HYDROGEOLOGIC & HYDROLOGIC ASSESSMENT REPORT CLARINGTON TRANSFORMER STATION

Prepared for:
Hydro One Networks Inc.
483 Bay Street
South Tower, 4th Floor
Toronto, ON M5G 2P5

Prepared by:
Stantec Consulting Ltd.
300 – 675 Cochrane Drive
Markham, ON L3R 0B8

Project No.:160900764

March 10, 2014

Sign-off Sheet

This document entitled HYDROGEOLOGIC & HYDROLOGIC ASSESSMENT REPORT CLARINGTON TRANSFORMER STATION was prepared by Stantec Consulting Ltd. for the account of Hydro One Networks Inc. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

HYDROGEOLOGICAL COMPONENTS

Prepared by  original signed and stamped
(signature)

Angela Ducharme, B.Sc., EPt
Environmental Scientist

Reviewed by  original signed and stamped
(signature)

Lesley Veale, M.Sc., P.Geo
Hydrogeologist

Reviewed by  original signed and stamped
(signature)

J. Brant Gill, H.B.Sc., P.Geo.
Senior Hydrogeologist

HYDROLOGIC COMPONENTS

Prepared by  original signed and stamped
(signature)

Trevor Fraser, B.Eng.
Water Resources EIT

Reviewed by  original signed and stamped
(signature)

Scott Robertson, P.Eng.
Associate, Water Resources Project Manager

Stantec

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

LIST OF FIGURES

1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by Hydro One Networks Inc. (Hydro One) to complete a hydrogeologic and hydrologic assessment related to the development of the 500-230 kV Clarington auto-transformer Station on the Hydro One property ('*Project Area*') located in the Regional Municipality of Durham, in the Municipality of Clarington, on Part Lots 33, 34, and 35, Concession Road #7. The *Project Area* and the extents of the transformer station itself, hereinafter referred to as the '*Site*', are shown on Figures 1 and 2 in Appendix A.

This hydrogeologic and hydrologic assessment involved a review and consolidation of available literature and technical information for the *Project Area* that was collected during the Class EA process; including three (3) geotechnical investigations completed within the *Project Area*. This report also addresses the request by the Central Lake Ontario Conservation Authority (CLOCA) for a consolidated hydrogeologic and hydrologic assessment report of the *Project Area*.

Some of the information presented in this Hydrogeologic and Hydrologic Assessment Report has been summarized and included in the Project's Class EA Environmental Study Report (ESR) that was filed with the MOE in January 2014.

1.1 PROJECT AREA

The Project Area comprises a total area of approximately 63 ha, which includes the smaller limits of the 'Site'. The *Site* encompasses approximately 17 ha within which grading will occur and drainage infrastructure and transformers will be installed, and is entirely located within the *Project Area* (Appendix A, Figure 2).

The extent of the area considered in this assessment includes the *Project Area* described above, and relies on the reports of detailed geotechnical investigations completed within the limits of the *Project Area*. However, because of the regional scale of some of the natural environment features that are identified within and in relative proximity to the *Project Area*, this assessment considers the form and function of these specific key regional features as well. As a result, the natural environment features discussed throughout this report are of both regional and local importance, as they specifically relate to the hydrogeology and hydrology of the *Project Area*. As such, fixed boundaries defining the lateral limits of this assessment are not shown on any figures appended to this report.

1.2 OBJECTIVES

The objective of the following hydrogeologic and hydrologic assessment report prepared by Stantec is to with the following key objectives:

1. Compile the hydrogeologic and hydrologic data collected during the Class EA process, as requested by CLOCA;
2. Provide a technical summary of current geologic/hydrogeologic and hydrologic conditions across the Project Area and related surroundings that were established during the Class EA process; and,
3. Summarize previous assessments, based on the available information assessed, regarding whether the natural function of hydrogeologic and hydrologic features within the *Project Area* would be adversely impacted by the development, and assess potential adverse impacts to human and natural environment receptors. In the event that adverse impacts are anticipated, recommend mitigative strategies.

1.3 REPORT FORMAT

The following report is arranged into six (6) sections, including this introduction. Section 2 provides a description of geologic, hydrogeologic, and hydrologic conditions that characterize the *Project Area* and the *Site*, with Section 3 presenting the *Site* development activities and an assessment of potential hydrogeologic and hydrologic impacts. Section 4 presents the recommended groundwater and surface water monitoring program. Section 5 provides the conclusions and recommendations of the report, while Section 6 provides a list of references. All figures referenced in this report are presented in Appendix A. Borehole Logs and nearby Ministry of the Environment (MOE) Water Well Records (WWR) are presented in Appendices B and C, respectively. Supporting information related to hydrologic analyses is included within Appendix D.

2.0 Setting

2.1 GENERAL ENVIRONMENTAL FEATURES

The Project Area falls within the planning area of the Region of Durham and the Municipality of Clarington, Part Lots 33, 34 and 35, Concession 7 (Figure 2). The upper tier regional plan identifies the *Project Area* as Countryside Area, and Natural Linkage Area and Natural Heritage Systems as per the Oak Ridges Moraine Conservation Plan (ORMCP) (Ministry of Municipal Affairs and Housing (MMAH), 2002) and Greenbelt Plan (MMAH, 2005) and also designates the *Project Area* as Prime Agricultural land.

Land throughout the *Project Area* is hilly but generally slopes from north to south. Within the *Project Area*, land predominantly slopes from northeast to southwest, directing surface runoff toward the watercourses at the western and southern portions of the Project Area. Ground surface elevation within the *Project Area* ranges from 235 m above mean sea level (AMSL) to 270 m AMSL.

2.2 PHYSIOGRAPHY

On a regional scale, the *Project Area* is occupied by the physiographic region defined by Chapman and Putnam (1984) as the South Slope, characterized by till plains with long, thin drumlins pointing upslope. The core of the Oak Ridges Moraine physiographic region is located approximately 6 km to the north of the *Project Area*. Recent planning mapping and land use characterization indicates that the *Project Area* is located within the southern edge of the of the Oak Ridges Moraine administrative planning boundary (Figure 1). In the vicinity of the *Project Area*, the Oak Ridges Moraine administrative planning boundary is delineated approximately by the 245 m elevation contour interval, rather than by site-specific geologic or hydrogeologic characteristics.

2.2.1 Oak Ridges Moraine

The Oak Ridges Moraine is a terminal moraine composed mainly of sands and gravels, with till layers present throughout the moraine. The Oak Ridges Moraine covers an area of 1,900 km^2 and extends from approximately Caledon, Ontario to north of Cobourg, Ontario and forms a regional topographic high. The Oak Ridges Moraine consists of quaternary deposits up to 200 m thick, grouped into the following five (5) general classifications as generally described by Geological Survey of Canada (2001) and presented from oldest to youngest:

- Lower Deposits which directly overly the bedrock and consist of interbedded layers of sand, silt, clay and till material. These deposits include the Thorncliffe Formation, Sunnybrook/Port Hope Till, Scarborough Formation, Don Formation, York Till and lower sediments;
- Newmarket Till described as a sandy till with some gravel extending up to 50 m in thickness;

- A regional unconformity that forms the upper drumlinized and channelized surface of the Newmarket Till. Tunnel channels oriented in a north–northeast to south-southwest direction extend through the Newmarket Till and may extend to the bedrock. The channels may be 10's of km long, < 4 km wide and up to 150 m deep. The channels primarily contain sandy sediments related to the Oak Ridges Moraine sediment but may also contain gravel material;
- Oakridge's Moraine Sediments described as interbedded silt and fine sand with local sandy gravel material; and,
- Halton Till or Kettleby Till overly portions of the Oak Ridge's Moraine and are predominantly composed of clayey silt to silt till with interbedded sand and silt material.

Groundwater recharge occurs within the surficial sand and gravel deposits of the Oakridge's Moraine Sediments and is discharged within seeps and springs toward the lower slopes of the moraine.

An interpretive schematic of the Oak Ridges Moraine is presented on Figure 3. As shown on the figure, the core of the moraine is largely the result of glaciofluvial deposition; the flanks of the moraine reflect glaciolacustrine sedimentation and till deposits. The *Project Area* is located on the southern extent of the moraine as shown on Figure 4. As previously discussed, the *Project Area* is located within the Oak Ridges Moraine administrative planning boundary; however, the Project Area is approximately 5 km south of where Oak Ridge's Moraine Sediments are exposed at ground surface, and approximately 6 km south of the core deposits.

2.3 GEOLOGY / HYDROGEOLOGY

The following sections detail the geology and hydrogeology within both the study area and the *Project Area*.

2.3.1 Bedrock

The bedrock underlying the *Project Area* consists of the Upper Ordovician Blue Mountain Formation (OGS, 1991) composed of blue grey non-calcareous shales. The top of bedrock occurs at an elevation of 60 m to 70 m AMSL at the Lake Ontario shoreline to 150 m AMSL at the topographic highs of the Oak Ridges Moraine (Singer et al., 2003). As previous stated, ground surface elevation within the *Project Area* ranges from 235 m AMSL to 270 m AMSL and bedrock will not be a factor for the development.

2.3.2 Surficial Geology

Surficial geology mapping, shown in Figures 4 and 5, presents the regional-scale surficial geology with respect to the Oak Ridges Moraine as well as the local-scale surficial geology within the *Project Area*, respectively.

The regional surficial geology mapping indicates that the coarse sand and gravel material associated with the core groundwater recharge zone within the Oak Ridges Moraine is located approximately 6 km north of the *Project Area* (Figure 4). The *Project Area* is located along the southern flank of the Oak Ridges Moraine, with surficial deposits primarily mapped as Newmarket Till, a silty to sandy till (Figure 5). Intermittent deposits of Halton Till, a silty to clayey till, were noted within the *Project Area* as well as modern alluvial deposits associated with local watercourses.

2.3.3 Overburden Stratigraphy

A review of nearby MOE WWR in the local study area (Figure 2) indicated that the overburden is primarily reported as stony clay material extending from near surface up to 104 m below ground surface (BGS) (160 m AMSL). Bedrock was not encountered at any of the nearby MOE WWR locations. MOE WWR indicated intermittent water-bearing sand and gravel lenses at various depths within the overburden, with the lenses ranging between 0.3 m and 5.8 m thick.

As previously stated, the topography within the *Project Area* is hilly. For ease of evaluation and comparison of MOE WWR data, the water level and stratigraphic data are presented as elevation (m AMSL) to account for changes in topography. When appropriate for discussion, the data are also presented as depth (m BGS).

There are twenty (20) MOE WWR located within 500 m of the *Project Area* installed to total depths of between 5.2 m and 108 m BGS. For ease of discussion in the report, the wells are grouped together based on depth. This grouping is for discussion purposes only, and is not interpreted to be representative of specific aquifers, but rather wells that are completed within sandy material at similar elevations. The noted well groups are as follows:

- Three (3) shallow wells completed at total elevations of 241 m AMSL to 248 m AMSL (depths of 5 m BGS to 14 m BGS). These wells are interpreted to be installed within discrete intermittent sand and gravel lenses up to 0.6 m thick with no significant continuous aquifer noted. These wells include MOE Well Record Nos. 1909285 and 1904535, located to the northeast of the *Project Area;* and Well No. 7128981, located south of the *Project Area* (Figure 2). The reported well installation details were as follows:
  - Well No. 1909285 – Clay to sandy clay material to 13.7 m BGS underlain by sand to 14.3 m BGS (246.1 m AMSL);
  - Well No. 1904535 – Stoney clay material to 5.2 m BGS (245.4 m AMSL) with a gravel lens at 2.4 to 2.7 m BGS; and,
  - Well No. 7128981 – Sandy clay, silt and silty clay to 11.4 m BGS (240.5 m AMSL).
- Eight (8) intermediate wells completed at total elevations of 204 m AMSL to 226 m AMSL (depths of 8 m BGS to 22 m BGS). The overburden material was primarily described as clayey material overlying a screened aquifer material. The aquifer material is interpreted as a discrete intermittent sand and gravel lens(es), with no significant continuous intermediate aquifer noted across the *Project Area*; and,

- Nine (9) deep wells completed at total elevations of 160 m AMSL to 189 m AMSL (depths of 49 m BGS to 108 m BGS). The overburden was primarily described as clayey material overlying the screened aquifer material. The available water well records in the area are not adequate to confirm the presence of a continuous aquifer; however, based on regional interpretation, these deep wells may be intersecting the upper portion of the Thorncliffe Formation.

Cross Section A-A' (Figure 6) presents the interpreted overburden stratigraphy across the *Project Area;* indicating the predominant till or aquitard material throughout the majority of the overburden, with intermittent sand and gravel deposits at various depths. The locations of nearby private wells are also shown on the cross-section; including examples of nearby off-site shallow, intermediate, and deep private wells.

Reports of geotechnical investigations completed within the *Project Area* to further characterize the shallow stratigraphy were reviewed, including Geo-Canada Ltd. (2007), exp (2012), and Inspec-Sol (2013). These geotechnical investigations included drilling numerous boreholes and installing four (4) monitoring wells across the *Project Area*. The geotechnical borehole and monitoring well locations are shown on Figure 2.

In 2007, Geo-Canada Ltd. completed a geotechnical investigation within the general *Project Area*. The report indicated that the overburden material within the northeast portion of the *development area* was characterized by 5.5 m of sandy silt till, overlying 2.8 m of very dense, saturated silty fine sand/fine sandy silt, followed by 5.7 m of sandy silt till to the depth of the borehole (Stantec, 2008).

More recently, geotechnical boreholes and monitoring wells were completed throughout the *Project Area* to document shallow overburden conditions (exp, 2012; Inspec-Sol, 2013). A total of twenty-nine (29) boreholes were advanced within the *Project Area* to depths between 11 m BGS and 16 m BGS, with total depths ranging in elevation from 228 m AMSL to 245 m AMSL. A total of four (4) boreholes were completed as monitoring wells, including BH7A, BH2-12, BH4-12 and BH11-12 (Figure 2). Borehole logs indicate sandy silt till as the dominant stratigraphic unit across the *Project Area* within the depth of investigation, with occasional intermittent lenses of silty sand material, typically between 0.5 m and 3 m thick.

The borehole logs were consistent with conditions presented by MOE WWR and Ontario Geological Survey (OGS) mapping. The interpreted shallow stratigraphy within the *Project Area* is shown in the cross sections presented on Figures 6 and 7. The figures were compiled using stratigraphic data from boreholes, monitoring wells, and nearby MOE WWR, and present both shallow and deep geological stratigraphy. The shallow overburden material within the *Project Area* is predominantly composed of relatively low permeability dense Newmarket Till (silt till) with discrete layers of silty sand, clayey silt, and sand and gravel material.

2.3.4 Groundwater Levels

Groundwater elevations within the *Project Area* were evaluated based on data from nearby MOE WWR and available monitoring wells. For the nearby MOE WWR, the following groundwater levels were presented on the original well logs recorded between 1954 to 2010:

- Three (3) shallow wells indicated static groundwater levels of 2.1 m to 2.4 m BGS (248.1 m AMSL to 258.3 m AMSL);
- Eight (8) intermediate wells indicated static groundwater levels of 5.5 m to 9.1 m BGS (218 m AMSL to 234 m AMSL); and,
- Nine (9) deep wells indicated static groundwater levels of 19 m to 49 m BGS (204 m AMSL to 222 m AMSL).

As described in Section 2.3.3, the nearby shallow and intermediate depth wells are all completed within intermittent silty sand, and sand and gravel material. Some of the deep wells may be installed within the top of the Thorncliffe Formation. The available water level data generally indicates a vertical hydraulic stratification within the *Project Area* with downward gradient within the overburden material. Downward flow is controlled and restricted by the fine textured, low permeability Newmarket Till, as such, minimal groundwater recharge is expected.

Permeability is the ability of the material to allow water to flow through it. A high permeability material, such as sand and gravel, acts as an aquifer allowing water to easily flow through the material. A low permeability material, such as clay or silt till (as is the Newmarket Till), acts as an aquitard, impeding the flow of groundwater. This low permeable till material within the *Project Area* extends from ground surface up to at least 104 m BGS (160 m AMSL), with intermittent discrete water bearing silty sand and gravel lenses.

Groundwater levels were also measured in open boreholes and monitoring wells as part of the drilling activities completed by exp and Inspec-Sol. Groundwater levels measured in open boreholes during drilling operations may not have yet equilibrated, and may not be representative of static conditions. For example, borehole BH2-12 was completed within silt till material and a water level of 14.85 m BGS was noted within the borehole immediately following drilling. A monitoring well was then installed within this borehole and the well was allowed to equilibrate. A static groundwater level of 0.16 m BGS was measured 5 days after well installation. Based on this potential underestimate of groundwater levels based on data from the open boreholes, groundwater levels from the open boreholes are only presented on the borehole logs in Appendix B but are not discussed in this report.

Groundwater levels were measured at the four (4) monitoring wells within the *Project Area* by exp (May 2012, Inspec-Sol (November 2012), and Stantec (September and December 2013) with the following results:

- The monitoring well at BH11-12 was screened across silt and sand material at 13.7 m BGS to 14.8 m BGS. Artesian conditions were noted at BH11-12 with the groundwater level ranging from 0.9 m above ground surface (AGS) in November 2012 and December 2013 to 0.3 m below ground surface in September 2013 (254.5 m to 253.3 m AMSL). This level indicates the groundwater level or pressure within the screened silt and sand material, and does not necessarily indicate that water is naturally discharging at ground surface at this specific location;
- Groundwater levels recorded at BH7A varied between 1.4 m BGS in December 2013 and 2.4 m BGS in May 2012 and September 2013 (251.8 to 250.8 m AMSL) and indicate potential seasonal fluctuations in groundwater levels at this well;
- Groundwater levels recorded at BH2-12 varied between 0.2 m BGS in November 2012, 1.9 m BGS in September 2013, and 0.9 m BGS in December 2013 (246.0 to 244.3 m AMSL), located within the center and southern portions of the *Site*, respectively; and,
- Groundwater levels recorded at BH4-12 were dry upon installation in November 2012, 9.6 m BGS in September 2013, and 9.0 m BGS in December 2013 suggest the well has responded very slowly from installation, and that the screened interval is installed within soil with low hydraulic conductivity.

These results are representative of pre-construction groundwater levels within the *Project Area;* indicating a general groundwater flow direction from northeast to southwest, and consistent with topography. As previously stated, based on the fine textured, low permeability Newmarket Till present across the *Project Area*, minimal groundwater recharge is expected.

There is anecdotal evidence that groundwater seepage may be occurring at some locations within the *Project Area*. Site visits in June, July, September, November, and December 2013 found no evidence of groundwater seepage within the Project Area; indicating that groundwater seepage, if present, may occur in spring months following recharge from snow melt. Overland runoff has been observed following rain events within the *Project Area*, as would be anticipated, given the low permeability surficial till present.

Available water level data from monitoring wells and MOE WWR are presented on Figure 6 and Figure 7. Water levels in Figure 6 indicate the general northeast to southwest groundwater flow direction.

2.3.5 Aquifer Vulnerability and Groundwater Recharge

A review of aquifer vulnerability and groundwater recharge zones was completed as part of the source water assessment for the Central Lake Ontario Source Water Protection Area completed by CLOCA (2012).

Mapping indicated that the entire *Site* and majority of *Project Area* are considered low aquifer vulnerability. The mapping indicated high aquifer vulnerability at the eastern extent of the *Project Area*, which is likely related to alluvial deposits along the seasonal stream. This high vulnerability area is outside of the *Site* boundaries.

CLOCA (2012) mapping also indicated that the *Project Area* and *development area* were not mapped as a significant groundwater recharge areas. This description is consistent with both OGS mapping and available borehole logs; which primarily indicated clayey material or silt till at ground surface, with occasional intermittent discrete lenses of silty sand material at depth.

2.3.6 Summary

The *Project Area* is located within the South Slope physiographic region, along the southern boundary of the Oak Ridges Moraine planning administrative boundary, with surficial deposits of Newmarket Till and isolated deposits of Halton Till. Alluvial deposits associated with watercourse erosion and sediment deposition were also mapped at surface along Farewell Creek and Harmony Creek and their tributaries. The overburden in the vicinity of the *Project Area* primarily consists of till material (Newmarket Till) or fine grained material with low permeability; extending from ground surface up to 104 m BGS (160 m AMSL), with intermittent discrete water bearing silty sand lenses.

A review by CLOCA indicated that the *Project Area* is not considered a significant recharge area and, due to the low permeability fine grained surficial material, the entire *Site* and majority of *Project Area* are considered low aquifer vulnerability.

The shallow stratigraphy within the *Site* consists of sandy silt till with occasional intermittent discrete lenses of silty sand material typically between 0.5 m and 3 m thick. Groundwater levels within the shallow overburden are expected to range from 254.5 m AMSL (BH11-12) to 246.0 m AMSL (BH2-12). The groundwater flow direction within the shallow overburden is from northeast to southwest, generally consistent with topography. There was no evidence to confirm the presence of shallow groundwater discharge conditions were occurring during the summer months in 2013; however, based on anecdotal evidence, shallow groundwater seepage may occur at select locations with the *Project Area* during spring months, possibly within the southern portion of the *Project Area*.

The deeper overburden stratigraphy within the *Project Area* predominantly consists of Newmarket Till or aquitard material, with intermittent silty sand and gravel deposits at various depths. Nearby private wells are installed within these intermittent sand lenses, as encountered, at varying depths. The range in well installation depth suggests that a significant extensive sand aquifer is not located within the vicinity of the *Project Area*. The degree to which the discrete shallow and intermediate depth sand lenses may be hydraulically connected is not known at this time. . At all wells, clayey material was noted overlying the screened aquifer material. Low permeability clayey material typically acts as a confining unit, minimizing recharge / impacts from ground surface to the water supply.

2.4 HYDROLOGY

The delineation of surface water subwatershed boundaries and identification of major flow paths were completed using Ontario Base Maps (OBM) with 5 m topographic contour intervals. Site-specific topographic survey information, as provided by Hydro One, is consistent with drainage divides within the *Project Area*, as mapped using the OBM data. Generally, the subwatershed terrain for the external contributing drainage areas and for the *Project Area* exhibits moderate relief, with typical slopes in the 5-10% range. The topographic range within the *Project Area* varies from a high point of approximately 270 m AMSL at the northern boundary of the property, to a low of approximately 235 m AMSL at the southwest discharge location. The delineation of existing conditions drainage catchments and graphical information relating to other parameters of interest (soil type, topography, aerial imagery) are provided on Figures 8 and 9.

Under existing conditions, there are four (4) points of defined surface water flow from the *Project Area* boundaries, including two (2) intermittent watercourses at the west and east property limits; a tributary to Harmony Creek (main tributary and south branch) and a tributary to Farewell Creek, respectively (Figure 8). Two (2) low-lying surficial drainage features with no defined watercourse attributes (i.e., bed and banks) flow off-site to the south generally in the middle of the property, confluencing immediately downstream of the *Project Area*. Two (2) small wetland pockets are found within the *Project Area*; one coinciding with the upper portion of the south branch of the Harmony Creek tributary immediately north of the *Site*, and another found along the riparian areas of Farewell Creek, east of the *Site* near Langmaid Road (Figure 9).

The existing conditions drainage system has been delineated with four (4) subcatchments, as shown on Figures 8 and 9, and summarized as follows:

- Catchment 100: 24 ha draining to the east-to-west tributary, identified as Reaches 1-4 and 1-5 in the *Natural Heritage Existing Conditions Report* (Stantec, August 22, 2012), bordering the north limits of the developing area and combining with the main Harmony Creek tributary from Catchment 101 at Key Point A;
- Catchment 101: 78 ha draining to the main tributary of Harmony Creek flowing north-to-south at the west limits of the *Project Area*, combining with the east-west tributary described above at Key Point A, and discharging from the property at Key Point B;
- Catchment 102: 142 ha draining to the tributary of Farewell Creek crossing the east limits of the *Project Area*, discharging at Key Point C; and,
- Catchment 103: 23 ha catchment, predominantly contained within the south-central portion of the *Project Area*, draining to the two low-lying surficial drains discharging at the south property boundary at Key Point D.

Land uses within the majority of the tributary subwatershed consist of cropped agricultural land with some small woodlots. At-surface soil conditions within the overall drainage catchment are based on data from Agriculture and Agri-Food Canada soils reports for the Durham Region and indicate predominant coverage of Bondhead Loam and Muck (Hydrologic Soil Type B) (Figure 8). The Bondhead Loam was derived from the underlying till material.

2.4.1 Hydrologic Model Development

A hydrologic model was created to provide a quantitative estimate of the flows to and across the *Project Area*, using the Stormwater Management Hydrologic Model (SWMHYMO) software package and return-period rainfall events (1:2-year, 1:5-year, and 1:100-year). Design rainfall events were derived from Intensity-Duration-Frequency (IDF) data applicable to the Burketon McLaughlin rainfall gauge, located approximately 7 km from the *Project Area*. Utilizing a Soil Conservation Service (SCS) statistical rainfall distribution, a variety of storm durations (6 and 24-hour) were developed to understand hydrologic characteristics under a range of conditions. Table 1 presents a summary of the input rainfall event depths and durations.

Table 1 Design Rainfall Parameters for Burketon McLaughlin Gauge

Return Period	6-hr Storm Event Depth (mm)	24-hr Storm Event Depth (mm)
2-year	37.9 mm	47.1 mm
5-year	50.0 mm	59.2 mm
100-year	83.1 mm	92.4 mm

To reflect *Project Area* and Region-specific hydrologic characteristics, some modification to "standard" modeling assumptions were incorporated. Typically, standard modeling subroutines are used for hydrologic model development, utilizing default calibration parameters in the determination of rainfall-runoff relationships. In the *Project Area*, however, the CLOCA provides detailed recommendations for model development, requiring the consideration of non-default parameters. For example, the default initial abstraction (IA) value in SWMHYMO, identifying that initial portion of the rainfall event that is 'lost' to incidental storage or use (e.g., intercepted by vegetation, at-ground depressions storage, etc.) is 1.5 mm, whereas CLOCA's recommended value for crops is 7.0 mm. Details of the input parameters for the hydrologic model are included in Appendix D.

Table 2 presents the results of the peak flow rates under the existing conditions model.

Table 2 Existing Conditions Hydrologic Model Results

Key Flow Point / Subcatchment Outlet	Storm Duration (hrs)	Storm Event Return-Period					
		2-yr		5-yr		100-yr	
		Peak Flow (m^3/s)	Runoff Volume (m^3)	Peak Flow (m^3/s)	Runoff Volume (m^3)	Peak Flow (m^3/s)	Runoff Volume (m^3)
A / 100	6	0.25	1,700	0.46	3,020	1.22	7,700
B / 100+101		0.93	7,670	1.69	13,560	4.41	34,290
C / 102		1.06	10,760	1.90	19,170	4.92	48,370
D / 103		0.33	1,760	0.61	3,110	1.59	7,830
Key Flow Point / Subcatchment Outlet	**Storm Duration (hrs)**	**Storm Event Return-Period**					
		2-yr		**5-yr**		**100-yr**	
		Peak Flow (m^3/s)	**Runoff Volume (m^3)**	**Peak Flow (m^3/s)**	**Runoff Volume (m^3)**	**Peak Flow (m^3/s)**	**Runoff Volume (m^3)**
A / 100	24	0.29	2,680	0.46	4,190	1.06	9,250
B / 100+101		1.07	12,040	1.71	18,740	3.86	40,970
C / 102		1.21	17,040	1.93	26,470	4.34	57,740
D / 103		0.39	2,760	0.61	4,300	1.38	9,350

3.0 Site Development and Impact Assessment

Development of the *Site* is understood to involve the construction of above ground switchyard infrastructure, small buildings, and access roads. The specific construction activities pertaining to the hydrogeologic and hydrologic assessment are summarized as follows:

- Of the total *Project Area* of approximately 63 ha, it is understood that the switchyard infrastructure and small buildings will be located within the *Site* boundaries, covering roughly 17 ha. The *Site* is shown on Figure 2;
- Aside from internal access roads and relatively small concrete bases necessary to support specific infrastructure components, the switchyard is to be predominantly constructed upon a sub base of granular materials (depth depending on soil conditions) with a top layer consisting of 400 – 450 mm depth of ¾" crushed stone, required due to the grounding system installed below grade;
- The development involves grading within the *Site* boundaries from an existing ground surface of approximately 248 m AMSL to 259 m AMSL to a more level area ranging from 253 m AMSL to 254 m AMSL. Depending on the specific location within the *Site*, the grading ranges from placing up to 5 m of fill material to the excavation of up to 6 m of native overburden material. In general, excavation will be completed at the eastern extent of the *Site,* with the fill to be placed at the western extent of the *Site* to create a generally level grade for the transformer station;
- A perforated and solid pipe stormwater conveyance system underlying the granular base will be installed to remove at-surface water and convey water percolating through the granular top layers away from the core switchyard / transformer for discharge northward to the south branch of the Harmony Creek tributary;
- The piped drainage system is designed to route stormflow to a single discharge point at the north limits of the *Project Area*; and,
- Specific spills containment measures will be incorporated at the two transformer locations, in the form of concrete containment pits from which effluent will discharge to holding tanks acting as an oil-water separator, with sufficient storage volume provided to contain 100% of the transformer oil volume plus a 100-year, 24-hour storm. Clean water discharged from the oil-water separator unit will be drained to the piped drainage conveyance system.

3.1 HYDROGEOLOGY

As detailed above, development of the *Site* involves placing up to 5 m of fill material at the western extent of the *Site* and the excavation of up to 6 m of native overburden material at the eastern extent of the *Site*.

Based on the water level data from BH11-12, groundwater at the northern extent of the *Site* may be approximately 255 m AMSL. The transformer station's graded ground surface of 253 m AMSL will be approximately 2 m below the interpreted static groundwater level from November 2012. This static water level is likely a seasonal low or near seasonal low following minimal precipitation during summer 2012.

The current ground surface elevation and the *Site*'s graded ground surface are presented on Figures 6 and 7. As shown on these figures, the grading is entirely within fine grained material, however, it is anticipated that *Site* grading may extend below the shallow static groundwater level within the east side of the *Site*.

It is expected that any excavation within the eastern portion of the *Site* will result in some shallow groundwater seepage. Groundwater seepage would be collected as part of the storm water collection system around the perimeter of the *Site*. Given the extent of fine grained material within the *Project Area*, the extent of seepage is anticipated to be minimal; however, additional seepage may be present in the event that a localized shallow sand seam is encountered.

The transformer station construction within the *Site* primarily involves grading of fine textured silt till material. Based on the geology and general depth of excavation, no significant changes to groundwater flow / conditions are expected due to the grading, construction, and development scenario. It is anticipated that shallow groundwater flow will remain in a northeast to southwest direction.

The existing interpreted shallow groundwater flow direction is to the southwest towards the tributary of Harmony Creek. Depending on seasonal groundwater elevations and local sediments, shallow groundwater discharge within the *Site* boundaries has been anecdotally reported within local seeps or within the creek tributaries. However, *Site* field investigations have not confirmed these anecdotal reports. Given that no significant impact is anticipated to the overall groundwater regime, no significant impacts are anticipated to the natural heritage features (creeks and wetlands) that may be influenced seasonally by shallow groundwater flow. Furthermore, any groundwater seepage collected by the perimeter collection system resulting from *Site* regrading will be directed via the perimeter collection system to the same tributary of Harmony Creek.

As discussed in Section 2.3.3, MOE water well records indicate some nearby private wells are installed within intermittent sand lenses at varying depths ranging from 5.2 m BGS to 108 m BGS, with water-bearing sand and gravel lenses surrounded by lower permeability till. Based on available data, a significant, continuous aquifer was not noted within the local study area. Regional mapping suggests that deep wells may be installed within the top of the Thorncliffe Formation; however, this could not be confirmed based on available data. At all wells, clayey material was noted overlying the screened aquifer material. This clayey material will act as a hydraulic confining unit, minimizing recharge and/or adverse impacts from ground surface to the shallow or intermediate groundwater supply. No adverse impacts due to construction of the transformer station to the underlying Thorncliffe Aquifer are anticipated.

Based on available data, no adverse impacts to nearby private wells or local creeks are anticipated due to *Site* development. Hydraulic testing of on-*Site* monitoring wells and water quality testing of selected nearby residential wells will be completed as a due diligence measure to monitor groundwater conditions and to confirm the assessments presented in this report. The recommended Groundwater and Surface Water Monitoring Program is presented in Section 4.

