



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL REPORT DERRY ROAD AND ARGENTIA ROAD INTERSECTION IMPROVEMENTS REGION OF PEEL, ONTARIO

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1.0 INTRODUCTION

Terraprobe Inc. (Terraprobe) has been retained by HDR Corporation (HDR) to provide geotechnical engineering services in support of the proposed intersection improvements at Derry Road and Argentia Road in the Region of Peel, Ontario. A site location plan is provided as Figure 1 and site photographs are presented in Figures 2 and 3.

The scope of work for the geotechnical engineering services is outlined in Terraprobe's proposal titled "*Schedule 'B' Municipal Class EA for Derry Road and Argentia Road From 300m of All Quadrants of the Intersection, RFP 2013-261P, City of Mississauga, The Regional Municipality of Peel*" dated May 10, 2013.

The purpose of this investigation was to explore the subsurface conditions within the study area by borehole drilling and pavement coring, in-situ testing and laboratory testing on soil samples. The data obtained from this investigation was used to provide Borehole Location Plan, Borehole Logs, laboratory test results, a description of the subsurface conditions and geotechnical design recommendations.

A geotechnical investigation was carried out for a section of Derry Road within the current project limits and selected data from this investigation is provided in this report. The following document is referenced in the preparation of this report:

- SPL Consultants Limited, "*Geotechnical Investigation, Derry Road between Argentia & Millcreek, City of Mississauga, Ontario*" Project No. 592-1078, dated February 25, 2013.

2.0 PROJECT AND SITE DESCRIPTION

Derry Road is an east/west oriented arterial road that intersects Argentia Road. This intersection is located in a full developed area with hotels at the northeast and southeast quadrants and commercial enterprises at the remaining quadrants of the intersection. A Highway 401 overpass and a railway bridge are located at the east and west limits of the study area respectively. Both roadways currently conform to an urban cross-section.

The purpose of this study is to identify long term improvements on the intersection for the horizon year of 2031 and, geotechnical consulting services are required to support the design.

3.0 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing were carried out on June 6 and 9, 2014, and consisted of drilling and sampling twenty eight boreholes to depths ranging from approximately 0.6 m to 1.8 m below ground surface including asphalt pavement coring at four locations. The approximate borehole and corehole locations are shown on Figure 4 with the approximate locations of SPL's Boreholes from the referenced report.

The borehole and corehole locations were marked in the field by Terraprobe's field staff in relation to existing features shown on the base plan provided by HDR. Utility clearances and permits were obtained by Terraprobe prior to drilling.

On the existing roadways the boreholes were drilled with a CME 75 truck-mounted drill rig supplied and operated by Strong Soil Search of Claremont, Ontario. These borings were extended through the asphalt pavement and the overburden soils using solid stem augering techniques and soil



samples were obtained at selected intervals of depth using a 50 mm outer diameter (O.D.) split- spoon sampler in conjunction with the Standard Penetration Test (SPT) procedures as specified in ASTM Method D1586¹. Cores of the existing pavement were obtained with a 150 mm diameter core barrel.

The boreholes in the boulevard areas were extended manually by advancing a split-spoon sampler with portable hand operated vibratory equipment (Pionjar) supplied and operated by Sonic Soil Sampling of Concord, Ontario. Ground water conditions in the open boreholes were observed during and immediately following the drilling operations.

A member of Terraprobe's technical staff observed and recorded the borehole drilling and the sampling operations on a full-time basis. The soil samples were visually inspected in the field, placed in labelled plastic containers and transferred to Terraprobe's Brampton laboratory for further examination and testing.

The recovered soil samples were subjected to Visual Identification (VI) and select soil samples were subjected to a laboratory testing programme consisting of natural water content and grain size distribution in accordance with MTO and/or ASTM Standards as appropriate. The results of the soil testing program are presented on the Borehole Logs in Appendix A and on the figures in Appendix B. Two soil samples were also submitted to Agat Laboratories for soil chemical testing to assess soil disposal options for excess soils generated during construction. The results of the soil chemical tests are provided in Appendix D.

A visual pavement condition survey of Derry Road and Argentia Road was completed in August 2014. The survey was conducted in accordance with the procedures outlined in the Ministry of Transportation of Ontario (MTO) *Manual for Condition Rating of Flexible Pavements - Distress Manifestations (SP-024)*. The Flexible Pavement Condition Evaluation Forms are included in Appendix C.

4.0 SUBSURFACE CONDITIONS

4.1 General

Reference is made to the Borehole Logs and Core Logs in Appendix A. Details of the encountered pavement structure and soil stratigraphy are provided in this appendix. An overall description of the pavement structure and soil stratigraphy is given in the following paragraphs. However; the factual data presented in the Borehole Logs and Core Logs governs any interpretation of the site conditions. The subsurface conditions will vary between and beyond the borehole locations.

¹ ASTM D1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.



4.1.1 Pavement Structure

The average pavement structures of the roadways are summarized below.

Pavement Component	Derry Road East Leg	Derry Road West Leg	Argentia Road North Leg	Argentia Road South Leg
HMA (mm)	165	120*	145	170
Granular (mm)	630	*	525	585
Total (mm)	795	*	670	755

* The average asphalt thickness was derived from SPL Core Logs. Information on pavement granular thickness was not provided.

The granular material comprising the base/subbase courses of the roadways generally consists of gravelly sand to sand and gravel fill material. The pavement boreholes extended through the south leg of Argentia Road (Boreholes 16, 17, 22 and 23) encountered beneath the asphaltic concrete a sand layer that ranges from 560 mm to 620 mm in thickness. The locations, fill thickness and the range of SPT N-values and moisture contents are summarized below.

Gravelly Sand to Sand and Gravel Fill

Borehole No.	Fill Thickness (m)	Range of SPT N-values (blows/0.3m)	Range of Moisture Content (% by weight)
8	0.64	41	-
9	1.04	21 – 48	-
12	0.89	23 – 46	-
13	0.62	49	-
16	0.62	28	4
17	0.60	31	-
22	0.56	23	-
23	0.57	14	-
26	0.43	17	-
27	0.41	17	-
31	0.60	21	-
34	0.65	19	5

Two (2) samples of this gravelly sand to sand and gravel fill were subjected to grain size distribution tests and the results are presented in Figure B1 in Appendix B. The results are compared to the Ontario Provincial Standards (OPSS) Granular A and Granular B Type I specifications. Based on the SPT N-values the relative density of the gravelly sand, to sand and gravel fill is described as generally compact with occasional dense zones.



4.1.2 Topsoil

Topsoil thicknesses were measured in the widening areas beyond the existing pavement platform and the topsoil thickness ranged from 150 mm to 280 mm. Topsoil thickness may vary between and beyond the borehole locations.

4.1.3 Concrete

Boreholes 10 and 11 were drilled through the concrete sidewalk because of space restrictions and underground utilities in the general area. The concrete sidewalk is about 140 mm to 150 mm thick and is underlain by granular material that ranges from 410 mm to 1080 mm in thickness.

4.1.4 Fill – Sand and Gravel to Silty Sand

Sand and gravel to silty sand fill material were encountered below the topsoil and concrete sidewalk. The locations, fill thickness and moisture contents are summarized below.

Sand and Gravel to Silty Sand Fill

Borehole No.	Fill Thickness (m)	Range of Moisture Content (% by weight)
4	0.6	-
7	0.4	14
10	0.4	6
11	1.1	-
20	0.7	-

4.1.5 Fill – Silty Clay

Silty clay fill material was encountered within the project limits and the locations, fill thickness, range of SPT N-values and moisture contents are summarized below.

Silty Clay Fill

Borehole No.	Fill Thickness (m)	Range of SPT N-values (blows/0.3m)	Range of Moisture Content (% by weight)
17	1.0*	4 – 11	13
18	0.4*	-	-
19	0.4	-	-
20	0.6*	-	-
21	0.3	-	-
24	0.9	-	-
25	0.4	-	-
28	0.7	-	-
29	0.4	-	-
30	0.4	-	11
32	0.3	-	-



Borehole No.	Fill Thickness (m)	Range of SPT N-values (blows/0.3m)	Range of Moisture Content (% by weight)
33	0.4	-	-
34	0.4	10	-

*Borehole termination depth.

Based on the SPT N-values, the consistency of the silty clay fill is described as firm to stiff.

4.1.6 Till - Silty Clay

A silty clay till deposit was encountered across the site. Summarized below are the locations where these soils were found, their explored depths, range of SPT N-values and moisture contents.

Silty Clay Till

Borehole No.	Depth of Deposit (m)	Range of SPT N-values (blows/0.3m)	Range of Moisture Content (% by weight)
4	1.8*	-	-
7	1.8*	-	14
8	1.6*	23 – 72/22.5 cm	-
9	1.8*	33	-
10	1.8*	-	15
11	1.7*	-	-
12	1.8*	32	-
13	1.8*	13 – 26	-
15	0.9*	-	-
16	1.7*	12 – 74/27.5 cm	11 - 16
19	1.5*	-	-
21	1.8*	-	-
22	1.6*	10 – 99/22.5 cm	-
23	1.8*	11 – 15	-
24	1.8*	-	-
25	1.1*	-	-
26	1.8*	65 – 77	-
27	1.8*	55 – 59	-
28	1.5*	-	-
29	1.1*	-	-
30	1.7*	-	14
31	1.8*	22 – 45	-
32	1.1*	-	-
33	1.1*	-	-
34	1.8*	22	-

*Borehole termination depth.



Two samples of the silty clay till were subjected to grain size distribution tests and the results are presented in Figure B2 in Appendix B. These results show a soil matrix consisting of 0 – 2 % gravel, 17 – 22 % sand, 51 – 53 % silt and 25 – 30 % clay sized particles. Till soils can also be expected to contain random cobble and boulder inclusions.

Based on the SPT N-values the consistency of the silty clay till is described as stiff to hard.

4.2 Ground Water Levels

No free water was encountered in any of the boreholes during drilling. The ground water level is expected to fluctuate seasonally and will be influenced by major weather events and perched water can be expected to occur where surficial layers of gravelly sands are underlain by relatively impermeable silty clay soils.



5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

This section of the report presents an interpretation of the factual geotechnical data and provides geotechnical design recommendations. These discussions and recommendations are based on our understanding of the project, and our interpretation of the factual data obtained from the current and previous subsurface investigations.

Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project, and for which special provisions or operational constraints may be required in the Contract Documents. Those requiring information on the aspects of construction should make their own interpretation and assessment of the geotechnical information provided, as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

HDR's design drawings illustrate that the intersection is to be upgraded by providing additional turning lanes on each leg of the intersection. The east and west legs of Derry Road will be widened on the south sides to accommodate additional left turn lanes. The south leg of Argentia Road will be widened on the east side to accommodate a new northbound through lane. The north leg of Argentia Road will be widened on the west side to accommodate a right turn lane.

5.2 Pavement Condition

A visual pavement condition evaluation of Derry Road and Argentia Road was completed in August 2014. The survey was conducted in accordance with the procedures outlined in the Ministry of Transportation of Ontario (MTO) *Manual for Condition Rating of Flexible Pavements - Distress Manifestations (SP-024)*. The Pavement Condition Evaluation Forms are included in Appendix C. Summarized below are the observed pavement distresses and the overall pavement condition of the evaluated pavement sections.

Summarized Pavement Conditions

Section	Overall Condition	General Distresses
Derry Road Sta. 9+720 to Sta. 10+166	PCR = 70, RCR = 7 Good	<ul style="list-style-type: none"> ▪ Intermittent slight raveling and coarse aggregate loss. ▪ Intermittent slight wheel track rutting. ▪ Intermittent slight single and multiple longitudinal wheel track cracking. ▪ Intermittent slight transverse cracking.
Argentia Road Sta. 1+790 to Sta. 2+280	PCR = 70, RCR = 7 Good	<ul style="list-style-type: none"> ▪ Frequent moderate raveling and coarse aggregate loss. ▪ Intermittent slight wheel track rutting. ▪ Intermittent slight single and multiple longitudinal wheel track cracking. ▪ Intermittent moderate alligator pavement edge cracking. ▪ Intermittent slight transverse cracking.

5.3 Traffic Data

The AADT values, annual growth rates and percentage of commercial vehicles used for the pavement design were provided by HDR. This traffic data and the derived Equivalent Single Axle Loads (ESALs) are provided in the following table.



Traffic Data and ESAL's

Parameters	Derry Road	Argentia Road
Projected AADT (2015)	40,730	15,520
Projected AADT (2021)	43,240	16,480
Projected AADT (2031)	47,730	18,180
Annual Growth Rate (2015 – 2031)	1%	1%
Percent Commercial Vehicles	5%	5%
Design ESALs (2021)	2,100,000	516,300
Design ESALs (2031)	5,050,000	1,450,000

5.4 Pavement Designs

The pavement structures were designed based on the traffic information provided by HDR and the data obtained from the field investigations. Pavement designs were carried out for new construction (widening) as well as rehabilitation of the existing roadway.

The following references and guidelines were used for the pavement designs.

- MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions, MI-183", March 19, 2008; and
- American Association of State Highway and Transportation Officials, "AASHTO Guide for Design of Pavement Structures", 1993.

The pavement design parameters are summarized in the following table.

AASHTO Pavement Design Parameters

Design Parameter	Values
Initial/Terminal Serviceability Index	$P_i = 4.2$ $P_t = 2.2$
Loss in Serviceability Index	2.0
Desired Reliability (R %) and Standard Deviation (SD)	$R = 85$ $SD = 0.45$
Estimated Resilient Modulus of Subgrade Soil (MPa)	35
Layer Coefficients of Hot Mix Asphalt (HMA)	New HMA = 0.42 Existing HMA = 0.25 to 0.30
Layer Coefficient of Granular Materials	Gran. A = 0.14 Gran. B Type I = 0.09 Existing Granular 'A' Material = 0.10 to 0.14 Existing Granular 'B' Material = 0.08
Drainage Coefficient of Granular Materials	New Granular = 1.0 Existing Granular = 0.9 to 1.0



5.4.1 Pavement Structures (New Construction – Widening)

Based on our pavement condition survey both roads are in good condition and have performed well over the years which likely indicates a structurally adequate pavement structure. Furthermore, since the turning traffic volume is less than the traffic volume in the main lanes; a pavement structure similar to the main lanes of the roadways will suffice. Existing and new pavement structures of at least equal thicknesses are also required to provide positive lateral drainage across the pavement platform.

The recommended pavement structure for new construction (widening) is:

Hot mix asphalt	HL-1 Surface Course	50 mm (except Argentia Road south leg)
	DFC Surface Course	50 mm (Argentia Road south Leg only)
	HL-8 Binder Course	100 mm
Granular A Base Course		150 mm
Granular B Type I Subbase		500 mm
Total thickness		800 mm
Granular Base Equivalency		783 mm

5.4.2 Existing Pavement Rehabilitation

The structural capacities of the existing east leg of Derry Road and the north and south legs of Argentia Road were analyzed for the design traffic using AASHTO’s pavement overlay design procedure. The structural capacities of the existing pavements are inadequate to support the design loads and pavement strengthening is required.

Consideration was given to strengthening the existing pavement by partial depth milling and repaving. The rehabilitation treatments for the existing pavements for service life extensions of 6 years and 16 years i.e. for horizon years 2021 and 2031 respectively are tabulated below:

Existing Pavement Rehabilitation

Rehabilitation Treatment	Derry Rd East Leg		Derry Rd West Leg		Argentia Rd North Leg		Argentia Rd South Leg	
	2021	2031	2021	2031	2021	2031	2021	2031
Horizon Year	2021	2031	2021	2031	2021	2031	2021	2031
Mill existing pavement (mm)	50	90	*	*	50	50	50	50
Overlay with HMA (mm)	50	100	*	*	50	50	50	50
Structural Number Provided (mm)	106	123	*	*	101	101	101	101
Design Structural Number (mm)	106	120	*	*	86	100	86	100

* Derry Road west leg was recently repaved and the existing pavement structure of this section of the roadway was not available when this report was written.

Rehabilitation by milling the existing pavement a partial depth of 50 mm and repaving with a 50 mm thick HMA overlay is adequate to sustain the design traffic loads for a service life extension to Year 2021 on the east leg of Derry Road and service life extensions to Year 2021 and Year 2031 for the north and south legs of Argentia Road. If a service life extension to Year 2031 is required on the east leg of Derry Road, we recommend milling the existing pavement a partial depth of 90 mm and repaving with a 50 mm thick HL-1 surface course and a 50 mm thick HL-8 binder course. This recommended rehabilitation strategy will result in a grade raise of 10 mm.



The asphalt core sample extracted from the south leg of Argentia Road (Borehole 16) show a surface course comprising of Dense Friction Course (DFC) asphalt. We believe that DFC was used as a surface course because of the heavy traffic loads from busses arriving at and departing from the GO Station facility on Argentia Road south of Derry Road. Therefore, for new construction (widening) and rehabilitation of the south leg of Argentia Road, we recommend a 50 mm thick DFC surface course.

6.0 RECOMMENDATIONS AND COSTRUCTION FEATURES

6.1 Pavement Structure and Material Types

The following mix types are considered suitable for this project.

HL-1 or Superpave 12.5 FC1	Surface Course (except Argentia Road south leg);
DFC or Superpave 12.5 FC2	Surface Course (Argentia Road south Leg only); and
HL-8 or Superpave 19	Binder Course.

Granular A material should be used as base material for all new roadways and Granular B Type I is recommended as subbase material. Both the Granular A and the Granular B Type I materials should meet the OPSS.MUNI 1010 specifications.

SP 12.5 FC1, SP 12.5 FC2 and SP 19 hot mix asphalt types should be designed for Traffic Category C in accordance with OPSS MUNI 1151.

6.2 Padding

Superpave 9.5 (or alternatively HL 3HS for Marshall mixes) is recommended as padding. Padding should be placed in lifts not exceeding 50 mm below binder courses.

6.3 Asphalt Cement Grade

Performance graded asphalt cement PG 64-28 conforming to OPSS MUNI 1101 requirements, is recommended for the HMA binder and surface courses.

6.4 Routing and Sealing & Tack Coat

After milling, all cracks wider than 3 mm should be routed and sealed and a tack coat applied to the milled surface prior to placing the overlay.

A tack coat (SS1) should be applied to all construction joints prior to placing hot mix asphalt to create an adhesive bond. Prior to placing hot mix asphalt SS1 tack coat must also be applied to all existing or milled surfaces and between all new lifts.

6.5 Key-in Detail

Asphalt joint between the existing pavement and new construction should be constructed in accordance with applicable Region of Peel standards. Alternatively, a longitudinal key-in can be considered between the existing pavement and new construction.



6.6 Pavement Crossfall

The finished pavement surface should be adequately sloped (normally 2%) towards the sides to provide positive drainage. Continuity of drainage through the granular road base and subbase layers should be maintained between the existing and new pavement structures. In this regard, the granular thickness for any new pavement structure may have to be increased from the above recommended thickness in some areas to match any thicker granular fill encountered under the existing pavement.

6.7 Pavement Tapers

At the limits of construction, appropriate tapering of the pavement thickness to match the existing pavement structure should be implemented in accordance with OPSS or applicable Region and City's standard.

6.8 Subdrains

Since the widened roadways will conform to an urban section, full-length subdrains placed beneath the curb in accordance with OPSD 216.021 are required to provide pavement drainage. The subdrains should be connected to a positive outlet.

6.9 Compaction of Base & Sub-Base Materials

All granular base and subbase materials should be placed in 150 mm lifts and compacted to 100% of the material's Standard Proctor Maximum Dry Density (SPMDD) at $\pm 2\%$ of its Optimum Moisture Content (OMC). Asphalt concrete should be placed and compacted in accordance with the appropriate OPSS or Region of Peel and City of Mississauga specifications.

6.10 Reuse of Existing Granular Fill

It is envisaged that some of the existing granular material below the roadways would be salvaged during construction operations. The grain size analyses of two selected samples (Figure B1, Appendix B) of the existing pavement base and sub-base granular material indicate that the material does not meet the OPSS 1010 specifications for Granular 'A' and the fines content also exceeds the allowable fines content for OPSS 1010 Granular B Type I material. Therefore, this granular fill cannot be used as Granular 'A' or Granular 'B' for pavement construction. However, the granular material can be used as fill elsewhere on this project provided it is free of topsoil, organics and other deleterious material.

6.11 Excavations

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the soils at this site may be classified as:

- Fill material – Type 3 soil.
- Silty Clay Till – Type 2 soil.



