows:

Borehole	Ground Surface Geodetic Elevation (m)		Difference in Elevation (m)
	Terraprobe Study (2016)	Revised Measurement based on Recent Survey	
201	226.5	226.50	0.00
202	224.9	225.00	0.10
203	229.3	228.38	-0.92
204	230.3	229.28	-1.02
205	230.6	229.89	-0.71
206	229.5	229.51	0.01
207	228.7	227.89	-0.81
208	227.6	226.57	-1.03
209	226.6	226.70	0.10
106	229.4	229.58	0.18
107	226.9	Not Found	N/A

It is noted that all elevations referenced in the subsequent sections of this letter report are based on the revised elevation measurements based on the most recent survey by Jones Consulting Group. It must be noted that all borehole ground surface elevations presented in the Terraprobe geotechnical report must be revised when utilizing the recommendations they provide.

Foundations (Section 6.1)

As stated in the Geotechnical Report, the site is generally comprised of compact to dense native sands with deposits of underlying very stiff to hard clayey silt soils noted in some boreholes. These soils are generally suitable for the support of spread and strip footing foundations. The Geotechnical Report states the following:

> *"The compact to dense native conditions encountered (i.e. typical 'N' values greater than 10 to 15 blows per 0.3m of penetration) will allow structure foundations, etc. to be designed for a net geotechnical resistance of 150kPa (SLS). A corresponding factored geotechnical resistance at Ultimate Limit States (ULS) of approximately 225kPa may be used."*

It is noted that GEI uses different terminology and refers to a geotechnical reaction (not a net geotechnical resistance) at Serviceability Limit States (SLS), which is consistent with the terminology used in the Ontario Building Code.

Due to the presence of loose to very loose and wet sands encountered in the upper 2.7 to 4.0 metres of Boreholes 204 and 206 advanced within the site, the following alterations are recommended by GEI to the foundation design table within Section 6.1 of the Geotechnical Report:

Borehole Number	***Ground Surface Elevation (m)***	***Recommended Geotechnical Reaction at SLS (kPa)***	***Approximate Founding Level***	
			Depth (m)	***Elevation (m)***
204	~~*230.3*~~ ***229.28***	~~*75*~~ **50**	*>2.7*	~~*Below 227.6*~~ ***Below 226.6***
206	~~*229.5*~~ ***229.51***	~~*75*~~ **50**	*0.8 – 3.0*	*228.7 – 226.5*

The proposed development will consist of residential dwellings that are typically lightly loaded structures and typically do not require high capacity foundations. To simplify the design process, spread or strip footings founded on the undisturbed sands encountered at depths of approximately 0.8 to 2.7 metres below grade across the site can be uniformly designed using a geotechnical reaction at SLS of 50 kPa, for 25 mm of total settlement. The factored geotechnical resistance at ULS is 75 kPa. The table provided in the Geotechnical Report and the modifications in the table above can be consulted if higher SLS and ULS values are required in specific locations on site.

If the client wishes to pursue the option of foundations made on engineered fill as outlined in the Geotechnical Report, GEI can provide additional recommendations at that time.

It is recommended that the foundations are inspected by a qualified member of GEI's geotechnical staff prior to the placement of concrete for footings to confirm the quality and bearing capacity of the founding soils.

The remainder of recommendations provided within section ***"6.1 Foundations"*** are deemed appropriate for use in the design and construction of the proposed development.

Concrete Slab-On-Grade or Basement Floors (Section 6.2)

Recommendations provided within section ***"6.2 Concrete Slab-On-Grade or Basement Floors"*** are deemed appropriate for use with the addition of the following recommendations:

- The proposed subgrade should be proof-rolled and inspected by geotechnical engineering staff. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material, they must be locally sub-excavated and backfilled with approved clean earth fill or imported granular material and compacted to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD).
- It is anticipated that the subgrade bearing modulus will be 20,000 kPa/m for a slab-on-grade made on a subgrade as described above.

Excavations (Section 6.3)

All recommendations provided within section ***"6.3 Excavations"*** are deemed appropriate for use in the design and construction of the proposed development, with the following additional recommendations:

- Type 4 soils must be sloped at no steeper than 3 horizontal to 1 vertical from the base of the excavation.
- If more than one type of soil is encountered, the excavation sidewalls must be sloped following the most conservative soil type.
- Additional considerations for temporary groundwater control and the need for registration on the Environmental Activity and Sector Registry (EASR) or a Permit to Take Water (PTTW) from the MECP would be addressed in the hydrogeological report being completed by others for the site (if applicable).

Backfill (Section 6.4)

Recommendations provided within section ***"6.4 Backfill"*** are deemed appropriate for use save for the following alteration and additional recommendations:

- *"Earth fill materials placed beneath settlement sensitive areas such as floor slabs, sidewalks, pavement structures and the like should be compacted to a minimum of ~~95%~~ **98%** of Standard Proctor Maximum Dry Density in lifts not exceeding 200mm."*
- It should be noted that the moisture of stockpiled or in-situ soil can also change depending on the prevailing weather conditions.
- *"The topsoil materials and organic rich sands encountered at the site should not be used as backfill ~~in settlement sensitive areas such as those noted above~~. The topsoil…"*
- It is recommended that inspection and testing be carried out by GEI to confirm the quality, thickness and compaction of trench backfill during construction.

Lateral Earth Pressure on Subsurface Walls (Section 6.5)

It is recommended to replace the details in section ***"6.5 Lateral Earth Pressure on Subsurface Walls"*** with the following:

Underground levels, basements, retaining walls and cantilevered shoring walls all must be designed to resist unbalanced lateral earth pressures imparted from the weight of adjacent soils. Lateral earth pressures are calculated using the following equation:

$$P = K[\gamma h + q]$$

where,
P = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (dimensionless)
h = depth below ground surface (m)
γ = the bulk unit weight of soil, (kN/m^3)
q = surcharge loading (kPa)

The above equation assumes that a drainage system is present which prevents the build-up of any hydrostatic pressure behind the structure subjected to the unbalanced lateral earth pressures. If this is not the case, the equation must be revised to also incorporate the submerged unit weight of the soil multiplied by the earth pressure coefficient, in addition to the water pressure itself.

The values for use in the design of structures subjected to unbalanced lateral earth pressures at this site are as follows.

Soil Type	γ - Bulk Unit Weight (kN/m^3)	φ - Friction Angle (degrees)	Earth Pressure Coefficient (dimensionless)		
			K_a - Active	K_o – At-Rest	K_p - Passive
Imported Granular Material	20.0	32	0.31	0.47	3.25
Earth Fill	19.0	30	0.33	0.50	3.00
Upper Loose Sands					

Soil Type	γ - Bulk Unit Weight (kN/m^3)	φ - Friction Angle (degrees)	Earth Pressure Coefficient (dimensionless)		
			K_a - Active	K_o – At-Rest	K_p - Passive
Lower Compact to Dense Sands (Typ. Below a Depth of 3 m)	20.0	35	0.27	0.43	3.69

The calculation of the earth pressure coefficients is based on Rankine theory, which provides a conservative estimate as no friction between the soil and the structure is accounted for. The earth pressure coefficients provided above are applicable for flat ground surfaces beyond the structure and must be revised for sloping ground surfaces.

The earth pressure coefficients referenced within the above table are a function of the friction angle of the adjacent soil, and both the degree and direction of movement of the structure subjected to unbalanced lateral earth pressures. For structures that are restrained at the top (such as basement walls), the at-rest earth pressure coefficient will apply. For structures that allow for 0.1 to 1% of movement away from the soil (such as unrestrained retaining walls), the full active earth pressure coefficient will apply. For structures that allow for 1 to 10% of movement into the soil, the full passive earth pressure coefficient will apply. The percentage movement is based on the height of the structure.

Other types of structures such as shoring walls with multiple rows of tiebacks and soil nail walls are subject to different loading conditions and must be analyzed separately.

Pipe Bedding (Section 6.6)

Recommendations provided within section ***"6.6 Pipe Bedding"*** are deemed appropriate for use save for the following alteration:

- *"…Granular 'A' bedding material should be placed in thin lifts and compacted to a minimum of ~~95%~~* **98%** *of SPMDD. If HL 8 course…"*

It is recommended that inspection and testing be carried out by GEI to confirm the quality, thickness and compaction of pipe bedding materials during construction.

Thrust Blocks and Pipe Restraints (Section 6.7)

All recommendations provided within section ***"6.7 Thrust Blocks and Pipe Restraints"*** are deemed appropriate for use in the design and construction of the proposed development, with the following recommended alternation:

- Based on GEI's previous assessment of the very loose and wet sands in some locations on site, it is recommended to assume that thrust blocks made against the undisturbed native soils across the site can be designed using a geotechnical reaction at SLS of 50 kPa and a maximum factored geotechnical resistance at ULS of 75 kPa.

Pavement Design Thickness (Section 6.8)

Recommendations provided within section ***"6.8 Pavement Design Thickness"*** are deemed appropriate for use save for the alterations and additions discussed below.

Street 'A' will run through the proposed development will be an extension of Pioneer Trail, which is a public roadway owned and maintained by the City of Barrie. Traffic design parameters are unknown for the proposed street. Though it is understood that Street 'A' will be a private roadway owned by the condominium, it is still recommended that the pavement structure is recommended to conform to the minimum local pavement structure thickness described in *"Transportation Design Manual"* (City of Barrie, 2020) as follows:

- HL3 Top Course Asphalt = 40 mm
- HL8 Bottom Course Asphalt = 70 mm
- OPSS.MUNI 1010 Granular A Base Course = 150 mm
- OPSS.MUNI 1010 Granular B Subbase Course = 450 mm (the Terraprobe report designates only a minimum of 350 mm)

Other alterations and additions include the following:

- *"The pavement subgrade is expected to comprise of primarily sands and silts in most cases or perhaps clean earth fill compacted to a minimum of ~~95%~~* **98%** *of SPMDD. The exposed subgrade …"*
- *"…It should be noted that the majority of the upper site soils are considered ~~somewhat frost susceptible~~* **to have a Low Susceptibility to Frost Heaving (LSFH)**. *~~Therefore, adequate subgrade drainage is recommended~~."*
- The frost susceptibility of soils is correlated to the percentage of particles within a grain size range of 5-75 µm (silt and very fine sand) and divided into three categories summarized below from the Pavement Design and Rehabilitation Manual (2nd Edition, MTO, 2013):

Percentage of Particles Between 5-75 µm by Mass	Susceptibility to Frost Heaving
0 to 40%	Low Susceptibility to Frost Heaving (LSFH)
40% to 55%	Moderate Susceptibility to Frost Heaving (MSFH)
55 to 100%	High Susceptibility to Frost Heaving (HSFH)

- Based on hydrometer testing of select soil samples, the site soils appear to have a low susceptibility to frost heaving with contents of particles between 5-75 µm ranging from 1% to 32%.

- ~~*"It should be reiterated that the subgrade soils are frost susceptible. The subdrains are considered a valuable protection against frost heave damage and subgrade softening particularly impacting the long term performance of the pavement."*~~ **Although the site soils appear to be LSFH, isolated areas of frost susceptible soils may be present along the proposed roadway alignments, as such adequate subgrade drainage through the provision of subdrains is recommended to prolong the life of the pavement structure and reduce the possibility of distresses due to frost action and loss of subgrade support.**
- *"…Asphaltic concrete materials should be rolled and compacted* **in accordance with the latest version of OPSS.MUNI 310** ~~*to a minimum of 97% of Marshall Bulk Density (MBD)*~~ *based on nuclear density testing."*

It is recommended that inspection and testing be carried out by GEI to confirm the quality, thickness and compaction of subgrade earth fills, roadway granular materials, and hot mix asphalt during construction.

Earthquake Design Parameters (Section 6.9)

All recommendations provided within section ***"6.9 Earthquake Design Parameters"*** are deemed appropriate for use in the design and construction of the proposed development.

Stormwater Management Facilities (Section 6.10)

All recommendations provided within section ***"6.10 Stormwater Management Facilities"*** are deemed appropriate for use in the design and construction of the proposed development.

It is noted that additional details such as liner considerations and hydrostatic uplift are typically provided in a hydrological engineering report, which is being completed for the site by others.

REVIEW OF HISTORICAL GROUNDWATER LEVELS

In the following section the historical groundwater level monitoring summary provided within the letter titled "*Assessment of Groundwater Levels, February 2015 to August 2016 Monitoring, Proposed Residential Development, 70 Pioneer Trail, City of Barrie, Ontario*", File No. 31-15-2003, dated September 13, 2016, by Terraprobe Inc. (hereinafter referred to as Groundwater Monitoring Letter) will be reviewed and relevant commentary, alterations and/or additional recommendations, if any, will be provided. Any additional recommendations or commentary should be read in conjunction with the Groundwater Monitoring Letter and be incorporated into the final design and construction of the development.

A copy of the Groundwater Monitoring Letter is attached to this letter report as Enclosure 2.

Summary of Groundwater Monitoring Report

Following the geotechnical investigation completed in February 2015 and discussed above, Terraprobe undertook a monthly groundwater monitoring program measuring the static groundwater level in each of the eleven (11) piezometers within the limits of the site from February 2015 to August 2016. The collected measurements showed a general trend of high groundwater elevations during the spring, with levels falling to a minimum around the end of fall and onset of winter.

Generally the peak groundwater levels were found at greater depths within the northern portion of the site (closer to Lake Simcoe) as measured in piezometers installed within Boreholes 201, 202, and 107 at depths between 3.6 and 5.7 metres below grade (Elev. 219.2 to 223.4 metres), with the peak groundwater levels in the remaining boreholes encountered at depths between ground surface and 2.6 metres below grade (Elev. 226.4 to 228.9 metres).

Subsequent Site Visit and Groundwater Monitoring

On May 18, 2021 the site was visited by one of GEI's geotechnical engineers to perform a general inspection of the property and slope, as well as gather groundwater level measurements from the eleven (11) piezometers installed throughout the site for comparison to the historic groundwater level measurements. Upon arrival to the site it was determined that the piezometer installed in Borehole 202 was blocked by unknow debris at approximately ground surface and measurements were taken from the ten (10) accessible piezometers.

Groundwater was measured at depths varying from 0.3 to 5.3 metres below ground surface, with the piezometer in borehole 107 found to be dry to a depth of 4.6 metres. The recorded measurements were compared to the data available in the Groundwater Monitoring Report and it was determined that the depth of the groundwater encountered during this recent site visit was generally 0.1 to 1.0 metres below the previously determined high groundwater levels in each of the piezometers installed across the site. A summary of the encountered groundwater elevation throughout the site is provided in the table below:

Borehole Number	Measured on May 18th, 2021	
	Measured Groundwater Depth (metres below ground surface)	Approximate Groundwater Elevation (metres)
201	5.3	221.2
202	Piezometer Blocked at Ground Surface	
203	2.4	226.0
204	3.0	226.3
205	3.5	226.4
206	0.9	228.6
207	0.9	227.0

Borehole Number	Measured on May 18th, 2021	
	Measured Groundwater Depth (metres below ground surface)	Approximate Groundwater Elevation (metres)
208	0.3	226.3
209	0.6	226.1
106	1.0	228.6
107	No Groundwater Encountered	Below 222.3

Based on the recent groundwater measurements not exceeding those reported in the Groundwater Monitoring Letter it is GEI's opinion that the groundwater depths as reported in the Groundwater Monitoring Letter are still applicable to the design and construction of the proposed development. The seasonally high groundwater elevation determined in that report should still be used.

REVIEW OF DEVELOPMENT SETBACK AND SLOPE STABILITY REPORT

In the following section the existing development setback and slope stability requirements provided within the report titled *"Development Setback and Slope Stability Requirements, Residential Development, 70 Pioneer Trail, Barrie, Ontario", File No. 31-15-2003, dated September 13, 2016, by Terraprobe Inc.* (hereinafter referred to as "Slope Stability Report") will be reviewed and relevant commentary, alterations and/or additional recommendations, if any, will be provided. Any additional recommendations or findings should be read in conjunction with the Slope Stability Report and be incorporated into the final design and construction of the development.

A copy of the Slope Stability Report is attached to this letter report as Enclosure 3.

Summary of the Slope Stability Report

In April 2015 the site was visited by one of Terraprobe's Senior Soil Engineers to visually inspect the slope conditions and assess its stability rating in accordance with the Ministry of Natural Resources (MNR) Natural Hazards Technical Guidelines. General observations noted of the slope at the time of inspection included:

- Kempenfelt Bay shoreline is generally near or immediately adjacent to the toe of slope.
- Topographic survey indicated the slope was generally at an inclination of 1H:1V to 2H:1V with locally steeper areas noted approaching near vertical.
- The slope was generally well vegetated with ground cover and several mid to large sized trees noted.
- No significant toe protection was noted.
- The slope was generally 3 to 6 metres in height from toe to crest.
- Previous landslide activity was noted along the face of the slope in isolated areas.

Based on site conditions, slope characteristics, vegetation cover, drainage, water course characteristics, etc. the slope was found to have the characteristics of a Level 3 slope with a 'Moderate' potential for instability. A Level 3 slope requires site specific subsurface investigation, surveying, slope modeling, analysis, and detailed report.

As part of the geotechnical investigation executed at the site in February 2015 (discussed above) nine (9) boreholes were advanced throughout the site. Two of the boreholes, Boreholes 201 and 202, were advanced at the northern portion of the site with Borehole 202 immediately adjacent to the crest of the slope.

The boreholes encountered 0.1 to 0.7 metres of surficial silty sand fill or topsoil underlain by native compact to very dense sand based on SPT 'N' values from 14 to greater than 50 blows. Borehole 201 encountered hard silt and clay soils below a depth of 3.0 metres with SPT 'N' values ranging from 33 to 37. The site groundwater table was intercepted in borehole 202 at a depth of 6.0 metres below ground surface or an elevation of 218.9 metres.

Using soil properties, slope geometry, and groundwater levels as inputs the Factor of Safety (FOS) of the slope was calculated using a specialized slope analysis software (Slide 6.036) to compute several standard methods of limit equilibrium analysis. Based on the steepest section of the slope the computed FOS was 0.73, which indicated an unstable condition. Analysis was then performed again with a theoretical slope inclination of 2H:1V and the computed FOS was 1.5 which met the MNR design standards discussed below.

Based on the information provided within the MNR Natural Hazards Technical Guidelines a minimum FOS of 1.3 to 1.5 is appropriate for slopes adjacent to residential, habitable structures. The engineering analysis determined a slope inclination of 2H:1V or flatter to be the long-term stable slope inclination for the site conditions to achieve an FOS of 1.5. For a slope height of 6 metres this equated to a minimum stable slope allowance of 12 metres measured horizontally from the existing toe of slope. The setback varied based on the height of the slope.

MNR Policy Guidelines also required a recession rate set-back (erosion allowance) which is typically based on 100 years of the average recession rate recorded over a minimum 35-year period. Alternatively, for large inland lakes where there is no reliable information available, such as Lake Simcoe, a setback distance of 15 metres is specified.

To calculate the zone potentially threatened by erosion a two-step method was used. First, the stable slope allowance was calculated, and the erosion allowance was added to it. Second, the erosion allowance is measured inland from the crest of the existing slope. The larger of these two measurements was used as the limit of the erosion hazard. In this case an erosion hazard limit of 27 metres measured inland from the toe of slope was deemed appropriate for the purposes of this development.

Subsequent Site Visit and Commentary on the Slope Stability Report

One of GEI's geotechnical engineers attended the site on May 18, 2021 to perform a general inspection of the overall site, collect groundwater level measurements and perform a detailed visual slope inspection from accessible areas. During the inspection several photographs were taken of the slope for comparison to the conditions observed during the previous inspection in 2015 as described in the Slope Stability Report. Photographs of the recent site visit are attached as Enclosure 4.

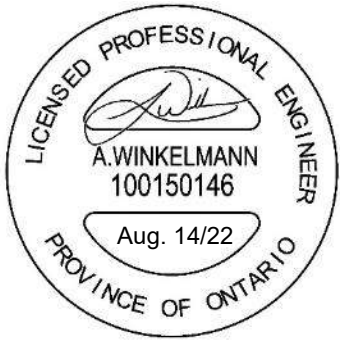
In general, the conditions observed at the site matched those reported in the Slope Stability Report, the slope was generally well vegetated with mature trees and shrubs, and no significant signs of recent landslide activities or instability were observed at the time of inspection. An attempt was made to determine the groundwater level within the piezometer installed in Borehole 202 adjacent to the crest of the slope during the site visit, however it was found to be blocked at ground surface.

As there were not significant changes from the previously reported site conditions, or signs of recent instability within the slope, GEI is of the opinion that the analysis of the slope and associated recommendations/setbacks presented in the Slope Stability Report are still applicable to the site as a whole and should be incorporated into the design and construction of the proposed development.

CONCLUSION

We trust this information is sufficient for your present purposes. Should you have any questions concerning the above, or can be of any further assistance, please do not hesitate to contact the undersigned.

Yours truly,
GEI Consultants



Alexander Winkelmann, P.Eng.
Geotechnical & Earth Sciences Manager

Enclosures (4)

Enclosure 1 – Terraprobe Geotechnical Report
Enclosure 2 – Terraprobe Assessment of Groundwater Levels
Enclosure 3 – Terraprobe Slope Stability Report
Enclosure 4 – Site and Slope Photographs

ENCLOSURE 1

Enclosure 1 – Terraprobe Geotechnical Report

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
70 PIONEER TRAIL
CITY OF BARRIE, ONTARIO

Prepared for: Fernbrook Homes (Parkside) Ltd.
2220 Highway 7 West
Concord, ON
L4K 1W7

Attention: Mr. Danny Salvatore

File No. 31-15-2003
September 13, 2016

Distribution:

8 cc: Jones Consulting Group Inc.
1 cc: Terraprobe Inc., Barrie

Table of Contents

1.0 EXECUTIVE SUMMARY 1
2.0 INTRODUCTION 1
3.0 SITE AND PROJECT DESCRIPTION 2
4.0 FIELD WORK 2
5.0 SUBSURFACE CONDITIONS 3
6.0 DISCUSSION AND RECOMMENDATIONS 5
6.1 Foundations 5
6.2 Concrete Slab-On-Grade or Basement Floors 7
6.3 Excavations 8
6.4 Backfill 8
6.5 Lateral Earth Pressures on Subsurface Walls 9
6.6 Pipe Bedding 9
6.7 Thrust Blocks and Pipe Restraints 10
6.8 Pavement Design Thickness 10
6.9 Earthquake Design Parameters 12
6.10 Stormwater Management Facilities 13
6.11 Environmental Considerations 14
6.12 Slope Stability Analysis and Development Setbacks 15
7.0 CONCLUSIONS 15

Borehole Logs 201 to 209
Well Record
Grain Size Analyses
Previous Borehole Logs 106 & 107 (3-07-3012)
Figures 1 to 4
Groundwater Level Monitoring Data and Plots
Chemistry Results

1.0 EXECUTIVE SUMMARY

Terraprobe was retained to provide geotechnical characterization of the site and to provide recommendations based on these findings to help guide design decisions.

Terraprobe recently observed and recorded the advancement of nine (9) sampled boreholes on the subject property. The boreholes generally indicated layered sands to silty sand with surficial fills and/or organics overlying silt and clay to clayey silt overburden soils. Groundwater levels were measured in mid-March 2015 in the installed standpipes with levels recorded from 1.1m to at least 6.5m below existing grade.

Two (2) boreholes (#106 and 107) were advanced on the property as part of a larger preliminary investigation in 2007. These borehole logs are appended to this report for reference.

It is recommended that groundwater level monitoring in the installed standpipes should continue on a monthly basis in order to evaluate the magnitude of seasonal groundwater fluctuations and estimate peak levels which will affect the final design such as basement levels, deep road cuts, stormwater management design, etc.

Terraprobe should be involved through the design process to provide geotechnical consultation and support. Further investigation and/or review may be required for specific details of the development as the design progresses.

2.0 INTRODUCTION

We are pleased to present our report on the geotechnical investigation carried out for the proposed residential development in the City of Barrie, Ontario. Authorization to complete this investigation was provided by Mr. Danny Salvatore on January 27, 2015.

The purpose of the investigation was to determine the soil and groundwater conditions on the site as they pertain to the design and installation of proposed municipal services, internal road construction, stormwater management, basement floor levels and general structure foundations. Excavation, dewatering, backfill and general construction constraints are also considered and discussed below.

Terraprobe was retained to provide geotechnical characterization of the site in order to guide design decisions. Additional investigation, monitoring and/or consulting may be required as the design progresses to final approvals. Specific details of the final design components such as grading elevations, servicing inverts, pond elevations, structure footing levels etc., were not available at the time of the submission of this report.

3.0 SITE AND PROJECT DESCRIPTION

The site is located along the south shore of Kempenfelt Bay, east of the end of Pioneer Trail, at the eastern limit of the City of Barrie (see Figure 1 to 3). The subject property is identified as #70 Pioneer Trail in the City of Barrie, Ontario.

It is proposed to proceed with design and construction of full municipal services and internal streets associated with a residential development.

The property is currently treed, vacant land for the most part with formerly one house and garage which have been demolished. The site generally falls in grade by about 5 to 6m from south to north. Further to the north, grades fall another 4 to 5m along a natural slope down to the Kempenfelt Bay water's edge.

The current Development Concept Plan is included as Figure 4 of this report.

4.0 FIELD WORK

The recent field work associated with this project comprised of the advancement of nine (9) sampled boreholes to depths of 6.6m below existing grade.