3.2 HYDROLOGY

The *Site* drainage design for the project is currently in the detailed design phase, and will be subject to Environmental Compliance Approval (ECA) for Drainage from the MOE. In terms of assessing the potential impacts on the existing hydrologic condition (surface water) and receiving environs, the following conclusions have been drawn based on current *Site* drainage plans:

- The installation of free-draining granular material at-surface would not, in and of itself, result in result in significant alterations to surface water response to rainfall events from those experienced under existing conditions;
- However, the introduction of an engineered drainage system (grading and tile drainage) will likely result in discharge of runoff at higher peak rates and volumes to the south branch of the Harmony Creek tributary (north of the *Site*) than experienced under existing conditions, particularly for small, frequent events. Conversely, re-directing drainage away from the two, low-lying surficial drains south of the *Site* will reduce both peak flows and volumes to these systems;
- The net impact of this drainage system is not considered to represent a negative impact on the natural environment and could arguably improve conditions within the north and west reaches, providing a more consistent condition of fish habitat and seasonally moist wetland pockets. As such, there are no significant negative surface water impacts anticipated to the natural heritage features as a result of the proposal;
- Alterations within the remaining 36 ha of the *Project Area* outside of the *Site*, including the construction of new towers and access road(s), are also anticipated to result in only minor hydrologic impacts, typically mitigated through the creation of vegetated (grassed) conveyance systems (i.e., ditches); and,

- As mentioned in the existing conditions analysis, there are three (3) watercourses located within the *Project Area*, none of which will be directly impacted by the core switchyard / transformer station infrastructure, but crossings of the watercourses will be required as part of the access road system. Any crossings should be designed to manage the peak flows / volumes as presented within the existing conditions hydrologic synopsis.

4.0 Groundwater and Surface Water Monitoring Program

4.1 OBJECTIVES

The following Groundwater and Surface Water Monitoring Program has three primary objectives: to fulfill Hydro One's commitment to implement a pre, during, and post transformer station construction groundwater and surface water monitoring program; to refine our understanding of the physical and chemical characteristics of the shallow and intermediate depth groundwater systems at the *Site*; and to establish a pre-construction baseline of groundwater conditions, including seasonal variations of groundwater quality, quantity, and surface water / groundwater interaction. The monitoring data collected will provide the technical foundation on which to assess whether adverse impacts occurred during or post construction.

4.2 MONITORING PROGRAM SCOPE

The Groundwater and Surface Water Monitoring Program includes several key tasks, including installing new groundwater monitoring wells (completed in Fall 2013), implementing a private well monitoring program, surface water monitoring, decommissioning of geotechnical monitoring wells (completed Fall 2013), water level and water quality monitoring, and preparing annual monitoring summary reports through the duration of the monitoring program.

Complementing the groundwater monitoring program, surface water features located on the north (wetland), west (creek), and south (drainage swale) sides of the *Site* will be monitored. Background water levels within three newly installed shallow piezometers (mini shallow wells) will be recorded prior to construction of the transformer station, and compared to monitoring results recorded during and post construction. The monitoring data collected will provide the technical foundation on which to further characterize our understanding of the shallow groundwater system, to assess whether adverse impacts occurred during or post construction, and to provide guidance for appropriate mitigation, if needed.

Owners of private wells on properties immediately adjacent to the east and south of the *Site* will be able to have the water level and water quality in their wells monitored prior to, during, and post construction of the transformer station. A baseline of seasonal normal groundwater levels and groundwater quality will be established prior to construction of the transformer station. Once construction of the transformer station begins, the well monitoring program will continue with observations compared to baseline conditions, allowing for an assessment of potential impacts on the natural environment and of the efficacy of the engineered containment structures and water treatment systems to be installed.

Groundwater and surface water data collected prior to construction of the transformer station will help define the relationship between the shallow and intermediate depth groundwater systems at the Site and how they interact with each other; providing a baseline to which monitoring data collected during construction and post construction will be compared. Specifically, the Groundwater and Surface Water Monitoring Program will allow for quantification of the following hydrogeological characteristics of the site:

- Refinement of Site geologic stratigraphy;
- Seasonal shallow and intermediate groundwater water levels across the site;
- Seasonal shallow and intermediate groundwater chemistry;
- Vertical groundwater gradients (identify areas of upward, neutral, or downward groundwater movement) between surface water and shallow groundwater system, and shallow and intermediate depth groundwater systems;
- Shallow and intermediate depth hydraulic conductivity, including variations in hydraulic conductivity associated with the different geologic materials identified during previous and recent drilling programs;
- Continuous (hourly) groundwater level monitoring to allow for observation and calculation of seasonal variations in surface water, groundwater, and private wells; and,
- Potential changes in shallow groundwater elevation associated with the cut portion (east side) of the grading area, including the potential radius of groundwater influence, and potential for private well interference.

The hydrogeologic conditions presented in the Project ESR will be confirmed through the analyses and interpretation of groundwater and surface water data collected prior to construction of the transformer station. The monitoring program will continue during and post construction of the transformer station in order to confirm that the mitigation measures and engineered containment structures designed to protect the natural form and function of the surface water system, shallow and intermediate groundwater systems, and the adjacent private water wells are functioning as designed.

This monitoring program will also be adaptive. Changes to the monitoring program and/or laboratory analyses may be implemented, as determined by Hydro One and its environmental consultant, depending on the monitoring results and interpretations derived from them.

4.3 MONITORING INSTALLATIONS

The Groundwater and Surface Water Monitoring Program takes into consideration potential adverse impacts of the project on the natural environment in the absence of implementing any mitigations measures (containment structures, water treatment, etc.). These include the introduction of chemical substances and changes to the natural form and function of the shallow and intermediate depth groundwater and surface water systems. As a result, the depths of the monitoring wells, monitoring frequency, and selected water quality analyses of the entire monitoring program have been selected with detection of potential changes to these receptors as their primary objective.

4.3.1 Site Monitoring Wells

The groundwater monitoring wells installed at the *Site* during the previous geotechnical investigations were all installed at an intermediate depth (screened between approximately 11 m and 15 m depth). These monitoring wells were located where excavations for footings or foundations are planned, and as a result, needed to be decommissioned prior to construction of these foundations.

In the Fall of 2013, this monitoring program was initiated by installing pairs of new monitoring wells on each side of the *Site* (Figure 1). The new intermediate depth (approximately 10 m to 15 m depth) wells have been paired with shallow depth wells (approximately 1 m to 3 m depth) intended to intersect the elevation of the shallow water table. By installing pairs of shallow and intermediate depth wells, changes in groundwater levels, groundwater chemistry and vertical hydraulic gradients (upward or downward movement of groundwater) will be able to be measured and monitored seasonally prior to, during, and post construction of the transformer station.

Drive point piezometers (shallow mini wells) have also been installed within *Site* surface water features in order to monitor seasonal shallow groundwater and surface water levels within the wetland (north side), creek (west side) and drainage swale (south side) features found on-*Site*.

The new groundwater monitoring wells were installed according to the MOE Water Resource Act (O. Reg. 903). A licensed well drilling contractor was retained and has completed the following:

- Installation of three (3) stream/wetland drive-point piezometers;
- Drilling and installation of four (4) shallow and intermediate depth pairs of groundwater monitoring wells (8 wells in total); advanced to depth of approximately 1 to 3 metres and 10 to 15 metres, respectively;
- Complete grouting (sealing) of outer well annulus;
- Installation of protective and lockable well casing; and,
- Decommissioning of former geotechnical wells according to the MOE Water Resource Act (O. Reg. 903).

Upon completing installation of the new monitoring wells in December 2013, the water level in several wells were observed to have recovered slowly, with some not recovering sufficiently after several days to allow for a collection of water quality samples. Monitoring of the new wells will continue with the completion of a water level monitoring event in Winter 2014, noting if any wells are frozen.

In Spring 2014, the new wells will be further developed, hydraulically tested (slug testing) to confirm estimates presented in the Project ESR, and sampled for groundwater quality. Selected representative soil samples obtained and preserved during drilling will be submitted for laboratory sieve grain size analyses.

4.3.2 Private Well Monitoring

A review of the MOE water well record database indicates that there are approximately 10 wells registered with the MOE on properties immediately to the east and south of the *Site*. The private well monitoring program will include providing notification to all potential groundwater users immediately adjacent to the *Site*, informing the property and/or well owners of the transformer station construction schedule, and the parameters of the private well monitoring program. The notification information will provide the details of the monitoring program, and include appropriate project contact information for Hydro One regarding construction concerns. During the door-to-door site visits, Stantec will also make note of and attempt to contact well owners that may not appear in the MOE's records for the purpose of offering participation in the private well monitoring program.

Participation in the private well monitoring program will only be completed with the owner's authorization, and will include water quality sampling and water level monitoring, depending on well accessibility. Water level monitoring involves installing an automated well water level logger (pressure transducer), which can only be completed at accessible wells by a licensed well contractor. The automated loggers will monitor 'continuous' water levels (at 5 to 60 minute intervals) from Spring 2014 until two years following completion of construction. The loggers would be removed at the end of the monitoring program.

Private well water quality samples will be collected from a raw water tap (prior to any treatment or filtration), where available. If no raw water tap is present, a sample may be collected directly from the well, depending on well accessibility and well owner authorization. After purging water from the well, the samples will be collected directly into laboratory supplied sample containers. The samples will not be field filtered and will be submitted for general chemistry, turbidity, metals, hydrocarbons (F1-F4 and BTEX), and bacteriological analyses. To supplement and provide quality assurance, temperature, conductivity, and pH data will be collected in the field at the time of sampling.

Individual private well analytical results will be presented in a letter to each resident following each sampling event along with the available water level data. Private well data will remain confidential, and is not permitted to be shared with the general public. However, monitoring reports for data collected on-*Site* will be prepared annually and made available to the public by Hydro One.

4.4 SURFACE WATER MONITORING

A Stantec terrestrial ecologist will monitor the *Site* prior to transformer station construction to confirm the presence or absence of groundwater seeps within the *Project Area*, identifying notable indicator parameters and plant species. Ecological monitoring will continue annually during construction of the transformer station, and for two years following completion of construction. Surface water levels and water quality samples will be collected from three (3) surface water monitoring locations (at piezometer installation locations) and submitted for laboratory analyses following the monitoring schedule discussed below.

4.5 WATER QUALITY ANALYSES

Groundwater water quality samples from each of the new on-*Site* monitoring wells and participating private wells will be collected according to laboratory protocols, preserved, and submitted for laboratory analyses (general chemistry, metals, and hydrocarbons (F1-F4 and BTEX)) to Maxxam Analytics, an accredited laboratory. Well water quality parameter analyses will be compared to Ontario Drinking Water Quality Standards (ODWQS).

Surface water quality samples will be collected from each of the three new surface water monitoring locations adjacent to the new piezometer installations (when surface water is present) according to laboratory protocols, preserved, and submitted for laboratory analyses (general chemistry, metals, and hydrocarbons (F1-F4 and BTEX)) to Maxxam Analytics. Surface water quality parameter analyses will be compared to Provincial Water Quality Objectives (PWQO).

A water quality parameter list is included in Appendix A.

4.6 MONITORING SCHEDULE

The Groundwater and Surface Water Monitoring Program schedule frequency is designed to record groundwater levels continuously with the use of automated pressure transducers, and to seasonally (quarterly) collect groundwater and surface water quality samples for laboratory analyses for the first year of monitoring in order to establish potential seasonal variations in groundwater levels and chemistry. Table 3 presents the program water quality sampling schedule. Following the first year of quarterly (seasonal) monitoring, the schedule will change to semi-annual monitoring (spring and fall). Upon completion of construction, monitoring of groundwater, surface water, and private wells will continue semi-annually for two years.

For scheduling purposes, it is anticipated that quarterly seasonal monitoring will take place from Fall 2013 to Summer 2014; semi-annual (construction) monitoring will continue from Fall 2014 through to Fall 2017; and semi-annual post-construction monitoring will extend for 2 years following completion of construction. Presently construction is anticipated to be completed in Fall 2017, with this monitoring program continuing until Fall 2019.

Table 3 Monitoring Schedule

Pre-Construction and Construction Monitoring Schedule											
2013				2014				2015			
Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
			X	X	X	X	X		X		X
2016				2017							
Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall				
	X		X		X		X				
Post-Construction Monitoring Schedule											
2018				2019							
Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall				
	X		X		X		X				

4.7 REPORTING

A *Baseline Conditions Report* will be prepared following the Fall 2014 monitoring event summarizing the *Site* baseline groundwater and surface water conditions prior to construction of the transformer station.

Subsequent annual monitoring program summary reports will be prepared following the Fall monitoring and sampling events. The reports will present all on-Site groundwater and surface water monitoring data and a general summary of private well water level and water quality data. Private well owners will be provided with the data (water level and water quality) from their own individual well only. In the event an exceedence of the ODWQS is received from the laboratory, the private well owner will be advised of the exceedence immediately upon receipt and review of the laboratory data.

5.0 Conclusions and Recommendations

Based on the background information reviewed, and hydrogeologic and hydrologic information compiled and summarized herein and in the Project ESR, it is concluded that development of the *Site* should not result in any associated negative impacts on receiving surface water or groundwater systems including to the natural environment (creeks and wetlands) or adjacent private property infrastructure (i.e., water supply wells). It is understood that pre-, during- and post-construction monitoring programs to field verify these conclusions will be implemented.

The following specific conclusions are provided:

- The Clarington Transmission Station is located within the southern boundary of the area delineated by the Oak Ridges Moraine Conservation Plan;
- Stratigraphy within the *Project Area* consists of thick silt till overburden, which is representative of the Newmarket Till with pockets of Halton Till at surface. The till material is considered an aquitard and will impede surface water recharge or groundwater discharge within the *Project Area*. Occasional sand lenses were noted at variable depths and adjacent private wells are installed within these sand lenses;
- CLOCA (2012) mapping indicated that the *Site* is considered low aquifer vulnerability and not an area of significant recharge;
- Shallow groundwater within the *Project Area* flows in the general direction of surficial topography, from northeast to southwest. Shallow groundwater seepage may be occurring in select locations of the *Project Area*, specifically to the southern drains;
- Development of the *Site* includes approximately 5 to 6 m of cut and fill grading of fine textured material consisting of silt till material with excavation at the eastern extent of the *Site* with the fill to be placed at the western extent of the *Site*. The excavation within the eastern portion of the *Site* will result in some shallow groundwater seepage; however, given the fine grained material, the extent of seepage is expected to be minimal. Any seepage would be collected as part of the storm water collection system and discharge to the south branch of the Harmony Creek tributary. . No significant changes to groundwater flow / conditions are expected due to *Site* grading, construction, and development scenario. It is expected that groundwater flow will remain in a northeast to southwest direction;

- The majority of nearby private wells are installed within discrete sand deposits, significantly deeper than the *Site* development activity. Available stratigraphy does not indicate the presence of direct hydraulic connection between surficial activities within the *Site* boundaries to the nearby private wells. The degree to which the discrete sand lenses may be hydraulically connected in not known at this time. The deep private wells may be installed within the top of the Thorncliffe Formation; however, this was not confirmed based on available records. The range in well installation and depth suggests that a significant sand aquifer is not located in the vicinity of the *Project Area*. The *Site* development is not expected to significantly impact groundwater flow or quality conditions or affect nearby private wells;
- The net impact on local hydrology is expected to be negligible, and possibly result in an improvement in the surface water receiving systems in Harmony Creek tributary; and,
- The Groundwater and Surface Water Monitoring Program presented in Section 4.0 will fulfill the environmental monitoring commitments made by Hydro One in the Project's ESR by establishing background hydrogeological conditions and by providing a monitoring program that will identify and monitor the natural form and function of the shallow and intermediate depth groundwater system during and post construction.

As proper due diligence, the following monitoring recommendation is proposed:

- Implement the Groundwater and Surface Water Monitoring Program discussed in Section 4.0 of this report to confirm the findings of this assessment and to mitigate potential adverse impacts to the shallow groundwater system and private water well users.

6.0 References

Chapman, L.J. and D.F. Putnam, 1984. The Physiography of Southern Ontario. Ontario Geological Survey, Special Volume 2, 270 pp.

CLOCA, 2012. Approved Assessment Report, Central Lake Ontario Source Protection Area. Chapter 4 – Assessing Vulnerability of Drinking Water Sources. January 18, 2012.

exp Services Inc. 2012. Geotechnical Report – Clarington TS, Municipality of Clarington. Project No. BAR-00025036-A0, June 19, 2012.

Hydro One Networks Inc., 2008. Enfield Transformer Station, Class Environmental Assessment, Final Environmental Study Report. August 2008.

Hydro One Networks Inc., 2012. Clarington Transformer Station, Class Environmental Assessment, Draft Environmental Study Report. Project No. 590-CLEA-12-11, November 2012.

Inspec-Sol Inc. 2013. Geotechnical Investigation – Clarington Transformer Station (TS). Report T040774a1, January 23, 2013.

Geological Survey of Canada, 2001. Regional three-dimensional stratigraphic modeling of the Oak Ridges Moraine area, Southern Ontario.

Ontario Geological Survey (OGS). 2003. Surficial Geology of Southern Ontario.

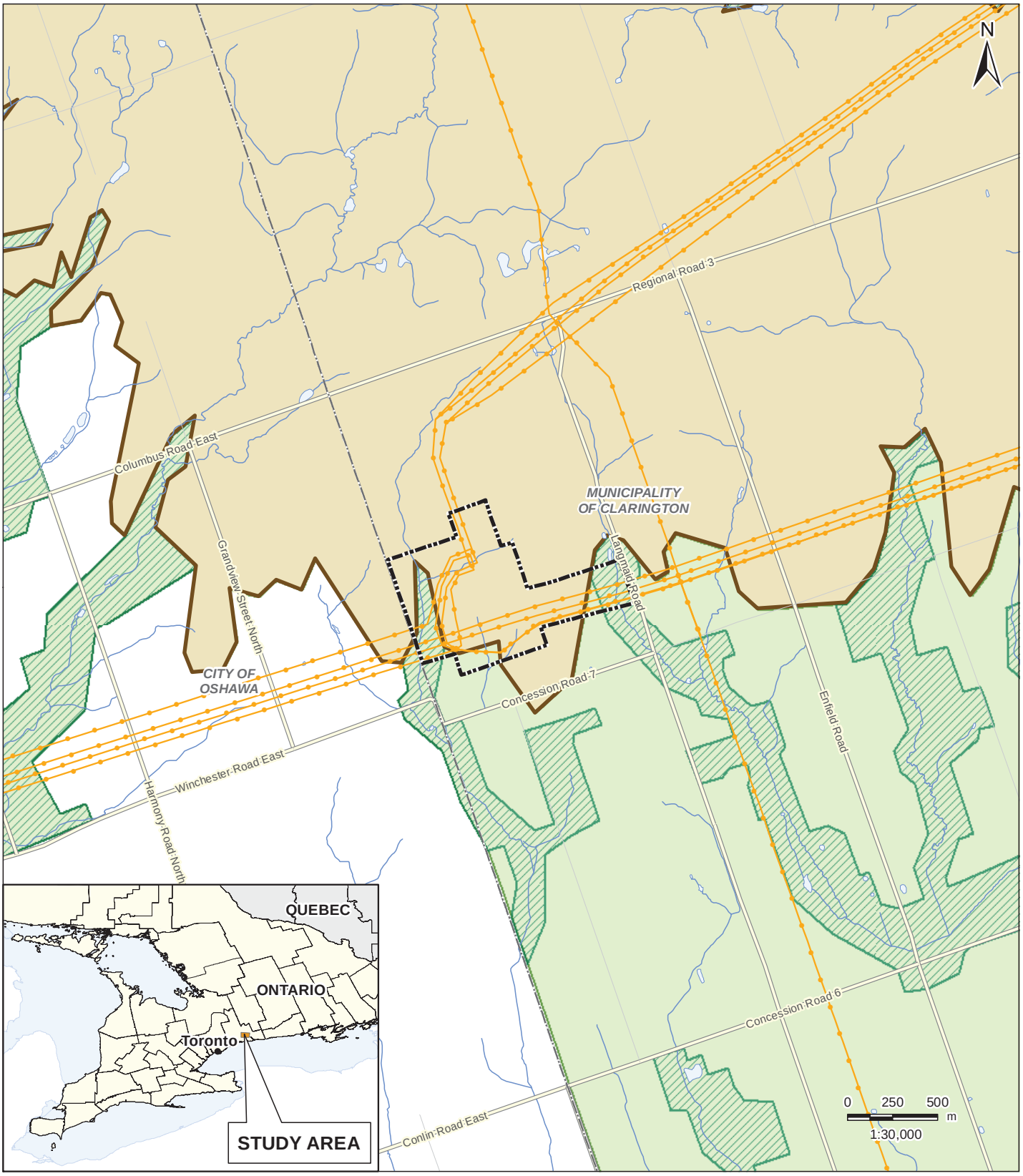
Ontario Ministry of Municipal Affairs and Housing (MMAH). 2002. Oak Ridges Moraine Conservation Plan (ORMCP).

Ontario Ministry of Municipal Affairs and Housing (MMAH). 2005. Greenbelt Plan. February 29, 2005. 57 pp.

Singer, S.N., C.K. Cheng and M.G. Scafe. 2003. The Hydrogeology of Southern Ontario. 2nd edition. Ministry of the Environment, Hydrogeology of Ontario Series (Report 1). April 2003.

Stantec Consulting Ltd., 2008. Hydro One Proposed Enfield Transformer Station – Environmental Baseline. Project No. 1609-60217. Prepared for Hydro One Networks Inc., March 2008.

Appendix A Figures



\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig01_SiteLocation.mxd
Revised: 2013-03-26 By: ccoghlan

March 2013
160960745

Stantec

Legend

- Project Area
- Highway
- Major Road
- Local Road
- Watercourse
- Utility Line
- Municipal Boundary
- Greenbelt - Natural Heritage System
- Greenbelt - Protected Countryside
- Oak Ridges Moraine
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

Client/Project

Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.

1

Title

Project Location

Legend

- Monitoring Well (Inspec-Sol, 2012)
- Monitoring Well (EXP, 2012)
- Borehole (Inspec-Sol, 2012)
- Borehole (EXP, 2012)
- MOE Water Well Record
- Project Area
- Proposed Development Area
- Cross-Section Location
- Topographic Contour (mAMSL)
- Watercourse
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthoimagery © First Base Solutions, 2012.
4. Topography derived from the MNR Digital Elevation Model - Version 2.0.0 - Provincial Tiled Dataset (DEM) © Queen's Printer for Ontario, 2006.

Stantec

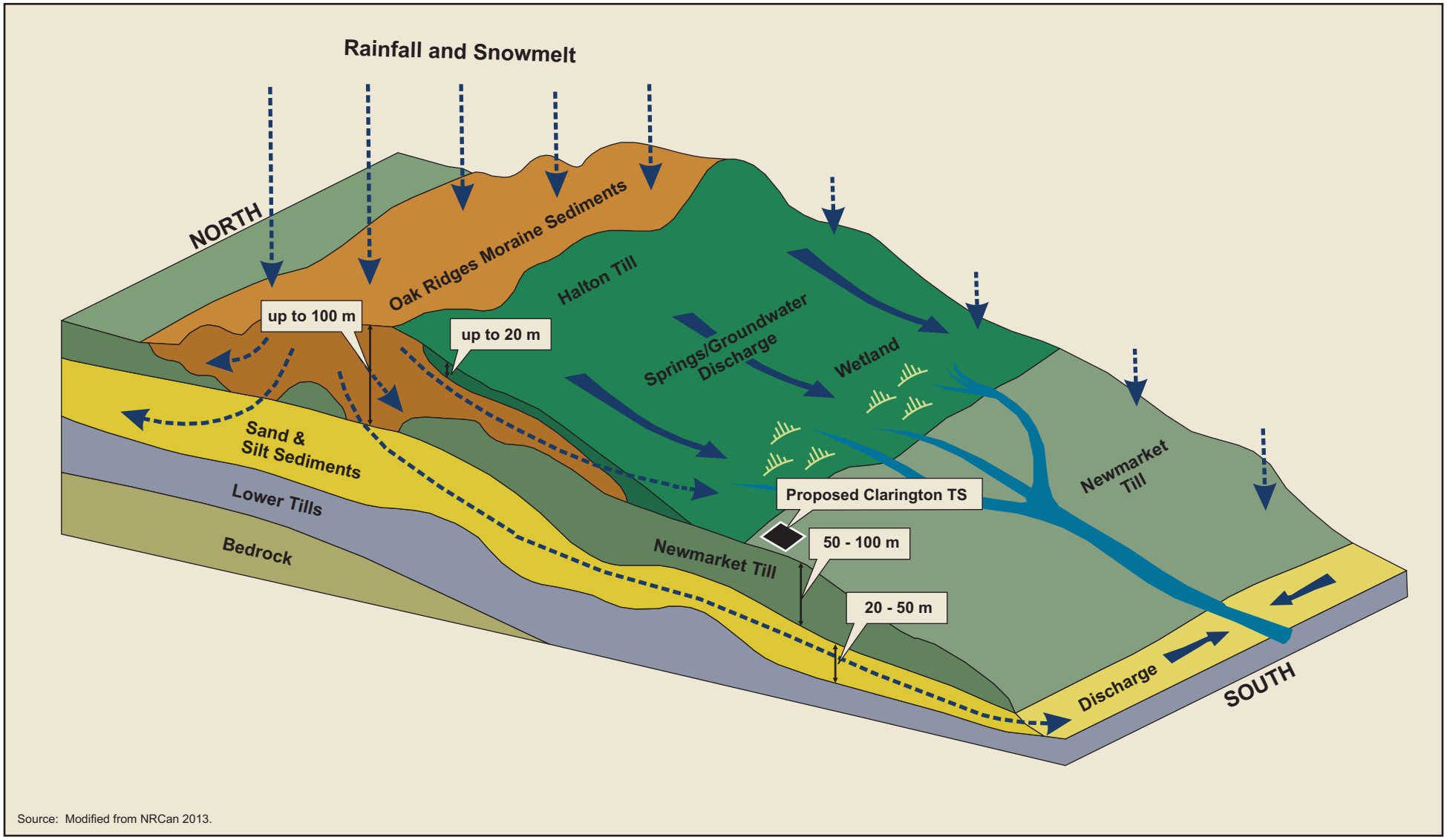
April 2013
160960745

Client/Project
Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.
2

Title
Project Site Plan

\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig02_SitePlan.mxd
Revised: 2013-04-11 By: ccoghlan



Source: Modified from NRCan 2013.

Filepath: \\cd1220-f02101609\active\60960745\drawing\Corel\ORM_schematic\60960745_ORMschematic_20130321_CEW.cdr

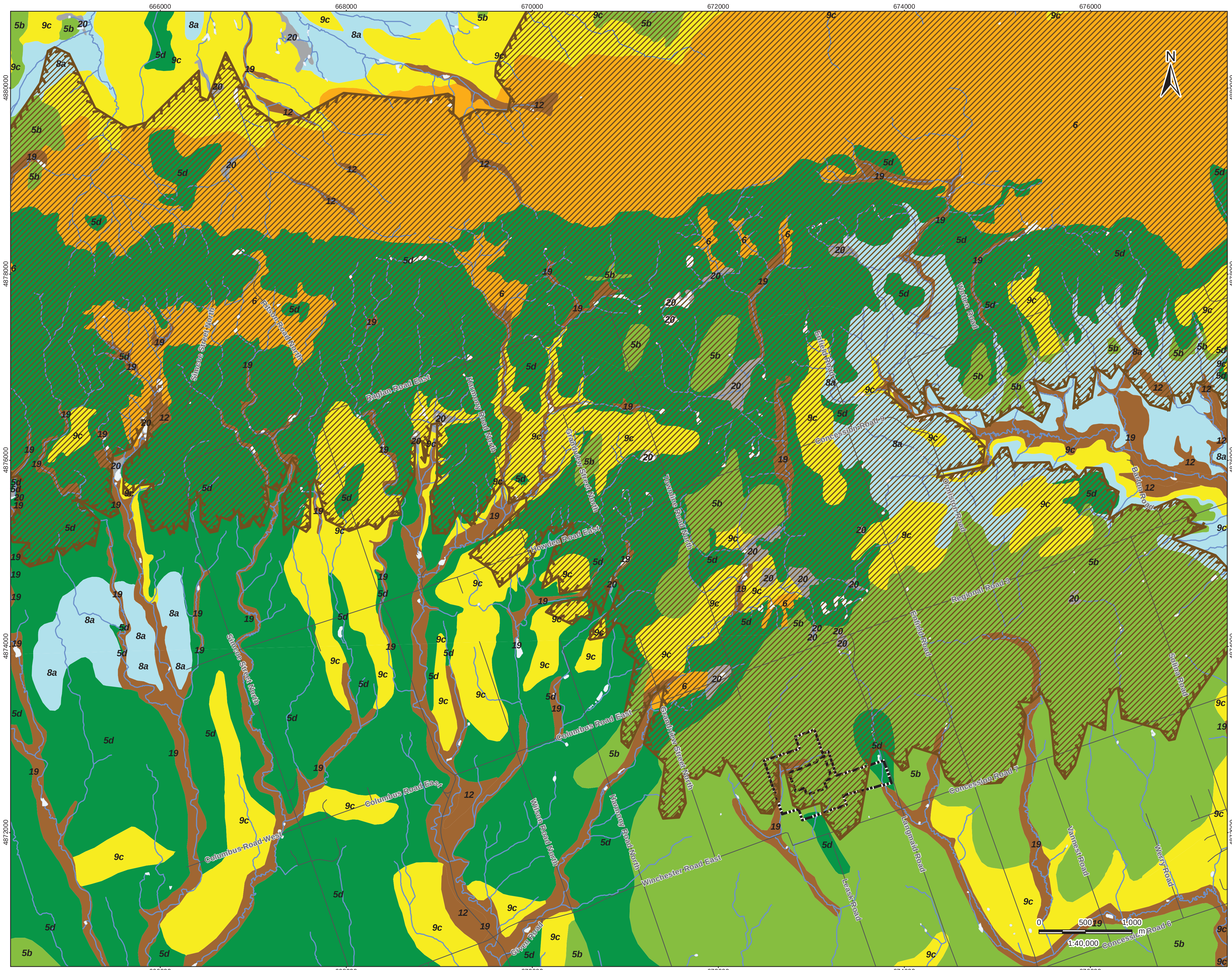
March 2013
160960745

Stantec

Client/Project
Hydro One Networks Inc.
Hydrogeologic and Hydrologic Assessment Report
Clarington, Ontario

Figure No.
3

Title
Schematic of Oak Ridges Moraine



Legend

- Project
- Proposed Development
- Watercourse
- Oak Ridges Moraine
- Waterbody

Surficial Geology

- 20: Organic deposits
- 19: Modern alluvial deposits
- 12: Older alluvial deposits
- 9c: Coarse-textured glaciolacustrine deposits (Foreshore-basinal deposits)
- 8a: Fine-textured glaciolacustrine deposits (Massive-well laminated)
- 6: Ice-contact stratified deposits
- 5b: Stone-poor, carbonate-derived silty to sandy till (Newmarket Till)
- 5d: Glaciolacustrine-derived silty to clayey till (Halton Till)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Surficial geology produced by the Ontario Geological Survey 2003. Surficial geology of Southern Ontario; Ontario Geological Survey, MRD 128.

Stantec

April 2013
160960745

Client/Project

Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.

4

Title

Regional Surficial Geology

\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig04_RegionalSurficialGeology.mxd
Revised: 2013-04-01 By: ccoghlan

672000

674000

4872000

Regional Road 3

Columbus Road East

Brealey Road

Grandview Street North

Winchester Road East

Concession Road 7

Lesmond Road

Leask Road

9c

20

19

6

5d

5b

BH12-12
BH2
BH11-12
BH3
BH9-12
BH5
BH10-12
BH6
BH8-12
BH13-12
BH1
BH12A
BH7-12
BH4
BH7B
BH7A
BH7D
BH7C
BH6-12
BH11
BH8
BH5-12
BH1-12
BH2-12
BH4-12
BH10
BH3-12
BH9
BH12B

1916307
1909285
1905014
1907905
1904535
1910299
1903352
1901742
1905307
1903511
1902984
7128981
7157947
1903520
1912622
1912514
1918378
4600451
4600450
7102525

N

0 250 500 m

1:10,000

Legend

- Monitoring Well (Inspec-Sol, 2012)
- Monitoring Well (EXP, 2012)
- Borehole (Inspec-Sol, 2012)
- Borehole (EXP, 2012)
- MOE Water Well Record
- Project
- Proposed Development
- Watercourse
- Oak Ridges Moraine
- Waterbody

Surficial Geology

- 20: Organic deposits
- 19: Modern alluvial deposits
- 9c: Coarse-textured glaciolacustrine deposits (Foreshore-basinal deposits)
- 6: Ice-contact stratified deposits
- 5b: Stone-poor, carbonate-derived silty to sandy till (Newmarket Till)
- 5d: Glaciolacustrine-derived silty to clayey till (Halton Till)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Surficial geology produced by the Ontario Geological Survey 2003. Surficial geology of Southern Ontario; Ontario Geological Survey, MRD 128.

