



**Geotechnical Factual Report,  
Revision 0**

BC Hydro Underground West End  
Substation

December 4, 2019

Prepared for:

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**GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END  
SUBSTATION**

<b>Revision No.</b>	<b>Date</b>	<b>Description</b>
A	September 26, 2019	Draft Report
0	November 19, 2019	<ul style="list-style-type: none"><li>• Added piezometer installation data</li><li>• Updated laboratory tests</li><li>• Updated Borehole Records</li><li>• Added Acid Rock Drainage (ARD) and Metal Leaching (ML) test results</li></ul>



## Table of Contents

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	PROJECT UNDERSTANDING .....	2
<b>2.0</b>	<b>SITE DESCRIPTION .....</b>	<b>3</b>
<b>3.0</b>	<b>GEOTECHNICAL SITE EXPLORATION .....</b>	<b>4</b>
3.1	WORKPLACE ISOLATION AND NOISE MITIGATION .....	4
3.2	UTILITY CLEARANCE .....	4
3.3	BOREHOLE DRILLING AND IN-SITU TESTING .....	4
3.3.1	Standard Penetration Tests .....	6
3.3.2	Piezometers/Monitoring Wells .....	6
3.4	LABORATORY TESTS .....	7
3.4.1	Soil Tests .....	8
3.4.2	Rock Testing .....	9
3.5	PREVIOUS WORK BY OTHERS .....	9
<b>4.0</b>	<b>CLOSURE .....</b>	<b>10</b>
<b>5.0</b>	<b>FIGURES .....</b>	<b>11</b>

## LIST OF TABLES

Table 1: Geotechnical Site Exploration Summary .....	5
Table 2: Summary of Piezometer Installation .....	7
Table 3: Summary of Laboratory Tests .....	8

## LIST OF APPENDICES

<b>APPENDIX A</b>	<b>STATEMENT OF GENERAL CONDITIONS .....</b>	<b>A.1</b>
<b>APPENDIX B</b>	<b>BOREHOLE RECORDS .....</b>	<b>B.1</b>
<b>APPENDIX C</b>	<b>LAB TEST RESULTS .....</b>	<b>C.1</b>
C.1	Laboratory Test Results – Soil .....	C.2
C.2	Laboratory Test Results – Rock .....	C.3
<b>APPENDIX D</b>	<b>CHEMICAL TEST RESULTS .....</b>	<b>D.1</b>
<b>APPENDIX E</b>	<b>BEDROCK CORE PHOTOGRAPHS .....</b>	<b>E.1</b>
<b>APPENDIX F</b>	<b>ACID ROCK DRAINAGE TEST RESULTS .....</b>	<b>F.1</b>
<b>APPENDIX G</b>	<b>RECORD OF GOLDER BOREHOLE BH18-01 .....</b>	<b>G.1</b>



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

## 1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by BC Hydro to carry out Geotechnical Risk Assessment and Feasibility Design for the Underground West End Substation Project (the Project). This report presents the Geotechnical factual data in support of the Project and includes the results of the geotechnical site exploration and laboratory testing (geotechnical exploration program). The Project site is located at 1150 Nelson Street, Vancouver, British Columbia.

The purpose of the geotechnical exploration program was to obtain information on the subsurface conditions and hence to support the Geotechnical Risk Assessment and Feasibility Design of the proposed underground West End Substation. Borehole locations were proposed by BC Hydro in the Request for Proposal (RFP) #12822, dated April 23, 2019, and adjusted onsite to avoid conflict with the conditions at the site, including existing trees, utilities, and structures.

The geotechnical exploration program was carried out in conjunction with the environmental soil and groundwater (geo-environmental) sampling and testing. The results of the geo-environmental sampling and testing are not discussed in this report and are presented separately.

The work was completed in general accordance with our proposal for RFP #12822: Geotechnical Risk Assessment and Feasibility Design for the underground West End Substation (File No.: 1233-P904931; May 22, 2019). The scope of geotechnical exploration work is provided our letter, "Geotechnical Risk Assessment and Feasibility Design for the Underground West End Substation: Recommended Site Exploration Scope and Additional Testing (Rev. 1)" dated July 4, 2019. In brief, the scope of geotechnical exploration work included the following:

- Desktop review of available information on existing utilities and previous geotechnical exploration work by others;
- Erection of temporary, 2.4 m high fence panels with privacy screens to isolate the workplace, limit visibility, and to control dust and debris for the duration of the exploration;
- Erection of temporary, 2.4 m high fence panels with acoustic panels to control noise generated by the geotechnical exploration work;
- Checking for and locating any existing underground utility lines near the proposed borehole locations;
- Hydro-vacuum excavation at one borehole location to clear or expose a potential buried utility infrastructure prior to drilling and in-situ testing;
- Borehole drilling in five locations using the mud rotary method
  - Two boreholes to approximately 35 m below the existing ground surface (to the bottom of the proposed excavation).
  - Two boreholes to approximately 40 m depth below the existing ground surface (5 m below the bottom of the proposed excavation).
  - One borehole 3 m depth into the bedrock for excavation design and to further delineate the bedrock surface across the Site.
- Borehole drilling using the solid-stem auger method in one location.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

- Standard Penetration Tests (SPTs) at 1.5 m depth intervals in mud rotary boreholes.
- Install standpipe piezometers and vapour wells, which includes:
  - Deep piezometers in three mud rotary boreholes.
  - Shallow piezometers in five mud rotary boreholes, three of them nested with the deeper piezometers.
  - A shallow groundwater well and a vapour well in the auger borehole to assess groundwater and soil vapour.
- Laboratory testing of soil samples collected from split-spoon and grab samples off the auger flights. Tests including moisture content, Atterberg Limits, particle size distribution, fines content, pH, conductivity, and sulphate content testing.
- Laboratory testing of bedrock core samples including point load, unconfined compressive strength, and acid rock drainage testing
- Preparation of this Geotechnical Factual Report.

This report describes the Project in brief, the physical setting of the Project, the geotechnical exploration work and the results. This report should be read in conjunction with the *Statement of General Conditions* provided in **Appendix A**.

## 1.1 PROJECT UNDERSTANDING

The Project is part of BC Hydro's Downtown Vancouver Electricity Supply (DVES) redevelopment plan and is the first project of this plan. This Project includes the construction of a new underground West End Substation (WTE) on the Vancouver School Board's Lord Roberts School Annex property at 1150 Nelson Street in Vancouver, British Columbia (the Site). The existing Lord Roberts School Annex building would be demolished prior to construction of the underground substation.

BC Hydro Pre-Needs Stage drawings WTE-E14-00901 through -00907, provided in RFP #12822, indicate that the WTE would comprise a multi-story underground structure to house high voltage electrical equipment and transformers. The WTE would be approximately 45 m by 88 m in plan and founded approximately 35 m below the existing site grade and located at the southeast end of the Site.

The Pre-Needs Stage drawings provided in the RFP show that a new/replacement school building would occupy an approximate 45 m by 45 m area at the northwest end of the Site. Two levels of underground parking, each 5 m high, would be constructed below the new school building. A ramp down to the underground parking would be constructed on the southwest side of the new school.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

## 2.0 SITE DESCRIPTION

The proposed WTE substation is located at 1150 Nelson Street in Vancouver, British Columbia, as shown on Figure No. 1. The Site is bounded by Nelson Street to the northeast, Bute Street to the northwest, and Nelson Park to the southwest and southeast and is approximately 135 m (parallel to Nelson Street) by 50 m (parallel to Bute Street).

Existing Lord Roberts School Annex presently occupies the middle of the Site. The existing school building is approximately 50 m long and 35 m wide. A parking lot, approximately 18 m by 25 m, was located near the northeast corner of the school, with access from Nelson Street. A chain link fence surrounded the Site and separated the parking lot from the school grounds.

A playground including jungle gym, swing set, and paved play yard area is located to the northwest of the school building. The remainder of the Site was generally grass-covered during the geotechnical exploration program. Numerous trees were present along the northwest and northeast sides of the Site, and sporadically elsewhere.

A Topographic Survey by BC Hydro (Dwg. No. 455D-S11-00001; dated January 8, 2019) indicates that the Site is relatively flat. Ground surface generally varies between EL. 45 m and EL. 43 m (Geodetic), though much of the site is within 0.5 m of EL. 43.5 m.



December 4, 2019

## **3.0 GEOTECHNICAL SITE EXPLORATION**

### **3.1 WORKPLACE ISOLATION AND NOISE MITIGATION**

The workplace was within the Vancouver School Board's property.

A temporary fence was erected to separate the existing playground from the rest of the Site for the duration of our field work. The fence panels were 2.4 m high and included privacy screens to limit visibility and mitigate dust and debris. The temporary fence panels were bolted together, and the ends bolted to the existing chain link fence that surrounds the Site to prevent public access to the workplace. Modu-Loc Fence Rentals (Modu-Loc, New Westminster, British Columbia), under contract to Stantec, supplied, erected, and removed the temporary fencing.

Modu-Loc also supplied 2.4 m high fence panels with acoustic panels (Echo Barriers) that were installed around the drill rig and auxiliary equipment to mitigate noise generated by the geotechnical exploration program. This fencing created a smaller, approximately 12 m by 18 m active work site within the overall workplace.

### **3.2 UTILITY CLEARANCE**

A BC One Call request was submitted to obtain available information on existing utilities near the Site. This request was made prior to executing the field work.

Following the desktop review of the information from BC One Call, a field program was performed using Ground Penetrating Radar (GPR) and electromagnetic (EM) scanning equipment to clear the proposed borehole locations free of any existing underground utility lines. Quadra Locating (Port Coquitlam, British Columbia), contracted to Stantec, carried out the GPR and EM scanning on July 17, 2019.

Presence of underground utilities was noted near planned borehole BH19-03. Hydro-vacuum excavation was used to expose the buried utility infrastructure and clear the locations prior to drilling and in-situ testing. Soil sampling was performed within hydro-vacuum excavated hole using a hand-held sampling tool. The hydro-vacuum excavation was carried out to approximately 3 m depth below the existing ground surface on July 25, 2019 by our subcontractor First Call Energy Ltd.

### **3.3 BOREHOLE DRILLING AND IN-SITU TESTING**

The field work for the geotechnical exploration program was carried out between July 15 and August 9, 2019, adhering to the prescribed working hours of Monday to Friday between 7:30 AM and 5:00 PM. No field work was carried out on weekends or holidays.

The geotechnical exploration program consisted of six boreholes. The boreholes were completed by Sea to Sky Drilling Ltd. (Sea to Sky), under contract to Stantec, using a Mobile B52 truck mounted drill rig. The borehole locations are shown on Figure 1.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

Boreholes BH19-01 to BH19-05 were drilled through the overburden soils with the mud rotary method. The drilling mud consisted of Baroid EZ-MUD® liquid polymer emulsion.

Triple-tube, NQ sized cores were advanced below the overburden soil into the underlying bedrock in boreholes BH19-01 to BH19-05 using diamond bit coring. Continuous bedrock core samples were retrieved every 1.5 m utilizing a wireline and overshot to bring the core to surface. Target depth for bedrock coring was 35 m below the existing ground surface (i.e., to the proposed bottom of the excavation) in BH19-01 and BH19-04, 40 m below the existing ground surface (i.e., 5 m below the proposed bottom of excavation) in BH19-02 and BH19-03, and 3 m into bedrock in BH19-05.

Borehole AH19-06 was drilled using solid-stem augers. The purpose of AH19-06 was to install a shallow groundwater well and a nested vapour well to assess groundwater and soil vapour near borehole BH18-01, where hydrocarbon contained soil was reported to be encountered by others (see Section 3.5 of this report).

Borehole coordinates were recorded with a handheld Global Positioning System (GPS) device with an accuracy of approximately +/- 3 m. The borehole coordinates were adjusted where necessary based field measurements of nearby landmarks or structures. Elevations were estimated to the nearest +/- 0.2 m based on 0.2 m contour lines shown on the Topographic Survey provided in RFP #12822 (Dwg. No. 455D-S11-00001, Rev. 2, January 8, 2019).

A summary of the geotechnical site exploration is provided in Table 1.

**Table 1: Geotechnical Site Exploration Summary**

Borehole	Date	UTM Coordinates <sup>1</sup>		Ground Elevation <sup>2</sup> , Geodetic	Depth below Ground Surface (m)	Sampling Methods	In-Situ Testing
		Northing	Easting				
BH19-01	July 22 to July 23, 2019	5458899	490601	EL. 44.6 m	35.1	Split spoon, NQ rock core	SPT
BH19-02	July 24 to July 26, 2019	5458927	490588	EL. 44.0 m	39.9	Split spoon, NQ rock core	SPT
BH19-03	July 26 to July 31, 2019	5458936	490540	EL. 44.0 m	39.9	Grab, split spoon, NQ rock core	SPT
BH19-04	July 31 to August 2, 2019	5458966	490527	EL. 43.4 m	35.1	Split spoon, NQ rock core	SPT
BH19-05	August 2 to August 7, 2019	5458982	490525	EL. 43.4 m	31.2	Split spoon, NQ rock core	SPT
AH19-06	July 19, 2019	5458903	490582	EL. 43.8 m	4.4	Grab	None
NOTES: <sup>1</sup> Based on Handheld GPS unit (with an accuracy of +/- 3 m) <sup>2</sup> Based on BC Hydro Dwg. No. 455D-S11-00001, Rev. 2, January 8, 2019 (with an accuracy of +/- 0.2 m)							





# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

Upon termination, the boreholes were backfilled with drill cuttings, filter sand, bentonite and grout and reinstated in accordance with the *BC Groundwater Protection Regulation*.

A Stantec geotechnical engineer coordinated the exploration work, located the boreholes in the site, classified the soils and rock encountered within the boreholes, maintained a detailed field log of each borehole, collected soil and rock core samples for laboratory testing, and observed and recorded pertinent site features.

The rock indices recorded in the field for each core run included the following:

- Total Core Recovery (TCR): the total length of core recovered as a percentage of the core run length.
- Solid Core Recovery (SCR): the cumulative length of pieces of solid core as a percentage of the core run length.
- Rock Quality Designation (RQD): the cumulative length of pieces of intact and sound bedrock core that are equal to or greater than 100 mm in length as a percentage of the core run length.

Details of the soil and groundwater conditions, results of the laboratory classification and index testing, borehole backfilling, and monitoring well installations are included on the Borehole Records in **Appendix B**. Soil descriptions presented on the Borehole Records are in general accordance with ASTM D2487 and D2488 for the Unified Soil Classification System (USCS) and with the information presented on the “Symbols and Terms Used in Borehole and Test Pit Records” in **Appendix B**.

Photographs of bedrock core samples are provided in **Appendix E**.

## 3.3.1 Standard Penetration Tests

Standard Penetration Tests (SPT) were performed at 1.5 m depth intervals in the mud rotary boreholes BH19-01 through BH19-05 using a 51 mm outside diameter, un-lined split spoon sampler driven with an automatic safety hammer in general accordance with ASTM D1586. The SPT involved driving a split spoon sampler with a 63.5 kg hammer, falling from a height of 760 mm. Blow counts were recorded over three consecutive 150 mm intervals during the testing. The SPT blow counts are the cumulative blows for the second and third 150 mm penetration (total 300 mm or less than 300 mm in cases of refusal for further penetration) and are reported on the Borehole Records in **Appendix C**.

## 3.3.2 Piezometers/Monitoring Wells

Standpipe piezometers, consisting of 25 mm diameter PVC Schedule 40 pipes were installed to enable long term monitoring of groundwater levels at the site and permit environmental groundwater sampling. Nested shallow and deep piezometers were installed in boreholes BH19-02 through BH19-04. Shallow piezometers were installed in boreholes BH19-01, BH19-05, and BH19-06. A flush mount protective cover was installed at the surface of each borehole.

Piezometer installation details are summarized in Table 2.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

**Table 2: Summary of Piezometer Installation**

Borehole	Piezometer Installation Date	Existing Ground Surface Elevation	Piezometer Screen depth below Existing Ground Surface	Piezometer Screen Elevation
BH19-01	July 23, 2019	EL. 44.6 m	2.8 m to 4.3 m	EL. 41.8 m to EL. 40.3 m
BH19-02	July 26, 2019	EL. 44.0 m	S: 2.8 m to 4.3 m D: 24.8 m to 30.9 m	S: EL. 41.2 m to EL. 39.7 m D: EL. 19.2 m to EL. 13.1 m
BH19-03	July 31, 2019	EL. 44.0 m	S: 2.9 m to 4.4 m D: 21.6 m to 27.7 m	S: EL. 41.1 m to EL. 39.6 m D: EL. 22.4 m to EL. 16.3 m
BH19-04	August 2, 2019	EL. 43.4 m	S: 4.3 m to 5.8 m D: 23.8 m to 29.9 m	S: EL. 39.1 m to EL. 37.6 m D: EL. 19.6 m to EL. 13.5 m
BH19-05	August 6, 2019	EL. 43.4 m	4.7 m to 6.2 m	EL. 38.7 m to EL. 37.2 m
AH19-06	July 19, 2019	EL. 43.8 m	2.2 m to 3.7 m	EL. 41.6 m to EL. 40.1 m
S: shallow nested well D: deep nested well				

Groundwater measurements were obtained on August 9, 2019 and are shown on the borehole records in **Appendix B**.

## 3.4 LABORATORY TESTS

Geotechnical laboratory tests were performed on soil samples taken from the SPT split spoons, auger flights, and from the bottom and side walls of the hydro-vacuumed holes. The tests comprised moisture content, Atterberg limits, particle-size distribution, and fines content measurements. Geotechnical laboratory tests performed on bedrock core samples included point load tests (axial and diametral) and unconfined compressive strength.

Chemical testing of soil samples (pH, conductivity and sulphate content testing) was carried out at the Bureau Veritas laboratory, located in Burnaby, British Columbia.

Select bedrock core samples, approximately one sample for every 2 m of rock core retrieved from the geotechnical exploration program, were subjected to Acid Base Accounting (ABA), Shake Flask Extraction (SFE), and Trace Metals testing. The test results would be used to assess Acid Rock Drainage (ARD) and Metal Leaching (ML) potential of the bedrock. The ARD and ML tests were carried out at Global ARD Testing Services Inc., located in Burnaby, British Columbia.

A summary of the laboratory tests is presented in Table 3.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

**Table 3: Summary of Laboratory Tests**

Laboratory Test	Number of Tests Performed
Moisture Content	93
Atterberg Limits	5
Fines Content Measurement (Particles less than 0.075 mm in size / passing sieve No. 200)	27
Particle Size Distribution	16
Soluble pH, Conductivity and Sulphate Content	16
Point Load	45
Unconfined Compressive Strength	16
Acid Rock Drainage	21

## 3.4.1 Soil Tests

### 3.4.1.1 Moisture Content

Moisture content tests were performed in general accordance with ASTM D2216. Natural moisture content measurements are presented on the borehole records in **Appendix B**.