6.12 Stripping

For estimating purposes assume an average topsoil thickness of 200 mm in the widening areas.

6.13 Subgrade Preparation

All topsoil, organics, soft/loose and otherwise disturbed soils should be stripped from the subgrade areas. The exposed subgrade is expected to consist of silty clay fill, sand and gravel to silty sand fill and native silty clay till. The silty clay fill and native silty clay till soils are fine-grained soils and will be weakened by construction traffic when wet; especially if site work is carried out during periods of wet weather. During these weather conditions, an adequate granular working surface would be required in order to minimize subgrade disturbance. Subgrade preparation and fill construction should not be done in the winter.

Immediately prior to placing the granular base, the exposed subgrade should be compacted and then proof-rolled with a heavy rubber tired vehicle (such as a loaded gravel truck). The subgrade should be inspected for signs of rutting or displacement. Areas displaying signs of rutting or displacement should be re-compacted and retested or, the material should be excavated and replaced with well-compacted and clean fill.

The fill may consist of either granular material or local inorganic soils provided that its moisture content is within $\pm 2\%$ of optimum. Fill should be placed and compacted in accordance with OPSS 501 and the final 300 mm of the subgrade should be compacted to 98% of SPMDD. The final subgrade surface should be sloped at least 3% to provide positive drainage.

6.14 Frost Protection

The grain size distribution results of the silty clay till indicate that the percentage of soil particles between 5 μm and 75 μm ranges from about 36% to 40%. Based on MTO's *Pavement Design and Rehabilitation Manual, SDO 90-01*, these soils are categorized as low to moderate frost susceptibility (LSFH to MSFH).

Based on *the City of Mississauga Standard No. 2220.020 Standard Frost Suitability of Soils*, these soils are assigned a frost value of 11.

For design purposes assume a frost penetration depth of 1.2 m.

6.15 Backfill

The native soils, the earth fill and the existing granular fill will generally be suitable for use as backfill materials provided they are free of topsoil, organics or other deleterious material.

To achieve the specified compaction, soils must neither be too wet nor too dry of their optimum moisture content. Soils that are too wet cannot be used immediately because the material will have to be dried to about $\pm 2\%$ of the optimum moisture content. If the construction operations are time sensitive, the use of imported granular material may be considered. Soils that are dry of optimum can be used immediately provided that the material is moisture conditioned (i.e. water added) to achieve a moisture content of $\pm 2\%$ of optimum.

Topsoil encountered at the site may be stockpiled and reused for landscaping purposes.



7.0 SOIL CHEMICAL ANALYSIS

Two soil samples were submitted to Agat Laboratories for chemical characterization with respect to general inorganic parameters including metals, pH, sodium adsorption ratio (SAR) and electrical conductivity (EC) to assess options for reuse or disposal of excess soils that will be generated during construction. Based on visual and/or olfactory screening of soil samples, these nominal parameters are analysed when there are no indications of environmental impacts. However, additional sampling/testing will likely be required during construction to confirm disposal or re-use options. The Certificates of Analysis are included in Appendix D.

The analytical results were compared to Table 1 (Agricultural) of the MOE Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act, April 15, 2011. Comparison of the test results to the MOE Standard indicates that the SAR and electrical conductivity of Sample SS2B from Borehole 17 retrieved at a depth of 0.8 m – 1.2 m, exceeded the guideline values. The metal concentrations of both tested samples are below the remediation concentrations stipulated in Table 1. Refer to the Guideline Violation table in Appendix D for further details.

The conclusions herein are based on limited analytical data and the actual quality of the excavated soils could vary during construction. Debris or stained/odorous soils, that are encountered during excavation, should be segregated and re-evaluated for disposal or re-use as fill and may require additional chemical analysis.

The testing carried out was intended to provide an overview of the soil quality and may not be adequate for the design of a soil management plan for construction. The actual acceptance criteria for surplus soil will vary with the receiving site and additional analyses may be needed to satisfy site specific acceptance criteria.

8.0 LIMITATIONS AND RISK

8.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling.



8.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Ground water levels are particularly susceptible to seasonal fluctuations.

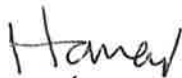
The discussion and recommendations are based on the factual data obtained from investigations made by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

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9.0 CLOSURE

This report was prepared by Mr. H Ahmed, P.Eng., a Geotechnical Engineer with Terraprobe, and reviewed by Mr. Rehman Abdul, M.S., P.Eng., a Senior Geotechnical Engineer and Associate with Terraprobe.

Terraprobe Inc.



H. Ahmed, P.Eng.
Geotechnical Engineer



R. Abdul, P.Eng.
Associate, Senior Geotechnical Engineer



REFERENCES

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ASTM D698-12, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort*, 2012.

ASTM D1586 - 08a, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, 2008.

Ontario Regulation 213/91, *Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects*, April 11, 2012.

Ministry of the Environment, April 15, 2011. *Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act*, PIBS # 7382e01.

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Ministry of Transportation Ontario. *Pavement Design and Rehabilitation Manual (SDO 90-01)*, 1990.

Ministry of Transportation Ontario, *Manual for Condition Rating of Flexible Pavements - Distress Manifestations (SP-024)*, August 1989.

Ontario Provincial Standard Specifications (OPSS)

OPSS 501	Construction Specification for Compacting.
OPSS 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material.
OPSS.MUNI 1010	Material Specification for Aggregates Base, Subbase, Select Subgrade and Backfill Material.
OPSS.MUNI 1101	Material Specification for Performance Graded Asphalt Cement.
OPSS.MUNI 1151	Material Specification for Superpave and Stone Mastic Asphalt Mixtures.

Ontario Provincial Standard Drawings (OPSD)

OPSD 216.021	Subdrain Pipe and Outlet Details.
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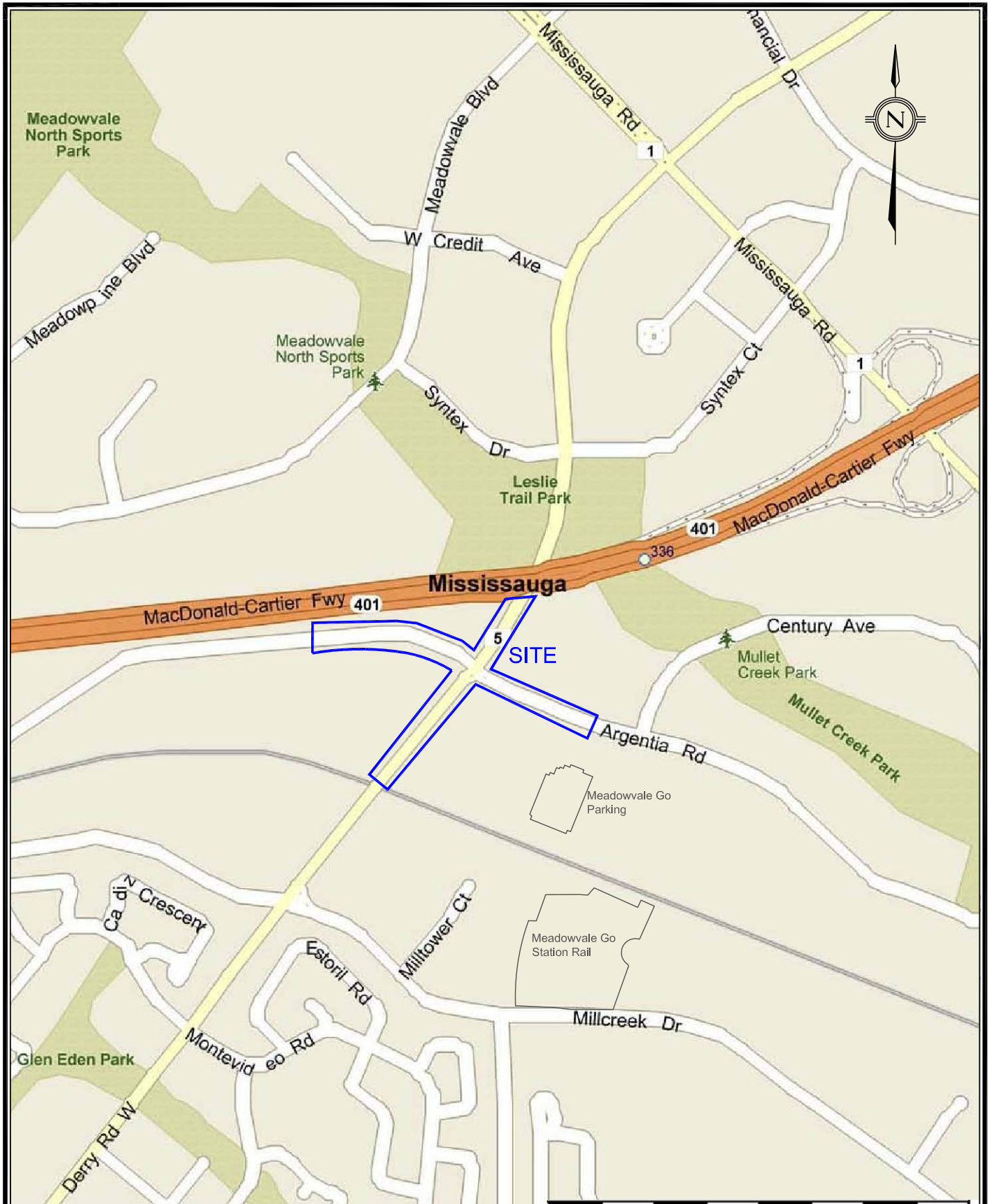
City of Mississauga T & W Standard Drawings

STANDARD No. 2220.010	Standard Pavement and Road Base Design Requirements.
STANDARD No. 2220.020	Standard Frost Suitability of Soils.