Stantec

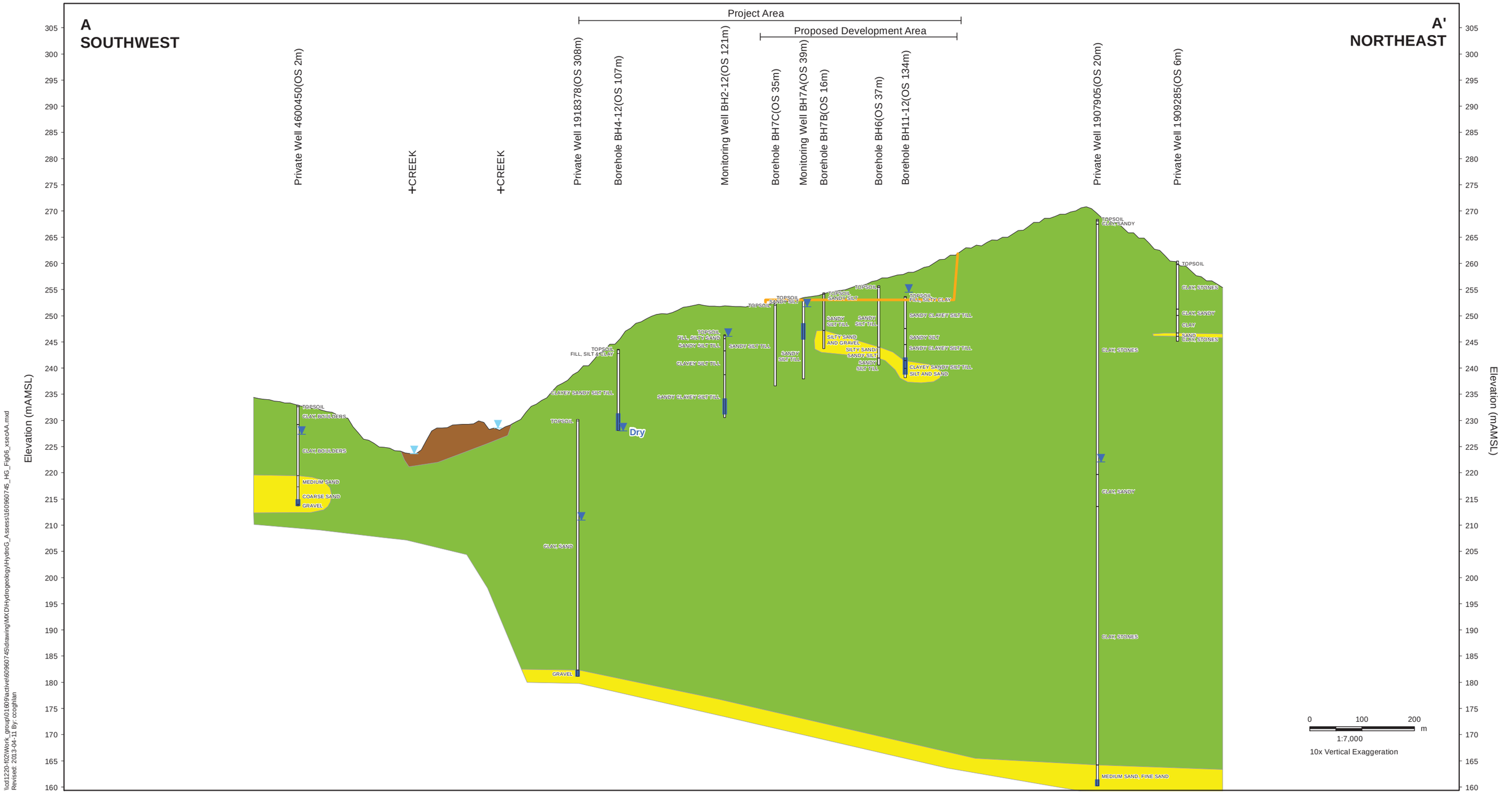
April 2013
160960745

Client/Project
Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.
5

Title
Project Area Surficial Geology

\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig05_ProjectSurficialGeology.mxd
Revised: 2013-04-01 By: ccoghlan



\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_Fig06_xsecAA.mxd
Revised: 2013-04-11 By: ccoghlan

April 2013
160960745

Legend

- 280874 (OS m) — Well ID (Offset)
- Sand — Stratigraphy
- Water Level
- Well Screen
- Surface Water
- Crossings
- Ground Surface
- Proposed Grading
- Silt Till (Newmarket Till)
- Modern Alluvial Deposits
- Sandy Silt to Silty Sand

Notes

1. Water level data as presented in MOE WWR or borehole log.

Client/Project

Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.

6

Title

Cross-Section A-A'

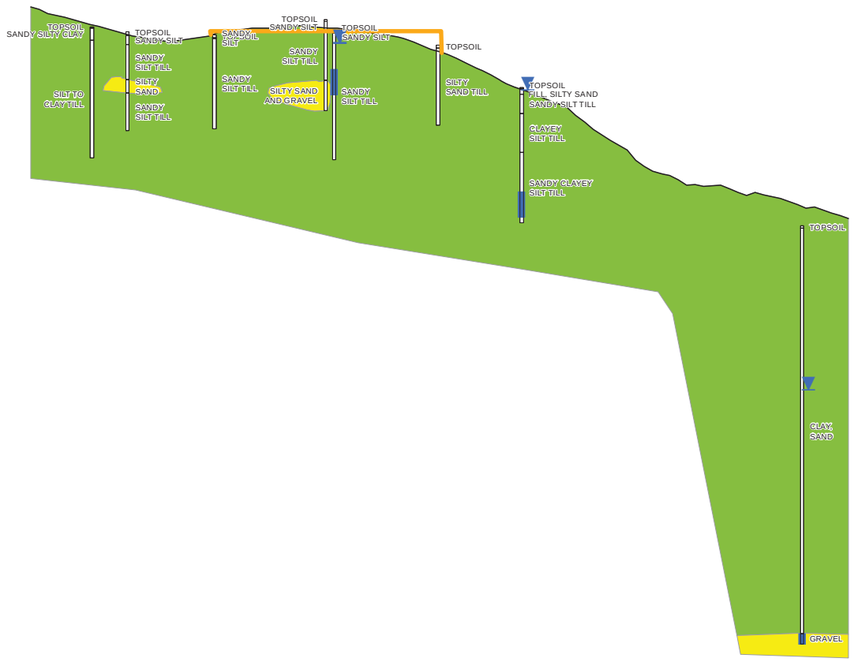
B
NORTH

B'
SOUTH

Project Area

Proposed Development Area

Borehole BH12-12(OS 2m)
Borehole BH2(OS 26m)
Borehole BH5(OS 6m)
Borehole BH7B(OS 44m)
Monitoring Well BH7A(OS 0m)
Borehole BH8(OS 47m)
Monitoring Well BH2-12(OS 3m)
Private Well 1918378(OS 70m)



Elevation (mAMSL)

Elevation (mAMSL)

0 100 200 m

1:7,000

10x Vertical Exaggeration

\\cd1220-f02\Work_group\01609\active\160960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig07_xsecBB.mxd
Revised: 2013-04-11 By: ccoghlan

April 2013
160960745

Legend

280874 (OS m) — Well ID (Offset)

Sand — Stratigraphy

Water Level

Well Screen

Ground Surface

Proposed Grading

Silt Till (Newmarket Till)

Sandy Silt to Silty Sand

Notes

1. Water level data as presented on borehole log.

Stantec

Client/Project

Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.

7

Title

Cross-Section B-B'

672000
673000
674000
4874000
4873000
N
Townline Road North
Regional Road 3
Columbus Road East
Enfield Road
Langmaid Road
Concession Road 7
Grandview Street North
North Branch
South Branch
Tributary of Harmony Creek
Tributary of Farewell Creek
Surficial Drain
Surficial Drain
Tributary of Farewell Creek
100
101
102
103
A
B
C
D
0
100
200
m
1:10,000

Legend

- Project Area
- Key Flow Points
- Drainage Catchment
- Road
- Topographic Contour (mAMSL)
- Watercourse
- Waterbody

Soil Type

- Bottom Land
- Bondhead Loam
- Lyons Loam
- Muck
- Smithfield Clay Loam

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Soils data provided by Agriculture and Agri-Food Canada, Region of Durham.

Stantec

April 2013
160960745

Client/Project
Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.
8

Title
Drainage Catchments and At-Surface Soils

\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig08_Catchments_and_Soils.mxd
Revised: 2013-04-01 By: ccoghlan

672000 673000 674000

4874000 4873000

Townline Road North
Regional Road 3
Enfield Road
Columbus Road East
Grandview Street North
Langmaid Road
Concession Road 7

North Branch
South Branch
Tributary of Farewell Creek
Tributary of Harmony Creek
Surficial Drain
Surficial Drain
Tributary of Farewell Creek

Wetland Area 1
Wetland Area 2

100
101
102
103

A
B
C
D

N

0 100 200 m
1:10,000

Legend

- Project Area
- Key Flow Points
- Drainage Catchment
- Topographic Contour (mAMSL)
- Watercourse

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthoimagery © First Base Solutions, 2008.

Stantec

April 2013
160960745

Client/Project
Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.
9

Title
Drainage Catchments and Aerial Imagery

\\cd1220-f02\Work_group\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig09_Catchments_and_Aerial.mxd
Revised: 2013-04-01 By: ccoghlan

673000

MP2
MW2-13
MW1-13
MP3
MW3-13
MP4
MW4-13

255
260
250
245
240
235

N

0 75 150 m
1:3,000

673000

Legend

- Monitoring Well (Stantec, 2013)
- Piezometer (Stantec, 2013)
- Existing Power Feature
- New Infrastructure
- Topographic Contour (mAMSL)
- Watercourse
- Project Area
- Clarington TS Site

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthoimagery © First Base Solutions, 2012.

Stantec

February 2014
160960745

Client/Project
Hydro One Networks Inc.
Hydrogeologic & Hydrologic Assessment Report
Clarington, Ontario

Figure No.
10

Title
Groundwater & Surface Water Monitoring Locations

W:\01609\active\60960745\drawing\MXD\Hydrogeology\HydroG_Assess\160960745_HG_Fig10_GW_SW_MonitoringLoc.mxd
Revised: 2014-02-10 By: searles

Appendix B Borehole Logs

Log of Borehole BH1

Project No. BAR-00025036-A0 | Figure No. 2

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

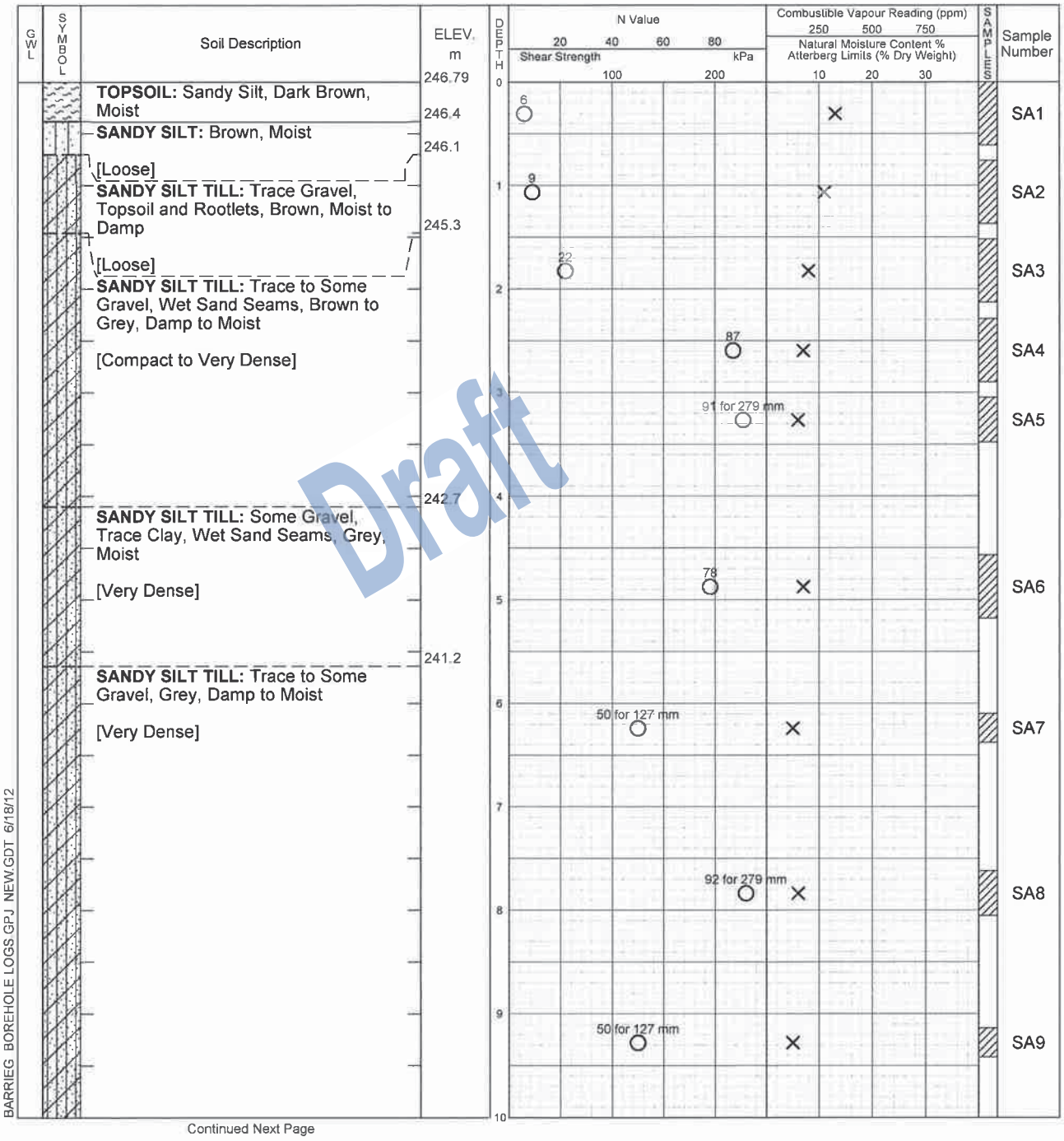
Date Drilled: May 17, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample ☒ | SPT (N) Value ○ ▨ | Dynamic Cone Test — | Shelby Tube ■ | Field Vane Test S

Combustible Vapour Reading □ | Natural Moisture × | Plastic and Liquid Limit ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Penetrometer ▲



Continued Next Page

BARRIEG BOREHOLE LOGS GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

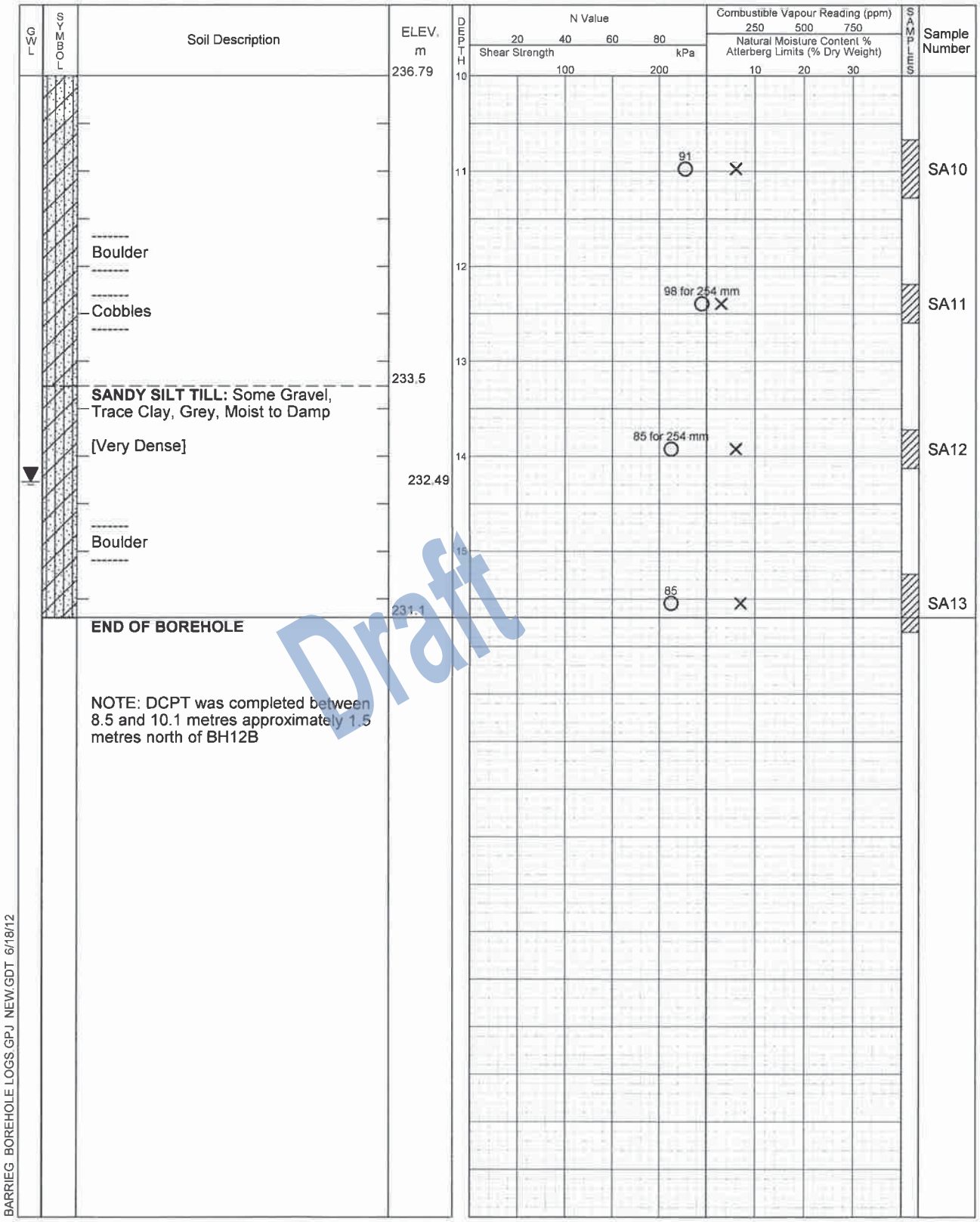
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	14.3	14.4

Log of Borehole BH1

Project No. BAR-00025036-A0 Figure No. 2

Project: Clarington TS Sheet No. 2 of 2



BARRIEG_BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	14.3	14.4

Log of Borehole BH2

Project No. BAR-00025036-A0 | Figure No. 3

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

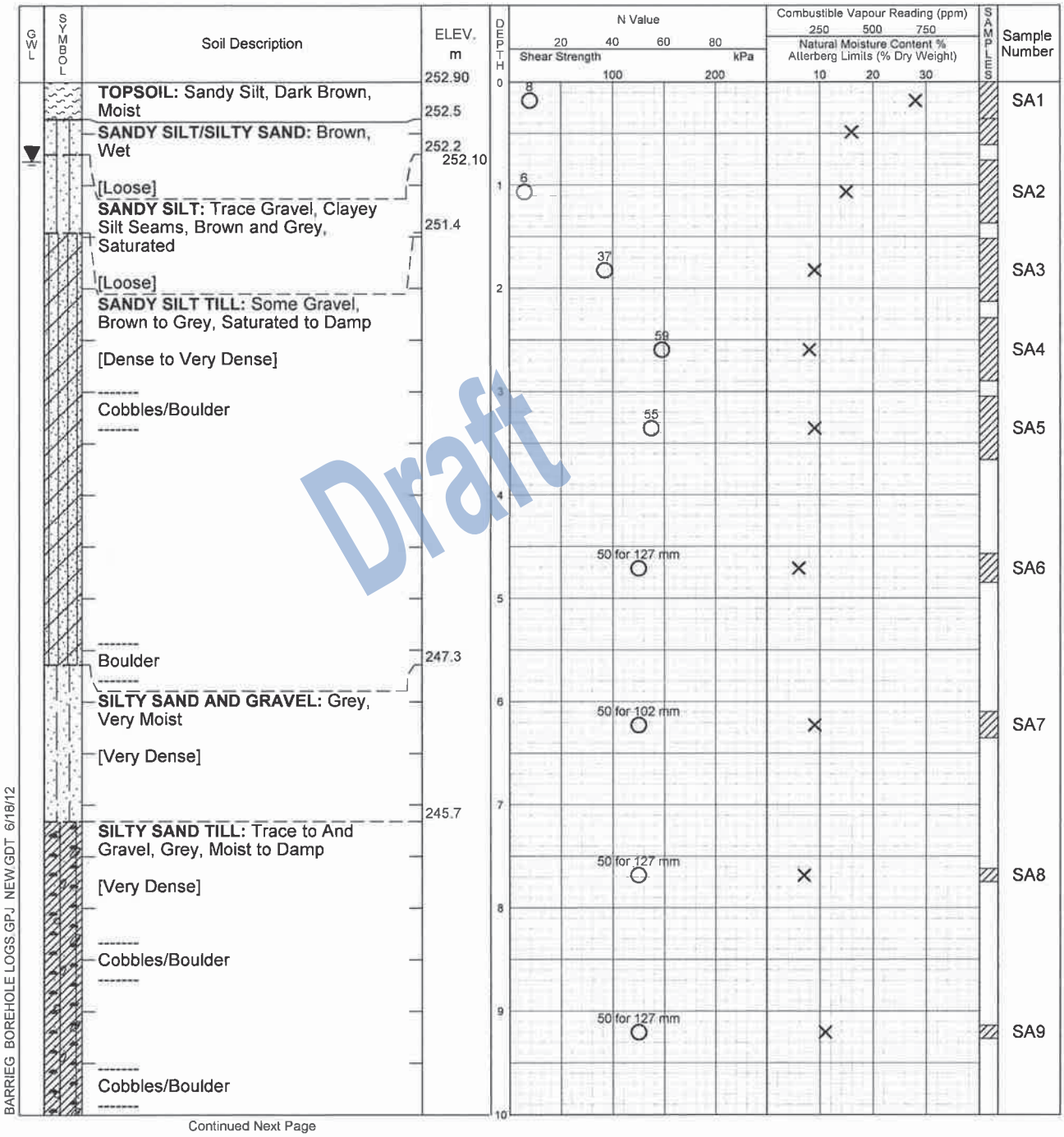
Date Drilled: May 16, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	0.8	1.4

Log of Borehole BH2

Project No. BAR-00025036-A0 Figure No. 3

Project: Clarington TS Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			242.90	10	20 40 60 80 / Shear Strength 100 200 kPa	250 500 750 / 10 20 30		
					50 for 127 mm	×		SA10
				11	70 for 102 mm			SA11
			241.3					
		AUGER REFUSAL ON PROBABLE BOULDER						

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	0.8	1.4

Log of Borehole BH3

Project No. BAR-00025036-A0 | Figure No. 4

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

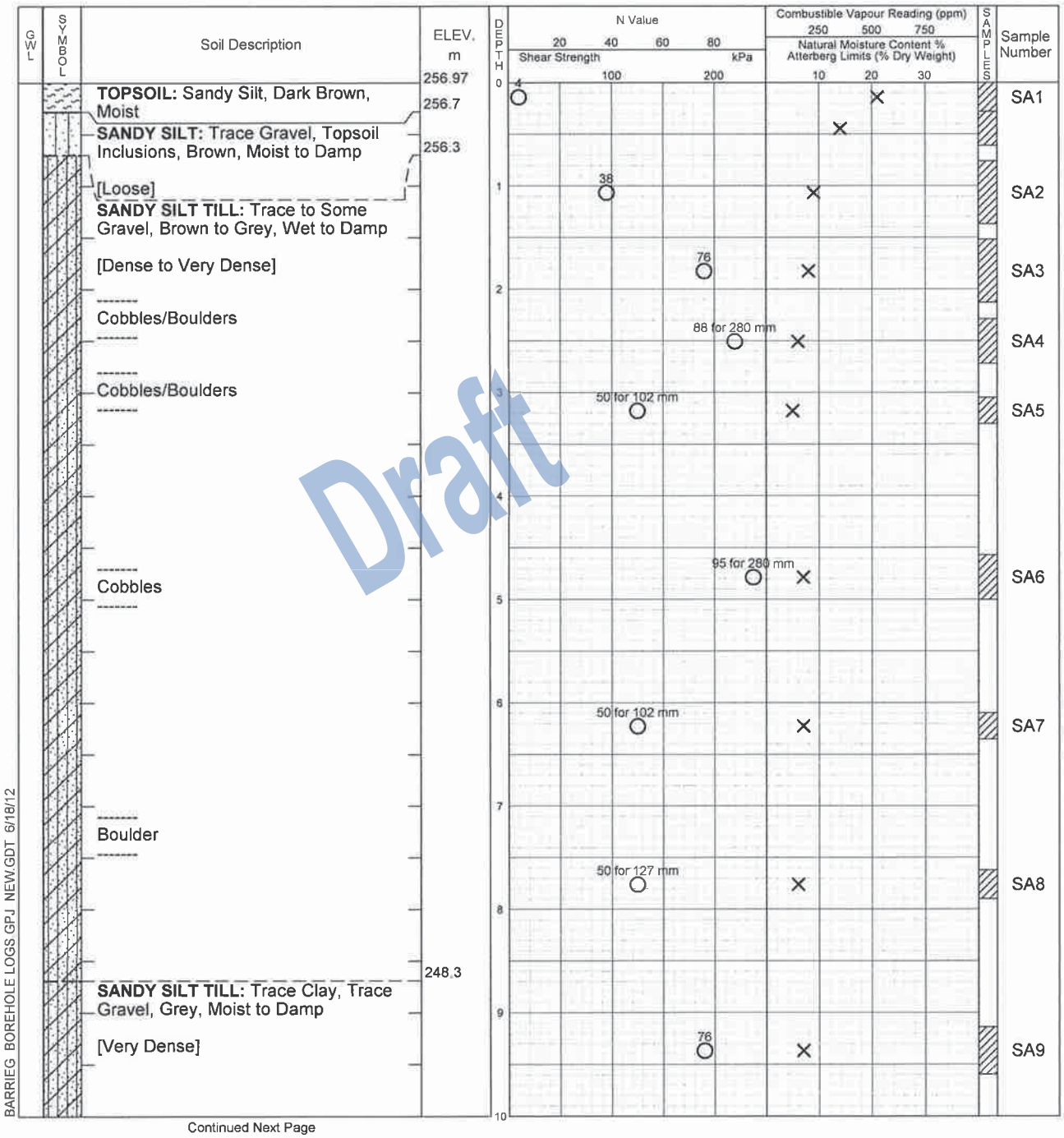
Date Drilled: May 15th & 16th, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

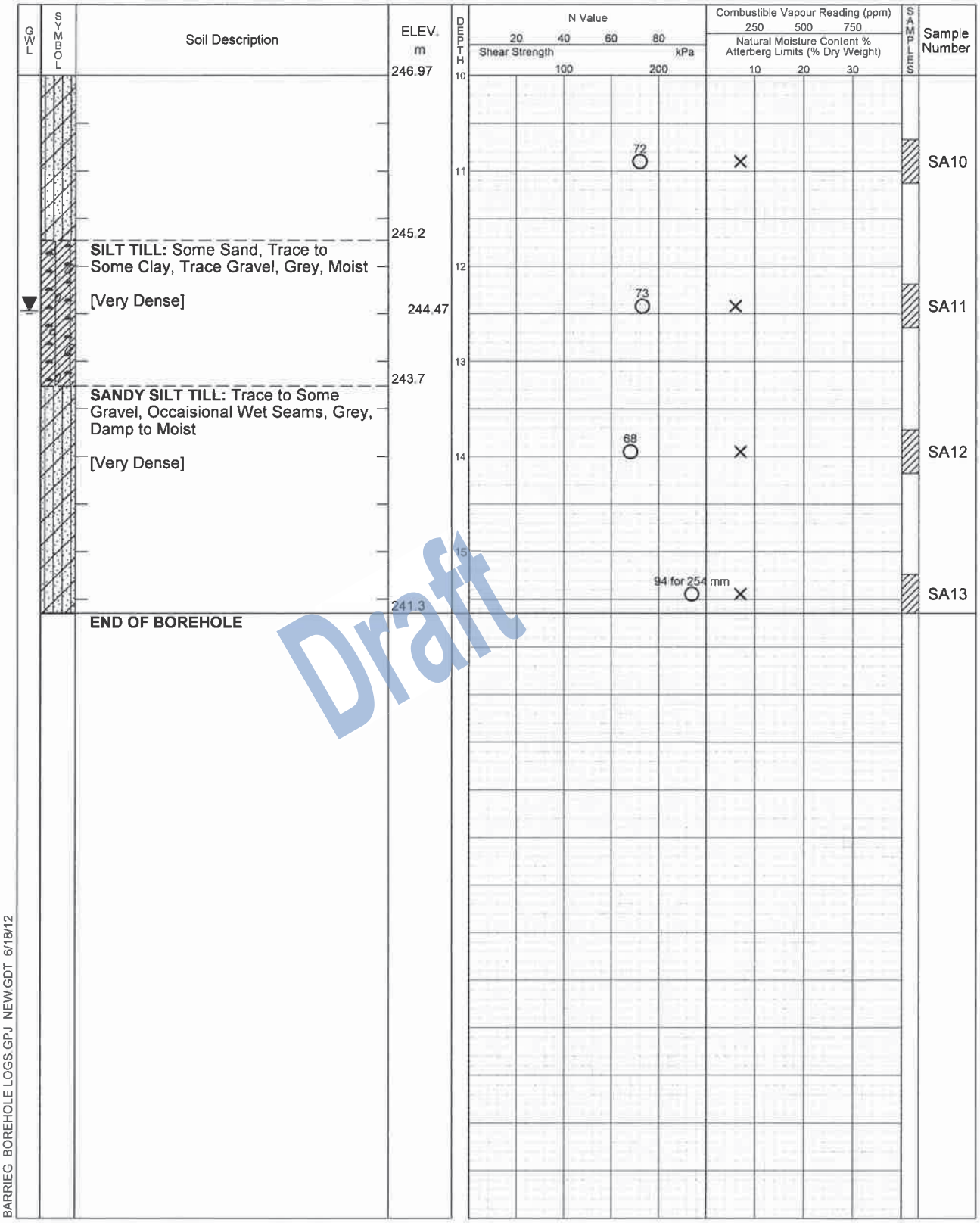
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	12.5	14.3