### 3.4.1.2 Atterberg Limits

Atterberg limit tests were using the multi-point method (Method A) described in ASTM D4318 and the results are presented on the borehole records in **Appendix B** and on test reports in **Appendix C1**.

### 3.4.1.3 Fines Content

Tests for the amount of material finer than 0.075 mm nominal diameter in select soil samples were completed in general accordance with ASTM D1140-14. The test results are presented on the borehole records in **Appendix B**.

### 3.4.1.4 Particle-Size Distribution

Particle size distribution tests of select soil samples were completed in general accordance with ASTM D6913 and the results are presented on the borehole records in **Appendix B** and on test reports in **Appendix C1**.

### 3.4.1.5 pH, Conductivity and Sulphate Content

pH, conductivity and sulphate content tests on select soil samples were completed in general accordance with testing standards SM 22 4500-H+B, SM 22 2510 B m, and SM 22 4500-SO42-E m respectively. The results are presented in **Appendix D**.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

## 3.4.2 Rock Testing

### 3.4.2.1 Point Load

Point load tests were performed in accordance with ASTM D5731 to estimate Point Load Strength Index,  $I_{s(50)}$ , values. Tests were performed at least once every 1 m of core length, alternating between axial and diametral sample testing. Samples with an invalid fracture from axial load test were immediately re-tested diametrically.

The point load tests with valid fractures are summarized on the Borehole Records in **Appendix B**. All point load test results are provided in **Appendix C.2**.

### 3.4.2.2 Unconfined Compressive Strength

Unconfined compressive strength (UCS) of rock cores was carried out once for every 3 m of rock core retrieved from the geotechnical exploration program. The UCS tests were performed in accordance with ASTM D7012 – Method C.

The UCS test results are summarized on the Borehole Records in **Appendix B** and the test report sheets are provided in **Appendix C.2**.

### 3.4.2.3 Acid Rock Drainage

The ARD and ML test results (Certificate of Analysis) are presented in **Appendix F**. Sample preparation, and the test methods are noted on the Certificate of Analysis.

## 3.5 PREVIOUS WORK BY OTHERS

A geotechnical site exploration, consisting of one borehole, BH18-01, to 20.7 m depth below the existing ground surface was completed by Golder Associates in 2018. Details of this work is provided in the Technical Memorandum by Golder Associates, dated November 13, 2018, included in RFP #12822.

The borehole was drilled using solid-stem augers to approximately 2.7 m depth, followed by HQ3 soil coring method to the termination depth. The approximate location of BH18-01 is shown on Figure 1. The Golder Technical Memorandum indicates hydrocarbon contamination was present within the fill materials between 1.2 m and 1.5 m depth below the existing ground surface and may be gasoline derived.

Record of borehole BH18-01 is provided in **Appendix G**.



# GEOTECHNICAL FACTUAL REPORT, REVISION 0: BC HYDRO UNDERGROUND WEST END SUBSTATION

December 4, 2019

## 4.0 CLOSURE

This report was prepared for the exclusive use of BC Hydro and its agents for specific application to the Underground West End Substation Project. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Stantec.

Use of this report is subject to the Statement of General Conditions included in **Appendix A**. It is the responsibility of BC Hydro, who is identified as "the Client" within the Statement of General Conditions, and their agents to review the conditions and notify Stantec should any of them not be satisfied.

The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design, or construction

We trust that this report meets your present requirements. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Regards,

STANTEC CONSULTING LTD.

Reviewed by:



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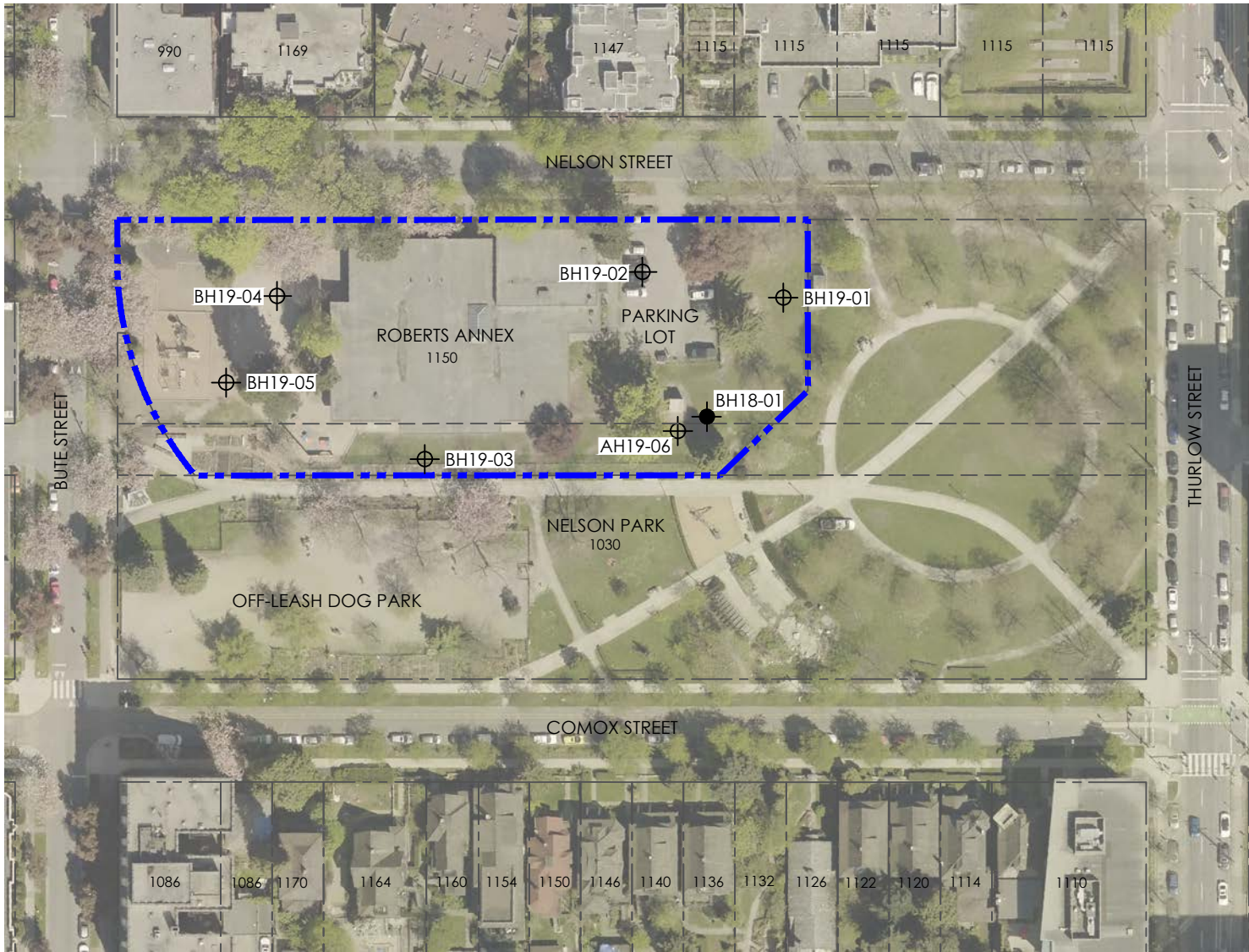


December 4, 2019

## **5.0 FIGURES**







#### Legend

- - - - - SITE PROPERTY LINE
- - - - - LOT LINE
- - - - - RIGHT-OF-WAY
- BOREHOLE LOCATION (STANTEC, 2019)
- APPROXIMATE BOREHOLE LOCATION (GOLDER, 2018)
- SCALE IN METRES
- 0 10 20 30 40 50
- 1:1250



DISCLAIMER: The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any error or omissions shall be reported to Stantec without delay. The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

#### Project Information

Project No.: 123314418  
 Scale: 1:1250  
 Date: 2019-SEPT-26  
 Drawn by: G. HUYNH  
 Checked by: N. GAUTAM

#### Project Location

1150 NELSON STREET  
 VANCOUVER, BC

#### Client/Project

BC HYDRO

UNDERGROUND WEST END SUBSTATION

#### Title

**BOREHOLE  
 LOCATION PLAN**

#### Figure No.

**1**

# APPENDICES



## Appendix A STATEMENT OF GENERAL CONDITIONS



## STATEMENT OF GENERAL CONDITIONS

**USE OF THIS REPORT:** This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec and the Client. Any use which a third party makes of this report is the responsibility of such third party.

**BASIS OF THE REPORT:** The information, opinions, and/or recommendations made in this report are in accordance with Stantec's present understanding of the site-specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site-specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

**STANDARD OF CARE:** Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

**INTERPRETATION OF SITE CONDITIONS:** Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock, and groundwater conditions as influenced by geological processes, construction activity, and site use.

**VARYING OR UNEXPECTED CONDITIONS:** Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec will not be responsible to any party for damages incurred as a result of failing to notify Stantec that differing site or sub-surface conditions are present upon becoming aware of such conditions.

**PLANNING, DESIGN, OR CONSTRUCTION:** Development or design plans and specifications should be reviewed by Stantec, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc.), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present.

## Appendix B BOREHOLE RECORDS



## SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

### SOIL DESCRIPTION

#### Terminology describing common soil genesis

<i>Rootmat</i>	vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
<i>Topsoil</i>	mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	material below the surface identified as placed by humans (excluding buried services)

#### Terminology describing soil structure

<i>Desiccated</i>	having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	having cracks, and hence a blocky structure
<i>Varved</i>	composed of regular alternating layers of silt and clay
<i>Stratified</i>	composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	> 75 mm in thickness
<i>Seam</i>	2 mm to 75 mm in thickness
<i>Parting</i>	< 2 mm in thickness

#### Terminology describing soil types

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

#### Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris)

Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

#### Terminology describing compactness of cohesionless soils

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on Page 2. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

#### Terminology describing consistency of cohesive soils

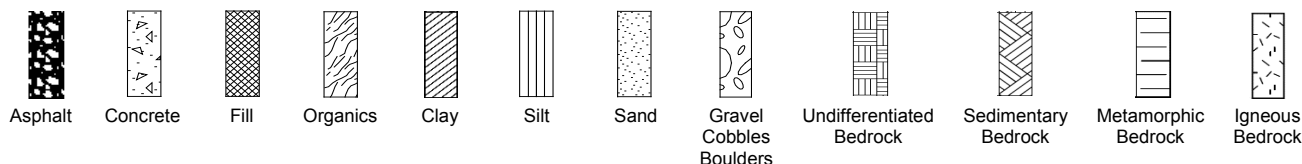
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kg/cm <sup>2</sup> or kips/sq.ft.	kPa	
<i>Very Soft</i>	<0.25	<12.5	<2
<i>Soft</i>	0.25 - 0.5	12.5 - 25	2-4
<i>Firm</i>	0.5 - 1.0	25 - 50	4-8
<i>Stiff</i>	1.0 - 2.0	50 - 100	8-15
<i>Very Stiff</i>	2.0 - 4.0	100 - 200	15-30
<i>Hard</i>	>4.0	>200	>30



## STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



## SAMPLE TYPE

AS, BS, GS	Auger sample; bulk sample; grab sample
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
SO	Sonic tube
SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby Tube or thin wall tube
SV	Shear vane
RC HQ, NQ, BQ, etc.	Rock Core; samples obtained with the use of standard size diamond coring bits.

## WATER LEVEL



**Measured:** in standpipe, piezometer, or well



**Inferred:** seepage noted, or; measured during or at completion of drilling

## RECOVERY FOR SOIL SAMPLES

The recovery is recorded as the length of the soil sample recovered in the direct push, split spoon sampler, Shelby Tube, or sonic tube.

## N-VALUE

Numbers in this column are the field results of the Standard Penetration Test (SPT): the number of blows of a 140-pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50 for 75 mm or 50/75 mm). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

## DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60-degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

## OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
$\gamma$	Unit weight
$G_s$	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
$Q_u$	Unconfined compression
$I_p$	Point Load Index ( $I_p$ on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer



## ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

**Total Core Recovery (TCR)** denotes the sum of all measurable rock core recovered in one drill run. The value is noted as a percentage of recovered rock core based on the total length of the drill run.

**Solid Core Recovery (SCR)** is defined as total length of solid core divided by the total drilled length, presented as a percentage. Solid core is defined as core with one full diameter.

**Rock Quality Designation (RQD)** is a modified core recovery that incorporates only pieces of solid core that are equal to or greater than 10 cm (4") along the core axis. It is calculated as the total cumulative length of solid core (> 10 cm) as measured along the centerline of the core divided by the total length of borehole drilled for each drill run or geotechnical interval, presented as a percentage. RQD is determined in accordance with ASTM D6032.

**Fracture Index (FI)** is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

### Terminology describing rock quality

Rock Mass Quality	Rock Quality Designation Number (RQD)	Alternate (Colloquial) Rock Mass Quality	
<i>Very Poor Quality</i>	0-25	<i>Very Severely Fractured</i>	<i>Crushed</i>
<i>Poor Quality</i>	25-50	<i>Severely Fractured</i>	<i>Shattered or Very Blocky</i>
<i>Fair Quality</i>	50-75	<i>Fractured</i>	<i>Blocky</i>
<i>Good Quality</i>	75-90	<i>Moderately Jointed</i>	<i>Sound</i>
<i>Excellent Quality</i>	90-100	<i>Intact</i>	<i>Very Sound</i>

### Terminology describing rock strength

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	R0	<1
<i>Very Weak</i>	R1	1 – 5
<i>Weak</i>	R2	5 – 25
<i>Medium Strong</i>	R3	25 – 50
<i>Strong</i>	R4	50 – 100
<i>Very Strong</i>	R5	100 – 250
<i>Extremely Strong</i>	R6	>250

### Terminology describing rock weathering

Term	Symbol	Description
<i>Fresh</i>	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
<i>Slightly</i>	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
<i>Moderately</i>	W3	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly</i>	W4	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely</i>	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
<i>Residual Soil</i>	W6	All the rock converted to soil. Structure and fabric destroyed.

### Terminology describing rock with respect to discontinuity and bedding spacing

Spacing (mm)	Discontinuities Spacing	Bedding
>6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>





**Stantec**

# BOREHOLE RECORD

**AH19-06**

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
 PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **43.8m**  
 LOCATION: **1150 Nelson Street, Vancouver, BC** 5458903.0N 490582.0E DATUM: **Geodetic**  
 DATE BORED: **July 19, 2019** WATER LEVEL: **Dry on August 9, 2019**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)				WATER CONTENT & ATTERBERG LIMITS SPT (N-value) BLOWS/0.3m	BACKFILL / MONITOR WELL / PIEZOMETER	ELEVATION (m)
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST POCKET PEN.	FIELD VANE TEST POCKET SHEAR VANE					
0	43.8	TOPSOIL: brown silty sand with organics													
	43.7	FILL: dark brown silty sand with gravel													
1		- wood debris, 0.9 m to 1.1 m		AS	01										
	42.4	Light brown SILTY SAND (SM) - trace gravel		AS	02										
2															
	40.1	Light brown poorly graded SAND (SP) with silt and gravel		AS	03			Grain Size Analysis: G S Fines 7% 50% 43%							
4															
5	39.4	End of Auger Hole at 4.4 m. Target depth reached. Soil vapour well installed at 1.2 m depth. Shallow piezometer installed at 3.7 m depth. Dry on August 9, 2019.													
6															
7															
8															
9															
10															

BACKFILL SYMBOL

ASPHALT  
 GROUT  
 CONCRETE  
 BENTONITE  
 DRILL CUTTINGS  
 SAND  
 SLOUGH

Drilling Contractor: Sea to Sky Drilling Ltd.

Drilling Method: Solid-stem Auger

Completion Depth: 4.4 m

Logged By: NG

Reviewed By: AM

Page 1 of 1



## BOREHOLE RECORD

BH19-01

CLIENT: **BC Hydro**

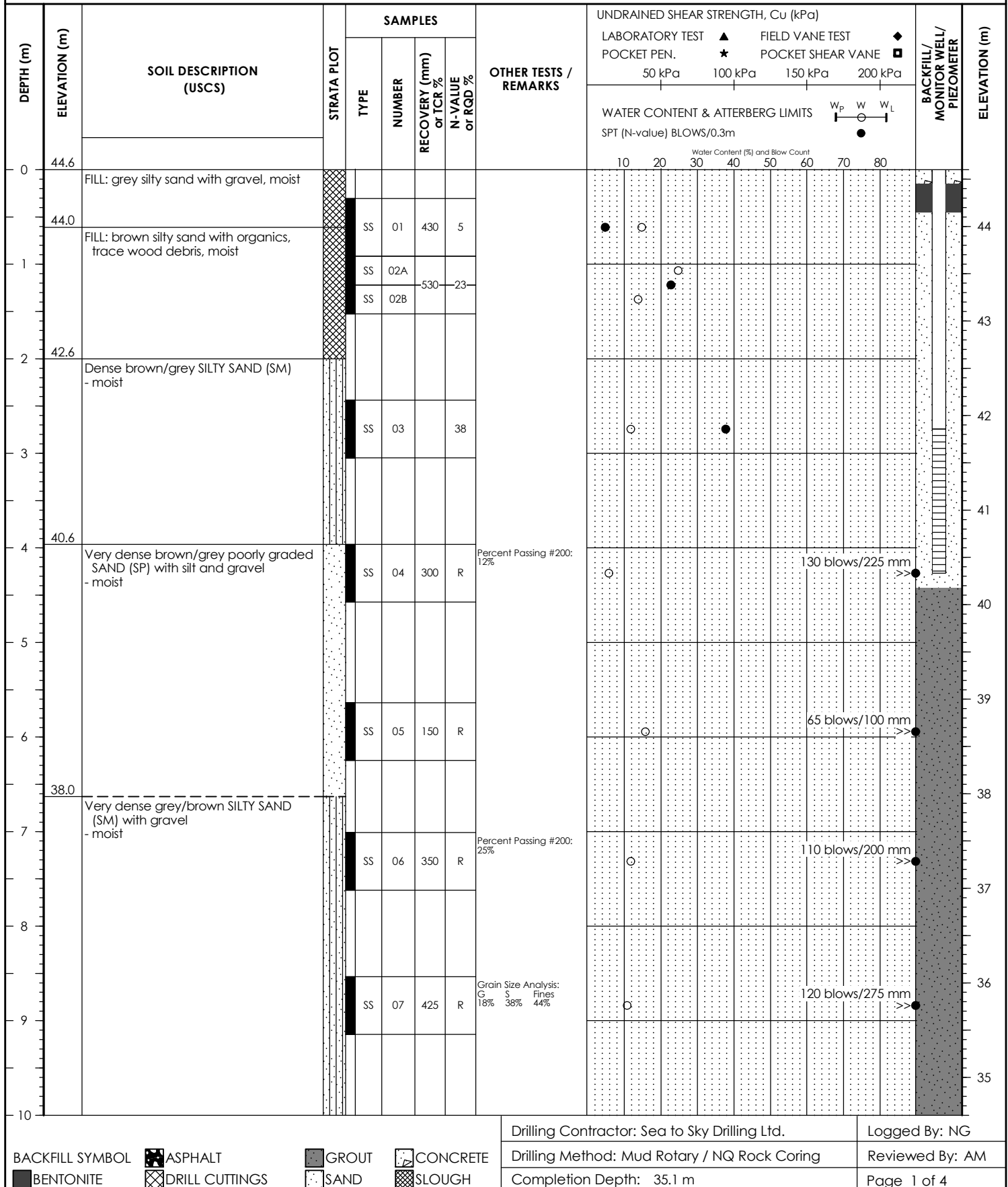
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44.6m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458899.0N 490601.0E