FIGURES





REFERENCE
Microsoft Streets & Trips 2011

0 km 0.2 0.4 0.6 0.8



Terraprobe

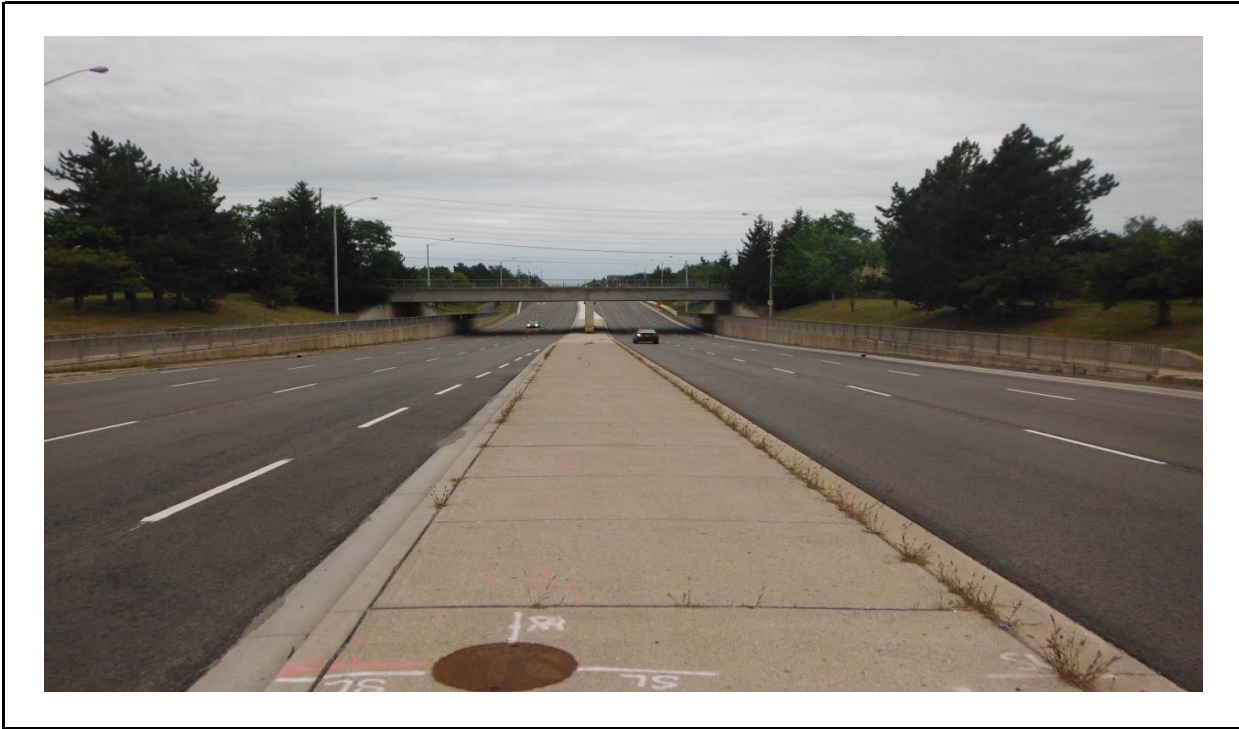
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: DERRY AND ARGENTIA INTERSECTION IMPROVEMENTS
(Site Location Plan)

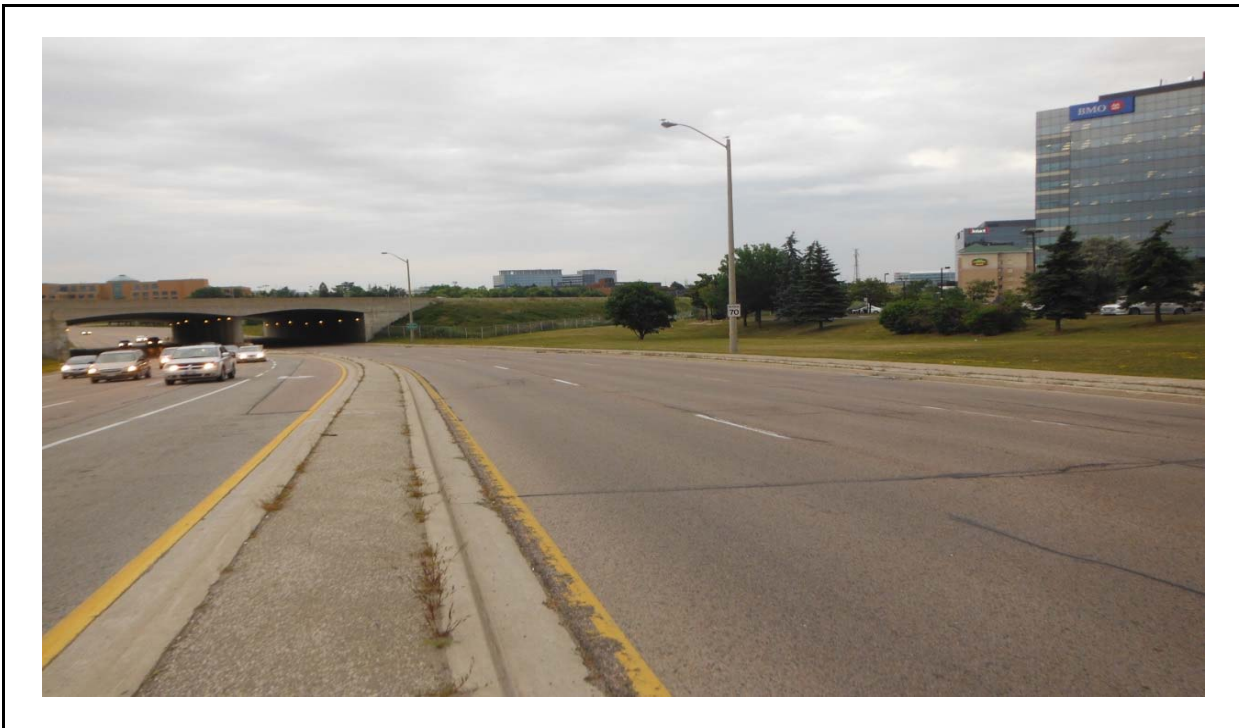
File No. 11-13-3148

FIGURE :
1

Derry and Argentia Roads Intersection Improvements



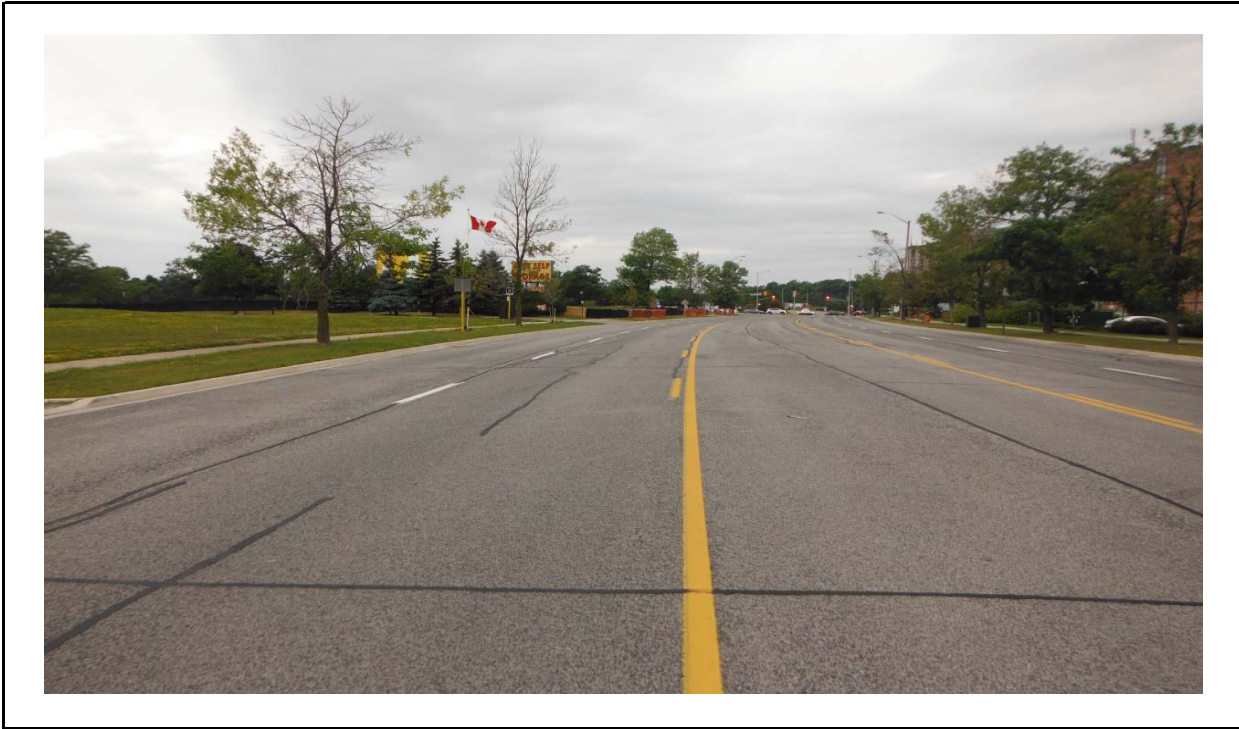
Photograph #1: Derry Road, Sta. 9+800 Approx., looking west



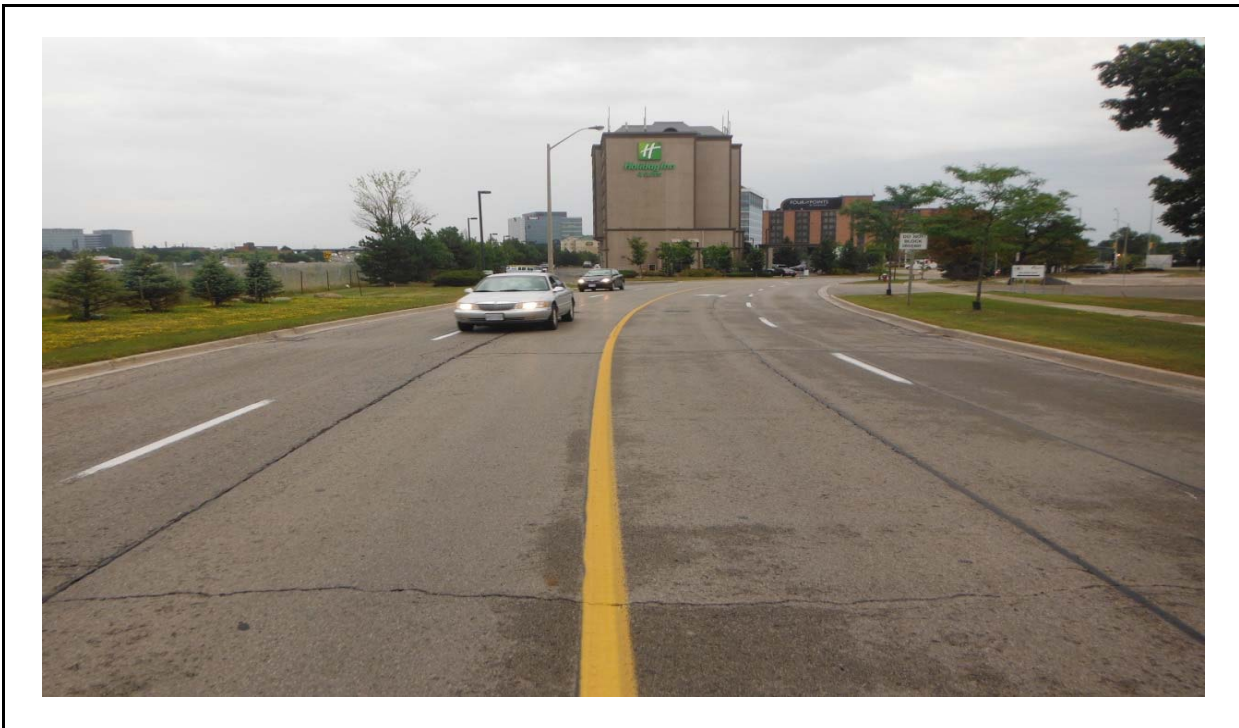
Photograph #2: Derry Road, Sta. 10+050 Approx., looking east