Log of Borehole BH3

Project No. BAR-00025036-A0 Figure No. 4

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	12.5	14.3

Log of Borehole BH4

Project No. BAR-00025036-A0 | Figure No. 5

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

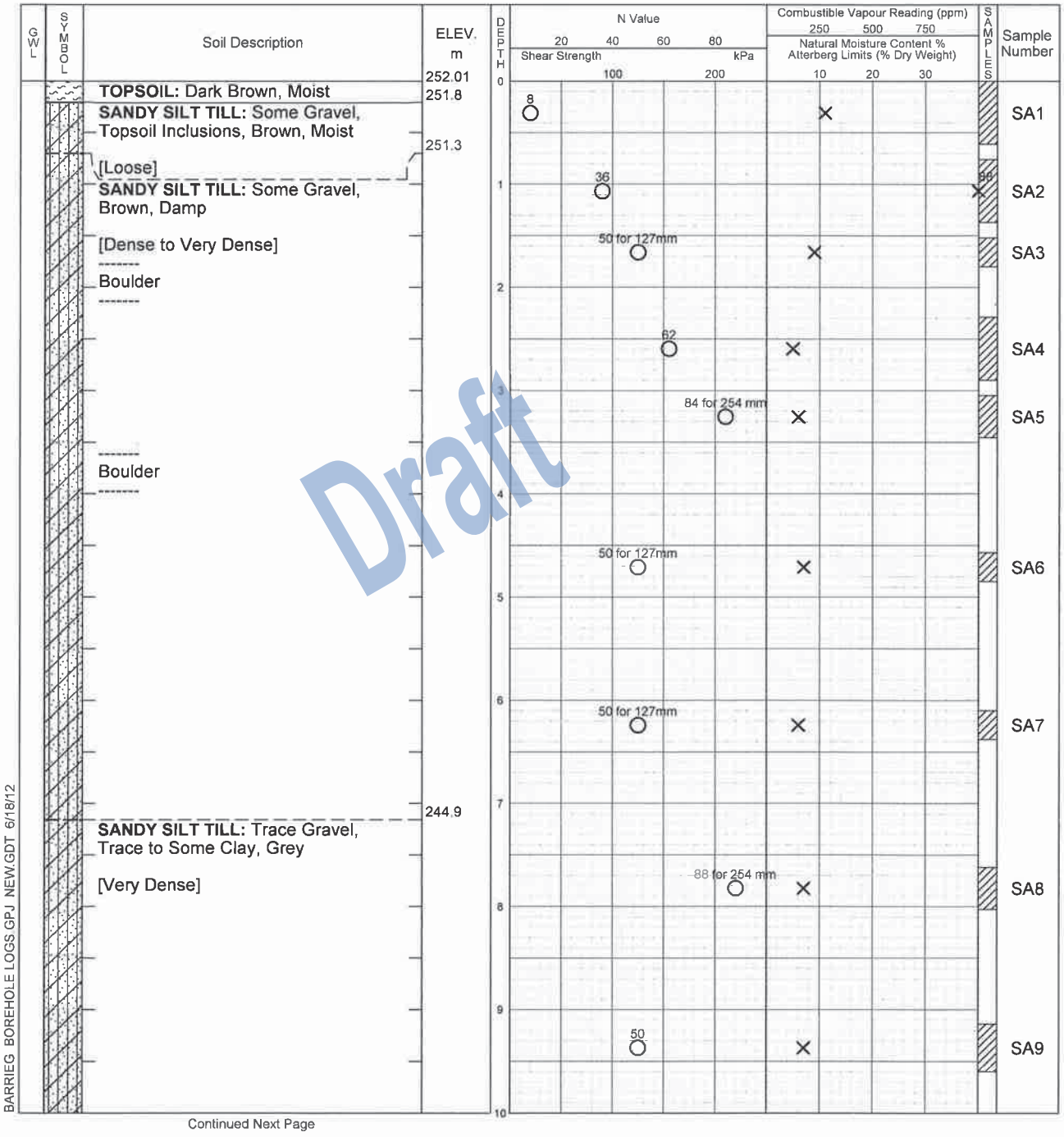
Date Drilled: May 25, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

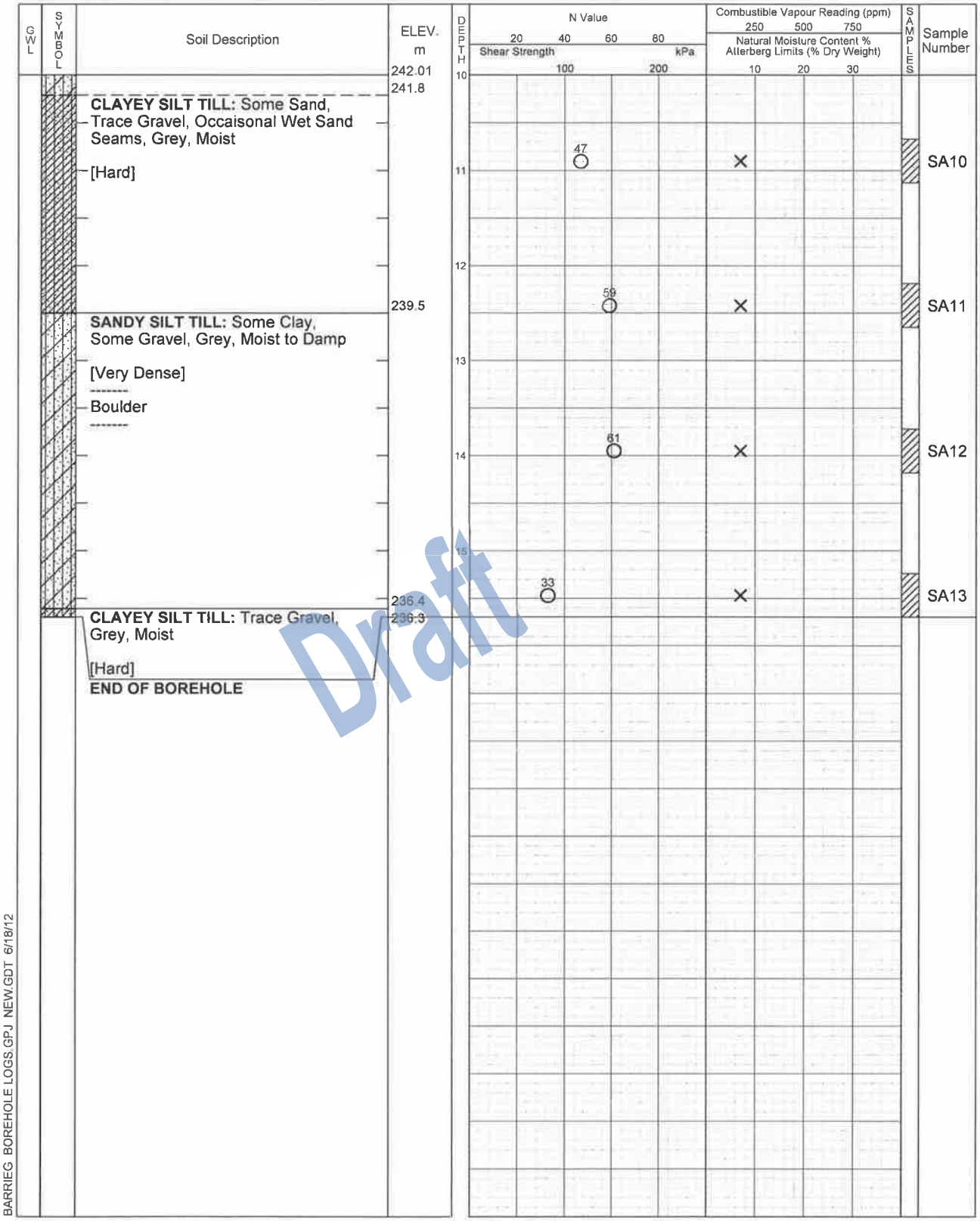
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	15.6

Log of Borehole BH4

Project No. BAR-00025036-A0 Figure No. 5

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	15.6

Log of Borehole BH5

Project No. BAR-00025036-A0 | Figure No. 6

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

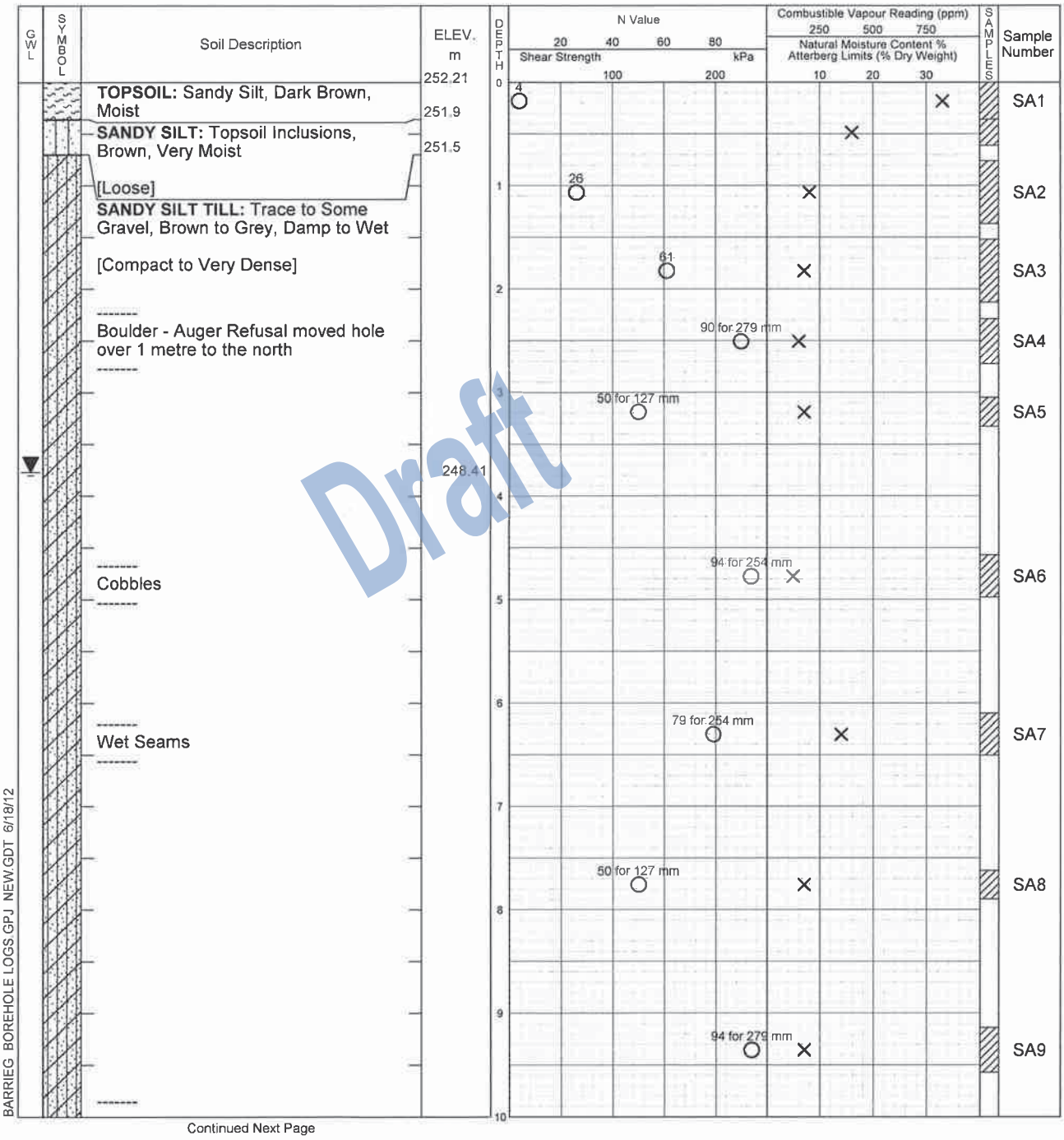
Date Drilled: May 15, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from Exp before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.8	6.1

Log of Borehole BH5

Project No. BAR-00025036-A0 Figure No. 6

Project: Clarington TS Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
		Boulder -------	242.21	0	50 for 127 mm	×		SA10
		AUGER REFUSAL ON PROBABLE BOULDER - END OF BOREHOLE	241.2	1				

N Value: 20 40 60 80
Shear Strength kPa: 100 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.8	6.1

Log of Borehole BH6

Project No. BAR-00025036-A0 | Figure No. 7

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

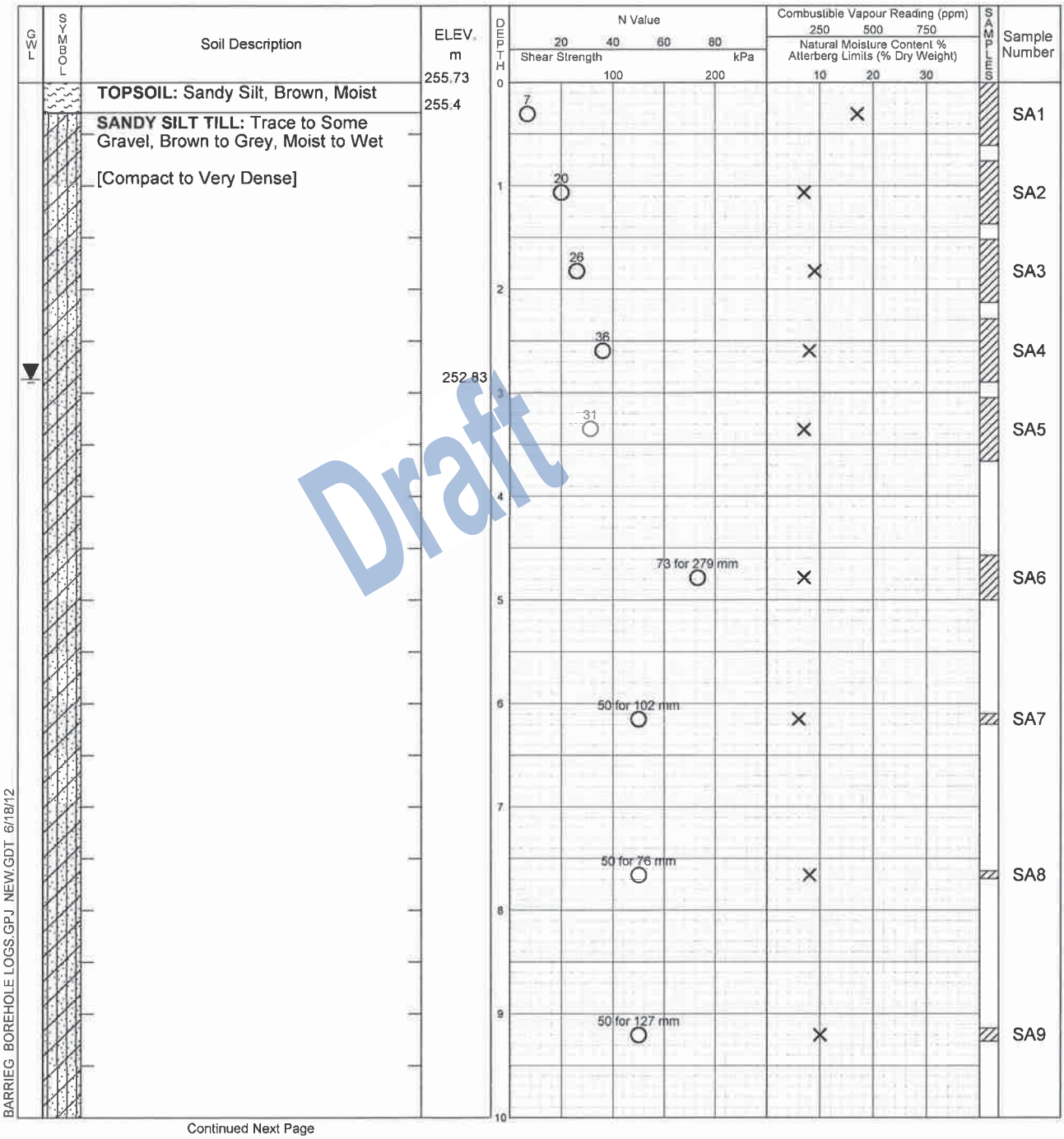
Date Drilled: May 28, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.9	5.8

Log of Borehole BH6

Project No. BAR-00025036-A0 Figure No. 7

Project: Clarington TS Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			245.73	10				
					50 for 102 mm		SA10	
				11				
			244.0					
		SILTY SAND/SANDY SILT: Grey, Wet to Saturated [Very Dense]		12	50 for 127 mm		SA11	
				13				
			241.9		50 for 76 mm		SA12	
		SANDY SILT TILL: Some Gravel, Grey, Moist to Very Moist [Very Dense]		14				
				15	50 for 102 mm		SA13	
			240.4					
		END OF BOREHOLE						

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.9	5.8

Log of Borehole BH7A

Project No. BAR-00025036-A0 | Figure No. 8

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

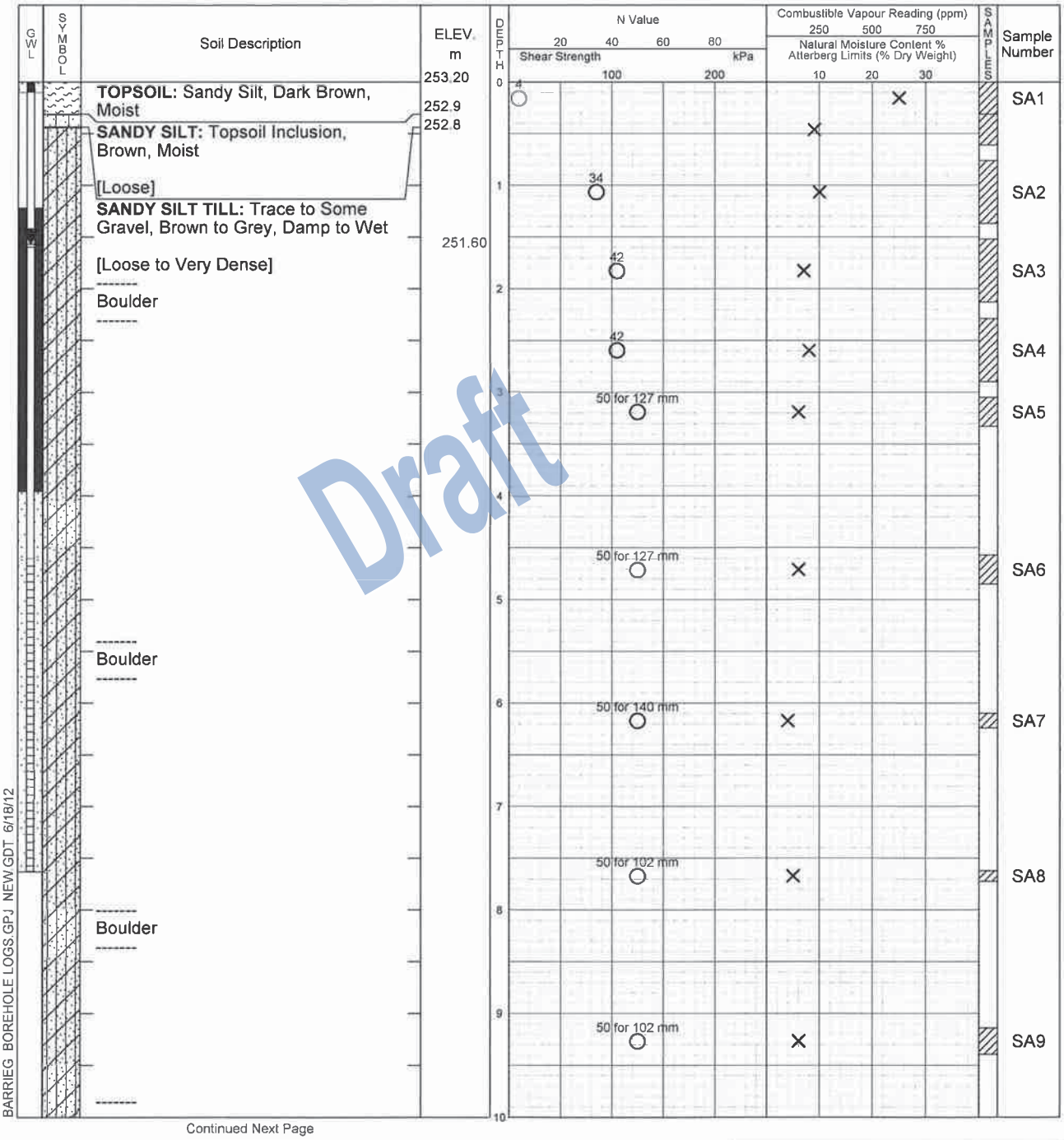
Date Drilled: May 24th & 25th, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from Exp before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.9	5.3
May 28, 2012	1.5	
May 29, 2012	2.4	
June 6, 2012	1.6	

Log of Borehole BH7A

Project No. BAR-00025036-A0 Figure No. 8

Project: Clarington TS Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
		Boulder -------	243.20	10	50 for 127 mm		SA10	SA10
				11				
				12	50 for 102 mm		SA11	SA11
				13				
				14	50 for 127 mm		SA12	SA12
				15	50 for 102 mm		SA13	SA13
		END OF BOREHOLE	237.9					

N Value: 20 40 60 80

Shear Strength: 100 200 kPa

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

NOTE: Borehole was relocated 3 times due to boulders at various depths.

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.9	5.3
May 28, 2012	1.5	
May 29, 2012	2.4	
June 6, 2012	1.6	

Log of Borehole BH7B

Project No. BAR-00025036-A0 | Figure No. 9

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

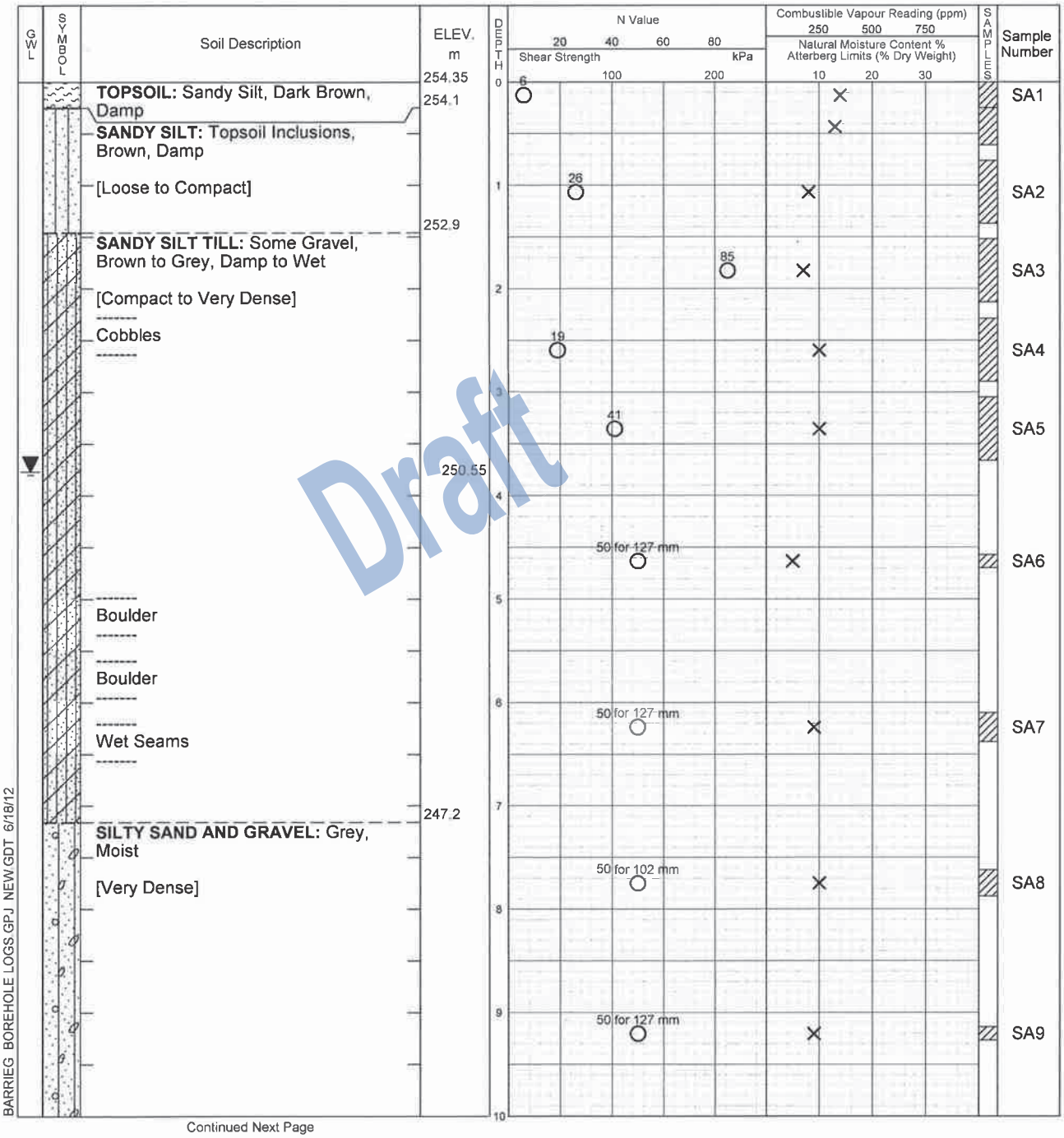
Date Drilled: May 25, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.8	7.5

Log of Borehole BH7B

Project No. BAR-00025036-A0 Figure No. 9

Project: Clarington TS Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			244.35	0	20 40 60 80 / 100 200	250 500 750 / 10 20 30		
		Boulder	243.7	10				
		AUGER REFUSAL ON PROBABLE BOULDER - END OF BOREHOLE						

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.8	7.5

Log of Borehole BH7C

Project No. BAR-00025036-A0 | Figure No. 10

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

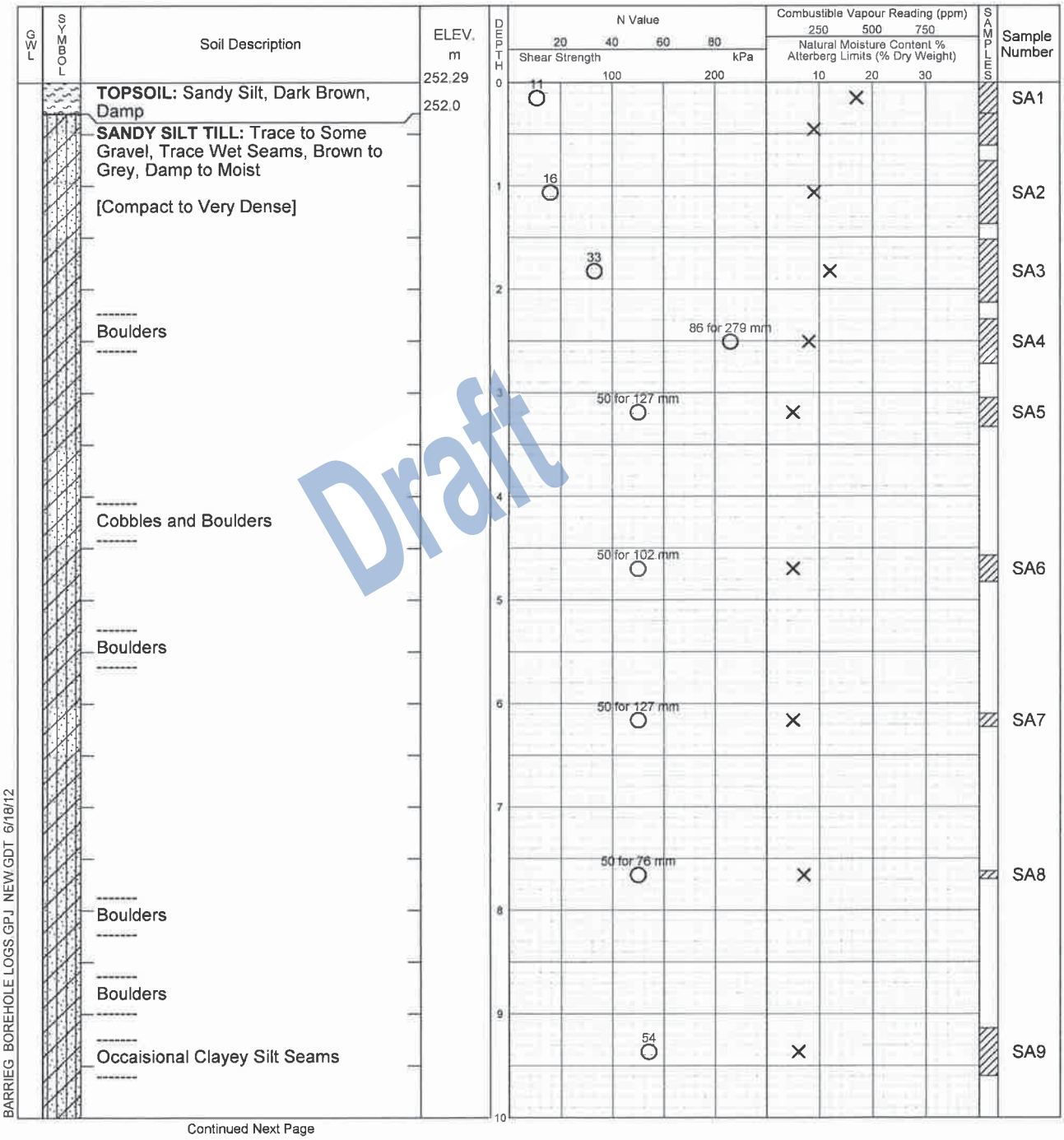
Date Drilled: May 30, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

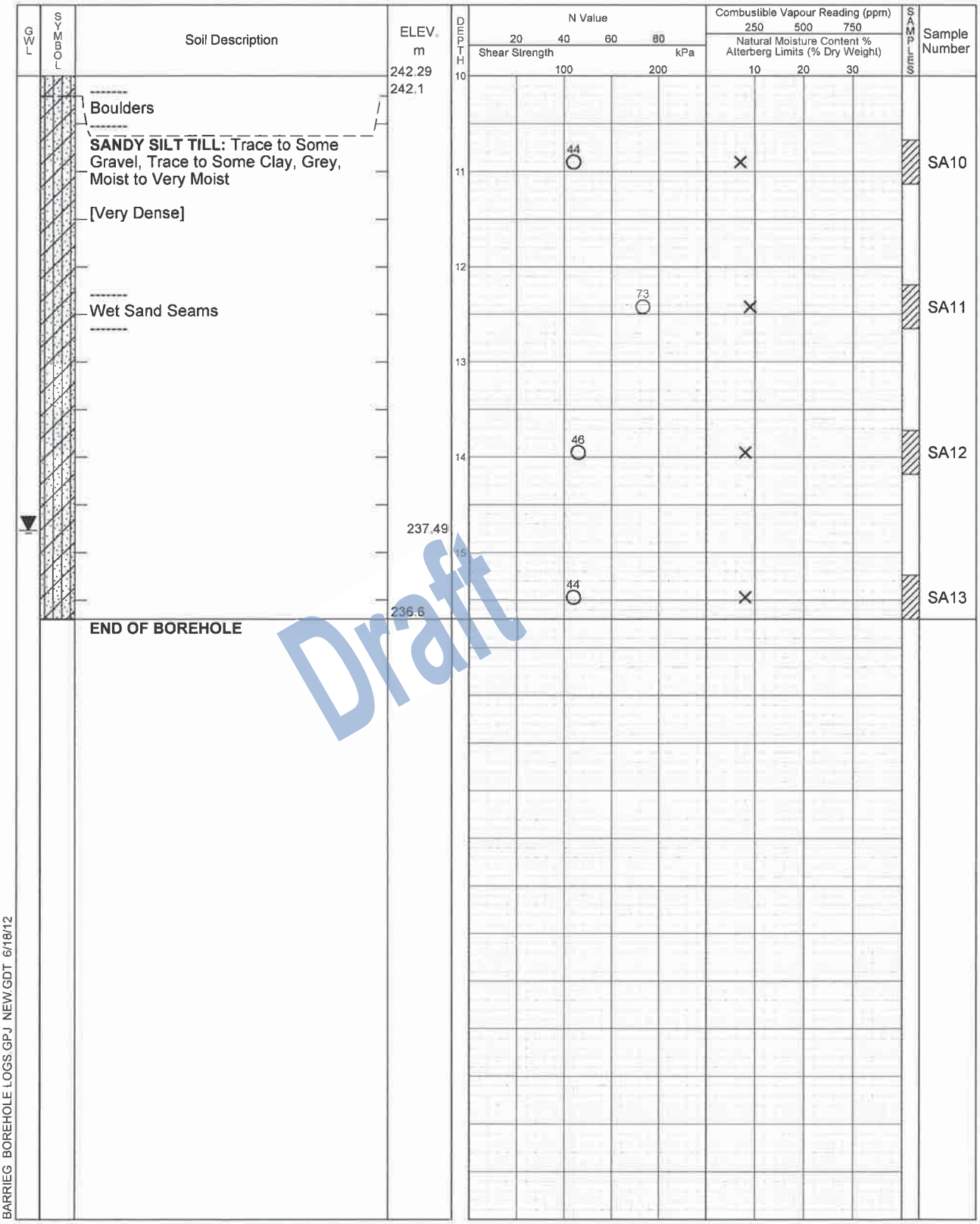
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	14.8	15.2

Log of Borehole BH7C

Project No. BAR-00025036-A0 Figure No. 10

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	14.8	15.2

Log of Borehole BH7D

Project No. BAR-00025036-A0 | Figure No. 11

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

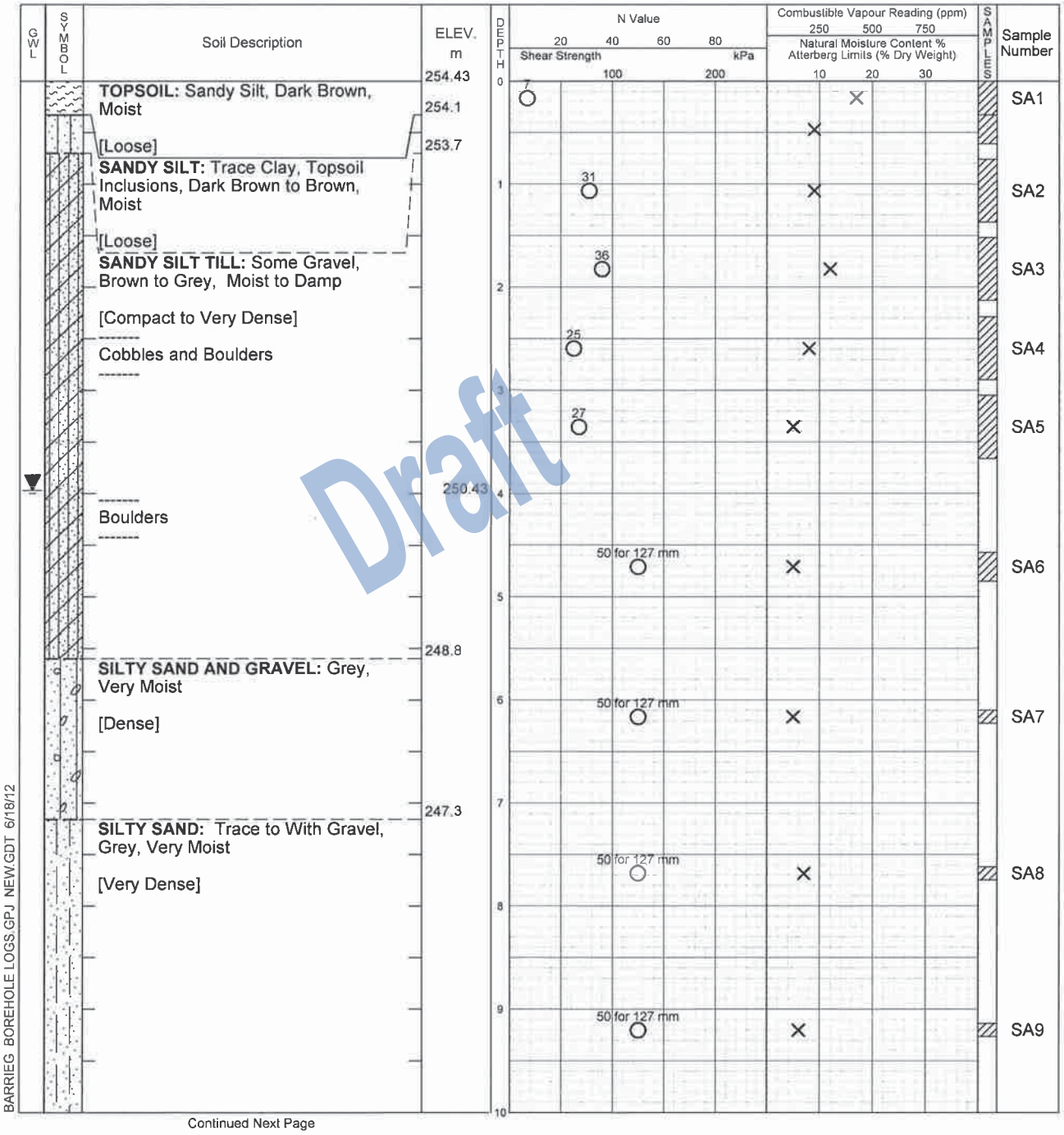
Date Drilled: May 25,2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

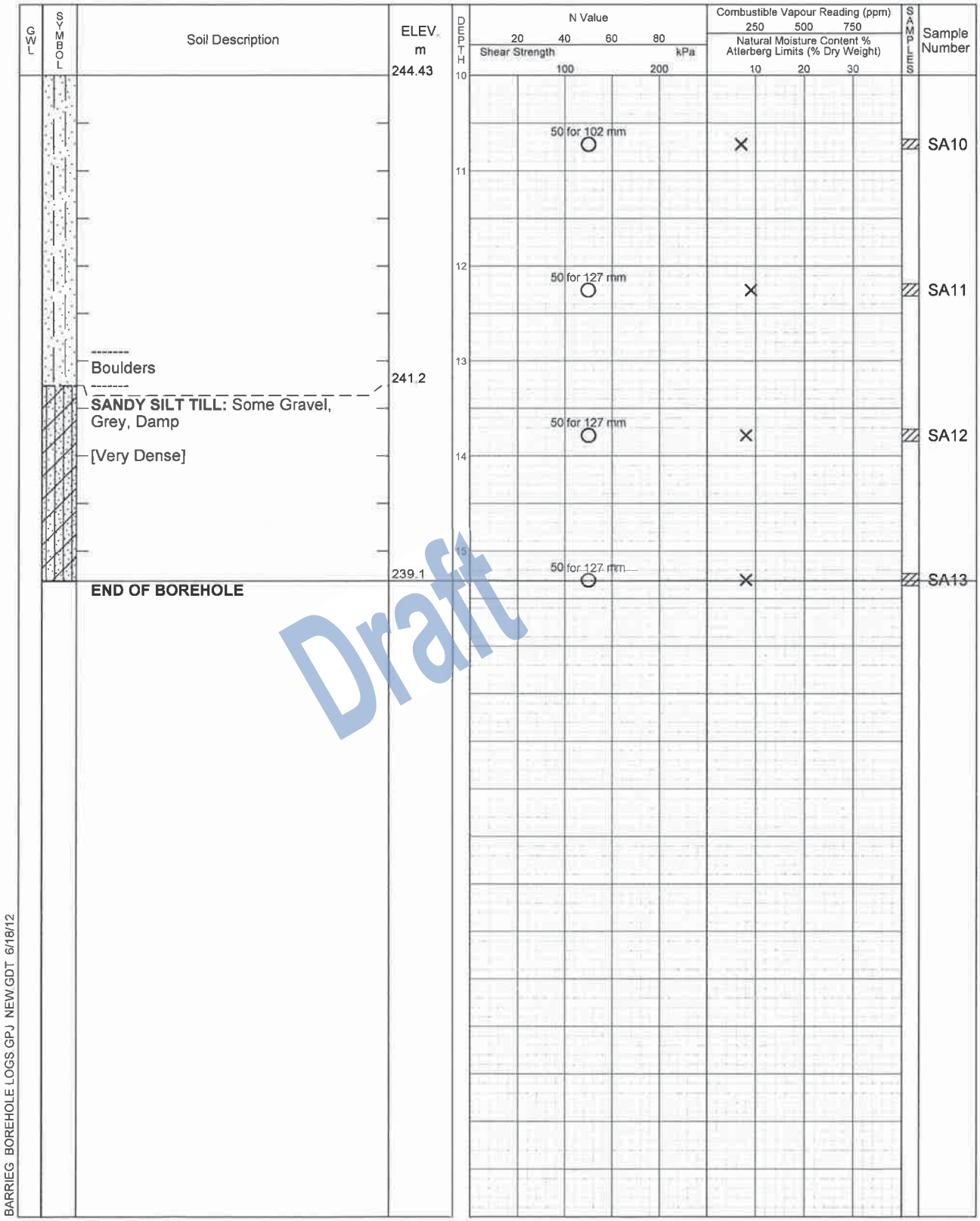
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.0	4.7

Log of Borehole BH7D

Project No. BAR-00025036-A0 Figure No. 11

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.0	4.7

Log of Borehole BH8

Project No. BAR-00025036-A0 | Figure No. 12

Project: Clarington TS | Sheet No. 1 of 1

City/ Municipality: Municipality of Clarington, Ontario

Location:

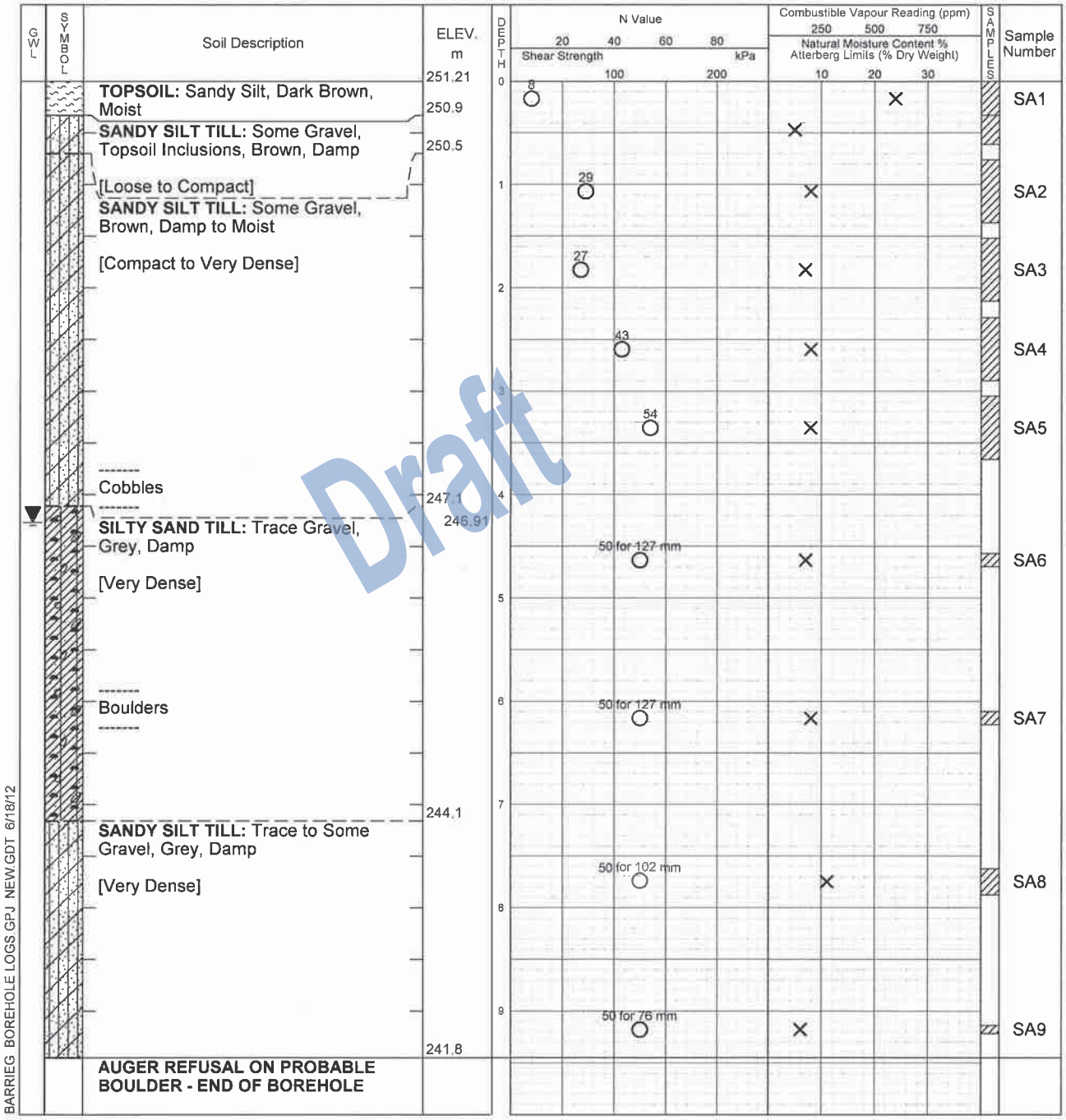
Date Drilled: May 22, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.3	4.4

Log of Borehole BH9

Project No. BAR-00025036-A0 | Figure No. 13

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

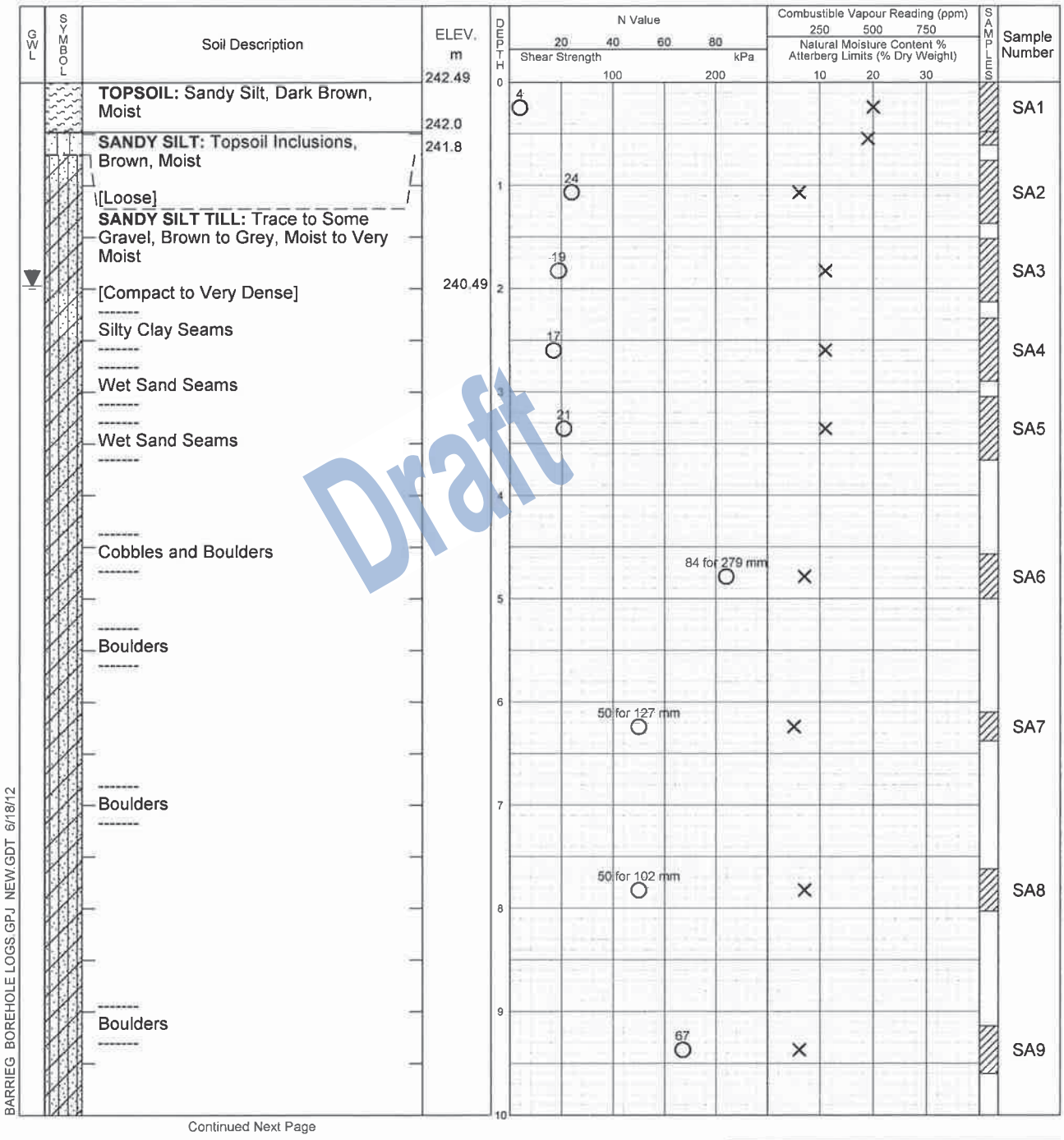
Date Drilled: May 18, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

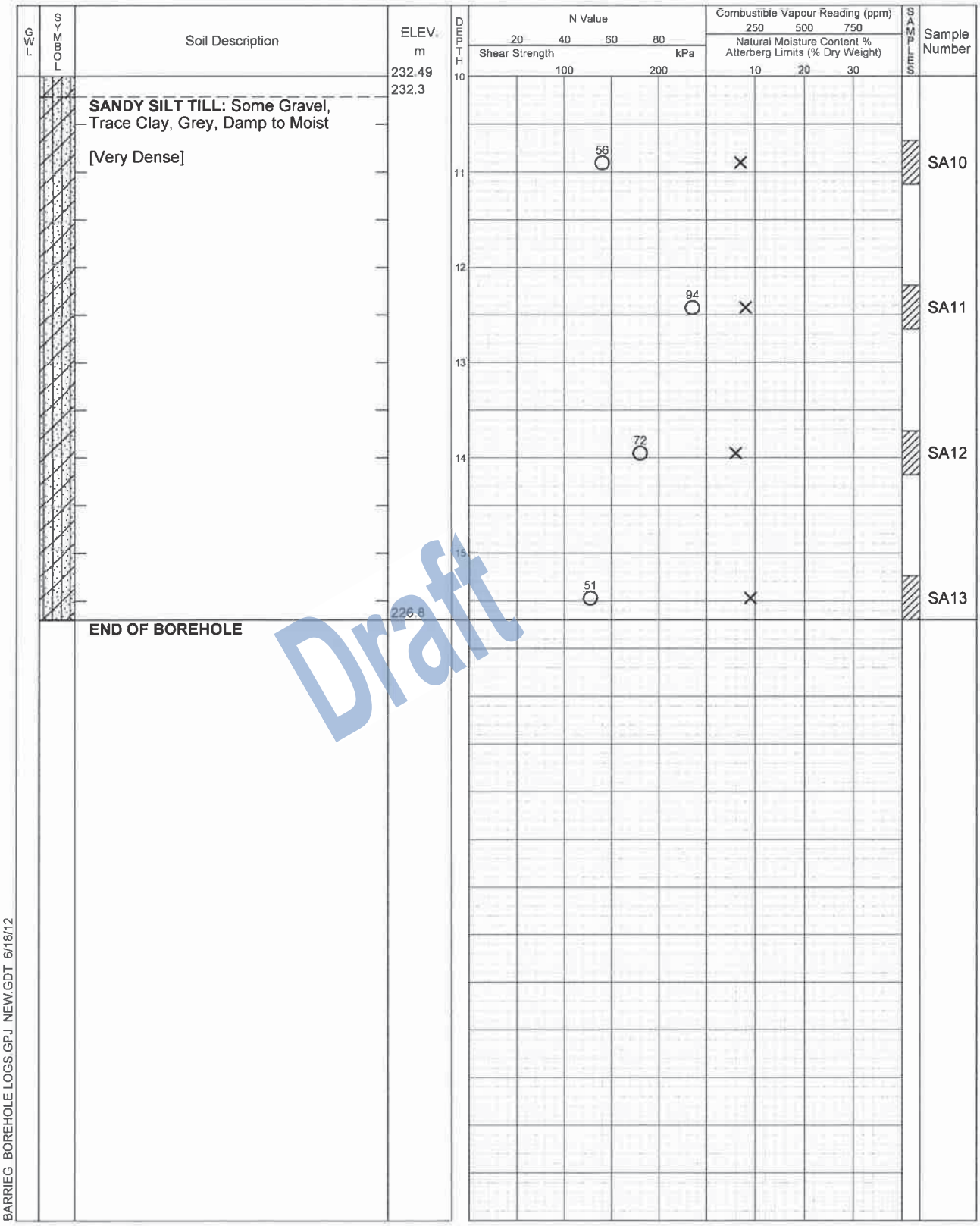
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.0	3.6

Log of Borehole BH9

Project No. BAR-00025036-A0 Figure No. 13

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.0	3.6

Log of Borehole BH10

Project No. BAR-00025036-A0 | Figure No. 14

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

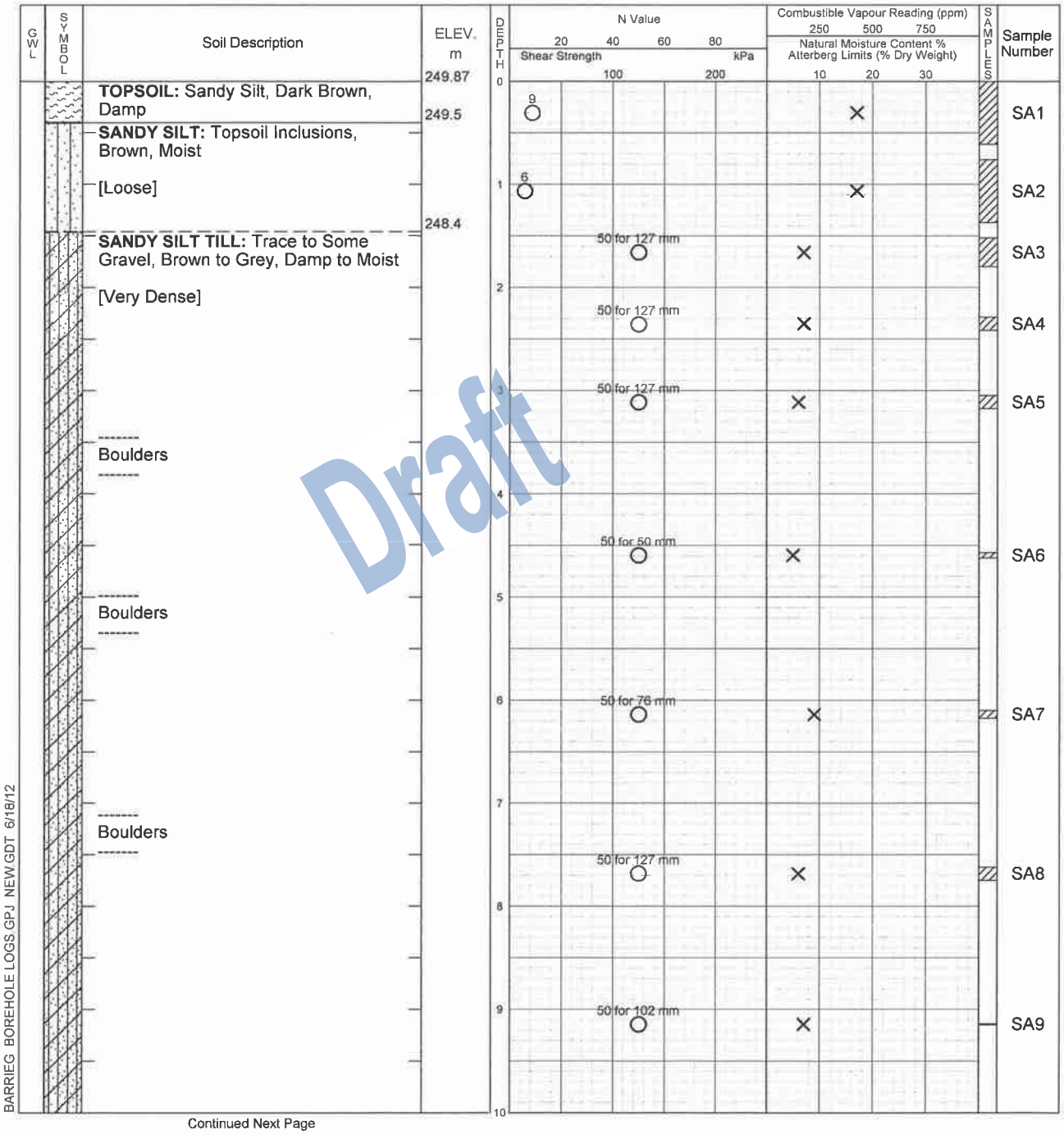
Date Drilled: May 22, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	15.5

Log of Borehole BH10

Project No. BAR-00025036-A0 Figure No. 14

Project: Clarington TS Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
			239.87	10	20 40 60 80 / 100 200	250 500 750 / 10 20 30		
		Boulders		11	50 for 102 mm	×		SA10
				12	50 for 127 mm	×		SA11
			236.6	13				
		SANDY SILT TILL: Some Gravel, Trace Clay, Grey, Damp [Very Dense]		14	78	×		SA12
				15	95 for 254 mm	×		SA13
			234.2					
		END OF BOREHOLE NOTE: Auger refusal at 5.2 metres; Borehole was moved 0.9 metres west of original location and re-drilled						

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	15.5

Log of Borehole BH11

Project No. BAR-00025036-A0 | Figure No. 15

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

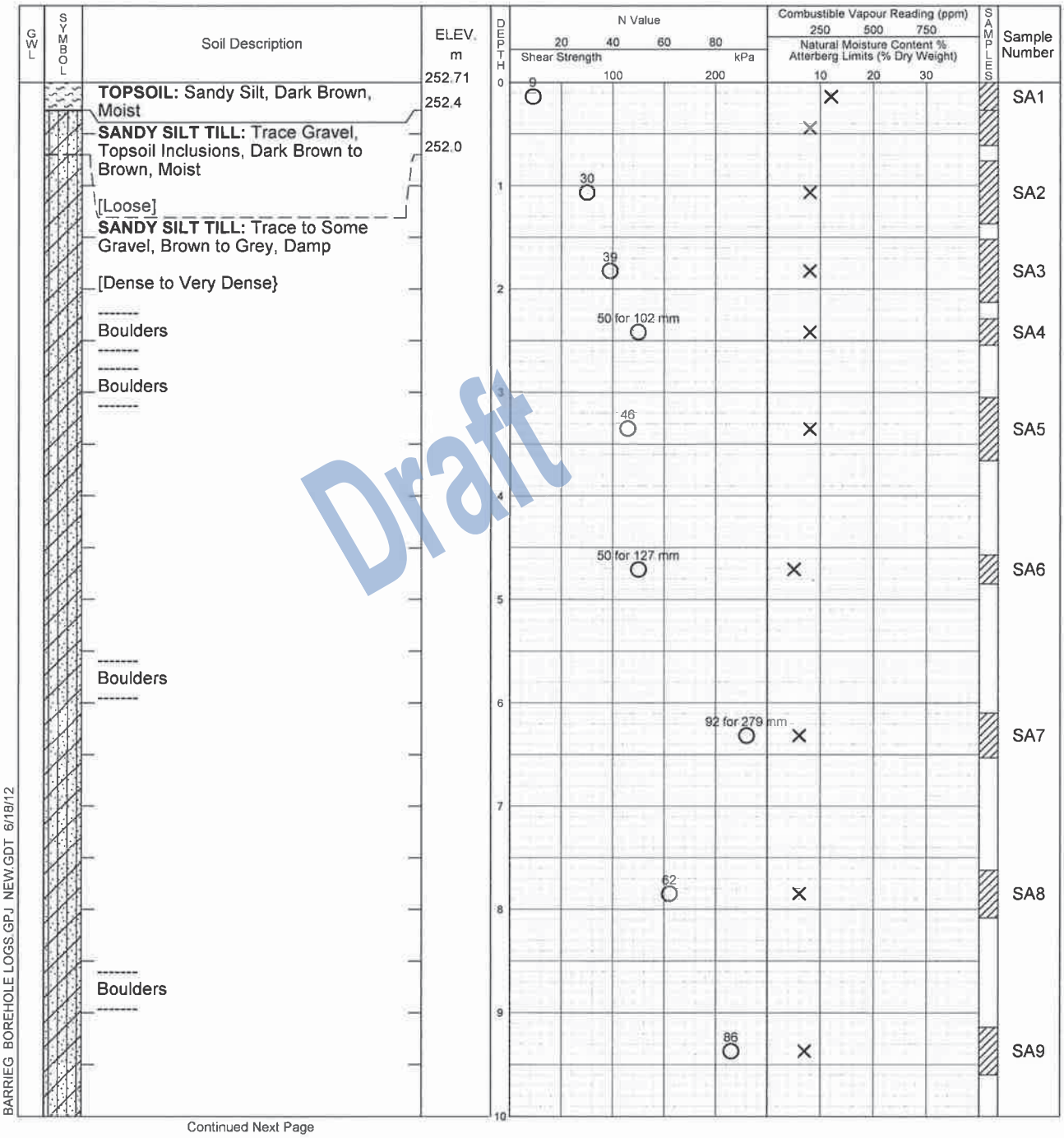
Date Drilled: May 30, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample ☒ | SPT (N) Value ○ ▨ | Dynamic Cone Test ——— | Shelby Tube ■ | Field Vane Test ✚ S

Combustible Vapour Reading □ | Natural Moisture × | Plastic and Liquid Limit ⊢—○ | Undrained Triaxial at % Strain at Failure ⊕ | Penetrometer ▲



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

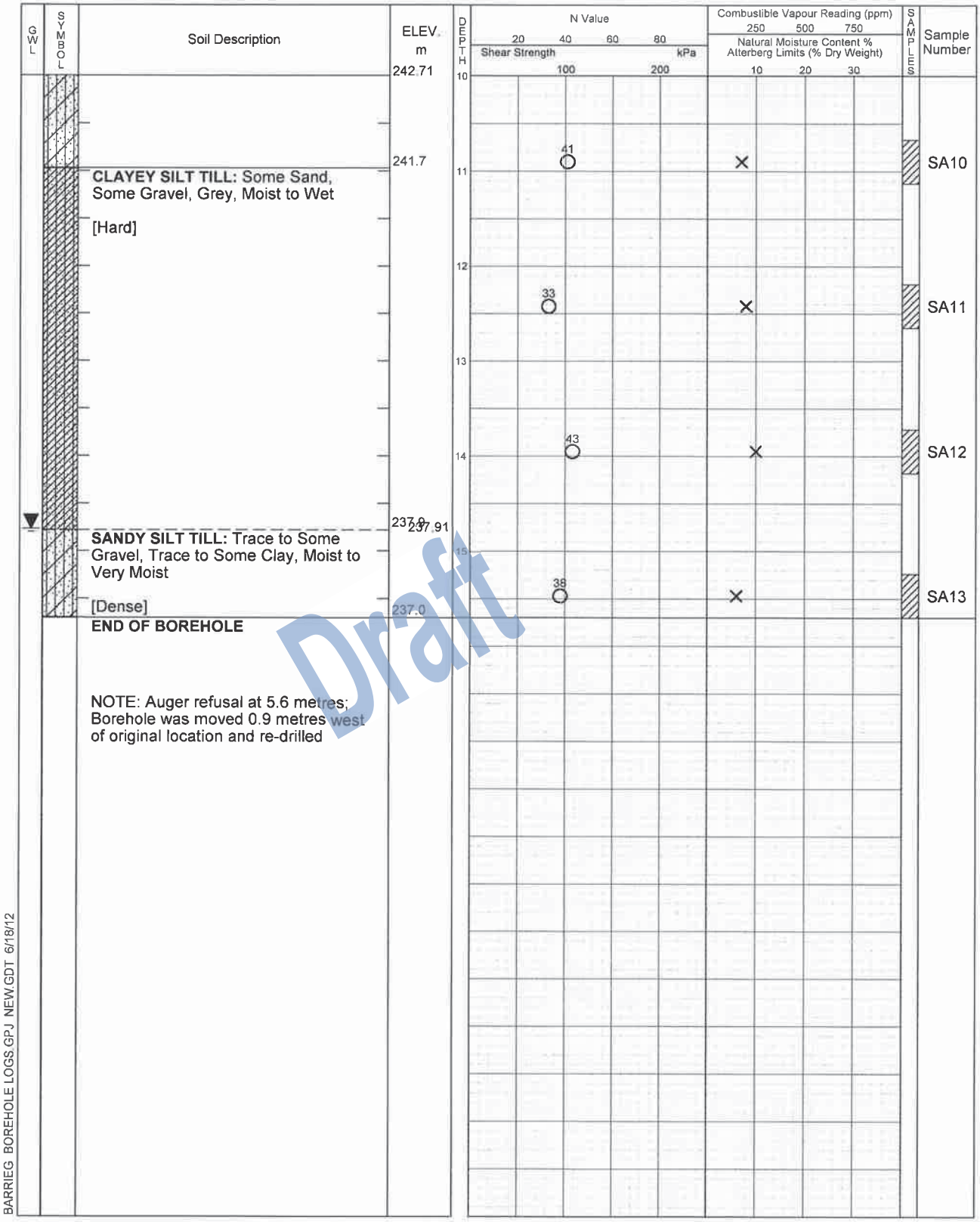
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	14.8	15.2

Log of Borehole BH11

Project No. BAR-00025036-A0 Figure No. 15

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	14.8	15.2

Log of Borehole BH12A

Project No. BAR-00025036-A0 | Figure No. 16

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

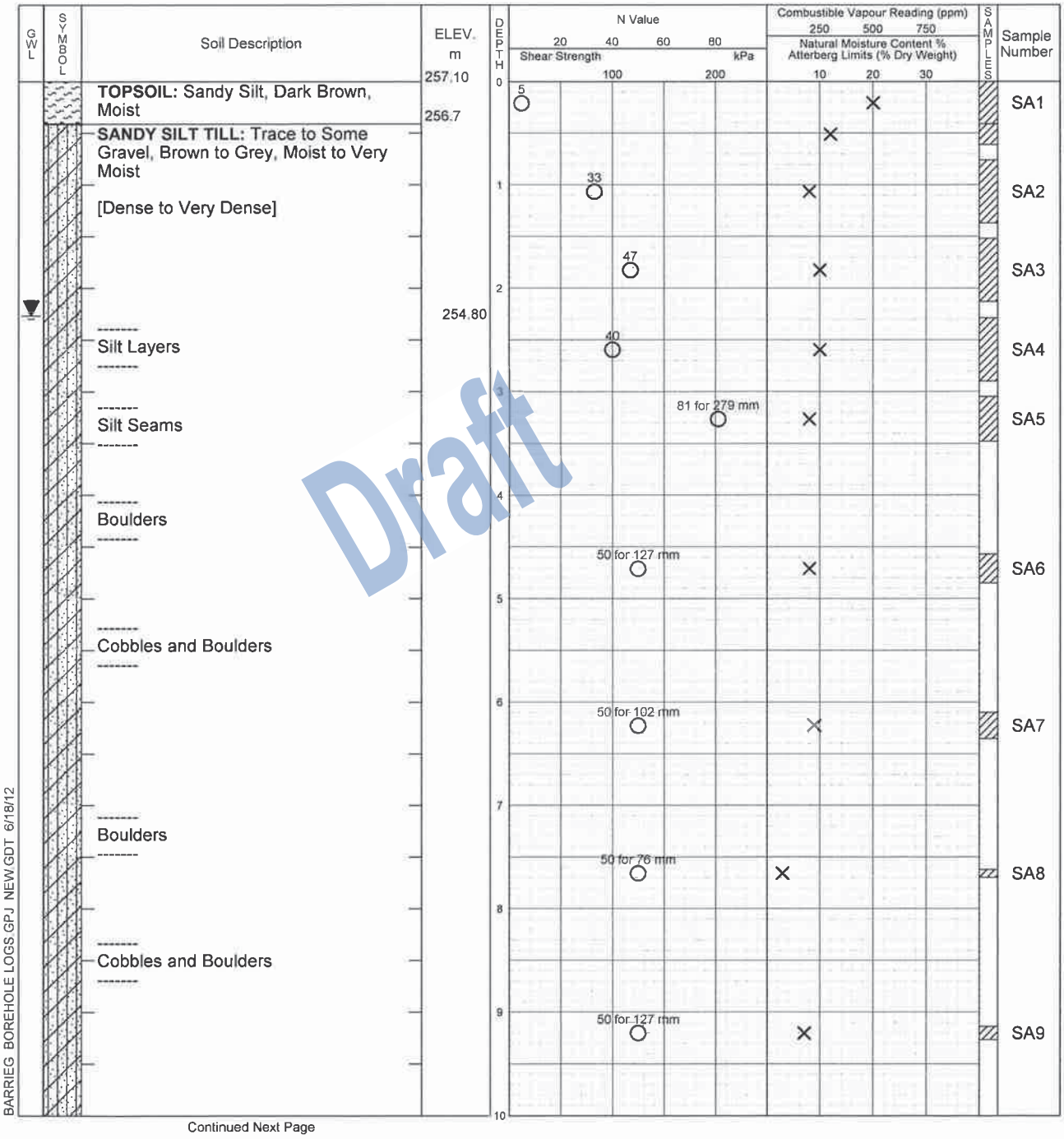
Date Drilled: May 23, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



Continued Next Page

BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from Exp before use by others.

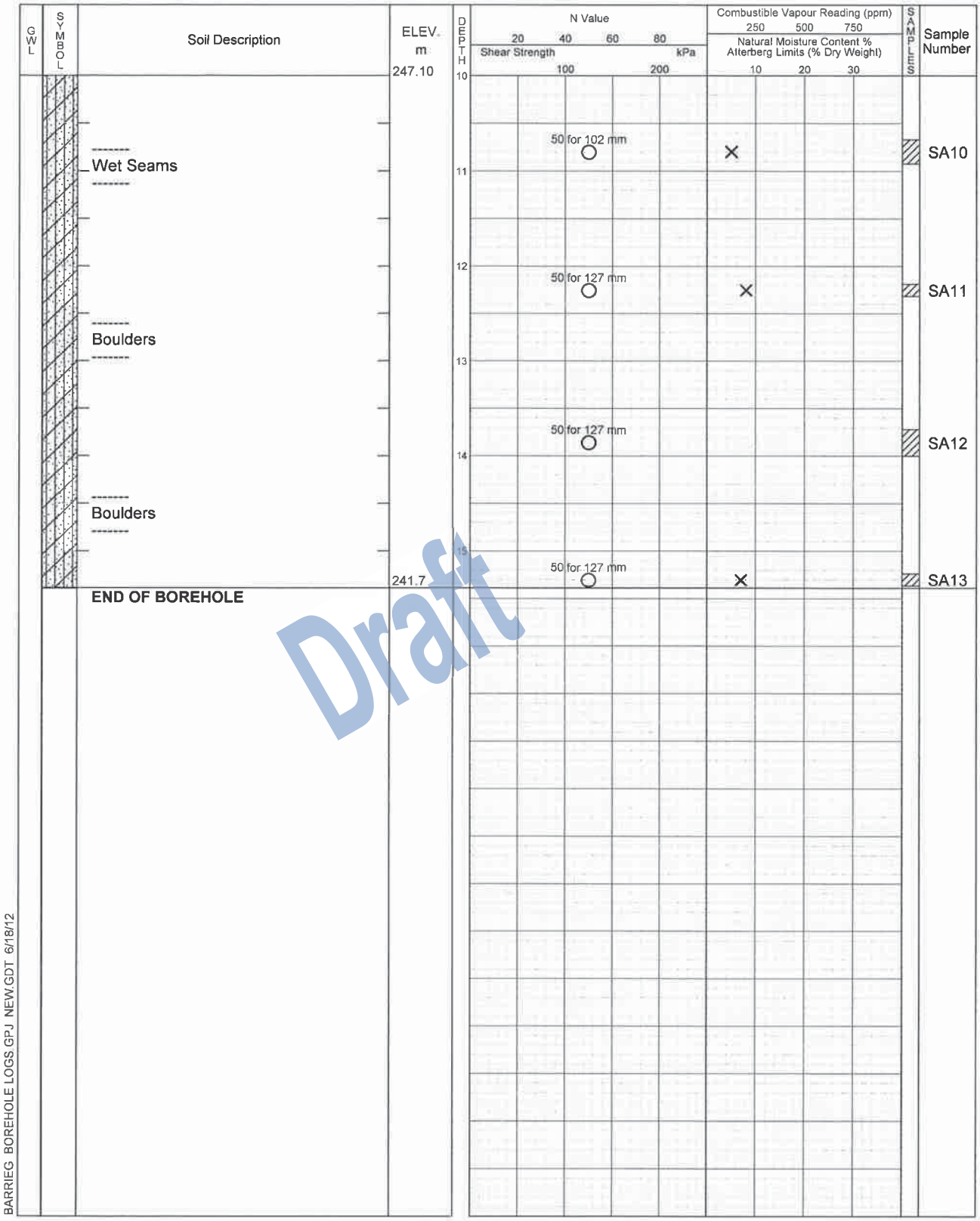
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.3	2.3

Log of Borehole BH12A

Project No. BAR-00025036-A0 Figure No. 16

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.3	2.3

Log of Borehole BH12B

Project No. BAR-00025036-A0 | Figure No. 17

Project: Clarington TS | Sheet No. 1 of 2

City/ Municipality: Municipality of Clarington, Ontario

Location:

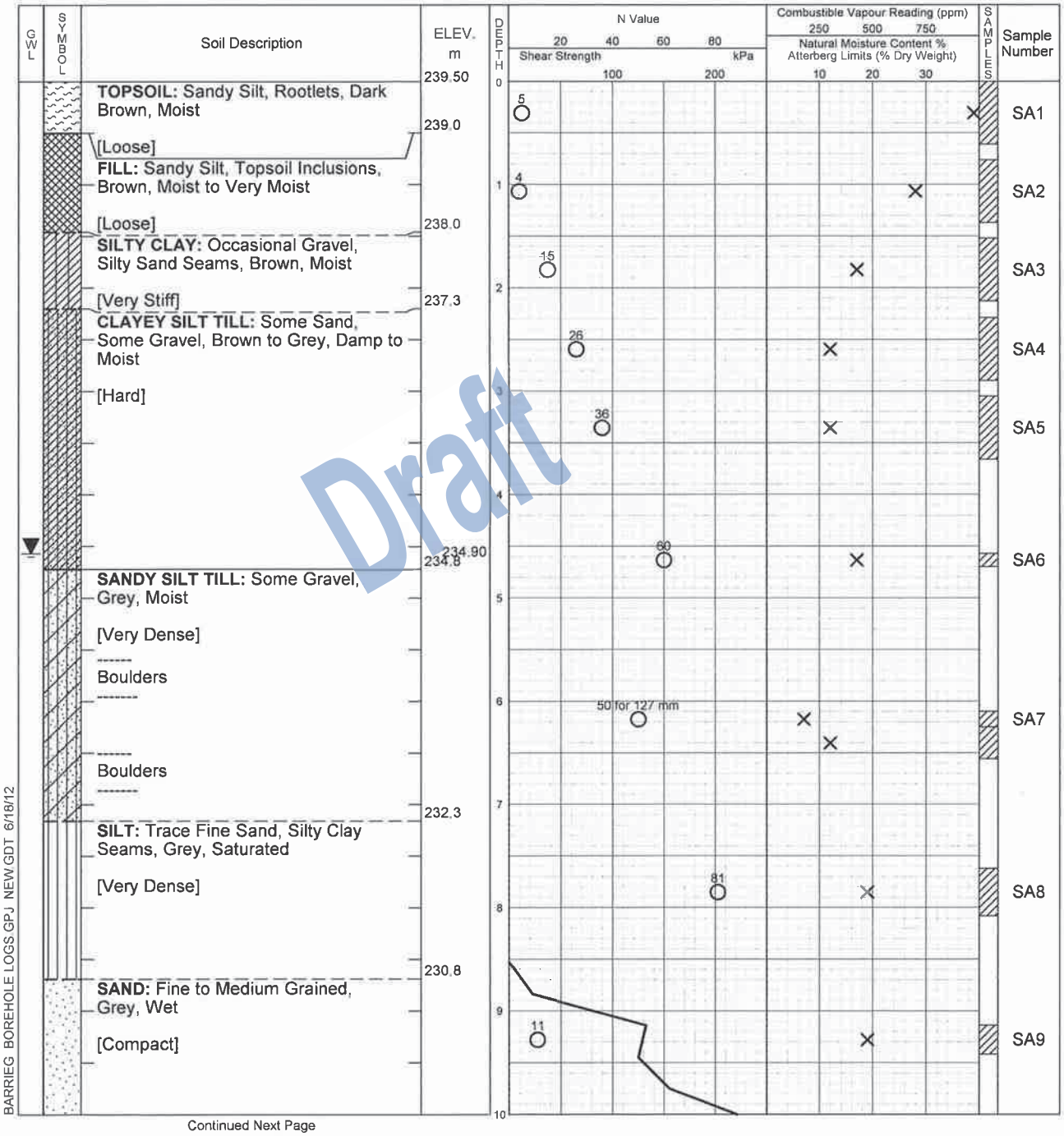
Date Drilled: May 31, 2012

Drill Type: Hollow Stem Augers

Datum:

Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Field Vane Test (S)

Combustible Vapour Reading | Natural Moisture | Plastic and Liquid Limit | Undrained Triaxial at % Strain at Failure | Penetrometer



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

Continued Next Page

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

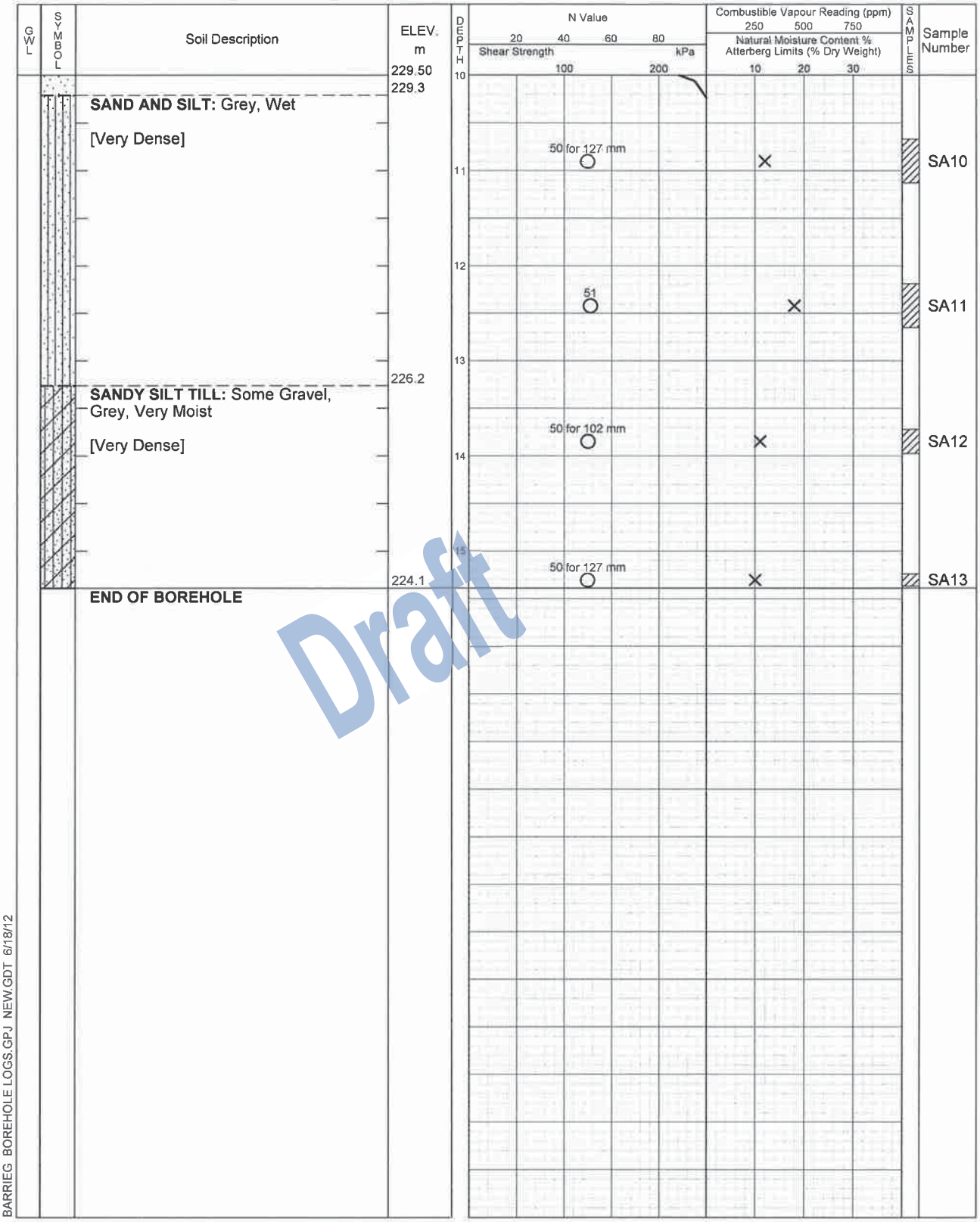
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.6	5.18

Log of Borehole BH12B

Project No. BAR-00025036-A0 Figure No. 17

Project: Clarington TS Sheet No. 2 of 2



BARRIEG BOREHOLE LOGS.GPJ NEW.GDT 6/18/12

exp. Services Inc.
561 Bryne Drive, Unit D
Barrie, ON L4N 9Y3
t: +1.705.734.6222
f: +1.705.734.6224

Borehole data requires interpretation assistance from **Exp** before use by others.

See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.6	5.18

REFERENCE No.: T040774a1 ENCLOSURE No.: 1

INSPEC·SOL

BOREHOLE No.: BH1-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 12, 2012 DATE (FINISH): November 13, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.12			TOPSOIL : 120 mm						
1				FILL : SILT and CLAY, trace gravel, trace topsoil and rootlets, brown, moist to very moist, soft		SS-1	92	34	1-1-2-3	3
2	0.76			NATIVE : SANDY CLAYEY SILT TILL to SANDY SILTY CLAY TILL, trace to some gravel, oxidized seams, greyish brown, moist to very moist, very stiff to hard		SS-2	92	12	4-6-11-14	17
3	1.0									
4										
5	1.52			SANDY SILTY CLAY TILL, trace gravel, grey, moist, hard		SS-3	100	9	16-33-36-37	69
6										
7	2.0									
8	2.29			Cobble fragments		SS-4	82	6	31-34-50/ 125mm	100
9										
10	3.0					SS-5	67	5	50/ 75mm	100
11										
12										
13	4.0									
14										
15						SS-6	67	6	50/ 75mm	100
16										
17	5.0									
18										
19										
20	6.0					SS-7	100	5	50/ 125mm	100
21										
22										
23	7.0									
24										
25										
26	8.0					SS-8	80	8	40-45-50/ 75mm	100
27										
28										
29	9.0									
30						SS-9	91	11	30-50/	100

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

WL2.9 11/13/2012

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 1

INSPEC·SOL

BOREHOLE No.: BH1-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 12, 2012 DATE (FINISH): November 13, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
				GROUND SURFACE							
									125mm		
32											
33	10.0										
34											
35											
36	11.0					SS-10	100	8	16-24-50/ 100mm	100	○ ●
37											
38											
39	12.0										
40											
41						SS-11	100	8	33-44-50/ 125mm	100	○ ●
42											
43	13.0										
44											
45											
46	14.0					SS-12	100	9	26-47-50/ 75mm	100	○ ●
47											
48											
49	15.0										
50											
51						SS-13	88	9	26-37-50/ 125mm	100	○ ●
52	15.67										
53	16.0			**END OF BOREHOLE**							
54											
55				NOTE :							
56	17.0			End of Borehole at 15.67 m bgs							
57				Water level at 2.88 m bgs upon completion							
58				Borehole caved to 14.8 m depth							
59	18.0			bgs denotes below ground surface							
60											
61											
62											

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 2

INSPEC·SOL

BOREHOLE No.: BH2-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 14, 2012 DATE (FINISH): November 14, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.10			TOPSOIL with organics : 100 mm						
1				FILL : SILTY SAND, some clay, trace gravel, topsoil and rootlets, dark brown to brown, very moist to saturated, loose		SS-1	58	--	1-2-3-6	5
2	0.76									
3	1.0			NATIVE : SANDY CLAYEY SILT TILL, trace to some gravel, sand pockets, cobble fragments, brown, moist, hard Sa : 42%, Gr : 5%, Si : 39%, Cl : 14%		SS-2	60	--	7-13-22-50/ 50mm	35
4										
5						SS-3	80	--	23-36-50/ 75mm	100
6	2.0									
7	2.29			Cobble fragments		SS-4	67	--	48-50/ 75mm	100
8										
9	3.0									
10	3.05			CLAYEY SILT TILL, trace to some sand and gravel, grey, moist, hard		SS-5	60	--	49-50/ 100mm	100
11										
12										
13	4.0									
14										
15						SS-6	60	--	50/ 125mm	100
16										
17	5.0									
18										
19										
20	6.0			Some sand, cobble fragments		SS-7	82	--	42-44-50/ 125mm	100
21										
22										
23	7.0									
24										
25	7.62			SANDY CLAYEY SILT TILL, some gravel, cobble fragments, grey, hard, moist		SS-8	96	--	12-24-32-50/ 125mm	56
26	8.0			Sa : 41%, Gr : 5%, Si : 37%, Cl : 17%						
27										
28										
29	9.0									
30									22-27-27-35	

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

0.90 m

WL0.2
11/19/2012
0.3 m

Bentonite Seal

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 2

INSPEC·SOL

BOREHOLE No.: BH2-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 14, 2012 DATE (FINISH): November 14, 2012

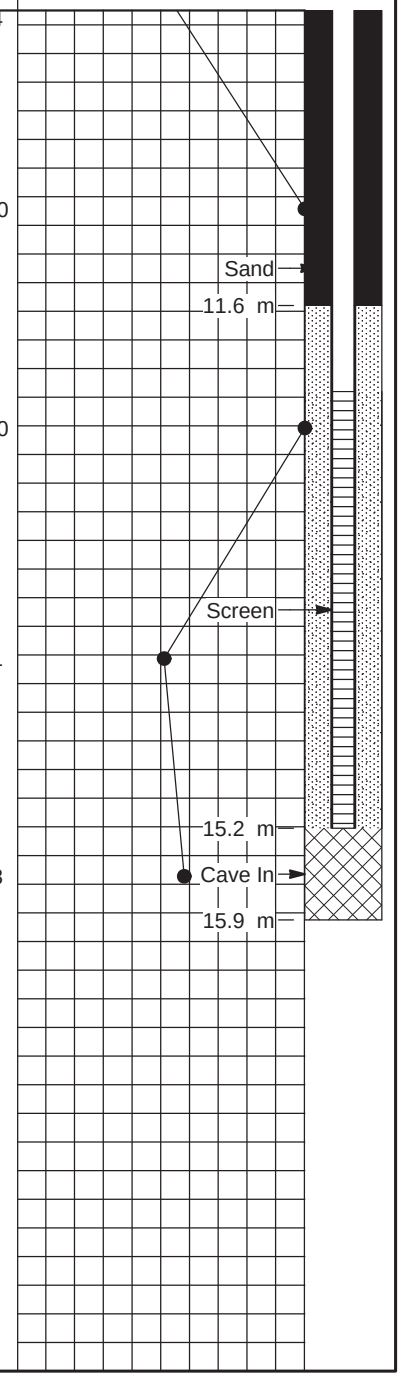
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
32	10.0					SS-9	92	--		54
36	11.0					SS-10	88	--	23-40-50/ 125mm	100
40	12.0					SS-11	100	--	26-36-50/ 125mm	100
44	13.0									
46	14.0					SS-12	100	--	14-25-26-30	51
48	15.0									
51						SS-13	100	--	16-24-34-47	58
52	15.85			**END OF BOREHOLE**						
	16.0									
56	17.0									
59	18.0									
62										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



NOTE :
End of Borehole at 15.85 m bgs
Water level at 14.85 m bgs upon completion
Water level at 0.16 m bgs on November 19, 2012
A monitoring well installed at 15.21 m depth
bgs denotes below ground surface
Sa, Gr, Si and Cl denote Sand, Gravel, Silt and Clay respectively

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 3

INSPEC·SOL

BOREHOLE No.: BH3-12
ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.
PROJECT: Geotechnical Investigation - Clarington Transformer Station
LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri
DATE (START): November 6, 2012 DATE (FINISH): November 7, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.12			TOPSOIL : 120 mm						
1				FILL : SANDY SILTY CLAY, trace gravel, trace topsoil and rootlets, brown, moist to very moist, soft		SS-1	100	28	1-2-2-2	4
2	0.76									
3	1.0			NATIVE : SANDY CLAYEY SILT TILL, some gravel, oxidized seams, greyish brown, moist, very stiff		SS-2	75	8	3-9-14-15	23
4										
5	1.52			Cobble fragments, grey, hard		SS-3	92	8	16-14-18-22	32
6	2.0									
7										
8						SS-4	75	7	20-17-27-28	44
9										
10	3.0					SS-5	82	9	20-36-50/ 125mm	100
11										
12										
13	4.0									
14										
15	4.57			Some sand and gravel, very moist		SS-6	67	10	50/ 150mm	100
16										
17	5.0									
18										
19										
20	6.0									
21	6.10			Trace sand, cobble fragments		SS-7	57	6	48-50/ 25mm	100
22										
23	7.0									
24										
25										
26	8.0					SS-8	100	7	28-30-45-50	75
27										
28										
29	9.0									
30						SS-9	50	8	28-50/	100

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

WL6.5
11/7/2012

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 3

INSPEC·SOL

BOREHOLE No.: BH3-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 6, 2012 DATE (FINISH): November 7, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
				GROUND SURFACE							
									150mm		
32	10.0										
33											
34											
35											
36	11.0					SS-10	100	7	14-24-20-35	44	
37											
38											
39	12.0										
40											
41						SS-11	87	8	27-45-45-50/ 125mm	100	
42	12.96			Possible boulder							
	13.0			**END OF BOREHOLE**							
43				NOTE :							
44				End of Borehole at 12.96 m bgs due to auger refusal							
45				Water level at 6.50 m bgs upon completion							
46	14.0			bgs denotes below ground surface							
47											
48											
49	15.0										
50											
51											
52	16.0										
53											
54											
55											
56	17.0										
57											
58											
59	18.0										
60											
61											
62											

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 4

INSPEC·SOL

BOREHOLE No.: BH4-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 5, 2012 DATE (FINISH): November 5, 2012

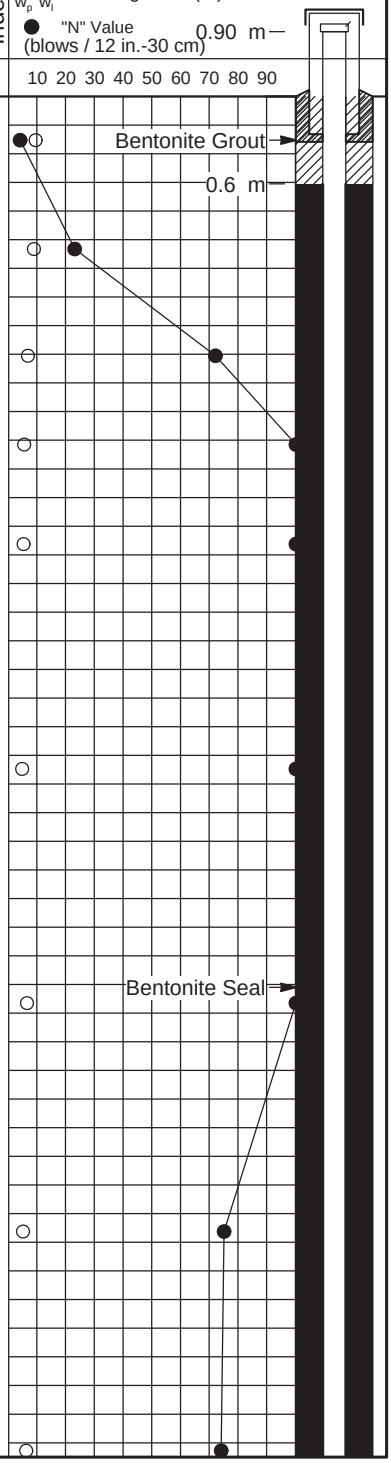
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.10			TOPSOIL : 100 mm						
1				FILL : SILT and CLAY, trace gravel, trace topsoil and rootlets, brown, moist, firm		SS-1	100	9	1-2-2-4	4
2	0.76			NATIVE : SANDY CLAYEY SILT TILL, trace gravel, cobble fragments, brown, moist, very stiff to hard						
3	1.0					SS-2	92	9	6-8-15-20	23
4										
5						SS-3	100	7	17-28-44-50/ 125mm	72
6	2.0									
7				Greyish brown		SS-4	91	5	35-50/ 125mm	100
8										
9						SS-5	50	5	50/ 150mm	100
10	3.0									
11										
12	3.66			Cobble/boulder (inferred) Auger grinding at 3.66 m bgs						
13	4.0									
14										
15	4.57			Grey		SS-6	80	5	48-50/ 75mm	100
16	5.0									
17										
18										
19										
20	6.0			Auger grinding at 6.1 m bgs						
21						SS-7	78	6	35-45-50/ 150mm	100
22										
23	7.0									
24										
25										
26	8.0					SS-8	100	5	20-30-45-50/ 150mm	75
27										
28										
29										
30	9.0								20-32-42-48	

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 4

INSPEC·SOL

BOREHOLE No.: BH4-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 5, 2012 DATE (FINISH): November 5, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
32						SS-9	100	6		74
33	10.0									
34										
35										
36	11.0					SS-10	100	6	14-25-30-50/ 125mm	100
37										
38										
39	12.0									
40						SS-11	83	7	22-50/ 150mm	100
41										
42										
43	13.0									
44										
45				Auger grinding at 13.72 m bgs						
46	14.0					SS-12	88	6	24-41-50/ 125mm	100
47										
48										
49	15.0									
50				Cobble fragments		SS-13	80	8	21-50/ 100mm	100
51	15.49									
52				**END OF BOREHOLE**						
53	16.0									
54				NOTE :						
55				End of Borehole at 15.49 m bgs						
56	17.0			Borehole open and dry upon completion						
57				Borehole dry on November 19, 2012						
58				Monitoring well installed at 15.49 m bgs						
59	18.0			bgs denotes below ground surface						
60										
61										
62										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

11.8 m Sand

Screen

15.5 m

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 5

INSPEC·SOL

BOREHOLE No.: BH5-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 15, 2012 DATE (FINISH): November 15, 2012

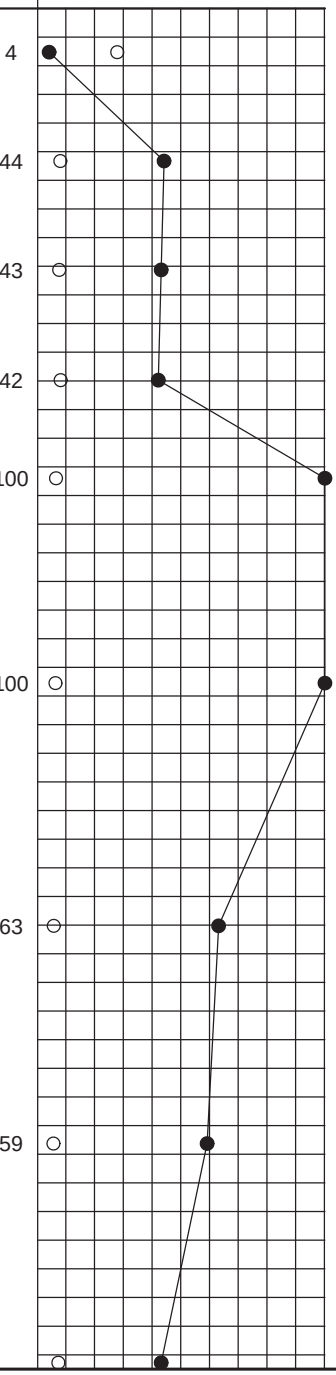
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.12			TOPSOIL with organics : 120 mm						
1				FILL : SILTY CLAY, some gravel, trace topsoil and rootlets, brown, moist, loose		SS-1	92	28	1-1-3-14	4
2	0.76			NATIVE : SANDY CLAYEY SILT TILL, some gravel, cobble fragments, brown, moist, hard						
3	1.0					SS-2	92	8	8-17-26-25	44
4										
5						SS-3	100	8	11-23-20-21	43
6	2.0									
7						SS-4	100	8	18-20-22-21	42
8										
9						SS-5	89	6	20-38-50/ 150mm	100
10	3.0									
11										
12										
13	4.0									
14										
15	4.57			Grey Auger grinding		SS-6	80	6	20-50/ 125mm	100
16										
17	5.0									
18										
19										
20	6.0									
	6.10			Auger grinding						
21						SS-7	67	6	49-33-30-35	63
22										
23	7.0									
24										
25										
26	8.0					SS-8	83	6	31-29-30-32	59
27										
28										
29	9.0									
30									12-22-21-23	

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 5

INSPEC·SOL

BOREHOLE No.: BH5-12
ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.
PROJECT: Geotechnical Investigation - Clarington Transformer Station
LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri
DATE (START): November 15, 2012 DATE (FINISH): November 15, 2012

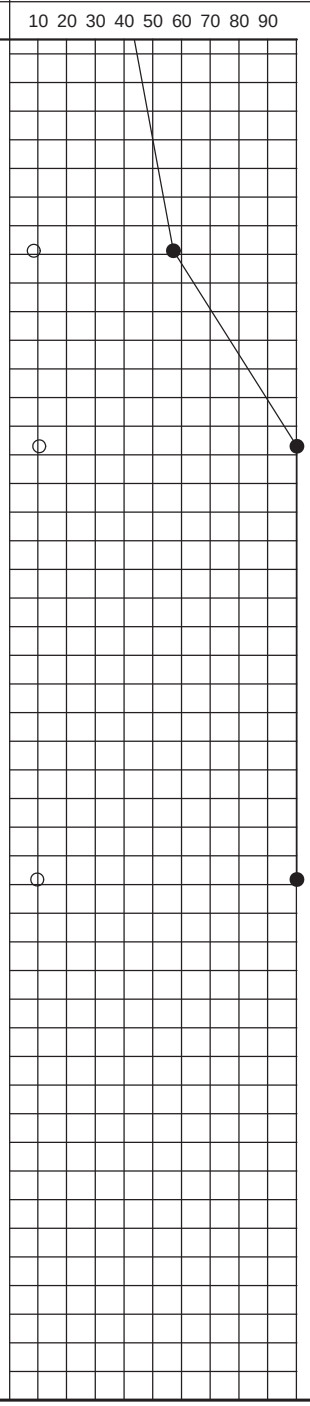
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
32	10.0					SS-9	33	7		43
36	11.0					SS-10	58	8	10-17-40-48	57
40	12.0					SS-11	73	10	20-50/ 125mm	100
50	15.0					SS-12	80	10	25-50/ 100mm	100
51	15.49			**END OF BOREHOLE**						

NOTE :
End of Borehole at 15.49 m bgs
Borehole open and dry upon completion
bgs denotes below ground surface

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 6

INSPEC·SOL

BOREHOLE No.: BH6-12
ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.
PROJECT: Geotechnical Investigation - Clarington Transformer Station
LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri
DATE (START): November 6, 2012 DATE (FINISH): November 6, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab, ○ Water content (%), W_p W_l Atterberg limits (%), ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
	0.08			GROUND SURFACE							
				TOPSOIL : 80 mm							
1				FILL : SILTY CLAY, trace to some gravel, trace topsoil and rootlets, brown, moist, firm to stiff		SS-1	100	25	1-2-3-2	5	
2											
3	0.86					SS-2A	--	13	--	11	
	1.0			Brown to grey		SS-2B	58	7	1-2-9-17	11	
4											
5	1.52			NATIVE : SANDY CLAYEY SILT TILL, trace to some gravel, cobble fragments, brownish grey, hard		SS-3	100	7	21-36-50/ 125mm	100	
6											
7	2.0					SS-4	80	6	36-50/ 100mm	100	
8											
9						SS-5	80	6	48-50/ 100mm	100	
10	3.0										
11											
12											
13	4.0										
14											
15	4.57			Grey		SS-6	80	8	48-50/ 100mm	100	
16											
17	5.0										
18											
19											
20	6.0										
	6.10			Cobble fragments		SS-7	91	6	35-50/ 125mm	100	
21											
22											
23	7.0										
24	7.32			Auger grinding at 7.32 m to 7.62 m bgs							
25						SS-8	100	6	50/ 25mm	100	
26	8.0										
27											
28											
29											
30	9.0					SS-9	100	7	21-30-50/	100	

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 6

INSPEC·SOL

BOREHOLE No.: BH6-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 6, 2012 DATE (FINISH): November 6, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
									125mm	
32	10.0									
33										
34										
35						SS-10	100	6	27-50/ 75mm	100
36	11.0									
37										
38										
39	12.0									
40										
41						SS-11	75	6	28-45-50/ 100mm	100
42										
43	13.0									
44										
45	13.72			Some gravel, cobble fragments						
46	14.0					SS-12	100	5	25-30-50/ 150mm	100
47										
48										
49	15.0									
50										
51	15.55					SS-13	83	6	26-50/ 150mm	100
52				**END OF BOREHOLE**						
53	16.0									
54				NOTE :						
55				End of Borehole at 15.55 m bgs						
56	17.0			Borehole open and dry upon completion						
57				bgs denotes below ground surface						
58										
59	18.0									
60										
61										
62										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 7

INSPEC·SOL

BOREHOLE No.: BH7-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 5, 2012 DATE (FINISH): November 5, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab, ○ Water content (%), W_p W_l Atterberg limits (%), ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
	0.10			TOPSOIL : 100 mm							
1				FILL : SILTY CLAY, trace gravel, trace topsoil and rootlets, brown, wet, soft		SS-1	83	23	1-2-2-3	4	
2											
3	1.0					SS-2	42	28	1-2-1-2	3	
4											
5	1.52			NATIVE : SANDY CLAYEY SILT TILL, trace to some gravel, oxidized seams, brown, very moist, stiff to hard		SS-3	100	10	4-4-5-6	9	
6											
7	2.0					SS-4	82	12	30-48-50/ 125mm	100	
8											
9											
10	3.0										
	3.05			Greyish brown		SS-5	88	5	32-48-50/ 125mm	100	
11											
12											
13	4.0										
14											
15						SS-6	88	6	25-39-50/ 125mm	100	
16											
17	5.0										
18											
19											
20	6.0										
	6.10			Grey		SS-7	73	6	39-50/ 125mm	100	
21											
22											
23	7.0										
24											
25											
26	8.0					SS-8	100	6	27-30-40-45	70	
27											
28											
29	9.0										
30	9.15			Cobble fragments		SS-9	36	6	36-50/	100	

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 7

INSPEC·SOL

BOREHOLE No.: BH7-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 5, 2012 DATE (FINISH): November 5, 2012

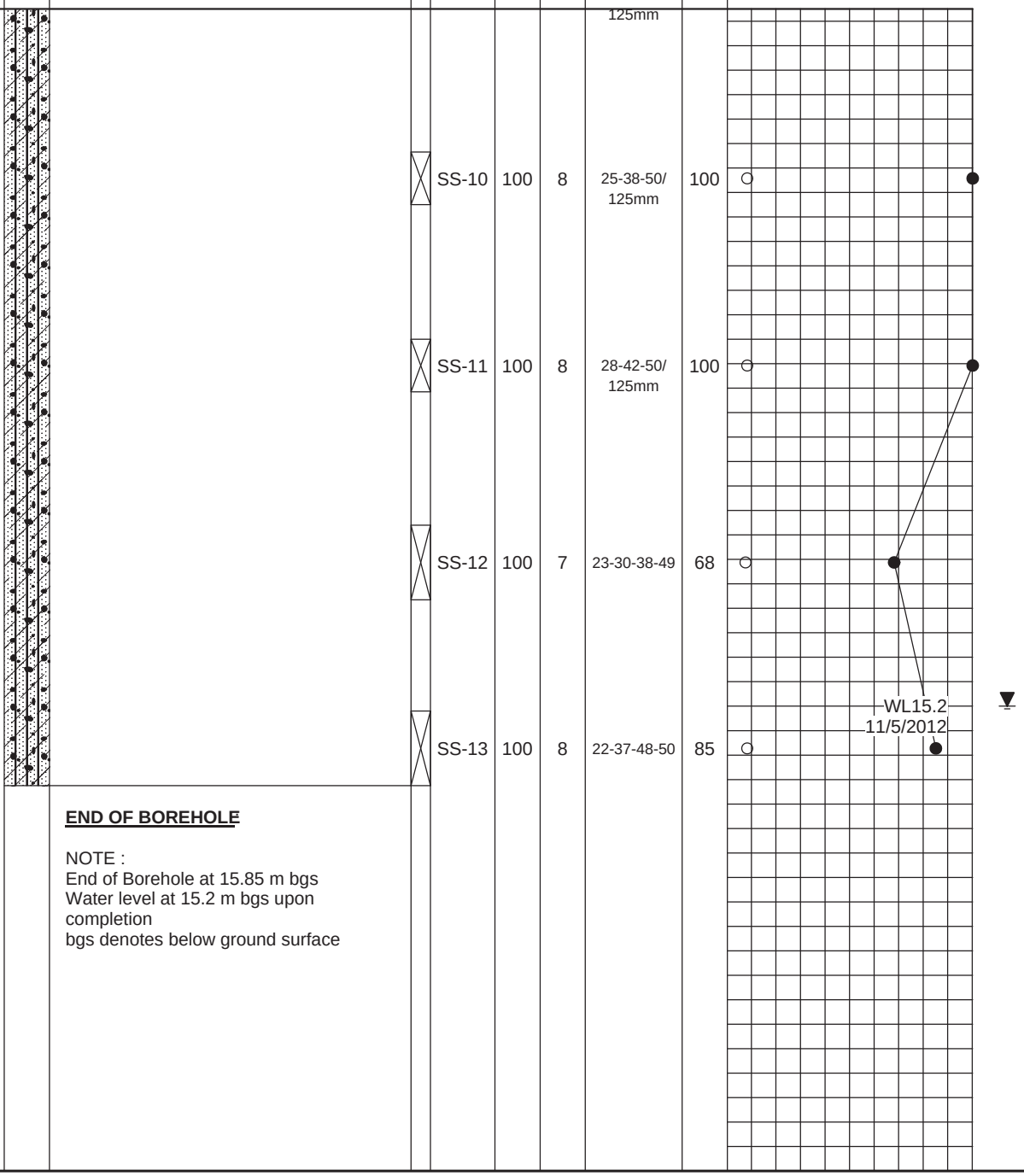
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
									125mm	
32	10.0									
33										
34										
35										
36	11.0					SS-10	100	8	25-38-50/ 125mm	100
37										
38										
39	12.0									
40										
41						SS-11	100	8	28-42-50/ 125mm	100
42										
43	13.0									
44										
45										
46	14.0					SS-12	100	7	23-30-38-49	68
47										
48										
49	15.0									
50										
51						SS-13	100	8	22-37-48-50	85
52	15.85									
	16.0			**END OF BOREHOLE**						
53										
54				NOTE :						
55				End of Borehole at 15.85 m bgs						
56	17.0			Water level at 15.2 m bgs upon completion						
57				bgs denotes below ground surface						
58										
59	18.0									
60										
61										
62										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 8

INSPEC·SOL

BOREHOLE No.: BH8-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 15, 2012 DATE (FINISH): November 15, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab, ○ Water content (%), W_p W_l Atterberg limits (%), ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
				GROUND SURFACE							
	0.12			TOPSOIL : 120 mm							
1				FILL : SANDY SILTY CLAY, trace gravel, trace topsoil and rootlets, brown, moist to very moist, loose		SS-1	92	20	1-1-2-2	3	
2	0.76			Some gravel, brownish grey							
3	1.0					SS-2	83	8	10-20-30-27	50	
4											
5	1.52			NATIVE : SANDY CLAYEY SILT TILL, trace gravel, grey, moist, very stiff to hard		SS-3	83	9	10-12-15-24	27	
6	2.0										
7	2.29			Cobble fragments							
8						SS-4	92	7	22-34-42-48	76	
9											
10	3.0					SS-5	100	7	22-25-20-23	45	
11											
12											
13	4.0										
14											
15	4.57			Grey		SS-6	73	6	42-50/ 125mm	100	
16											
17	5.0										
18											
19											
20	6.0					SS-7	73	10	44-50/ 125mm	100	
21											
22											
23	7.0										
24											
25	7.62			Auger grinding		SS-8	100	11	14-46-50/ 125mm	100	
26	8.0			Sa : 41%, Gr : 5%, Si : 37%, Cl : 17%							
27											
28											
29											
30	9.0 9.15			Auger grinding		SS-9	100	10	48-50/ 100mm	100	

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 8

INSPEC·SOL

BOREHOLE No.: BH8-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 15, 2012 DATE (FINISH): November 15, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
				GROUND SURFACE							
32	10.0										
33											
34											
35						SS-10	55	10	30-50/ 125mm	100	
36	11.0										
37											
38											
39	12.0										
40	12.20			Auger grinding		SS-11	100	10	50/ 150mm	100	
41											
42											
43	13.0										
44											
45						SS-12	91	9	44-50/ 125mm	100	
46	14.0										
47											
48											
49	15.0										
50											
51						SS-13	88	8	22-45-50/ 125mm	100	
52	15.67										
53	16.0			**END OF BOREHOLE**							
54											
55				NOTE :							
56	17.0			End of Borehole at 15.67 m bgs							
57				Borehole open and dry upon completion							
58				Sa, Gr, Si and Cl denote Sand, Gravel,							
59	18.0			Silt and Clay respectively							
60				bgs denotes below ground surface							
61											
62											

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 9

iNSPEC·SOL

BOREHOLE No.: BH9-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 9, 2012 DATE (FINISH): November 12, 2012

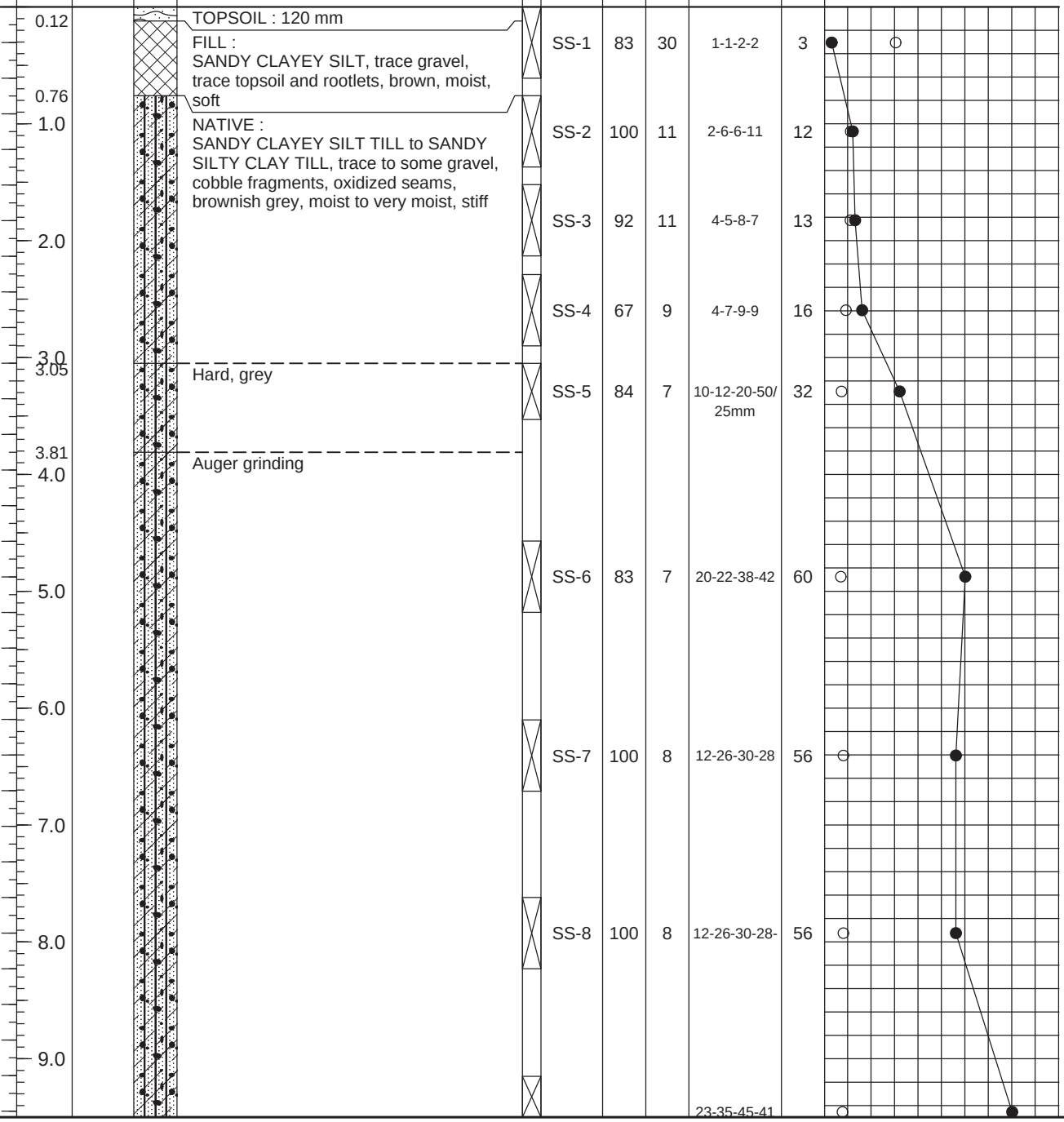
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.12			TOPSOIL : 120 mm						
1				FILL : SANDY CLAYEY SILT, trace gravel, trace topsoil and rootlets, brown, moist, soft		SS-1	83	30	1-1-2-2	3
2	0.76									
3	1.0			NATIVE : SANDY CLAYEY SILT TILL to SANDY SILTY CLAY TILL, trace to some gravel, cobble fragments, oxidized seams, brownish grey, moist to very moist, stiff		SS-2	100	11	2-6-6-11	12
4										
5						SS-3	92	11	4-5-8-7	13
6	2.0									
7						SS-4	67	9	4-7-9-9	16
8										
9										
10	3.0									
	3.05			Hard, grey		SS-5	84	7	10-12-20-50/ 25mm	32
11										
12										
13	3.81			Auger grinding						
	4.0									
14										
15										
16	5.0					SS-6	83	7	20-22-38-42	60
17										
18										
19										
20	6.0									
21						SS-7	100	8	12-26-30-28	56
22										
23	7.0									
24										
25										
26	8.0					SS-8	100	8	12-26-30-28-	56
27										
28										
29	9.0									
30									23-35-45-41	

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 9

INSPEC·SOL

BOREHOLE No.: BH9-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 9, 2012 DATE (FINISH): November 12, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
32	10.0					SS-9	92	8		80
35	10.67			Sand seams						
36	11.0					SS-10	100	6	10-20-25-24	45
41	12.0					SS-11	100	7	11-16-22-32	48
46	14.0					SS-12	100	7	15-22-28-37	50
51	15.0					SS-13	100	8	16-23-25-42	58
52	15.85			**END OF BOREHOLE**						
	16.0			NOTE : End of Borehole at 15.85 m bgs Water level at 14.45 m bgs upon completion bgs denotes below ground surface						
56	17.0									
59	18.0									
62										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

WL14.5
11/12/2012

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 10

INSPEC·SOL

BOREHOLE No.: BH10-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 7, 2012 DATE (FINISH): November 7, 2012

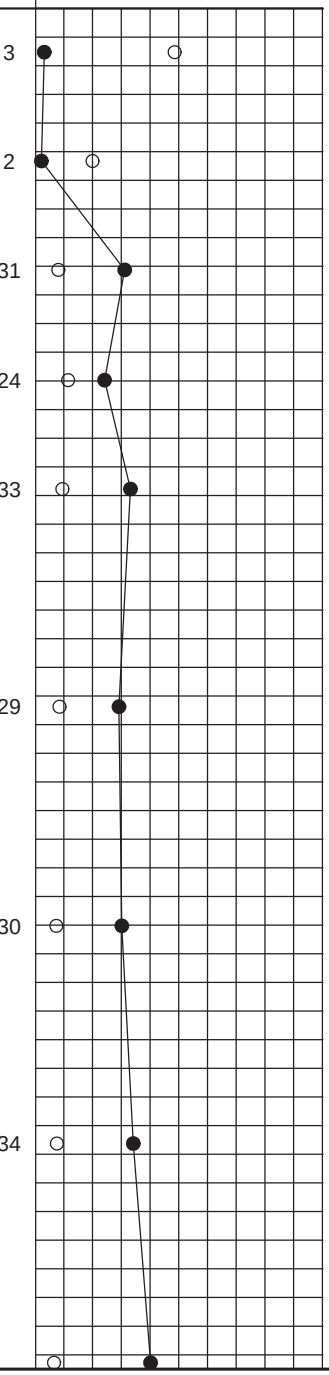
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.12			TOPSOIL : 120 mm						
1				FILL : SANDY SILTY CLAY, trace gravel, trace topsoil and rootlets, brown, very moist to wet, soft		SS-1	75	48	1-1-2-2	3
2	0.76			Trace sand, very soft						
3	1.0					SS-2	67	20	1-1-1-2	2
4										
5	1.52			NATIVE : SANDY CLAYEY SILT to SANDY SILTY CLAY TILL, some gravel, oxidized seams, cobble fragments, brown, moist, hard to very stiff		SS-3	75	8	14-18-13-15	31
6										
7	2.0					SS-4	92	11	8-11-13-22	24
8										
9										
10	3.0			Grey		SS-5	92	9	8-16-17-24	33
11	3.05									
12										
13	4.0									
14										
15	4.57			Trace sand, very stiff						
16						SS-6	92	8	13-11-18-18	29
17	5.0									
18										
19										
20	6.0									
21						SS-7	100	7	10-14-16-18	30
22										
23	7.0									
24										
25										
26	8.0					SS-8	67	7	10-12-22-35	34
27										
28										
29										
30	9.0									
	9.15			Cobble fragments					11-14-26-45	

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 10

INSPEC·SOL

BOREHOLE No.: BH10-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 7, 2012 DATE (FINISH): November 7, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
32	10.0					SS-9	100	6		40
36	11.0					SS-10	100	6	9-12-13-22	25
40	12.0					SS-11	100	7	10-14-18-23	32
46	14.0					SS-12	100	7	16-18-21-33	39
51	15.0					SS-13	100	6	11-24-27-37	51
52	15.85			**END OF BOREHOLE**						
	16.0			NOTE : End of Borehole at 15.85 m bgs. Borehole open and dry upon completion. bgs denotes below ground surface						
56	17.0									
59	18.0									
62										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 11

INSPEC·SOL

BOREHOLE No.: BH11-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 8, 2012 DATE (FINISH): November 9, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.10			TOPSOIL : 100 mm						
1				FILL : SILTY CLAY , trace gravel, trace topsoil and rootlets, brown, moist to very moist, soft		SS-1	100	31	1-1-3-2	4
2	0.76									
3	1.0			NATIVE : SANDY CLAYEY SILT TILL, trace to some gravel, cobble fragments, brown, moist, very stiff		SS-2	58	7	2-4-14-23	18
4										
5										
6						SS-3	100	4	28-30-35-50/ 125mm	65
7	2.0									
8	2.29			Grey		SS-4	100	6	22-32-41-35	73
9	2.74			Auger grinding from 2.74 m to 3.05 m bgs						
10	3.0					SS-5	100	7	27-40-37-40	77
11										
12										
13	4.0									
14										
15	4.57			Sand pockets Auger grinding		SS-6	100	14	11-23-50/ 150mm	73
16	5.0									
17										
18										
19										
20	6.0 6.10			SANDY SILT, some clay and gravel, grey, moist to very moist, very dense		SS-7	100	7	50/ 150mm	100
21										
22										
23	7.0									
24										
25	7.62			Auger grinding		SS-8	100	7	50/ 125mm	100
26	8.0									
27										
28										
29										
30	9.0 9.15			SANDY CLAYEY SILT TILL, cobble fragments, grey, moist, hard		SS-9	100	11	50/ 100mm	100

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

0.91 m

10 20 30 40 50 60 70 80 90

WL -0.9 m 11/19/2012

Bentonite Seal

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 11

INSPEC·SOL

BOREHOLE No.: BH11-12
ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.
PROJECT: Geotechnical Investigation - Clarington Transformer Station
LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri
DATE (START): November 8, 2012 DATE (FINISH): November 9, 2012

LEGEND

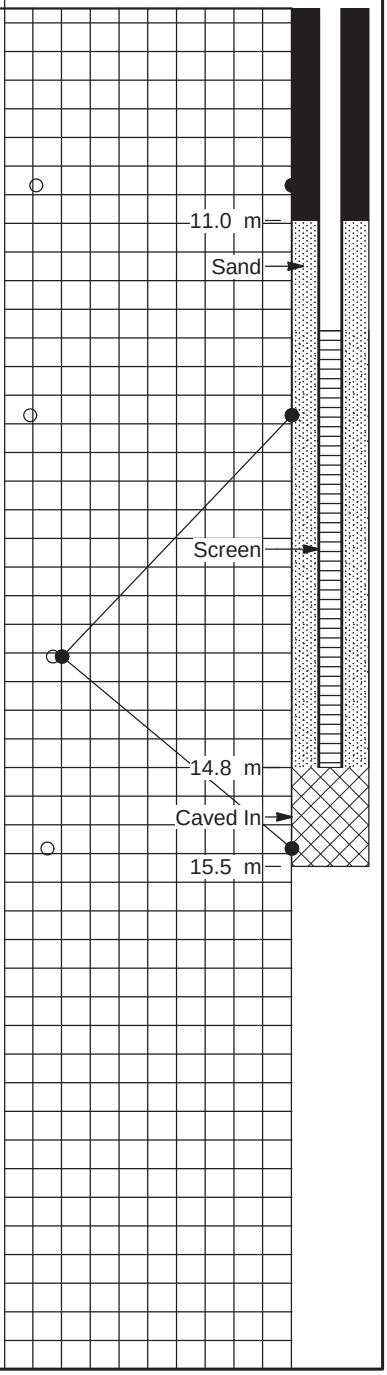
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
35	10.67			Auger grinding		SS-10	100	11	50/ 125mm	100
40	12.0					SS-11	0	9	35-50/ 125mm	100
45	13.72			SILT and SAND, trace to some gravel, grey, very moist to saturated, compact to very dense		SS-12	67	17	3-5-15-18	20
50	15.49			Very dense		SS-13	100	15	40-50/ 100mm	100

END OF BOREHOLE

NOTE :
End of Borehole at 15.49 m bgs
A 50 mm diameter monitoring well installed at 14.80 m bgs
Water level at 3.12 m bgs upon completion
Water level at 0.91 m above ground level on November 19, 2012
bgs denotes below ground surface

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)



SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/20/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 12

INSPEC·SOL

BOREHOLE No.: BH12-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 7, 2012 DATE (FINISH): November 8, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab, ○ Water content (%), W_p W_l Atterberg limits (%), ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
				GROUND SURFACE							
	0.12			TOPSOIL : 120 mm							
1				FILL : SANDY SILTY CLAY, trace gravel, topsoil/organics and rootlets, dark brown, very moist, soft		SS-1	100	29	2-2-2-3	4	
2	0.76										
3	1.0			Sand layer, brown, wet, stiff		SS-2	33	15	2-7-8-4	15	
4											
5	1.52			NATIVE : SANDY CLAYEY SILT to SANDY SILTY CLAY TILL, some gravel, oxidized seams, brown, moist to very moist, stiff		SS-3	67	12	2-5-6-9	11	
6	2.0										
7	2.29			Cobble fragments, brownish grey, hard		SS-4	100	9	10-33-50/ 125mm	100	
8											
9	3.0										
10	3.05			Grey, sand pockets, very stiff		SS-5	86	19	10-12-17-23	29	
11											
12											
13	4.0										
14											
15	4.57			Hard		SS-6	100	10	50/ 100mm	100	
16											
17	5.0										
18											
19											
20	6.0			Auger grinding		SS-7	67	10	40-50/ 75mm	100	
21											
22											
23	7.0										
24											
25						SS-8	100	9	50/ 100mm	100	
26	8.0										
27											
28											
29	9.0										
30				Sand pockets, cobble fragments		SS-9	91	12	20-50/	100	

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 12

INSPEC·SOL

BOREHOLE No.: BH12-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 7, 2012 DATE (FINISH): November 8, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE					125mm	
32	10.0				☒	SS-10	100	14	50/ 125mm	100
36	11.0									
40	12.0			Stone fragments	☒	SS-11	100	10	50/ 125mm	100
44	13.0									
45				Auger grinding	☒	SS-12	100	9	50/ 125mm	100
46	14.0									
49	15.0									
50	15.37				☒	SS-13	60	11	50/ 125mm	100
51				**END OF BOREHOLE**						
52	16.0			NOTE : End of Borehole at 15.37 m bgs Water level at 15.02 m bgs upon completion bgs denotes below ground surface						
56	17.0									
59	18.0									
62										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

WL15.0 11/8/2012 ▼

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 13

INSPEC·SOL

BOREHOLE No.: BH13-12

ELEVATION:

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 13, 2012 DATE (FINISH): November 13, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N
				GROUND SURFACE						
	0.10			TOPSOIL : 100 mm		SS-1A	--	19	1-1-2-2	--
1				FILL : SANDY CLAYEY SILT, some clay, trace gravel, trace and rootlets, brownish grey, moist, soft		SS-1B	92	14	1-1-2-2	3
2	0.76									
3	1.0			Brownish grey, moist, very stiff		SS-2	46	8	6-6-11-15	17
4										
5	1.52			NATIVE : SANDY SILTY CLAY TILL to SANDY CLAYEY SILT TILL, trace gravel, greyish brown to brown, moist, hard		SS-3	96	8	8-12-20-25	32
6	2.0									
7						SS-4	100	7	3-14-25-30	39
8										
9										
10	3.0									
	3.05			Auger grinding		SS-5	100	6	25-40-45-50/ 100mm	95
11										
12										
13	4.0									
14										
15	4.57			Grey		SS-6	100	6	25-50/ 100mm	100
16										
17	5.0									
18										
19										
20	6.0									
	6.10			Auger grinding		SS-7	100	6	8-30-50/ 125mm	100
21										
22										
23	7.0									
24										
25										
26	8.0					SS-8	100	6	10-27-50/ 75mm	100
27										
28										
29	9.0									
30						SS-9	100	5	40-47-50/	100

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

WL1.1 11/13/2012

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

REFERENCE No.: T040774a1 ENCLOSURE No.: 13

INSPEC·SOL

BOREHOLE No.: BH13-12

ELEVATION:

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Hydro One Networks Inc.

PROJECT: Geotechnical Investigation - Clarington Transformer Station

LOCATION: Townline Road North and Concession Road #7, Clarington, Ontario

DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Bagheri

DATE (START): November 13, 2012 DATE (FINISH): November 13, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index/SCR N	Shear test (Cu) △ Field, Sensitivity (S) □ Lab; ○ Water content (%); W_p W_l Atterberg limits (%); ● "N" Value (blows / 12 in.-30 cm) 10 20 30 40 50 60 70 80 90
				GROUND SURFACE							
									100mm		
32	10.0										
33	10.21			Auger grinding							
34											
35					☒	SS-10	100	4	50/ 125mm	100	○ ●
36	11.0										
37											
38											
39	12.0										
40					☒	SS-11	100	11	50/ 125mm	100	○ ●
41											
42											
43	13.0 13.11			Clay pockets Auger grinding							
44											
45					☒	SS-12	100	10	50/ 125mm	100	○ ●
46	14.0										
47											
48											
49	15.0										
50				Trace sand and gravel, grey, very moist							
51					☒	SS-13	100	8	25-30-47-45	77	○ ●
52	15.85										
53	16.0			**END OF BOREHOLE**							
54											
55				NOTE : End of Borehole at 15.85 m bgs Water level at 1.08 m bgs upon completion bgs denotes below ground surface							
56	17.0										
57											
58											
59	18.0										
60											
61											
62											

SOIL LOG WITH GRAPH+WELL T040774A1.GPJ INSPEC_SOL.GDT 12/19/12

Appendix C Water Well Records

C1: WELL USE DETAILS

Well ID	Zone	Easting	Northing	Well Type	Well Use	Date Constructed
1901742	17	673953	4872757	Water Supply	Livestock	3/2/1954
1902984	17	674155	4872223	Water Supply	Domestic	11/11/1970
1903352	17	673715	4872773	Water Supply	Domestic	2/18/1972
1903511	17	674165	4872313	Water Supply	Domestic	6/6/1972
1903520	17	674055	4872093	Water Supply	Domestic	12/29/1972
1904535	17	673575	4872943	Water Supply	Domestic	11/1/1976
1905014	17	673295	4873063	Water Supply	Domestic	10/16/1977
1905307	17	674115	4872323	Water Supply	Domestic	4/27/1979
1907905	17	673381	4872974	Water Supply	Domestic	9/1/1986
1909285	17	673454	4873111	Water Supply	Domestic	7/29/1988
1910299	17	673699	4872803	Water Supply	Domestic	11/22/1989
1912514	17	673672	4872041	Water Supply	Domestic	7/20/1995
1912622	17	673412	4872031	Water Supply	Domestic	10/26/1995
4600450	17	672430	4871780	Water Supply	Livestock	5/18/1959
4600451	17	672589	4871849	Water Supply	Domestic	11/16/1959
1916307	17	673452	4873111	Water Supply	Domestic	9/26/2002
1918378	17	672999	4872014	Water Supply	Domestic	6/19/2006
7102525	17	672820	4871777	Observation Well	Monitoring	12/19/2007
7128981	17	673438	4872158	Water Supply	unknown	1/1/2009
7157947	17	673849	4872145	Water Supply	Domestic	11/19/2010

C2: WELL STRATIGRAPHY

Well ID	Zone	Easting	Northing	Ground Elev. (m AMSL)	Formation Top (m BGS)	Formation Base (m BGS)	Formation Top (m AMSL)	Formation Base (m AMSL)	Primary Material	Secondary Material	Tertiary Material	Material Colour
1901742	17	673953	4872757	248.19	68.58	68.88	179.61	179.30	GRAVEL	-	-	
1902984	17	674155	4872223	231.64	6.10	10.36	225.55	221.28	MEDIUM SAND	STONES	GRAVEL	BROWN
1903352	17	673715	4872773	241.42	13.72	15.24	227.70	226.18	GRAVEL	SAND	-	BROWN
1903511	17	674165	4872313	233.15	8.84	9.75	224.31	223.39	COARSE SAND	-	-	GREY
1903520	17	674055	4872093	228.62	7.62	8.23	221.00	220.39	SAND	GRAVEL	-	GREY
1904535	17	673575	4872943	250.57	2.44	2.74	248.13	247.83	GRAVEL	WATER-BEARING	-	
1905014	17	673295	4873063	269.46	96.93	97.54	172.53	171.92	GRAVEL	-	-	BLUE
1905307	17	674115	4872323	234.16	56.39	58.22	177.77	175.95	SAND	GRAVEL	LOOSE	BROWN
1907905	17	673381	4872974	268.39	104.24	108.20	164.15	160.19	MEDIUM SAND	FINE SAND	-	GREY
1909285	17	673454	4873111	260.39	13.72	14.33	246.67	246.06	SAND	WATER-BEARING	-	GREY
1910299	17	673699	4872803	242.56	64.62	65.84	177.94	176.72	COARSE SAND	WATER-BEARING	LOOSE	BROWN
1912514	17	673672	4872041	241.07	57.91	60.96	183.16	180.11	GRAVEL	SAND	-	GREY
1912622	17	673412	4872031	251.31	65.23	67.06	186.09	184.26	SAND	GRAVEL	-	BROWN
4600450	17	672430	4871780	232.87	13.41	19.20	219.46	213.67	GRAVEL	COARSE SAND	MEDIUM SAND	
4600451	17	672589	4871849	226.66	21.34	22.56	205.33	204.11	GRAVEL	-	-	
1916307	17	673452	4873111	260.54	70.41	71.63	190.13	188.91	SAND	-	-	GREY
1918378	17	672999	4872014	230.17	47.85	49.07	182.32	181.10	GRAVEL	WATER-BEARING	-	BROWN
7102525	17	672820	4871777	221.51	10.70	13.72	210.81	207.79	SAND	SILTY	CLAY	GREY
7128981	17	673438	4872158	251.91	7.62	11.43	244.29	240.48	CLAY	SILT	STONES	GREY
7157947	17	673849	4872145	-	17.68	18.90	-	-	MEDIUM SAND	-	LOOSE	BROWN

C3: WELL SCREEN DETAILS

Well ID	Zone	Easting	Northing	Ground Elev. (m AMSL)	Screen Top (m BGS)	Screen Bottom (m BGS)	Screen Top (m AMSL)	Screen Bottom (m AMSL)
1901742	17	673953	4872757	248.19	-	-	-	-
1902984	17	674155	4872223	231.64	-	-	-	-
1903352	17	673715	4872773	241.42	-	-	-	-
1903511	17	674165	4872313	233.15	-	-	-	-
1903520	17	674055	4872093	228.62	-	-	-	-
1904535	17	673575	4872943	250.57	-	-	-	-
1905014	17	673295	4873063	269.46	-	-	-	-
1905307	17	674115	4872323	234.16	55.17	56.39	178.99	177.77
1907905	17	673381	4872974	268.39	106.98	108.20	161.41	160.19
1909285	17	673454	4873111	260.39	-	-	-	-
1910299	17	673699	4872803	242.56	64.62	65.84	177.94	176.72
1912514	17	673672	4872041	241.07	59.74	60.96	181.33	180.11
1912622	17	673412	4872031	251.31	65.84	67.06	185.48	184.26
4600450	17	672430	4871780	232.87	17.98	19.20	214.89	213.67
4600451	17	672589	4871849	226.66	-	-	-	-
1916307	17	673452	4873111	260.54	70.41	71.63	190.13	188.91
1918378	17	672999	4872014	230.17	47.85	49.07	182.32	181.10
7102525	17	672820	4871777	221.51	-	-	-	-
7128981	17	673438	4872158	251.91	-	-	-	-
7157947	17	673849	4872145	-	17.68	18.90	-	-

C4: WATER LEVEL DATA

Well ID	Zone	Easting	Northing	Ground Elev. (m AMSL)	Static Water Level (m BGS)	Static Water Elev. (m BGS)	Date Constructed
1901742	17	673953	4872757	248.19	44.20	203.99	3/2/1954
1902984	17	674155	4872223	231.64	8.53	223.11	11/11/1970
1903352	17	673715	4872773	241.42	7.32	234.10	2/18/1972
1903511	17	674165	4872313	233.15	3.35	229.79	6/6/1972
1903520	17	674055	4872093	228.62	7.62	221.00	12/29/1972
1904535	17	673575	4872943	250.57	2.44	248.13	11/1/1976
1905014	17	673295	4873063	269.46	49.38	220.08	10/16/1977
1905307	17	674115	4872323	234.16	27.43	206.73	4/27/1979
1907905	17	673381	4872974	268.39	46.33	222.06	9/1/1986
1909285	17	673454	4873111	260.39	2.13	258.26	7/29/1988
1910299	17	673699	4872803	242.56	28.96	213.60	11/22/1989
1912514	17	673672	4872041	241.07	32.00	209.06	7/20/1995
1912622	17	673412	4872031	251.31	38.40	212.91	10/26/1995
4600450	17	672430	4871780	232.87	5.49	227.38	5/18/1959
4600451	17	672589	4871849	226.66	9.14	217.52	11/16/1959
1916307	17	673452	4873111	260.54	38.10	222.44	9/26/2002
1918378	17	672999	4872014	230.17	19.20	210.97	6/19/2006
7102525	17	672820	4871777	221.51	-	-	12/19/2007
7128981	17	673438	4872158	251.91	-	-	1/1/2009
7157947	17	673849	4872145	-	-	-	11/19/2010

Appendix D Hydrology

Hydro One Networks Inc. Clarington - 1609-60745
NRCS (SCS) Curve Number Determination

Existing Conditions

Soil Type	**Hydrologic Soil Group**
Loam/Muck	B

TABLE OF CURVE NUMBERS (CN's)								
Land Use	Hydrologic Soil Type							Source
	A	AB	B	BC	C	CD	D	
Meadow "Good"	30	44	58	64.5	71	74.5	78	MTO
Woodlot "Fair"	36	48	60	66.5	73	76	79	MTO
Lawns "Good"	39	50	61	67.5	74	77	80	USDA
Pasture/Range	58	61.5	65	70.5	76	78.5	81	MTO
Crop	66	70	74	78	82	84	86	MTO
Gravel	76	80.5	85	87	89	90	91	Chin
Bare Soil (Fallow)	77	81.5	86	88.5	91	92.5	94	MTO
Impervious	98	98	98	98	98	98	98	MTO

MTO - Ministry of Transportation Ontario Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
USDA - United States Department of Agriculture (2004), National Engineering Handbook, Part 630 Hydrology,
Chapter 9 Hydrologic Soil Cover Compexes
Chin - Water-Resources Engineering (2000), David A. Chin, Table 6.13 Curve Numbers for Various Urban Land Uses

HYDROLOGIC SOIL TYPE (%) - Existing Conditions								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
100			100					100
101			100					100
102			100					100
103			100					100

LAND USE (%) - Existing Conditions									
Catchment	Meadow	Woodlot	Lawns	Pasture Range	Crop	Gravel	Bare Soil	Impervious	Total
100		20.0			80				100.0
101		10.0			90				100.0
102		5.0			95				100.0
103		5.0			95				100.0

CURVE NUMBER (CN) - Existing Conditions										
Catchment	Meadow	Woodlot	Lawns	Pasture Range	Crop	Gravel	Bare Soil	Impervious	Weighted CN w/ imp area	Weighted CN w/o imp area
100		12.0			59.2				71	71
101		6.0			66.6				73	73
102		3.0			70.3				73	73
103		3.0			70.3				73	73

Notes:

AMC II assumed

Hydrological Soil Groups taken from MTO Drainage Manual

[*1] Catchments with impervious greater than 20% - only pervious portions used for CN calculation

Hydro One Networks Inc. Clarington - 1609-60745
SWMHYMO Parameters

Existing Conditions

Catchment Number	Outlet	SWMHYMO Command	Area (ha)	CN	TIMP	XIMP	Rise (m)	Length (m)	Slope (%)	Tc (hrs)	Tp (hrs)
100		DESIGN NASHYD	24	71			35	990	3.5	1.01	0.61
101		DESIGN NASHYD	77	73			55	1760	3.1	1.41	0.85
102		DESIGN NASHYD	142	73			50	1980	2.5	1.82	1.09
103		DESIGN NASHYD	23	73			25	575	4.3	0.72	0.43

Notes:

TIMP — Total percent impervious

XIMP — Percent impervious directly connected

Time of Concentration calculated using the SCS Lag Equation (For areas greater than 100 ha)

$Tc = [259L^{0.8}[(1000 / CN) - 9]^{0.7}] / [1900S^{0.5}]$

Where: L = Length of Overland Flow (m)
CN = SCS Curve Number
S = Slope (%)

Time of Concentration calculated using the Airport Method (For areas less than 100 ha)

$Tc = [3.26 (1.1-C) L^{0.5}] / S^{0.33}$

Where: C = Runoff Coefficient = 0.2 for undeveloped areas
L = Length of Overland Flow (m)
S = Slope (%)

Time to Peak — $Tp = 0.6Tc$

CN calculated for pervious areas only for CALIB STANDHYD. CN is a weighed average for CALIB NASHYD

```
00001> 2     Metric units
00002> *#*************************************************************************
00003> *#  Project Name  : Hydro One - Clarington Trasnformer Station
00004> *#  Project Number: 1609-60745
00005> *#  Date          : May 15, 2012
00006> *#  Modeller      : T. Fraser
00007> *#  Revised       : June 5, 2012 by S. Robertson]
00008> *#  Company       : Stantec Consulting Ltd. (Kitchener)
00009> *#  License #     :  4730904
00010> *#
00011> *#  This hydrologic analysis was prepared to determine the flows to and across
00012> *#  the Site in this part of the Harmony Creek Watershed.
00013> *#
00014> *#*************************************************************************
00015> START               TZERO=[0.0]hrs or date,  METOUT=[2],  NSTORM=[1],  NRUN=[1]
00016> *                   ["bm2yr.6h"] <--storm filename, one per line for NSTORM time
00017> *%------------------|-------------------------------------------------------|
00018> READ STORM          STORM_FILENAME=["STORM.001"]
00019> *%------------------|-------------------------------------------------------|
00020> *#  Existing Conditions
00021> *%------------------|-------------------------------------------------------|
00022> *#  Catchment 100 - North-central portion of Site tributary to Key Point A
00023> *%------------------|-------------------------------------------------------|
00024> CALIB NASHYD        ID=[1], NHYD=["100"], DT=[5]min, AREA=[24](ha),
00025>                     DWF=[0](cms),  CN/C=[71], IA=[7.0](mm),
00026>                     N=[3], TP=[0.61]hrs,
00027>                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
00028> *%------------------|-------------------------------------------------------|
00029> *#  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00030> *%------------------|-------------------------------------------------------|
00031> CALIB NASHYD        ID=[2], NHYD=["101"], DT=[5]min, AREA=[78](ha),
00032>                     DWF=[0](cms),  CN/C=[73], IA=[7.0](mm),
00033>                     N=[3], TP=[0.85]hrs,
00034>                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
00035> *%------------------|-------------------------------------------------------|
00036> *#  Sum of Catchments 100 and 101 (Key Point B)
00037> *%------------------|-------------------------------------------------------|
00038> ADD HYD             IDsum=[3], NHYD=["ADD1"], IDs to add=[1+2]
00039> *%------------------|-------------------------------------------------------|
00040> *#  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00041> *%------------------|-------------------------------------------------------|
00042> CALIB NASHYD        ID=[4], NHYD=["102"], DT=[5]min, AREA=[142](ha),
00043>                     DWF=[0](cms),  CN/C=[73], IA=[7.0](mm),
00044>                     N=[3], TP=[1.09]hrs,
00045>                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
00046> *%------------------|-------------------------------------------------------|
00047> *#  Catchment 103 - South portion of site, discharging off-site at Key Point D
00048> *%------------------|-------------------------------------------------------|
00049> CALIB NASHYD        ID=[5], NHYD=["103"], DT=[5]min, AREA=[23](ha),
00050>                     DWF=[0](cms),  CN/C=[73], IA=[7.0](mm),
00051>                     N=[3], TP=[0.43]hrs,
00052>                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
00053> *%------------------|-------------------------------------------------------|
00054> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
00055> *%                   ["bm5yr.6h"] <--storm filename, one per line for NSTORM tim
00056> *%------------------|-------------------------------------------------------|
00057> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
00058> *%                   ["bm100yr.6h"] <--storm filename, one per line for NSTORM t
00059> *%------------------|-------------------------------------------------------|
00060> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[7]
00061> *%                   ["bm2yr.24h"] <--storm filename, one per line for NSTORM ti
00062> *%------------------|-------------------------------------------------------|
00063> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[8]
00064> *%                   ["bm5yr.24h"] <--storm filename, one per line for NSTORM ti
00065> *%------------------|-------------------------------------------------------|
00066> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[9]
00067> *%                   ["bm100yr.24h"] <--storm filename, one per line for NSTORM
00068> *%------------------|-------------------------------------------------------|
00069> FINISH
00070>
```

```
00001> ================================================================================
00002>
00003>    SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
00004>    S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
00005>    SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
00006>        S  W W W  M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
00007>    SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9   =========
00008>                                                          9   9  9   9   # 4730904
00009>          StormWater Management HYdrologic Model          999    999    =========
00010>
00011>  ********************************************************************************
00012>  ************************** SWMHYMO Ver/4.05  ***************************
00013>  *********  A single event and continuous hydrologic simulation model  *********
00014>  *********     based on the principles of HYMO and its successors      *********
00015>  *********                  OTTHYMO-83 and OTTHYMO-89.                  *********
00016>  ********************************************************************************
00017>  ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
00018>  *********                  Ottawa,  Ontario: (613) 836-3884           *********
00019>  *********                  Gatineau, Quebec: (819) 243-6858           *********
00020>  *********                  E-Mail: swmhymo@jfsa.Com                   *********
00021>  ********************************************************************************
00022>
00023>  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00024>  +++++++++ Licensed user: Stantec Consulting Ltd. (Kitchener)          +++++++++
00025>  +++++++++                Kitchener           SERIAL#:4730904         +++++++++
00026>  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00027>
00028>  ********************************************************************************
00029>  *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
00030>  *********           Maximum value for ID numbers  :     10           *********
00031>  *********           Max. number of rainfall points: 105408           *********
00032>  *********           Max. number of flow points    : 105408           *********
00033>  ********************************************************************************
00034>
00035>  ***** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) *****
00036>  *****------------------------------------------------------------------------*****
00037>  *****     ID:  Hydrograph IDentification numbers, (1-10).                    *****
00038>  *****  NHYD:  Hydrograph reference numbers, (6 digits or characters).        *****
00039>  *****  AREA:  Drainage area associated with hydrograph, (ac.) or (ha.).      *****
00040>  ***** QPEAK:  Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s).        *****
00041>  ***** TpeakDate_hh:mm is the date and time of the peak flow.                 *****
00042>  *****  R.V.:  Runoff Volume of simulated hydrograph, (in) or (mm).          *****
00043>  *****  R.C.:  Runoff Coefficient of simulated hydrograph, (ratio).          *****
00044>  *****     *:  see WARNING or NOTE message printed at end of run.            *****
00045>  *****    **:  see  ERROR  message printed at end of run.                    *****
00046>  ********************************************************************************
00047>  ********************************************************************************
00048>
00049>  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
00050>
00051>  ********************************************************************************
00052>
00053>  **********************   S U M M A R Y   O U T P U T   **********************
00054>  ********************************************************************************
00055>  *         DATE: 2012-06-06     TIME: 11:28:01     RUN COUNTER: 000104         *
00056>  ********************************************************************************
00057>  * Input  filename: C:\SWMHYMO\HONIex.dat                                        *
00058>  * Output  filename: C:\SWMHYMO\HONIex.out                                      *
00059>  * Summary filename: C:\SWMHYMO\HONIex.sum                                      *
00060>  * User comments:                                                              *
00061>  * 1:_____________________________________________________________________________*
00062>  * 2:_____________________________________________________________________________*
00063>  * 3:_____________________________________________________________________________*
00064>  ********************************************************************************
00065>
00066>
00067> #*******************************************************************************
00068> #  Project Name  : Hydro One - Clarington Trasnformer Station
00069> #  Project Number: 1609-60745
00070> #  Date         : May 15, 2012
00071> #  Modeller     : T. Fraser
00072> #  Revised      : June 5, 2012 by S. Robertson]
00073> #  Company      : Stantec Consulting Ltd. (Kitchener)
00074> #  License #    :  4730904
00075> #
00076> #  This hydrologic analysis was prepared to determine the flows to and across
00077> #  the Site in this part of the Harmony Creek Watershed.
00078> #
00079> #*******************************************************************************
00080>  RUN:COMMAND#
00081>  001:0001-------------------------------------------------------------------------
00082>      START
00083>       [TZERO =    .00 hrs on        0]
00084>       [METOUT=   2    (1=imperial, 2=metric output)]
00085>       [NSTORM=   1 ]
00086>       [NRUN  =   1 ]
00087>  001:0002-------------------------------------------------------------------------
00088>      READ STORM
00089>       Filename = STORM.001
00090>       Comment  =
00091>       [SDT=15.00:SDUR=   6.00:PTOT=  37.90]
00092> #  Existing Conditions
00093> #  Catchment 100 - North-central portion of Site tributary to Key Point A
00094>  001:0003---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00095>      CALIB NASHYD       01:100           24.00     .252 No_date    3:40    7.09
00096>       [CN= 71.0: N= 3.00]
00097>       [Tp=  .61:DT= 5.00]
00098> #  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00099>  001:0004---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00100>      CALIB NASHYD       02:101           78.00     .697 No_date    3:55    7.65
00101>       [CN= 73.0: N= 3.00]
00102>       [Tp=  .85:DT= 5.00]
00103> #  Sum of Catchments 100 and 101 (Key Point B)
00104>  001:0005---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00105>      ADD HYD            01:100           24.00     .252 No_date    3:40    7.09
00106>                       +  02:101           78.00     .697 No_date    3:55    7.65
00107>       [DT= 5.00]  SUM=  03:ADD1         102.00     .931 No_date    3:50    7.52
00108> #  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00109>  001:0006---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00110>      CALIB NASHYD       04:102          142.00    1.057 No_date    4:15    7.65
00111>       [CN= 73.0: N= 3.00]
00112>       [Tp= 1.09:DT= 5.00]
00113> #  Catchment 103 - South portion of site, discharging off-site at Key Point D
00114>  001:0007---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00115>      CALIB NASHYD       05:103           23.00     .331 No_date    3:25    7.65
00116>       [CN= 73.0: N= 3.00]
00117>       [Tp=  .43:DT= 5.00]
00118>   ** END OF RUN :   1
00119>
00120> ********************************************************************************
00121>
00122>
00123>
00124>
00125>
00126>  RUN:COMMAND#
00127>  002:0001-------------------------------------------------------------------------
00128>      START
00129>       [TZERO =    .00 hrs on        0]
00130>       [METOUT=   2    (1=imperial, 2=metric output)]
00131>       [NSTORM=   1 ]
00132>       [NRUN  =   2 ]
00133> #*******************************************************************************
00134> #  Project Name  : Hydro One - Clarington Trasnformer Station
00135> #  Project Number: 1609-60745
00136> #  Date         : May 15, 2012
00137> #  Modeller     : T. Fraser
00138> #  Revised      : June 5, 2012 by S. Robertson]
00139> #  Company      : Stantec Consulting Ltd. (Kitchener)
00140> #  License #    :  4730904
00141> #
00142> #  This hydrologic analysis was prepared to determine the flows to and across
00143> #  the Site in this part of the Harmony Creek Watershed.
00144> #
00145> #*******************************************************************************
00146>  002:0002-------------------------------------------------------------------------
00147>      READ STORM
00148>       Filename = STORM.001
00149>       Comment  =
00150>       [SDT=15.00:SDUR=   6.00:PTOT=  50.00]
00151> #  Existing Conditions
00152> #  Catchment 100 - North-central portion of Site tributary to Key Point A
00153>  002:0003---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00154>      CALIB NASHYD       01:100           24.00     .460 No_date    3:35   12.60
00155>       [CN= 71.0: N= 3.00]
00156>       [Tp=  .61:DT= 5.00]
00157> #  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00158>  002:0004---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00159>      CALIB NASHYD       02:101           78.00    1.260 No_date    3:55   13.50
00160>       [CN= 73.0: N= 3.00]
00161>       [Tp=  .85:DT= 5.00]
00162> #  Sum of Catchments 100 and 101 (Key Point B)
00163>  002:0005---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00164>      ADD HYD            01:100           24.00     .460 No_date    3:35   12.60
00165>                       +  02:101           78.00    1.260 No_date    3:55   13.50
00166>       [DT= 5.00]  SUM=  03:ADD1         102.00    1.686 No_date    3:50   13.29
00167> #  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00168>  002:0006---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00169>      CALIB NASHYD       04:102          142.00    1.902 No_date    4:10   13.50
00170>       [CN= 73.0: N= 3.00]
00171>       [Tp= 1.09:DT= 5.00]
00172> #  Catchment 103 - South portion of site, discharging off-site at Key Point D
00173>  002:0007---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00174>      CALIB NASHYD       05:103           23.00     .605 No_date    3:20   13.50
00175>       [CN= 73.0: N= 3.00]
00176>       [Tp=  .43:DT= 5.00]
00177>   ** END OF RUN :   2
00178>
00179> ********************************************************************************
00180>
00181>
00182>
00183>
00184>
00185>  RUN:COMMAND#
00186>  003:0001-------------------------------------------------------------------------
00187>      START
00188>       [TZERO =    .00 hrs on        0]
00189>       [METOUT=   2    (1=imperial, 2=metric output)]
00190>       [NSTORM=   1 ]
00191>       [NRUN  =   3 ]
00192> #*******************************************************************************
00193> #  Project Name  : Hydro One - Clarington Trasnformer Station
00194> #  Project Number: 1609-60745
00195> #  Date         : May 15, 2012
00196> #  Modeller     : T. Fraser
00197> #  Revised      : June 5, 2012 by S. Robertson]
00198> #  Company      : Stantec Consulting Ltd. (Kitchener)
00199> #  License #    :  4730904
00200> #
00201> #  This hydrologic analysis was prepared to determine the flows to and across
00202> #  the Site in this part of the Harmony Creek Watershed.
00203> #
00204> #*******************************************************************************
00205>  003:0002-------------------------------------------------------------------------
00206>      READ STORM
00207>       Filename = STORM.001
00208>       Comment  =
00209>       [SDT=15.00:SDUR=   6.00:PTOT=  83.10]
00210> #  Existing Conditions
00211> #  Catchment 100 - North-central portion of Site tributary to Key Point A
00212>  003:0003---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00213>      CALIB NASHYD       01:100           24.00    1.215 No_date    3:35   32.20
00214>       [CN= 71.0: N= 3.00]
00215>       [Tp=  .61:DT= 5.00]
00216> #  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00217>  003:0004---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00218>      CALIB NASHYD       02:101           78.00    3.276 No_date    3:50   34.06
00219>       [CN= 73.0: N= 3.00]
00220>       [Tp=  .85:DT= 5.00]
00221> #  Sum of Catchments 100 and 101 (Key Point B)
00222>  003:0005---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00223>      ADD HYD            01:100           24.00    1.215 No_date    3:35   32.20
00224>                       +  02:101           78.00    3.276 No_date    3:50   34.06
00225>       [DT= 5.00]  SUM=  03:ADD1         102.00    4.406 No_date    3:45   33.62
00226> #  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00227>  003:0006---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00228>      CALIB NASHYD       04:102          142.00    4.924 No_date    4:10   34.06
00229>       [CN= 73.0: N= 3.00]
00230>       [Tp= 1.09:DT= 5.00]
00231> #  Catchment 103 - South portion of site, discharging off-site at Key Point D
00232>  003:0007---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00233>      CALIB NASHYD       05:103           23.00    1.587 No_date    3:20   34.06
00234>       [CN= 73.0: N= 3.00]
00235>       [Tp=  .43:DT= 5.00]
00236>   ** END OF RUN :   6
00237>
00238> ********************************************************************************
00239>
00240>
00241>
00242>
00243>
00244>  RUN:COMMAND#
00245>  007:0001-------------------------------------------------------------------------
00246>      START
00247>       [TZERO =    .00 hrs on        0]
00248>       [METOUT=   2    (1=imperial, 2=metric output)]
00249>       [NSTORM=   1 ]
00250>       [NRUN  =   7 ]
00251> #*******************************************************************************
00252> #  Project Name  : Hydro One - Clarington Trasnformer Station
00253> #  Project Number: 1609-60745
00254> #  Date         : May 15, 2012
00255> #  Modeller     : T. Fraser
00256> #  Revised      : June 5, 2012 by S. Robertson]
00257> #  Company      : Stantec Consulting Ltd. (Kitchener)
00258> #  License #    :  4730904
00259> #
00260> #  This hydrologic analysis was prepared to determine the flows to and across
00261> #  the Site in this part of the Harmony Creek Watershed.
00262> #
00263> #*******************************************************************************
00264>  007:0002-------------------------------------------------------------------------
00265>      READ STORM
00266>       Filename = STORM.001
00267>       Comment  =
00268>       [SDT=15.00:SDUR=  24.00:PTOT=  47.10]
00269> #  Existing Conditions
00270> #  Catchment 100 - North-central portion of Site tributary to Key Point A
```

```
00271>  007:0003---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00272>      CALIB NASHYD       01:100           24.00     .290 No_date   12:35   11.18
00273>        [CN= 71.0: N= 3.00]
00274>        [Tp=  .61:DT= 5.00]
00275> #  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00276>  007:0004---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00277>      CALIB NASHYD       02:101           78.00     .801 No_date   12:50   12.00
00278>        [CN= 73.0: N= 3.00]
00279>        [Tp=  .85:DT= 5.00]
00280> #  Sum of Catchments 100 and 101 (Key Point B)
00281>  007:0005---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00282>      ADD HYD            01:100           24.00     .290 No_date   12:35   11.18
00283>                       +  02:101           78.00     .801 No_date   12:50   12.00
00284>        [DT= 5.00]  SUM=  03:ADD1         102.00    1.071 No_date   12:45   11.80
00285> #  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00286>  007:0006---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00287>      CALIB NASHYD       04:102          142.00    1.210 No_date   13:10   12.00
00288>        [CN= 73.0: N= 3.00]
00289>        [Tp= 1.09:DT= 5.00]
00290> #  Catchment 103 - South portion of site, discharging off-site at Key Point D
00291>  007:0007---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00292>      CALIB NASHYD       05:103           23.00     .386 No_date   12:20   12.00
00293>        [CN= 73.0: N= 3.00]
00294>        [Tp=  .43:DT= 5.00]
00295>   ** END OF RUN :   7
00296>
00297> ****************************************************************************
00298>
00299>
00300>
00301>
00302>
00303>  RUN:COMMAND#
00304>  008:0001---------------------------------------------------------------------
00305>      START
00306>        [TZERO =    .00 hrs on        0]
00307>        [METOUT=   2    (1=imperial, 2=metric output)]
00308>        [NSTORM=   1 ]
00309>        [NRUN  =   8 ]
00310> #****************************************************************************
00311> #  Project Name  : Hydro One - Clarington Trasnformer Station
00312> #  Project Number: 1609-60745
00313> #  Date          : May 15, 2012
00314> #  Modeller      : T. Fraser
00315> #  Revised       : June 5, 2012 by S. Robertson]
00316> #  Company       : Stantec Consulting Ltd. (Kitchener)
00317> #  License #     :  4730904
00318> #
00319> #  This hydrologic analysis was prepared to determine the flows to and across
00320> #  the Site in this part of the Harmony Creek Watershed.
00321> #
00322> #****************************************************************************
00323>  008:0002---------------------------------------------------------------------
00324>      READ STORM
00325>       Filename = STORM.001
00326>       Comment  =
00327>       [SDT=15.00:SDUR=  24.00:PTOT=  59.20]
00328> #  Existing Conditions
00329> #  Catchment 100 - North-central portion of Site tributary to Key Point A
00330>  008:0003---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00331>      CALIB NASHYD       01:100           24.00     .464 No_date   12:30   17.47
00332>        [CN= 71.0: N= 3.00]
00333>        [Tp=  .61:DT= 5.00]
00334> #  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00335>  008:0004---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00336>      CALIB NASHYD       02:101           78.00    1.275 No_date   12:50   18.64
00337>        [CN= 73.0: N= 3.00]
00338>        [Tp=  .85:DT= 5.00]
00339> #  Sum of Catchments 100 and 101 (Key Point B)
00340>  008:0005---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00341>      ADD HYD            01:100           24.00     .464 No_date   12:30   17.47
00342>                       +  02:101           78.00    1.275 No_date   12:50   18.64
00343>        [DT= 5.00]  SUM=  03:ADD1         102.00    1.708 No_date   12:45   18.37
00344> #  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00345>  008:0006---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00346>      CALIB NASHYD       04:102          142.00    1.927 No_date   13:05   18.64
00347>        [CN= 73.0: N= 3.00]
00348>        [Tp= 1.09:DT= 5.00]
00349> #  Catchment 103 - South portion of site, discharging off-site at Key Point D
00350>  008:0007---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00351>      CALIB NASHYD       05:103           23.00     .614 No_date   12:20   18.64
00352>        [CN= 73.0: N= 3.00]
00353>        [Tp=  .43:DT= 5.00]
00354>   ** END OF RUN :   8
00355>
00356> ****************************************************************************
00357>
00358>
00359>
00360>
00361>
00362>  RUN:COMMAND#
00363>  009:0001---------------------------------------------------------------------
00364>      START
00365>        [TZERO =    .00 hrs on        0]
00366>        [METOUT=   2    (1=imperial, 2=metric output)]
00367>        [NSTORM=   1 ]
00368>        [NRUN  =   9 ]
00369> #****************************************************************************
00370> #  Project Name  : Hydro One - Clarington Trasnformer Station
00371> #  Project Number: 1609-60745
00372> #  Date          : May 15, 2012
00373> #  Modeller      : T. Fraser
00374> #  Revised       : June 5, 2012 by S. Robertson]
00375> #  Company       : Stantec Consulting Ltd. (Kitchener)
00376> #  License #     :  4730904
00377> #
00378> #  This hydrologic analysis was prepared to determine the flows to and across
00379> #  the Site in this part of the Harmony Creek Watershed.
00380> #
00381> #****************************************************************************
00382>  009:0002---------------------------------------------------------------------
00383>      READ STORM
00384>       Filename = STORM.001
00385>       Comment  =
00386>       [SDT=15.00:SDUR=  24.00:PTOT=  92.40]
00387> #  Existing Conditions
00388> #  Catchment 100 - North-central portion of Site tributary to Key Point A
00389>  009:0003---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00390>      CALIB NASHYD       01:100           24.00    1.060 No_date   12:30   38.56
00391>        [CN= 71.0: N= 3.00]
00392>        [Tp=  .61:DT= 5.00]
00393> #  Catchment 101 - West end of site, western edge of Harmony Cr watershed
00394>  009:0004---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00395>      CALIB NASHYD       02:101           78.00    2.867 No_date   12:45   40.66
00396>        [CN= 73.0: N= 3.00]
00397>        [Tp=  .85:DT= 5.00]
00398> #  Sum of Catchments 100 and 101 (Key Point B)
00399>  009:0005---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00400>      ADD HYD            01:100           24.00    1.060 No_date   12:30   38.56
00401>                       +  02:101           78.00    2.867 No_date   12:45   40.66
00402>        [DT= 5.00]  SUM=  03:ADD1         102.00    3.856 No_date   12:40   40.17
00403> #  Catchment 102 - East catchment, drains to southeast end of site (Key Pt C)
00404>  009:0006---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00405>      CALIB NASHYD       04:102          142.00    4.336 No_date   13:05   40.66
00406>        [CN= 73.0: N= 3.00]
00407>        [Tp= 1.09:DT= 5.00]
00408> #  Catchment 103 - South portion of site, discharging off-site at Key Point D
00409>  009:0007---------------ID:NHYD----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
00410>      CALIB NASHYD       05:103           23.00    1.378 No_date   12:20   40.66
00411>        [CN= 73.0: N= 3.00]
00412>        [Tp=  .43:DT= 5.00]
00413>  009:0002---------------------------------------------------------------------
00414>      FINISH
00415> ---------------------------------------------------------------------------
00416> ****************************************************************************
00417>      WARNINGS / ERRORS / NOTES
00418>      -------------------------
00419>    Simulation ended on 2012-06-06     at 11:28:10
00420> ============================================================================
00421>
```