DATUM: **Geodetic**DATE BORED: **July 19, 2019 to July 23, 2019**WATER LEVEL: **Dry on August 9, 2019**





## BOREHOLE RECORD

BH19-01

CLIENT: **BC Hydro**

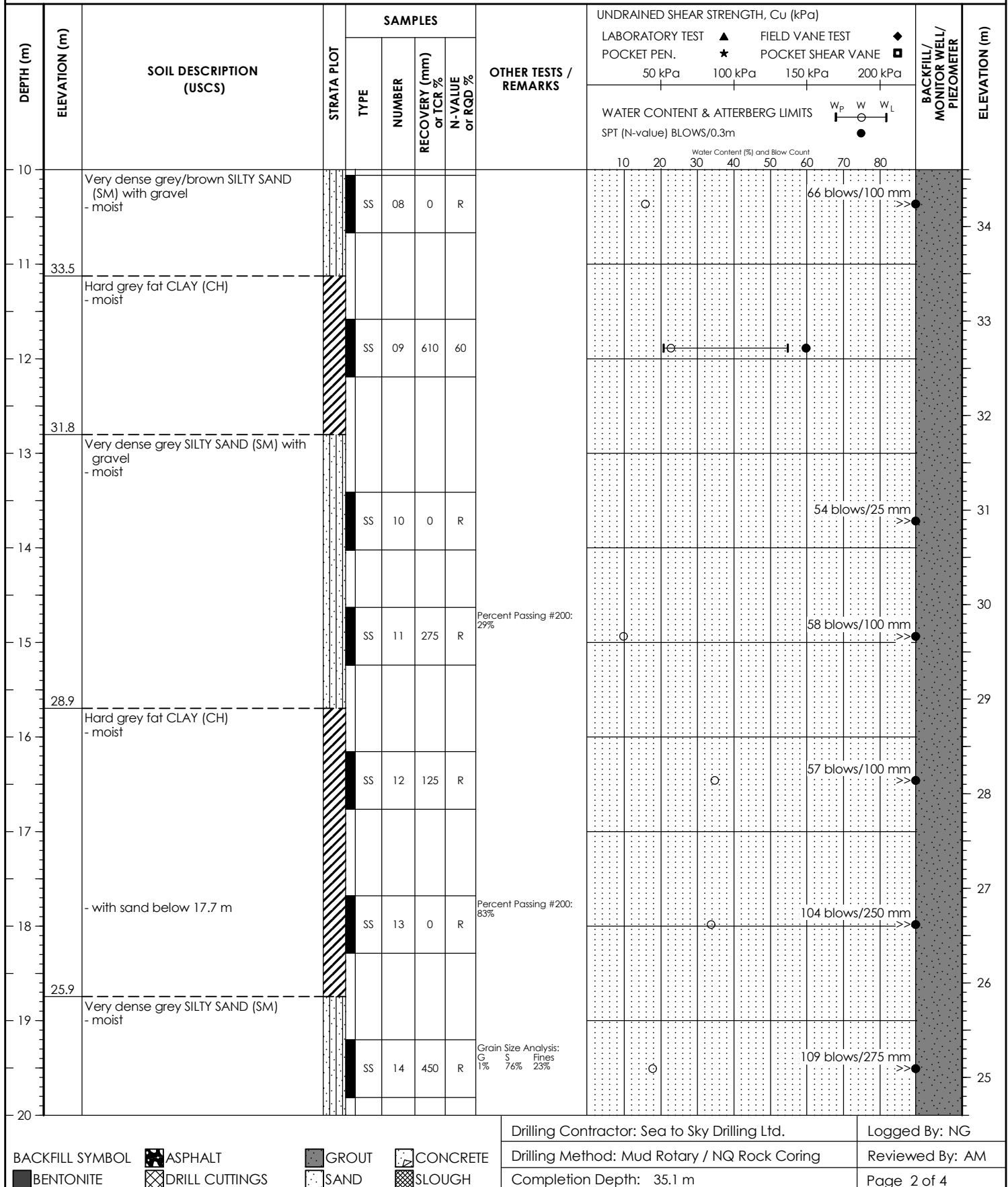
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44.6m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458899.0N 490601.0E

DATUM: **Geodetic**DATE BORED: **July 19, 2019 to July 23, 2019**WATER LEVEL: **Dry on August 9, 2019**



## BOREHOLE RECORD

BH19-01

CLIENT: **BC Hydro**

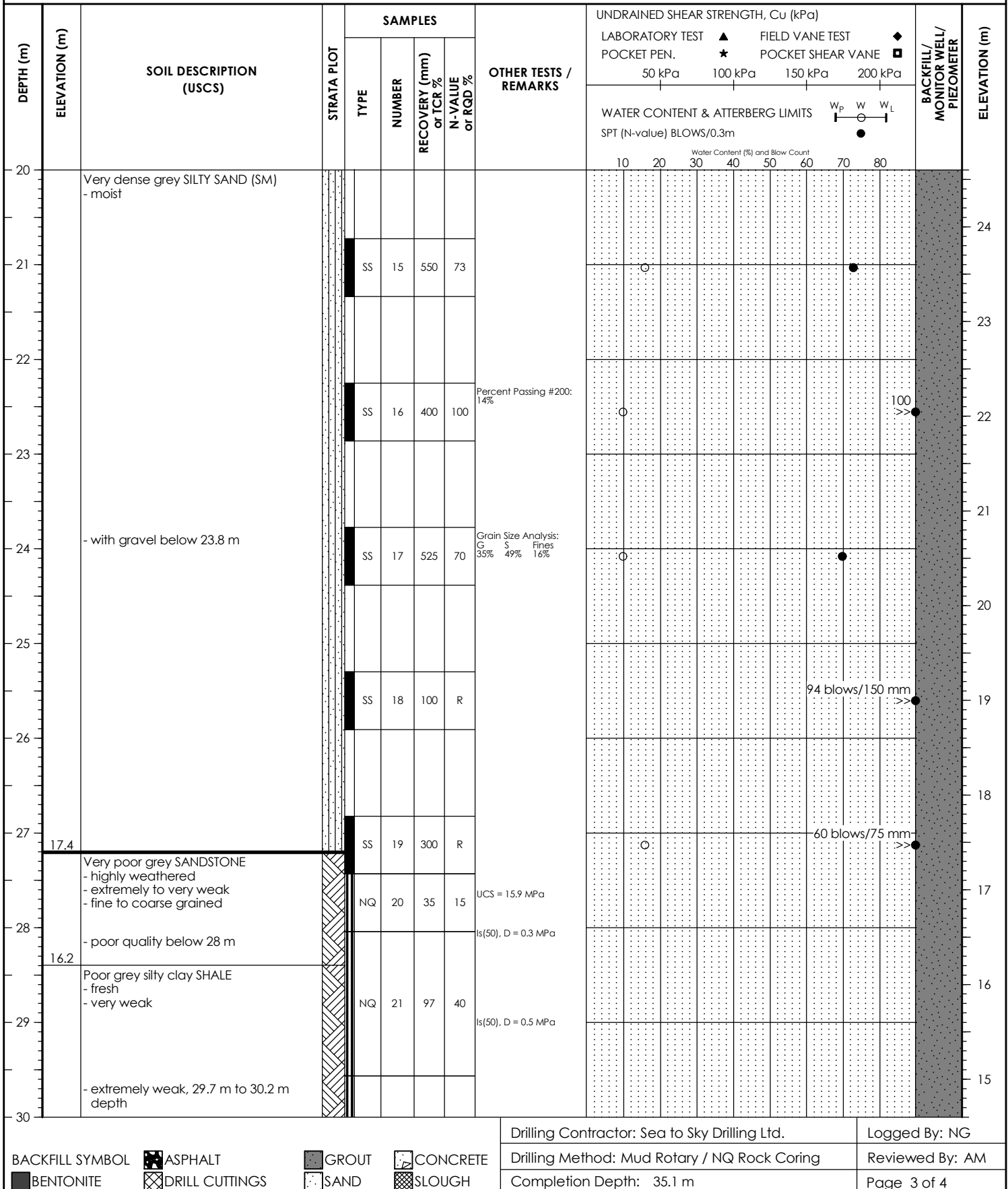
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44.6m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458899.0N 490601.0E

DATUM: **Geodetic**DATE BORED: **July 19, 2019 to July 23, 2019**WATER LEVEL: **Dry on August 9, 2019**



## BOREHOLE RECORD

BH19-01

CLIENT: **BC Hydro**

BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44.6m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458899.0N 490601.0E

DATUM: **Geodetic**DATE BORED: **July 19, 2019 to July 23, 2019**WATER LEVEL: **Dry on August 9, 2019**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)										BACKFILL/ MONITOR WELL/ PIEZOMETER	ELEVATION (m)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST		FIELD VANE TEST																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
									POCKET PEN.	POCKET SHEAR VANE	50 kPa	100 kPa	150 kPa	200 kPa	WATER CONTENT & ATTERBERG LIMITS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

Drilling Contractor: Sea to Sky Drilling Ltd.

Logged By: NG

Drilling Method: Mud Rotary / NQ Rock Coring

Reviewed By: AM

Completion Depth: 35.1 m

Page 4 of 4

BACKFILL SYMBOL

ASPHALT
 GROUT
 CONCRETE
 BENTONITE
 DRILL CUTTINGS
 SAND
 SLOUGH



## BOREHOLE RECORD

BH19-02

CLIENT: **BC Hydro**

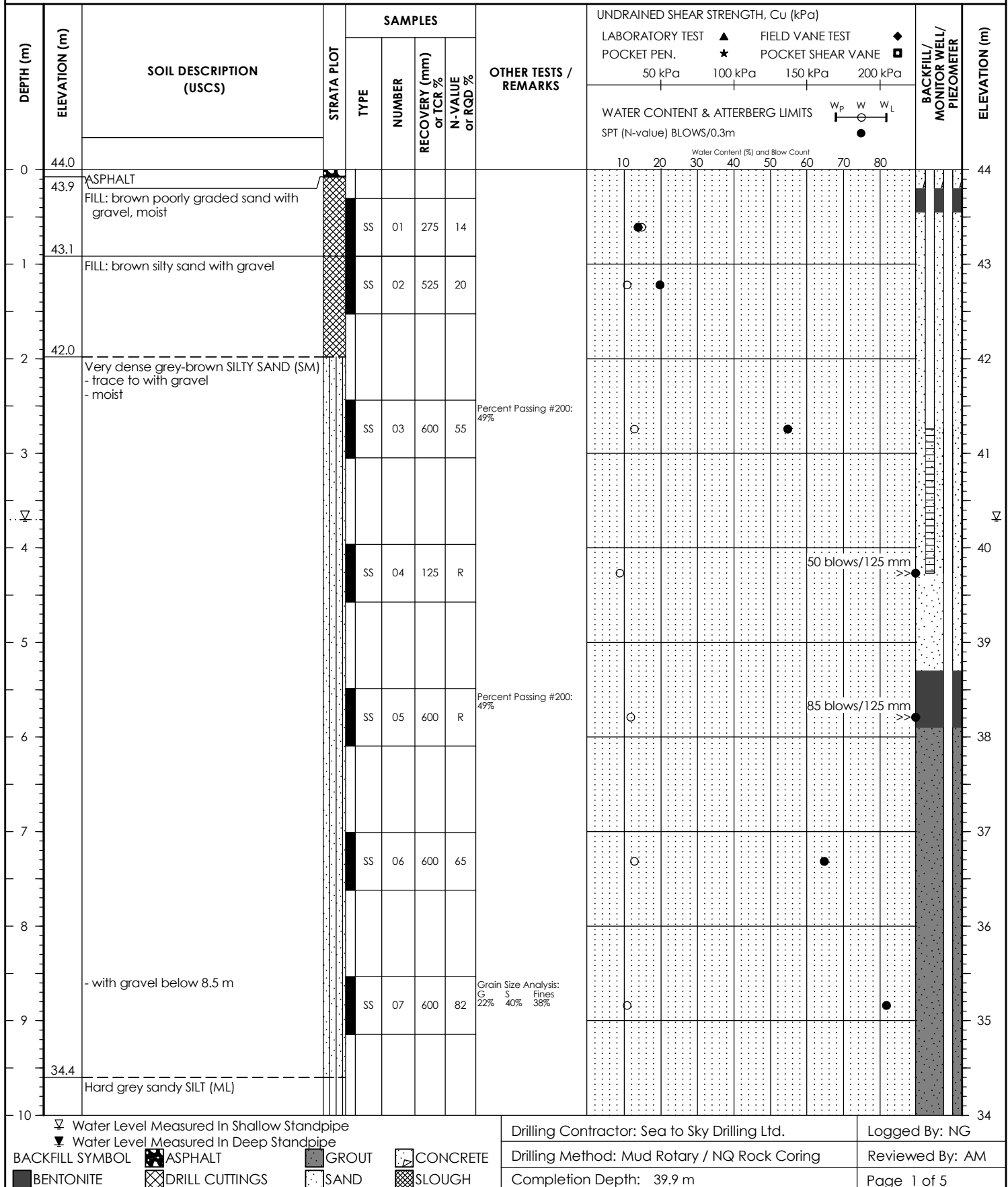
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458927.0N 490588.0E

DATUM: **Geodetic**DATE BORED: **July 24, 2019 to July 26, 2019**WATER LEVEL: **See Notes**



## BOREHOLE RECORD

BH19-02

CLIENT: **BC Hydro**

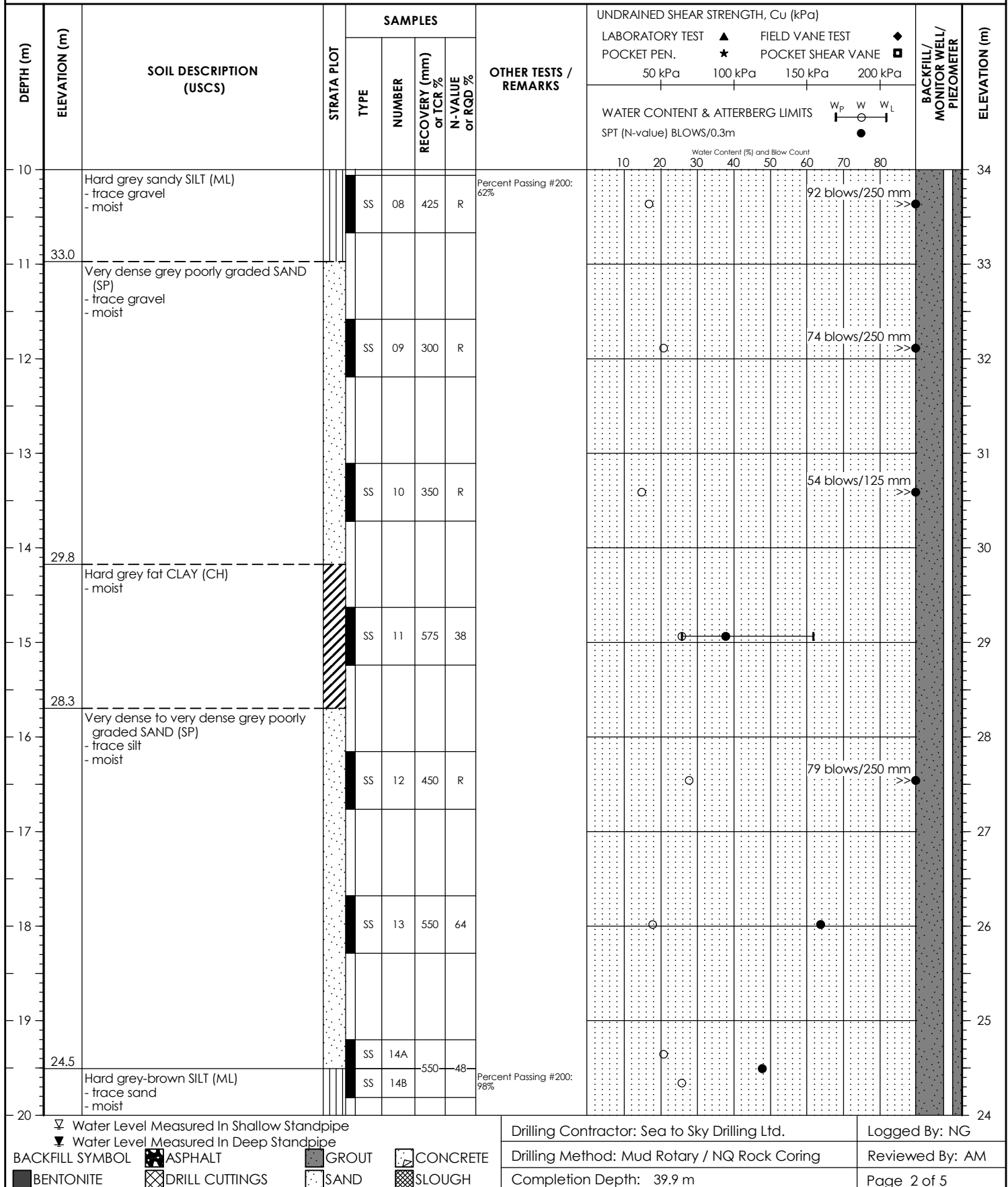
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458927.0N 490588.0E

DATUM: **Geodetic**DATE BORED: **July 24, 2019 to July 26, 2019**WATER LEVEL: **See Notes**