Derry and Argentia Roads Intersection Improvements

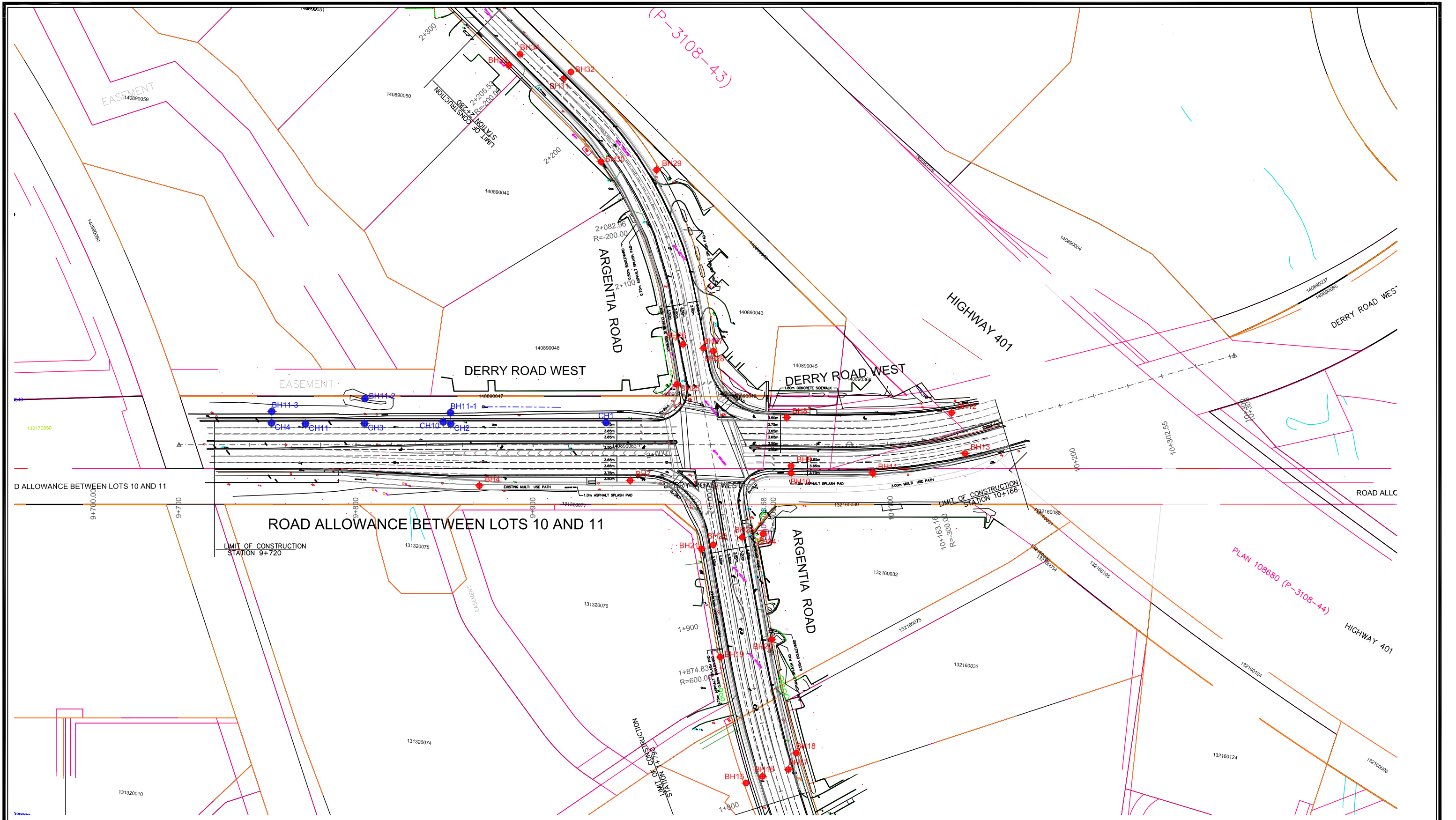


Photograph #3: Argentia Road, at South Limit, looking north



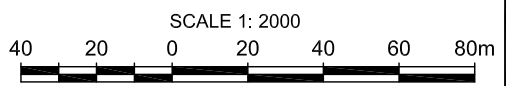
Photograph #4: Argentia Road, at North Limit, looking south





REFERENCE
 Drawings provided in digital format by HDR,
 drawing file xO1C-PL02-Layout with buffer 20140507,
 x 11-4295 property.dwg received by email dated May 8, 2014.

LEGEND
 ● Terraprobe Borehole
 ● SPL Borehole



Terraprobe
 11 Indell Lane, Brampton, Ontario, L6T 3Y3
 Tel: (905) 796-2650 Fax: (905) 796-2250

Title: DERRY AND ARGENTIA INTERSECTION IMPROVEMENTS
 (Borehole Location Plan)
File No. 11-13-3148

FIGURE :
4

APPENDIX A



Terraprobe Borehole and Core Logs





SAMPLING METHODS		PENETRATION RESISTANCE
AS	Auger sample	<p>Standard Penetration Test (SPT) N-value (penetration resistance) is defined as the number of blows required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.) with a hammer weighing 63.5 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.).</p> <p>Dynamic Cone Penetration Test (DCPT) resistance is defined as the number of blows required to advance a conical steel point 50 mm (2 in.) base diameter tapered 60° to the apex and attached to 'A' size drill rods for a distance of 0.3 m (12 in.), with a hammer weighing 63.5 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.).</p>
GS	Grab sample	
SS	Split spoon	
ST	Shelby tube	
WS	Wash sample	
RC SC	Rock core Soil core	

COHESIONLESS SOILS		COHESIVE SOILS		MINOR SOIL CONSTITUENTS		
Relative Density	N-value Blows/0.3m	Consistency	N-value Blows/0.3m	Undrained Shear Strength (kPa)	Modifier (e.g)	% by weight
Very loose	< 5	Very soft	< 2	< 12	<i>trace</i> (trace silt)	< 10
Loose	5 – 10	Soft	2 – 4	12 – 25	<i>some</i> (some silt)	10 – 20
Compact	10 – 30	Firm	4 – 8	25 – 50	(<i>ey</i>) or (<i>y</i>) (sandy)	20 – 35
Dense	30 – 50	Stiff	8 – 15	50 – 100	<i>and</i> (sand and silt)	> 35
Very dense	> 50	Very stiff	15 – 30	100 – 200		
		Hard	> 30	> 200		

TESTS AND SYMBOLS

MH	combined sieve and hydrometer analysis		Unstabilized water level
w,	water content		1 st water level measurement
w _L ,	liquid limit		2 nd water level measurement
w _P ,	plastic limit		Most recent water level measurement
I _P ,	plasticity index		3.0 ₊ Undrained shear strength from field vane (with sensitivity)
k	coefficient of permeability	C _c	compression index (normally consolidated range)
γ	soil unit weight, bulk	C _r	recompression index (overconsolidated range)
G _s	specific gravity	c _v	coefficient of consolidation
φ'	effective angle of internal friction	m _v	coefficient of compressibility (volume change)
c'	effective cohesion	e	void ratio
c _u	undrained shear strength (φ = 0 analysis)		




FIELD MOISTURE DESCRIPTIONS

Dry	refers to a soil sample with a moisture content well below optimum ($w < w_{opt}$), absence of moisture, dusty, dry to the touch.
Moist	refers to a soil sample with a moisture content at or near optimum ($w \approx w_{opt}$), no visible pore water.
Wet	refers to a soil sample with a moisture content well above optimum ($w > w_{opt}$), has visible pore water.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600277, N: 4828231 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	w_p	w			w_L	GR
	GROUND SURFACE 250mm TOPSOIL																	
0.3	FILL , silty sand, trace gravel, brown, damp ...sand and gravel below		1	SS														
0.9	SILTY CLAY , sandy, trace gravel, brown, moist (GLACIAL TILL) ...containing shale fragments, reddish brown below		2A 2B 3	SS														



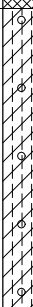
1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600328, N: 4828300 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE 150mm TOPSOIL																	
0.2	FILL , gravelly sand, some silt, brown, damp ...silty clay, moist below		1	SS								○						
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS														
			3	SS									○					




1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600355, N: 4828391 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
GROUND SURFACE																		
	200mm ASPHALTIC CONCRETE																	
0.2	640mm FILL-SAND AND GRAVEL, some silt, dense, brown, damp		1	SS	41													
0.8	SILTY CLAY, some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	23													
			3	SS	72 / 225mm													

1.6 END OF BOREHOLE ...at 1.6m, sampler bouncing /



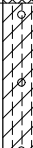
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600378, N: 4828376 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
GROUND SURFACE																
	180mm ASPHALTIC CONCRETE															
0.2	1040mm FILL-GRAVELLY SAND, some silt, compact to dense, brown, damp		1	SS	48											
			2	SS	21											
1.2	SILTY CLAY, some sand, trace gravel, hard, brown, moist (GLACIAL TILL)		3	SS	33											



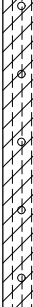
1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600381, N: 4828373 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR



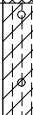
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	w_p	w			w_L	GR
	GROUND SURFACE																	
	150mm CONCRETE SIDEWALK																	
0.2	410mm FILL-SAND AND GRAVEL , some silt, brown, damp		1	SS														
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS														2 17 51 30
1.8	END OF BOREHOLE																	

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600410, N: 4828409 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
GROUND SURFACE																
	140mm CONCRETE SIDEWALK															
	1080mm FILL-GRAVELLY SAND , some silt, containing clay lumps, brown, moist		1	SS												
			2	SS												
1.2	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		3	SS												




1.7 **END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600411, N: 4828466 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers



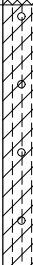
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE																	
	155mm ASPHALTIC CONCRETE																	
0.2	890mm FILL-GRAVELLY SAND , some silt, compact to dense, brown, damp		1	SS	46													
			2A	SS	23													
1.0	SILTY CLAY , some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2B															
			3	SS	32													
1.8	END OF BOREHOLE																	

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600434, N: 4828457 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE																	
	155mm ASPHALTIC CONCRETE																	
0.2	620mm FILL-GRAVELLY SAND , some silt, dense, brown, damp		1	SS	49													
			2A															
0.8	SILTY CLAY , some sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)		2B	SS	13													
			3	SS	26													


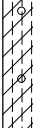
1.8 **END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No.: 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600503, N: 4828244 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR




SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
	GROUND SURFACE															
	150mm TOPSOIL															
0.2	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		1	SS												
			2	SS												

0.9
END OF BOREHOLE
 Unable to drill borehole deeper
 Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No.: 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600505, N: 4828254 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
GROUND SURFACE																		
	180mm ASPHALTIC CONCRETE																	
0.2	620mm FILL-SAND, some silt, trace clay, trace gravel, compact, grey, damp		1	SS	28							○						7 70 (23)
0.8	SILTY CLAY, some sand, trace gravel, stiff to hard, brown, moist (GLACIAL TILL) ...reddish brown below		2	SS	12								○					
			3	SS	74 / 275mm								○					




1.7
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600511, N: 4828268 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
	GROUND SURFACE															
	180mm ASPHALTIC CONCRETE															
0.2	600mm FILL-SAND , some silt, trace clay, trace gravel, dense, grey, damp		1	SS	31											
			2A													
0.8	FILL , silty clay, some sand, trace gravel, containing shale fragments, firm to stiff, reddish brown, moist		2B	SS	11											
			3	SS	4											



1.8 **END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600507, N: 4828277 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	w_p	w			w_L	GR
	GROUND SURFACE																	
	200mm TOPSOIL																	
0.2	FILL , silty clay, some sand, trace gravel, trace rootlets, brown, moist		1	SS														

0.6
END OF BOREHOLE



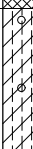

Borehole encountered obstruction at 0.6m and was moved within 2m radius around original location. Borehole was terminated at 0.6m after 3 attempts.

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600438, N: 4828277 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE																	
	150mm TOPSOIL																	
0.2	FILL , silty clay, some sand, trace gravel, brown, moist		1	SS														
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS														
	...containing shale fragments, reddish brown below		3	SS														




1.5 **END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600448, N: 4828306 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
	GROUND SURFACE															
	130mm TOPSOIL															
	FILL , silty sand, trace gravel, brown, damp		1	SS												
			2A													
0.8	FILL , silty clay, some sand, trace gravel, brown, damp		2B	SS												
			3	SS												

no further progress due to obstruction

1.4
END OF BOREHOLE
 Unable to drill borehole deeper





 Borehole was dry and open upon completion of drilling.

library: library - terraprobe gint.gdb report: mto-terraprobe soil (for non-mto jobs). file: 11-13-3148 bh logs.gpj

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600383, N: 4828307 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE 250mm TOPSOIL																	
0.3	FILL , silty clay, some sand, trace gravel, brown, moist		1	SS														
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS														
			3	SS														




1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600386, N: 4828314 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
	GROUND SURFACE															
	150mm ASPHALTIC CONCRETE															
0.2	560mm FILL-SAND , some silt, trace clay, trace gravel, compact, grey, damp		1	SS	23											
0.7	SILTY CLAY , some sand, trace gravel, stiff, brown, moist (GLACIAL TILL) ...containing shale fragments, hard, reddish brown below		2	SS	10											
			3	SS	99 / 225mm											





1.6 **END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600393, N: 4828329 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE																	
	180mm ASPHALTIC CONCRETE																	
0.2	570mm FILL-SAND , some silt, trace clay, trace gravel, compact, grey, damp		1	SS	14													
			2A															
0.8	SILTY CLAY , some sand, trace gravel, stiff, brown, moist (GLACIAL TILL)		2B	SS	11													
			3	SS	15													
1.8	...containing shale fragments, reddish brown below																	



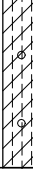
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600398, N: 4828340 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE 230mm TOPSOIL																	
0.2	FILL , silty clay, some sand, trace gravel, reddish brown, moist ...sand below		1	SS														
			2A	SS														
1.1	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2B															
			3	SS														




1.8 **END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600302, N: 4828354 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)					W _p	w	W _L		
	GROUND SURFACE 150mm TOPSOIL																
0.2	FILL , silty clay, some sand, trace gravel, brown, moist		1	SS													
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS													




1.1 **END OF BOREHOLE**
 Unable to drill borehole deeper

 Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600286, N: 4828371 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			20	40	60	80	100	W _p	w	W _L			GR
	GROUND SURFACE																	
	140mm ASPHALTIC CONCRETE																	
0.2	430mm FILL-GRAVELLY SAND , some silt, compact, brown, damp		1	SS	17													
0.6	SILTY CLAY , some sand, trace gravel, containing shale fragments, hard, reddish brown, moist (GLACIAL TILL)		2	SS	77													
			3	SS	65													



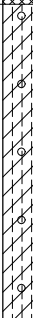
1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600295, N: 4828379 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers




SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
GROUND SURFACE																
	140mm ASPHALTIC CONCRETE															
0.2	410mm FILL-GRAVELLY SAND, some silt, compact, brown, damp		1A	SS	17											
0.5	SILTY CLAY, some sand, trace gravel, hard, brown, moist (GLACIAL TILL) ...containing shale fragments, reddish brown below		1B 2 3	SS SS SS	 55 59											

1.8
END OF BOREHOLE
 Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600300, N: 4828382 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	w_p	w			w_L	GR
	GROUND SURFACE																	
	230mm TOPSOIL																	
0.2	FILL , silty clay, some sand, trace gravel, reddish brown, moist		1	SS														
			2A															
0.9	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL) ...containing shale fragments, reddish brown below		2B	SS														
			3	SS														

1.5

END OF BOREHOLE




Unable to drill borehole deeper

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No.: 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600200, N: 4828421 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)					W _p	w	W _L		
	GROUND SURFACE 150mm TOPSOIL																
0.2	FILL , silty clay, some sand, trace gravel, trace rootlets, brown, moist		1	SS													
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS													





1.1 **END OF BOREHOLE**
 Unable to drill borehole deeper

 Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No.: 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600177, N: 4828399 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
	GROUND SURFACE 230mm TOPSOIL																	
0.2	FILL , silty clay, some sand, trace gravel, trace rootlets, brown, moist		1	SS								○						
0.6	SILTY CLAY , some sand to sandy, trace gravel, brown, moist (GLACIAL TILL)		2	SS														
			3	SS									○					0 22 53 25




1.7
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600127, N: 4828412 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w			W _L	GR
GROUND SURFACE																		
	120mm ASPHALTIC CONCRETE																	
	600mm FILL-GRAVELLY SAND , some silt, compact, brown, damp		1	SS	21													31 56 (13)
0.7	SILTY CLAY , some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	22													
			3	SS	45													




1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 0204
 Sheet No. : 1 of 1

Position : E: 600127, N: 4828417 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
	GROUND SURFACE 280mm TOPSOIL															
0.3	FILL , silty clay, some sand, trace gravel, trace rootlets, brown, moist		1	SS												
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS												




1.1
END OF BOREHOLE
 Unable to drill borehole deeper

 Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

Project No. : 11-13-3148
 Date started : June 9, 2014
 Sheet No. : 1 of 1

Position : E: 600102, N: 4828392 (UTM 17T) Elevation Datum : N/A
 Rig type : PIONJAR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
	GROUND SURFACE 230mm TOPSOIL															
0.2	FILL , silty clay, some sand, trace gravel, trace rootlets, brown, moist		1	SS												
0.6	SILTY CLAY , some sand, trace gravel, brown, moist (GLACIAL TILL)		2	SS												





1.1
END OF BOREHOLE
 Unable to drill borehole deeper

 Borehole was dry and open upon completion of drilling.

Client : HDR Corporation
 Project : Derry / Argentia Intersection Improvements
 Location : Mississauga, Ontario

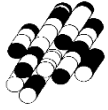
Project No. : 11-13-3148
 Date started : June 6, 2014
 Sheet No. : 1 of 1

Position : E: 600101, N: 4828401 (UTM 17T) Elevation Datum : N/A
 Rig type : CME 75, truck-mounted Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			SPT 'N' VALUE	20	40	60	80	100	W _p	w		
GROUND SURFACE																
	150mm ASPHALTIC CONCRETE															
0.2	650mm FILL-SAND AND GRAVEL, some silt, brown, damp		1	SS	19											
			2A													
0.8	FILL, silty clay, some sand, trace gravel, trace organics, stiff, brown, moist		2B	SS	10											
1.2	SILTY CLAY, some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		3	SS	22											

1.8
END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



Borehole #8	
Type	Core (mm)
HL3	85
HL3	50
HL8	65
Total	200

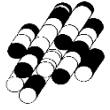


Borehole #13	
Type	Core (mm)
HL3	45
HL8	60
HL8	50
Total	155



Borehole #16	
Type	Core (mm)
DFC	65
HL8	45
Total	110

70mm of core lost during coring operation



Terraprobe

Core Photographs

**Derry / Argentia Intersection Improvements
11-13-3148**



Borehole #31

Type Core (mm)

HL3	70
HL8	50
Total	120

SPL Borehole and Core Logs



LOG OF BOREHOLE BH11-1

PROJECT: Geotechnical Investigation - Derry Road and Millcreek Drive
 CLIENT: ROP
 PROJECT LOCATION: Mississauga
 DATUM: Geodetic
 BH LOCATION: See Borehole Location Plan

DRILLING DATA
 Method: Solid Stem Augers
 Diameter: 115mm
 Date: Jan/16/2012
 REF. NO.: 592-1078
 ENCL NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (Mg/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80	100				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L
187.4																		
187.9	Topsoil: 75mm																	
0.1	FILL: sandy clayey silt, mixed with topsoil, trace rootlets, brown to dark brown, moist, compact		1	SS	12							○						3 31 46 20
186.5																		
0.9	CLAYEY SILT: reddish brown, moist, stiff to hard		2	SS	10							○						
185.3																		
2.1	SHALE: light grey																	
185.1			4	SS	50/													
2.3	END OF BOREHOLE Notes: 1) Spoon refusal on bedrock at 2.3m. 2) Borehole dry and open upon completion.																	

