DST
consulting engineers

GEOTECHNICAL INVESTIGATION REPORT
301 PALLADIUM DRIVE
OTTAWA, ONTARIO

301 Palladium Ltd.
c/o Citant Group Ltd.

October 2015

DST File No.: IN-SO-021872

203-2150 Thurston Drive
Ottawa, ON KG 5T9
CANADA www.dstgroup.com
Phone: 613.748.1415
Fax: 613.748.1356

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1. INTRODUCTION

DST Consulting Engineers Inc. (DST) was retained by 301 Palladium Ltd. c/o Citant Group Ltd. to conduct a geotechnical investigation for the proposed commercial building to be located at 301 Palladium Drive in Ottawa, Ontario. The geotechnical investigation was completed in general accordance with the work plan described in DST's proposal dated August 13, 2015 (DST Reference No. IN-SO-021872). Authorization to proceed with this investigation was provided by Mr. Peter Clare, RQS of Citant Group Ltd.

This report is prepared for the sole use of 301 Palladium Ltd. c/o Citant Group Ltd. and any use of the report, or any reliance on it by any other party, is the responsibility of such party.

This geotechnical engineering report is subject to the limitations shown in Appendix A.

2. PROJECT DESCRIPTION

The site for the proposed development is located at 301 Palladium Drive in Ottawa, Ontario located in the southwest corner of the Katimavik Drive/Palladium Drive and Terry Fox Drive intersection. Currently, the site is a vacant, landscaped area. The location of the site is shown in Figure1, Appendix B.

It is understood the proposed development will consist of a single story slab-on-grade commercial building with an approximate footprint of 550 m^2. The proposed design elevation of the floor slab will be Elevation 103.50 m. The development will include an outdoor paved parking lot with 72 parking stalls and the installation of municipal underground services.

3. AVAILABLE INFORMATION

The following drawings were made available and used as reference material in the preparation of this report:

- "Site Services and Grading Plan (Composite), Proposed Commercial Building, 301 Palladium Drive, Kanata, Ontario", Drawing No. SSG-1, dated July 2015 and prepared by Erion Associates Consulting Civil Engineers (Project No. EA 14-288). Drawing labelled preliminary review only.
- "Topographic Survey of Part of Lot 1 Concession 2 Geographic Township of March Now City of Ottawa", survey dated June 9, 2015 and prepared by Fairhall Moffat and Woodland Limited (Project No. V18200).

- Package of Architectural Conceptual Plans and Elevations prepared by KWC Architects Inc.

4. SCOPE OF SERVICES

The purpose of this geotechnical investigation is to provide geotechnical engineering commentary and recommendations regarding the design and construction of the proposed commercial building, parking lot and installation of municipal services.

DST has completed the following scope of work to meet the project requirements:

Fieldwork:

- Placement of three (3) boreholes within the proposed building footprint and advanced to auger refusal depths on inferred bedrock and termination depth of 4.3 to 8.9 m. Confirm the presence of bedrock in one (1) borehole by coring a 4.2 m length of bedrock.
- Placement of three (3) boreholes within the proposed parking lot area and advanced to depths ranging from 3.6 to 4.8 m. Install a standpipe piezometer in four (4) boreholes for the monitoring of the groundwater levels.
- Survey the borehole locations and geodetic elevations.
- Moisture content determination on all recovered soil samples.
- Grain size analysis on selected soil samples.
- Atterberg limit determination on selected soil samples.
- Chemical analyses of selected soil samples to assess the potential of sulphate attack on buried concrete structures and corrosion potential on buried steel structures.

Engineering Analyses and Reporting:

The geotechnical engineering report will include site and borehole location plans, borehole logs and laboratory test results and will discuss the following:

- Assessment of the subsurface soil, bedrock and groundwater conditions at the six (6) borehole locations.
- Site grade raise restriction.
- Foundation recommendations.
- Liquefaction potential of subsurface soils during a seismic event.
- Slab-on-grade construction.
- Frost penetration and protection.
- Pipe Bedding.

- Backfill Requirements.
- Excavation and de-watering during construction.
- Pavement structure design.
- Corrosion potential of subsurface soils.
- Tree planting.

5. FIELD INVESTIGATION AND LABORATORY TESTING

5.1 Field Investigation

The field work was conducted on September 24 and 25, 2015 and consisted of six (6) boreholes (BHs 1 to 6) advanced to auger refusal and termination depths of 3.6 to 8.9 m below existing grade. The borehole locations are shown in Figure 2, Appendix B.

The borehole locations and geodetic elevations were determined on site by DST. The following geodetic benchmark was used to determine the borehole elevations:

Benchmark: Top of magnetic nail in concrete base of light standard located in southeast corner of site.

- Geodetic Benchmark: 102.828 m (provided on drawing titled, "Topographic Survey of Part of Lot 1 Concession 2 Geographic Township of March Now City of Ottawa", survey dated June 9, 2015 and prepared by Fairhall Moffat and Woodland Limited (Project No. V18200).

The boreholes were advanced using a truck mounted CME 75 drill rig equipped with geotechnical soil sampling and rock coring capabilities. The borehole work was supervised on a full time basis by a geotechnical representative from DST.

Standard penetration tests (SPTs) were undertaken in each borehole at regular depth intervals with soil samples retrieved by the split spoon sampler. The undrained shear strength of the clayey soil was measured in situ by performing the field vane test. The bedrock was cored in one (1) borehole using conventional N size coring equipment. Standpipe piezometers were installed in four (4) boreholes for groundwater level monitoring purposes. All boreholes were backfilled on completion of drilling, sampling and standpipe piezometer installations.

The subsurface stratigraphy encountered in each borehole was recorded by the DST representative and the recovered soil samples and bedrock cores were labelled accordingly and submitted to the laboratory for detailed visual examination and laboratory testing.

5.2 Laboratory Testing

Laboratory testing of the soil samples consisted of moisture content determination on all samples. Grain size analysis, Atterberg limit determination and chemical analyses consisting of pH, chloride, conductivity, sulphate and redox potential determinations were conducted on selected representative soil samples.

6. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered in the boreholes are provided in the borehole logs shown in Appendix C and discussed below. The moisture contents, grain size analysis and Atterberg limits are shown on the borehole logs as well as in Appendix C.

A surficial topsoil layer was encountered in all six (6) boreholes. The approximate thickness of the topsoil is 150 mm.

6.1 Fill

A sand, sand and gravel fill material was encountered beneath the topsoil in all six (6) boreholes. The fill extends to depths of 0.8 to 2.1 m (Elev.102.7 to 100.8 m). SPT 'N' values obtained within the fill range from 3 to 17, indicating the fill is in a very loose to compact state. Moisture contents of tested samples of the fill vary from 2% to 28%.

6.2 Clay - silty

The fill is underlain by native silty clay in all six (6) boreholes. In Boreholes BHs 1 to 5, the silty clay is present to depths of 3.2 to 4.6 m (Elev.100.1 to 97.9 m). Borehole BH 6 terminated within the silty clay at 4.8 m depth (Elev.99.2 m). The field vane test results range from 32 to greater than 200 kPa indicating a firm to hard consistency. The moisture content of the tested samples range from 4% to 48%. The results from the grain size analysis and Atterberg limits determination conducted on selected samples of the silty clay are attached in Appendix D and are summarized in Tables 6.1 and 6.2, respectively.

Table 6.1 Summary of Grain Size Analysis Results

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
BH 1 SS3	2.4 – 3.0	37	54	9	0
BH 4 SS3	3.1 – 3.7	31	67	2	0

Table 6.2 Summary of Atterberg Limits

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
BH 1 SS3	2.4 – 3.0	41	20	21
BH 2 SS3	1.5 – 2.1	66	25	41
BH3 SS3	1.5 - 2.1	60	25	35
BH4 SS4	3.0 – 3.6	67	25	42

6.3 Till

A sand and gravel and silty clay till was contacted beneath the silty clay in Boreholes BHs 1 to 5 at 3.2 to 4.6 m depths (Elev. 100.1 to 97.9 m). Boreholes BHs 1, 2, 4, and 5 terminated within the till layer at 3.6 to 5.5 m depths (Elev. 99.4 to 93.6 m). The till extends to 4.6 m depth (Elev. 97.9 m) in Borehole BH 3. The till may contain cobbles and boulders. SPT 'N' values of the till range from 0 to greater than 50 indicating a very loose to very dense state. The low SPT N value of 0 may be attributed to disturbance to the soil by driving the sampler into a sand and gravel material below the measured groundwater level. The high SPT N value of greater than 50 may be attributed to the sampler possibly driving on a cobble, boulder or making contact with inferred bedrock. Moisture content of tested samples varied between 8% and 45 %.

Grain size analysis of the till from Borehole BH 4 (Sample No. SS5, 4.6 – 5.1 m depth) indicates a soil composition of 1% gravel, 15% sand, 54% silt and 30% clay.

6.4 Auger Refusal and Bedrock

Auger refusal on inferred cobbles, boulders or bedrock was encountered in Boreholes BH1 to 3 at 3.6 to 4.6 m depths (Elev. 98.6 to 97.9 m). The presence of bedrock in Borehole BH3 was proven by advancing the borehole 4.3 m into the bedrock from 4.6 to 8.9 m depth (Elev.97.9 to 93.6m). The Total Core Recovery (TCR) is 98 and 100%. The Rock Quality Designation (RQD) values range from 70 to 88% which corresponds to a rating of fair to good quality rock.

Groundwater levels were measured in the standpipe piezometers installed in Boreholes BHs 1, 4, 5 and 6 on October 21, 2015 (26 days following completion of drilling) and the measurements are summarized in Table 6.3. The groundwater levels may fluctuate seasonally and in response to climatic conditions.

Table 6.3 Summary of Groundwater Level Measurements

[redacted]	[redacted]	[redacted]	[redacted]
BH 1	102.15	DRY (up to 3.6 m)	N/A
BH 4	103.17	4.75	98.4
BH 5	103.45	2.67	100.8
BH 6	104.00	3.03	100.9

7. CHEMICAL TEST RESULTS ON SELECTED SOIL SAMPLES

Selected soil samples were submitted to Maxxam Laboratories for chemical analyses (pH, sulphate, redox, conductivity and chloride) to assess the potential for corrosion and sulphate attack on buried concrete and steel structures.

The results are presented below in Table 7.1 and a copy of the Laboratory Certificate of Analysis is provided in Appendix E.

Table 7.1 Chemical Test Results

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
BH1 @ 2.5 m depth	360	520	7.65	1.2	+168
BH6 @ 1.5m depth	<20	41	7.72	0.24	+117

The chemical sulphate content analyses for representative soil sample tested indicate a sulphate concentration of a maximum of 360 μg/g in soil.

The results were compared with Canadian Standards Association (CSA) Standards A23.1 for sulphate attack potential on concrete structures and possess a "negligible" risk for sulphate attack on concrete material and accordingly, conventional GU or MS Portland cement may be used in the construction of the proposed concrete elements.

The pH value for the soil samples was reported to range between 7.85 and 8.77, indicating a durable condition against corrosion. These results were evaluated using Table 2 of Building Research Establishment (BRE) Digest 363 (July 1991). The pH is greater than 5.5 indicating the concrete will not be exposed to attack from acids. The chloride content of the selected soil sample was also compared with the threshold level and present negligible concrete corrosion potential.

8. GEOTECHNICAL SOIL DESIGN PARAMETERS

Based on the in-situ and laboratory tests carried out, the following parameters shown in Table 8.1 below are suggested as design parameters for the soil types encountered in the boreholes. The internal friction angles of granular materials were estimated from standard penetration tests (SPTs) applying Wolff (1989) which provides an empirical correlation between SPT and internal friction angle.

The internal friction angles of cohesive materials were estimated from Atterberg Limits test results applying Kenji (1970) which provides an empirical correlation between plasticity index and internal friction angle.

Table 8.1 Geotechnical Soil Design Parameters

[redacted]	[redacted]	[redacted]	[redacted]
Sand and Gravel, Sand Fill	20	-	30-36 (30)
Silty Clay	16-18 (18)	30 to greater than 200 kPa (100)	22
Silty Clay Till	16-18 (18)	-	30
Sand and Gravel Till	19 – 20 (20)	-	30-35 (32)[1]

Note 1: The estimated internal friction of the sand and gravel till could not be determined from the SPTs, since the N values in this material are not considered representative. The estimated value was based on published literature.

9. DISCUSSION AND RECOMMENDATIONS

The general site stratigraphy consists of a surficial topsoil layer overlying sand, sand and gravel fill underlain by native silty clay, till mantling inferred bedrock. The presence of bedrock was proven in one (1) borehole. The groundwater level ranges from 2.7 to 4.8 m below the existing grade level (Elev. 101.0 to 98.4 m).

Unless noted otherwise, foundation design parameters are given for static, vertically and concentrically loaded foundations in compression. Dynamic, lateral, eccentric and uplift design parameters can be provided upon request, if applicable.

All foundation design recommendations presented in this report are based on the assumption that an adequate level of construction monitoring during foundation excavation and installation will be provided. An adequate level of construction monitoring is considered to be:

a) For shallow foundations: examination of all excavation surfaces prior to fill placement to ensure the integrity of the subgrade.

b) For earthwork and underground services: full-time monitoring and compaction testing.

9.1 Site Grade Raise

The elevation of the proposed floor slab is Elevation 103.50 m. The ground surface elevation of the boreholes located within the footprint of the proposed building ranges from Elevation 101.9 to 103.1m. Therefore, the proposed site grades within the building footprint will need to be raised by approximately 0.95 to 1.50 m. Elsewhere on the site, grade raises are in the order of 0.2 to 0.3 m.

The site is underlain by a firm to hard silty clay that is prone to settlement when overstressed by external loads that are close to or exceed the pre-consolidation pressure or yield stress of the silty clay. External loads include loads imposed by building foundations (such as footings), site grade raise and lowering of the groundwater level during construction. The proposed site grade raise is considered acceptable provided the building is supported by shallow foundations (footings) designed for the depths and geotechnical reaction at serviceability limit state (SLS) indicated in Section 9.2 of this report. The site grade raise is based on a 0.5 m long term groundwater lowering of the site.

9.2 Shallow Footings

Based on a review of the site and grading plan provided by the client, it is our understanding that the proposed commercial will be one (1) storey with a partial basement (Underside footing elevation is 102.00 m and 100.55m respectively) and a slab on grade (elevation of 103.50 m). Based on the boreholes information, native silt and clay to clayey silt material was found to be at depth varies between 1.5 to 2 m below existing grade.

In addition, depth of the native cohesive inorganic soil may vary predictably within the proposed footprint building and, thus, a step down shallow foundation may be considered in order to ensure a consistent subgrade material beneath the proposed foundation.

9.2.1.1 Strip Footing

It is assumed and strongly recommended that the proposed foundation wall will be constructed on a strip footing elements and founded on the native inorganic silty clay or clayey silt layer (approx. Elevation 101.0). To provide geotechnical reactions that meet the maximum Serviceability Limits States (SLS) loading (within maximum settlements of 25 mm) and Ultimate Limit States (ULS) resistances, reactions have been provided in the following tables. For these bearing pressures to be realized, soil covers of 1.5 m and 2.5 m are required respectively above the footings as shown in the Table 9.1. A minimum distance of one footing width is required between adjacent footings.

Table 9.1 Geotechnical resistances and reactions for strip footings on native undisturbed soil

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
101.00	0.5	750	375	170
	1.0	754	377	110
	1.5	670	330	85

Total settlement is not expected to exceed 25 mm with differential settlement less than 20 mm. In situations where column loads dictate footings wider than those widths provided are required, the geotechnical engineer should be contacted with specific column loads, and options can possibly be developed.

All existing topsoil, fill and/or other deleterious materials (including fill and construction debris) must be removed prior to the start of subgrade preparation. All excavations should be backfilled with approved engineered fill compacted to 100% of the SPMDD.

Bearing areas will require very careful preparation. Following excavation all bearing surfaces should be cleaned of all organic, loose, disturbed, or slough material prior to concreting or placing compacted fill material. Bearing surfaces should be protected at all times from rain, freezing temperatures and the ingress of groundwater before, during and after construction.

The engineered backfill should comprise Granular B Type I fill material meeting Ontario Provincial Standard Specifications SSP110S13. The fill should be placed and compacted in an unfrozen condition and the subgrade should be protected at all times from frost penetration.

All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to confirm the integrity of the bearing surface.

9.2.1.2 Square Footings

Square Footing elements for the building should be founded on the native inorganic undisturbed Silt and clay or clayey silt. Spread footings may be designed using limit state static bearing pressures listed in the Table 9.2. For these bearing pressure to be realized soil covers of 1.5 m and 2.5 m are required respectively above the footing as described below. Minimum and maximum footing widths of 1.0 m and 2.5 m are recommended respectively. A minimum distance of one footing width is also required between adjacent footings.

Table 9.2 Geotechnical resistances and reactions for square footings on native undisturbed soil

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
101.00	1.0	900	450	190
	1.5	860	430	130
	2.0	870	435	100
	2.5	900	450	80

9.3 Liquefaction Potential of Subsurface Soils during a Seismic Event

The subsurface soils are not considered to have a potential to liquefy during a seismic event.

9.4 Slab-On-Grade

Boreholes BH2, 3 and 4 indicate the building footprint is underlain by existing fill to depths ranging from 1.3 to 2.1 m, Elevation 101.1 to 100.8 m. The existing fill is not considered suitable for supporting the slab-on-grade. Therefore, the floor slab may be designed and constructed as a slab-on-grade constructed on an engineered fill pad as discussed below.

All topsoil, fill and deleterious material should be excavated and removed from within the slab footprint to the surface of the native silty clay. The exposed clay subgrade should be evaluated by a geotechnical engineer prior to placement of the engineered fill. Once the exposed subgrade has been approved, the site grades within the floor slab area may be raised by the placement of engineered fill to the underside of the granular base of the slab. The engineered fill should consist of OPSS Granular B Types I or II placed in 300 mm max. Loose lift thicknesses, with each lift compacted to 98% SPMDD. Once the slab subgrade has been prepared, the floor slab may be constructed on a 200 mm thick compacted bed of 19 mm clear stone.

The slab should be structurally independent from walls and columns, which are supported by the foundations. This is to reduce any structural distress that may occur as a result of differential soil movement. If it is intended to place any internal non-load bearing partitions directly on the slab-on-grade, such walls should also be structurally independent from other elements of the building founded on the conventional foundation system so that some relative vertical movement of the walls can occur freely.

The subgrade beneath the slab-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of water. This applies during and after the construction period.

Some relative movement between the slab-on-grade floor and adjacent walls or foundations and differential movement within the slab should be anticipated. Generally, if the recommendations outlined in this report are followed, these movements are estimated to be less than 10 mm.

The finished exterior grade should be sloped away from the building to prevent ponding of surface water close to the exterior walls of the building.

9.5 Frost Protection

9.5.1.1 Building Foundations

Based on the Ministry of Environment published data, which is based on an 85% probability, the design freezing index for Ottawa has been estimated to be 1,000 degrees-days Celsius (1,832 degree-days Fahrenheit). Based on this data, the calculated depth of frost penetration for silty clay for an area assumed to have been kept clear of snow cover will be in the order of 1.8 m.

To limit the effects of frost penetration, a minimum depth of soil cover of 1.5 m is required for perimeter footings of heated structures provided the structure is heated to at least 18 degrees Celsius and there is some heat loss through the foundation wall and floor. Where earth cover is less than required, thermal rigid insulation should be provided. DST can provide additional information regarding thermal rigid insulation, if required.

9.5.1.2 Underground Services

The underground services should be located below the depth of frost penetration of 1.8 m and in accordance with City of Ottawa specifications. The City of Ottawa specifies watermains require a soil cover above of 2.4 m. Where the available soil cover is less than the required 2.4 m, thermal rigid insulation should be used as specified in the City of Ottawa Drawing No. W22.

9.6 Pipe Bedding

The bedding material over the silty clay should be placed on a layer of non-woven geotextile to provide separation and of the bedding material into the subgrade. This geotextile should extend across the trench bottom and up the sides of the pipe invert level. The bedding material should be compacted to at least 95% SPMDD with appropriate equipment such as low energy vibratory plate tamper. Pipe bedding should be in accordance with the City of Ottawa Standard Drawings.

Compaction of the pipe bedding materials will likely prove problematic where the subgrade consists of soft/loose material, which is sensitive to disturbance. Where compaction proves difficult, the placement of say 300 mm of "self-compacting" fill, such as 19 mm clear stone may be considered to provide a stable base. The clear stone would require a non-woven geotextile to completely surround the stone, thus minimizing settlement caused by surrounding soils migrating into the stone void spaces.

Heavy compaction equipment should not be used until a minimum of 800 mm of compacted backfill has been placed over the pipe, and should be used in accordance with OPSD – 808.010, "Pipe Protection against Heavy Construction Equipment". During backfilling operation, care should be taken to ensure that the backfilling proceeds in equal stages simultaneously on both sides of the pipe. It should be noted that services trenches completed within the underlying native silty clay will be prone to rapid deterioration under joint action of water and excessive foot, or small equipment traffic. Accordingly, care should be taken to keep the base of the excavation as dry as possible and to limit the amount of activity within the trench between excavation to final grade and pipe installation.

9.7 Backfill Requirements

9.7.1.1 Building

Backfill against foundations should consist of an Ontario Provincial Standard Specifications (OPSS) Granular B Type I or II fill material. Exterior building backfill beneath settlement sensitive hard surfaces such as sidewalks, interlocking paving stones and paved surfaces should be compacted to 95% SPMDD. In areas where the settlement sensitive hard surfaces will extend from the building exterior over the building backfill zone and non-backfilled zone, 1H:1V frost tapers should be provided from a 1.5 m depth. Landscaped areas or areas that are not settlement sensitive may be compacted to 90% SPMDD.

9.7.1.2 Underground Services

The quality of the trench backfill will affect the performance of the pavement as well as other structures existing above and beside the service trenches. Therefore, general trench backfilling should be carried out in a manner compatible with requirements of pavement structures and other adjoining structures and utilities.

All trenches should be backfilled with inorganic soil, free of debris, compacted to achieve at least 95% SPMDD throughout and 98% in the upper 300 mm below pavement structure. Trench backfill should be carried out in lifts not to exceed 300mm in thickness, and should be within ± 2% of its optimum moisture content and be compacted with suitable compaction equipment. Trench backfill placed in the upper 1.5 m should be similar in nature with the soils exposed in the trench walls or alternatively 3H:1V frost tapers should be constructed. Below 1.5 m, the trench backfill should consist of approved site generated materials or imported OPSS Select Subgrade Material (SSM). As noted above, these materials should be compacted to 95% SPMDD. Utility chambers (manholes) should be backfilled using Granular B Type II material.

Any fill required to be imported should conform to OPSS requirements for SSM or Granular B Types I or II materials.

The proposed service trenches should be provided with water stops (clay seals) as per City of Ottawa Detail S8 to minimize potential long term groundwater lowering in the area. Water stops should be placed at 50 to 100 m intervals.

The water stops should be constructed full width from trench bottom to underside of roadway pavement structure (subbase). The water stops should consist of compactible clay material placed in lifts not thicker than 300 mm and compacted to 95% SPMDD or a lean concrete mix.

The underground service should be installed in a series of short lengths with the maximum permissible length of open trench limited to 10 m. No excavations should be allowed to be left open overnight, weekends or holidays. The suggested measures would ensure stability of the excavated trenches as well as adjacent buildings and/or structures.

9.8 Excavations

9.8.1.1 Excavation

Excavations for the development are anticipated to extend into the fill and silty clay, sandy soils and bedrock and in some areas extend below the groundwater level. Excavations for this project should be carried out in accordance with the requirements of the Occupational Health and Safety Act of Ontario.

Excavation of the soils may be undertaken with large mechanical equipment capable of removing debris within the fill. The contractor should have suitable equipment to excavate the soils shown on the borehole logs and to meet the requirements of the project schedule and construction methodology.

Excavations must be undertaken in accordance with the Occupational Health and Safety Act (OHSA). The subsurface soils are considered to be Type 3 soil and the excavation sideslopes must be cut back at 1H:1V gradient as specified in OHSA. Local flattening of the sideslopes may be required in zones of persistent seepage.

If open cut, unsupported excavations are not feasible, the excavations will have to be undertaken within the confines of a supported excavation such as a prefabricated support system (trench box) and engineered support system (shoring system). These systems must be designed and installed in accordance with OHSA.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to the depth of the excavation, unless an excavation support system is designed and incorporated to accommodate such surcharge.

Attention should be paid to structures or buried service lines close to the excavation. As a general guideline, if a line projected down at 30 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, underpinning or special shoring techniques may be required to avoid damaging earth movements.

9.8.1.2 Dewatering

It is anticipated that excavations will extend below the groundwater level in some areas of the site.

Groundwater control during construction may be achieved by conventional sump pump techniques. High capacity pumps may be required in zones of persistent seepage.

It is to be noted that dewatering effort will depend on a number of factors, including excavation depth, season and weather conditions, and the length of time the excavations are open. It should be left to the contractor to determine the means and methods of dewatering necessary to meet the project requirements and align with their construction methodology and schedule.

It should be realized that dewatering within compressible deposits (silty clay/silt) can cause ground settlement and such ground settlement would extend laterally beyond the immediate area of dewatering. It is recommended that the contractor assess the likely impact of dewatering, and use methods which will control dewatering impact on nearby existing structures and services to tolerable levels. A pre-construction survey documenting the existing conditions of nearby settlement-sensitive facilities/infrastructure should be completed.

9.9 Pavement Design

It is understood that a proposed 72 stalls will be taking place within the development subject site at the subject Site will include access roads and parking areas, which will be used by light vehicles. Table 9.3 below summarizes proposed asphalt designs for the parking lot

Table 9.3 Parking Lot Pavement Design Recommendation

Super pave 12.5 Level C Asphalt (PG58-34)	50 90 (loading areas and truck route)
OPSS Granular A Base	150
OPSS Granular B (Type I) subbase	300

Paving is to be completed in accordance with the Ministry of Transportation of Ontario OPSS1151 and 310 and related Special Provisions or applicable City of Ottawa standards.

Design grades should ensure that there are no low points where water can stand within the pavement structure. Grades should be uniform with positive slopes. The integrity of the subgrade and pavement structure layers must be protected and maintained during construction against water, frost and traffic.

Prior to constructing the subbase, the subgrade should be cleaned and free of any topsoil and organic materials, debris and deleterious materials. The subgrade shall be compacted to 95% of SPMDD and sloped for drainage at a minimum of 3%.

Excavation of the existing and reinstatement of the granular base material should be such that the surface of the new pavement matches the elevation of the existing pavement surface, as adjusted during the detailed design. Construction traffic is to be controlled to minimize damage and protect the integrity of the subgrade, base and subbase layers during construction. Butt joints, step joints, and tack coating are recommended to tie the new pavement with the existing pavement. At the transition where the new pavement structure meets the existing pavement structure, the subgrade is to be transitioned at a slope of 3 horizontal to 1 vertical (3H: 1V).

All granular pavement materials should meet Ontario Provincial Standard Specification (OPSS) requirements and should be compacted to at least 98% of SPMDD. In particular it is imperative that the fines content does not exceed the 8% limit specified by OPSS for Granular A and B Type I. Asphaltic concrete should also be produced and placed in accordance with OPSS standards. Compaction efforts must be inspected and approved by a geotechnical engineer or his representative. All methods should be in accordance with applicable OPSS standards.

Asphaltic concrete should also be produced and placed in accordance with OPSS standards.

Compaction efforts must be inspected and approved by a qualified professional. All methods should be in accordance with applicable OPSS standards.

9.10 **Monitoring During Construction**

All foundation design recommendations presented in this report are based on the assumption that an adequate level of construction monitoring by qualified geotechnical personnel during construction will be provided. An adequate level of construction monitoring is considered to be: a) for deep and shallow foundations: full-time monitoring and design review during construction; and b) for earthworks: full-time quality control and compaction testing.

An important purpose of providing an adequate level of monitoring is to check that recommendations, based on data obtained at discrete borehole locations, are relevant to other areas of the site.

In order to provide an adequate level of construction monitoring, qualified geotechnical personnel should manage and supervise the following tasks during construction:

Shallow Foundations:

- Confirm that materials and methods meet specifications.
- Inspect foundation subgrades.
- Inspect excavation.
- Review shallow foundation installation/testing methods.
- Review compaction testing records.
- Provide review comments, including any discrepancies found with respect to specifications as well as this report, and the need for any modifications to the design or methods.

Earthworks:

- Confirm that materials and methods meet specifications.
- Inspect subgrade prior to fill placement.
- Quality control of fill material.
- Review compaction testing records.

Pavement:

- Confirm that materials and methods meet specifications and mix design.

An adequate level of construction monitoring for granular pavement materials is considered to be inspection of the subgrade and compaction testing. An adequate level of construction monitoring for asphalt paving is considered full-time monitoring and testing of the compaction, asphalt cement content, gradation and Marshall properties of the mix.

10. REFERENCES

Bowles Joseph E., (1988). *Foundation Analysis and Design, Fourth Edition*, McGraw-Hill Book Company.

Wolff, T.F. (1989), *Spreadsheet Applications in Geotechnical Engineering*, PWS Publishing Company, Boston, MA.

Occupational Health and Safety Act and Regulations for Construction Projects, Ministry of Labour, Publications Ontario.

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Special Provisions SSP110S13, Amendment to Ontario Provincial Standard Specification OPSS 1010, April 2004, Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material.

Ontario Building Code (2012), Ontario Regulation 350/06.

11. LIMITATIONS OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix A, and forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

Alfred Abboud, P.Eng.
Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
Oct 29, 2015
G. THOMAS
PROVINCE OF ONTARIO

George Thomas, P. Eng.
Sr. Principal

APPENDIX A

LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testhole may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

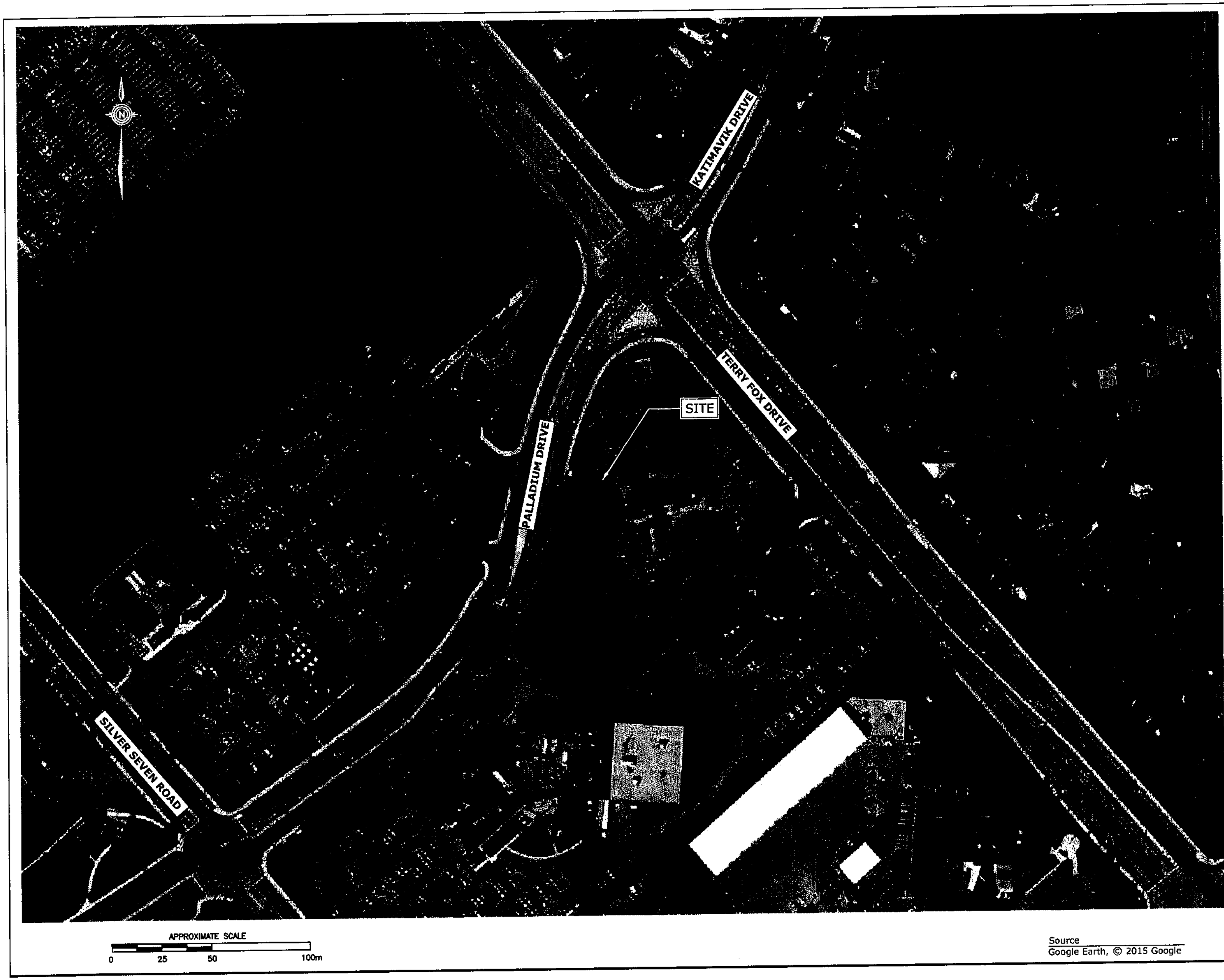
Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the Client.

APPENDIX B

FIGURES



Source
Google Earth, © 2015 Google

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OTTAWA, ONTARIO, K1G 5T9
TEL (613) 748-1415 FAX (613) 748-1356
www.dstgroup.com

LEGEND:

— — — PROPERTY LINE

NOTE:
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ASSOCIATED TECHNICAL REPORT.

0	29/10/15	ORIGINAL	G.T.
REV	DATE	ISSUE	APPROVAL

PROJECT TITLE

GEOTECHNICAL INVESTIGATION –
PROPOSED COMMERCIAL DEVELOPMENT
301 PALLADIUM DRIVE OTTAWA, ON

DRAWING TITLE

SITE LOCATION MAP

DESIGNED BY A.A.	SCALE AS SHOWN
DRAWN BY R.P.	DATE October 2015
PROJECT MANAGER A.A.	PROJECT NO.: IN-SO-021872
Figure No.:	FIGURE 1

[redacted]

Source
ERION associates consulting civil engineers

DST
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LEGEND:

BH6	APPROXIMATE BOREHOLE LOCATIONS
⌖	GEODETIC ELEVATION

NOTE:
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE ASSOCIATED TECHNICAL REPORT.

0	29/10/15	ORIGINAL	G.T.
REV	DATE	ISSUE	APPROVAL

PROJECT TITLE

GEOTECHNICAL INVESTIGATION –
PROPOSED COMMERCIAL DEVELOPMENT
301 PALLADIUM DRIVE OTTAWA, ON

DRAWING TITLE

BOREHOLE LOCATION PLAN

DESIGNED BY A.A.	SCALE AS SHOWN
DRAWN BY R.P.	DATE October 2015
PROJECT MANAGER A.A.	PROJECT NO.: IN-SO-021872
Figure No.:	FIGURE 2

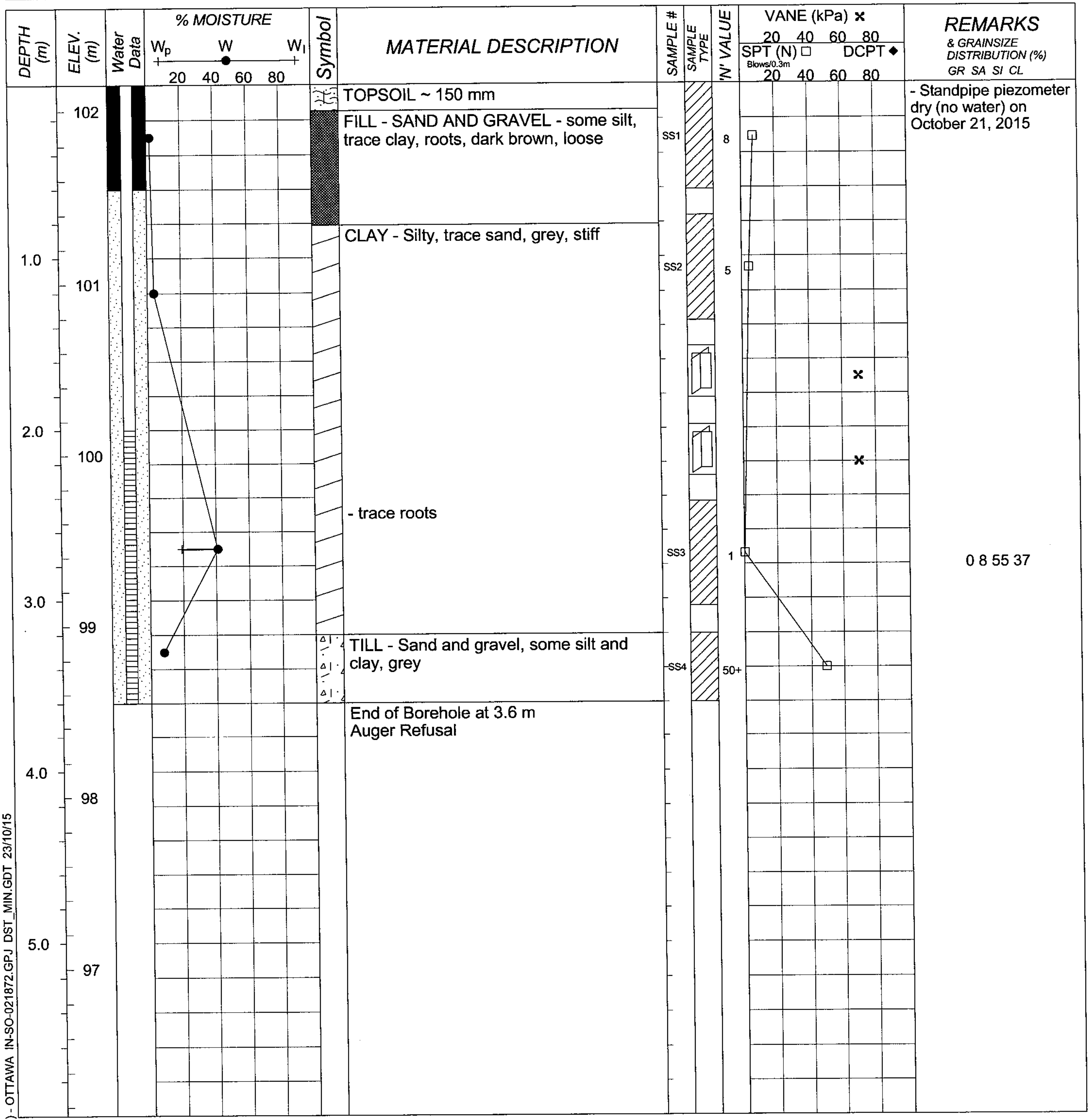
APPENDIX C

BOREHOLE LOGS

LOG OF BOREHOLE BH1

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 102.15 metres

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **220 mm OD**
DATE: **24 September 2015**



TOPSOIL ~ 150 mm

FILL - SAND AND GRAVEL - some silt, trace clay, roots, dark brown, loose

CLAY - Silty, trace sand, grey, stiff

- trace roots

TILL - Sand and gravel, some silt and clay, grey

End of Borehole at 3.6 m
Auger Refusal

- Standpipe piezometer dry (no water) on October 21, 2015

0 8 55 37

BOREHOLE (STANDARD) - OTTAWA IN-SO-021872.GPJ DST_MIN.GDT 23/10/15

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203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

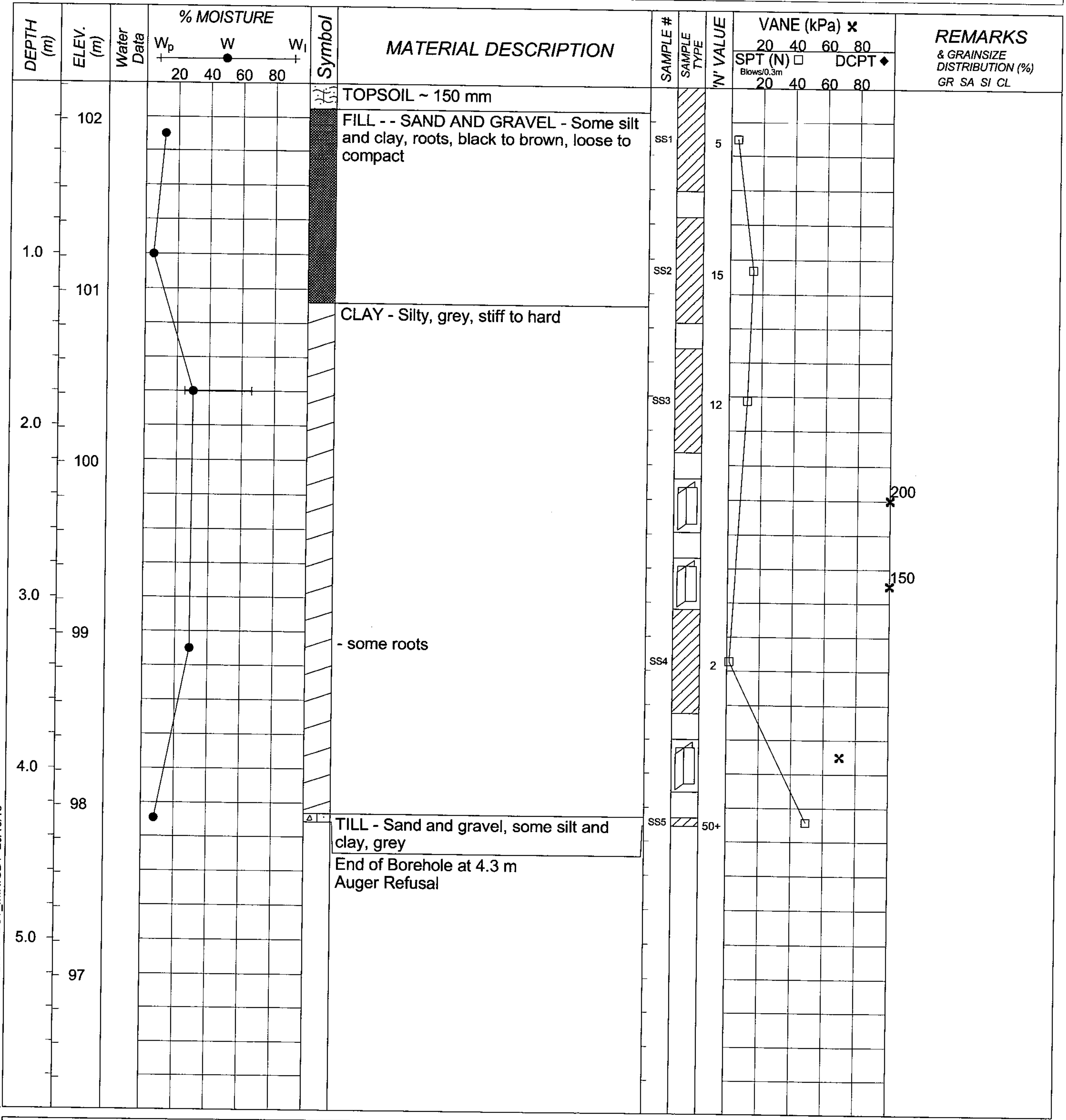
▭	Auger Sample	◫	Rock Core	■	Bentonite
▨	Split Spoon Sample	▩	Hiller Peat Sampler	░	Sand
▥	Bulk Sample	▯	70mm Thin Wall Tube		

ENCLOSURE 1

LOG OF BOREHOLE BH2

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 102.22 metres

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **220 mm OD**
DATE: **24 September 2015**



TOPSOIL ~ 150 mm

FILL - - SAND AND GRAVEL - Some silt and clay, roots, black to brown, loose to compact

CLAY - Silty, grey, stiff to hard

- some roots

TILL - Sand and gravel, some silt and clay, grey

End of Borehole at 4.3 m
Auger Refusal

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203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

☐	Auger Sample	▯	Rock Core	■	Bentonite
▨	Split Spoon Sample	▩	Hiller Peat Sampler	░	Sand
▥	Bulk Sample	▯	70mm Thin Wall Tube		

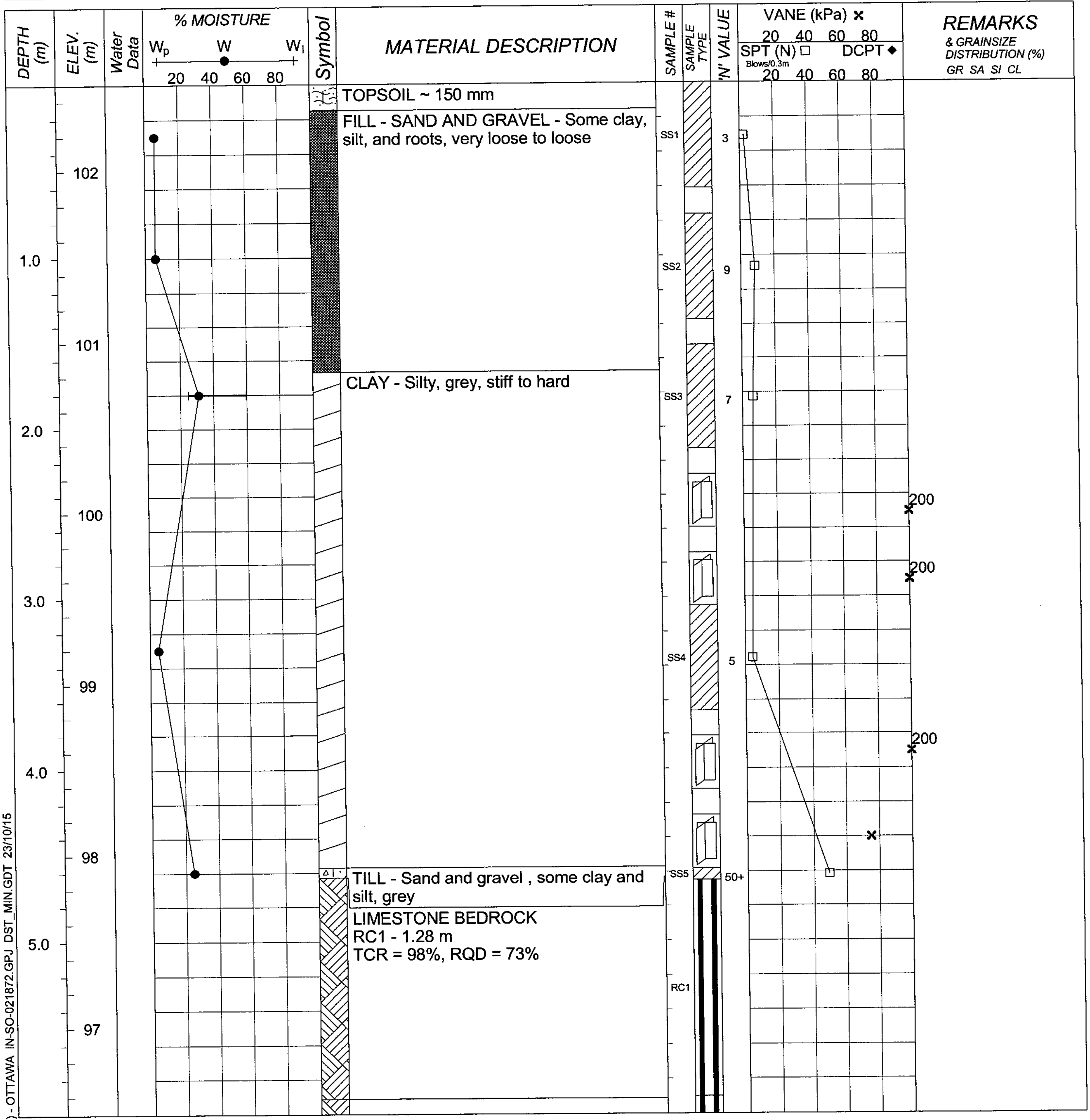
ENCLOSURE 2

BOREHOLE (STANDARD) - OTTAWA IN-SO-021872.GPJ DST_MIN.GDT 23/10/15

LOG OF BOREHOLE BH3

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 102.50 metres

Drilling Data
METHOD: **Hollow Stem Auger/NQ Size Rock Coring**
DIAMETER: **220 mm OD**
DATE: **24 and 25 September 2015**



TOPSOIL ~ 150 mm

FILL - SAND AND GRAVEL - Some clay, silt, and roots, very loose to loose

CLAY - Silty, grey, stiff to hard

TILL - Sand and gravel , some clay and silt, grey

LIMESTONE BEDROCK
RC1 - 1.28 m
TCR = 98%, RQD = 73%

SS1	3
SS2	9
SS3	7
SS4	5
SS5	50+
RC1	

BOREHOLE (STANDARD) - OTTAWA IN-SO-021872.GPJ DST_MIN.GDT 23/10/15

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DST Consulting Engineers Inc.
203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

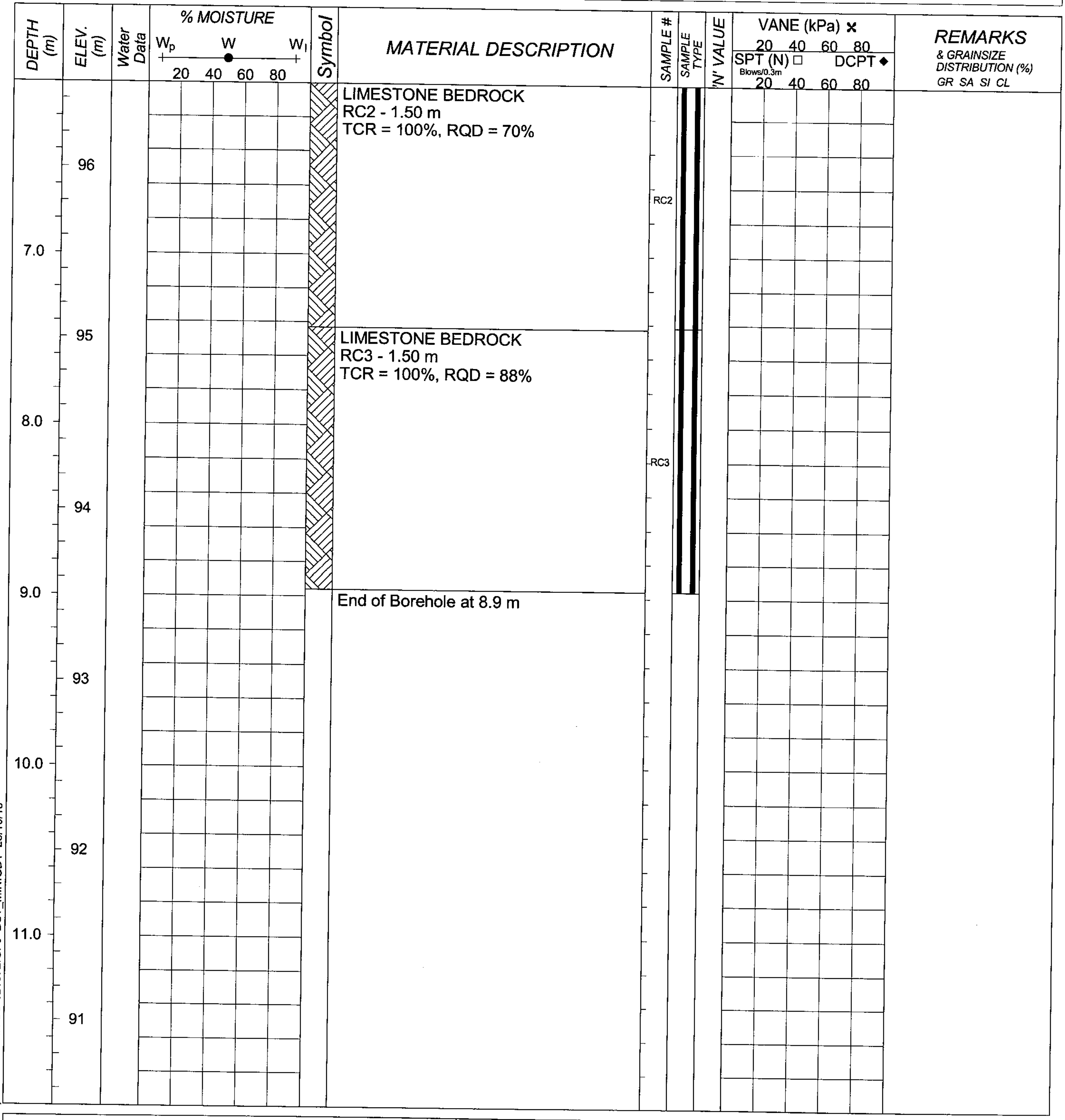
☐ Auger Sample	▮ Rock Core	■ Bentonite
▨ Split Spoon Sample	▩ Hiller Peat Sampler	░ Sand
▥ Bulk Sample	☐ 70mm Thin Wall Tube	

ENCLOSURE 3

LOG OF BOREHOLE BH3

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 102.50 metres

Drilling Data
METHOD: **Hollow Stem Auger/NQ Size Rock Coring**
DIAMETER: **220 mm OD**
DATE: **24 and 25 September 2015**



LIMESTONE BEDROCK
RC2 - 1.50 m
TCR = 100%, RQD = 70%

LIMESTONE BEDROCK
RC3 - 1.50 m
TCR = 100%, RQD = 88%

End of Borehole at 8.9 m

BOREHOLE (STANDARD) - OTTAWA IN-SO-021872.GPJ DST_MIN.GDT 23/10/15

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203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

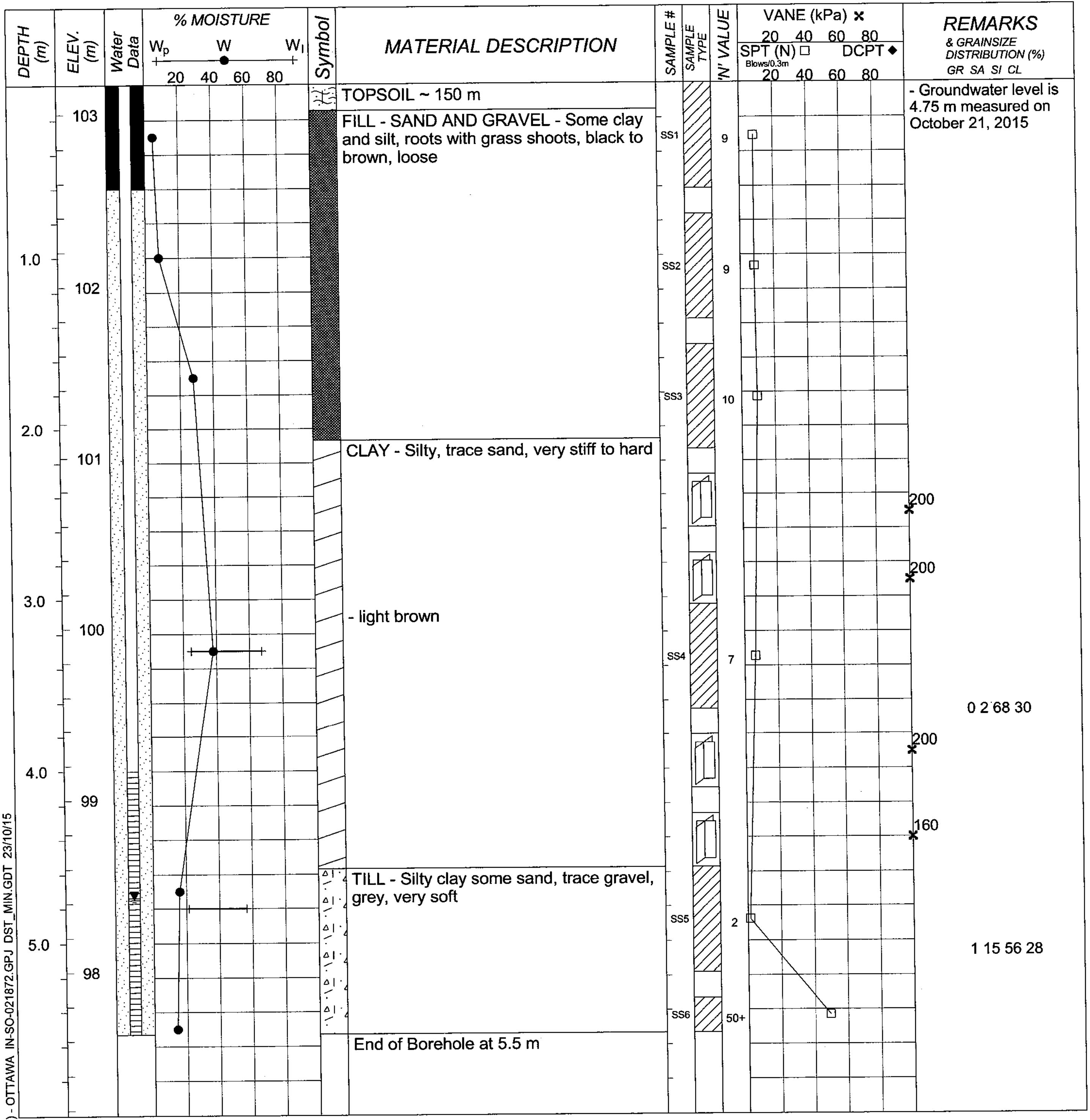
- ☐ Auger Sample
- ▨ Split Spoon Sample
- Bulk Sample
- Rock Core
- ▧ Hiller Peat Sampler
- 70mm Thin Wall Tube
- ■ Bentonite
- ░ Sand

ENCLOSURE 4

LOG OF BOREHOLE BH4

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 103.17 metres

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **220 mm OD**
DATE: **24 September 2015**



MATERIAL DESCRIPTION

TOPSOIL ~ 150 m

FILL - SAND AND GRAVEL - Some clay and silt, roots with grass shoots, black to brown, loose

CLAY - Silty, trace sand, very stiff to hard

- light brown

TILL - Silty clay some sand, trace gravel, grey, very soft

End of Borehole at 5.5 m

REMARKS

- Groundwater level is 4.75 m measured on October 21, 2015

0 2 68 30

1 15 56 28

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203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

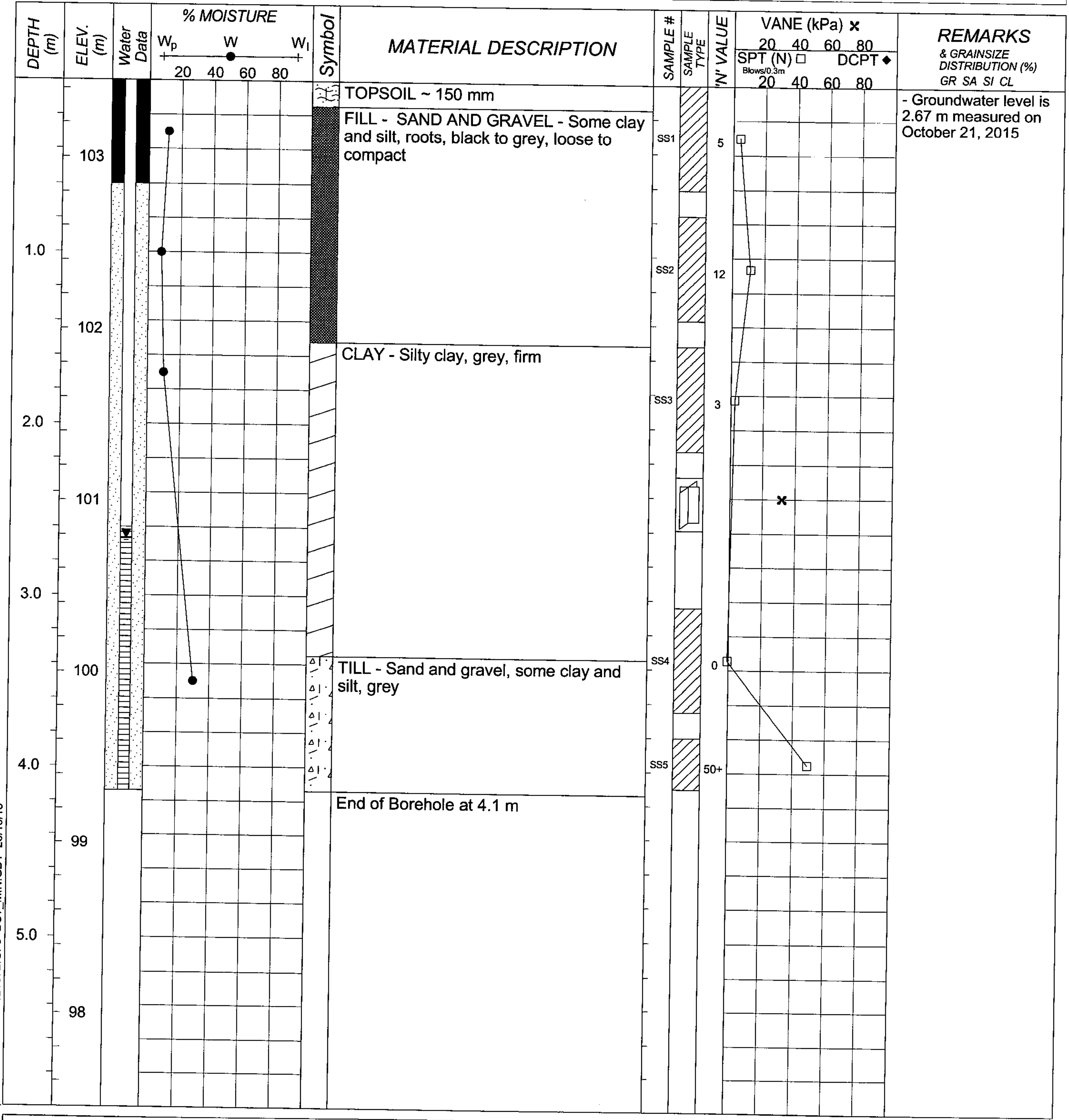
▭ Auger Sample	▮ Rock Core	■ Bentonite
▨ Split Spoon Sample	▩ Hiller Peat Sampler	░ Sand
▥ Bulk Sample	▯ 70mm Thin Wall Tube	

ENCLOSURE 5

LOG OF BOREHOLE BH5

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 103.45 metres

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **220 mm OD**
DATE: **24 September 2015**



TOPSOIL ~ 150 mm

FILL - SAND AND GRAVEL - Some clay and silt, roots, black to grey, loose to compact

CLAY - Silty clay, grey, firm

TILL - Sand and gravel, some clay and silt, grey

End of Borehole at 4.1 m

REMARKS

- Groundwater level is 2.67 m measured on October 21, 2015

BOREHOLE (STANDARD) - OTTAWA IN-SO-021872.GPJ DST_MIN.GDT 23/10/15

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DST Consulting Engineers Inc.
203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

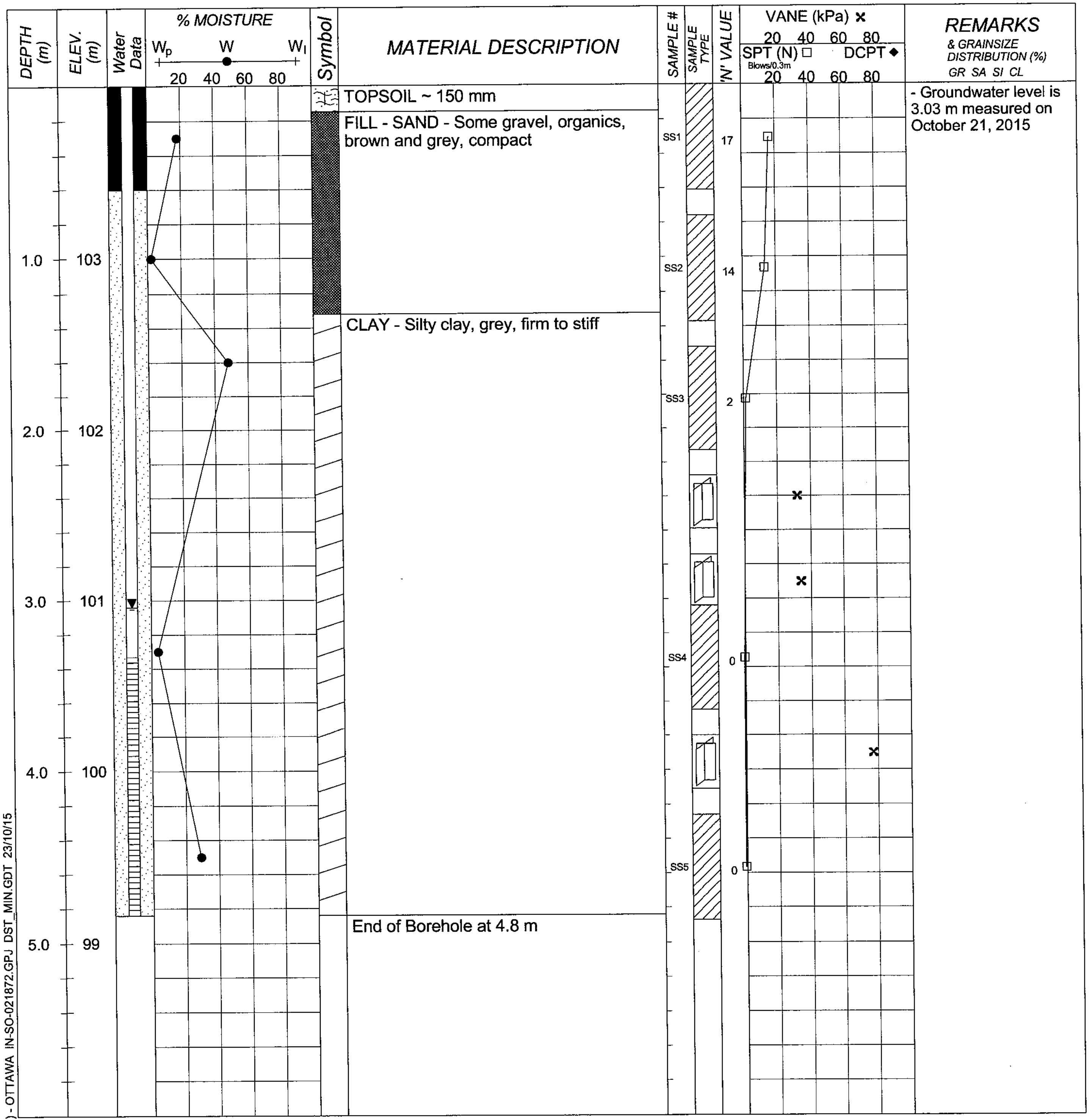
☐ Auger Sample	◫ Rock Core	■ Bentonite
▨ Split Spoon Sample	▨ Hiller Peat Sampler	░ Sand
▥ Bulk Sample	▯ 70mm Thin Wall Tube	

ENCLOSURE 6

LOG OF BOREHOLE BH6

DST REF. No.: **IN-SO-021872**
CLIENT: **Citant Group Ltd.**
PROJECT: **Proposed Commercial Development**
LOCATION: **301 Palladium Drive, Ottawa, Ontario**
SURFACE ELEVATION: 104.00 metres

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **220 mm OD**
DATE: **24 September 2015**



TOPSOIL ~ 150 mm

FILL - SAND - Some gravel, organics, brown and grey, compact

CLAY - Silty clay, grey, firm to stiff

End of Borehole at 4.8 m

- Groundwater level is 3.03 m measured on October 21, 2015

BOREHOLE (STANDARD) - OTTAWA IN-SO-021872.GPJ DST_MIN.GDT 23/10/15

DST consulting engineers

DST Consulting Engineers Inc.
203 - 2150 THURSTON DRIVE
OTTAWA, ONTARIO, K1G 5T9
PH: (613)748-1415
FX: (613)748-1356
Email: ottawa@dstgroup.com
Web: www.dstgroup.com

SAMPLE TYPE LEGEND

☐	Auger Sample	▯	Rock Core	■	Bentonite
▨	Split Spoon Sample	▨	Hiller Peat Sampler	░	Sand
▥	Bulk Sample	▯	70mm Thin Wall Tube		

ENCLOSURE 7

APPENDIX D

LABORATORY RESULTS

Stantec

Stantec Consulting Ltd
2781 Lancaster Rd, Suite 101
Ottawa, ON K1B 1A7
Tel: (613) 738-6075
Fax: (613) 722-2799

October 15, 2015
File: 122411080

Attention: **Alfred Abboud, DST Consulting Engineers Inc.**

Reference: **ASTM D4318 Atterberg Limit, DST Reference: INSO 021872**

The table below summarizes Atterberg Limit results for five (5) samples.

Source	Depth	Liquid Limit	Plastic Limit	Plasticity Index
BH-1 SS3	8’-10’	40.9	19.3	21.7
BH-2 SS3	5’-7’	66.0	24.9	41.1
BH-3 SS3	5’-7’	59.6	24.8	34.8
BH-4 SS4	10’-12’	67.4	24.9	42.5
BH-4 SS5	15’-17’	56.3	21.4	34.8

Sincerely,

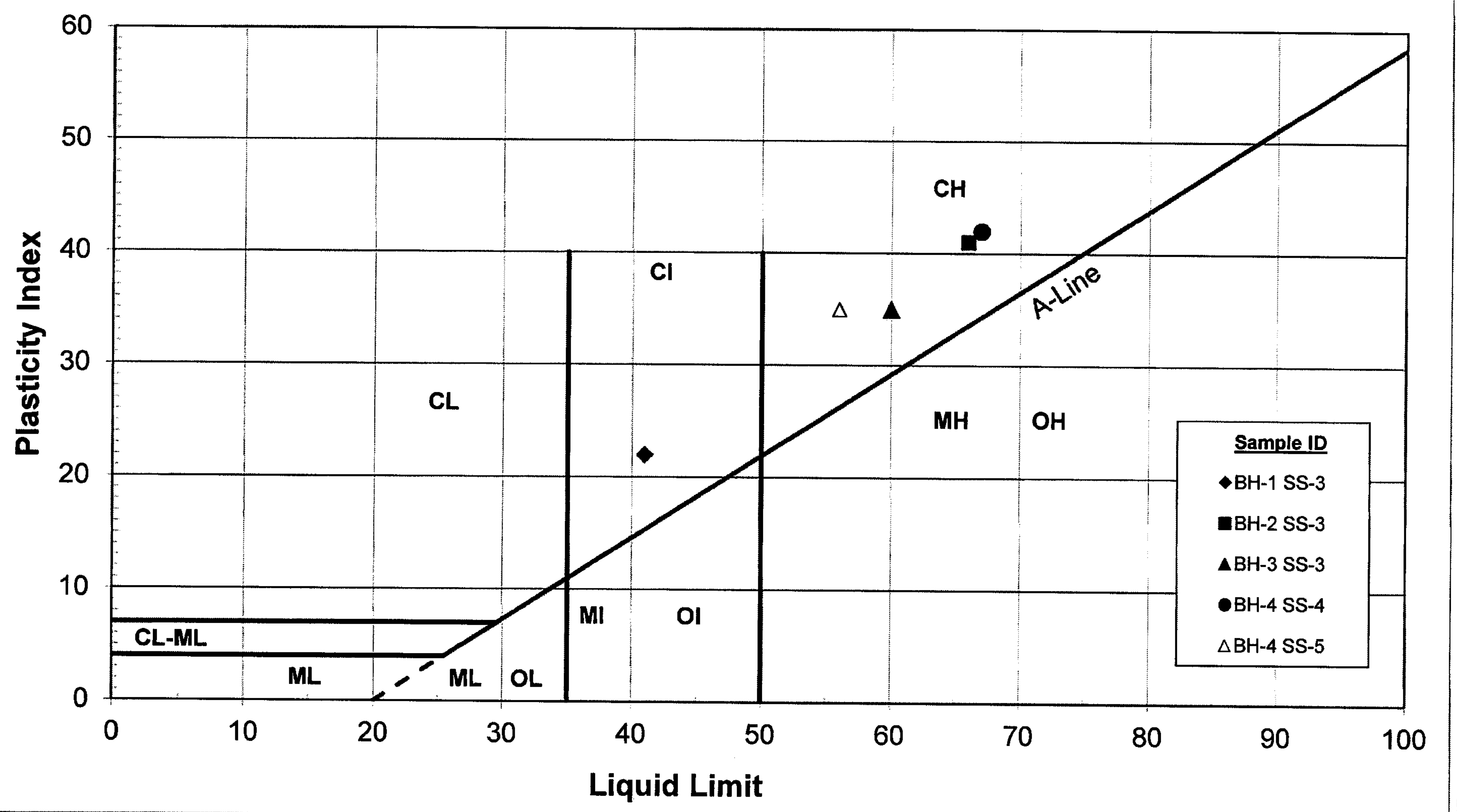
Stantec Consulting Ltd

Brian Prevost

Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
brian.prevost@stantec.com

Attachments: Plasticity Chart

v:\01224\active\laboratory_standing_offers\2015 laboratory standing offers\11080 dst consulting engineers inc\october 9, limit & hydrometers, dst #inso 021872\letter, limits doc



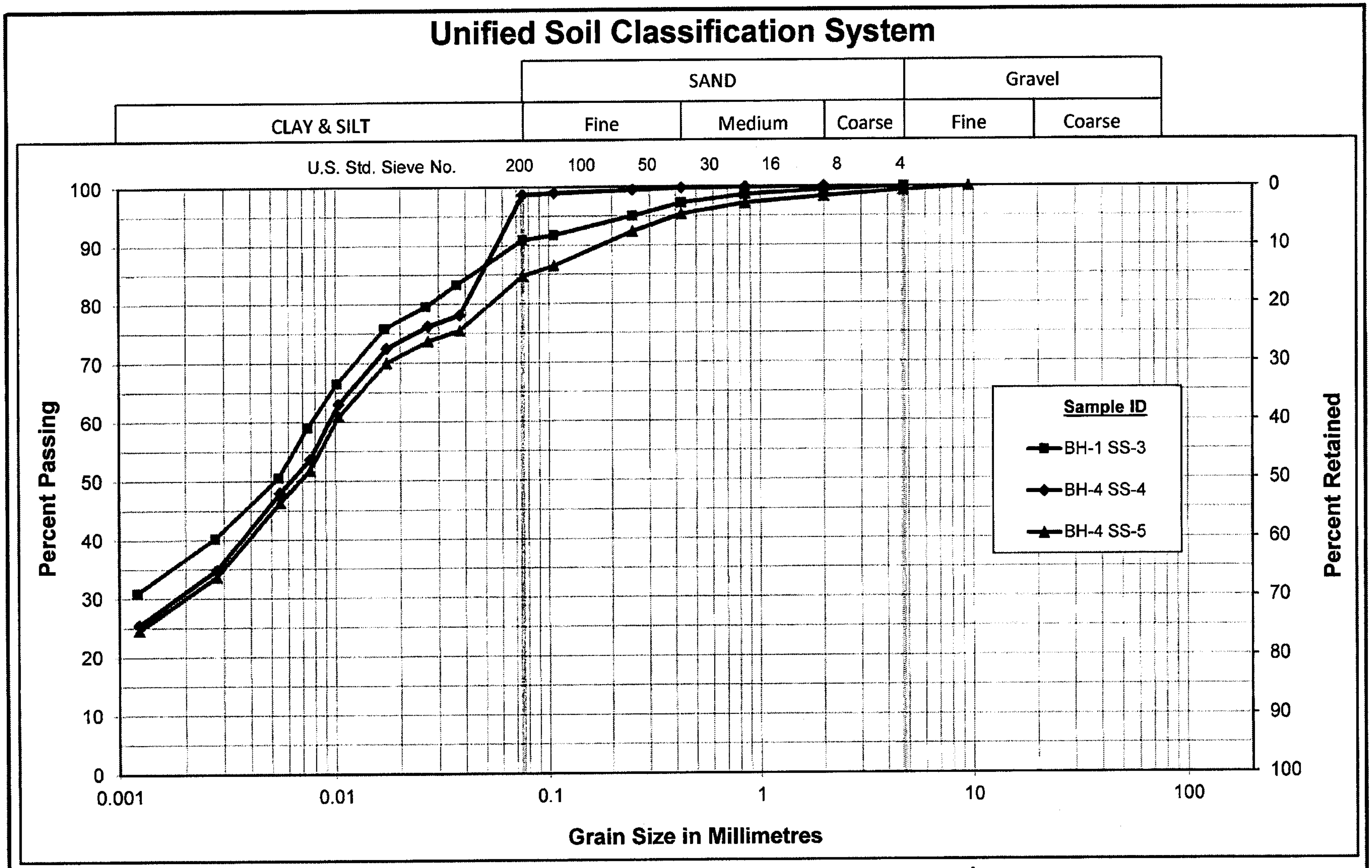
Stantec

PLASTICITY CHART

DST Consultuing Engineers, Reference: INSO 021872

Figure No.

Project No. 122411080



Stantec

GRAIN SIZE DISTRIBUTION

DST Consulting Engineers, Reference: INSO-021872

301 Palladium Drive, Ottawa, ON

Figure No.

Project No. 122411080

Stantec
2781 Lancaster Road, Suite 101
Ottawa ON, K1B 1A7

Particle-Size Analysis of Soils
LS702
ASTM D422

PROJECT DETAILS

Client:	DST Consulting Engineers, Reference: INSO-021872	Project No.:	122411080
Project:	301 Palladium Drive, Ottawa, ON	Test Method:	LS702
Material Type:	Soil	Sampled By:	DST Consulting Engineers
Source:	BH-1	Date Sampled:	October 8, 2015
Sample No.:	SS-3	Tested By:	Denis Rodriguez
Sample Depth:	8-10'	Date Tested:	October 14, 2015

WASH TEST DATA

Oven Dry Mass in Hydrometer Analysis (g)	52.00
Sample Weight after Hydrometer and Wash (g)	4.50
Percent Passing No. 200 Sieve (%)	91.3
Percent Passing Corrected (%)	90.87

PERCENT LOSS IN SIEVE

Sample Weight Before Sieve (g)	115.70
Sample Weight After Sieve (g)	115.10
Percent Loss in Sieve (%)	0.52

SOIL INFORMATION

Liquid Limit (LL)	40.9	
Plasticity Index (PI)	21.7	
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS

Oven Dried Mass (W_o), (g)	60.97
Air Dried Mass (W_a), (g)	61.62
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9895
Air Dried Mass in Analysis (M_a), (g)	52.55
Oven Dried Mass in Analysis (M_o), (g)	52.00
Percent Passing 2.0 mm Sieve (P_{10}), (%)	99.48
Sample Represented (W), (g)	52.27

SIEVE ANALYSIS

Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5		100.0
26.5		100.0
19.0		100.0
13.2		100.0
9.5		100.0
4.75	0.0	100.0
2.00	0.6	99.5
Total (C + F)[1]	115.10	
0.850	0.45	98.62
0.425	1.16	97.26
0.250	2.33	95.02
0.106	4.01	91.81
0.075	4.45	90.97
PAN	4.47	

Note 1: (C + F) = Coarse + Fine

HYDROMETER DETAILS

Volume of Bulb (V_B), (cm^3)	63.0
Length of Bulb (L_2), (cm)	14.47
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.29
Scale Dimension (h_s), (cm/Div)	0.155
Cross-Sectional Area of Cylinder (A), (cm^2)	27.2
Meniscus Correction (H_m), (g/L)	1.0

START TIME 8:31 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
14-Oct-15	8:32 AM	1	51.0	6.5	24.5	44.5	83.30	8.30691	9.07441	0.012599	0.03631
14-Oct-15	8:33 AM	2	49.0	6.5	24.5	42.5	79.55	8.61691	9.07441	0.012599	0.02615
14-Oct-15	8:36 AM	5	47.0	6.5	24.5	40.5	75.81	8.92691	9.07441	0.012599	0.01684
14-Oct-15	8:46 AM	15	42.0	6.5	24.5	35.5	66.45	9.70191	9.07441	0.012599	0.01013
14-Oct-15	9:01 AM	30	38.0	6.5	24.5	31.5	58.96	10.32191	9.07441	0.012599	0.00739
14-Oct-15	9:31 AM	60	33.5	6.5	24.5	27.0	50.54	11.01941	9.07441	0.012599	0.00540
14-Oct-15	12:41 PM	250	28.0	6.5	25.0	21.5	40.25	11.87191	8.97259	0.012529	0.00273
15-Oct-15	8:31 AM	1440	23.0	6.5	22.5	16.5	30.89	12.64691	9.50295	0.012894	0.00121

Remarks:

Reviewed By: Brian Prevost
Date: October 15/2015

V:\01224\active\laboratory_standing_offers\2015 Laboratory Standing Offers\11080 DST Consulting Engineers Inc\October 9, Limit & Hydrometers, DST #INSO 021872\Hydrometer, Three (3).xlsx

Stantec
2781 Lancaster Road, Suite 101
Ottawa ON, K1B 1A7

Particle-Size Analysis of Soils
LS702
ASTM D422

PROJECT DETAILS

Client:	DST Consulting Engineers, Reference: INSO-021872	Project No.:	122411080
Project:	301 Palladium Drive, Ottawa, ON	Test Method:	LS702
Material Type:	Soil	Sampled By:	DST Consulting Engineers
Source:	BH-4	Date Sampled:	October 8, 2015
Sample No.:	SS-4	Tested By:	Denis Rodriguez
Sample Depth	10-12'	Date Tested:	October 14, 2015

WASH TEST DATA

Oven Dry Mass In Hydrometer Analysis (g)	52.02
Sample Weight after Hydrometer and Wash (g)	0.73
Percent Passing No. 200 Sieve (%)	98.6
Percent Passing Corrected (%)	98.60

PERCENT LOSS IN SIEVE

Sample Weight Before Sieve (g)	107.60
Sample Weight After Sieve (g)	107.60
Percent Loss in Sieve (%)	0.00

SOIL INFORMATION

Liquid Limit (LL)	67.4	
Plasticity Index (PI)	42.5	
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS

Oven Dried Mass (W_o), (g)	52.10
Air Dried Mass (W_a), (g)	53.82
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9680
Air Dried Mass in Analysis (M_a), (g)	53.74
Oven Dried Mass in Analysis (M_o), (g)	52.02
Percent Passing 2.0 mm Sieve (P_{10}), (%)	100.00
Sample Represented (W), (g)	52.02

SIEVE ANALYSIS

Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5		100.0
26.5		100.0
19.0		100.0
13.2		100.0
9.5		100.0
4.75		100.0
2.00	0.0	100.0
Total (C + F)[1]	107.60	
0.850	0.05	99.90
0.425	0.13	99.75
0.250	0.30	99.42
0.106	0.58	98.89
0.075	0.73	98.60
PAN	0.73	

Note 1: (C + F) = Coarse + Fine

HYDROMETER DETAILS

Volume of Bulb (V_B), (cm^3)	63.0
Length of Bulb (L_2), (cm)	14.47
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.29
Scale Dimension (h_s), (cm/Div)	0.155
Cross-Sectional Area of Cylinder (A), (cm^2)	27.2
Meniscus Correction (H_m), (g/L)	1.0

START TIME 8:49 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
14-Oct-15	8:50 AM	1	48.0	6.5	24.0	41.5	78.05	8.77191	9.17830	0.012671	0.03753
14-Oct-15	8:51 AM	2	47.0	6.5	24.0	40.5	76.17	8.92691	9.17830	0.012671	0.02677
14-Oct-15	8:54 AM	5	45.0	6.5	24.0	38.5	72.41	9.23691	9.17830	0.012671	0.01722
14-Oct-15	9:04 AM	15	40.0	6.5	24.0	33.5	63.00	10.01191	9.17830	0.012671	0.01035
14-Oct-15	9:19 AM	30	35.0	6.5	24	28.5	53.60	10.78691	9.17830	0.012671	0.00760
14-Oct-15	9:49 AM	60	32.0	6.5	24.0	25.5	47.96	11.25191	9.17830	0.012671	0.00549
14-Oct-15	12:59 PM	250	25.0	6.5	25	18.5	34.79	12.33691	8.97259	0.012529	0.00278
15-Oct-15	8:49 AM	1440	20.0	6.5	22.5	13.5	25.39	13.11191	9.50295	0.012894	0.00123

Remarks:

Reviewed By: Brian Preust
Date: October 15/2015

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Stantec 2781 Lancaster Road, Suite 101
Ottawa ON, K1B 1A7

Particle-Size Analysis of Soils
LS702
ASTM D422

PROJECT DETAILS

Client:	DST Consulting Engineers, Reference: INSO-021872	Project No.:	122411080
Project:	301 Palladium Drive, Ottawa, ON	Test Method:	LS702
Material Type:	Soil	Sampled By:	DST Consulting Engineers
Source:	BH-4	Date Sampled:	October 8, 2015
Sample No.:	SS-5	Tested By:	Denis Rodriguez
Sample Depth	15-17'	Date Tested:	October 14, 2015

WASH TEST DATA

Oven Dry Mass In Hydrometer Analysis (g)	52.90
Sample Weight after Hydrometer and Wash (g)	7.36
Percent Passing No. 200 Sieve (%)	86.1
Percent Passing Corrected (%)	84.63

PERCENT LOSS IN SIEVE

Sample Weight Before Sieve (g)	112.20
Sample Weight After Sieve (g)	112.00
Percent Loss in Sieve (%)	0.18

SOIL INFORMATION

Liquid Limit (LL)	56.3	
Plasticity Index (PI)	34.8	
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS

Oven Dried Mass (W_o), (g)	55.62
Air Dried Mass (W_a), (g)	56.27
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9884
Air Dried Mass in Analysis (M_a), (g)	53.52
Oven Dried Mass in Analysis (M_o), (g)	52.90
Percent Passing 2.0 mm Sieve (P_{10}), (%)	98.31
Sample Represented (W), (g)	53.81

SIEVE ANALYSIS

Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5		100.0
26.5		100.0
19.0		100.0
13.2		100.0
9.5	0.0	100.0
4.75	0.8	99.3
2.00	1.9	98.3
Total (C + F)[1]	112.00	
0.850	0.62	97.15
0.425	1.62	95.30
0.250	3.19	92.38
0.106	6.33	86.54
0.075	7.29	84.76
PAN	7.34	

Note 1: (C + F) = Coarse + Fine

HYDROMETER DETAILS

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Meniscus Correction (H_m), (g/L)	1.0

START TIME 8:49 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
14-Oct-15	8:50 AM	1	48.0	6.5	24.0	41.5	75.45	8.77191	9.17830	0.012671	0.03753
14-Oct-15	8:51 AM	2	47.0	6.5	24.0	40.5	73.63	8.92691	9.17830	0.012671	0.02677
14-Oct-15	8:54 AM	5	45.0	6.5	24.0	38.5	70.00	9.23691	9.17830	0.012671	0.01722
14-Oct-15	9:04 AM	15	40.0	6.5	24.0	33.5	60.91	10.01191	9.17830	0.012671	0.01035
14-Oct-15	9:19 AM	30	35.0	6.5	24	28.5	51.82	10.78691	9.17830	0.012671	0.00760
14-Oct-15	9:49 AM	60	32.0	6.5	24.0	25.5	46.36	11.25191	9.17830	0.012671	0.00549
14-Oct-15	12:59 PM	250	25.0	6.5	25	18.5	33.63	12.33691	8.97259	0.012529	0.00278
15-Oct-15	8:49 AM	1440	20.0	6.5	22.5	13.5	24.54	13.11191	9.50295	0.012894	0.00123

Remarks:

Reviewed By: Brian Prevost
Date: October 15/2015

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APPENDIX E

CHEMICAL ANALYSIS DATA

Maxxam
A Bureau Veritas Group Company

Your Project #: IN-SO-021872
Your C.O.C. #: 54671

Attention:Alfred Abboud

DST Consulting Engineers Inc
Ottawa - Standing Offer
2150 Thurston Dr
Unit 203
Ottawa, ON
K1G 5T9

Report Date: 2015/10/16
Report #: R3722839
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B5K6134
Received: 2015/10/09, 09:50

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract) (1)	2	N/A	2015/10/16	CAM SOP-00463	EPA 325.2 m
Conductivity (1)	2	N/A	2015/10/15	CAM SOP-00414	OMOE E3138 v2 m
pH CaCl2 EXTRACT (1)	1	2015/10/14	2015/10/14	CAM SOP-00413	EPA 9045 D m
pH CaCl2 EXTRACT (1)	1	2015/10/15	2015/10/15	CAM SOP-00413	EPA 9045 D m
Sulphate (20:1 Extract) (1)	2	N/A	2015/10/16	CAM SOP-00464	EPA 375.4 m
Redox Potential (2)	2	2015/10/14	2015/10/15	SLA SOP-00101	In house

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Analytics Mississauga
(2) This test was performed by Maxxam Sladeview Petrochemical

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Madison Bingley, Project Manager Assistant
Email: MBingley@maxxam.ca
Phone# (613)274-0573
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

RESULTS OF ANALYSES OF SOIL

Maxxam ID		BDF423		BDF424	BDF424		
Sampling Date		2015/09/24 12:00		2015/09/24 12:00	2015/09/24 12:00		
COC Number		54671		54671	54671		
	UNITS	**BH1 SS3**	**QC Batch**	**BH6 SS3**	**BH6 SS3 Lab-Dup**	**RDL**	**QC Batch**
Inorganics							
Soluble (20:1) Chloride (Cl)	ug/g	520	4230922	41		20	4230922
Conductivity	mS/cm	1.2	4230645	0.24		0.002	4230645
Available (CaCl2) pH	pH	7.65	4228442	7.72		N/A	4228049
Soluble (20:1) Sulphate (SO4)	ug/g	360	4230923	<20	<20	20	4230923
Subcontracted Analysis							
Redox Potential	mV	+168	4228651	+135	+117		4228651

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

TEST SUMMARY

Maxxam ID: BDF423
Sample ID: BH1 SS3
Matrix: Soil

Collected: 2015/09/24
Shipped:
Received: 2015/10/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4230922	N/A	2015/10/16	Deonarine Ramnarine
Conductivity	AT	4230645	N/A	2015/10/15	Lemeneh Addis
pH CaCl2 EXTRACT	AT	4228442	2015/10/15	2015/10/15	Neil Dassanayake
Sulphate (20:1 Extract)	KONE/EC	4230923	N/A	2015/10/16	Deonarine Ramnarine
Redox Potential	PH	4228651	2015/10/14	2015/10/15	Grace Sison

Maxxam ID: BDF424
Sample ID: BH6 SS3
Matrix: Soil

Collected: 2015/09/24
Shipped:
Received: 2015/10/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4230922	N/A	2015/10/16	Deonarine Ramnarine
Conductivity	AT	4230645	N/A	2015/10/15	Lemeneh Addis
pH CaCl2 EXTRACT	AT	4228049	2015/10/14	2015/10/14	Neil Dassanayake
Sulphate (20:1 Extract)	KONE/EC	4230923	N/A	2015/10/16	Deonarine Ramnarine
Redox Potential	PH	4228651	2015/10/14	2015/10/15	Grace Sison

Maxxam ID: BDF424 Dup
Sample ID: BH6 SS3
Matrix: Soil

Collected: 2015/09/24
Shipped:
Received: 2015/10/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	4230923	N/A	2015/10/16	Deonarine Ramnarine
Redox Potential	PH	4228651	2015/10/14	2015/10/15	Grace Sison

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	10.0°C

Custody seal was not present on the cooler.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4228049	Available (CaCl2) pH	2015/10/14			100	97 - 103			0.60	N/A		
4228442	Available (CaCl2) pH	2015/10/15			100	97 - 103			1.4	N/A		
4228651	Redox Potential	2015/10/15					+146	mV	14	20	+244	238 - 248
4230645	Conductivity	2015/10/15			100	90 - 110	<0.002	mS/cm	1.4	10		
4230922	Soluble (20:1) Chloride (Cl)	2015/10/16	NC	70 - 130	106	70 - 130	<20	ug/g	NC	35		
4230923	Soluble (20:1) Sulphate (SO4)	2015/10/16	NC	70 - 130	106	70 - 130	<20	ug/g	NC	35		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Services

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Grace M. Sison
CHEMIST

Grace Sison, B.Sc., C.Chem, Senior Project Manager - Petroleum Division

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 54671

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: DST CONSULTING ENGINEERS	Company Name:	Quotation #:	☑ Regular TAT (5-7 days) Most analyses
Contact Name:	Contact Name: ALFRED ABBOUD	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:	Project #: INSO 021872	Rush TAT (Surcharges will be applied)
		Site Location:	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Phone: Fax:	Phone: Fax:	Site #:	
Email:	Email:	Sampled By:	Date Required:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Rush Confirmation #:

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____
FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region ____
☐ Other (Specify) ____
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested (REFER TO BACK OF COC)

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PH	SULPHATE	CONDUCTIVITY	REDOX	CHLORIDE					HOLD- DO NOT ANALYZE
1	BH1 SS3	2015/07/24	12:00										✓	✓	✓	✓	✓					
2	BH6 SS3	2015/07/24	12:00										✓	✓	✓	✓	✓					
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

9-Oct-15 09:50
Madison Bingley
B5K6134
FHB OTT-002

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
	N	10,10,10
	N	
	N	

COOLING MEDIA PRESENT: [✓ Y] / N

COMMENTS

RECEIVED IN OTTAWA

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Jonathan	2015/10/09	9:50	Madison Bingley	15/10/09	9:50	

COC-1004 (10/14) - ENV. ENG

White: Maxxam ~ Yellow: Client