## BOREHOLE RECORD

BH19-02

CLIENT: **BC Hydro**

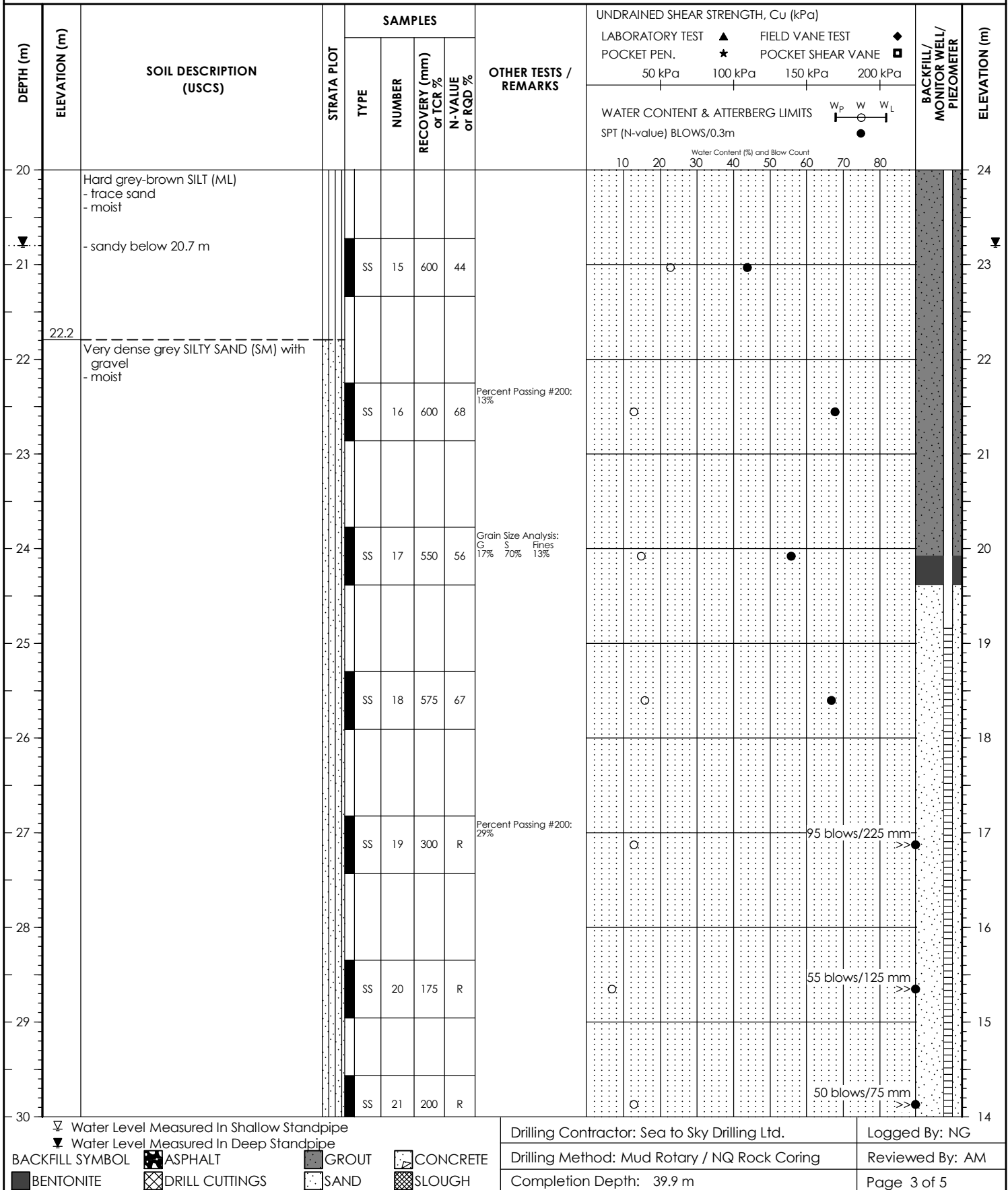
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458927.0N 490588.0E

DATUM: **Geodetic**DATE BORED: **July 24, 2019 to July 26, 2019**WATER LEVEL: **See Notes**

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
 PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **44m**  
 LOCATION: **1150 Nelson Street, Vancouver, BC** 5458927.0N 490588.0E DATUM: **Geodetic**  
 DATE BORED: **July 24, 2019 to July 26, 2019** WATER LEVEL: **See Notes**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)										BACKFILL/ MONITOR WELL/ PIEZOMETER	ELEVATION (m)
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST		FIELD VANE TEST		POCKET PEN.		POCKET SHEAR VANE		WATER CONTENT & ATTERBERG LIMITS			
									50 kPa	100 kPa	150 kPa	200 kPa	SPT (N-value) BLOWS/0.3m	Water Content (%) and Blow Count						
														W <sub>p</sub>	W <sub>L</sub>					
30	13.7	Very dense grey SILTY SAND (SM) with gravel moist																	14	
	13.2	Very poor grey SILTSTONE moderately to highly weathered extremely to very weak	NQ	22	83	0	Is(50), D = 0.1 MPa													13
31	13.1	Fair grey SANDSTONE extremely weak slightly to moderately weathered medium to coarse grained					UCS = 31.3 MPa													12
		Fair grey SILTSTONE moderately weathered very weak coal stain between 30.9 m to 31.1 m slightly weatehred below 31.1 m fresh to slighly weathered below 32.3 m	NQ	23	100	68	Is(50), A = 2.7 MPa													11
							Is(50), D = 1.8 MPa													10
32							UCS = 33.4 MPa													9
33		- very poor quality below 33.8 m	NQ	24	100	75	Is(50), D = 1.6 MPa													8
							Is(50), A = 0.1 MPa													7
34		- fair quality below 35.4 m	NQ	25	30	9	UCS = 27.4 MPa Is(50), D = 0.6 MPa													6
							Is(50), D = 0.6 MPa													5
35																				4
36	7.4	Fair grey SANDSTONE fresh very weak to weak medium to coarse grained					Is(50), A = 0.3 MPa													
	7.3	Fair grey SILTSTONE moderately weathered very weak	NQ	27	94	53	UCS = 29.8 MPa Is(50), D = 0.6 MPa													
37		- good quality below 38.4 m																		
38		- irregular, polished fracture at 39.3 m	NQ	28	98	80	Is(50), D = 0.5 MPa													
39		- medium to coarse grained below 39.6 m																		
40	4.1																			
▽ Water Level Measured In Shallow Standpipe ▼ Water Level Measured In Deep Standpipe								Drilling Contractor: Sea to Sky Drilling Ltd.								Logged By: NG				
BACKFILL SYMBOL								Drilling Method: Mud Rotary / NQ Rock Coring								Reviewed By: AM				
ASPHALT								Completion Depth: 39.9 m								Page 4 of 5				
GROUT																				
CONCRETE																				
BENTONITE																				
DRILL CUTTINGS																				
SAND																				
SLOUGH																				

▽ Water Level Measured In Shallow Standpipe  
 ▼ Water Level Measured In Deep Standpipe

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: Sea to Sky Drilling Ltd.

Logged By: NG

Drilling Method: Mud Rotary / NQ Rock Coring

Reviewed By: AM

Completion Depth: 39.9 m

Page 4 of 5



## BOREHOLE RECORD

BH19-02

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
 PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **44m**  
 LOCATION: **1150 Nelson Street, Vancouver, BC** 5458927.0N 490588.0E DATUM: **Geodetic**  
 DATE BORED: **July 24, 2019 to July 26, 2019** WATER LEVEL: **See Notes**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, $C_u$ (kPa)				BACKFILL / MONITOR WELL / PIEZOMETER	ELEVATION (m)
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST POCKET PEN. 50 kPa	FIELD VANE TEST POCKET SHEAR VANE 100 kPa	150 kPa	200 kPa		
40		End of Borehole BH19-02 at 39.9 m. Target depth reached. Shallow and deep piezometers installed at 4.3 m and 30.9 m depth below ground surface, respectively. Water levels on August 9, 2019: - at 3.7 m depth in shallow piezometer - at 20.8 m depth in deep piezometer												4
41														3
42														2
43														1
44														0
45														-1
46														-2
47														-3
48														-4
49														-5
50														-6

☐ Water Level Measured In Shallow Standpipe  
☒ Water Level Measured In Deep Standpipe

**BACKFILL SYMBOL**  
☒ ASPHALT    ☐ GROUT    ☐ CONCRETE  
☐ BENTONITE    ☐ DRILL CUTTINGS    ☐ SAND    ☐ SLOUGH

Drilling Contractor: Sea to Sky Drilling Ltd.

Drilling Method: Mud Rotary / NQ Rock Coring

Completion Depth: 39.9 m

Logged By: NG

Reviewed By: AM

Page 5 of 5

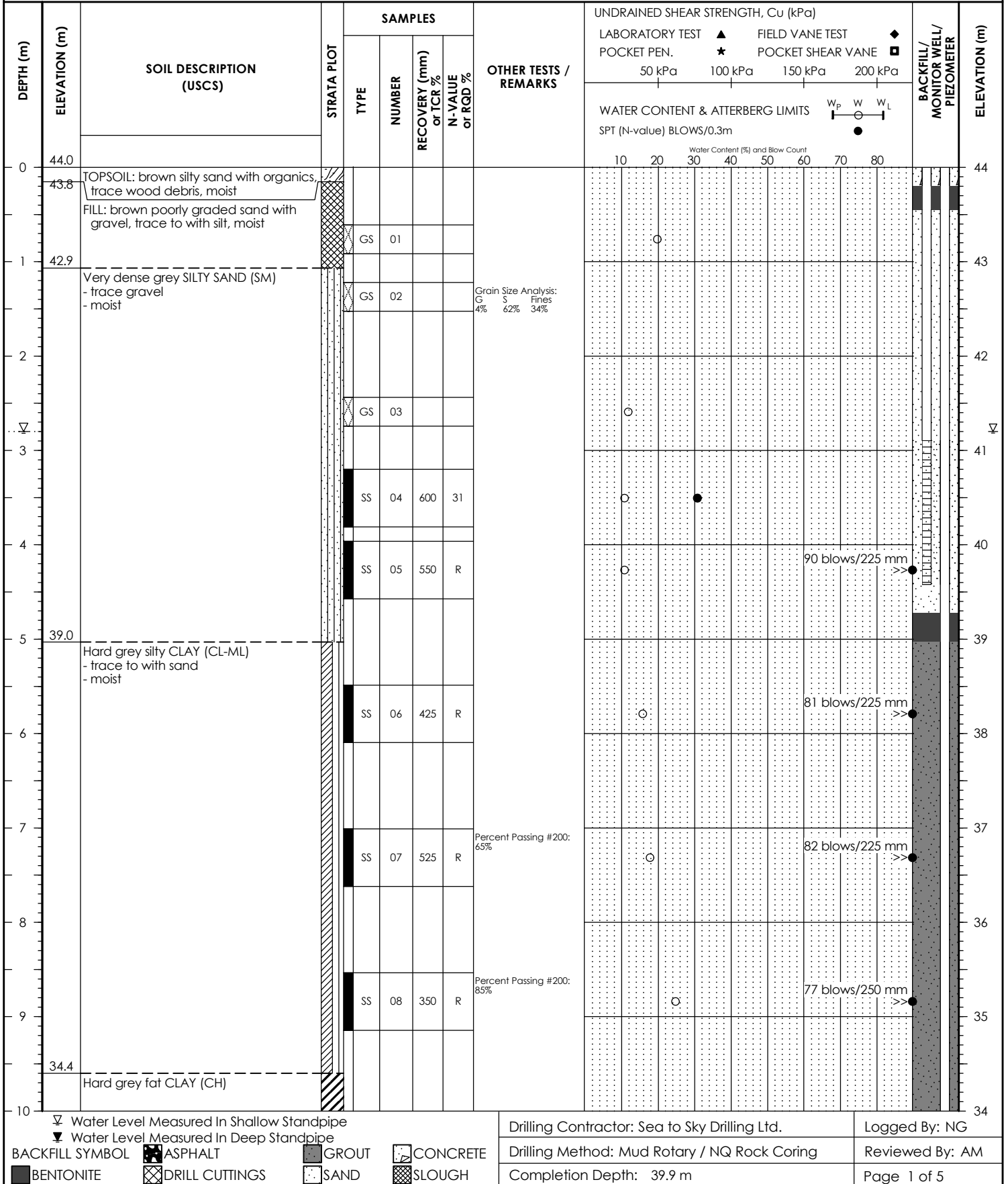




# BOREHOLE RECORD

BH19-03

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **44m**  
LOCATION: **1150 Nelson Street, Vancouver, BC** 5458936.0N 490540.0E DATUM: **Geodetic**  
DATE BORED: **July 26, 2019 to July 31, 2019** WATER LEVEL: **See Notes**





## BOREHOLE RECORD

BH19-03

CLIENT: **BC Hydro**

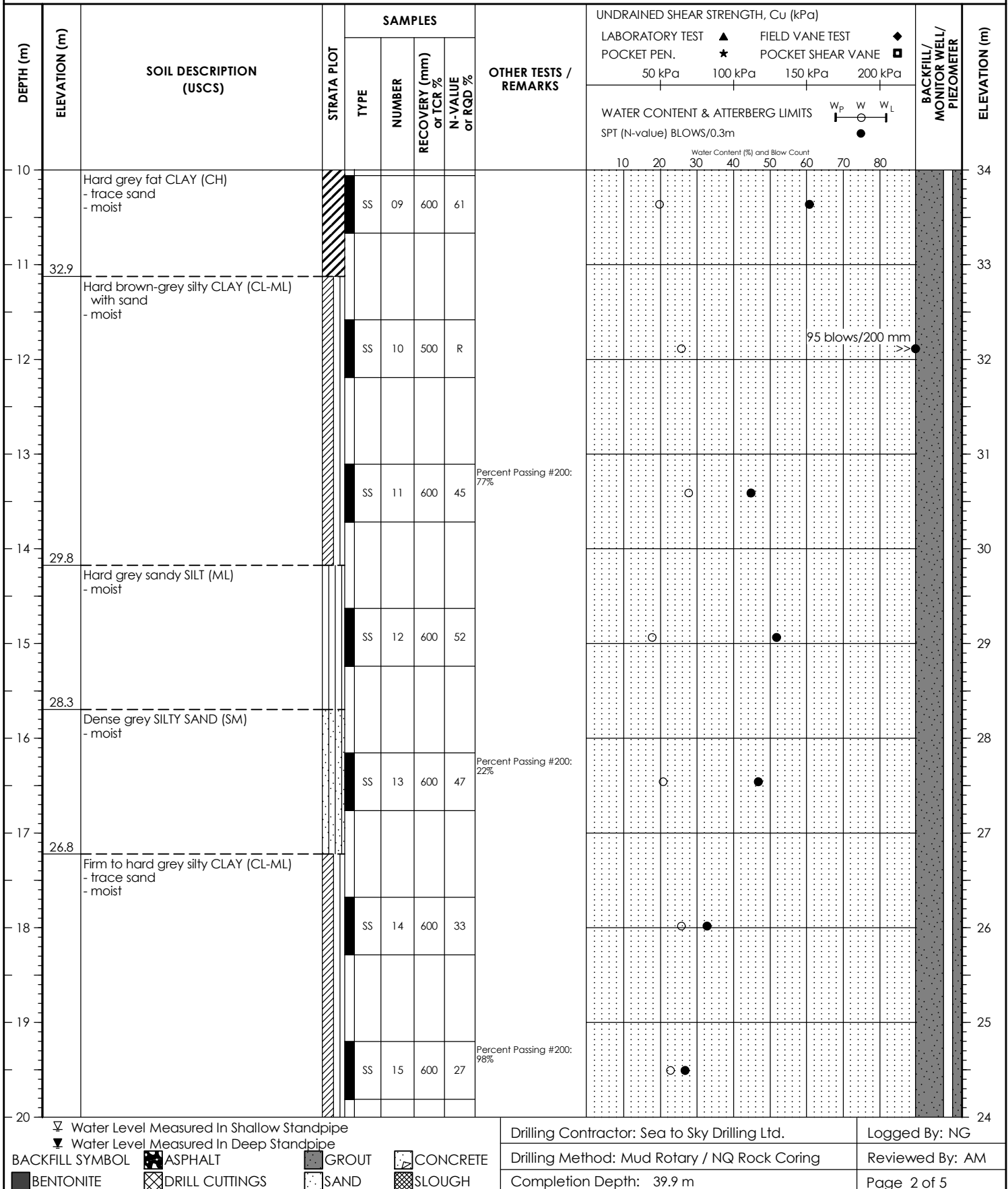
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458936.0N 490540.0E

DATUM: **Geodetic**DATE BORED: **July 26, 2019 to July 31, 2019**WATER LEVEL: **See Notes**

**Stantec****BOREHOLE RECORD****BH19-03**CLIENT: **BC Hydro**

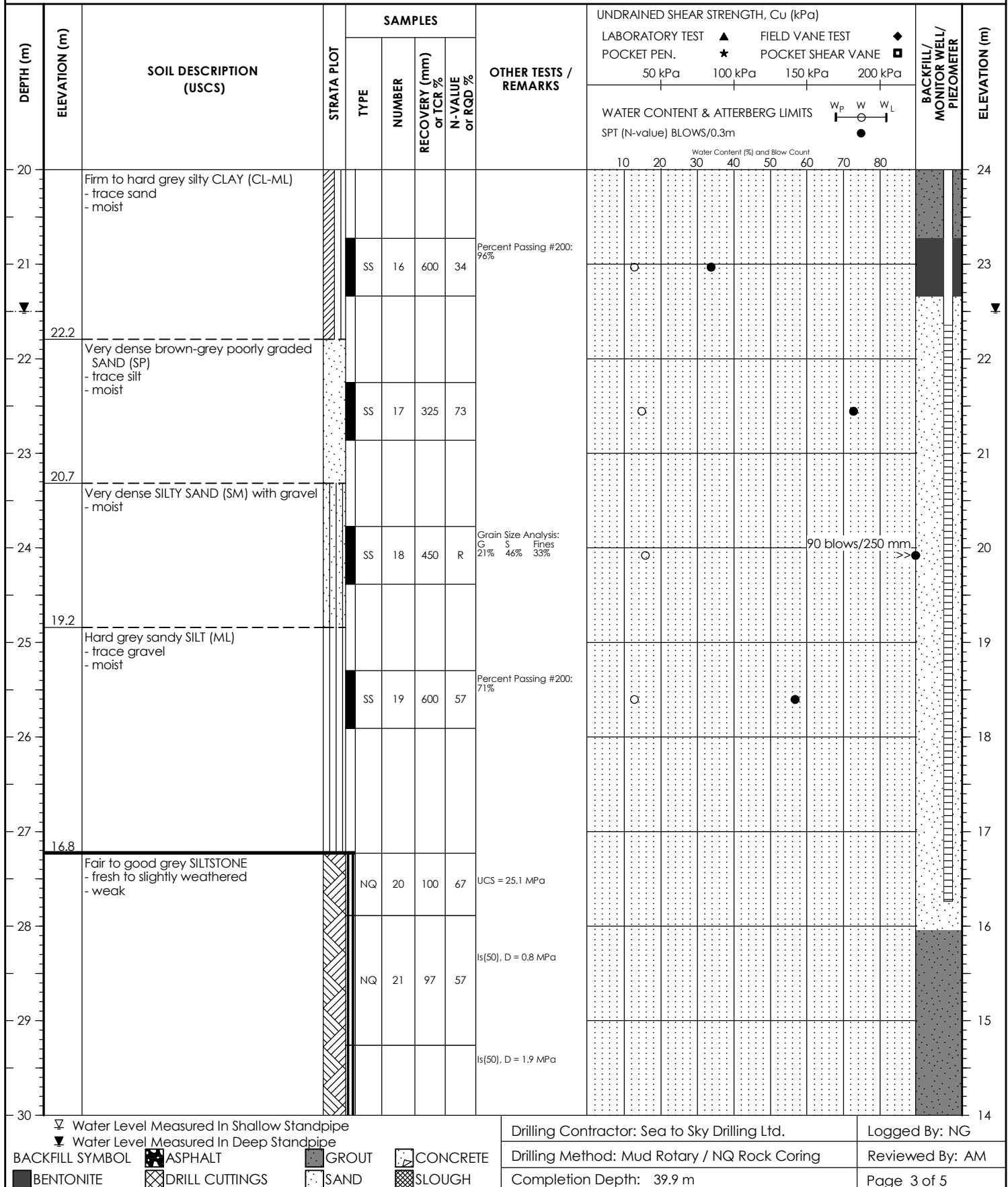
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **44m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458936.0N 490540.0E

DATUM: **Geodetic**DATE BORED: **July 26, 2019 to July 31, 2019**WATER LEVEL: **See Notes**



**Stantec**

# BOREHOLE RECORD

**BH19-03**

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
 PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **44m**  
 LOCATION: **1150 Nelson Street, Vancouver, BC** 5458936.0N 490540.0E DATUM: **Geodetic**  
 DATE BORED: **July 26, 2019 to July 31, 2019** WATER LEVEL: **See Notes**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)				BACKFILL / MONITOR WELL / PIEZOMETER	ELEVATION (m)
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST POCKET PEN. 50 kPa 100 kPa 150 kPa 200 kPa	FIELD VANE TEST POCKET SHEAR VANE				
30		Fair to good grey SILTSTONE - fresh to slightly weathered - weak		NQ	22	98	65	Is(50), D = 1.6 MPa UCS = 34.4 MPa						14
31		- good quality below 30.8 m		NQ	23	94	78	Is(50), D = 0.5 MPa						13
32	11.7												12	
33		Good grey SANDSTONE - fresh to slightly weathered - medium strong - fine grained		NQ	24	93	87	Is(50), D = 1.1 MPa Is(50), D = 1.4 MPa						11
34													10	
35				NQ	25	78	57	Is(50), A = 0.8 MPa UCS = 10.4 MPa						9
36	8.3	Poor grey SILTSTONE - fresh - medium strong		NQ	26	98	46	Is(50), A = 1.6 MPa						8
37								Is(50), D = 0.6 MPa						7
38				NQ	27	95	35	UCS = 27.9 MPa Is(50), D = 0.6 MPa						6
39													5	
40	4.1			NQ	28	100	32	UCS = 19.5 MPa Is(50), D = 0.4 MPa						4

▽ Water Level Measured In Shallow Standpipe  
 ▼ Water Level Measured In Deep Standpipe

BACKFILL SYMBOL

ASPHALT  
 BENTONITE  
 DRILL CUTTINGS

GROUT  
 SAND

CONCRETE  
 SLOUGH

Drilling Contractor: Sea to Sky Drilling Ltd.

Drilling Method: Mud Rotary / NQ Rock Coring

Completion Depth: 39.9 m

Logged By: NG

Reviewed By: AM

Page 4 of 5



# BOREHOLE RECORD

BH19-03

CLIENT: BC Hydro BH COORDINATES PROJECT NO.: 123314418  
PROJECT: Underground West End Substation [UTM] BH ELEVATION: 44m  
LOCATION: 1150 Nelson Street, Vancouver, BC 5458936.0N 490540.0E DATUM: Geodetic  
DATE BORED: July 26, 2019 to July 31, 2019 WATER LEVEL: See Notes

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)				BACKFILL / MONITOR WELL / PIEZOMETER	ELEVATION (m)		
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST	FIELD VANE TEST	POCKET PEN.	POCKET SHEAR VANE				
									50 kPa	100 kPa	150 kPa	200 kPa				
									WATER CONTENT & ATTERBERG LIMITS				W <sub>p</sub> W W <sub>L</sub>			
									SPT (N-value) BLOWS/0.3m							
									10	20	30	40	50	60	70	80
40		End of borehole BH19-03 at 39.9 m. Target depth reached. Shallow and deep piezometers installed at 4.4 m and 27.7 m depth below ground surface, respectively. Water levels on August 9, 2019: - at 2.8 m depth in shallow piezometer - at 21.5 m depth in deep piezometer						Is(50), A = 0.7 MPa							4	
41															3	
42															2	
43															1	
44															0	
45															-1	
46															-2	
47															-3	
48															-4	
49															-5	
50															-6	

☐ Water Level Measured In Shallow Standpipe  
☐ Water Level Measured In Deep Standpipe

BACKFILL SYMBOL ☐ ASPHALT ☐ GROUT ☐ CONCRETE  
☐ BENTONITE ☐ DRILL CUTTINGS ☐ SAND ☐ SLOUGH

Drilling Contractor: Sea to Sky Drilling Ltd.  
Drilling Method: Mud Rotary / NQ Rock Coring  
Completion Depth: 39.9 m

Logged By: NG  
Reviewed By: AM  
Page 5 of 5



## BOREHOLE RECORD

BH19-04

CLIENT: **BC Hydro**

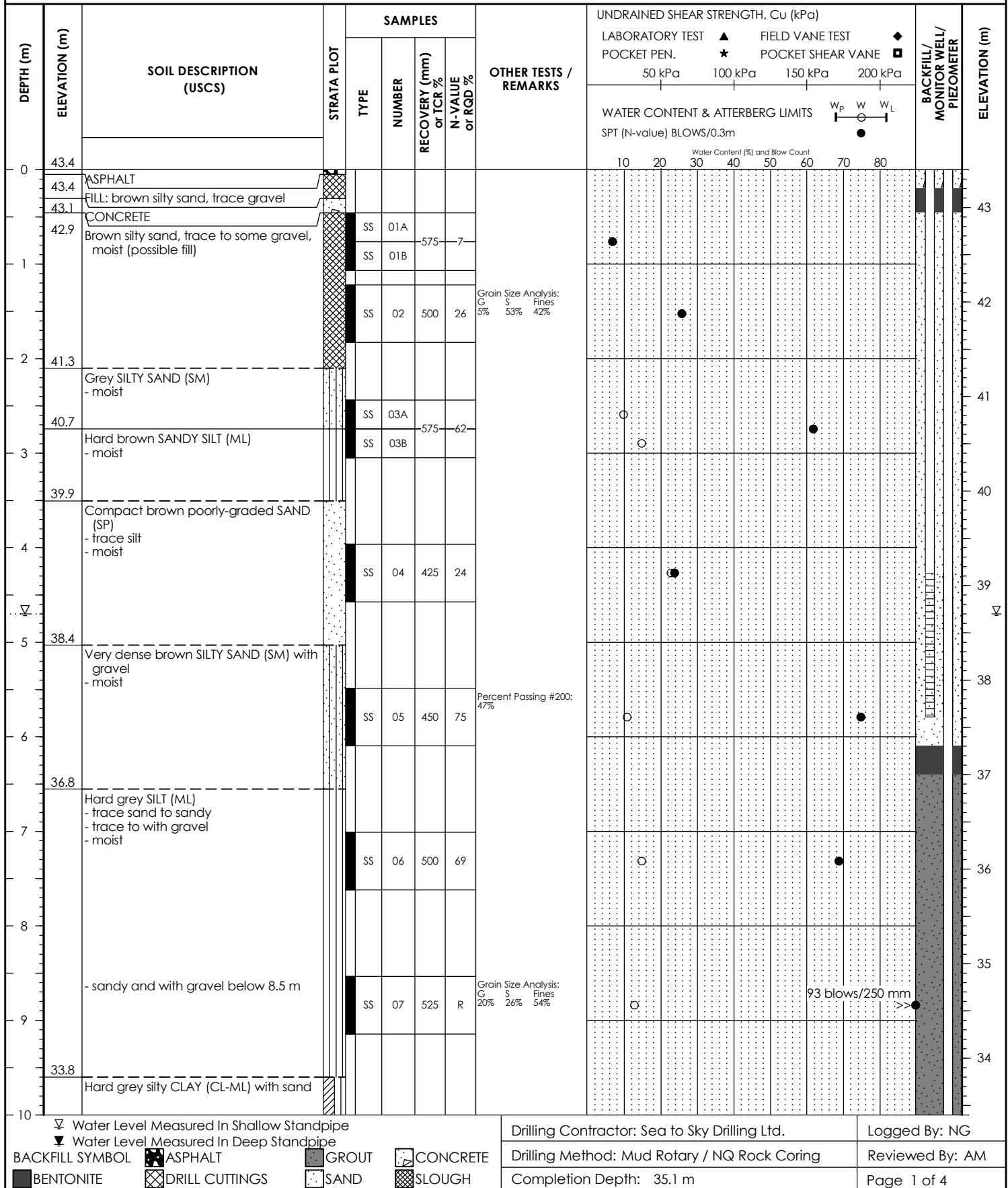
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **43.4m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458966.0N 490527.0E

DATUM: **Geodetic**DATE BORED: **August 1, 2019 to August 2, 2019**WATER LEVEL: **See Notes**



## BOREHOLE RECORD

BH19-04

CLIENT: **BC Hydro**

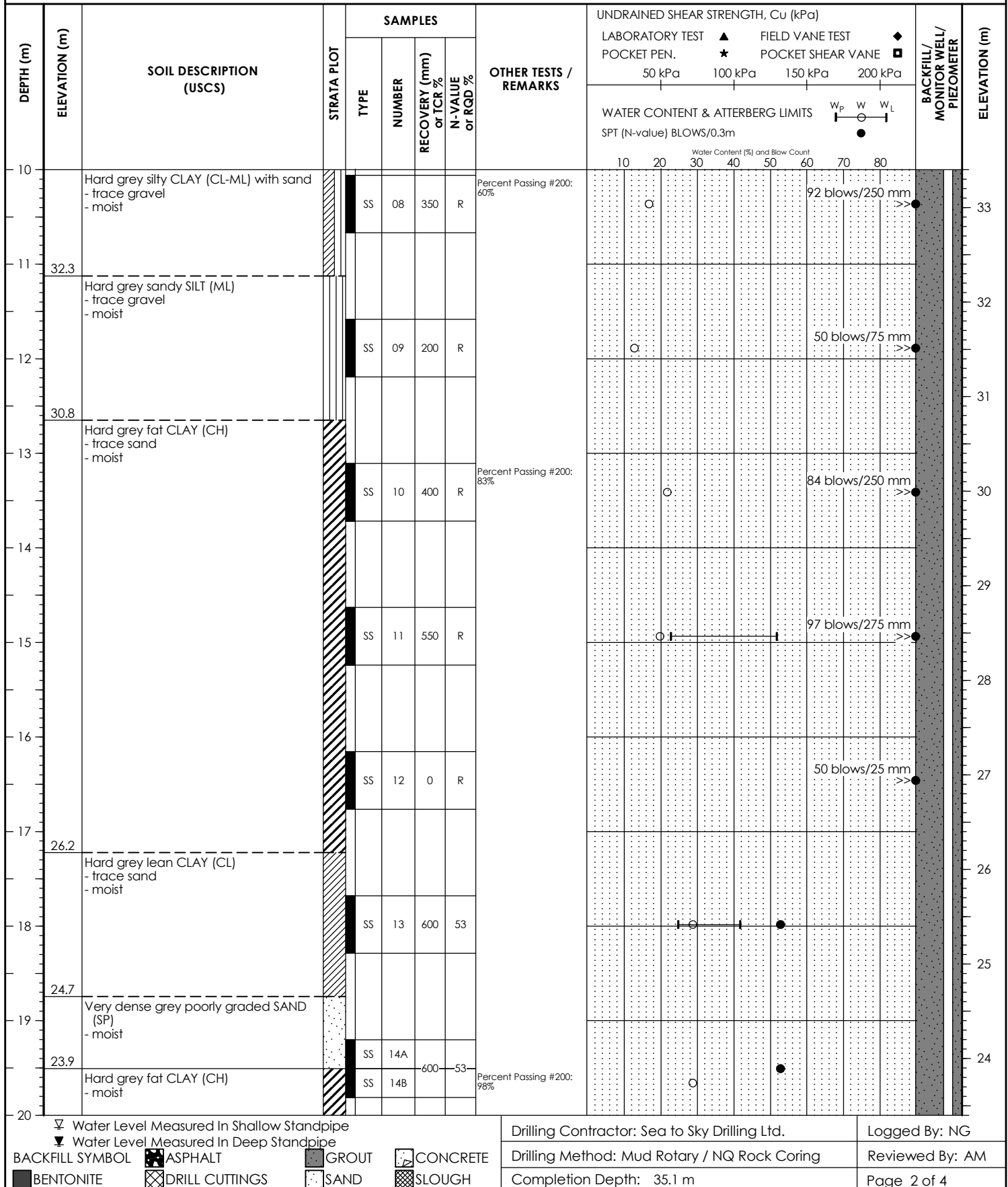
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **43.4m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458966.0N 490527.0E

DATUM: **Geodetic**DATE BORED: **August 1, 2019 to August 2, 2019**WATER LEVEL: **See Notes**



## BOREHOLE RECORD

BH19-04

CLIENT: **BC Hydro**

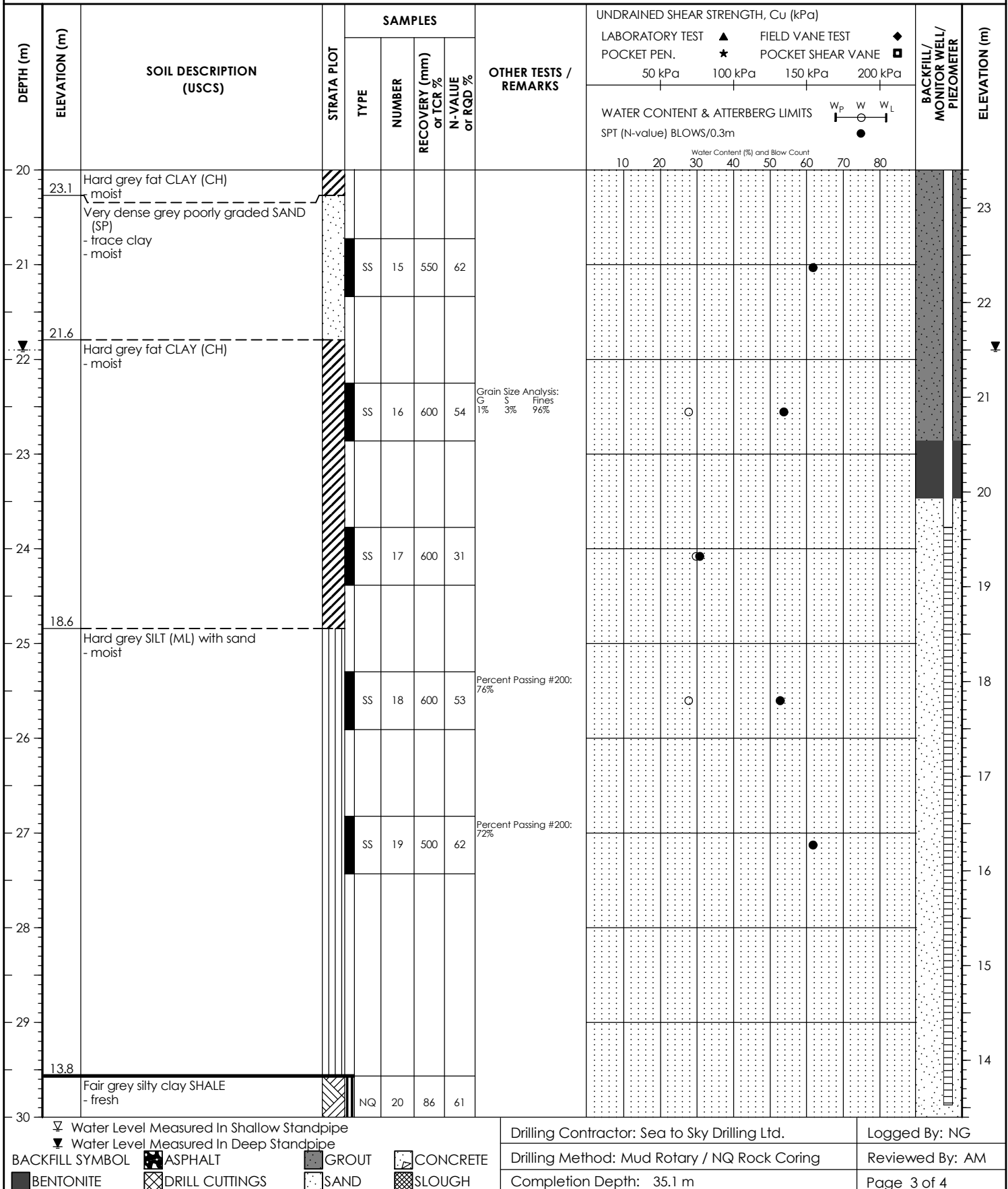
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **43.4m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458966.0N 490527.0E

DATUM: **Geodetic**DATE BORED: **August 1, 2019 to August 2, 2019**WATER LEVEL: **See Notes**





## BOREHOLE RECORD

BH19-04

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
 PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **43.4m**  
 LOCATION: **1150 Nelson Street, Vancouver, BC** 5458966.0N 490527.0E DATUM: **Geodetic**  
 DATE BORED: **August 1, 2019 to August 2, 2019** WATER LEVEL: **See Notes**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, $C_u$ (kPa)				BACKFILL / MONITOR WELL / PIEZOMETER	ELEVATION (m)	
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST POCKET PEN. 50 kPa	FIELD VANE TEST POCKET SHEAR VANE 100 kPa	150 kPa	200 kPa			
30		- extremely weak to very weak Fair grey silty clay SHALE - fresh - extremely weak to very weak		NQ	21	87	28								13
31		- extremely weak from 30.9 m to 31.0 m - slightly weathered from 31.1 m to 31.4 m - very poor quality below 31.1 m		NQ	22	95	13	Is(50), D = 0.6 MPa							12
32															11
33		- extremely weak from 32.6 m to 32.8 m		NQ	23	95	47	Is(50), D = 0.5 MPa							10
34								UCS = 31.5 MPa Is(50), D = 1.3 MPa							9
35	8.3			NQ	24	97	39	UCS = 20.4 MPa							9
35		End of borehole BH19-04 at 35.1 m. Target depth reached. Shallow and deep piezometers installed at 5.8 m and 29.9 m depth below ground surface, respectively. Water levels on August 9, 2019: - at 4.7 m depth in shallow piezometer - at 21.9 m depth in deep piezometer						Is(50), D = 1.3 MPa							8
36															7
37															6
38															5
39															4
40															

☐ Water Level Measured In Shallow Standpipe  
☒ Water Level Measured In Deep Standpipe

**BACKFILL SYMBOL**  
☒ ASPHALT   ☐ GROUT   ☐ CONCRETE  
☐ BENTONITE   ☐ DRILL CUTTINGS   ☐ SAND   ☐ SLOUGH

Drilling Contractor: Sea to Sky Drilling Ltd.

Drilling Method: Mud Rotary / NQ Rock Coring

Completion Depth: 35.1 m

Logged By: NG

Reviewed By: AM

Page 4 of 4



## BOREHOLE RECORD

BH19-05

CLIENT: **BC Hydro**

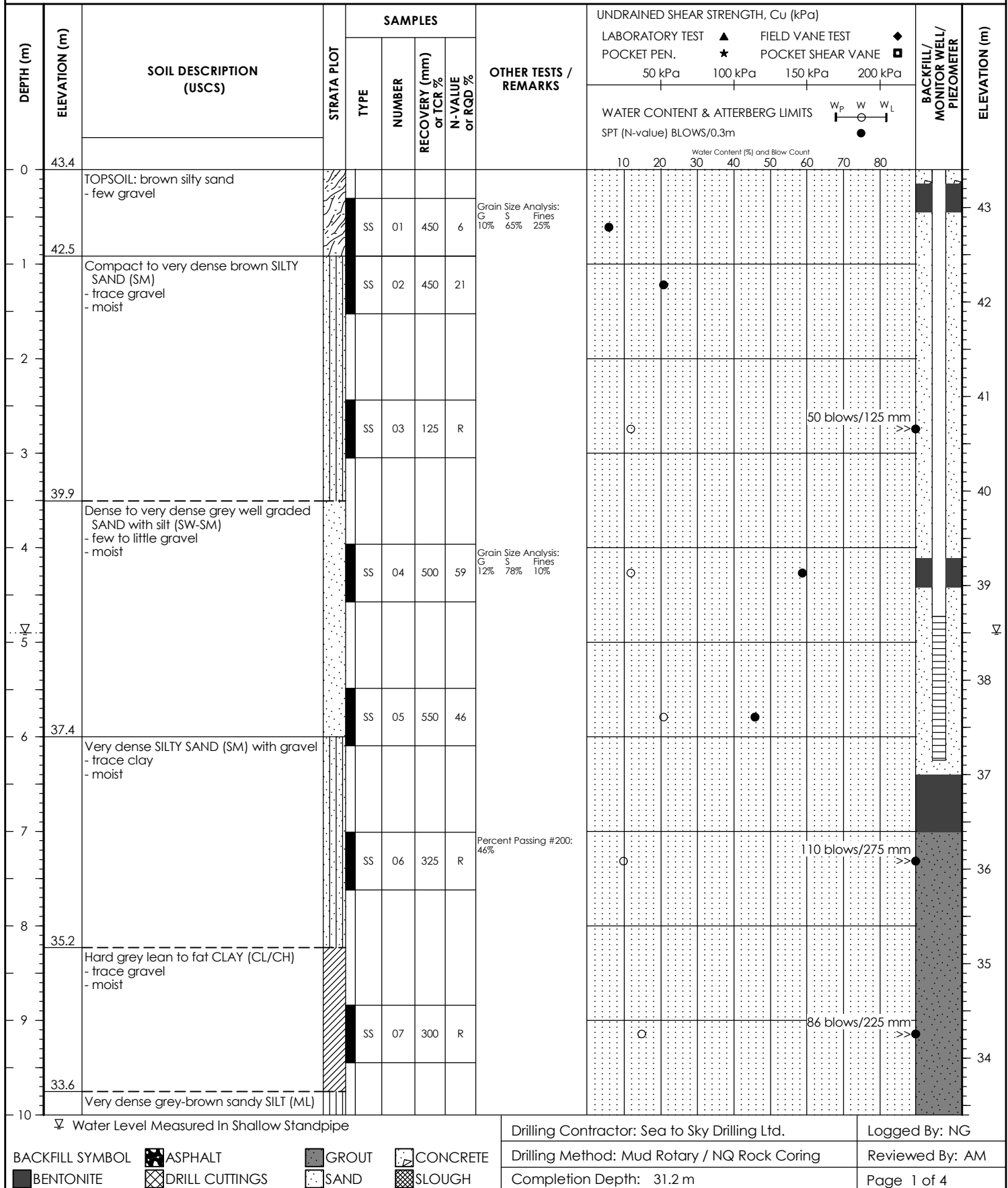
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **43.4m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458982.0N 490525.0E

DATUM: **Geodetic**DATE BORED: **August 2, 2019 to August 6, 2019**WATER LEVEL: **4.9 m depth on August 9, 2019**



## BOREHOLE RECORD

BH19-05

CLIENT: **BC Hydro**

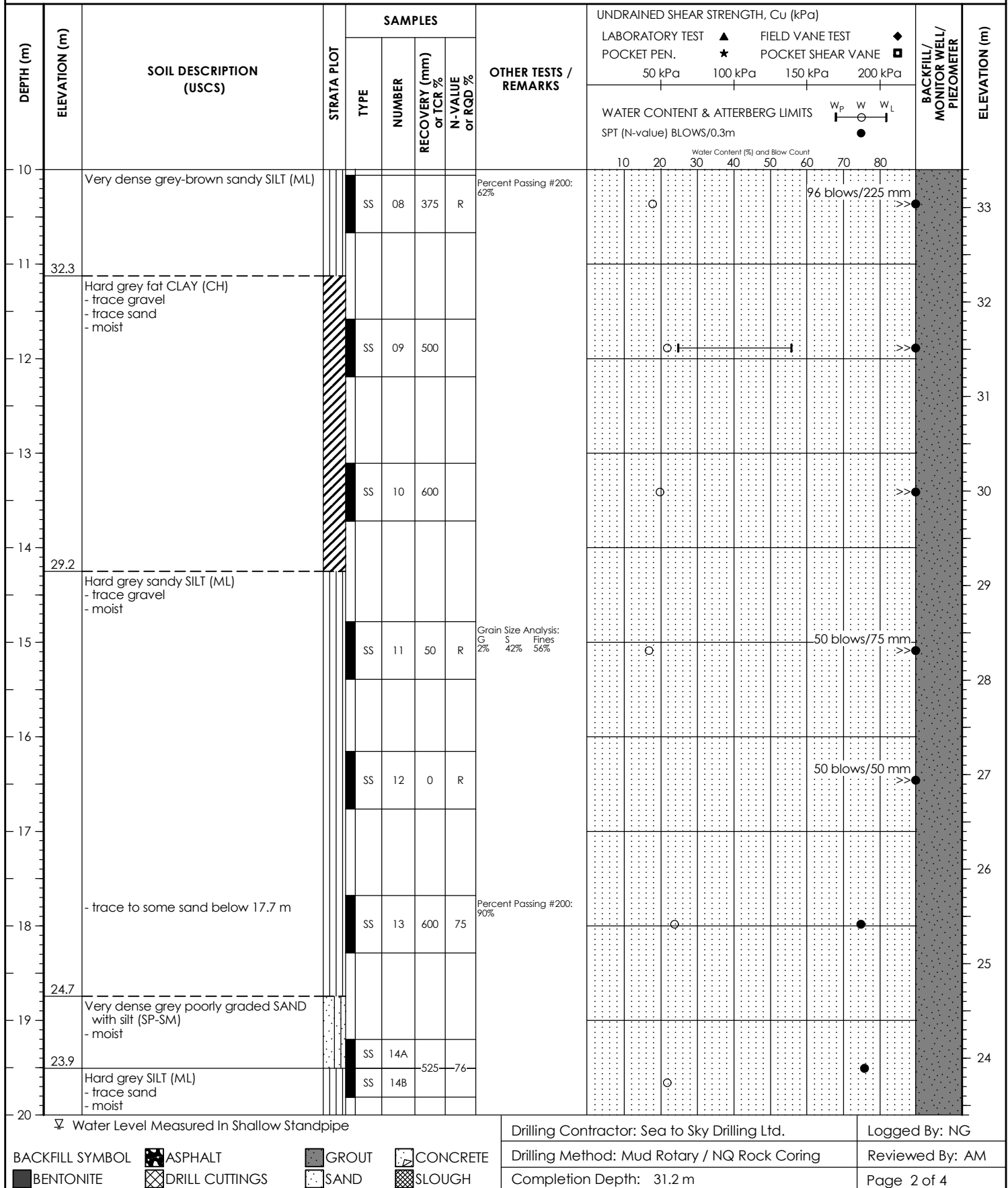
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **43.4m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458982.0N 490525.0E

DATUM: **Geodetic**DATE BORED: **August 2, 2019 to August 6, 2019**WATER LEVEL: **4.9 m depth on August 9, 2019**



## BOREHOLE RECORD

BH19-05

CLIENT: **BC Hydro**

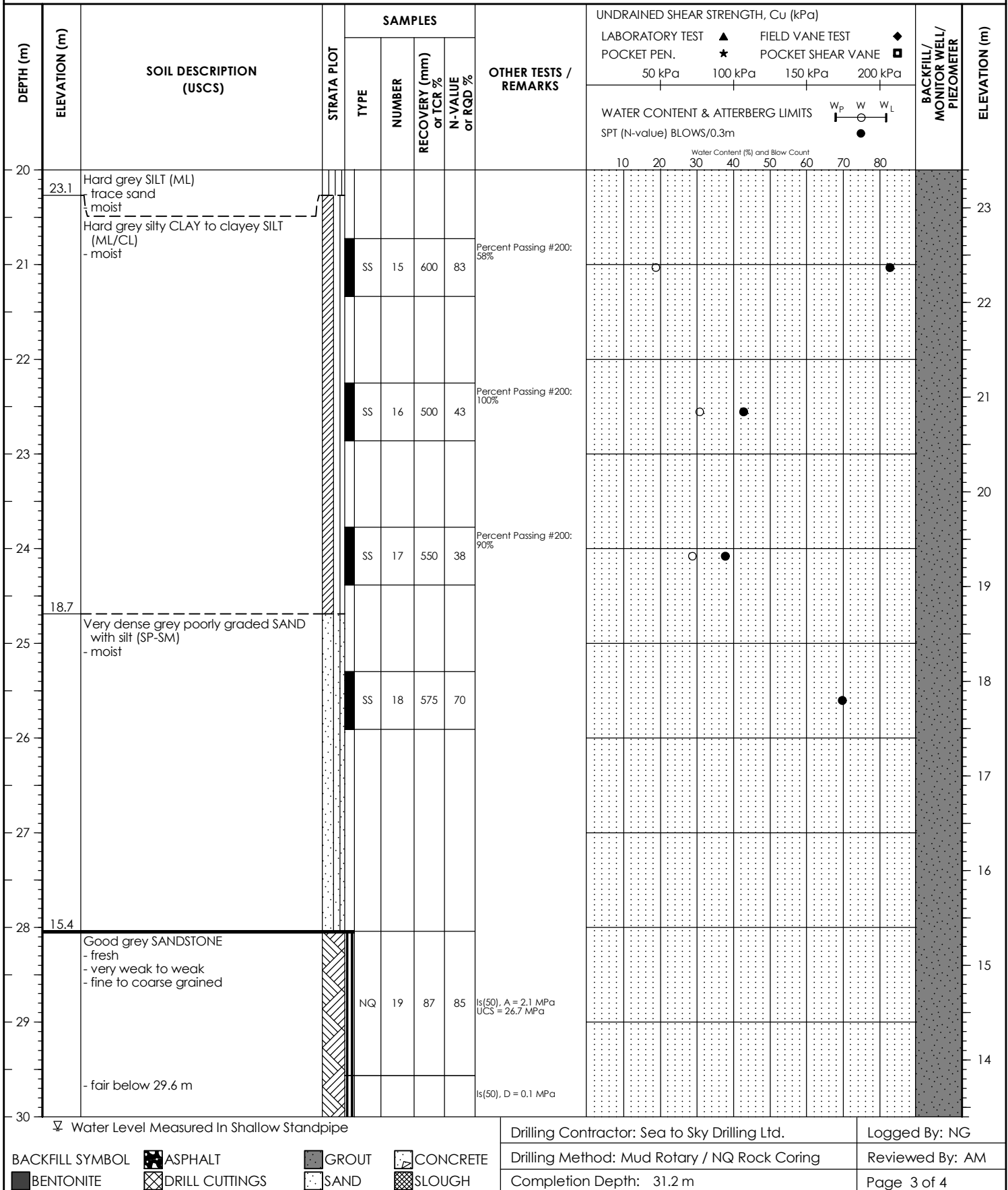
BH COORDINATES

PROJECT NO.: **123314418**PROJECT: **Underground West End Substation**

[UTM]

BH ELEVATION: **43.4m**LOCATION: **1150 Nelson Street, Vancouver, BC**

5458982.0N 490525.0E

DATUM: **Geodetic**DATE BORED: **August 2, 2019 to August 6, 2019**WATER LEVEL: **4.9 m depth on August 9, 2019**



## BOREHOLE RECORD

BH19-05

CLIENT: **BC Hydro** BH COORDINATES PROJECT NO.: **123314418**  
 PROJECT: **Underground West End Substation** [UTM] BH ELEVATION: **43.4m**  
 LOCATION: **1150 Nelson Street, Vancouver, BC** 5458982.0N 490525.0E DATUM: **Geodetic**  
 DATE BORED: **August 2, 2019 to August 6, 2019** WATER LEVEL: **4.9 m depth on August 9, 2019**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	SAMPLES				OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, $C_u$ (kPa)		BACKFILL / MONITOR WELL / PIEZOMETER	ELEVATION (m)
				TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %		LABORATORY TEST POCKET PEN. 50 kPa 100 kPa 150 kPa 200 kPa	FIELD VANE TEST POCKET SHEAR VANE		
30	13.4	Good grey SANDSTONE - fresh - very weak to weak - fine to coarse grained		NQ	20	96	70	Is(50), A = 2.2 MPa				13
31	12.2	Fair grey silty clay SHALE - fresh - very weak - excellent quality below 30.9 m		NQ	21	100	100	Is(50), D = 0.2 MPa Is(50), D = 0.5 MPa UCS = 11.0 MPa				12
32		End of borehole BH19-05 at 31.2 m. Target depth reached. Shallow piezometer installed at 6.2 m depth. Dry on August 9, 2019.										11
33												10
34												9
35												8
36												7
37												6
38												5
39												4
40												

Water Level Measured In Shallow Standpipe

Drilling Contractor: Sea to Sky Drilling Ltd.      Logged By: NG

Drilling Method: Mud Rotary / NQ Rock Coring      Reviewed By: AM

Completion Depth: 31.2 m      Page 4 of 4

## Appendix C LAB TEST RESULTS



## **C.1    LABORATORY TEST RESULTS – SOIL**





**Atterberg Limits**  
ASTM D4318  
Method A- Multi-Point

Client: BC Hydro  
Project Name: West End Underground Substa.  
Project No: 123314418  
Date Received: July 26, 2019  
Date Tested: August 22, 2019  
Tested By: HQ / WdC / JD

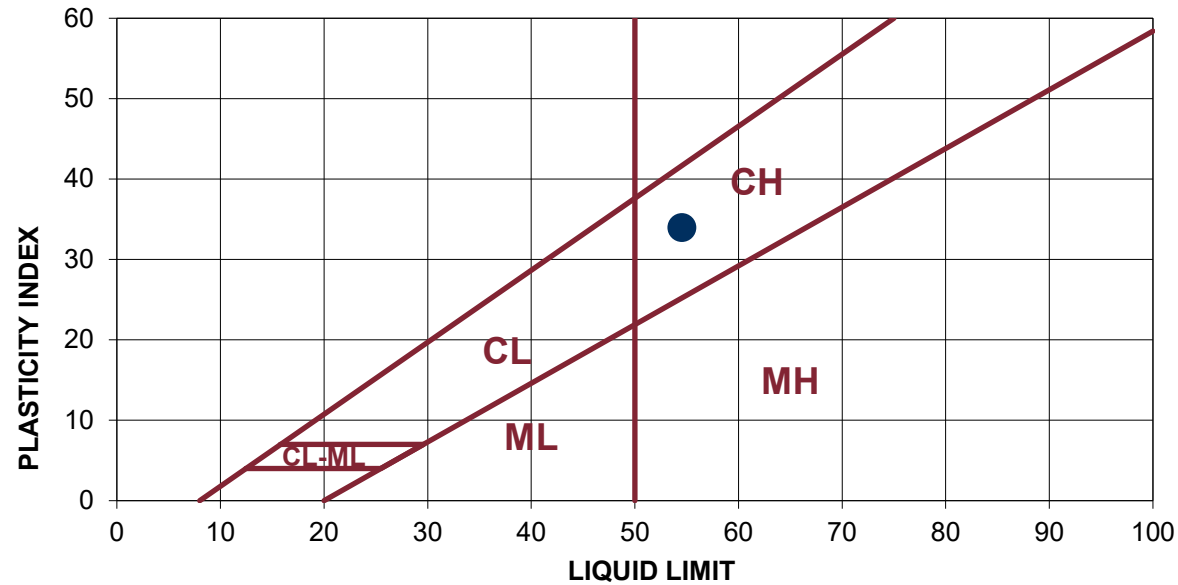
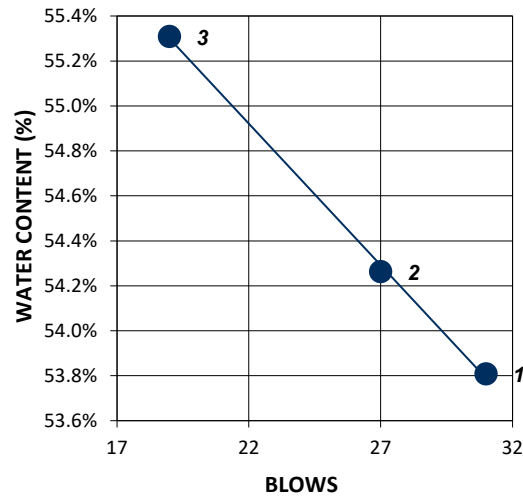
**OFFICE**  
4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

**LABORATORY**  
3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

Sample : BH19-01, SS-09, 38'-40'

LIQUID LIMIT				PLASTIC LIMIT		
Trial	1	2	3	Trial	1	2
No. of Blows	31	27	19	Tare No.		
Tare No.				Wt. Sa. (wet+tare)(g)	29.81	29.795
Wt. Sa. (wet+tare)(g)	6	7	8	Wt. Sa. (dry+tare)(g)	28.26	28.229
Wt. Sa. (dry+tare)(g)	5	5	6	Wt. Tare (g)	20.91	20.895
Wt. Tare (g)	1	1	1	Wt. Dry Soil (g)	7.4	7.3
Wt. Dry Soil (g)	3.4	3.4	4.3	Wt. Water (g)	1.6	1.6
Wt. Water (g)	1.8	1.9	2.4	Water Content (%)	21.1%	21.4%
Water Content (%)	53.8%	54.3%	55.3%			

RESULTS	
LL	55
PL	21
PI	34
Natural MC (%)	
23.0%	



Reviewed By: \_\_\_\_\_

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request. The data presented above is for the sole use of the client stipulated above. STANTEC is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of STANTEC.





**Atterberg Limits**  
ASTM D4318  
Method A- Multi-Point

Client: BC Hydro  
Project Name: West End Underground Substa.  
Project No: 123314418  
Date Received: July 26, 2019  
Date Tested: August 22, 2019  
Tested By: HQ / WdC / JD

**OFFICE**

4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

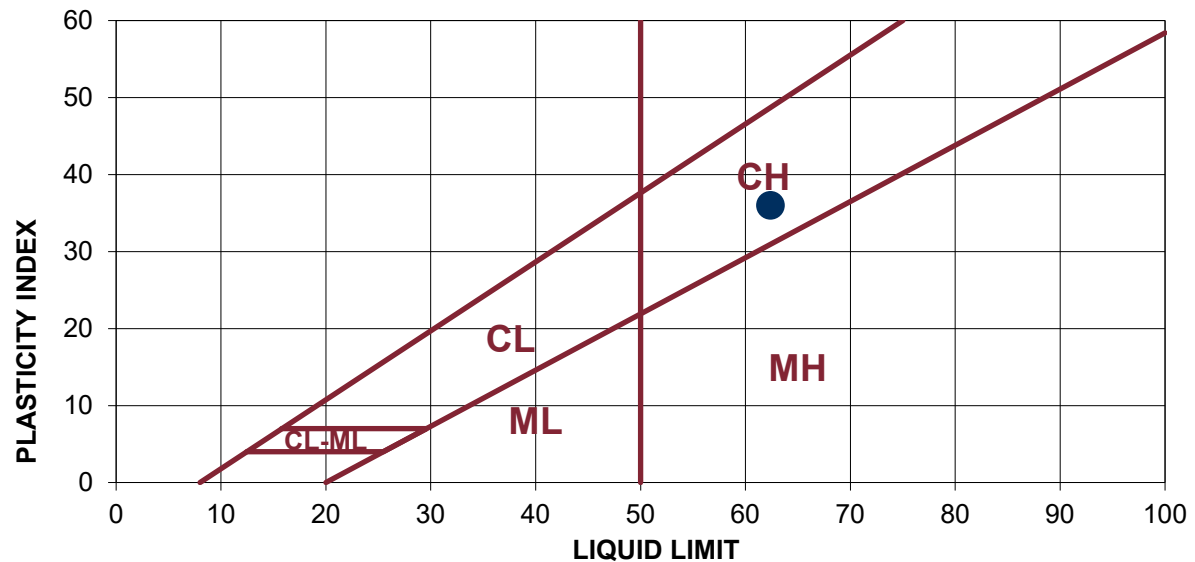
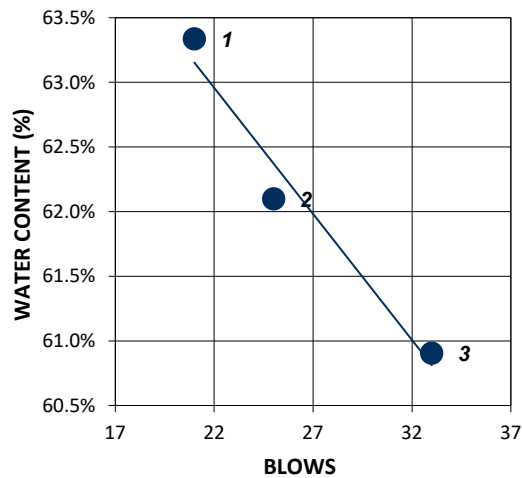
**LABORATORY**

3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

Sample : BH19-02, SS-11, 48'-50'

LIQUID LIMIT				PLASTIC LIMIT		
Trial	1	2	3	Trial	1	2
No. of Blows	21	25	33	Tare No.		
Tare No.				Wt. Sa. (wet+tare)(g)	28.02	28.561
Wt. Sa. (wet+tare)(g)	10	7	12	Wt. Sa. (dry+tare)(g)	26.54	27.025
Wt. Sa. (dry+tare)(g)	7	5	8	Wt. Tare (g)	20.93	20.895
Wt. Tare (g)	1	1	1	Wt. Dry Soil (g)	5.6	6.1
Wt. Dry Soil (g)	5.3	3.8	6.9	Wt. Water (g)	1.5	1.5
Wt. Water (g)	3.4	2.4	4.2	Water Content (%)	26.2%	25.1%
Water Content (%)	63.3%	62.1%	60.9%			

RESULTS	
LL	62
PL	26
PI	36
Natural MC (%)	
25.6%	



Reviewed By: \_\_\_\_\_

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**Atterberg Limits**  
ASTM D4318  
Method A- Multi-Point

Client: BC Hydro  
Project Name: West End Underground Substa.  
Project No: 123314418  
Date Received: July 26, 2019  
Date Tested: August 22, 2019  
Tested By: HQ / WdC / JD

**OFFICE**

4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

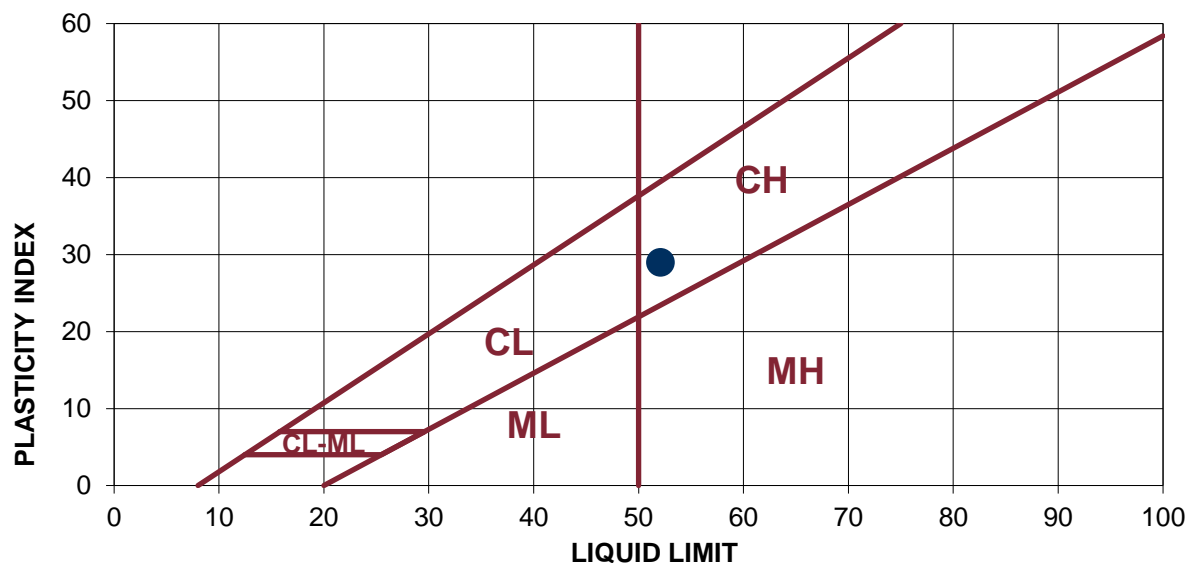
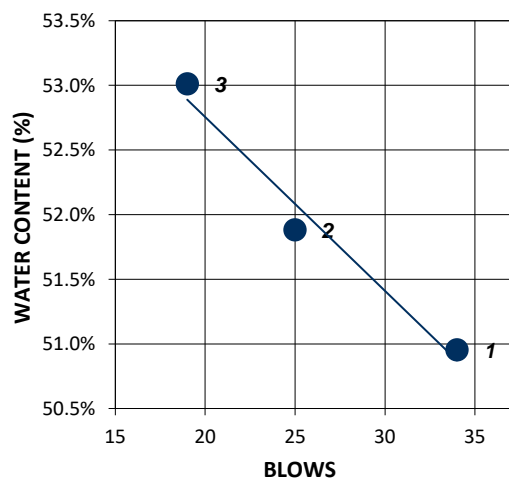
**LABORATORY**

3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

Sample : BH19-04, SS-11, 48'-50'

LIQUID LIMIT				PLASTIC LIMIT		
Trial	1	2	3	Trial	1	2
No. of Blows	34	25	19	Tare No.		
Tare No.				Wt. Sa. (wet+tare)(g)	26.62	30.446
Wt. Sa. (wet+tare)(g)	7	7	8	Wt. Sa. (dry+tare)(g)	25.57	28.64
Wt. Sa. (dry+tare)(g)	5	5	6	Wt. Tare (g)	20.92	20.838
Wt. Tare (g)	1	1	1	Wt. Dry Soil (g)	4.7	7.8
Wt. Dry Soil (g)	4.0	3.5	4.5	Wt. Water (g)	1.0	1.8
Wt. Water (g)	2.0	1.8	2.4	Water Content (%)	22.4%	23.1%
Water Content (%)	51.0%	51.9%	53.0%			

RESULTS	
LL	52
PL	23
PI	29
Natural MC (%)	
20.3%	



Reviewed By: \_\_\_\_\_

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**Atterberg Limits**  
ASTM D4318  
Method A- Multi-Point

Client: BC Hydro  
Project Name: West End Underground Substa.  
Project No: 123314418  
Date Received: July 26, 2019  
Date Tested: August 22, 2019  
Tested By: HQ / WdC / JD

**OFFICE**

4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

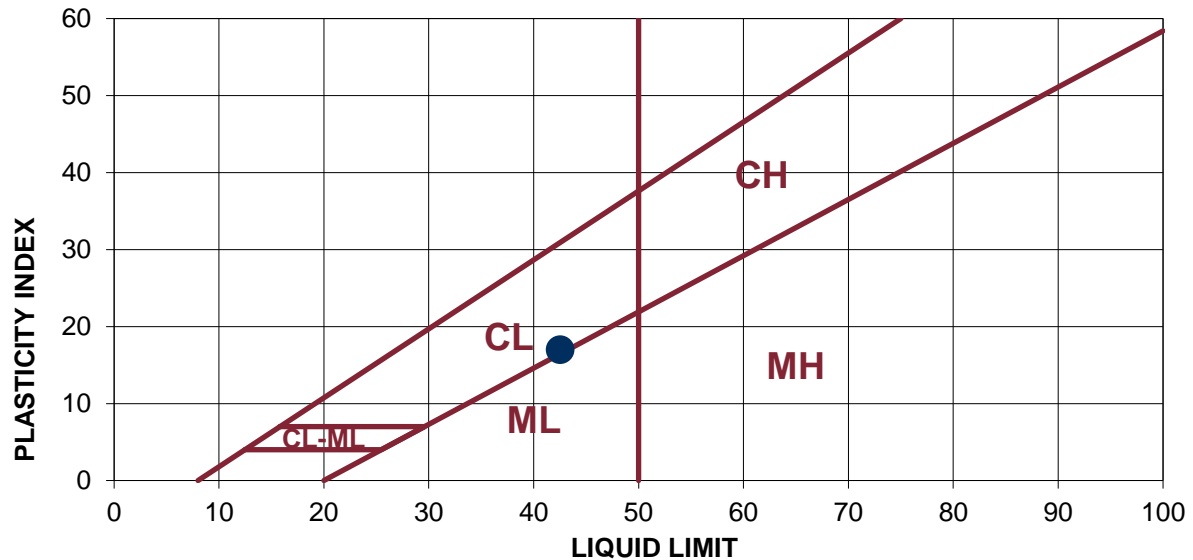
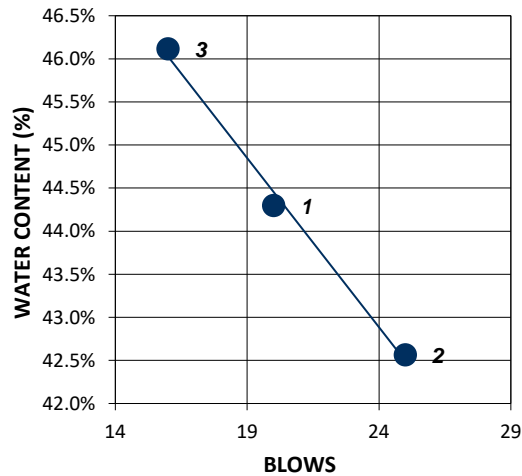
**LABORATORY**

3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

Sample : BH19-04, SS-13, 58'-60'

LIQUID LIMIT				PLASTIC LIMIT		
Trial	1	2	3	Trial	1	2
No. of Blows	20	25	16	Tare No.		
Tare No.				Wt. Sa. (wet+tare)(g)	29.18	27.9
Wt. Sa. (wet+tare)(g)	11	12	8	Wt. Sa. (dry+tare)(g)	27.52	26.486
Wt. Sa. (dry+tare)(g)	8	9	6	Wt. Tare (g)	21.01	20.873
Wt. Tare (g)	1	1	1	Wt. Dry Soil (g)	6.5	5.6
Wt. Dry Soil (g)	6.6	7.6	4.8	Wt. Water (g)	1.7	1.4
Wt. Water (g)	2.9	3.2	2.2	Water Content (%)	25.4%	25.2%
Water Content (%)	44.3%	42.6%	46.1%			

RESULTS	
LL	42
PL	25
PI	17
Natural MC (%)	
28.9%	



Reviewed By: \_\_\_\_\_

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**Atterberg Limits**  
ASTM D4318  
Method A- Multi-Point

Client: BC Hydro  
Project Name: West End Underground Substa.  
Project No: 123314418  
Date Received: July 26, 2019  
Date Tested: August 22, 2019  
Tested By: HQ / WdC / JD

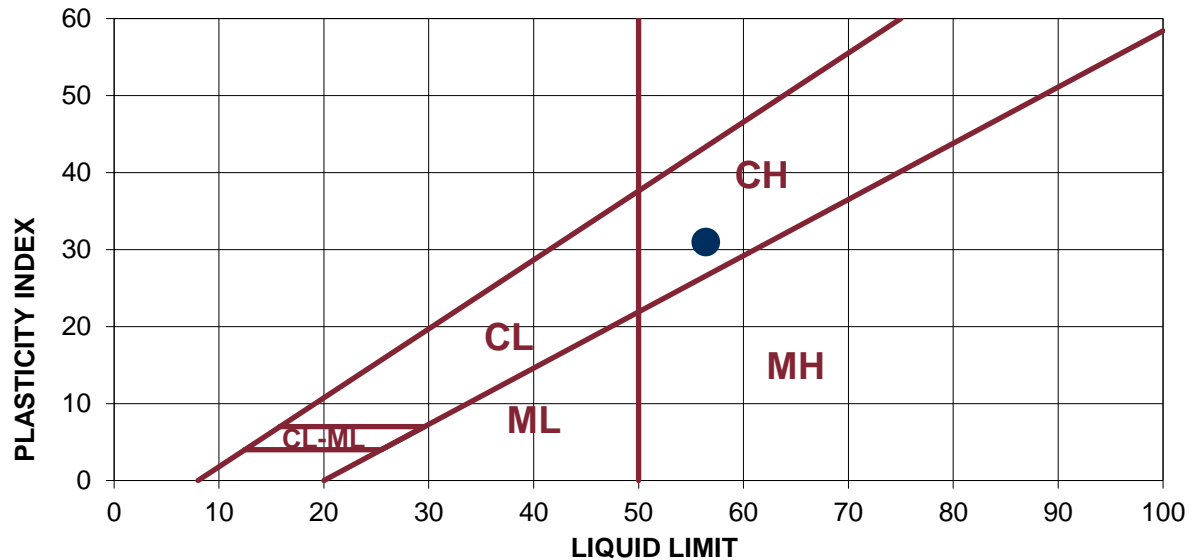
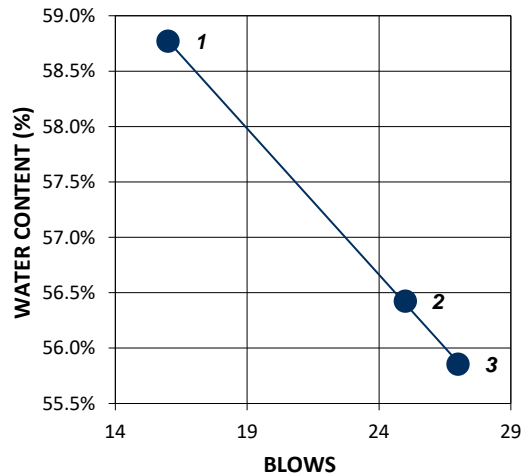
**OFFICE**  
4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

**LABORATORY**  
3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

Sample : BH19-05, SS-09, 38'-40'

LIQUID LIMIT				PLASTIC LIMIT		
Trial	1	2	3	Trial	1	2
No. of Blows	16	25	27	Tare No.		
Tare No.				Wt. Sa. (wet+tare)(g)	27.67	29.24
Wt. Sa. (wet+tare)(g)	9	7	11	Wt. Sa. (dry+tare)(g)	26.35	27.601
Wt. Sa. (dry+tare)(g)	6	5	8	Wt. Tare (g)	20.95	21.055
Wt. Tare (g)	1	1	1	Wt. Dry Soil (g)	5.4	6.5
Wt. Dry Soil (g)	5.1	3.9	6.4	Wt. Water (g)	1.3	1.6
Wt. Water (g)	3.0	2.2	3.6	Water Content (%)	24.3%	25.0%
Water Content (%)	58.8%	56.4%	55.9%			

RESULTS	
LL	56
PL	25
PI	31
Natural MC (%)	
49.5%	



Reviewed By: \_\_\_\_\_



# Grain Size Analysis

ASTM C136, ASTM C117

Client: BC Hydro  
Project Name: West End Underground Substa.

Project No: 123314418

## OFFICE

4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

## LABORATORY

3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

SAMPLE No.: BH19-01, SS-07, 28'-30'

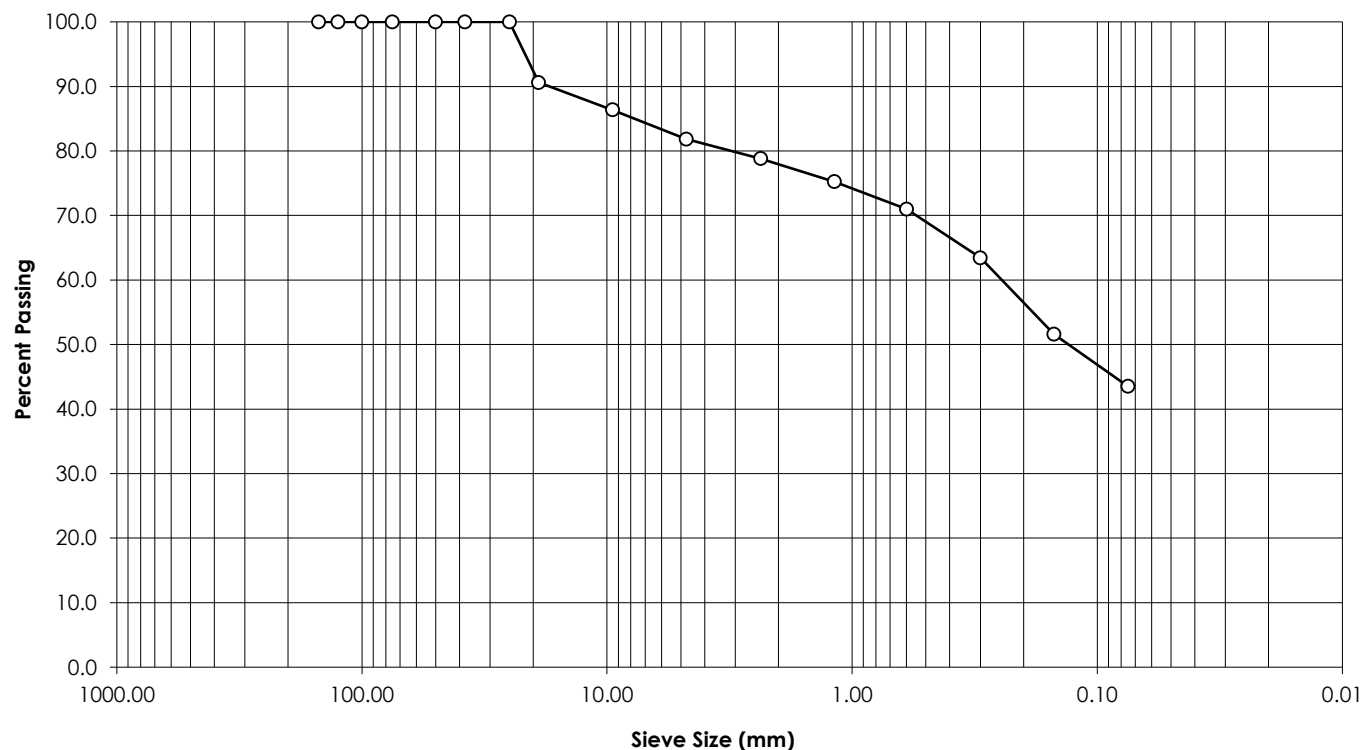
SOURCE: 1150 Nelson ST.

TESTED BY: HQ / WdC

DATE RECEIVED: July 25, 2019

DATE TESTED: August 21, 2019

SAMPLE DESCRIPTION: Gray, silty SAND with gravel, (SM)



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	-	-	-
125.0	-	-	-
100.0	-	-	-
75.0	-	-	-
50.0	-	-	-
38.0	-	-	-
25.0	100.0	-	-
19.0	90.6	-	-
16.0	-	-	-
12.5	-	-	-
9.5	86.4	-	-
4.75	81.8	-	-
2.36	78.8	-	-
1.18	75.2	-	-
0.600	71.0	-	-
0.300	63.4	-	-
0.150	51.6	-	-
0.075	43.5	-	-
Cobble: 0.0%		D <sub>10</sub> : -	
Gravel: 18.2%		D <sub>30</sub> : -	
Sand: 38.3%		D <sub>60</sub> : 0.2597	
Fines: 43.5%		C <sub>u</sub> : -	
		C <sub>c</sub> : -	

## Comments:

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Reviewed by:



# Grain Size Analysis

ASTM C136, ASTM C117

Client: BC Hydro  
Project Name: West End Underground Substa.

Project No: 123314418

## OFFICE

4730 Kingsway  
Suite 500  
Burnaby, BC  
Canada V5H 0C6  
Tel: (604) 436-3014

## LABORATORY

3711 North Fraser Way  
Suite 400  
Burnaby, BC  
Canada V5J 5J2  
Tel: (604) 436-3014

SAMPLE No.: BH19-01, SS-14, 63.0'-65.0'

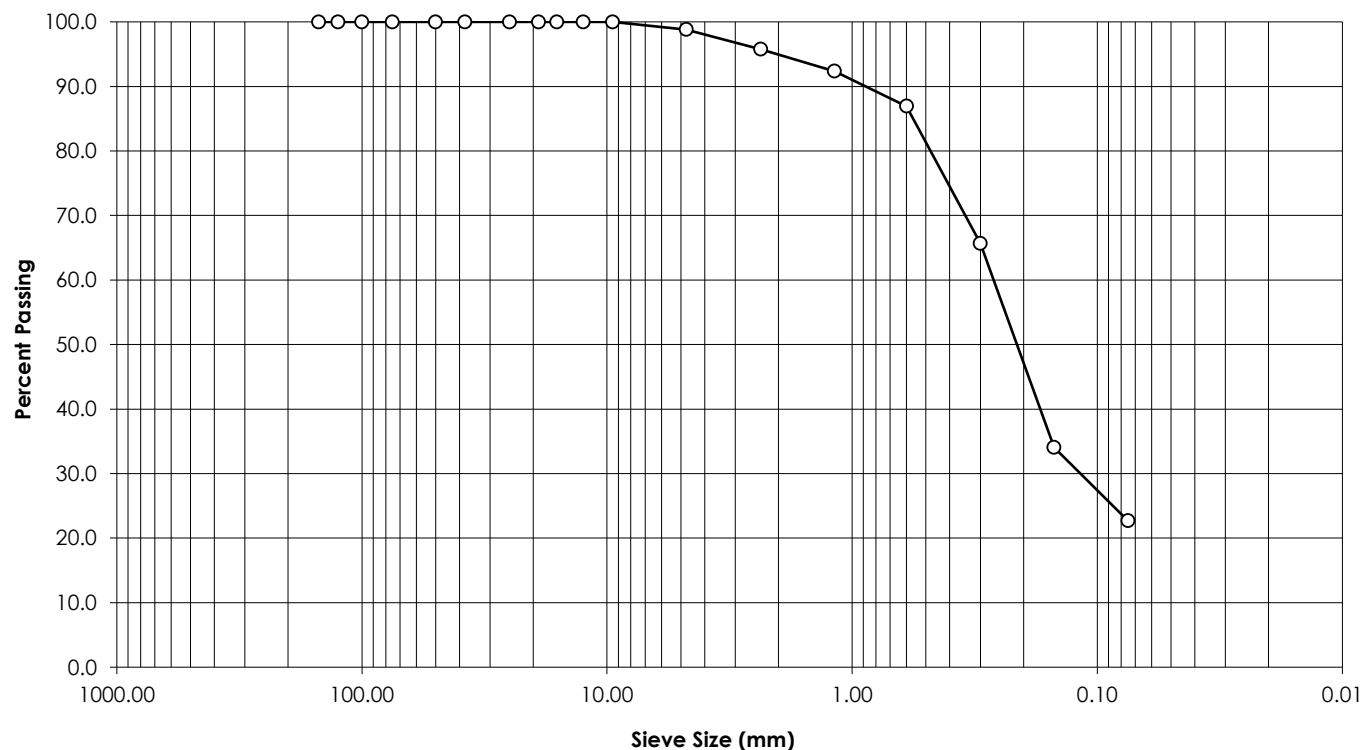
SOURCE: 1150 Nelson ST.

TESTED BY: HQ / WdC

DATE RECEIVED: July 25, 2019

DATE TESTED: August 23, 2019

SAMPLE DESCRIPTION: Gray, silty SAND, (SM)



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	-	-	-
125.0	-	-	-
100.0	-	-	-
75.0	-	-	-
50.0	-	-	-
38.0	-	-	-
25.0	-	-	-
19.0	-	-	-
16.0	-	-	-
12.5	-	-	-
9.5	100.0	-	-
4.75	98.8	-	-
2.36	95.7	-	-
1.18	92.4	-	-
0.600	86.9	-	-
0.300	65.6	-	-
0.150	34.1	-	-
0.075	22.7	-	-
Cobble: 0.0%		D <sub>10</sub> : -	
Gravel: 1.2%		D <sub>30</sub> : 0.1266	
Sand: 76.1%		D <sub>60</sub> : 0.2794	
Fines: 22.7%		C <sub>u</sub> : -	
		C <sub>c</sub> : -	

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Reviewed by:



# Grain Size Analysis

ASTM C136, ASTM C117

Client: BC Hydro  
Project Name: West End Underground Substa.

Project No: 123314418

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## LABORATORY

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Tel: (604) 436-3014

SAMPLE No.: BH19-01, SS-17, 78.0'-80.0'

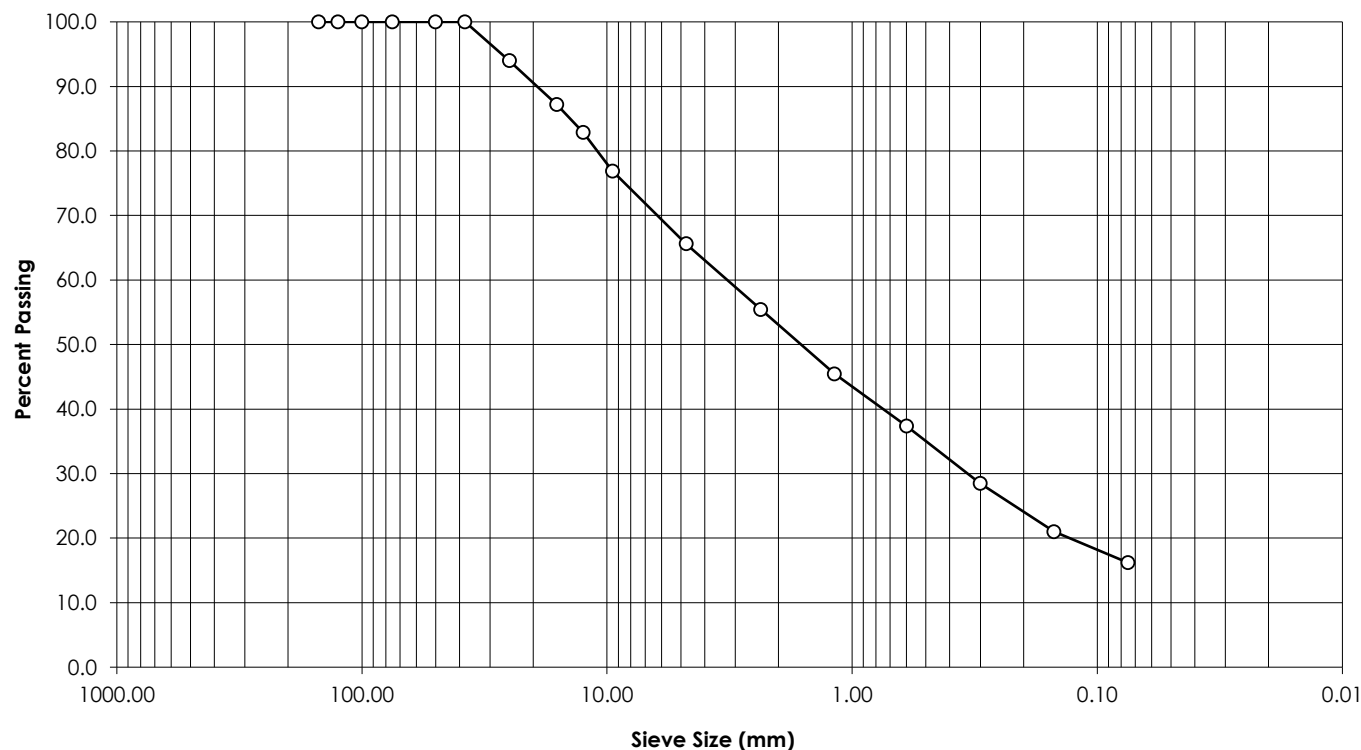
SOURCE: 1150 Nelson ST.

TESTED BY: HQ / WdC

DATE RECEIVED: July 25, 2019

DATE TESTED: August 23, 2019

SAMPLE DESCRIPTION: Gray, silty SAND with gravel, (SM)



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	-	-	-
125.0	-	-	-
100.0	-	-	-
75.0	-	-	-
50.0	-	-	-
38.0	100.0	-	-
25.0	94.0	-	-
19.0	-	-	-
16.0	87.2	-	-
12.5	82.8	-	-
9.5	76.9	-	-
4.75	65.6	-	-
2.36	55.4	-	-
1.18	45.4	-	-
0.600	37.4	-	-
0.300	28.5	-	-
0.150	21.0	-	-
0.075	16.2	-	-
Cobble: 0.0%		D <sub>10</sub> : -	
Gravel: 34.4%		D <sub>30</sub> : 0.3579	
Sand: 49.4%		D <sub>60</sub> : 3.4864	
Fines: 16.2%		C <sub>u</sub> : -	
		C <sub>c</sub> : -	

## Comments:

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Reviewed by:



# Grain Size Analysis

ASTM C136, ASTM C117

Client: BC Hydro  
Project Name: West End Underground Substa.

Project No: 123314418

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Canada V5J 5J2  
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SAMPLE No.: BH19-02, SS-07, 28.0'-30.0'

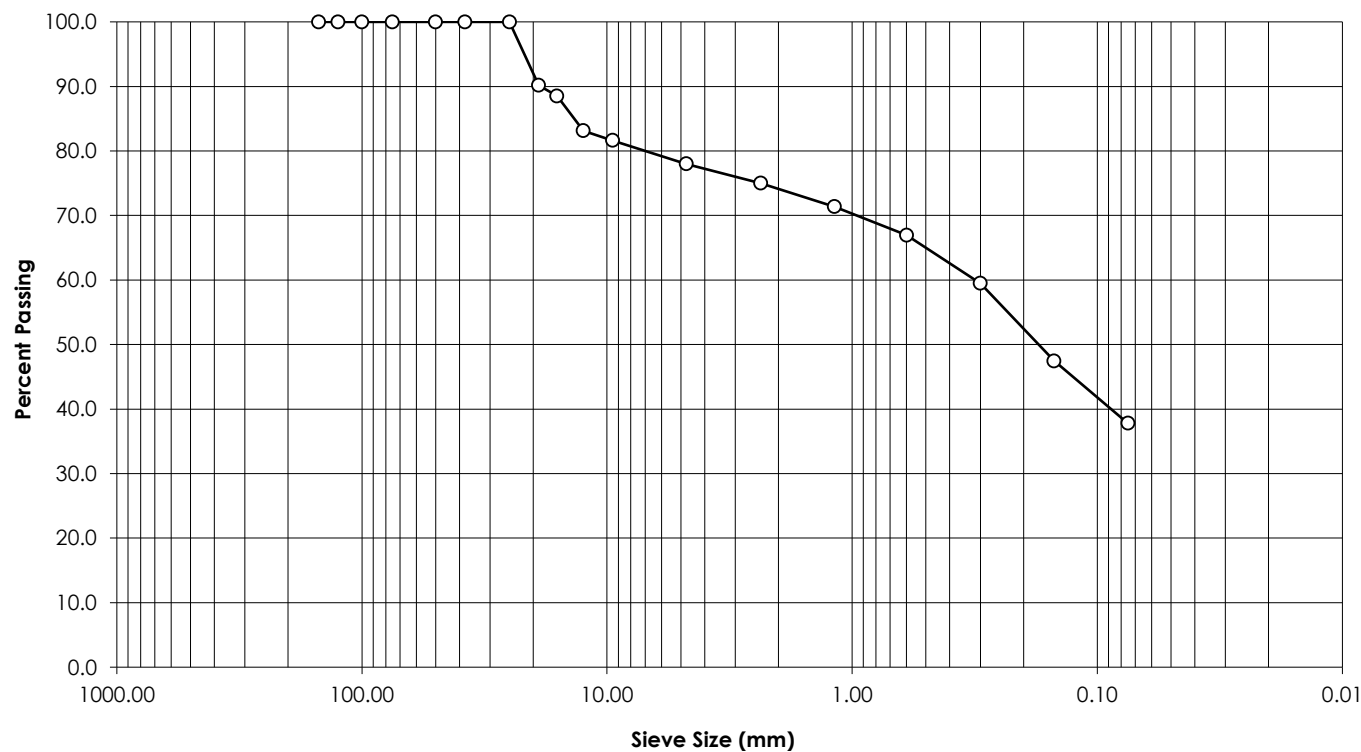
SOURCE: 1150 Nelson ST.

TESTED BY: HQ / WdC

DATE RECEIVED: July 25, 2019

DATE TESTED: August 23, 2019

SAMPLE DESCRIPTION: Gray, silty SAND with gravel, (SM)



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	-	-	-
125.0	-	-	-
100.0	-	-	-
75.0	-	-	-
50.0	-	-	-
38.0	-	-	-
25.0	100.0	-	-
19.0	90.1	-	-
16.0	88.5	-	-
12.5	83.1	-	-
9.5	81.6	-	-
4.75	78.0	-	-
2.36	75.0	-	-
1.18	71.3	-	-
0.600	67.0	-	-
0.300	59.5	-	-
0.150	47.5	-	-
0.075	37.8	-	-
Cobble: 0.0%		D <sub>10</sub> : -	
Gravel: 22.0%		D <sub>30</sub> : -	
Sand: 40.2%		D <sub>60</sub> : 0.3220	
Fines: 37.8%		C <sub>u</sub> : -	
		C <sub>c</sub> : -	

## Comments:

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