SPL SOIL LOG 592-1078.GPJ SPL.GDT 19/3/12

GROUNDWATER ELEVATIONS

Shallow/ Single Installation ▽ ▽ Deep/Dual Installation ▽ ▽

GRAPH NOTES

+³, ×³: Numbers refer to Sensitivity

○ ●=3% Strain at Failure

LOG OF BOREHOLE BH11-2

PROJECT: Geotechnical Investigation - Derry Road and Millcreek Drive
 CLIENT: ROP
 PROJECT LOCATION: Mississauga
 DATUM: Geodetic
 BH LOCATION: See Borehole Location Plan

DRILLING DATA
 Method: Solid Stem Augers
 Diameter: 115mm
 Date: Jan/16/2012
 REF. NO.: 592-1078
 ENCL NO.: 3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (Mg/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							PLASTIC LIMIT
							20	40	60	80	100	W _p	w	W _L	GR SA SI CL
186.7															
186.6	Topsoil: 75mm														
0.1	FILL: clayey silt to silty clay, trace rootlets, reddish brown, moist, compact		1	SS	13										
			2	SS	19										
			3	SS	19										
	decayed wood pieces at 2.4m		4	SS	14										
			5	SS	11										
	organics at 3.5 m														
183.0															
3.7	END OF BOREHOLE Notes: 1) Borehole dry and open upon completion.														

SPL SOIL LOG 592-1078.GPJ SPL.GDT 19/3/12

GROUNDWATER ELEVATIONS

Shallow/ Single Installation ▽ ▽ ▽ Deep/Dual Installation ▽ ▽ ▽

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

LOG OF BOREHOLE BH11-3

PROJECT: Geotechnical Investigation - Derry Road and Millcreek Drive	DRILLING DATA
CLIENT: ROP	Method: Solid Stem Augers
PROJECT LOCATION: Mississauga	Diameter: 115mm
DATUM: Geodetic	Date: Jan/13/2012
BH LOCATION: See Borehole Location Plan	REF. NO.: 592-1078
	ENCL NO.: 4

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (Mg/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40						
185.2															
0.0	FILL: sand and gravel over 50mm thick brick, brown, moist, compact														
184.9			1	SS	13										
0.3	CLAYEY SILT: reddish brown, moist, stiff to hard														
			2	SS	50/ 100mm										
183.9															
183.8	SHALE: light grey		3	SS	50/ 50mm										
1.4	END OF BOREHOLE Notes: 1) Spoon refusal on bedrock at 1.4m. 2) Borehole dry and open upon completion.														

SPL SOIL LOG 592-1078.GPJ SPL.GDT 19/3/12

GROUNDWATER ELEVATIONS **GRAPH NOTES** + 3, × 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

Shallow/Single Installation ▽ ▽ Deep/Dual Installation ▽ ▽

ASPHALT CORE PHOTOGRAPHS AND DESCRIPTIONS

Derry Rd & Millcreek Dr. Mississauga



CORE NO.: 1

LOCATION:

DESCRIPTION:

Good bond between lift 1 and lift 2

LIFT THICKNESSES:

Lift 1: 30 mm

Lift 2: 89 mm

AVERAGE THICKNESS:

119 mm



CORE NO.: 2

LOCATION:

DESCRIPTION:

Good bond between lift 1 and lift 2

LIFT THICKNESSES:

Lift 1: 30 mm

Lift 2: 89 mm

AVERAGE THICKNESS:

119 mm

ASPHALT CORE PHOTOGRAPHS AND DESCRIPTIONS

Derry Rd & Millcreek Dr. Mississauga



CORE NO.: 3

LOCATION:

DESCRIPTION:

Good bond between lift 1 and lift 2

LIFT THICKNESSES:

Lift 1: 25 mm

Lift 2: 100 mm

AVERAGE THICKNESS:

125 mm



CORE NO.: 4

LOCATION:

DESCRIPTION:

Good bond between lift 1 and lift 2

LIFT THICKNESSES:

Lift 1: 20 mm

Lift 2: 99 mm

AVERAGE THICKNESS:

119 mm

ASPHALT CORE PHOTOGRAPHS AND DESCRIPTIONS

Derry Rd & Millcreek Dr. Mississauga



CORE NO.: 9

LOCATION:

DESCRIPTION:

Good bond between lift 1 and lift 2

LIFT THICKNESSES:

Lift 1: 30 mm

Lift 2: 76 mm

AVERAGE THICKNESS:

106 mm



CORE NO.: 10

LOCATION:

DESCRIPTION:

1 lift

LIFT THICKNESSES:

Lift 1: 75 mm

AVERAGE THICKNESS:

75 mm

ASPHALT CORE PHOTOGRAPHS AND DESCRIPTIONS

Derry Rd & Millcreek Dr. Mississauga



CORE NO.: 11

LOCATION:

DESCRIPTION:
1 lift (Concrete)

LIFT THICKNESSES:
Lift 1: 138 mm

AVERAGE THICKNESS:
138 mm

CH-11



CORE NO.: 12

LOCATION:

DESCRIPTION:
1 lift (Concrete)

LIFT THICKNESSES:
Lift 1: 150 mm

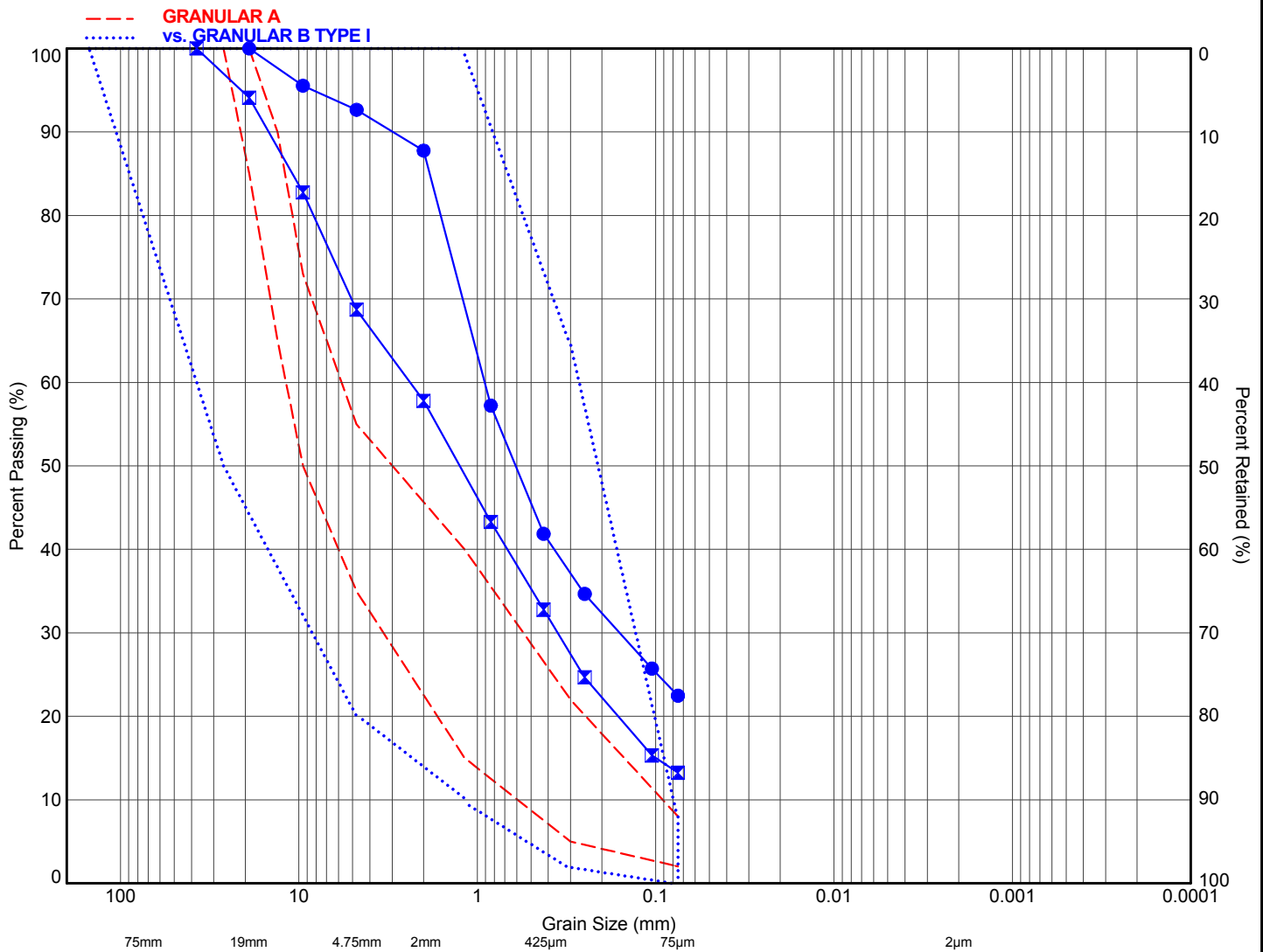
AVERAGE THICKNESS:
150 mm

CH-12

APPENDIX B

Laboratory Test Results





MITO	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)
● 16	SS1	0.4		7	70			(23)
■ 31	SS1	0.4		31	56			(13)