Borehole locations, depths and installations were selected in consultation with The Jones Consulting Group Ltd. The proposed borehole locations were staked in the field by Terraprobe and surveyed by the client's surveyor. Buried service locates were organized by Terraprobe prior to initiating the field investigation.

The field work was completed on February 24 and 25, 2015, using a track-mounted D50T power auger provided by a specialist soil drilling contractor.

The sampled boreholes were advanced using Standard Penetration Test methods at regular 0.75 to 1.5 m intervals in each borehole. All soil samples were sealed in plastic containers and returned to our laboratory for further evaluation and testing including moisture content determination and select grain size analyses.

Following completion of the advancement of the boreholes, a standpipe type piezometer comprising of 19 mm diameter PVC tubing slotted at the base was installed in each borehole.

A return visit was made to the site on March 10, 2015 to measure static water levels in the installed standpipes.

The field work (drilling, sampling, testing) was observed and recorded by a member of our engineering staff, who also transported the samples to our geotechnical testing laboratory.

The borehole locations and elevations were surveyed by the owner's surveyor and are understood to be referenced to geodetic datum (see Figure 3).

5.0 SUBSURFACE CONDITIONS

The details of the subsurface conditions encountered at each borehole are presented on the attached Borehole Logs. It should be noted that the conditions are confirmed at the borehole locations only and could vary between and beyond these locations. In addition, the changes in soil stratigraphy delineated on the Borehole Logs have been inferred from non-continuous sampling. In this regard, the changes should be taken as transitions from one soil type to another as opposed to exact planes of geologic change.

In general, the boreholes encountered about 0.1 to 2.4m of surficial organics and/or silty sand fill. The native soils were primarily loose to dense sand to silty sand with trace to some gravel and trace clay. Boreholes 201, 206 and 207 encountered very stiff to hard clayey silt to silt and clay below 2.8 to 5.5m depth (see attached grain size analyses). Occasional cobbles/boulders were also noted as shown on the attached logs. Borehole 204 encountered deep fills and unusually loose to very loose soils to at least 6.6m depth (borehole termination). Former excavation and/or disturbance may have occurred in this area.

It must be noted that larger size particle (cobbles and boulders) that are not specifically identified in the boreholes may be present in the glacial till. The size and distribution of such obstructions cannot be

predicted with borings, because the borehole sampler size is insufficient to secure representative samples of particles of this size. Provision must be made in the excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

The native soils exhibited moisture contents varying between about 5 to 25% and generally increased with depth. Some perched groundwater should be anticipated in sandy seams/layers above very dense soils and/or silts and clays.

Across the site, Standard Penetration Tests conducted in each borehole generally indicated 'N' values of about 2 to greater than 50 blows per 0.3 m of penetration with depth in the native soils. Therefore, these soils are considered to be very loose to very dense and hard at depth.

The water levels noted during drilling and measured during our return site visit are tabulated below.

Borehole Number	Ground Surface Elevation (m)	Water Level			
		Noted During Drilling		Measured March 10, 2015	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
201	226.5	Dry	-	Dry to 6.5	Below 220.0
202	224.9	6.1	218.8	6.0	218.9
203	229.3	3.3	226.0	3.4	225.9
204	230.3	4.0	226.3	4.1	226.2
205	230.6	4.2	226.4	4.6	226.0
206	229.5	1.8	227.7	1.8	227.7
207	228.7	1.2	227.5	1.6	227.1
208	227.6	1.5	226.1	1.1	226.5
209	226.6	1.5	225.1	1.7	224.9
106 (3-07-3012)	229.4	1.2	228.2	1.9	227.5
107 (3-07-3012)	226.9	Dry	-	4.6	222.3

It is anticipated that some fluctuations of the groundwater table will occur seasonally and may be higher during wetter seasons and/or years. It is our recommendation that ongoing monthly monitoring of static groundwater levels continue through 2015 as a minimum and preferably for a full year in order to better

define the seasonal fluctuation and peak levels. Shallow groundwater flow direction appears to generally fall with surface topography from a high point in the south, down towards the north, and Kempenfelt Bay. Recent groundwater level monitoring has taken place and is ongoing. Measurements to date are appended to this report.

6.0 DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use by the design engineers 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.

6.1 Foundations

The undisturbed soils beneath the topsoil and/or any fill are considered marginally suitable for the support of conventional spread and/or strip footings for structures.

The compact to dense native conditions encountered (i.e: typical 'N' values greater than 10 to 15 blows per 0.3m of penetration) will allow structure foundations, etc. to be designed for a net geotechnical resistance of 150kPa (SLS). A corresponding factored geotechnical resistance at Ultimate Limit State (ULS) of approximately 225kPa may be used. Greater capacity may be available at greater depth if required for specific components and can be assessed by Terraprobe on a case by case basis, if required. Certain areas of the site indicate very loose or loose soils at shallow depth which will support a lower bearing pressure as tabulated below:

Borehole Number	Ground Surface Elevation (m)	Recommended Net Geotechnical Resistance at SLS (kPa)	Approximate Founding Level	
			Depth (m)	Elevation (m)
201	226.5	150	>1.0	Below 225.5
202	224.9	150	>0.8	Below 224.1
203	229.3	75 150	0.8 - 3.0 >3.0	228.5 - 226.3 Below 226.3
204	230.3	75	>2.7	Below 227.6
205	230.6	150	>0.8	Below 229.8
206	229.5	75 150	0.8 - 3.0 >3.0	228.7 - 226.5 Below 226.5
207	228.7	150	>1.0	Below 227.7
208	227.6	150	>0.8	Below 226.8
209	226.6	150	>0.8	Below 225.8
106 (3-07-3012)	229.4	100	0.5 - 4.0	228.9 - 225.4
107 (3-07-3012)	226.9	150	1.5 - 4.0	225.4 - 222.9

A minimum soil cover of 1.2m or equivalent insulation is recommended for frost protection to footings in exterior or unheated areas. Construction during cold weather should also ensure temporary frost protection of footing bases.

The minimum footing widths to be used in conjunction with the above recommended soil bearing pressures should be 0.5m for continuous footings and 0.8m for individual footings. The above recommended bearing capacities are based on estimated maximum total settlement of 25 mm and differential settlement of 19mm.

It should also be noted that due to the variable conditions in the upper 2.0 to 3.0m of the site, some downward stepping of footings should be anticipated in order to extend to competent soils.

Prior to placement of concrete for footings, the footing bases should be cleaned of all deleterious materials such as topsoil, fill, softened or disturbed materials as well as any standing water. It is recommended that the foundations be inspected by Terraprobe in order to confirm the exposed soil conditions and recommended bearing capacities. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

Perimeter drainage measures for basements as per the Ontario Building Code should be implemented.

Areas of the property may require engineered fill to raise grades. This should be completed under full time supervision by Terraprobe to monitor extent, lift thickness, compaction, material quality and the like.

Where structures are placed on at least 0.5m of engineered fill, the recommended maximum bearing capacity may be 75 to 150 kPa depending on the potential for overstressing of underlying native soils. This should be further investigated with Terraprobe if the option is pursued. Engineered fill material may consist of granular type soils placed with moisture control in maximum 150 mm loose lifts and compacted uniformly to a minimum of 98% of Standard Proctor Maximum Dry Density. Terraprobe's detailed engineered fill specifications will need to be followed if this option is pursued.

6.2 Concrete Slab-On-Grade or Basement Floors

Conventional lightly loaded concrete slab-on-grade or basement floors can be placed on the existing native inorganic soil subgrade below all deleterious materials, or on engineered fill placed under full time supervision, provided a moisture break consisting of a minimum of 150 mm of OPSS Granular 'A' type material compacted to a minimum of 100% of Standard Proctor Maximum Dry Density (SPMDD) is placed directly below the slab.

All basement floors should be constructed at least 0.5m above the seasonally high water level. Perimeter, filtered, weeping drains must also be installed leading to positive outlets such as a sump pump in the basement as per the current building code. Basement walls must be backfilled either with imported Granular 'B' type backfill or drainage mediums utilized as per the Ontario Building Code.

Based on the magnitude and importance of this proposed development, we would strongly recommend continued monthly monitoring of groundwater levels in the installed standpipes in order to support design decisions (such as basement levels, stormwater management facilities, deep excavations, etc.) as the design progresses.

6.3 Excavations

The recommended safe side slope configuration for temporary unbraced excavations above the groundwater level through the native soils is 1.5 to 1 (horizontal to vertical) typically.

A Type 3 soil is characteristic of the site soils above the water level where maximum 1 to 1 side slopes from the base of the trench to ground surface should be used when workers must enter trenches deeper than 1.2m. Soils below the groundwater level should be considered Type 4 soils.

Excavations up to about 0.3m below the encountered water level where sandy seams are intercepted may require localized sump pumping from widened trenches. More positive dewatering methods such as well points and/or deep wells will be required where excavations extend more than about 0.3m below the encountered water level in sand, silty sand and similar coarse deposits. Depending on excavation depths, a Permit to Take Water from the MOECC will likely be required for construction works at this site (ie: more than 50,000 litres per day dewatering). These permits are currently taking several months to obtain.

The attached grain size analyses indicate permeabilities of the native sand to silt and clay soils in the range of 1×10^{-2} to 1×10^{-8}cm/s.

6.4 Backfill

Based on our experience with sand and silty sand soils, the water contents of the upper native site soils are primarily in the range of 5 to 25% by weight. The estimated optimum water content for Standard Proctor compaction is about 9 to 12%. Generally, soils can be sufficiently compacted at moisture contents up to about 3% wetter than optimum. In this regard, a small portion of the upper native site soils fall within this range and will be suitable for reuse as compacted fills during the construction process (without being mixed with drier soils). Generally, the remaining native soils will not be suitable for recompaction and should be dried, mixed with drier soils or be wasted during construction.

Earth fill materials placed beneath settlement sensitive areas such as floor slabs, sidewalks, pavement structures and the like should be compacted to a minimum of 95% of Standard Proctor Maximum Dry Density in lifts not exceeding 200mm.

The topsoil materials and organic rich sands encountered at the site should not be used as backfill in settlement sensitive areas such as those noted above. The topsoil material may be stockpiled and reused for landscaping purposes or wasted.

Should construction be conducted during the winter season, it is imperative to ensure that frozen materials are not utilized as trench backfill.

It is recommended that inspection and testing be carried out by Terraprobe during construction to confirm trench backfill quality, thickness and to ensure adequate compaction.

6.5 Lateral Earth Pressures on Subsurface Walls

The boreholes encountered primarily sand to silty sand for the most part in a loose to dense condition within the upper 2 to 3m of ground surface.

For design of rigid concrete walls, the following design parameters are recommended.

		Loose to dense
soil unit weight	γ	19 kN/m^3
angle of internal friction	Φ'	32°
coefficient of lateral earth pressure "at rest"	k_o	0.5
coefficient of lateral earth pressure, active	k_a	0.31

The recommended design angle of friction between concrete and the native soil is 24°. Associated with the above is the inherent assumption that hydrostatic pressure will not be allowed to develop behind these wall structures. In this regard, perimeter drainage systems will need to be implemented.

6.6 Pipe Bedding

Based on anticipated service inverts of about 2 to 4m below existing grade, the trench base is expected to consist of sand, silt and clay and/or silty sand soils. The undisturbed native soils encountered at the site will generally be suitable for support of underground services with conventional Class 'B' granular bedding. Additional granular bedding may be necessary for stabilization of wet trench bases. The granular bedding

should consist of a well graded material such as Granular 'A'. Excavation bases should be free of standing water prior to and during bedding and service placement.

Any soft, loose or disturbed soils encountered as a result of groundwater seepage or construction traffic should be subexcavated and replaced with suitably compacted granular fill. Granular 'A' bedding material should be placed in thin lifts and compacted to a minimum of 95% of SPMDD. If HL 8 course aggregate or 19mm clear stone is used this will require light tamping only. However, it should be cautioned that this HL8 aggregate or clear stone should not be used directly against native deposits unless a geotextile fabric is also considered as a complete wrap to prevent migration of fines into the bedding from the surrounding fine soil.

6.7 Thrust Blocks and Pipe Restraints

It is recommended that the thrust blocks be cast directly against undisturbed native ground. The maximum allowable bearing pressures for design of thrust blocks against undisturbed native soil where there is soil cover over the block that equals the height of the block, is 100kPa.

The internal angle of friction between the thrust block and the soil may be taken as 33°.

The following design parameters are recommended for design of restrained joints;

- Ultimate friction angle between plastic or ductile iron pipe and compact bedding 24°
- Ultimate friction angle between concrete pipe and compact bedding 33°
- Maximum bearing of thrust pressure of pipe normal to bedding against native soil 100 kPa

6.8 Pavement Design Thickness

The pavement subgrade is expected to comprise of primarily sands and silts in most cases or perhaps clean earth fill compacted to a minimum of 95% of SPMDD. The exposed subgrade should be shaped and graded with a typical 3% cross-fall, directed towards continuous subdrains and/or open ditches with inverts at least 0.3m below subgrade level.

The pavement subgrade should be proof rolled to evaluate its stability. All unstable areas will require sub-excavation and re-compaction or increased thickness of granular subbase. It should be noted that the majority of the upper site soils are considered somewhat frost susceptible. Therefore, adequate subgrade drainage is recommended.

Based on the soil conditions encountered during our investigation, we recommend that a sufficient pavement structure for internal, local, residential roads will be as follows;

HL 3 (surface) asphalt	40 mm
HL 8 (binder) asphalt	70 mm
OPSS Granular 'A' (base course)	150 mm
OPSS Granular 'B' (subbase course)	350 mm
Total	610 mm

The above design assumes that sub-drainage of the granular fill will be provided. This should consist of continuous subdrains leading to catch basins and/or open ditches.

It should be reiterated that the subgrade soils are frost susceptible. The subdrains are considered a valuable protection against frost heave damage and subgrade softening particularly impacting the long term performance of the pavement.

All topsoil and any organic-rich material should be removed from below settlement sensitive areas such as pavements. Immediately prior to placement of the pavement granular courses, the subgrade should be proof rolled with a heavy rubber tired vehicle (such as a grader) and any loose, soft or unstable areas should be subexcavated and backfilled with compacted materials.

The granular subbase and base fill materials should be compacted to a minimum of 100% of Standard Proctor Maximum Dry Density (SPMDD), placed in lifts of 150 mm or less. Asphaltic concrete materials should be rolled and compacted to a minimum of 97% of Marshall Bulk Density (MBD) based on nuclear density testing.

The above pavement design thicknesses are considered adequate for the design traffic. However, if pavement construction occurs in wet inclement weather it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular subbase or base course materials.

Further, main traffic access areas for construction equipment may experience unstable subgrade conditions. These may need stabilization utilizing additional thickness of granular materials.

It is recommended that inspection and testing be carried out during construction to confirm material quality, thickness and to ensure adequate compaction.

6.9 Earthquake Design Parameters

The Ontario Building Code (2006) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the Ontario Building Code (2006). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (v_s) measurements have been taken. Alternatively, the classification is estimated on the basis of rational analysis of undrained shear strength (s_u) or penetration resistance.

$$\upsilon_{s\text{-}avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{\upsilon_{si}}} \qquad s_{u\text{-}avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{s_{ui}}} \qquad N_{avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

Shear wave velocity **Undrained shear strength** **SPT N-values**

At this site the stratigraphy beneath the buildings will consist of at least 6 metres of soil with a penetration resistance averaging at least 20 to 30 blows per 300 mm. The soils are primarily compact to dense silty sand at depth. It is known that the deeper stratigraphy in this area is at least as competent. On this basis, the site designation for seismic analysis is Class D, according to Table 4.1.8.4.A of the Ontario Building Code (2206). Tables 4.1.8.4B and 4.1.8.4C of the same code provide the applicable acceleration and velocity based site coefficients.

Site Class	Values of F_a				
	$S_a(0.2) \leq 0.25$	$S_a(0.2) = 0.50$	$S_a(0.2) = 0.75$	$S_a(0.2) = 1.00$	$S_a(0.2) \geq 1.25$
D	1.3	1.2	1.1	1.1	1

Site Class	Values of F_v				
	$S_a(1.0) \leq 0.1$	$S_a(1.0) = 0.2$	$S_a(1.0) = 0.3$	$S_a(1.0) = 0.4$	$S_a(1.0) \geq 0.5$
D	1.4	1.3	1.2	1.1	1.1

6.10 Stormwater Management Facilities

At the time of this investigation the location(s) of proposed storm facilities were not known to Terraprobe.

The attached reports indicate grain size analyses for the different strata encountered in the boreholes. According to Hazen's Rule, we would estimate a coefficient of permeability for each of the tested samples as follows:

Borehole Number	Sample Number	Estimated Coefficient of Permeability (cm/s)
201	5	1×10^{-8}
205	4	1.5×10^{-3}
209	5	1.5×10^{-2}

Pond geometry of 4:1 to 5:1 (horizontal to vertical) internal side slopes are appropriate below the normal high groundwater level for the type and density of the soils encountered during our investigation. Additional monitoring would be required to confirm groundwater levels. Interior slopes above the normal high water level could be constructed to a maximum of 3:1 (horizontal to vertical). Exterior berm slopes may be created to 3:1 which will also be suitable from a geotechnical perspective depending on whether maintenance and/or grass cutting will be required on the slopes.

6.11 ENVIRONMENTAL CONSIDERATIONS

Select soil samples were obtained at representative depths during the drilling operations in February, 2015 to assess current shallow soil conditions and provide a preliminary analytical assessment of the soil. A complete soil management plan may be needed eventually, pending the possible removal of soils off-site. The following table (Summary of Soil Samples and Analytical Testing) is a summary of the collected soil samples and the analytical schedule.

SUMMARY OF SOIL SAMPLES AND ANALYTICAL TESTING

Sample ID	Sample Depth (m)	General Quality Metals and Inorganics	F1-F4 PHC	BTEX	TCLP	Soil Description
BH209-SS2	0.8-1.2	-	-	-	✓	Sand, trace to some silt
BH201-SS3	1.5-2.0	✓	✓	✓	-	Sand, trace to some silt
BH204- SS3	1.5-2.0	✓	✓	✓	-	Organic Fill
BH206-SS3	1.5-20	✓	✓	✓	-	Sand, trace to some silt

The O.Reg. 153(511) analytical results were compared to the MOECC, Table 1, Site Condition Standards (SCS), Residential, Parkland, Institutional, Industrial, Commercial, Community property use (All). The laboratory Certificate of Analyses including the Laboratory Quality Assurance Report is appended.

No soil parameter exceedances were recorded with regard to the O. Reg. 153(511) analytical results as compared to MOECC Table 1 SCS.

Based on the above analytical soil testing results, the soil is suitable to be permanently stored on a Table 1 or Table 2 SCS site willing to accept the material. The soil may also be left on site if agreed upon by /with the property owner.

No exceedances were recorded in regard to O.Reg. 558 TCLP testing within the soil sample from Borehole 209. Based on this result, the soil is considered to be non-hazardous and non-registerable.

The select representative soil sampling and soil chemical analyses reported herein has been conducted in order to assess possible options for soil management and/or disposal and is not intended to constitute a Phase Two Environmental Site Assessment and as such does not comment on the environmental condition of the site. Soil quality may vary at locations other than those tested. Furthermore, the testing conducted as part of this program will not substantiate the preparation of a Record of Site Condition in accordance with the Ontario Ministry of the Environment and Climate Change (MOECC) Standards.

Please note that the representative sampled and analytically tested soils do not guarantee that there are no further impacted soils at site or other environmental related issues. These samples are representative of their location and results may vary elsewhere.

6.12 Slope Stability Analysis and Development Setbacks

Concurrent with this geotechnical study, Terraprobe is conducting a comprehensive slope stability study based on the subsurface findings of this investigation. The results of this assessment and the recommended development setbacks are being reported under separate cover by Terraprobe.

7.0 CONCLUSIONS

Terraprobe was retained to provide geotechnical characterization of the site and to provide recommendations based on these findings to guide design decisions.

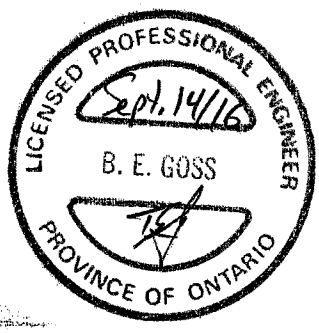
Terraprobe recently observed and recorded the advancement of nine (9) sampled boreholes on the subject property. The boreholes generally indicated sand to silty sand overlying silt and clay to clayey silt in localized areas. As noted above, groundwater levels were measured once in mid-March in the installed standpipes with levels recorded from 1.1 to at least 6.5m below existing grade.

It is recommended that groundwater monitoring in the installed standpipes should continue on a monthly basis in order to evaluate the magnitude of seasonal groundwater fluctuations and estimate peak levels which will affect the final design such as basement levels, deep road cuts, stormwater management facility design, etc.

Terraprobe should be involved through the design process to provide geotechnical consultation and support. Further investigation and/or review may be required for specific details of the development as the design progresses.

We trust the foregoing information will satisfy your present requirements. If you should have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Sincerely,
Terraprobe Inc.

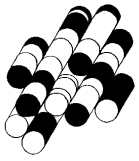


Blair E. Goss, P. Eng.
Associate

Michael Tanos, P. Eng.
Principal

BEG/ct

BOREHOLE LOGS



Terraprobe Inc.

Terraprobe

ABBREVIATIONS, TERMINOLOGY, GENERAL INFORMATION

BOREHOLE LOGS

SAMPLING METHOD

SS	split spoon
ST	Shelby tube
AS	auger sample
WS	wash sample
RC	rock core
WH	weight of hammer
PH	pressure, hydraulic

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.).

SOIL DESCRIPTION - COHESIONLESS SOILS

Relative Density	'N' value
very loose	< 4
loose	4 - 10
compact	10 - 30
dense	30 - 50
very dense	> 50

SOIL DESCRIPTION - COHESIVE SOILS

Consistency	Undrained Shear Strength, kPa	'N' value
very soft	< 12	< 2
soft	12 - 25	2 - 4
firm	25 - 50	4 - 8
stiff	50 - 100	8 - 16
very stiff	100 - 200	16 - 32
hard	> 200	> 32

SOIL COMPOSITION

	% by weight
'trace' (e.g. trace silt)	< 10
'some' (e.g. some gravel)	10 - 20
adjective (e.g. sandy)	20 - 35
'and' (e.g. sand and gravel)	35 - 50

TESTS, SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
ϕ'	angle of internal friction
c'	cohesion shear strength
C_c	compression index

GENERAL INFORMATION, LIMITATIONS

The conclusions and recommendations provided in this report are based on the factual information obtained from the boreholes and/or test pits. Subsurface conditions between the test holes may vary.

The engineering interpretation and report recommendations are given only for the specific project detailed within, and only for the original client. Any third party decision, reliance, or use of this report is the sole and exclusive responsibility of such third party. The number and siting of boreholes and/or test pits may not be sufficient to determine all factors required for different purposes.

It is recommended Terraprobe be retained to review the project final design and to provide construction inspection and testing.

Terraprobe

LOG OF BOREHOLE ..201..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		226.5			
175mm – TOPSOIL 500mm – SILTY SAND FILL, trace organics Brown Compact Moist		0.0	1	SS	24
			2	SS	14
SAND, trace to some silt, trace gravel			3	SS	22
			4	SS	15
		223.5			
Grey Hard Moist		3.0	5	SS	33
SILT & CLAY, to clayey, trace sand			6	SS	36
			7	SS	37
		219.9			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80

SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION

1. Borehole remained open and dry upon completion of drilling.

2. Water level on March 10, 2015 measured dry to 6.5m.

Terraprobe

LOG OF BOREHOLE ..202..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

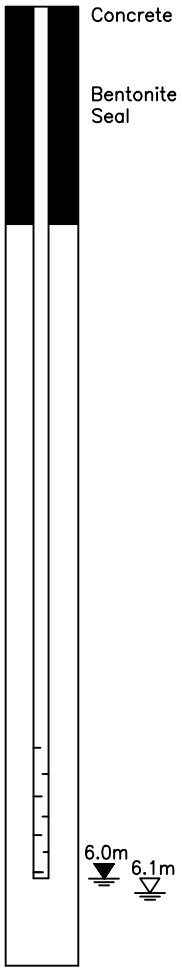
BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
	GROUND SURFACE		224.9			
0	100mm - TOPSOIL		0.0			
	Brown Compact to Very Dense Moist to Wet			1	SS	36
1	SAND, trace to some silt, trace gravel, medium to fine			2	SS	22
				3	SS	31
2				4	SS	43
3				5	SS	36
4						
				6	SS	42
5						
6				7	SS	52
			218.3			
	End of Borehole		6.6			
7						
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 6.1m upon completion of drilling.

2. Water level on March 10, 2015 measured at 6.0m (elev. 218.9m).

Terraprobe

LOG OF BOREHOLE ..203..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

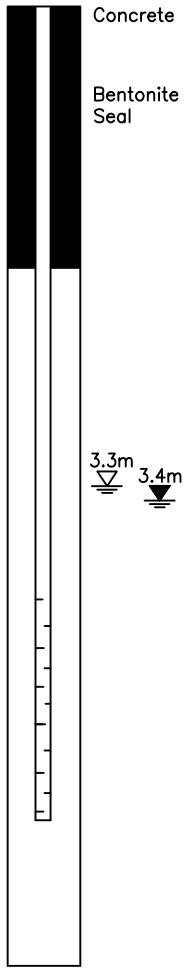
BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE
0	GROUND SURFACE		229.3			
0	175mm - TOPSOIL		0.0			
0	Brown Loose to Dense Moist to Wet			1	SS	54
1	SAND, trace to some silt, trace gravel			2	SS	6
2				3	SS	6
2				4	SS	6
3				5	SS	25
4						
5				6	SS	37
6				7	SS	29
6			222.7			
7	End of Borehole		6.6			
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
WP W WL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 3.3m upon completion of drilling.

2. Water level on March 10, 2015 measured at 3.4m (elev. 225.9m).

Terraprobe

LOG OF BOREHOLE ..204..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

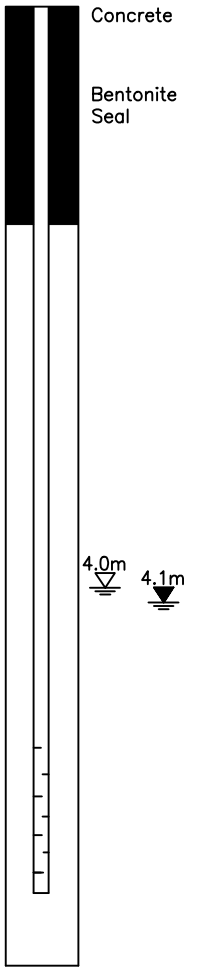
DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		230.3			
Dark Brown Compact Moist SAND, some silt to silty, some organics, trace gravel, FILL		0.0 229.0	1	SS	17
			2	SS	15
Dark Brown Loose Moist ORGANIC PEAT, FILL		1.3 227.9	3	SS	6
Brown Loose to Very Loose Moist to Wet SAND, trace to some silt, trace gravel		2.4	4	SS	5
			5	SS	4
			6	SS	2
			7	SS	2
		223.7			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 4m upon completion of drilling.

2. Water level on March 10, 2015 measured at 4.1m (elev. 226.2m).

Terraprobe

LOG OF BOREHOLE ..205..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
0	GROUND SURFACE		230.6			
0	Brown Compact Moist		0.0	1	SS	27
1	SAND, some gravel to gravelly, trace to some silt			2	SS	14
2				3	SS	32
2			228.5			
2	Brown Dense to Very Dense Moist to Wet		2.1	4	SS	33
3	SAND, fine to medium, silty to trace silt, trace gravel			5	SS	39
4						
5				6	SS	54
6						
6			224.0	7	SS	36
7	End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION

1. Borehole caved and water level noted at 4.2m upon completion of drilling.

2. Water level on March 10, 2015 measured at 4.6m (elev. 226.0m).

Terraprobe

LOG OF BOREHOLE ..206..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		229.5			
500mm - Organic stained Sand		0.0			
Brown Loose to Dense Moist to Wet			1	AS	
SAND, trace to some silt, trace gravel			2	SS	4
			3	SS	3
			4	SS	4
			5	SS	19
			6	SS	44
		224.0			
Grey Very Stiff Moist		5.5			
SILT, some clay to clayey, trace sand			7	SS	18
		222.9			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
WP W WL
10 20 30

INSTALLATION INFORMATION

1. Borehole caved and water level noted at 1.8m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.8m (elev. 227.7m).

Terraprobe

LOG OF BOREHOLE ..207..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31–15–2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

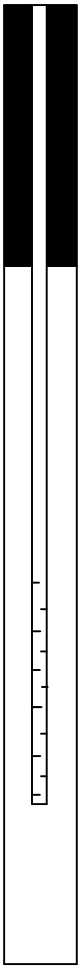
BORING METHOD: D–50T Crawler–mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
0	GROUND SURFACE		228.7			
	Brown Compact Moist SAND, some organics, trace silt, trace gravel, FILL		0.0 228.0	1	SS	11
1	Brown Compact Moist to Wet SAND, trace to some silt, trace gravel		0.7	2	SS	16
				3	SS	28
2				4	SS	28
			225.9			
3	Grey Very Stiff to Hard Moist SILT & CLAY to CLAYEY, trace sand		2.8	5	SS	26
4						
				6	SS	40
5						
6				7	SS	47
			222.1			
7	End of Borehole		6.6			
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 1.2m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.6m (elev. 227.1m).

Terraprobe

LOG OF BOREHOLE ..208..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

SOIL PROFILE

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)
GROUND SURFACE		227.6
300mm - TOPSOIL		0.0
Brown to Grey; Compact to Very Dense; Moist to Wet		
SAND, trace to some silt, trace gravel		
Grey		
		221.0
End of Borehole		6.6

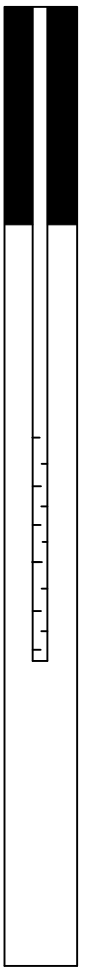
SAMPLES

NUMBER	TYPE	"N" VALUE
1	AS	
2	SS	22
3	SS	19
4	SS	22
5	SS	39
6	SS	52
7	SS	50/150mm

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - +
rem.V - ⊕
Q - ●
U - ○
20 40 60 80

WATER CONTENT (%)
WP w WL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 1.5m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.1m (elev. 226.5m).

Terraprobe

LOG OF BOREHOLE ..209..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE	PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (nat.V +, rem.V ⊕, Q ●, U ○)	WATER CONTENT (%) (WP, W, WL)	INSTALLATION INFORMATION
	GROUND SURFACE		226.6						
0	450mm - TOPSOIL		0.0						
	Brown Compact to Dense Moist to Wet			1	AS				
1	SAND, medium to fine, trace to some silt, trace gravel			2	SS	11	x		
				3	SS	27	x		
2				4	SS	35	x		
3				5	SS	24	x		
4				6	SS	46	x		
5									
6				7	SS	35	x		
			220.0						
7	End of Borehole		6.6						
8									
9									

PENETRATION RESISTANCE PLOT: 20 40 60 80
SHEAR STRENGTH kPa: nat.V - +, rem.V - ⊕, Q - ●, U - ○
WATER CONTENT (%): WP, W, WL; 10 20 30

INSTALLATION INFORMATION

1. Borehole caved and water level noted at 1.5m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.7m (elev. 224.9m).

WATER WELL RECORDS

Terraprobe Inc.

Ontario Ministry of the Environment

Well Tag No. (Place Sticker and/or Print Below) **Tag#: A177457**

31-15-2003

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Measurements recorded in: ☐ Metric ☑ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
Richwood Estates Inc		russpmenon@rogers.com	

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
2220 Hwy 7 W, Unit 5	Concord	ON	L4K 1W4	416 669 1447

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
70 Pioneer Trail			

County/District/Municipality	City/Town/Village	Province	Postal Code
County of Simcoe	Barrie	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	609546	4918980		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
brown	topsoil		traces at times	0	1
brown	medium coarse sand		loose	1	15
brown	medium coarse sand	traces silt	loose	15	20
	"cluster of 9 monitoring wells"				

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	1	concrete	
1	5	bentonite	
5	20	sand	

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping: hrs + min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

Well production (l/min / GPM)

Disinfected? ☐ Yes ☒ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool ☐ Diamond ☒ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☐ Air percussion ☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used ☐ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☐ Test Hole ☒ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
4"	steel	1/16	+3	-1'
3/4	plastic	1/4	+2.5	15'

Status of Well

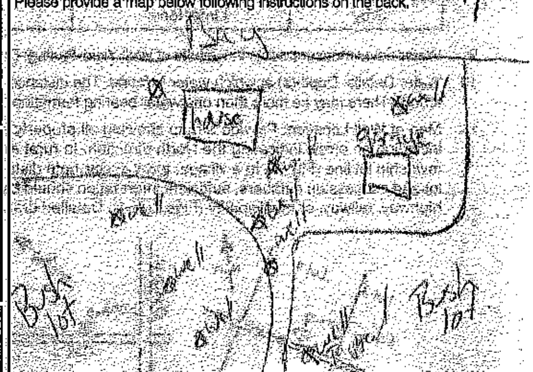
☐ Water Supply ☐ Replacement Well ☒ Test Hole ☐ Recharge Well ☐ Dewatering Well ☒ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
1"	plastic	6"	15'	20'

Map of Well Location

Please provide a map below following instructions on the back.



Water Details

Water found at Depth	Kind of Water
5 (m/ft) ☐ Gas	☐ Fresh ☒ Untested ☐ Other, specify
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	20	6

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
London Soil Test Ltd.	7190

Business Address (Street Number/Name)	Municipality
3376 White Oak Rd Unit 16	London

Province	Postal Code	Business E-mail Address
ON	N6E 2Z9	info@londonsoil.com

Bus. Telephone No. (inc. area code): 519 915 5777 — Name of Well Technician (Last Name, First Name): Ross T...

Well Technician's Licence No.: 9190 — Signature of Technician and/or Contractor — Date Submitted: 2015 09 15

Comments:

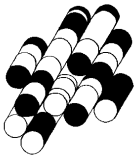
Well owner's information package delivered: ☐ Yes ☐ No

Date Package Delivered: Y Y Y Y M M D D

Date Work Completed: 2015 08 15

Ministry Use Only — Audit No. Z 202363 — Received

GRAIN SIZE ANALYSIS



Terraprobe Inc.

Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

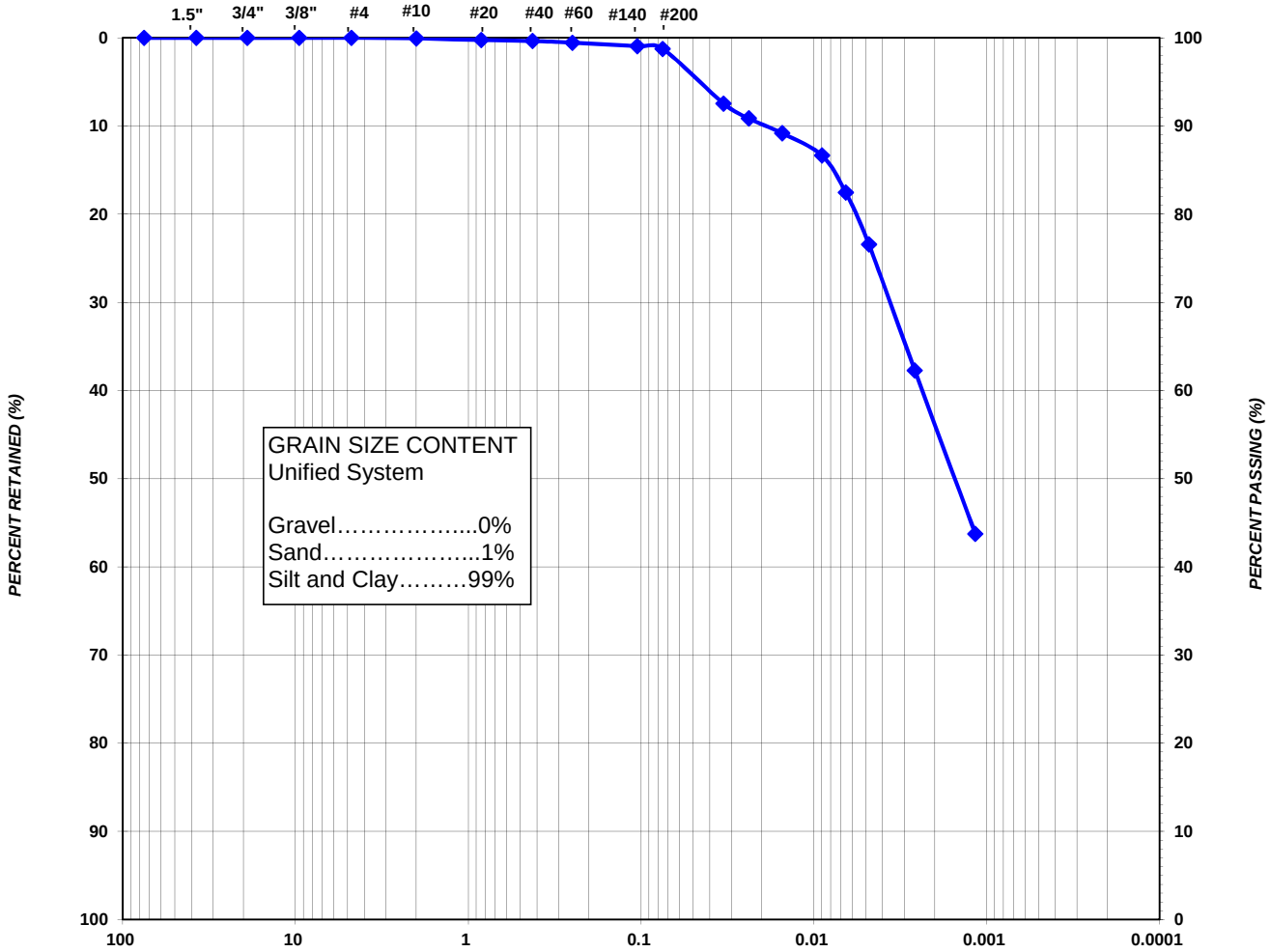
PROJECT: **70 Pioneer Trail Subdivision**
LOCATION: **Barrie, ON**
CLIENT: **Richwood Estates Inc.**

FILE NO.: **32-15-2003**
LAB NO.: **1188a**
SAMPLE DATE: **Feb-27-15**
SAMPLED BY: **B.H.**

BOREHOLE NUMBER: **201** SAMPLE DEPTH: **10 to 11.5'**
SAMPLE NUMBER: **5**
SAMPLE LOCATION: **as above**
SAMPLE DESCRIPTION: **Silt and clay, trace sand**

GRAIN SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZES



MIT SYSTEM	GRAVEL	COARSE	MEDIUM	FINE	SILT	CLAY
		SAND				

UNIFIED SYSTEM	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

Terraprobe

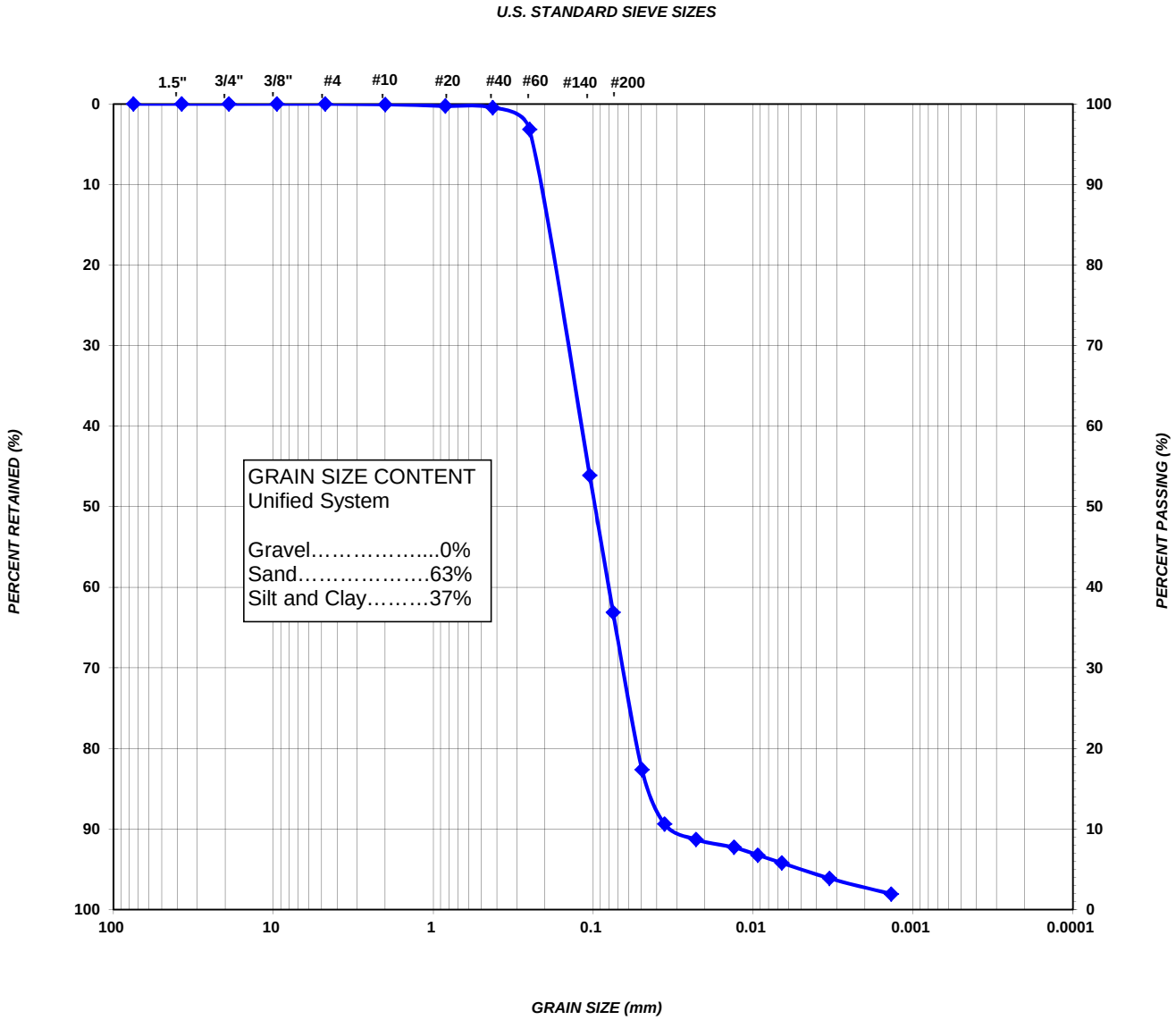
SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: **70 Pioneer Trail Subdivision**
LOCATION: **Barrie, ON**
CLIENT: **Richwood Estates Inc.**

FILE NO.: **32-15-2003**
LAB NO.: **1188b**
SAMPLE DATE: **Feb-27-15**
SAMPLED BY: **B.H.**

BOREHOLE NUMBER: **205** SAMPLE DEPTH: **7.5 to 9'**
SAMPLE NUMBER: **4**
SAMPLE LOCATION: **as above**
SAMPLE DESCRIPTION: **Silty sand, trace clay**

GRAIN SIZE DISTRIBUTION



MIT SYSTEM	GRAVEL	COARSE	MEDIUM	FINE	SILT	CLAY
		SAND				

UNIFIED SYSTEM	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

Terraprobe

WASH SIEVE ANALYSIS TEST REPORT

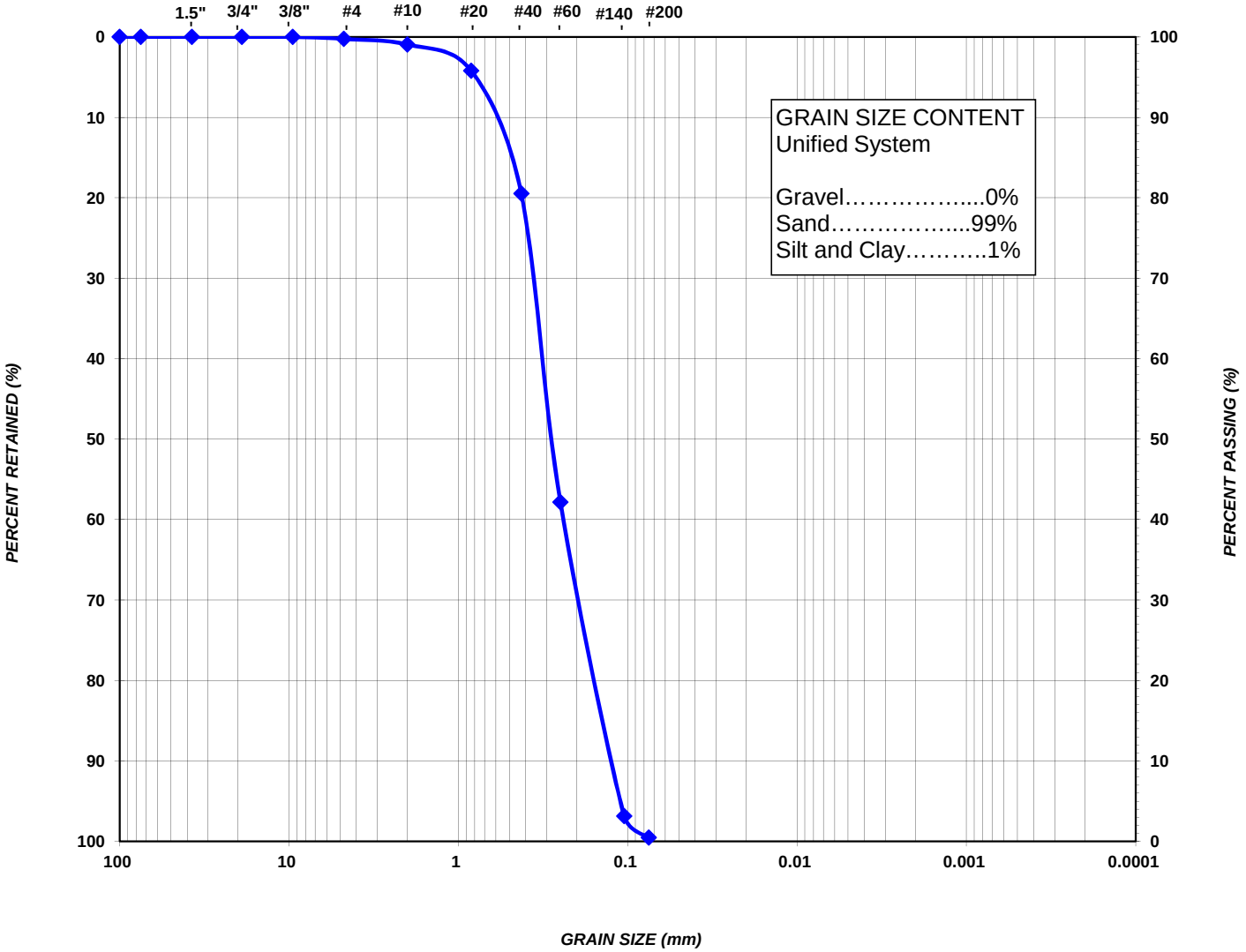
PROJECT: **70 Pioneer Trail Subdivision**
LOCATION: **Barrie, ON**
CLIENT: **Richwood Estates Inc.**

FILE NO.: **32-15-2003**
LAB NO.: **1188c**
SAMPLE DATE: **Feb-27-15**
SAMPLED BY: **B.H.**

BOREHOLE NUMBER: **209**
SAMPLE DEPTH: **10 to 11.5'**
SAMPLE NUMBER: **5**
SAMPLE LOCATION: **as above**
SAMPLE DESCRIPTION: **Sand, trace silt**

GRAIN SIZE DISTRIBUTION

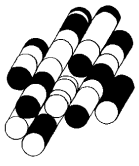
U.S. STANDARD SIEVE SIZES



MIT SYSTEM	GRAVEL	COARSE	MEDIUM	FINE	SILT	CLAY
		SAND				

UNIFIED SYSTEM	COARSE	FINE	COARSE	MEDIUM	FINE	
	GRAVEL		SAND			SILT AND CLAY

PREVIOUS BOREHOLE LOGS



Terraprobe Inc.

Terraprobe

LOG OF BOREHOLE ..106..

PROJECT NAME:Ontario Mission of the Deaf Subdivision PROJECT No.: 3-07-3012

CLIENT: Ontario Mission of the Deaf BORING DATE: February 20, 2007

LOCATION: Barrie, Ontario ELEVATION DATUM: Geodetic

BORING METHOD: D50 Crawler-mounted Drill Rig / 108mm Diameter Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUE
GROUND SURFACE		229.4			
150mm – TOPSOIL		0.0			
Brown Loose Moist to Wet			1	SS	9
			2	SS	8
SAND, trace to some silt			3	SS	9
			4	SS	3
			5	SS	6
			6	SS	10
		224.4			
End of Borehole		5.0			

PENETRATION RESISTANCE PLOT (20 40 60 80)

SHEAR STRENGTH kPa
nat.V – +
rem.V – ⊕
Q – ●
U – ○
(20 40 60 80)

WATER CONTENT (%) (10 20 30)

INSTALLATION INFORMATION

1. Borehole caved at 2m upon completion of drilling.

2. Water level noted at 1.2m during drilling.

3. Water level on February 28, 2007 measured at 1.6m (elev. 227.8m).

Terraprobe

LOG OF BOREHOLE ..107..

PROJECT NAME:Ontario Mission of the Deaf Subdivision PROJECT No.: 3-07-3012

CLIENT: Ontario Mission of the Deaf BORING DATE: February 20, 2007

LOCATION: Barrie, Ontario ELEVATION DATUM: Geodetic

BORING METHOD: D50 Crawler-mounted Drill Rig / 108mm Diameter Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		226.9			
Brown to Black — Loose to Compact — Moist		0.0	1	SS	5
SAND, trace to some organics, FILL			2	SS	27
		225.6			
Light Brown — Compact to Very Dense — Moist		1.3	3	SS	16
SILTY SAND, fine, with sandy silt, inclusions/layers			4	SS	43
			5	SS	50/125mm
			6	SS	50/150mm
		221.9			
End of Borehole		5.0			

PENETRATION RESISTANCE PLOT (20 40 60 80)

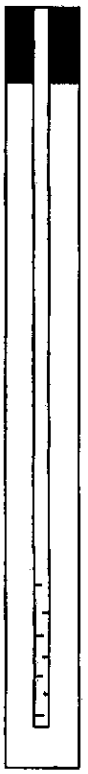
SHEAR STRENGTH kPa (20 40 60 80)

natV. – + Q – ●

rem.V. – ⊕ U – ○

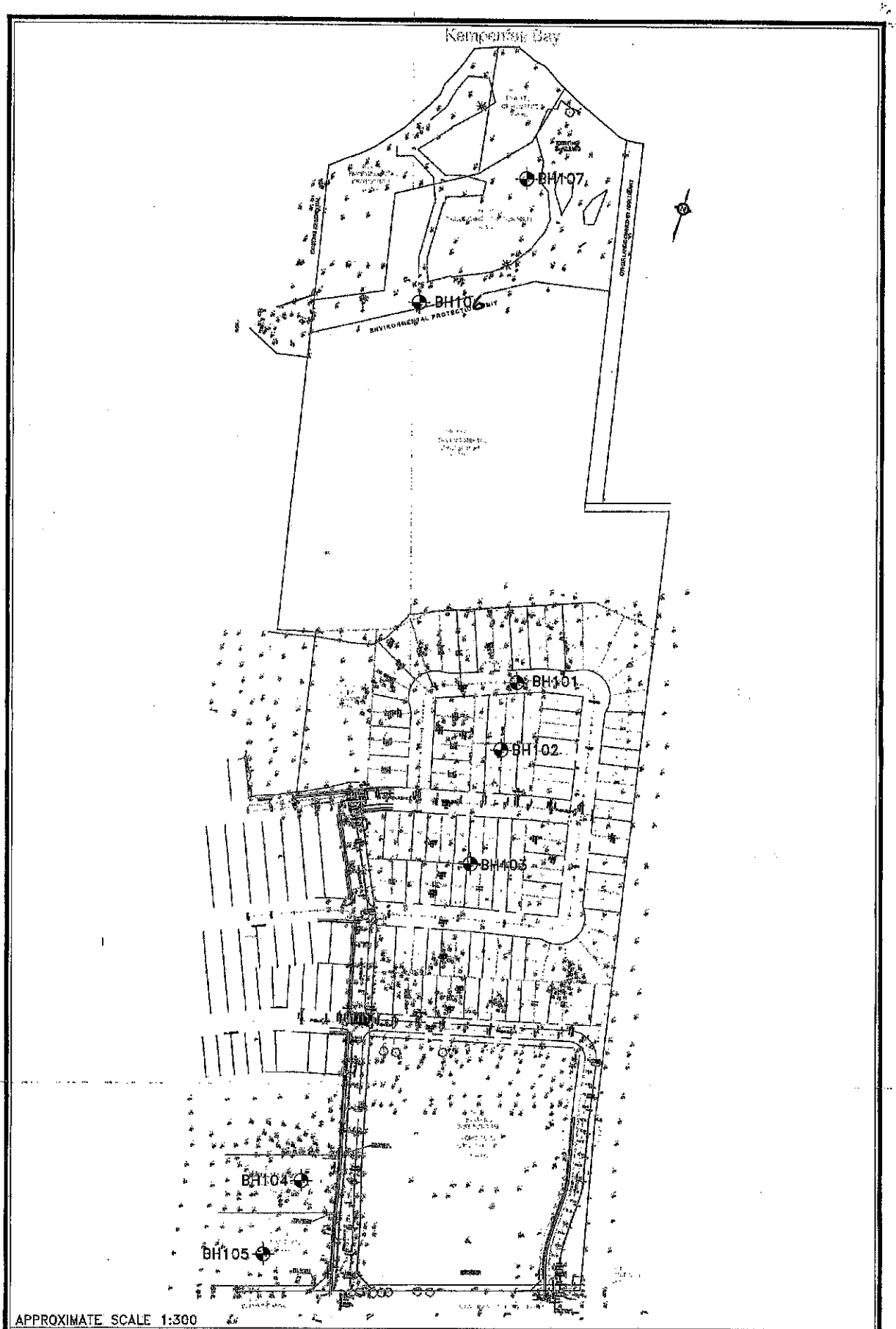
WATER CONTENT (%) (10 20 30)

INSTALLATION INFORMATION



1. Borehole remained open and dry upon completion of drilling.

2. Water level on February 26, 2007 measured dry to 4.7m.



APPROXIMATE SCALE 1:300

FEBRUARY 2007

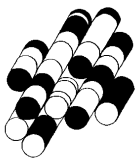
BOREHOLE LOCATION PLAN

3-07-3012

Terraprobe

FIGURE 2

FIGURES



Terraprobe Inc.

MARCH 2015

SITE LOCATION PLAN

31-15-2003

Terraprobe

FIGURE 1

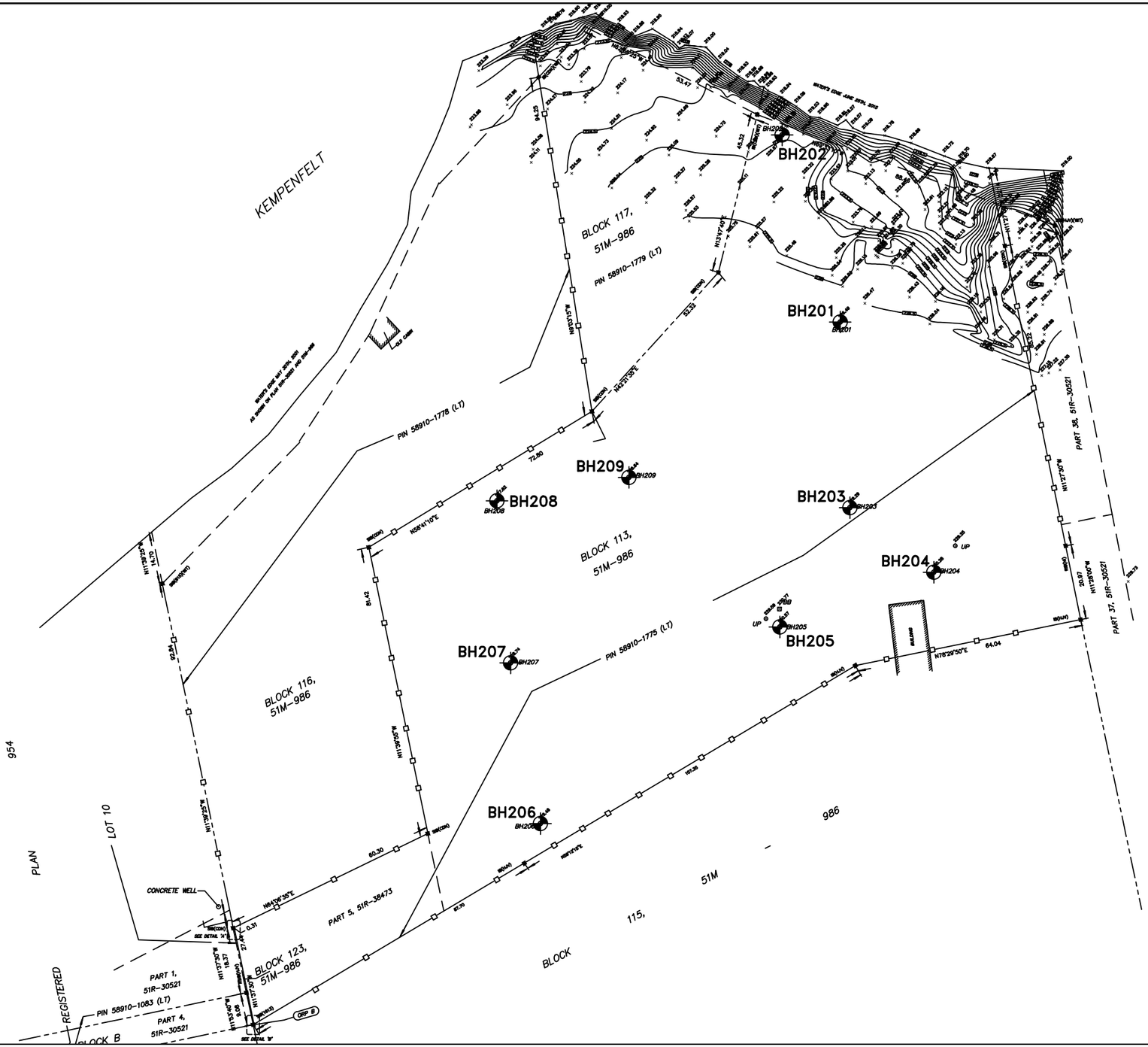
MARCH 2015

BOREHOLE LOCATION PLAN

31-15-2003

Terraprobe

FIGURE 2



AUGUST 2015

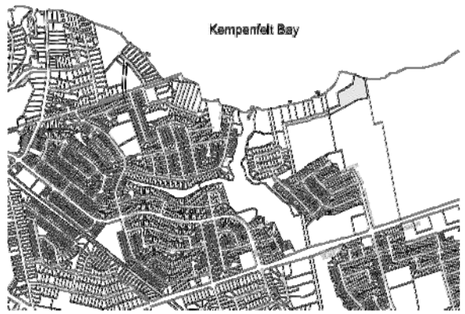
BOREHOLE LOCATION PLAN

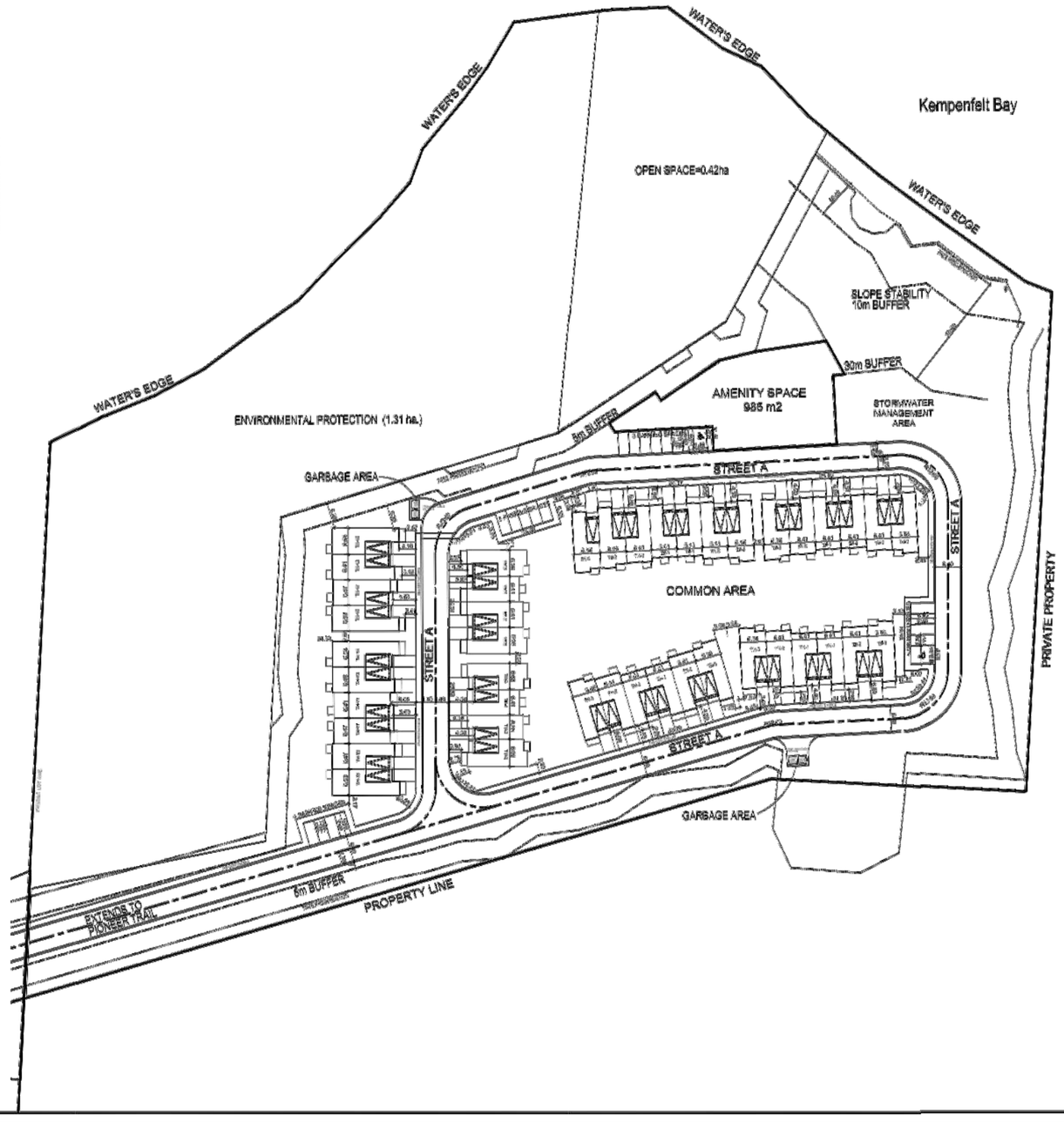
31-15-2003

Terraprobe

FIGURE 3

KEY MAP: 1:15,000





SITE STATISTICS

UNIT COUNT:

TH-01 STANDARD TOWNS	= 10 Units
TH-02 STANDARD TOWNS	= 10 Units
TH-03 STANDARD TOWNS	= 10 Units
TH-10 STANDARD TOWNS	= 4 Units
TH-11 STANDARD TOWNS	= 3 Units
TH-12 STANDARD TOWNS	= 3 Units
TOTAL	= 40 Units

AREA:

SITE AREA	= 2.89 HA = 7.14 AC
OPEN SPACE AREA	= 0.42 HA = 1.04 AC
DEVELOPABLE AREA	= 2.48 HA = 6.16 AC
LOT COVERAGE	= 0.44 HA = 15 %

DENSITY:

=	17.24 Units/HA
=	7.02 Units/AC

PARKING:

RESIDENTIAL	= 68 Spaces
VISITOR	= 33 Spaces
BARRIER FREE	= 02 Spaces
TOTAL	= 105 Spaces

NOTES:

1) Snow storage to be taken off site.
2) Private garbage pick up.

FERNBROOK HOMES

KEMPENFELT BAY
BARRIE, ONTARIO

SITE PLAN

SEPTEMBER 2016

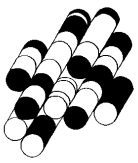
CONCEPT DEVELOPMENT PLAN

31-15-2003

Terraprobe

FIGURE 4

GROUNDWATER LEVEL MONITORING DATA



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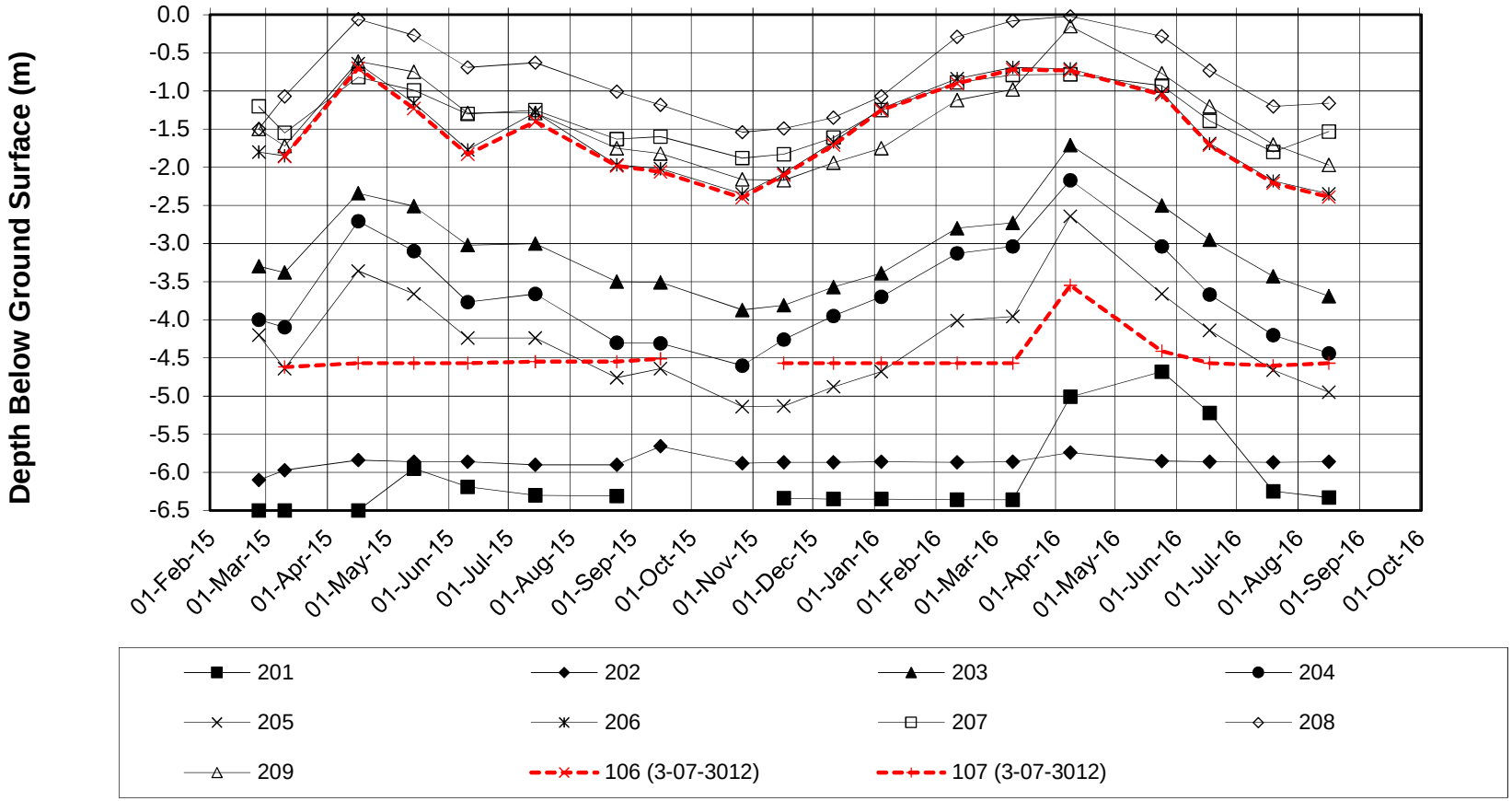
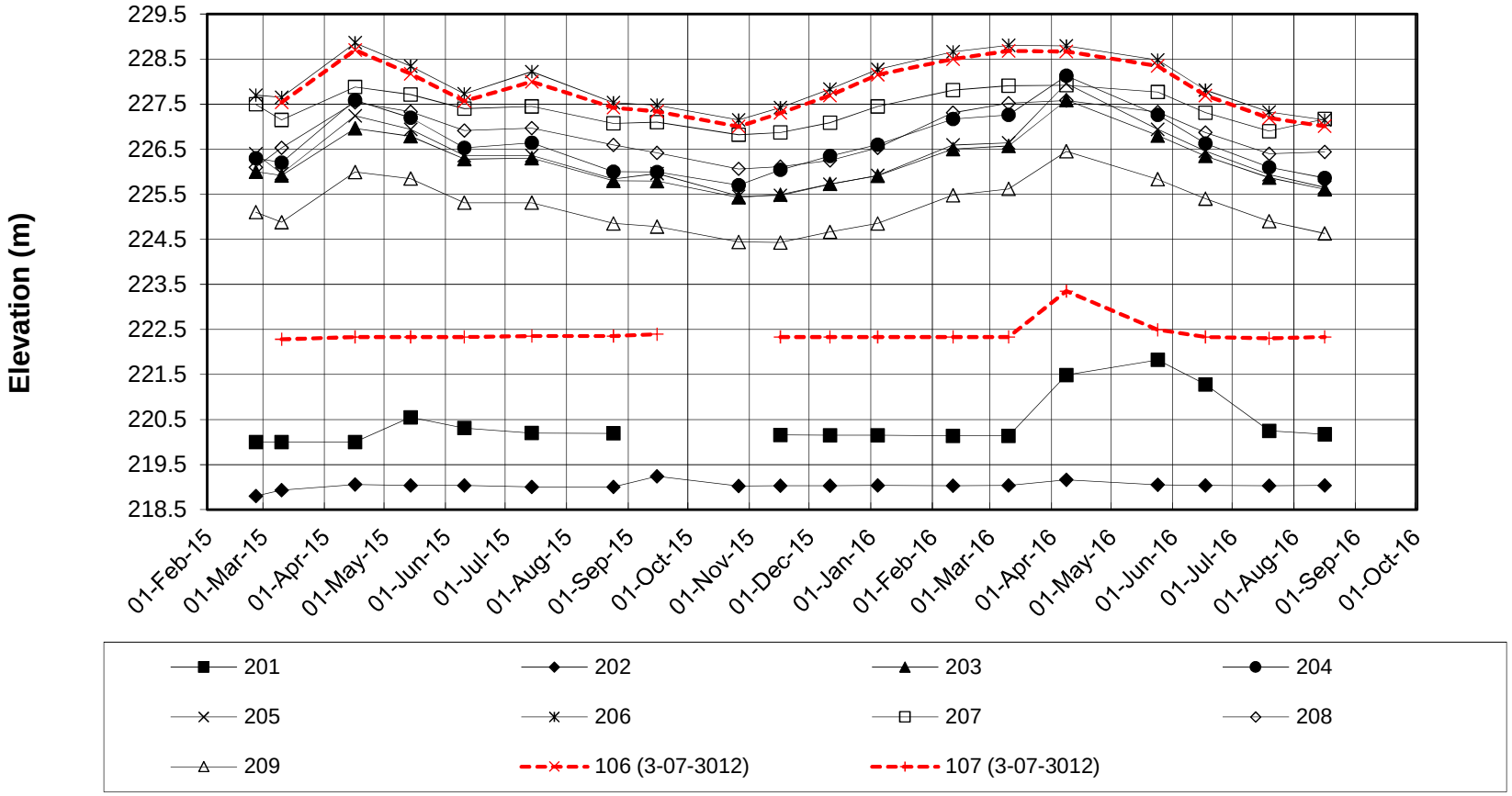
Static Water Level Monitoring
70 Pioneer Trail, Barrie - (Feb. 2015 to)
Terraprobe -- 31-15-2003



Static Water Level Monitoring
70 Pioneer Trail, Barrie - (Feb. 2015 to)
Terraprobe -- 31-15-2003

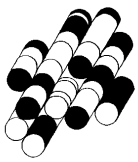


Terraprobe -- 31-15-2003
70 Pioneer Trail, Barrie

Monitoring/ Borehole Location	Ground Surface Elevation (m)	Static Water Level Depth Below Existing Ground Surface (m)																						
		20-Feb-07	26-Feb-07	25-Feb-15	10-Mar-15	16-Apr-15	14-May-15	10-Jun-15	14-Jul-15	24-Aug-15	15-Sep-15	26-Oct-15	16-Nov-15	11-Dec-15	4-Jan-16	11-Feb-16	10-Mar-16	8-Apr-16	24-May-16	17-Jun-16	19-Jul-16	16-Aug-16			
201	226.5			-6.5	-6.5	-6.5	-6.0	-6.2	-6.3	-6.3			-6.3	-6.4	-6.4	-6.4	-6.4	-5.0	-4.7	-5.2	-6.3	-6.3			
202	224.9			-6.1	-6.0	-5.8	-5.9	-5.9	-5.9	-5.9	-5.7	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.7	-5.9	-5.9	-5.9	-5.9			
203	229.3			-3.3	-3.4	-2.3	-2.5	-3.0	-3.0	-3.5	-3.5	-3.9	-3.8	-3.6	-3.4	-2.8	-2.7	-1.7	-2.5	-3.0	-3.4	-3.7			
204	230.3			-4.0	-4.1	-2.7	-3.1	-3.8	-3.7	-4.3	-4.3	-4.6	-4.3	-4.0	-3.7	-3.1	-3.0	-2.2	-3.0	-3.7	-4.2	-4.4			
205	230.6			-4.2	-4.6	-3.4	-3.7	-4.2	-4.2	-4.8	-4.6	-5.1	-5.1	-4.9	-4.7	-4.0	-4.0	-2.6	-3.7	-4.1	-4.7	-5.0			
206	229.5			-1.8	-1.9	-0.6	-1.2	-1.8	-1.3	-2.0	-2.0	-2.4	-2.1	-1.7	-1.2	-0.8	-0.7	-0.7	-1.0	-1.7	-2.2	-2.4			
207	228.7			-1.2	-1.6	-0.8	-1.0	-1.3	-1.3	-1.6	-1.6	-1.9	-1.8	-1.6	-1.3	-0.9	-0.8	-0.8	-0.9	-1.4	-1.8	-1.5			
208	227.6			-1.5	-1.1	-0.1	-0.3	-0.7	-0.6	-1.0	-1.2	-1.5	-1.5	-1.4	-1.1	-0.3	-0.1	0.0	-0.3	-0.7	-1.2	-1.2			
209	226.6			-1.5	-1.7	-0.6	-0.8	-1.3	-1.3	-1.8	-1.8	-2.2	-2.2	-1.9	-1.8	-1.1	-1.0	-0.2	-0.8	-1.2	-1.7	-2.0			
106 (3-07-3012)	229.4	-1.2	-1.6		-1.9	-0.7	-1.2	-1.8	-1.4	-2.0	-2.1	-2.4	-2.1	-1.7	-1.3	-0.9	-0.7	-0.7	-1.1	-1.7	-2.2	-2.4			
107 (3-07-3012)	226.9	-5.0	-5.0		-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.5		-4.6	-4.6	-4.6	-4.6	-4.6	-3.6	-4.4	-4.6	-4.6	-4.6			
		noted		noted		A&B?						107?	107 Dry					208 frozen		107 Dry		107 Dry			

Monitoring/ Borehole Location	Ground Surface Elevation (m)	Static Water Level Elevation (m)																						
		20-Feb-07	26-Feb-07	25-Feb-15	10-Mar-15	16-Apr-15	14-May-15	10-Jun-15	14-Jul-15	24-Aug-15	15-Sep-15	26-Oct-15	16-Nov-15	11-Dec-15	4-Jan-16	11-Feb-16	10-Mar-16	8-Apr-16	24-May-16	17-Jun-16	19-Jul-16	16-Aug-16			
201	226.5			220.0	220.0	220.0	220.6	220.3	220.2	220.2			220.2	220.2	220.2	220.1	220.1	221.5	221.8	221.3	220.3	220.2			
202	224.9			218.8	218.9	219.1	219.0	219.0	219.0	219.0	219.2	219.0	219.0	219.0	219.0	219.0	219.0	219.2	219.1	219.0	219.0	219.0			
203	229.3			226.0	225.9	227.0	226.8	226.3	226.3	225.8	225.8	225.4	225.5	225.7	225.9	226.5	226.6	227.6	226.8	226.4	225.9	225.6			
204	230.3			226.3	226.2	227.6	227.2	226.5	226.6	226.0	226.0	225.7	226.0	226.4	226.6	227.2	227.3	228.1	227.3	226.6	226.1	225.9			
205	230.6			226.4	226.0	227.2	226.9	226.4	226.4	225.8	226.0	225.5	225.5	225.7	225.9	226.6	226.6	228.0	226.9	226.5	225.9	225.7			
206	229.5			227.7	227.7	228.9	228.3	227.7	228.2	227.5	227.5	227.2	227.4	227.8	228.3	228.7	228.8	228.8	228.5	227.8	227.3	227.2			
207	228.7			227.5	227.2	227.9	227.7	227.4	227.5	227.1	227.1	226.8	226.9	227.1	227.5	227.8	227.9	227.9	227.8	227.3	226.9	227.2			
208	227.6			226.1	226.5	227.5	227.3	226.9	227.0	226.6	226.4	226.1	226.1	226.3	226.5	227.3	227.5	227.6	227.3	226.9	226.4	226.4			
209	226.6			225.1	224.9	226.0	225.9	225.3	225.3	224.9	224.8	224.4	224.4	224.7	224.9	225.5	225.6	226.5	225.8	225.4	224.9	224.6			
106 (3-07-3012)	229.4	228.2	227.8		227.5	228.7	228.2	227.6	228.0	227.4	227.3	227.0	227.3	227.7	228.2	228.5	228.7	228.7	228.4	227.7	227.2	227.0			
107 (3-07-3012)	226.9	221.9	221.9		222.3	222.3	222.3	222.3	222.4	222.4	222.4		222.3	222.3	222.3	222.3	222.3	223.4	222.5	222.3	222.3	222.3			
		noted		noted																					

CHEMISTRY RESULTS



Terraprobe Inc.

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: **TERRAPROBE INC.**
220 BAYVIEW DRIVE, UNIT 25
BARRIE, ON L4N4Y8
(705) 739-8355

ATTENTION TO: **Blair Goss**

PROJECT: **31-15-2003**

AGAT WORK ORDER: **15T950250**

SOIL ANALYSIS REVIEWED BY: **Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor**

TRACE ORGANICS REVIEWED BY: **Oksana Gushyla, Trace Organics Lab Supervisor**

DATE REPORTED: **Mar 10, 2015**

PAGES (INCLUDING COVER): **14**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

Ignitability in Soil

DATE RECEIVED: 2015-03-04

DATE REPORTED: 2015-03-10

				SAMPLE DESCRIPTION:	TCLP
				SAMPLE TYPE:	Soil
				DATE SAMPLED:	2/25/2015
Parameter	Unit	G / S	RDL	6348380	
Ignitability				N	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6348380 N = Non-Flammable Solid.
Moist, sandy soil.

Certified By: Elizabeth Rolakowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2015-03-04

DATE REPORTED: 2015-03-10

		SAMPLE DESCRIPTION:		BH201-SS3	BH204-SS3	BH206-SS3	BH209-SS2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		2/24/2015	2/24/2015	2/25/2015	2/25/2015
Parameter	Unit	G / S	RDL	6348361	6348366	6348372	6348376
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	<1	2	<1	<1
Barium	µg/g	220	2	9	79	14	20
Beryllium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5
Boron	µg/g	36	5	<5	<5	<5	<5
Boron (Hot Water Soluble)	µg/g	NA	0.10	<0.10	0.29	<0.10	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	3	10	5	5
Cobalt	µg/g	21	0.5	1.4	3.5	2.1	2.4
Copper	µg/g	92	1	2	6	2	5
Lead	µg/g	120	1	<1	6	1	1
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	2	5	2	6
Selenium	µg/g	1.5	0.4	<0.4	0.5	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5
Vanadium	µg/g	86	1	7	20	14	12
Zinc	µg/g	290	5	7	40	9	9
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.057	0.150	0.056	0.078
Sodium Adsorption Ratio	NA	2.4	NA	0.097	0.105	0.081	0.124
pH, 2:1 CaCl2 Extraction	pH Units		NA	8.04	7.33	7.35	8.03

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

6348361-6348376 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Elizabeth Rolokowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2015-03-04

DATE REPORTED: 2015-03-10

		SAMPLE DESCRIPTION:		TCLP
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2/25/2015
Parameter	Unit	G / S	RDL	6348380
Arsenic Leachate	mg/L	2.5	0.010	<0.010
Barium Leachate	mg/L	100	0.100	0.249
Boron Leachate	mg/L	500	0.050	<0.050
Cadmium Leachate	mg/L	0.5	0.010	<0.010
Chromium Leachate	mg/L	5.0	0.010	0.014
Lead Leachate	mg/L	5.0	0.010	<0.010
Mercury Leachate	mg/L	0.1	0.010	<0.010
Selenium Leachate	mg/L	1.0	0.010	<0.010
Silver Leachate	mg/L	5.0	0.010	<0.010
Uranium Leachate	mg/L	10.0	0.050	<0.050
Fluoride Leachate	mg/L	150	0.05	0.11
Cyanide Leachate	mg/L	20.0	0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L	1000	0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Regulation 558

Certified By: Elizabeth Rolakowska

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Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2015-03-04

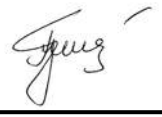
DATE REPORTED: 2015-03-10

		SAMPLE DESCRIPTION:		BH201-SS3	BH204-SS3	BH206-SS3
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2/24/2015	2/24/2015	2/25/2015
Parameter	**Unit**	**G / S**	**RDL**	**6348361**	**6348366**	**6348372**
Benzene	µg/g	0.02	0.02	<0.02	<0.02	<0.02
Toluene	µg/g	0.2	0.08	<0.08	<0.08	<0.08
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05	<0.05
Xylene Mixture	µg/g	0.05	0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA
Moisture Content	%		0.1	5.5	19.5	18.5
Surrogate	**Unit**	**Acceptable Limits**				
Terphenyl	%	60-140		95	99	98

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

6348361-6348372 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By:



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Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

ON Regulation 558 Benzo(a) pyrene

DATE RECEIVED: 2015-03-04

DATE REPORTED: 2015-03-10

		SAMPLE DESCRIPTION:		TCLP
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2/25/2015
Parameter	Unit	G / S	RDL	6348380
Benzo(a)pyrene	mg/L	0.001	0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Regulation 558

6348380 The sample was leached according to Regulation 558 protocol. Analysis was performed on the leachate.

Certified By:

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

ON Regulation 558 PCBs

DATE RECEIVED: 2015-03-04

DATE REPORTED: 2015-03-10

		SAMPLE DESCRIPTION:		TCLP
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2/25/2015
Parameter	**Unit**	**G / S**	**RDL**	**6348380**
Polychlorinated Biphenyls	mg/L	0.3	0.005	<0.005
Surrogate	**Unit**	**Acceptable Limits**		
Decachlorobiphenyl	%	60-130		82

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Regulation 558

6348380 The soil sample was leached using the Regulation 558 procedure. Analysis was performed on the leachate.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

ON Regulation 558 VOCs

DATE RECEIVED: 2015-03-04

DATE REPORTED: 2015-03-10

		SAMPLE DESCRIPTION:		TCLP
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2/25/2015
Parameter	**Unit**	**G / S**	**RDL**	**6348380**
Vinyl Chloride	mg/L	0.2	0.030	<0.030
1,1 Dichloroethene	mg/L	1.4	0.020	<0.020
Dichloromethane	mg/L	5.0	0.030	<0.030
Methyl Ethyl Ketone	mg/L	200	0.090	<0.090
Chloroform	mg/L	10.0	0.020	<0.020
1,2-Dichloroethane	mg/L	0.5	0.020	<0.020
Carbon Tetrachloride	mg/L	0.5	0.020	<0.020
Benzene	mg/L	0.5	0.020	<0.020
Trichloroethene	mg/L	5.0	0.020	<0.020
Tetrachloroethene	mg/L	3.0	0.050	<0.050
Chlorobenzene	mg/L	8.0	0.010	<0.010
1,2-Dichlorobenzene	mg/L	20.0	0.010	<0.010
1,4-Dichlorobenzene	mg/L	0.5	0.010	<0.010
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8	% Recovery	60-130		100

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Reg. 558

6348380 Sample was prepared using Regulation 558 protocol and a zero headspace extractor.

Certified By:

AGAT Laboratories

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Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

Soil Analysis

RPT Date: Mar 10, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	6342120		<0.8	<0.8	0.0%	< 0.8	99%	70%	130%	85%	80%	120%	84%	70%	130%
Arsenic	6342120		3	3	0.0%	< 1	105%	70%	130%	97%	80%	120%	102%	70%	130%
Barium	6342120		202	198	2.0%	< 2	98%	70%	130%	96%	80%	120%	96%	70%	130%
Beryllium	6342120		0.9	0.8	11.8%	< 0.5	95%	70%	130%	96%	80%	120%	86%	70%	130%
Boron	6342120		12	11	8.7%	< 5	80%	70%	130%	102%	80%	120%	91%	70%	130%
Boron (Hot Water Soluble)	6347218		0.20	0.18	10.5%	< 0.10	101%	60%	140%	90%	70%	130%	93%	60%	140%
Cadmium	6342120		<0.5	<0.5	0.0%	< 0.5	104%	70%	130%	99%	80%	120%	112%	70%	130%
Chromium	6342120		34	34	0.0%	< 2	88%	70%	130%	92%	80%	120%	93%	70%	130%
Cobalt	6342120		13.8	14.1	2.2%	< 0.5	87%	70%	130%	93%	80%	120%	93%	70%	130%
Copper	6342120		25	25	0.0%	< 1	89%	70%	130%	97%	80%	120%	92%	70%	130%
Lead	6342120		9	10	10.5%	< 1	95%	70%	130%	94%	80%	120%	87%	70%	130%
Molybdenum	6342120		<0.5	<0.5	0.0%	< 0.5	97%	70%	130%	102%	80%	120%	112%	70%	130%
Nickel	6342120		29	29	0.0%	< 1	92%	70%	130%	98%	80%	120%	96%	70%	130%
Selenium	6342120		<0.4	<0.4	0.0%	< 0.4	104%	70%	130%	95%	80%	120%	98%	70%	130%
Silver	6342120		<0.2	<0.2	0.0%	< 0.2	96%	70%	130%	108%	80%	120%	109%	70%	130%
Thallium	6342120		<0.4	<0.4	0.0%	< 0.4	84%	70%	130%	96%	80%	120%	93%	70%	130%
Uranium	6342120		<0.5	<0.5	0.0%	< 0.5	84%	70%	130%	84%	80%	120%	81%	70%	130%
Vanadium	6342120		42	41	2.4%	< 1	84%	70%	130%	89%	80%	120%	93%	70%	130%
Zinc	6342120		69	69	0.0%	< 5	97%	70%	130%	103%	80%	120%	92%	70%	130%
Chromium VI	6350919		<0.2	<0.2	0.0%	< 0.2	95%	70%	130%	94%	80%	120%	94%	70%	130%
Cyanide	6348361	6348361	<0.040	<0.040	0.0%	< 0.040	99%	70%	130%	93%	80%	120%	103%	70%	130%
Mercury	6342120		<0.10	<0.10	0.0%	< 0.10	109%	70%	130%	93%	80%	120%	80%	70%	130%
Electrical Conductivity	6347218		0.632	0.636	0.6%	< 0.005	100%	90%	110%	NA			NA		
Sodium Adsorption Ratio	6347218		10.7	10.7	0.0%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	6349188		7.90	7.88	0.3%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.

O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.10	98%	90%	110%	98%	80%	120%	106%	70%	130%
Barium Leachate	6347219		0.778	0.788	1.3%	< 1.00	95%	90%	110%	97%	80%	120%	103%	70%	130%
Boron Leachate	6347219		< 0.050	< 0.050	0.0%	< 0.50	105%	90%	110%	100%	80%	120%	97%	70%	130%
Cadmium Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.10	95%	90%	110%	94%	80%	120%	97%	70%	130%
Chromium Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.10	99%	90%	110%	99%	80%	120%	100%	70%	130%
Lead Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.10	94%	90%	110%	93%	80%	120%	83%	70%	130%
Mercury Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.1	101%	90%	110%	86%	80%	120%	77%	70%	130%
Selenium Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.10	95%	90%	110%	93%	80%	120%	96%	70%	130%
Silver Leachate	6347219		< 0.010	< 0.010	0.0%	< 0.10	97%	90%	110%	105%	80%	120%	100%	70%	130%
Uranium Leachate	6347219		< 0.050	< 0.050	0.0%	< 0.50	91%	90%	110%	94%	80%	120%	76%	70%	130%
Fluoride Leachate	6347219		0.15	0.15	0.0%	< 0.05	104%	90%	110%	109%	90%	110%	91%	70%	130%

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Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

Soil Analysis (Continued)

RPT Date: Mar 10, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Cyanide Leachate	6347219		<0.05	<0.05	0.0%	< 0.05	90%	90%	110%	101%	90%	110%	97%	70%	130%
(Nitrate + Nitrite) as N Leachate	6345683		<0.70	<0.70	0.0%	< 0.70	98%	80%	120%	96%	80%	120%	96%	70%	130%

Certified By: Elizabeth Pokolowska

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Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

Trace Organics Analysis

RPT Date: Mar 10, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6344800		< 0.02	< 0.02	0.0%	< 0.02	104%	50%	140%	102%	60%	130%	94%	50%	140%
Toluene	6344800		< 0.08	< 0.08	0.0%	< 0.08	96%	50%	140%	98%	60%	130%	89%	50%	140%
Ethylbenzene	6344800		< 0.05	< 0.05	0.0%	< 0.05	93%	50%	140%	97%	60%	130%	89%	50%	140%
Xylene Mixture	6344800		< 0.05	< 0.05	0.0%	< 0.05	95%	50%	140%	98%	60%	130%	90%	50%	140%
F1 (C6 to C10)	6344800		< 5	< 5	0.0%	< 5	94%	60%	140%	91%	80%	120%	82%	60%	140%
F2 (C10 to C16)	6346980		< 10	< 10	0.0%	< 10	104%	60%	140%	87%	80%	120%	87%	60%	140%
F3 (C16 to C34)	6346980		< 50	< 50	0.0%	< 50	98%	60%	140%	98%	80%	120%	98%	60%	140%
F4 (C34 to C50)	6346980		< 50	< 50	0.0%	< 50	73%	60%	140%	93%	80%	120%	96%	60%	140%
ON Regulation 558 Benzo(a) pyrene															
Benzo(a)pyrene	6348380	6348380	< 0.001	< 0.001	0.0%	< 0.001	111%	70%	130%	74%	70%	130%	NA	70%	130%
ON Regulation 558 PCBs															
Polychlorinated Biphenyls	6348380	6348380	< 0.005	< 0.005	0.0%	< 0.005	113%	60%	130%	117%	60%	130%	NA	60%	130%
ON Regulation 558 VOCs															
Vinyl Chloride	6348380	6348380	< 0.030	< 0.030	0.0%	< 0.030	94%	60%	140%	101%	60%	140%	NA	60%	140%
1,1 Dichloroethene	6348380	6348380	< 0.020	< 0.020	0.0%	< 0.020	85%	70%	130%	98%	70%	130%	NA	60%	140%
Dichloromethane	6348380	6348380	< 0.030	< 0.030	0.0%	< 0.030	97%	70%	130%	92%	70%	130%	NA	60%	140%
Methyl Ethyl Ketone	6348380	6348380	< 0.090	< 0.090	0.0%	< 0.090	97%	70%	130%	87%	70%	130%	NA	60%	140%
Chloroform	6348380	6348380	< 0.020	< 0.020	0.0%	< 0.020	105%	70%	130%	104%	70%	130%	NA	60%	140%
1,2-Dichloroethane	6348380	6348380	< 0.020	< 0.020	0.0%	< 0.020	98%	70%	130%	92%	70%	130%	NA	60%	140%
Carbon Tetrachloride	6348380	6348380	< 0.020	< 0.020	0.0%	< 0.020	86%	70%	130%	94%	70%	130%	NA	60%	140%
Benzene	6348380	6348380	< 0.020	< 0.020	0.0%	< 0.020	89%	70%	130%	89%	70%	130%	NA	60%	140%
Trichloroethene	6348380	6348380	< 0.020	< 0.020	0.0%	< 0.020	102%	70%	130%	96%	70%	130%	NA	60%	140%
Tetrachloroethene	6348380	6348380	< 0.050	< 0.050	0.0%	< 0.050	102%	70%	130%	106%	70%	130%	NA	60%	140%
Chlorobenzene	6348380	6348380	< 0.010	< 0.010	0.0%	< 0.010	101%	70%	130%	105%	70%	130%	NA	60%	140%
1,2-Dichlorobenzene	6348380	6348380	< 0.010	< 0.010	0.0%	< 0.010	94%	70%	130%	96%	70%	130%	NA	60%	140%
1,4-Dichlorobenzene	6348380	6348380	< 0.010	< 0.010	0.0%	< 0.010	101%	70%	130%	103%	70%	130%	NA	60%	140%

Certified By:

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Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Ignitability		EPA SW-846 1030	BURN MOLD
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Arsenic Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Barium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Boron Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cadmium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Chromium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Lead Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Mercury Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Selenium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Silver Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Uranium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Fluoride Leachate	INOR-93-6018	EPA SW-846-1311 & SM4500-F- C	ION SELECTIVE ELECTRODE
Cyanide Leachate	INOR-93-6052	EPA SW-846-1311 & MOE 3015 & SM 4500 CN- I	TECHNICON AUTO ANALYZER
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & SM 4500 - NO3- I	LACHAT FIA

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Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 15T950250

PROJECT: 31-15-2003

ATTENTION TO: Blair Goss

SAMPLING SITE:

SAMPLED BY:B.H.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Benzo(a)pyrene	ORG-91-5114	EPA SW846 3540 & 8270	GC/MS
Polychlorinated Biphenyls	ORG-91-5112	Regulation 558, EPA SW846 3510C/8082	GC/ECD
Decachlorobiphenyl	ORG-91-5112	EPA SW846 3510C/8082	GC/ECD
Vinyl Chloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,1 Dichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Dichloromethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chloroform	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Benzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Trichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS

AGAT Laboratories

1 large

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L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 4.4 - 4.2 - 3.8
AGAT WO #:
Lab Temperature: 3.2 - 2.7 - 3
Notes: 15T950250

Client Information

Company: Terraprobe Inc
Contact: Blair Goss
Address: 220 Bayview Dr. unit 25
Barrie ON
Phone: 705-739-8355 Fax: 705-739-8369
Project: 31-15-2003 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

- [x] Regulation 153/04 (reg. 511 Amend.) — Table 1 (Indicate one)
  - [ ] Ind/Com
  - [x] Res/Park
  - [ ] Agriculture
- Soil Texture (check one): [x] Coarse [ ] Fine
- [ ] Sewer Use — Region (Indicate one)
  - [ ] Sanitary
  - [ ] Storm
- [ ] Regulation 558
- [ ] CCME
- [ ] Other (specify)
- [ ] Prov. Water Quality Objectives (PWQO)
- [ ] None

Turnaround Time Required (TAT) Required*

Regular TAT
- [x] 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
- [ ] 3 Working Days
- [ ] 2 Working Days
- [ ] 1 Working Day

OR

Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To

Same: Yes [x] No [ ]
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) [ ] Yes [ ] No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition**? [ ] Yes [ ] No

Legend Matrix

GW Ground Water · O Oil
SW Surface Water · P Paint
SD Sediment · S Soil

Report Information – reports to be sent to:

1. Name: Blair Goss
   Email: bgoss@terraprobe.ca
2. Name:
   Email:

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ Hg ☐ pH ☐ N- Total ☐ NO_3/NO_2	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☑ BTEX	CCME Fractions 1 to 4	ABNs	PAHs (TCLP)	Chlorophenols	PCBs (TCLP)	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	VOC (TCLP)	Ignitability
BH201-SS3	Feb 24	PM	S	3		V						V	V								
BH204-SS3	"	AM	S	3		V						V	V								
BH206-SS3	Feb 25	PM	S	3		V						V	V								
BH209-SS2	Feb 25	AM	S	1		V															
TCLP	"	AM	S	5											V	V	V		V	V	

Samples Relinquished By (Print Name and Sign): Beyang Hwang
Date/Time: Mar 2, 2015
Samples Received By (Print Name and Sign): [illegible] Mar 4/15
Date/Time: 9:56
Samples Relinquished By (Print Name and Sign):
Date/Time:
Samples Received By (Print Name and Sign): [illegible] March 4/15
Date/Time: 1:50

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page _____ of _____
N°: 34773

ENCLOSURE 2

Enclosure 2 – Terraprobe Assessment of Groundwater Levels

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

September 13, 2016 Our File No. 31-15-2003

Fernbrook Homes (Parkside) Ltd.
c/o The Jones Consulting Group Ltd.
229 Mapleview Drive East, Unit 1
Barrie, Ontario
L4N 0W5

Attention: Ms. Brandi Clement Email: bclement@jonesconsulting.com

**RE: ASSESSMENT OF GROUNDWATER LEVELS
FEBRUARY 2015 TO AUGUST 2016 MONITORING
PROPOSED RESIDENTIAL DEVELOPMENT
70 PIONEER TRAIL
CITY OF BARRIE, ONTARIO**

Dear Ms. Clement;

Further to our geotechnical investigation report being prepared for the above property, Terraprobe was authorized to visit the above site monthly beginning in February 2015 in order to assess anticipated fluctuations in the groundwater level. It is our understanding that this work is being conducted to support engineering design.

The attached graphs and tabulated data summarize our measured water levels in the previously installed piezometers through these periods to the present date. A borehole location plan is also attached indicating borehole/piezometer locations.

The most recent visit to the site (August 16, 2016) generally indicated fallling groundwater levels following a period of higher levels going back to March/April/May 2016. Groundwater levels were generally measured to be at their lowest stable elevation in October 2015 as shown on the attached graphs. Peak levels recorded to date were measured in April 2015 and March/April/May 2016.

The peak groundwater levels recorded to date may not represent the highest levels to be expected.

The groundwater surface elevation generally falls with surface topography from south to north, towards Kempenfelt Bay. The piezometers at Boreholes 201, 202 and 107 have generally been found to be dry during the various sampling events with the exception of a spring peak.

Unless otherwise instructed, Terraprobe will continue with groundwater level monitoring through the fall of 2016 to assist the designers. As noted in our geotechnical investigation report, the basement/lower floor levels of the structures must be kept at least 0.5m above the seasonally high groundwater level. Ongoing monthly groundwater level monitoring will assist in defining the magnitude of seasonal fluctuations and anticipated peak levels above which basements must be kept.

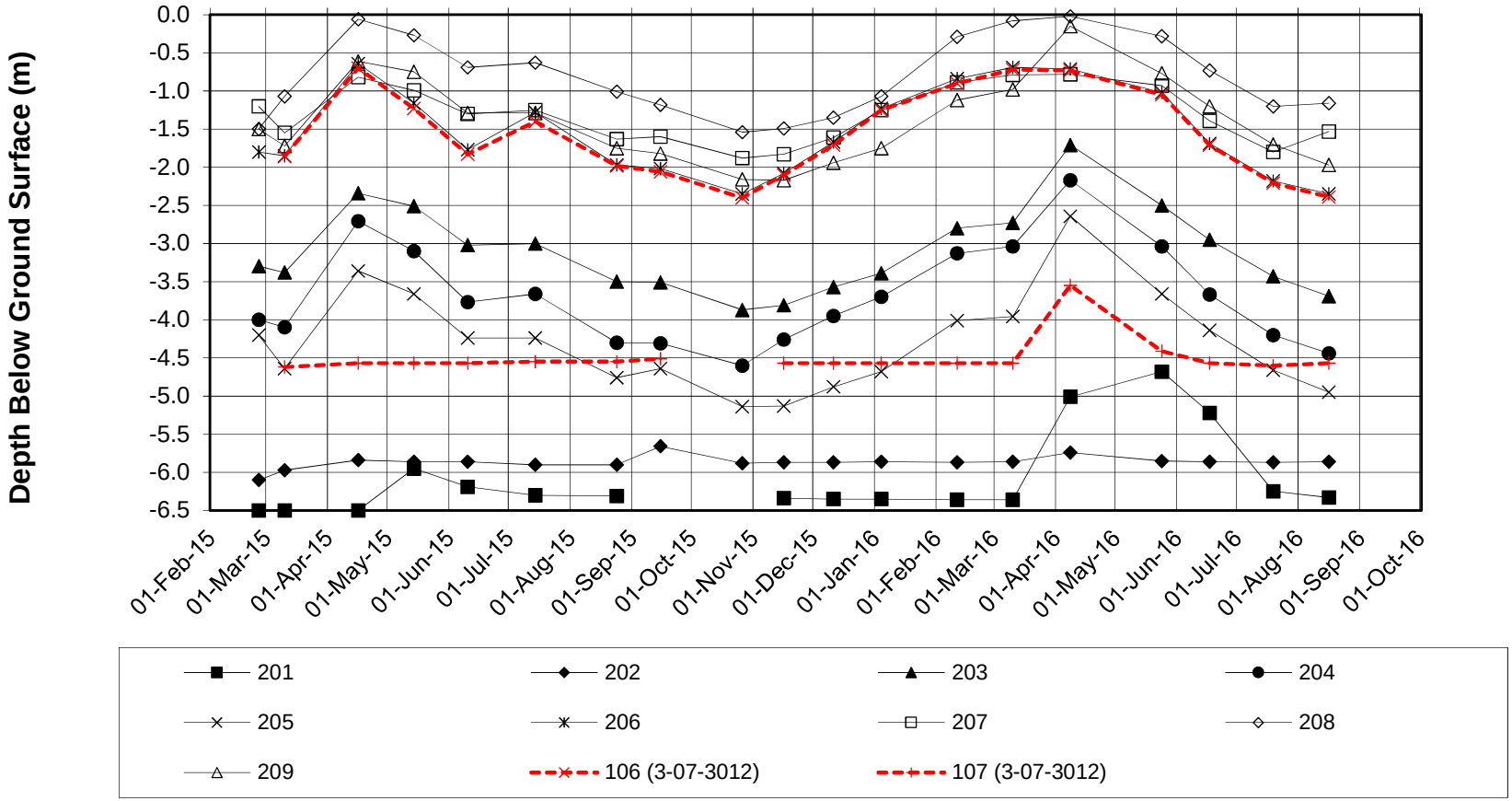
We trust that the above information and attachments are sufficient for your present requirements. If you should have any questions, or if we can be of further assistance, please do not hesitate to contact the undersigned.

Sincerely,
Terraprobe Inc.

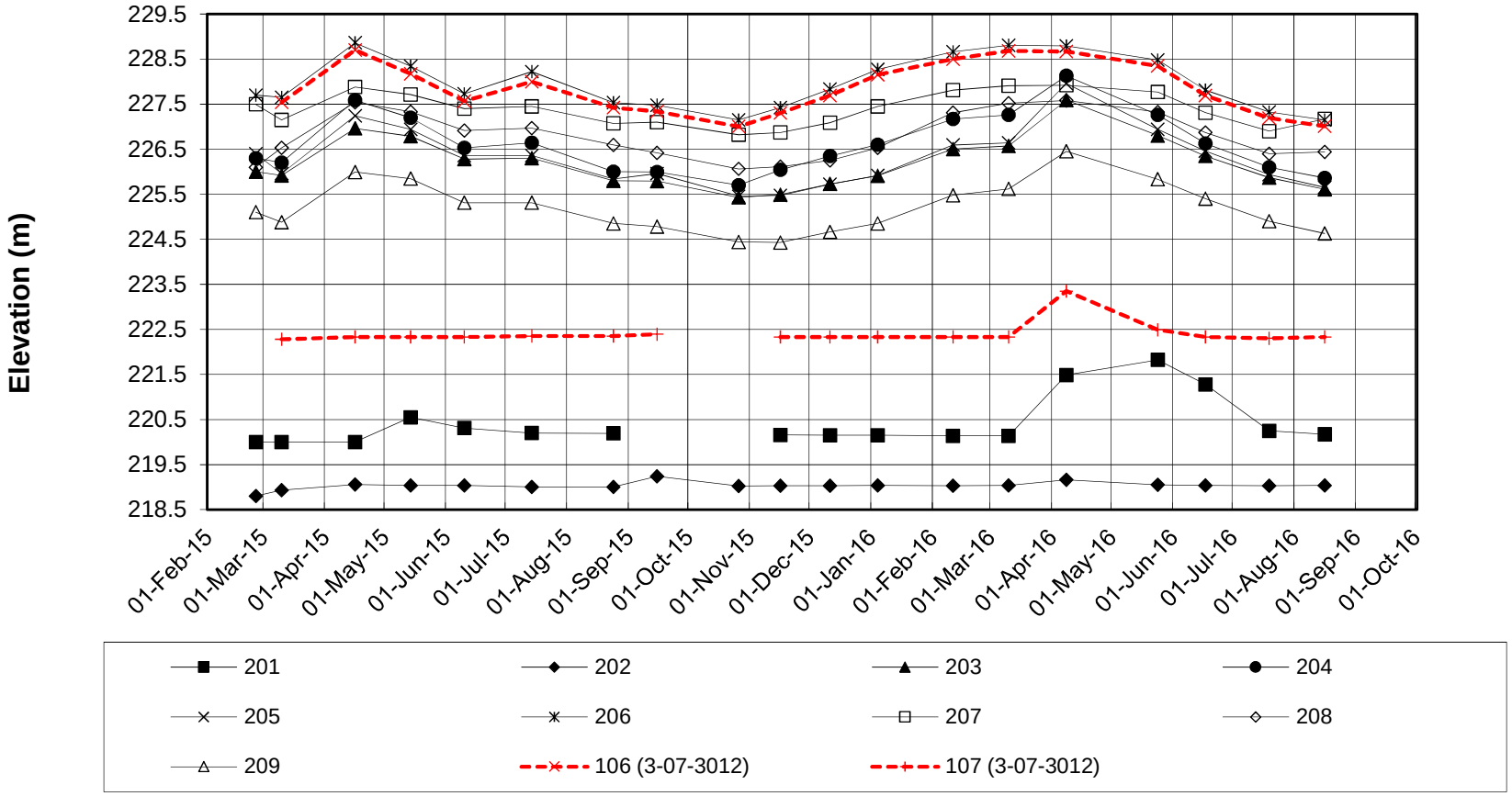
Blair E. Goss, P. Eng.
Associate

Attached: Static Water Level Monitoring Graphs and Data Table
Borehole Logs 201 to 209 and 106 to 107 (3-07-3012)
Figures 1 and 2

Static Water Level Monitoring
70 Pioneer Trail, Barrie - (Feb. 2015 to)
Terraprobe -- 31-15-2003



Static Water Level Monitoring
70 Pioneer Trail, Barrie - (Feb. 2015 to)
Terraprobe -- 31-15-2003



Terraprobe -- 31-15-2003
70 Pioneer Trail, Barrie

Monitoring/ Borehole Location	Ground Surface Elevation (m)	Static Water Level Depth Below Existing Ground Surface (m)																						
		20-Feb-07	26-Feb-07	25-Feb-15	10-Mar-15	16-Apr-15	14-May-15	10-Jun-15	14-Jul-15	24-Aug-15	15-Sep-15	26-Oct-15	16-Nov-15	11-Dec-15	4-Jan-16	11-Feb-16	10-Mar-16	8-Apr-16	24-May-16	17-Jun-16	19-Jul-16	16-Aug-16			
201	226.5			-6.5	-6.5	-6.5	-6.0	-6.2	-6.3	-6.3			-6.3	-6.4	-6.4	-6.4	-6.4	-5.0	-4.7	-5.2	-6.3	-6.3			
202	224.9			-6.1	-6.0	-5.8	-5.9	-5.9	-5.9	-5.9	-5.7	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.7	-5.9	-5.9	-5.9	-5.9			
203	229.3			-3.3	-3.4	-2.3	-2.5	-3.0	-3.0	-3.5	-3.5	-3.9	-3.8	-3.6	-3.4	-2.8	-2.7	-1.7	-2.5	-3.0	-3.4	-3.7			
204	230.3			-4.0	-4.1	-2.7	-3.1	-3.8	-3.7	-4.3	-4.3	-4.6	-4.3	-4.0	-3.7	-3.1	-3.0	-2.2	-3.0	-3.7	-4.2	-4.4			
205	230.6			-4.2	-4.6	-3.4	-3.7	-4.2	-4.2	-4.8	-4.6	-5.1	-5.1	-4.9	-4.7	-4.0	-4.0	-2.6	-3.7	-4.1	-4.7	-5.0			
206	229.5			-1.8	-1.9	-0.6	-1.2	-1.8	-1.3	-2.0	-2.0	-2.4	-2.1	-1.7	-1.2	-0.8	-0.7	-0.7	-1.0	-1.7	-2.2	-2.4			
207	228.7			-1.2	-1.6	-0.8	-1.0	-1.3	-1.3	-1.6	-1.6	-1.9	-1.8	-1.6	-1.3	-0.9	-0.8	-0.8	-0.9	-1.4	-1.8	-1.5			
208	227.6			-1.5	-1.1	-0.1	-0.3	-0.7	-0.6	-1.0	-1.2	-1.5	-1.5	-1.4	-1.1	-0.3	-0.1	0.0	-0.3	-0.7	-1.2	-1.2			
209	226.6			-1.5	-1.7	-0.6	-0.8	-1.3	-1.3	-1.8	-1.8	-2.2	-2.2	-1.9	-1.8	-1.1	-1.0	-0.2	-0.8	-1.2	-1.7	-2.0			
106 (3-07-3012)	229.4	-1.2	-1.6		-1.9	-0.7	-1.2	-1.8	-1.4	-2.0	-2.1	-2.4	-2.1	-1.7	-1.3	-0.9	-0.7	-0.7	-1.1	-1.7	-2.2	-2.4			
107 (3-07-3012)	226.9	-5.0	-5.0		-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.5		-4.6	-4.6	-4.6	-4.6	-4.6	-3.6	-4.4	-4.6	-4.6	-4.6			
		noted		noted		A&B?						107?	107 Dry					208 frozen		107 Dry		107 Dry			

Monitoring/ Borehole Location	Ground Surface Elevation (m)	Static Water Level Elevation (m)																						
		20-Feb-07	26-Feb-07	25-Feb-15	10-Mar-15	16-Apr-15	14-May-15	10-Jun-15	14-Jul-15	24-Aug-15	15-Sep-15	26-Oct-15	16-Nov-15	11-Dec-15	4-Jan-16	11-Feb-16	10-Mar-16	8-Apr-16	24-May-16	17-Jun-16	19-Jul-16	16-Aug-16			
201	226.5			220.0	220.0	220.0	220.6	220.3	220.2	220.2			220.2	220.2	220.2	220.1	220.1	221.5	221.8	221.3	220.3	220.2			
202	224.9			218.8	218.9	219.1	219.0	219.0	219.0	219.0	219.2	219.0	219.0	219.0	219.0	219.0	219.0	219.2	219.1	219.0	219.0	219.0			
203	229.3			226.0	225.9	227.0	226.8	226.3	226.3	225.8	225.8	225.4	225.5	225.7	225.9	226.5	226.6	227.6	226.8	226.4	225.9	225.6			
204	230.3			226.3	226.2	227.6	227.2	226.5	226.6	226.0	226.0	225.7	226.0	226.4	226.6	227.2	227.3	228.1	227.3	226.6	226.1	225.9			
205	230.6			226.4	226.0	227.2	226.9	226.4	226.4	225.8	226.0	225.5	225.5	225.7	225.9	226.6	226.6	228.0	226.9	226.5	225.9	225.7			
206	229.5			227.7	227.7	228.9	228.3	227.7	228.2	227.5	227.5	227.2	227.4	227.8	228.3	228.7	228.8	228.8	228.5	227.8	227.3	227.2			
207	228.7			227.5	227.2	227.9	227.7	227.4	227.5	227.1	227.1	226.8	226.9	227.1	227.5	227.8	227.9	227.9	227.8	227.3	226.9	227.2			
208	227.6			226.1	226.5	227.5	227.3	226.9	227.0	226.6	226.4	226.1	226.1	226.3	226.5	227.3	227.5	227.6	227.3	226.9	226.4	226.4			
209	226.6			225.1	224.9	226.0	225.9	225.3	225.3	224.9	224.8	224.4	224.4	224.7	224.9	225.5	225.6	226.5	225.8	225.4	224.9	224.6			
106 (3-07-3012)	229.4	228.2	227.8		227.5	228.7	228.2	227.6	228.0	227.4	227.3	227.0	227.3	227.7	228.2	228.5	228.7	228.7	228.4	227.7	227.2	227.0			
107 (3-07-3012)	226.9	221.9	221.9		222.3	222.3	222.3	222.3	222.4	222.4	222.4		222.3	222.3	222.3	222.3	222.3	223.4	222.5	222.3	222.3	222.3			
		noted		noted																					

Terraprobe

LOG OF BOREHOLE ..201..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		226.5			
175mm – TOPSOIL 500mm – SILTY SAND FILL, trace organics Brown Compact Moist		0.0	1	SS	24
			2	SS	14
SAND, trace to some silt, trace gravel			3	SS	22
			4	SS	15
		223.5			
Grey Hard Moist		3.0	5	SS	33
SILT & CLAY, to clayey, trace sand			6	SS	36
			7	SS	37
		219.9			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80

SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION

1. Borehole remained open and dry upon completion of drilling.

2. Water level on March 10, 2015 measured dry to 6.5m.

Terraprobe

LOG OF BOREHOLE ..202..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

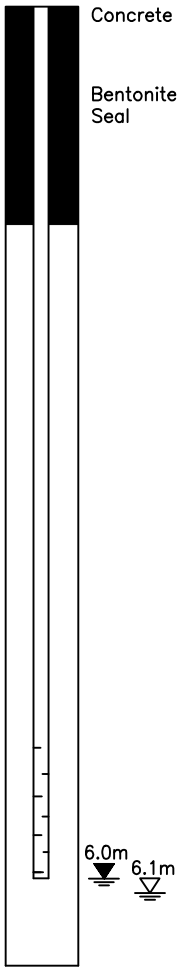
BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
	GROUND SURFACE		224.9			
0	100mm - TOPSOIL		0.0			
	Brown Compact to Very Dense Moist to Wet			1	SS	36
1	SAND, trace to some silt, trace gravel, medium to fine			2	SS	22
				3	SS	31
2				4	SS	43
3				5	SS	36
4						
				6	SS	42
5						
6				7	SS	52
			218.3			
	End of Borehole		6.6			
7						
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 6.1m upon completion of drilling.

2. Water level on March 10, 2015 measured at 6.0m (elev. 218.9m).

Terraprobe

LOG OF BOREHOLE ..203..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

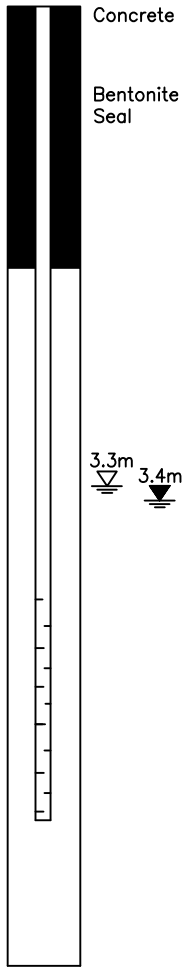
BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE
0	GROUND SURFACE		229.3			
0	175mm - TOPSOIL		0.0			
0	Brown Loose to Dense Moist to Wet			1	SS	54
1	SAND, trace to some silt, trace gravel			2	SS	6
2				3	SS	6
2				4	SS	6
3				5	SS	25
4						
5				6	SS	37
6				7	SS	29
6			222.7			
7	End of Borehole		6.6			
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
WP W WL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 3.3m upon completion of drilling.

2. Water level on March 10, 2015 measured at 3.4m (elev. 225.9m).

Terraprobe

LOG OF BOREHOLE ..204..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

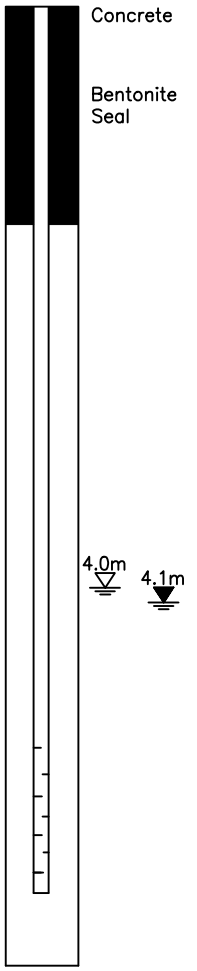
DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		230.3			
Dark Brown Compact Moist SAND, some silt to silty, some organics, trace gravel, FILL		0.0 229.0	1	SS	17
			2	SS	15
Dark Brown Loose Moist ORGANIC PEAT, FILL		1.3 227.9	3	SS	6
Brown Loose to Very Loose Moist to Wet SAND, trace to some silt, trace gravel		2.4	4	SS	5
			5	SS	4
			6	SS	2
			7	SS	2
		223.7			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 4m upon completion of drilling.

2. Water level on March 10, 2015 measured at 4.1m (elev. 226.2m).

Terraprobe

LOG OF BOREHOLE ..205..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
0	GROUND SURFACE		230.6			
0	Brown Compact Moist		0.0	1	SS	27
1	SAND, some gravel to gravelly, trace to some silt			2	SS	14
2				3	SS	32
2			228.5			
2	Brown Dense to Very Dense Moist to Wet		2.1	4	SS	33
3	SAND, fine to medium, silty to trace silt, trace gravel			5	SS	39
4						
5				6	SS	54
6						
6			224.0	7	SS	36
7	End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION

1. Borehole caved and water level noted at 4.2m upon completion of drilling.

2. Water level on March 10, 2015 measured at 4.6m (elev. 226.0m).

Terraprobe

LOG OF BOREHOLE ..206..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		229.5			
500mm - Organic stained Sand		0.0			
Brown Loose to Dense Moist to Wet			1	AS	
SAND, trace to some silt, trace gravel			2	SS	4
			3	SS	3
			4	SS	4
			5	SS	19
			6	SS	44
		224.0			
Grey Very Stiff Moist		5.5			
SILT, some clay to clayey, trace sand			7	SS	18
		222.9			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
WP W WL
10 20 30

INSTALLATION INFORMATION

1. Borehole caved and water level noted at 1.8m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.8m (elev. 227.7m).

Terraprobe

LOG OF BOREHOLE ..207..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31–15–2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

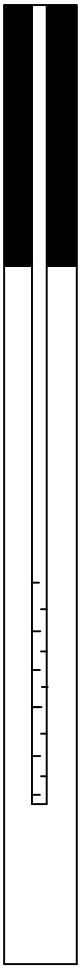
BORING METHOD: D–50T Crawler–mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
0	GROUND SURFACE		228.7			
	Brown Compact Moist SAND, some organics, trace silt, trace gravel, FILL		0.0 228.0	1	SS	11
1	Brown Compact Moist to Wet SAND, trace to some silt, trace gravel		0.7	2	SS	16
				3	SS	28
2				4	SS	28
			225.9			
3	Grey Very Stiff to Hard Moist SILT & CLAY to CLAYEY, trace sand		2.8	5	SS	26
4						
				6	SS	40
5						
6				7	SS	47
			222.1			
7	End of Borehole		6.6			
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 1.2m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.6m (elev. 227.1m).

Terraprobe

LOG OF BOREHOLE ..208..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

SOIL PROFILE

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)
GROUND SURFACE		227.6
300mm - TOPSOIL		0.0
Brown to Grey; Compact to Very Dense; Moist to Wet		
SAND, trace to some silt, trace gravel		
Grey		
		221.0
End of Borehole		6.6

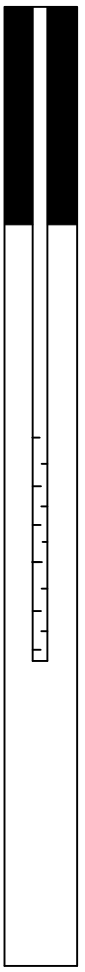
SAMPLES

NUMBER	TYPE	"N" VALUE
1	AS	
2	SS	22
3	SS	19
4	SS	22
5	SS	39
6	SS	52
7	SS	50/150mm

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - +
rem.V - ⊕
Q - ●
U - ○
20 40 60 80

WATER CONTENT (%)
WP w WL
10 20 30

INSTALLATION INFORMATION



1. Borehole caved and water level noted at 1.5m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.1m (elev. 226.5m).

Terraprobe

LOG OF BOREHOLE ..209..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 25, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE	PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (nat.V +, rem.V ⊕, Q ●, U ○)	WATER CONTENT (%) (WP, W, WL)	INSTALLATION INFORMATION
	GROUND SURFACE		226.6						
0	450mm - TOPSOIL		0.0						
	Brown Compact to Dense Moist to Wet			1	AS				
1	SAND, medium to fine, trace to some silt, trace gravel			2	SS	11	x		
				3	SS	27	x		
2				4	SS	35	x		
3				5	SS	24	x		
4				6	SS	46	x		
5									
6				7	SS	35	x		
			220.0						
7	End of Borehole		6.6						
8									
9									

PENETRATION RESISTANCE PLOT: 20 40 60 80
SHEAR STRENGTH kPa: nat.V - +, rem.V - ⊕, Q - ●, U - ○
WATER CONTENT (%): WP, W, WL; 10 20 30

INSTALLATION INFORMATION

1. Borehole caved and water level noted at 1.5m upon completion of drilling.

2. Water level on March 10, 2015 measured at 1.7m (elev. 224.9m).

Terraprobe

LOG OF BOREHOLE ..106..

PROJECT NAME:Ontario Mission of the Deaf Subdivision PROJECT No.: 3-07-3012

CLIENT: Ontario Mission of the Deaf BORING DATE: February 20, 2007

LOCATION: Barrie, Ontario ELEVATION DATUM: Geodetic

BORING METHOD: D50 Crawler-mounted Drill Rig / 108mm Diameter Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		229.4			
150mm – TOPSOIL		0.0			
Brown Loose Moist to Wet			1	SS	9
			2	SS	8
SAND, trace to some silt			3	SS	9
			4	SS	3
			5	SS	6
			6	SS	10
		224.4			
End of Borehole		5.0			

SOIL PROFILE

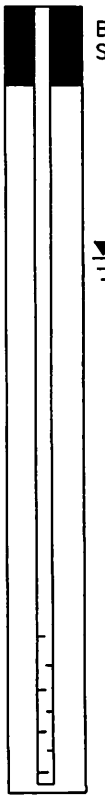
SAMPLES

PENETRATION RESISTANCE PLOT
20 40 60 80

SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
P 10 20 30

INSTALLATION INFORMATION



1. Borehole caved at 2m upon completion of drilling.

2. Water level noted at 1.2m during drilling.

3. Water level on February 26, 2007 measured at 1.6m (elev. 227.8m).

Terraprobe

LOG OF BOREHOLE ..107..

PROJECT NAME:Ontario Mission of the Deaf Subdivision PROJECT No.: 3-07-3012

CLIENT: Ontario Mission of the Deaf BORING DATE: February 20, 2007

LOCATION: Barrie, Ontario ELEVATION DATUM: Geodetic

BORING METHOD: D50 Crawler-mounted Drill Rig / 108mm Diameter Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		226.9			
Brown to Black — Loose to Compact — Moist		0.0	1	SS	5
SAND, trace to some organics, FILL			2	SS	27
		225.6			
Light Brown — Compact to Very Dense — Moist		1.3	3	SS	16
SILTY SAND, fine, with sandy silt, inclusions/layers			4	SS	43
			5	SS	50/125mm
		221.9	6	SS	50/150mm
End of Borehole		5.0			

SOIL PROFILE; SAMPLES

PENETRATION RESISTANCE PLOT

20 40 60 80

SHEAR STRENGTH kPa

nat.V - + Q - ●

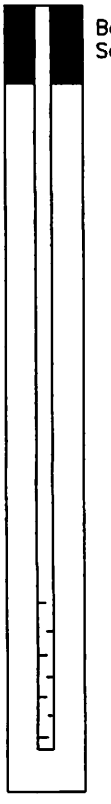
rem.V - ⊕ U - ○

20 40 60 80

WATER CONTENT (%)

10 20 30

INSTALLATION INFORMATION



1. Borehole remained open and dry upon completion of drilling.

2. Water level on February 26, 2007 measured dry to 4.7m.

MARCH 2015

SITE LOCATION PLAN

31-15-2003

Terraprobe

FIGURE 1

MARCH 2015

BOREHOLE LOCATION PLAN

31-15-2003

Terraprobe

FIGURE 2

ENCLOSURE 3

Enclosure 3 – Terraprobe Slope Stability Report

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

DEVELOPMENT SETBACK AND SLOPE STABILITY REQUIREMENTS RESIDENTIAL DEVELOPMENT 70 PIONEER TRAIL BARRIE, ONTARIO

Prepared for: Fernbrook Homes (Parkside) Ltd.
2220 Highway 7 West
Concord, ON
L4K 1W7

Attention: Mr. Danny Salvatore

File No. 31-15-2003
September 13, 2016

Distribution:

8 cc: The Jones Consulting Group Ltd.
1 cc: Terraprobe Inc., Barrie

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

September 13, 2016 File No. 31-15-2003

Fernbrook Homes (Parkside) Ltd.
2220 Highway 7 West
Concord, ON
L4K 1W7

Attention: Mr. Danny Salvatore

RE: DEVELOPMENT SETBACK AND SLOPE STABILITY REQUIREMENTS RESIDENTIAL DEVELOPMENT 70 PIONEER TRAIL BARRIE, ONTARIO

Dear Sir:

We are pleased to present the findings of our slope stability assessment conducted on the above property. Terraprobe was retained to investigate and assess the current slope conditions to provide comment on appropriate construction relative to the slope.

SITE AND PROJECT DESCRIPTION

A Senior Soil Engineer visited the site (see Figure 1) on April 9, 2015, to visually inspect the slope conditions and assess its stability rating in accordance with the MNR Natural Hazards Technical Guidelines (see attached Slope Rating Chart). Further to the site inspection, which noted some steepened slopes, we were authorized to proceed with a more detailed (Level 3) assessment and slope analysis as recommended by Terraprobe.

The site is located on the north side of Pioneer Trail (#70), east of Camelot Square in Barrie, Ontario (see Figures 1 and 2). The property is located on the south shore of Kempenfelt Bay, having approximately 70m of waterfront shoreline.

During our April 9, 2015 site visit, Terraprobe completed a Slope Rating assessment. Based on the site conditions, slope characteristics, vegetative cover, drainage, water course characteristics, etc. the total rating value was determined to be about 44 for this slope (see attached Slope Rating Chart). Being within the range of >35 rating (Level 3) indicates 'moderate' potential respectively for slope instability, suggesting the presence of several surface features that could create an unstable slope situation.

A Level 3 study includes site-specific subsurface (borehole) investigation, surveying, slope modeling, analysis and detailed report.

This Level 3 study report will include assessment of topographic survey information and slope cross section(s), photographs of the site and slope conditions and a model of the slope conditions (using recent subsurface borehole information completed by Terraprobe) to determine a calculation of the estimated Factor of Safety for the existing slope.

The ground surface elevations across the subject property, and more specifically along the existing slope on the property, were provided by the client's surveyor. A portion of the topographic plan generated is included as our Figure 3 and a representative slope cross-section as our Figure 5.

It is our understanding that the property is being considered for a development of low-rise, condominium type structures. A concept plan showing proposed structures is included as Figure 4.

FIELD WORK

The field work was carried out using crawler-mounted drilling equipment provided by a specialist soil drilling contractor. Borehole 202 of a larger investigation was located near the slope crest and advanced using Standard Penetration Test methods. All soil samples obtained were sealed in plastic containers and returned to our laboratory for further evaluation and testing including moisture content determination and select grain size analyses.

The ground surface elevations along the existing slope at specific locations, were provided by the owner's surveyor (Figure 3). The slope cross section generated from the survey is included as our Figure 5.

SUBSURFACE CONDITIONS

The details of the subsurface conditions encountered at the boreholes are presented on the attached Borehole Logs, and are summarized below. It should be noted that the conditions are confirmed at the borehole locations only and could vary between and beyond these locations. In addition, the changes in the soil stratigraphy delineated on the Borehole Logs have been inferred from non-continuous sampling. In this regard, the changes should be taken as transitions from one soil type to another as opposed to exact planes of geologic change.

Quaternary geological mapping for the area indicates that the development area and slope section are located within a zone of glaciolacustrine beach and bar sediments of gravel, sandy gravel and gravelly sand. Drift thickness mapping for the area indicates that the bedrock surface would be expected at a depth of about 100m below grade.

In general, Boreholes 201 and 202 (near the slope) encountered about 0.1 to 0.7m of surficial organics and/or silty sand fill. The native soils were primarily loose to very dense sand with trace to some gravel and silt. Borehole 201encountered hard silt and clay below 3.0m depth.

Some perched groundwater should be anticipated in sandy seams/layers above very dense soils and/or silts and clays.

Across the site, Standard Penetration Tests conducted in each borehole generally indicated 'N' values of about 2 to greater than 50 blows per 0.3 m of penetration with depth in the native soils. Therefore, these soils are considered to be very loose to very dense and hard at depth.

The water levels noted during drilling and measured in Boreholes 201 and 202 during our return site visit are tabulated below.

Borehole Number	Ground Surface Elevation (m)	Water Level			
		Noted During Drilling		Measured March 10, 2015	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
201	226.5	Dry	-	Dry to 6.5	Below 220.0
202	224.9	6.1	218.8	6.0	218.9

It is anticipated that some fluctuations of the groundwater table will occur seasonally and may be higher during wetter seasons and/or years. It is our recommendation that ongoing monthly monitoring of static groundwater levels continue through 2015 as a minimum and preferably for a full year in order to better define the seasonal fluctuation and peak levels. Shallow groundwater flow direction appears to generally fall with surface topography from a high point in the south, down towards the north, and Kempenfelt Bay.

During Terraprobe's site inspection on April 9, 2015, the near-surface soils were confirmed at a few accessible locations. In each of these cases, the soils were found to be sand to silty sand with some gravel and occasional cobbles. Groundwater seepage was observed from localized zones along the slope toe adjacent to the shoreline area.

SLOPE ASSESSMENT

The characteristics of the slope along the length of the site waterfront are represented by cross section A-A' included as Figure 5. The section is located in plan view on Figure 3 for reference.

The cross section represents the north-facing slope which shows evidence of active erosion characteristics. The Kempenfelt Bay shoreline runs near or adjacent to the slope toe in the area below the proposed development. Based on the topographic survey provided, the overall slope inclination along the north-facing main slope is generally in the range of 1:1 to 2:1 (horizontal to vertical). Inclination measurements taken during our site visit indicate that the steeper slope areas range from about 1:1 (horizontal to vertical) to near vertical with some flatter sections present.

A visual inspection of the area indicates well established vegetation on the majority of the slope, including ground cover and mid to large sized trees. Site photographs are appended which show the vegetated slope and the existing shoreline conditions. No significant, continuous toe protection is present along the slope toe/waters edge.

Based on the survey information provided and our site inspection, the main slope toe is situated within 15m of the shoreline. The main slope heights in and around the property are generally about 3 to 6m from toe to crest.

SLOPE STABILITY ANALYSIS

A detailed engineering analysis of the slope stability was carried for one representative slope cross-section (A-A') as shown on Figure 3.

The analysis was conducted utilizing computer software (Slide 6.036, released July 13, 2015, developed by Rocscience Inc.) and several standard methods of limit equilibrium analysis (Bishop, Janbu, Morgenstern/Price, and Spencer). These methods of analysis allow the calculation of Factors of Safety for hypothetical or assumed slip surfaces through the slope. The analysis method is used to assess potential for movements of large masses of soil over a specific slip surface which can be curved or circular, or non-circular. The analysis involves dividing the sliding mass into many thin slices and calculating the forces on each slice. The normal and shear forces acting on the sides and base of each slice are calculated. It is an iterative process that converges on a solution. An example analysis is provided as Appendix A, which shows the critical slip surface, the slices, and the inter-slice forces, as well as pertinent aspects of the slope stability output.

For a specific slip surface, the Factor of Safety is defined as the ratio of the available soil strength resisting movement, divided by the gravitational forces tending to cause movement. The Factor of Safety of 1.0 represents a "limiting equilibrium" condition where the slope is at a point of pending failure since the soil resistance is equal to forces tending to cause movement. It is usual to require a Factor of Safety greater than one (1) to ensure the stability of the slope. The typical Factor of Safety used for engineering design of slopes for stability ranges from about 1.3 to 1.5 for developments situated close to the slope crest. The most common design guidelines are based on a 1.5 minimum Factor of Safety.

Each analysis was carried out by preparing a model of the slope geometry and subsurface conditions, and analyzing numerous different slip surfaces through the slope in search of the minimum or critical Factor of Safety for specific conditions. The pertinent data obtained from topographic plan, slope profiles, slope mapping and the borehole information, were input for the slope stability analysis. Many calculations were carried out to examine the Factor of Safety for varying depths of potential slip surfaces.

The analysis was carried out by preparing a representative model of the existing slope geometry at Section A-A' with subsurface conditions and then analyzing numerous failure surface through the slopes in search of the minimum or critical Factor of Safety for specific conditions (see Figure 6). In addition, a hypothetical

2:1 slope section was modeled as shown on Figure 7. This was completed in order to determine the stable slope condition with the required Factor of Safety for the land use proposed on the table land above the slope (Factor of Safety $\geq$1.5).

The results of the field surveying, topographic mapping, subsurface investigation and geologic mapping, were input for the slope stability analysis. Many calculations were carried out to examine the Factor of Safety for varying depths of potential failure surfaces. The following conservative soil properties were utilized for the slope strata in the slope stability analysis, based on the above results.

Soil Strata	Effective Angle of Internal Friction Φ' (degrees)	Unit Weight, ɣ (kN/m^3)	Cohesion, c' (kPa)
Sand, dense	36	19	0

The above soil strength parameters are based on effective stress for long-term slope stability.

The results of the slope stability analyses are summarized on the attached Figures 6 and 7. The minimum Factor of Safety calculated by the analyses are as follows;

	Calculated Minimum Factor of Safety for Side Slopes	Shown on Figure
Section A-A' Existing Profile	0.73	6
Hypothetical Profile (2:1 Inclination)	1.54	7

For residential, habitable structures (Type C: active land-use), the MNR Policy Guidelines allow a minimum Factor of Safety of 1.3 to 1.5 for slope stability as follows:

TYPE	LAND-USES	DESIGN MINIMUM FACTOR OF SAFETY
A	**PASSIVE**: no buildings near slope; farm field, bush, forest, timberland, woods, wasteland, badlands, tundra	1.1
B	**LIGHT**: no habitable structures near slope; recreational parks, golf courses, buried small utilities, tile beds, barns, garages, swimming pools, shed, satellite dishes, dog houses	1.20 to 1.30
C	**ACTIVE**: habitable or occupied structures near slopes; residential, commercial and industrial buildings, retaining walls, storage/warehousing of non-hazardous substances	1.30 to 1.50
D	**INFRASTRUCTURE and PUBLIC USE**: public use structures and buildings (i.e. hospitals, schools, stadiums), cemeteries, bridges, high voltage power transmission lines, towers, storage/warehousing of hazardous materials, waste management areas	1.40 to 1.50

Based on the analysis results, the natural undisturbed and well vegetated slope is considered to be adequately stable against slope slides when a 2 to 1 slope or flatter is experienced with a Factor of Safety of 1.5.

The analysis confirms the observed site conditions of a marginally stable and well-vegetated slope with some ongoing creep observed and previous failures due to toe undercutting.

Based on this engineering analysis, a slope inclination of 2 to 1 (26°) or flatter is required, to obtain a minimum Factor of Safety of 1.5. This slope inclination of 2 to 1 (horizontal to vertical) is considered to be the long term stable slope inclination for the site conditions. For a slope height of about 6m, the stable slope crest position will be about 12m (2 x 6m) measured horizontally from the slope toe. This distance is considered the stable slope allowance or set-back. This setback will vary with the height of the slope.

EROSION ALLOWANCE

MNR Policy Guidelines (ref. Natural Hazards Policies (3.1), 2001) also require a recession rate set-back equal to 100 years of the average annual recession rate based on at least 35 years of reliable data. Where there is no reliable recession information, the province suggests a setback distance to allow for erosion along unprotected shorelines of large inland lakes such as Lake Simcoe.

The MNR Technical Guideline suggests a two-step method of calculating the zone potentially threatened by erosion. First, the stable slope allowance is measured as noted above and added to it is an erosion allowance of 15 metres on large inland lakes where there is insufficient recession rate information. Second, a 15m erosion allowance for large inland lakes is measured towards the land from the top of bank. The larger of the two measurements are used as the limit of the erosion hazard.

These two (2) lines are shown approximately on Figure 3 of this report with the development setback line being the greater (or farthest inland) of the two measurements discussed above. At this site, this natural hazard setback is governed by the stable slope allowance plus 15m erosion setback as shown.

Access to the shoreline and slope toe is available from the water by barge if at any point in the future it is determined that maintenance is required. If structures are to be placed at the slope toe or along the shoreline, it would be prudent to retain the services of a shoreline engineer such as Shoreplan Engineering Ltd. to assess wave/ice action and design appropriate protection.

In summary, our analysis has enabled a natural hazard setback line to be delineated (see Figure 3). It is recommended that all buildings, decks, swimming pools, septic beds, etc. that are proposed on the upper plateau (behind the slope crest) be constructed behind this line.

Terraprobe recommends that the roof runoff and stormwater grading is not directed over the slope in a concentrated manner which would increase the potential for surface erosion. It would be best not to cut trees/shrubs from the existing slope aside from what is required for specific features, but rather their growth should be encouraged, as the deep root structures contribute to surficial stability.

Care must be taken to ensure that, both during and after construction, surface water runoff (including that from roof downspouts) is not directed to concentrated discharge over the slope as this will cause surface erosion and long-term maintenance concerns. Surface water from above the slope may be collected in swales and/or discharge media to be directed through enclosed piping and/or drop structures to the slope toe or waters edge for discharge, if necessary.

Disturbed areas due to the construction and other regrading will need to be restored. All bared surface areas must be revegetated or otherwise protected to prevent surface erosion. Drainage media and frequent outlets should be provided behind the proposed stairway structures.

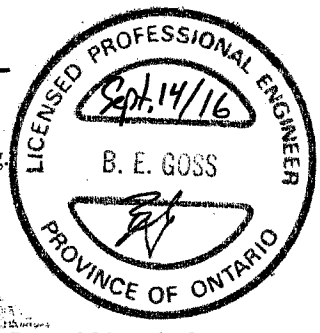
Where boulder terraces are to be created, drainage media, filter fabric and drainage tile should be placed in order to collect and divert any groundwater seepage from the bank down to the water's edge. The rear and side walls of any stairway and/or retaining structures will need to be designed as retaining walls to resist the earth pressure developed.

Some surficial creep of the upper soils has been occurring and will likely continue which may require some maintenance in the future.

The owner should be aware that some ongoing maintenance and reinstatement of the slope landscaping and/or boulder toe protection may be required over time.

We trust that this report, with attached figures and analyses, will meet your present requirements. If you should have any questions, or if we can be of further assistance, please do not hesitate to contact the undersigned.

Sincerely,
Terraprobe Inc.



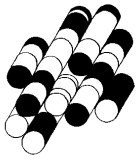
Blair E. Goss, P. Eng.
Associate

Michael Tanos, P. Eng.
Principal

BEG/ct

Attached: Borehole Logs 201 and 202
Figure 1: Site Location Plan
Figure 2: Borehole Location Plan
Figure 3: Borehole and Cross Section Location Plan
Figure 4: Concept Development Plan
Figure 5: Site Cross Section A-A'
Figures 6 to 7: Slope Stability Analysis Results
Site Photographs
Slope Rating Chart
Appendix A: Example Analyses

BOREHOLE LOGS



Terraprobe Inc.

Terraprobe

ABBREVIATIONS, TERMINOLOGY, GENERAL INFORMATION

BOREHOLE LOGS

SAMPLING METHOD

SS	split spoon
ST	Shelby tube
AS	auger sample
WS	wash sample
RC	rock core
WH	weight of hammer
PH	pressure, hydraulic

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.).

SOIL DESCRIPTION - COHESIONLESS SOILS

Relative Density	'N' value
very loose	< 4
loose	4 - 10
compact	10 - 30
dense	30 - 50
very dense	> 50

SOIL DESCRIPTION - COHESIVE SOILS

Consistency	Undrained Shear Strength, kPa	'N' value
very soft	< 12	< 2
soft	12 - 25	2 - 4
firm	25 - 50	4 - 8
stiff	50 - 100	8 - 16
very stiff	100 - 200	16 - 32
hard	> 200	> 32

SOIL COMPOSITION

	% by weight
'trace' (e.g. trace silt)	< 10
'some' (e.g. some gravel)	10 - 20
adjective (e.g. sandy)	20 - 35
'and' (e.g. sand and gravel)	35 - 50

TESTS, SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
ϕ'	angle of internal friction
c'	cohesion shear strength
C_c	compression index

GENERAL INFORMATION, LIMITATIONS

The conclusions and recommendations provided in this report are based on the factual information obtained from the boreholes and/or test pits. Subsurface conditions between the test holes may vary.

The engineering interpretation and report recommendations are given only for the specific project detailed within, and only for the original client. Any third party decision, reliance, or use of this report is the sole and exclusive responsibility of such third party. The number and siting of boreholes and/or test pits may not be sufficient to determine all factors required for different purposes.

It is recommended Terraprobe be retained to review the project final design and to provide construction inspection and testing.

Terraprobe

LOG OF BOREHOLE ..201..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES

DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
GROUND SURFACE		226.5			
175mm – TOPSOIL 500mm – SILTY SAND FILL, trace organics Brown Compact Moist		0.0	1	SS	24
			2	SS	14
SAND, trace to some silt, trace gravel			3	SS	22
			4	SS	15
		223.5			
Grey Hard Moist		3.0	5	SS	33
SILT & CLAY, to clayey, trace sand			6	SS	36
			7	SS	37
		219.9			
End of Borehole		6.6			

PENETRATION RESISTANCE PLOT
20 40 60 80

SHEAR STRENGTH kPa
nat.V – + Q – ●
rem.V – ⊕ U – ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

INSTALLATION INFORMATION

1. Borehole remained open and dry upon completion of drilling.

2. Water level on March 10, 2015 measured dry to 6.5m.

Terraprobe

LOG OF BOREHOLE ..202..

PROJECT NAME: 70 Pioneer Trail Subdivision
PROJECT No.: 31-15-2003
CLIENT: Richwood Estates Inc.
BORING DATE: February 24, 2015
LOCATION: Barrie, Ontario
ELEVATION DATUM: Geodetic

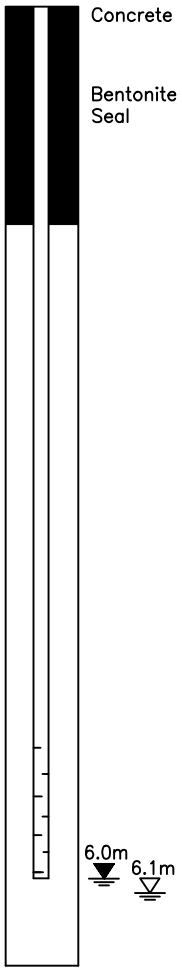
BORING METHOD: D-50T Crawler-mounted Drill Rig / Solid Stem Augers

DEPTH SCALE IN METRES	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	"N" VALUE
	GROUND SURFACE		224.9			
0	100mm - TOPSOIL		0.0			
	Brown Compact to Very Dense Moist to Wet			1	SS	36
1	SAND, trace to some silt, trace gravel, medium to fine			2	SS	22
				3	SS	31
2				4	SS	43
3				5	SS	36
4						
				6	SS	42
5						
6				7	SS	52
			218.3			
	End of Borehole		6.6			
7						
8						
9						

PENETRATION RESISTANCE PLOT
20 40 60 80
SHEAR STRENGTH kPa
nat.V - + Q - ●
rem.V - ⊕ U - ○
20 40 60 80

WATER CONTENT (%)
wP w wL
10 20 30

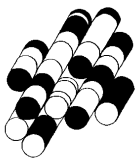
INSTALLATION INFORMATION



1. Borehole caved and water level noted at 6.1m upon completion of drilling.

2. Water level on March 10, 2015 measured at 6.0m (elev. 218.9m).

FIGURES



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MARCH 2015

SITE LOCATION PLAN

31-15-2003

Terraprobe

FIGURE 1

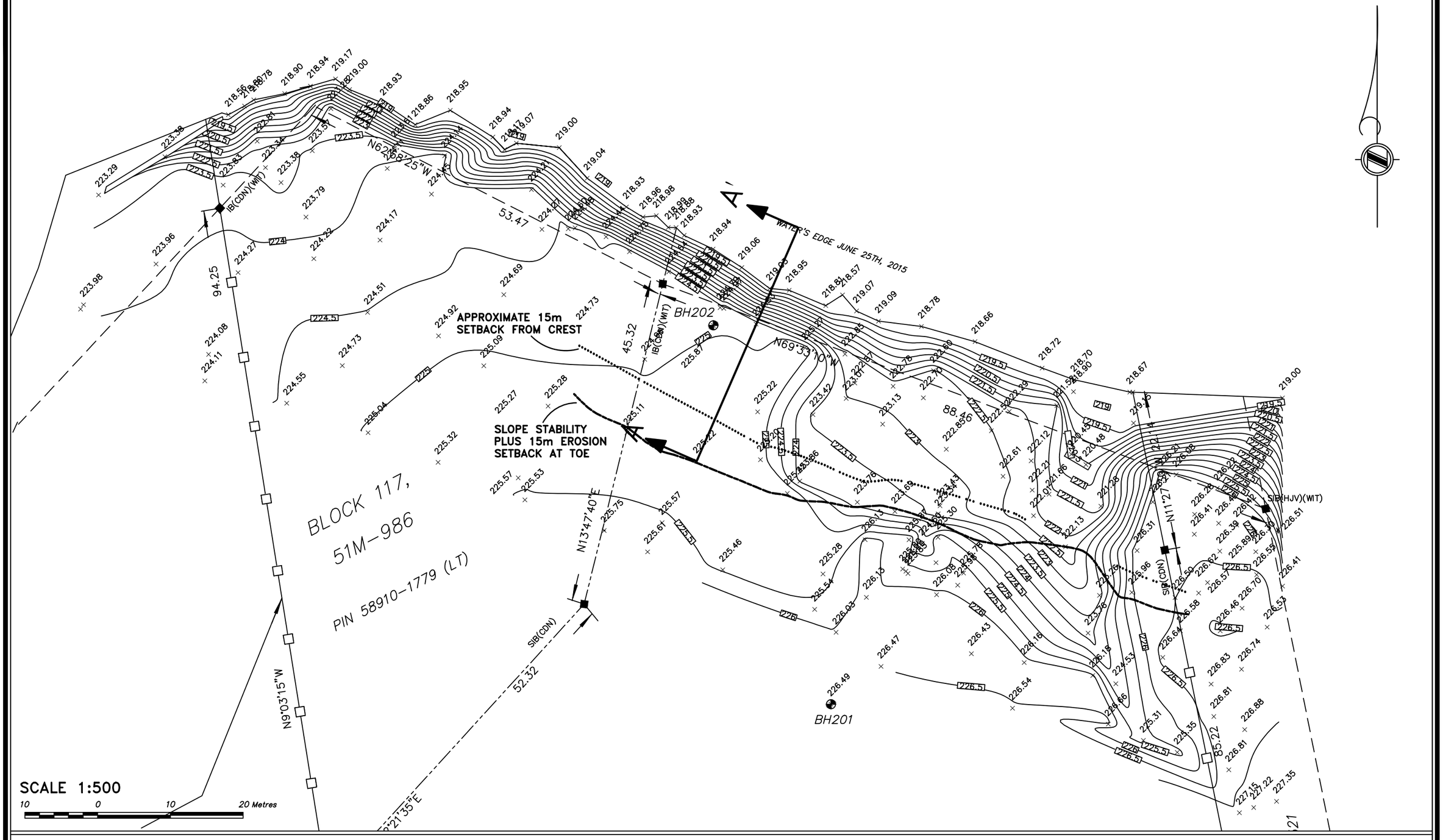
MARCH 2015

BOREHOLE LOCATION PLAN

31-15-2003

Terraprobe

FIGURE 2



AUGUST 2015

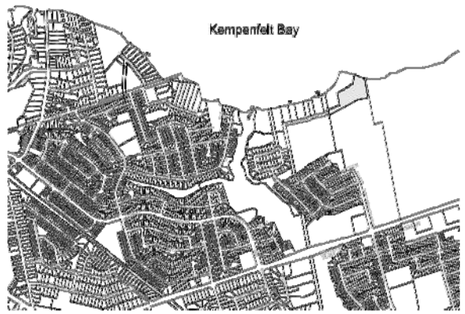
BOREHOLE & CROSS SECTION LOCATION PLAN

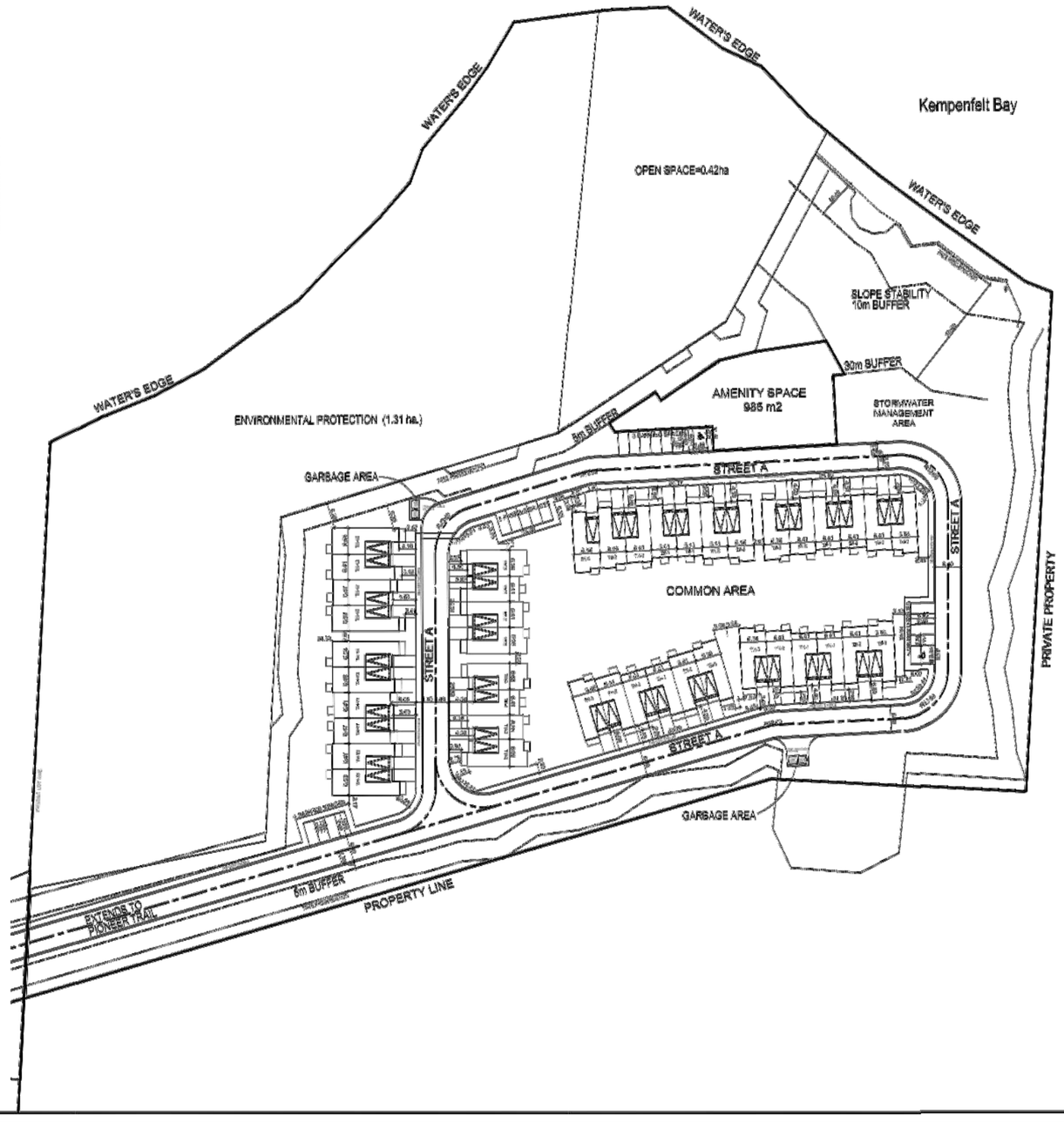
31-15-2003

Terraprobe

FIGURE 3

KEY MAP: 1:15,000





SITE STATISTICS

UNIT COUNT:

TH-01 STANDARD TOWNS	= 10 Units
TH-02 STANDARD TOWNS	= 10 Units
TH-03 STANDARD TOWNS	= 10 Units
TH-10 STANDARD TOWNS	= 4 Units
TH-11 STANDARD TOWNS	= 3 Units
TH-12 STANDARD TOWNS	= 3 Units
TOTAL	= 40 Units

AREA:

SITE AREA	= 2.89 HA = 7.14 AC
OPEN SPACE AREA	= 0.42 HA = 1.04 AC
DEVELOPABLE AREA	= 2.48 HA = 6.16 AC
LOT COVERAGE	= 0.44 HA = 15 %

DENSITY:

=	17.24 Units/HA
=	7.02 Units/AC

PARKING:

RESIDENTIAL	= 68 Spaces
VISITOR	= 33 Spaces
BARRIER FREE	= 02 Spaces
TOTAL	= 105 Spaces

NOTES:

1) Snow storage to be taken off site.
2) Private garbage pick up.

FERNBROOK HOMES

KEMPENFELT BAY
BARRIE, ONTARIO

SITE PLAN

SEPTEMBER 2016

CONCEPT DEVELOPMENT PLAN

31-15-2003

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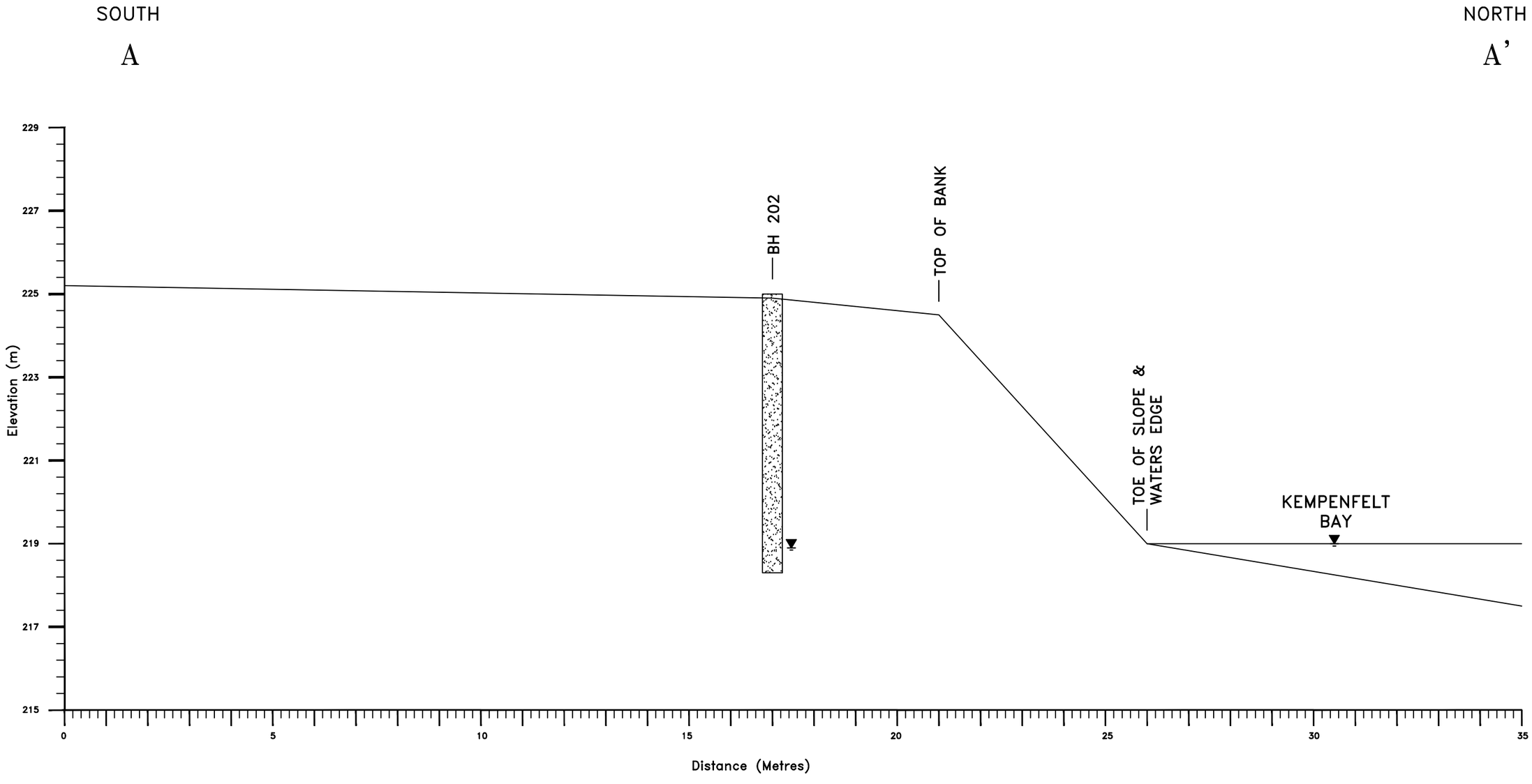
FIGURE 4

SECTION A – A'



SCALES:

Horizontal	1 : 100
Vertical	1 : 100

AUGUST 2015

SITE CROSS SECTION A–A'

31–15–2003

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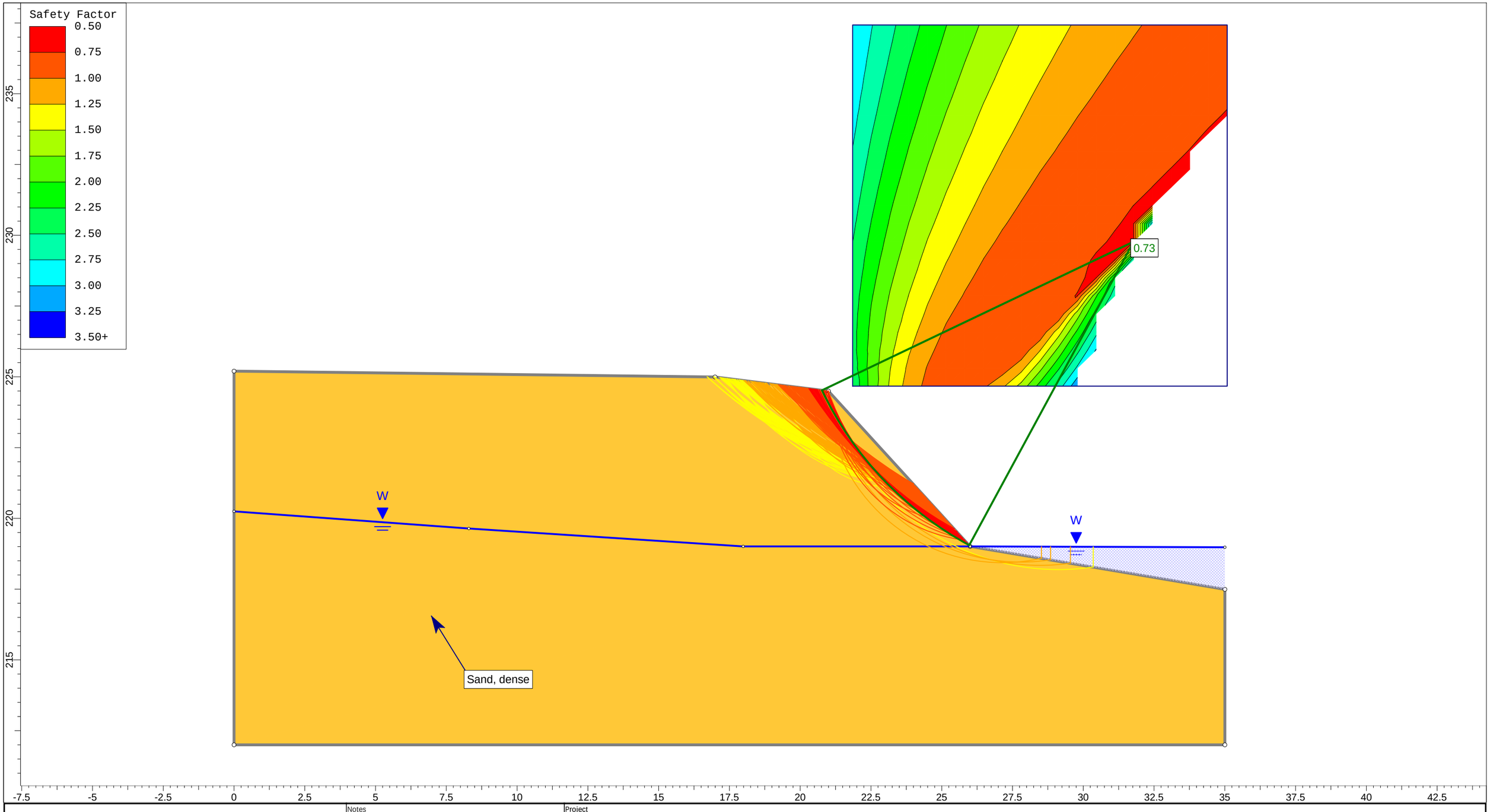
FIGURE 5



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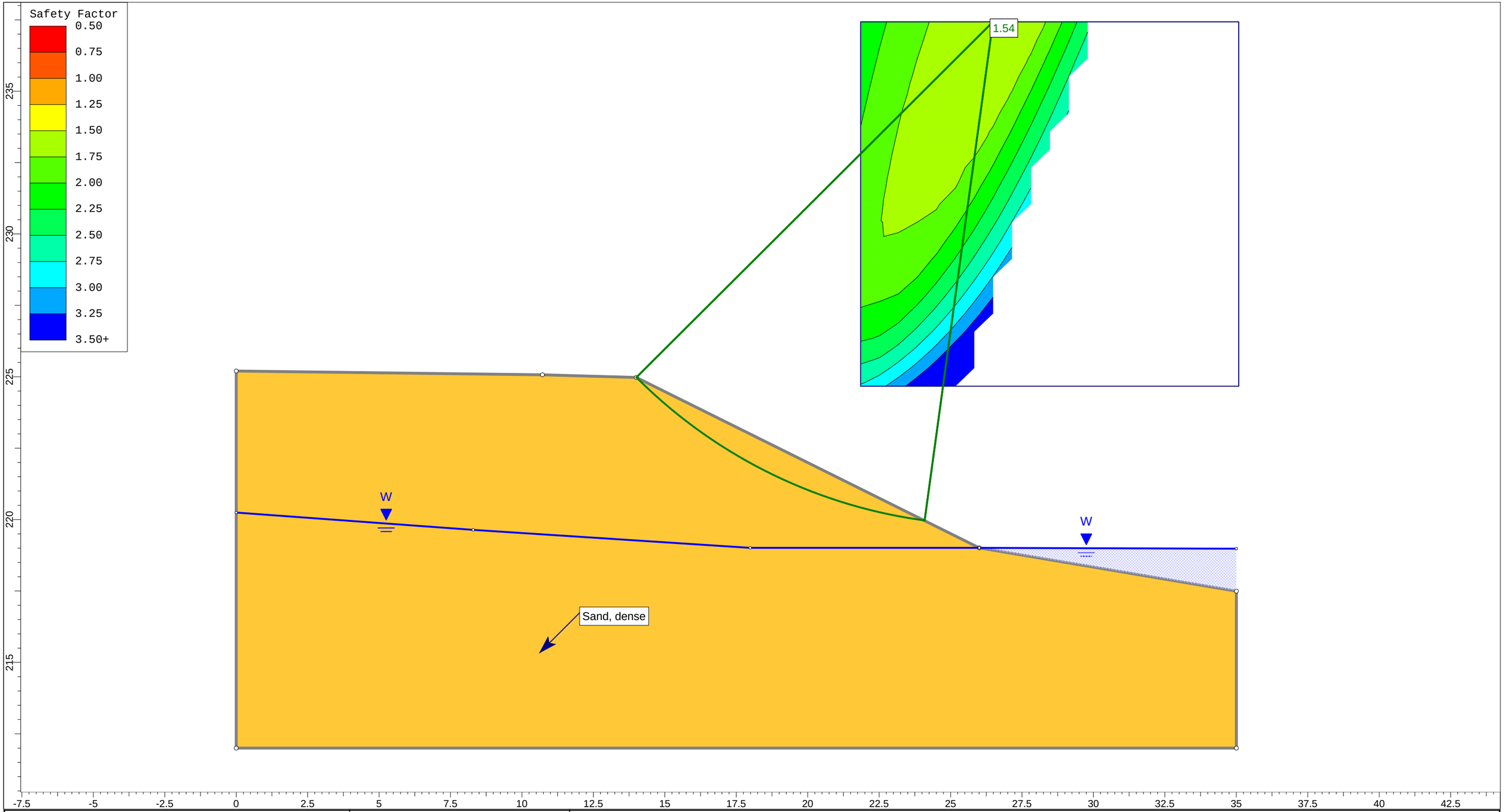
SLIDEINTERPRET 6.030

Notes

Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project	**31-15-2003, 70 Pioneer Trail, Barrie**		
Analysis Description	Existing Section A-A'		
Date 7/28/2015	Scale 1:125	File	31-15-2003, 70 Pioneer Trail, Existing Section AA, Fig 6.slim
By BG	Ref.		



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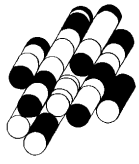
Notes
Refer to appended Slope Stability Analysis Explanation sheets for legend. Refer to cross-sections for inclinations and other pertinent slope information.

Project	**31-15-2003, 70 Pioneer Trail, Barrie**		
Analysis Description	Typical 2:1 Section		
Date 7/28/2015	Scale 1:125	File	31-15-2003, 70 Pioneer Trail, Typical 2to1 Section, Fig 7.slim
By BG	Ref.		

SITE PHOTOGRAPHS



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APRIL 2015

SITE PHOTOGRAPHS

31-15-2003

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APRIL 2015

SITE PHOTOGRAPHS

31-15-2003

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APRIL 2015

SITE PHOTOGRAPHS

31-15-2003

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APRIL 2015

SITE PHOTOGRAPHS

31-15-2003

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SLOPE RATING CHART

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Construction Materials Inspection & Testing

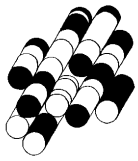
SLOPE RATING CHART

Site Location: 70 PIONEER TRAIL, BARRIE, ON. File No. 31-15-2003
Property Owner: RICHWOOD ESTATES INC. Inspection Date: APRIL 9, 2015
Inspected By: B. GOSS Weather: OVERCAST, +4°C

				Rating Value
1.	**SLOPE INCLINATION**			
	degrees	**horiz. : vert.**	generally 1:1 to 0.5:1 with localized steeper sections	
a)	18 or less	3 : 1 or flatter		0
b)	18 - 26	2 : 1 to 3 : 1		6
c)	more than 26	steeper than 2 : 1		(16)
2.	**SOIL STRATIGRAPHY**			
a)	Shale, Limestone, Granite (Bedrock)			0
b)	Sand, Gravel			(6)
c)	Glacial Till			9
d)	Clay, Silt			12
e)	Fill			16
f)	Leda Clay			24
3.	**SEEPAGE FROM SLOPE FACE**			
a)	None or Near bottom only			(0)
b)	Near mid-slope only			6
c)	Near crest only or, From several levels			12
4.	**SLOPE HEIGHT**			
a)	2 m or less			0
b)	2.1 to 5 m			2
c)	5.1 to 10 m			(4)
d)	more than 10 m			8
5.	**VEGETATION COVER ON SLOPE FACE**			
a)	Well vegetated; heavy shrubs or forested with mature trees			0
b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs			(4)
c)	No vegetation, bare			8
6.	**TABLE LAND DRAINAGE**			
a)	Table land flat, no apparent drainage over slope			0
b)	Minor drainage over slope, no active erosion			(2)
c)	Drainage over slope, active erosion, gullies			4
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**			
a)	15 metres or more from slope toe			0
b)	Less than 15 metres from slope toe			(6)
8.	**PREVIOUS LANDSLIDE ACTIVITY**			
a)	No			0
b)	Yes			(6)
	SLOPE INSTABILITY RATING	**RATING VALUES TOTAL**	**INVESTIGATION REQUIREMENTS**	**TOTAL** 44
1.	Low potential	< 24	Site inspection only, confirmation, report letter.	
2.	Slight potential	25-35	Site Inspection and surveying, preliminary study, detailed report.	
3.	Moderate potential	(> 35)	Boreholes, piezometers, lab tests, surveying, detailed report.	

NOTES: a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.

APPENDIX A



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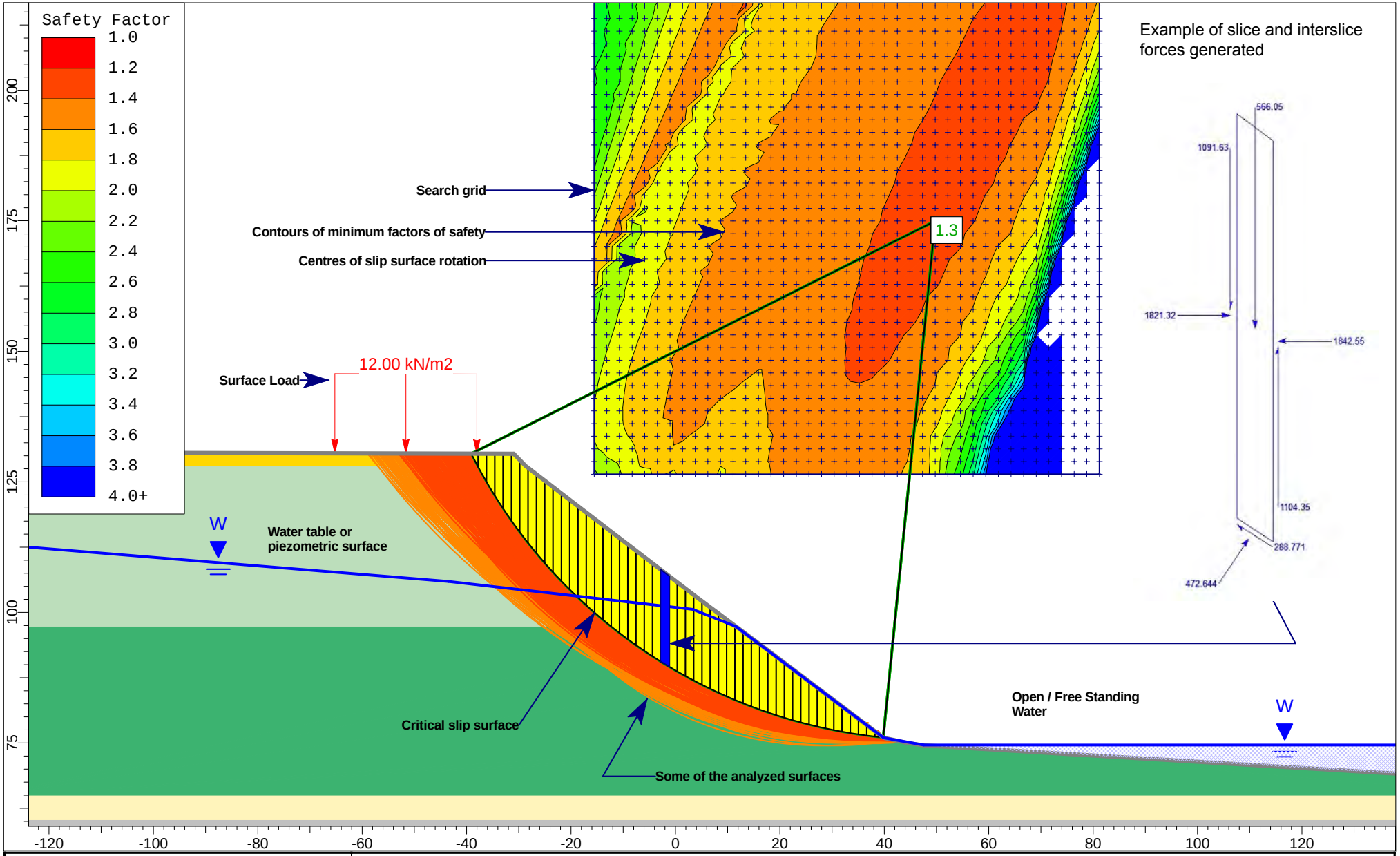

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Construction Materials Inspection & Testing

SLIDEINTERPRET 6.026

Project

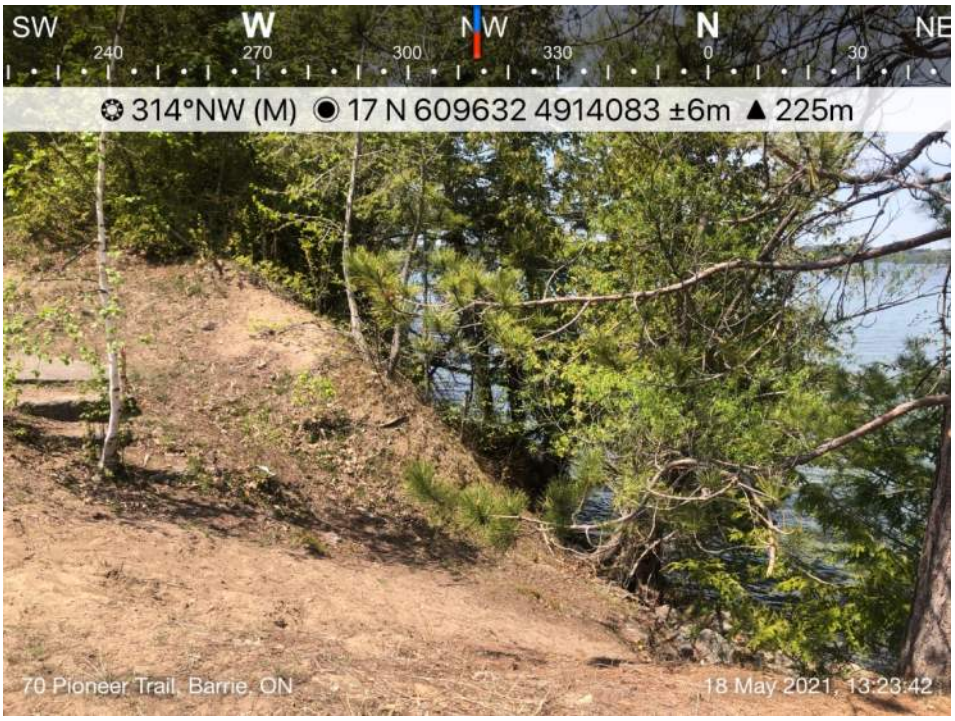
Slope Stability Analysis - Explanation with Slices and Slice Forces

Analysis Description

Circular Analysis (example)

ENCLOSURE 4

Enclosure 4 – Site and Slope Photographs



PHOTOGRAPH 1

(GEI 2021)

Description: A view of the slope and shoreline.

PHOTOGRAPH 2

(GEI 2021)

Description: Another view of the slope and shoreline.

PHOTOGRAPH 3

(GEI 2021)

Description: A view of the tableland near the slope, facing inland from the slope crest.

PHOTOGRAPH 4

(GEI 2021)

Description: Another view of the tableland near the slope, facing the slope crest.