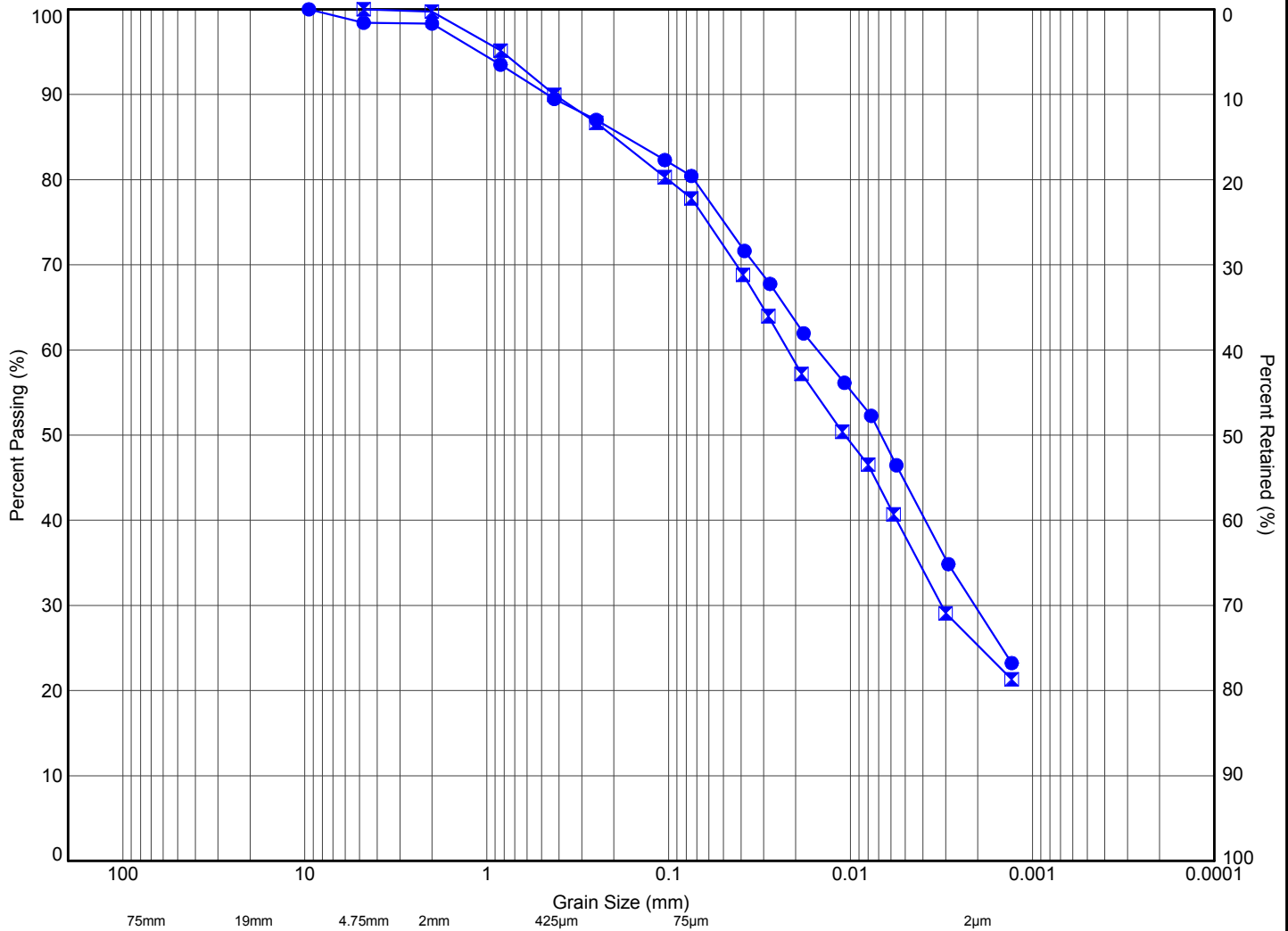
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**DERRY / ARGENTIA INTERSECTION IMPROVEMENTS
FIGURE B1 W / GRANULAR B TYPE 1 SPEC VS GRANULAR A SPEC**

File No.:

11-13-3148



MTO	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)
● 10	SS2	0.9		2	17	51	30	
■ 30	SS3	1.4		0	22	53	25	



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**DERRY / ARGENTIA INTERSECTION IMPROVEMENTS
FIGURE B2 - SILTY CLAY TILL**

File No.:

11-13-3148

APPENDIX C

Flexible Pavement Condition Evaluation Forms



APPENDIX D
Certificate of Chemical Analysis (Soil Chemistry)





CLIENT NAME: TERRAPROBE INC.
11 INDELL LANE
BRAMPTON, ON L6T3Y3
(905) 796-2650

ATTENTION TO: Hussein Ahmed

PROJECT: 11-13-3148

AGAT WORK ORDER: 14T852410

SOIL ANALYSIS REVIEWED BY: Sofka Pehlyova, Senior Analyst

DATE REPORTED: Jun 20, 2014

PAGES (INCLUDING COVER): 5

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.



Certificate of Analysis

AGAT WORK ORDER: 14T852410

PROJECT: 11-13-3148

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Hussein Ahmed

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

DATE RECEIVED: 2014-06-16

DATE REPORTED: 2014-06-20

Parameter	Unit	SAMPLE DESCRIPTION:		BH17/SS2B	BH25/SS1
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		6/13/2014	6/13/2014
		G / S	RDL	5481141	5481159
Antimony	µg/g	1	0.8	<0.8	<0.8
Arsenic	µg/g	11	1	6	6
Barium	µg/g	210	2	80	78
Beryllium	µg/g	2.5	0.5	0.6	0.7
Boron	µg/g	36	5	14	9
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.28	0.19
Cadmium	µg/g	1	0.5	<0.5	<0.5
Chromium	µg/g	67	2	21	19
Cobalt	µg/g	19	0.5	12.0	10.6
Copper	µg/g	62	1	20	23
Lead	µg/g	45	1	10	10
Molybdenum	µg/g	2	0.5	0.8	<0.5
Nickel	µg/g	37	1	26	23
Selenium	µg/g	1.2	0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4
Uranium	µg/g	1.9	0.5	0.5	<0.5
Vanadium	µg/g	86	1	27	26
Zinc	µg/g	290	5	60	58
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	0.16	0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.47	0.005	2.35	0.146
Sodium Adsorption Ratio (2:1)	NA	1	NA	50.3	0.630
pH, 2:1 CaCl ₂ Extraction	pH Units			8.12	7.74

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard; Refers to T1(AG) - Current
5481141-5481159 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:

Sofra Pehlyora



Guideline Violation

AGAT WORK ORDER: 14T852410

PROJECT: 11-13-3148

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Hussein Ahmed

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
5481141	BH17/SS2B	T1(AG) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.47	2.35
5481141	BH17/SS2B	T1(AG) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1)	1	50.3

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 14T852410

PROJECT: 11-13-3148

ATTENTION TO: Hussein Ahmed

Soil Analysis																
RPT Date: Jun 20, 2014			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits		
								Lower	Upper		Lower	Upper		Lower	Upper	
O. Reg. 153(511) - Metals & Inorganics (Soil)																
Antimony	1		< 0.8	< 0.8	0.0%	< 0.8	106%	70%	130%	98%	80%	120%	98%	70%	130%	
Arsenic	1		4	4	0.0%	< 1	114%	70%	130%	101%	80%	120%	102%	70%	130%	
Barium	1		117	118	0.9%	< 2	97%	70%	130%	87%	80%	120%	89%	70%	130%	
Beryllium	1		0.7	0.8	13.3%	< 0.5	102%	70%	130%	104%	80%	120%	94%	70%	130%	
Boron	1		7	7	0.0%	< 5	80%	70%	130%	106%	80%	120%	96%	70%	130%	
Boron (Hot Water Soluble)	5481141	5481141	0.28	0.28	0.0%	< 0.10	112%	60%	140%	103%	70%	130%	95%	60%	140%	
Cadmium	1		< 0.5	< 0.5	0.0%	< 0.5	89%	70%	130%	104%	80%	120%	101%	70%	130%	
Chromium	1		22	22	0.0%	< 2	94%	70%	130%	98%	80%	120%	101%	70%	130%	
Cobalt	1		10.6	10.6	0.0%	< 0.5	95%	70%	130%	98%	80%	120%	93%	70%	130%	
Copper	1		18	17	5.7%	< 1	103%	70%	130%	104%	80%	120%	93%	70%	130%	
Lead	1		15	14	6.9%	< 1	97%	70%	130%	96%	80%	120%	91%	70%	130%	
Molybdenum	1		0.5	0.5	0.0%	< 0.5	114%	70%	130%	104%	80%	120%	108%	70%	130%	
Nickel	1		20	20	0.0%	< 1	106%	70%	130%	104%	80%	120%	97%	70%	130%	
Selenium	1		0.4	0.5	22.2%	< 0.4	99%	70%	130%	101%	80%	120%	101%	70%	130%	
Silver	1		< 0.2	< 0.2	0.0%	< 0.2	107%	70%	130%	114%	80%	120%	111%	70%	130%	
Thallium	1		< 0.4	< 0.4	0.0%	< 0.4	105%	70%	130%	108%	80%	120%	99%	70%	130%	
Uranium	1		0.6	0.6	0.0%	< 0.5	92%	70%	130%	98%	80%	120%	98%	70%	130%	
Vanadium	1		31	31	0.0%	< 1	92%	70%	130%	96%	80%	120%	95%	70%	130%	
Zinc	1		71	70	1.4%	< 5	98%	70%	130%	101%	80%	120%	91%	70%	130%	
Chromium VI	1		< 0.2	< 0.2	0.0%	< 0.2	97%	70%	130%	94%	80%	120%	100%	70%	130%	
Cyanide	1		< 0.040	< 0.040	0.0%	< 0.040	100%	70%	130%	99%	80%	120%	109%	70%	130%	
Mercury	1		< 0.10	< 0.10	0.0%	< 0.10	114%	70%	130%	97%	80%	120%	95%	70%	130%	
Electrical Conductivity (2:1)	1		0.137	0.139	1.4%	< 0.005	101%	90%	110%	NA			NA			
Sodium Adsorption Ratio (2:1)	1		15.5	15.4	0.6%	NA	NA			NA			NA			
pH, 2:1 CaCl2 Extraction	1		7.30	7.34	0.5%	NA	100%	80%	120%	NA			NA			

Comments: NA signifies Not Applicable.


 Certified By: _____

Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 14T852410

PROJECT: 11-13-3148

ATTENTION TO: Hussein Ahmed

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
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 (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio (2:1)	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl ₂ Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER