Appendix A

Geotechnical Data Report

Environmental Health Centre
(EHC) Building Demolition
50 Colombine Driveway,
Ottawa, ON

Prepared for:
Public Works and Government Services Canada (PWGSC)
11 Laurier Street, Phase III, Place du Portage
Gatineau, QC K1A 0S5

Prepared by:
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Project No. 122411146

Contract No. EP076-161096
PWGSC Project No. R.069710.004

February 2016

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Stantec consulting Ltd. (Stantec)to provide geotechnical engineering services for the proposed demolition of the Environmental Health Centre (EHC) Building located at 50 Colombine Driveway in Ottawa, ON.

Limitations associated with this report and its contents are provided in the statement of conditions included in Appendix A.

1.1 SCOPE OF WORK

The work has been carried out in accordance with the PWGSC Terms of Reference dated July 31, 2015 (R.069710.004). The scope of work for this geotechnical investigation included the following:

- Advance boreholes along the EHC building limits to refusal on bedrock.
- Perform laboratory tests including moisture content and grain size analysis on selected soil samples.
- Prepare a geotechnical investigation report that summarizes the results of the field investigation and laboratory tests for the proposed demolition of EHC building.

1.2 BACKGROUND

The following historical information was reviewed as part of the investigation:

- Boring report No. 2324 from Subsurface investigation for National Health and Welfare Headquarters Building, Tunney's Pasture, Ottawa, Ontario, dated September 1960.
- Detail of boring, Public Works of Canada, Environmental Health Centre, Ottawa, Ontario, Plan No. 2130 dated October 1957.
- Golder Associates investigation titled, "Geotechnical Site Characterization Tunny's Pasture Complex, Ottawa, Ontario" dated November 2009.
- Supplemental Phase III ESA – Tunney's Environmental Health Centre Building #8 DFRP#50064, Version 4 by Arcadis, dated January 6, 2016.

The borehole locations from the historical information (the first two documents mentioned above) are shown on the Borehole Location Plan, Drawing No. 2 in Appendix B and the borehole records are provided in Appendix C.

Based on Detail of boring, Public Works of Canada, Plan No. 2130, the overburden soils are mostly comprised of sand, gravel, stones and silt underlain by the limestone bedrock. Boring report No. 2324 indicated that the overburden soil are comprised mostly of boulders underlain by a dark grey, fine to medium grain limestone with closely spaced, irregular shaped, thin films of black shale.

Natural Resources Canada on-line geological mapping indicates that the surficial material at the site consists of till underlain by limestone bedrock interbedded of the Bobcaygeon Formation. Mapping suggests the depth to bedrock is approximately 0 to 3 m below ground surface. Note that according to the borehole records from Detail of Boring, Public Works of Canada, Plan No. 2130, it is anticipated that depth to bedrock is shallow and varies from 0.2 m North East to 2.4 m North West of EHC building. A summary of bedrock elevations obtained from the above mentioned reference is provided in Table 1.1.

Table 1.1: Summary of Bedrock Elevations and Depths

BH	Bedrock Elevations (ft)	Geodetic Elevations (ft) *	Geodetic Elevations (m)	Bedrock Depth (m)
1	68.3	190.27	57.9	1.5
2	69.4	191.37	58.3	0.8
3	67.0	188.97	57.6	1.7
4	67.6	189.57	57.8	0.2
5	66.5	188.47	57.4	2.4
*To obtain Geodetic Datum, 121.97 ft, is added to each elevation (see Public Works of Canada Drawing Plan 2130 Ottawa, Ont., Environmental Health Centre)				

A summary of the groundwater level elevations and depths from Public Works Canada's investigation 1957 (see Detail of boring, Public Works of Canada, Environmental Health Centre, Ottawa, Ontario, Plan 2130) and Arcadis Supplemental Phase III ESA – Tunney's Environmental Health Centre Building #8 DFRP #50064, Version 4, January 6, 2016 is provided in Table 1.2.

Table 1.2: Summary of Ground Water Level Elevations and Depths

BH	Ground water Elevations (ft)	Geodetic Elevations (ft) *	Geodetic Elevations (m)	Ground Water Depth (m)
1	63.7	185.67	56.6	2.9
2	67.0	188.97	57.6	1.5
3	66.0	187.97	57.3	1.9
4	62.6	185.57	56.6	1.7
5	-	-	-	-
*To obtain Geodetic Datum, 121.97 ft, is added to each elevation (see Public Works of Canada Drawing Plan 2130 Ottawa, Ont., Environmental Health Centre)				

MW	Ground Surface Elevation (m)	Water Level Elevation (m)
15-1	58.94	57.45
15-2	58.86	57.69
15-3	59.03	57.74
15-4	60.20	57.47
15-5	59.64	58.26

According to Golder Associates investigation (2009) titled, "Geotechnical Site Characterization

Tunny's Pasture Complex, Ottawa, Ontario" the ground water level may be about 2 to 3 meter below ground surface and for the most part coincides with the overburden bedrock contact.

2.0 INVESTIGATION PROCEDURES

2.1 FIELD INVESTIGATION

The field drilling program was carried out on November 16, 2015. Four (4) boreholes were advanced at the approximate location shown on Drawing No. 2 in Appendix B.

The boreholes were drilled with a track mount drill rig. The subsurface stratigraphy encountered in each borehole was recorded in the field by experienced Stantec personnel while performing Standard Penetration Tests (SPT). Split-spoon samples were collected at regular and continuous depth intervals in the boreholes. All recovered soil samples were stored in moisture-proof bags. All samples were transported to the Stantec Ottawa laboratory for detailed geotechnical classification and testing.

One (1) Monitoring well (MW) was installed in BH15-1 to allow for long term monitoring of groundwater levels. The monitoring well consisted of 50 mm diameter rigid pipes with 1.5 m long screened portion installed at the bottom of the borehole. The monitoring well was backfilled with filter sand up to approximately 0.6 m above the slotted screen section. The remaining portion of the borehole annulus was backfilled with hole-plug seal and auger cuttings. The monitoring well was secured using protective casing and cover. The remaining boreholes without well installations were backfilled with a mixture of auger cuttings and bentonite to match the existing stratigraphy.

Note that at BH15-4, auger refusal occurred from an obstruction at a shallow depth of 0.3 m. The second attempt (BH15-4b) was advanced in the close vicinity of BH15-4 as shown on Drawing No. 2 borehole location plan.

2.2 SURVEY

The ground surface elevation at each borehole was surveyed using a Trimble GPS unit with decimeter accuracy. The instrument's accuracy may be affected by satellite coverage at the time of the survey. Note that at BH15-4 and BH15-4b the GPS unit had inadequate satellite coverage, the ground surface elevations are estimated from Demolition Site Plan drawing, A100. Geodetic elevations at the borehole location are shown on the Borehole Record in Appendix C.

2.3 LABORATORY TESTING

All samples returned to the laboratory were subjected to detailed visual examination and additional classification by a geotechnical engineer. Moisture content determination was undertaken on all recovered samples. Grain size analysis was conducted on selected soil samples.

The results of the laboratory tests are discussed in the text of this report and are provided on the Borehole (BH) Records in Appendix C and the figures included in the laboratory test results in Appendix D.

Soil samples will be stored for twelve (12) months after the issuance of the final report unless otherwise directed by the client.

3.0 RESULTS OF INVESTIGATION

Detailed descriptions of subsurface conditions encountered during site investigation at BH15-1, BH15-2, BH15-3, and BH15-4, 4b are presented on the Borehole records provided in Appendix C. An explanation of symbols and terms used to describe the borehole records is also provided. Borehole locations are provided on Drawing No. 2 in Appendix B.

Generally the subsurface conditions encountered within the boreholes BH15-1 to BH15-4 consisted of topsoil and granular fill overlying a dense glacial till and/or inferred bedrock. Frequent cobbles and boulders were inferred in the fill.

A brief description of the underlying soils encountered in the boreholes is provided below.

3.1 SURFICIAL MATERIALS

3.1.1 Topsoil

A layer of dark brown topsoil with sand and gravel was observed in all boreholes with a thickness of approximately 500 mm.

3.1.2 Fill

Fill was encountered in all boreholes beneath the topsoil. The fill extended to depths ranging from 0.9 to 3 m. The fill consisted of sand with variable amounts of gravel and silt. Frequent cobbles and boulders were inferred in the fill material. The Standard Penetration Test (SPT) N values measured in the field ranged from 8 to 29, indicating a loose to compact state. Moisture content testing yielded results from 2% to 26%.

Three representative samples of the fill were submitted for grain size analysis testing. The test results are summarized below. The grain size distribution curve is shown on Figure No.1 in Appendix D.

- Gravel: 31% to 46%
- Sand: 36% to 47%
- Fines (silt and clay size particles): 16% to 23%

According to the Unified Soil Classification System (USCS), the material can be classified as silty sand with gravel (SM) to silty gravel with sand (GM).

3.1.3 Till

A dense glacial till deposit was encountered in BH15-1 at depth of 2.1 m. The standard Penetration Test (SPT) N values for this material ranged from 30 to 38 indicating a dense compactness. Moisture content of till ranged from 2% to 8%. One representative sample of the till was submitted for grain size analysis testing. The test results are summarized below. The grain size distribution curve is shown on Figure No. 2 in Appendix D.

- Gravel: 20%
- Sand: 40%
- Fines (silt and clay size particles): 32%

According to the USCS, the material can be classified as silty sand with gravel (SM).

3.2 INFERRED BEDROCK

Boreholes put down as part of 1957 Public Works Canada's investigation (see Detail of boring, Public Works of Canada, Environmental Health Centre, Ottawa, Ontario, Plan 2130) indicated that the limestone bedrock was encountered at depths 0.2 m (elevation 57.8 m) to 2.4 m (elevation 57.4 m). For more details see Table 1.1 and Detail of boring, Public Works of Canada, Environmental Health Centre, Ottawa, Ontario, Plan 2130 (1957).

Auger refusal was encountered in boreholes BH15-1 to BH15-4b. Table 3.1 summarizes the approximate depths of refusal. The auger refusal depths could be due to obstructions such as boulders or possible bedrock surface.

Table 3.1: Borehole Auger Refusal Depths

Borehole	Elevation (m)	Depth Below Ground Surface (m)
BH15-1	57.3	3.9
BH15-2	58.0	3.1
BH15-3	58.3	1.6
BH15-4b	57.7	2.1

3.3 GROUNDWATER

One (1) monitoring well was installed (BH15-1) as per the Terms of Reference. We observed that the borehole was dry on December 7, 2015 within the investigation depth.

Fluctuations of the groundwater level due to seasonal variations or precipitation events should be anticipated. Groundwater level information presented in this report may not necessarily represent groundwater conditions at the time the watermain construction work is to be conducted.

4.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Public Works and Government Services Canada who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd should any of these 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

Respectfully submitted,

STANTEC CONSULTING LTD.

For

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Associate, Senior Geotechnical Engineer

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5.0 REFERENCES

Arcadis "Supplemental Phase III ESA – Tunney's Environmental Health Centre Building #8, DFRP #50064, Version 4" dated January 6, 2016.

ASTM4.08. Standard D422-63: Standard Test Method for Particle-Size Analysis of Soils.

ASTM4.08. Standard D1586-99: Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM4.08. Standard D2216-98: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

ASTM4.08. Standard D2487-00: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

OPSS1010. Material Specification for Aggregates - base, subbase, select subgrade, and backfill material

OPSS 501 Construction Specification for compacting

The best practices Guide for Recycling Aggregate by The Toronto Area Road Builders Association (TARBA) and The Ontario Stone, Sand & Gravel Association (OSSGA).

Boring report No. 2324 from Subsurface investigation for National Health and Welfare Headquarters Building, Tunny's Pasture, Ottawa, Ontario, dated September 1960.

Detail of boring, Public Works of Canada, Environmental Health Centre, Ottawa, Ontario, Plan 2130 dated October 1957.

Golder Associates investigation titled, "Geotechnical Site Characterization Tunny's Pasture Complex, Ottawa, Ontario" dated November 2009.

Sewer Design Guidelines, Second Edition, October 2012 SDG002, W.R. Newell, P.Eng., General Manager, Infrastructure services.

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 Consulting Ltd. 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 Consulting Ltd.'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 Consulting Ltd. 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 Consulting Ltd. 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.

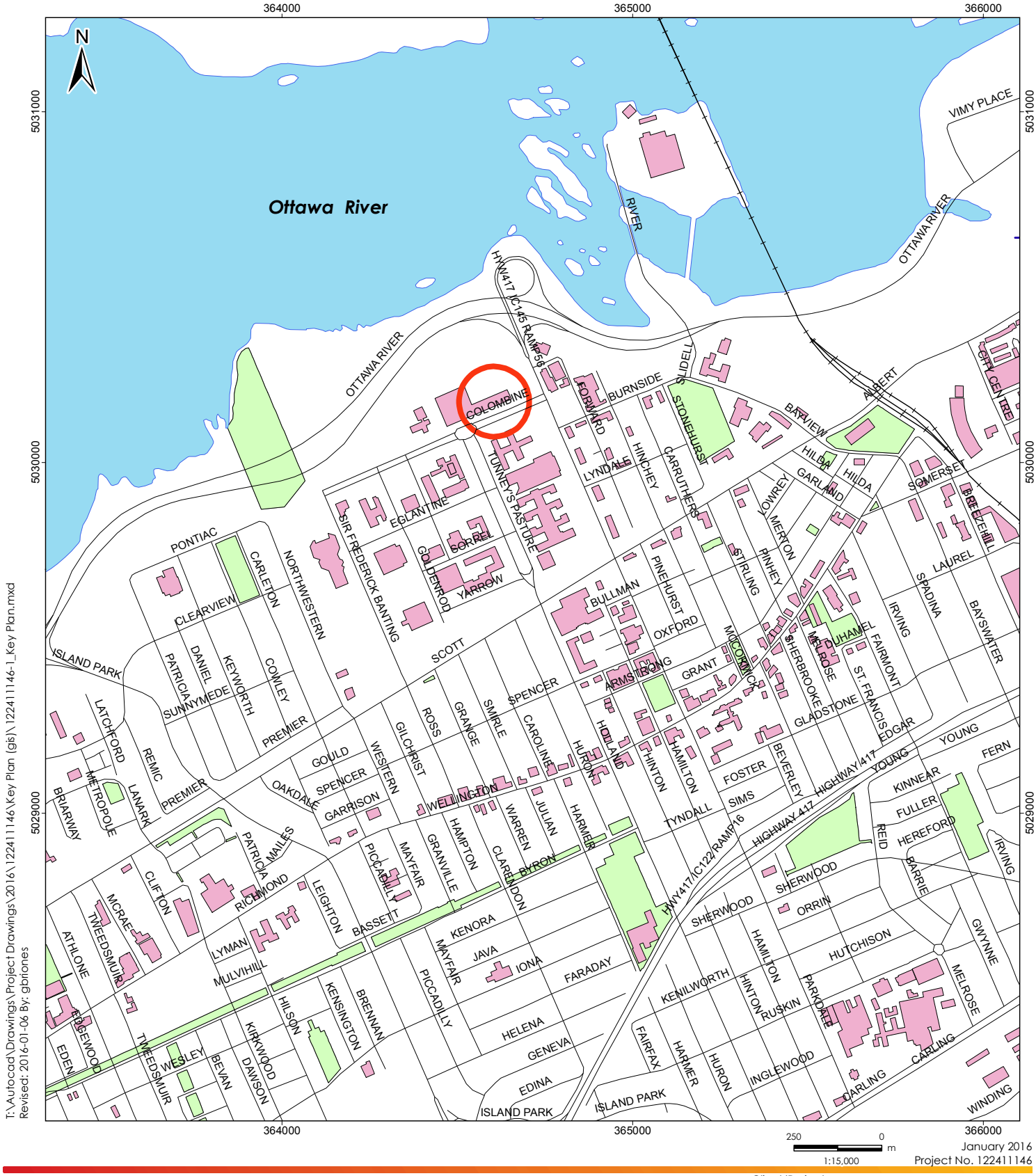
VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. 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 Consulting Ltd., 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 Consulting Ltd. cannot be responsible for site work carried out without being present.

APPENDIX B

Drawing No. 1 Key Plan

Drawing No. 2 Borehole Location Plan



T:\Autocad\Drawings\Project Drawings\2016\122411146\Key Plan (gis)\ 122411146-1_Key Plan.mxd
Revised: 2016-01-06 By: gbriones

January 2016
Project No. 122411146

Legend

- Site
- Road
- Railway
- Building
- Parkland
- Waterbody

Notes

1. Coordinate System: NAD 1983 MTM Zone 9.
2. Base features from City of Ottawa.

Stantec

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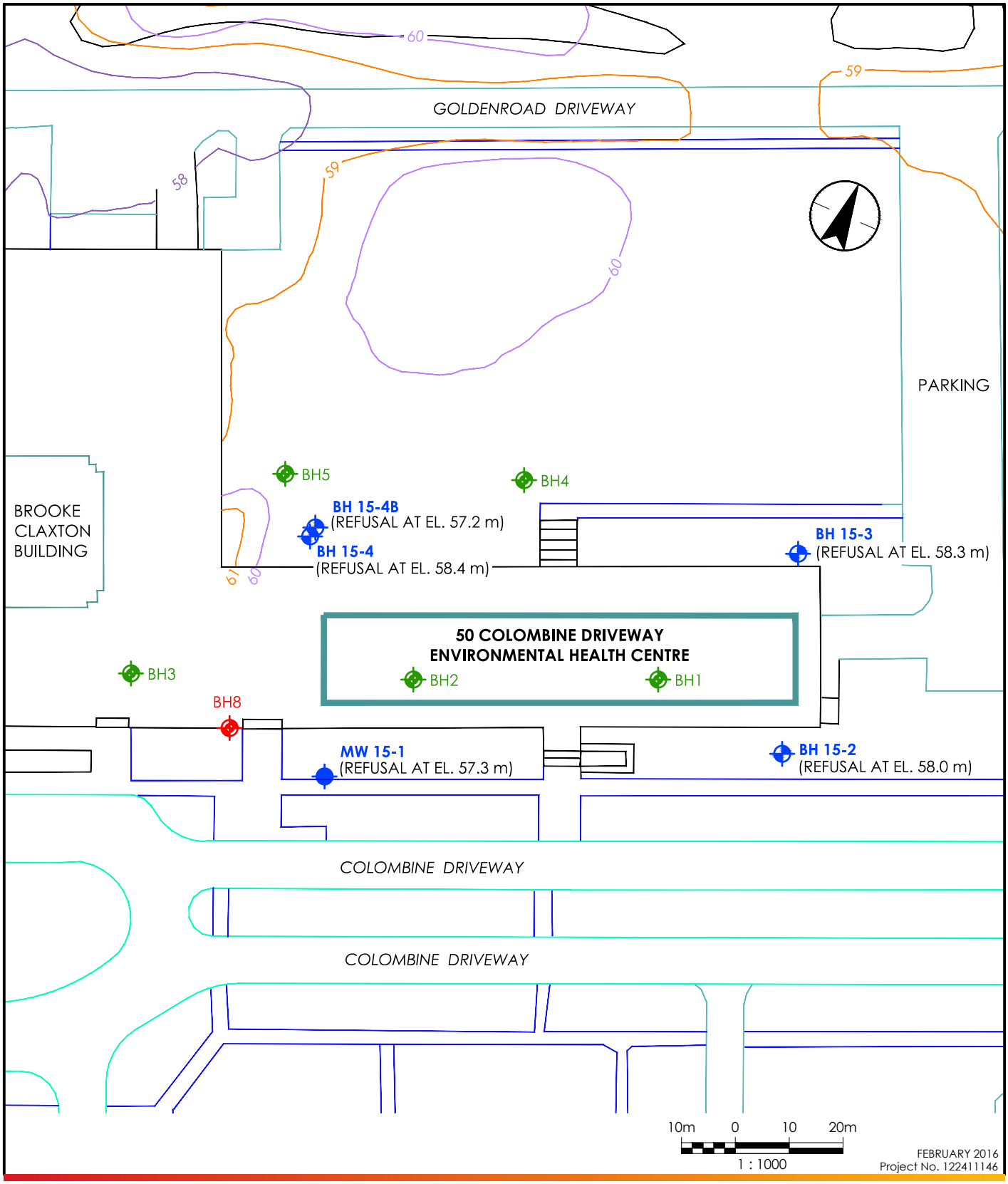
Ottawa, ON Canada K2C 3G4
www.stantec.com

Client/Project
PWGSC
EHC BUILDING DEMOLITION
50 COLOMBINE DRIVEWAY
OTTAWA, ONTARIO

Drawing No.
1

Title
KEY PLAN



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2016/02/04 8:50 AM By: Briones, Gliceria

Stantec

400 - 1331 Clyde Avenue
Ottawa, ON, Canada K2C 3G4
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LEGEND

- BOREHOLE
- MONITORING WELL
- BOREHOLE, BORING REPORT No. 2324, DEPARTMENT OF PUBLIC WORKS, SEP. 1960
- BOREHOLE, DETAIL OF BORINGS, PLAN 2130, PUBLIC WORKS OF CANADA, OCT. 1957

NOTES

1. COORDINATE SYSTEM: NAD 1983 MTM ZONE 9.
2. BASE FEATURES FROM CITY OF OTTAWA.

Client/Project

PWGSC

EHC BUILDING DEMOLITION
50 COLOMBINE DRIVEWAY, OTTAWA, ON.

Drawing No.

2

Title

BOREHOLE LOCATION PLAN

APPENDIX C

Symbols and Terms Used on Borehole Records
Borehole Records

Stantec

BOREHOLE RECORD

N: 5 028 607 E: 442 376

BH15-1

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH15-1

LOCATION Ottawa — PROJECT No. 122411146

DATES: BORING November 16, 2015 — WATER LEVEL December 7, 2015 — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	61.28							
	60.7	TOPSOIL: Dark brown TOPSOIL with occasional gravel and cobbles			GS	1		
1		FILL: Brown Sand			SS	2	150	12
	59.8							
2	59.1	FILL: Brown sand with frequent gravel, cobbles and boulders			SS	3	300	17
		TILL: Dense grey silty SAND with gravel (SM)			SS	4	450	30
3					SS	5	50	38
	57.3				SS	6	40/150 mm	
4		End of Borehole Auger Refusal Monitoring Well Installed Monitoring well Dry on December 7, 2015.						
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd

Date

Stantec

BOREHOLE RECORD

N: 5 028 643 E: 442 453

BH15-2

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH15-2

LOCATION Ottawa — PROJECT No. 122411146

DATES: BORING November 16, 2015 WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**61.09**							
		TOPSOIL: Dark brown TOPSOIL with occasional gravel and cobbles			GS	1		
	60.5							
1		FILL: Brown silty GRAVEL with sand (GM) with frequent cobbles and boulders			SS	2	340	8
2					SS	3	150	16
					SS	4	150	29
3	58.0				SS	5	50	50/50 mm
		End of Borehole						
		Auger Refusal						
4								
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa App'd

△ Pocket Penetrometer Test, kPa Date

Stantec

BOREHOLE RECORD

N: 5 028 679 E: 442 441

BH15-3

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH15-3

LOCATION Ottawa — PROJECT No. 122411146

DATES: BORING November 16, 2015 — WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**59.96**							
		TOPSOIL: Dark brown TOPSOIL with occasional gravel and cobbles			GS	1		
	59.4							
1		FILL: Brown silty SAND with gravel (SM)			SS	2	300	15
	58.3				SS	3	150	50/100 mm
		End of Borehole						
2		Auger Refusal						
3								
4								
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd

Date

STN13-STAN-GEO 122411146 ENVIRONMENTAL HEALTH CENTER BUILDING DEMOLITION.GPJ SMART.GDT 1/6/16

Stantec

BOREHOLE RECORD

N: 5 028 647 E: 442 356

BH15-4

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH15-4

LOCATION Ottawa — PROJECT No. 122411146

DATES: BORING November 16, 2015 — WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**59.30**	**Elevation estimated from Demolition Site Plan Drawing, A100**						
		TOPSOIL: Dark brown TOPSOIL with occasional gravel and cobbles			GS	1		
	58.7							
	58.4	FILL: Poorly Graded SAND (SP) with frequent cobbles and boulders			SS	2	50	50/100 mm
1		End of Borehole						
		Auger Refusal						
2								
3								
4								
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd

Date

Stantec

BOREHOLE RECORD

N: 5 028 647 E: 442 356

BH15-4b

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH15-4b

LOCATION Ottawa — PROJECT No. 122411146

DATES: BORING November 16, 2015 WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**59.30**	**Elevation estimated from Demolition Site Plan Drawing, A100**						
	58.7	TOPSOIL: Dark brown TOPSOIL with occasional gravel and cobbles						
1		FILL: Brown poorly graded SAND (SP)						
	57.8							
2	57.2	FILL: Brown silty SAND with gravel (SM) with frequent cobbles and boulders			SS	1	400	25
		End of Borehole						
		Auger Refusal						
3								
4								
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

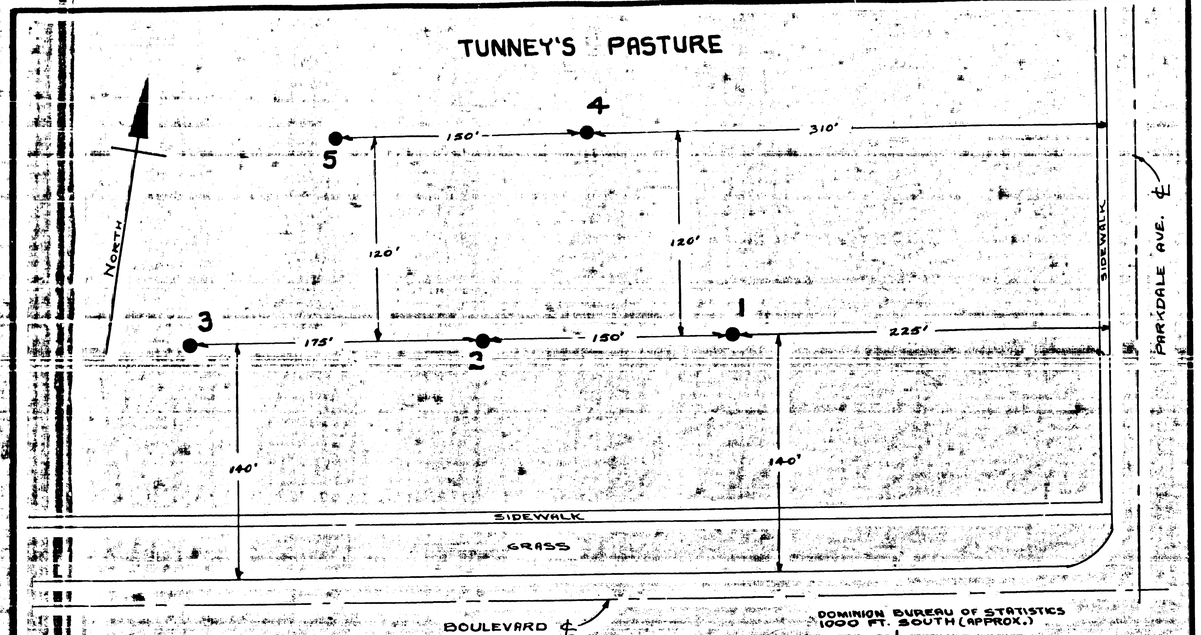
▼ Groundwater Level Measured in Standpipe

□ Field Vane Test, kPa

□ Remoulded Vane Test, kPa App'd

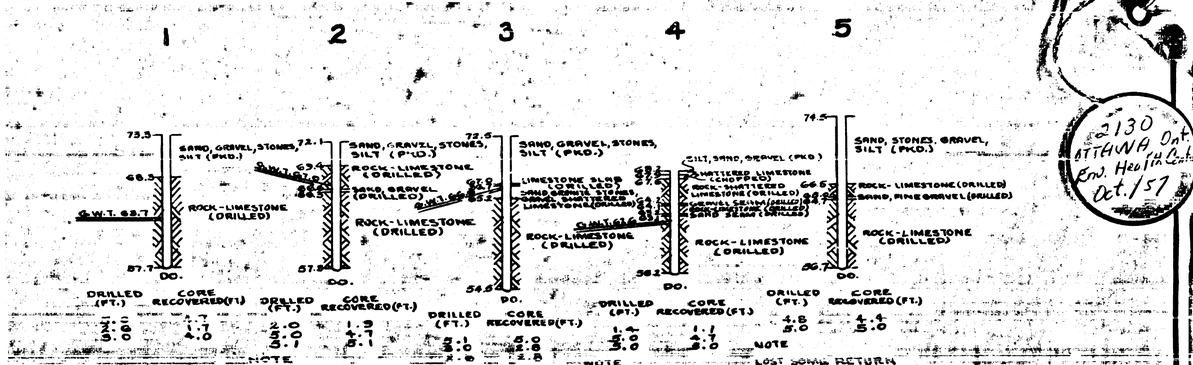
△ Pocket Penetrometer Test, kPa Date

STN13-STAN-GEO 122411146 ENVIRONMENTAL HEALTH CENTER BUILDING DEMOLITION.GPJ SMART.GDT 1/6/16



LOCATION OF BORINGS

SCALE: 1 IN. = 50 FT.



DETAIL OF BORINGS

SCALES: VERTICAL - 1 IN. = 10 FT.
HORIZ. - NOT TO SCALE

LEGEND
THE GROUND WATER TABLE ELEVATION SHOWN THUS: G.W.T. 67.9

NOTE
ALL ELEVATIONS ARE REFERRED TO CITY DATUM. TO OBTAIN GEODETIC DATUM ADD 121.97 FT. TO EACH ELEVATION.
LEVELS WERE RUN FROM CITY B.M. X 7 GEODETIC ELEVATIONS 200.12 LOCATED ON THE NORTH EAST CORNER OF HOUSE 2 HERON AVE.

REVISIONS	
DATE	DETAILS

PUBLIC WORKS OF CANADA
DEVELOPMENT ENGINEERING BRANCH - TESTING LABORATORIES DIVISION
SOIL MECHANICS SECTION

PLAN OF BORINGS
OTTAWA (TUNNEY'S PASTURE), ONT.
ENVIRONMENTAL HEALTH CENTRE

SCALES AS SHOWN
DATE OF BORINGS OCTOBER, 1957
BORINGS BY J. E. LEBLANC
DRAWING BY R. A. LALONDE
CHECKED BY A.H.G.
M. LaBel
I/C SOIL MECHANICS SECTION
PLAN No. 2130

2130 Ottawa Dist. Env. Health Centre Oct. 157

2130

24X

REPORT # 2324

Department of Public Works

Development Engineering Branch

Testing Laboratories

Ottawa, Ontario.

REPORT ON

SUBSURFACE INVESTIGATION

FOR

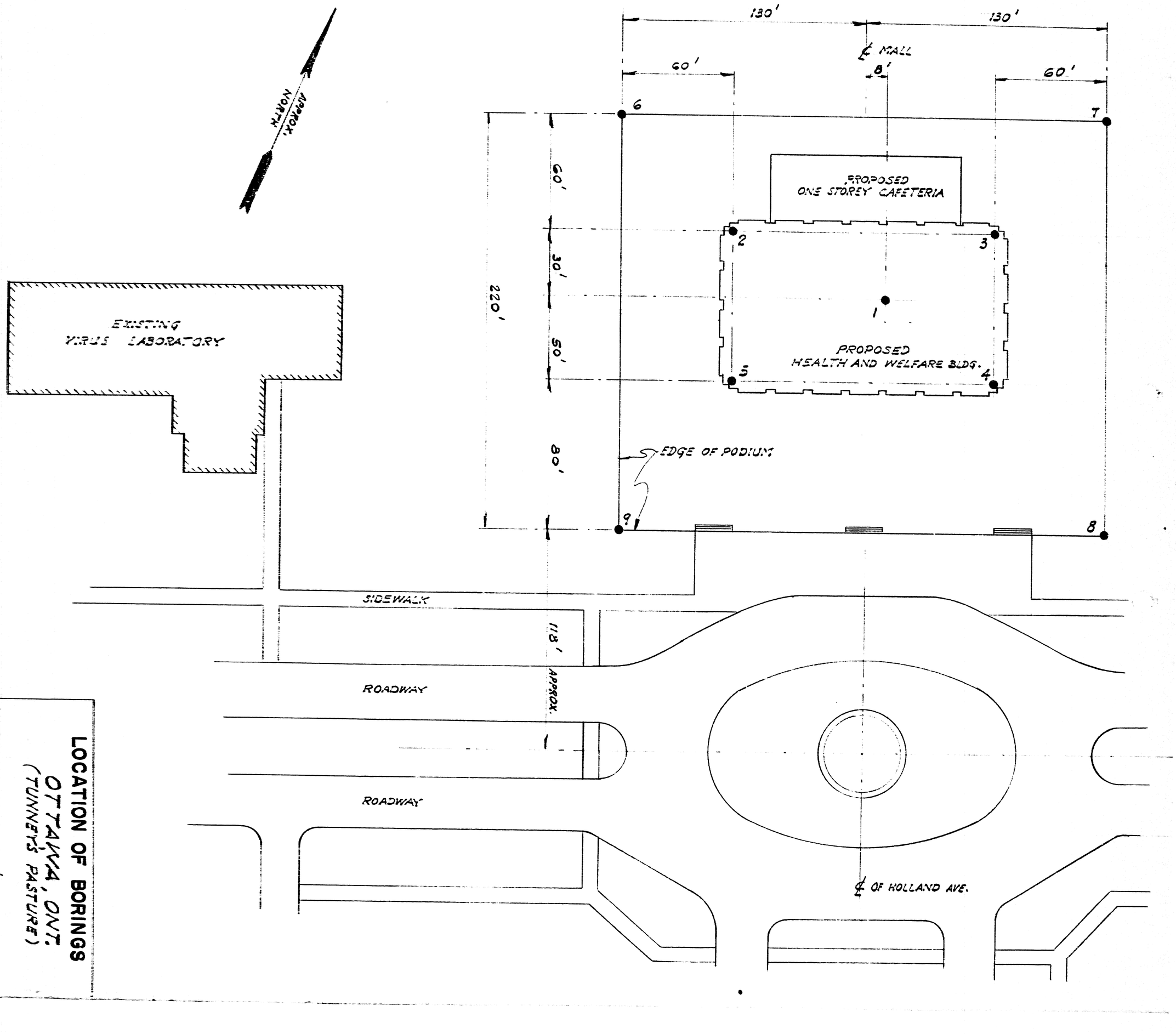
NATIONAL HEALTH AND WELFARE HEADQUARTERS BUILDING

TUNNEY'S PASTURE

OTTAWA, ONTARIO.

September, 1960.

BORING REPORT NO. 2324



X 15

BORING REPORT N° 2324

RECORD — SUBSURFACE EXPLORATION — SOILS
TESTING LABORATORIES, DEVELOPMENT ENGINEERING BRANCH
DEPARTMENT OF PUBLIC WORKS, OTTAWA, ONTARIO.

HOLE N° 7
CHECKED [illegible]
DWN. H. LEFFING
APPROVED M. LeBel for N.C. LAYCRAFT
DATE OF BORING 30 & 31 AUG. 1960
BORING TECH. J. DUFRESNE DRILLING CO.

ELEVATION IN FEET OF

WATER SURFACE	BOTTOM OF HOLE	DATUM	GROUND
———	177.7	GEODETIC	198.2
		GROUND WATER ———	ROCK 189.2

LEGEND
SAMPLING METHOD
2" DIA SPLIT TUBE
2" SHELBY TUBE
PENETRATION RESISTANCE - R
2" SPLIT TUBE
2" DIA. CONE
CASING
STRENGTH
UNCONFINED COMPRESSION (QU)
VANE TEST (C) AND SENSITIVITY (S)
CONSISTENCY
NATURAL MOISTURE AND
LIQUIDITY INDEX (LI)
LIQUID LIMIT
PLASTIC LIMIT

PROPOSED STRUCTURE: NATIONAL HEALTH & WELFARE BLDG.

LOCATION: OTTAWA, ONT. (UNIVERSITY PASTURE)
FILE N° 32-3295

SAMPLE N°	TYPE	SYMBOLS	DESCRIPTION OF SOIL	ELEV. FT	DEPTH FT
				198.2	
			OVERBURDEN, MOSTLY BOULDERS (DRILLED)	189.2	
			ROCK (DRILLED)		
			BOTTOM OF HOLE DRILLED FT. RECOVERED FT. 1.3 0.0 GROUND CORE 4.7 4.7 5.5 5.3	177.7	

STRENGTH + PENETRATION RESISTANCE — COMPRESSIVE STRENGTH (TONS/FT²) — CONSISTENCY
UNIT WT. LBS/C.F.
ELEV. FT.

BORING REPORT N° 2324

RECORD — SUBSURFACE EXPLORATION — SOILS
TESTING LABORATORIES, DEVELOPMENT ENGINEERING BRANCH
DEPARTMENT OF PUBLIC WORKS, OTTAWA, ONTARIO.

HOLE N° 8
CHECKED [illegible]
DWN. H. LEFFING
APPROVED M. LeBel for N.C. LAYCRAFT
DATE OF BORING 30 AUG. 1960
BORING TECH. J. DUFRESNE DRILLING Co.

ELEVATION IN FEET OF

WATER SURFACE	BOTTOM OF HOLE	DATUM	GROUND
———	176.4	GEODETIC	199.7
		GROUND WATER ———	ROCK 199.7

LEGEND
SAMPLING METHOD
2" DIA SPLIT TUBE
2" SHELBY TUBE
PENETRATION RESISTANCE - R
2" SPLIT TUBE
2" DIA. CONE
CASING
STRENGTH
UNCONFINED COMPRESSION (QU)
VANE TEST (C) AND SENSITIVITY (S)
CONSISTENCY
NATURAL MOISTURE AND
LIQUIDITY INDEX (LI)
LIQUID LIMIT
PLASTIC LIMIT

PROPOSED STRUCTURE: NATIONAL HEALTH & WELFARE BLDG.

LOCATION: OTTAWA, ONT. (UNIVERSITY PASTURE)
FILE N° 32-3295

SAMPLE N°	TYPE	SYMBOLS	DESCRIPTION OF SOIL	ELEV. FT	DEPTH FT
				199.7	
			OVERBURDEN, MOSTLY BOULDERS (DRILLED)	189.7	
			ROCK (DRILLED)		
			BOTTOM OF HOLE DRILLED FT. RECOVERED FT. 1.3 0.0 GROUND CORE 4.7 4.7 5.4 5.3	176.4	

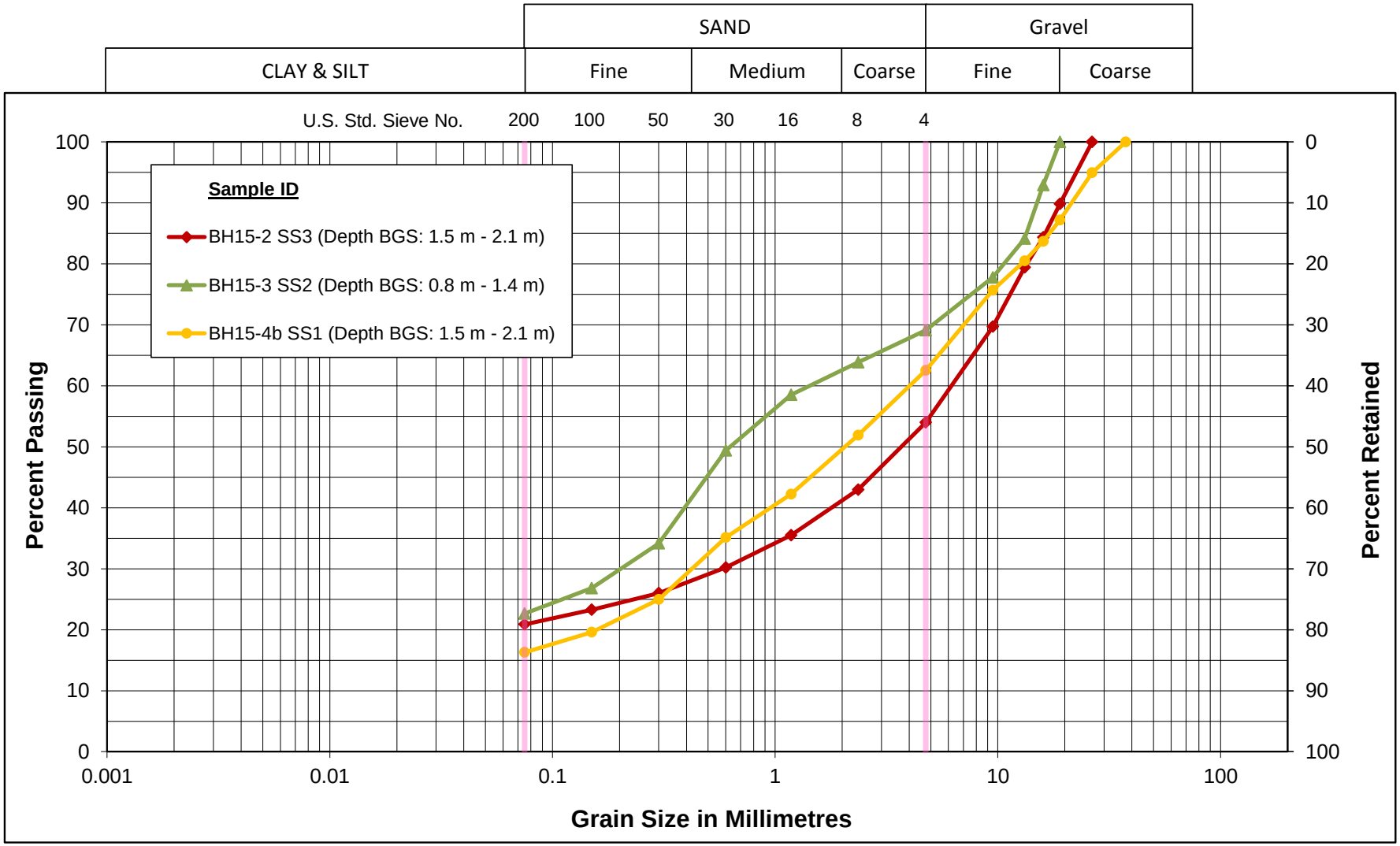
STRENGTH + PENETRATION RESISTANCE — COMPRESSIVE STRENGTH (TONS/FT²) — CONSISTENCY
UNIT WT. LBS/C.F.
ELEV. FT.

X24

APPENDIX D

Laboratory Test Results

Unified Soil Classification System



Stantec

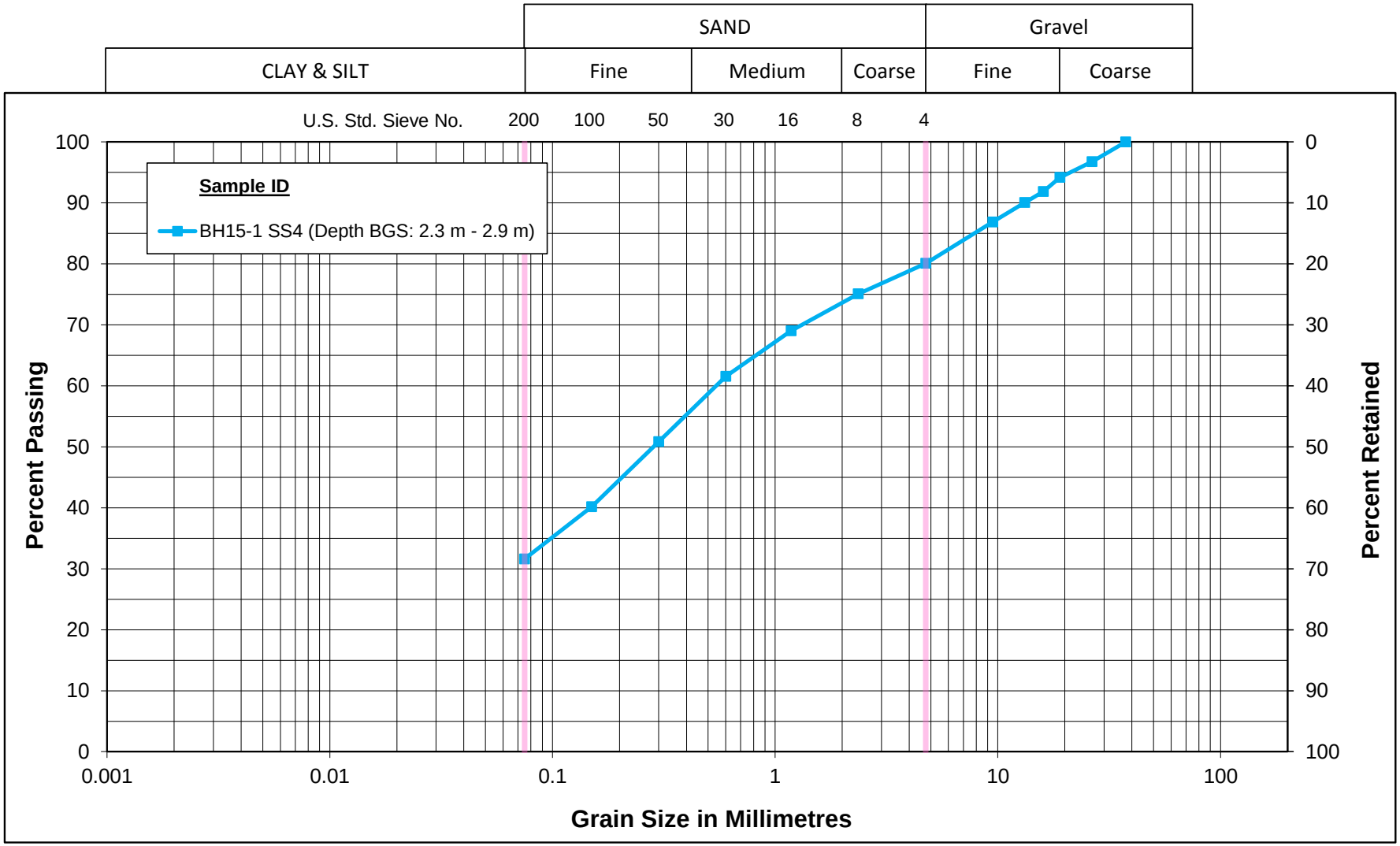
GRAIN SIZE DISTRIBUTION

FILL: Silty SAND with Gravel (SM) and Silty GRAVEL with sand (GM)

Figure No. 1

Project No. 122411146

Unified Soil Classification System



Stantec

GRAIN SIZE DISTRIBUTION

TILL: Silty SAND with Gravel (SM)

Figure No. 2

Project No. 122411146

Stantec

Memorandum

To:	Zoheir Zendagui	From:	Christopher McGrath Katurah Firdawsi
	PWGSC		Ottawa (Clyde Ave) ON Office
File:	122411146	Date:	February 4, 2016

Reference: Geotechnical Design Memorandum For Environmental Health Centre (EHC) Building Demolition , 50 Colombine Driveway, Ottawa, ON

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Stantec consulting Ltd. (Stantec)to provide geotechnical engineering services for the proposed demolition of the Environmental Health Centre (EHC) Building located at 50 Colombine Driveway in Ottawa, ON.

In general, issues addressed in this report will include:

- confirming bedrock levels within the EHC building footprint,
- re-use of demolished building concrete as backfill material,
- sloping requirements for temporary excavations,
- demolition and backfill details at a 2183 m diameter sewer,
- demolition and backfill details at service tunnel connection, and
- lateral earth pressure design parameters.

This report has been prepared specifically and solely for the project described herein and is intended for use by the PWGSC design team and is not intended for inclusion with tender documents. This Report should be read in conjunction with the Stantec Geotechnical Data Report titled "Environmental Health Centre (EHC) Building Demolition, 50 Colombine Driveway, Ottawa, ON" dated February 2016. It provides geotechnical recommendations for the proposed demolition of the EHC building. The work has been carried out in accordance with the Terms of Reference dated July 31, 2015 (R.069710.004).

Limitations associated with this report and its contents are provided in the statement of conditions appended to this memorandum.

1.1 PROJECT OUTLINE

We understand that PWGSC plans to demolish the existing four-storey EHC Building located at 50 Colombine Driveway in the Tunney's Pasture campus south of the Ottawa River in Ottawa, Ontario. Stantec is providing input regarding the existing soil conditions, and recommendations for the demolition, excavation, and site restoration.

At this time, we understand that the proposed work will include:

- demolition of the entire EHC building structure and podium,
- removal of basement slab-on-grade and footings,

- Disconnecting a service tunnel connection connecting the EHC building to Brooke Claxton building. The tunnel will be capped at the location of the termination.

The following sections provided discussion and recommendations for the proposed works.

2.0 DISCUSSION AND RECOMMENDATIONS

2.1 BACKFILL MATERIALS

This section specifies materials that can be used as backfill to fill voids and excavations, pertaining to demolition of EHC building and podium, as well as related structures, including basements, and foundations. This section also covers recommendations for backfilling details at large diameter sewer (located adjacent to Brooke Claxton Building), and service tunnel connection.

Table 2.1 summarizes the advantages and disadvantages of possible backfill materials.

Table 2.1: Summary of Advantages and Disadvantages of Possible Backfill Materials

Backfill Materials	Advantages	Disadvantages	Risk	Future Land Usage
Reclaimed Concrete Material (RCM)	Free Drainage	Does not retain water above the GWT	Poor media for vegetation	• Parking area • Landscaped Area • Slab-on-grade
Granular A/Granular B (Type I and II)	Free Drainage	Does not retain water above the GWT	Poor media for vegetation	• Parking area • Landscaped Area • Slab-on-grade • Shallow Foundation
Select Subgrade Material (SSM)	Lower Cost	Not Suitable for support of foundations	Sensitive to changes in moisture content, could become uncompactable	• Parking Area • Landscaped Area
Existing Fill or Native Till on Site (must meet the gradation requirements of SSM)	Lower Cost	Not Suitable for support of foundations	Sensitive to changes in moisture content, could become uncompactable	• Parking Area • Landscaped Area

Note(s): Reclaimed Concrete can be crushed on-site or off-site.

Our understanding of the project is that the future land usage will be a landscaped area; either the use of Select Subgrade Material, Site Generated Fill or Reclaimed Concrete Material would be suitable.

Table 2.2 outlines the recommended gradation limits for the suggested backfill materials; the gradation limits are based on the OPSS 1010 modified to meet the sieve sizes used in the National Master Specifications.

Table 2.2: Gradation Requirements - Percent Passing

Sieve	Granular			Select Subgrade Material
	A	B		
		Type I	Type II	
150 mm	N/A	100	N/A	100
106 mm	N/A	N/A	100	N/A
25 mm	100	50-100	50-100	50-100
19.0 mm	85-100	N/A	N/A	N/A
9.5 mm	50-73	N/A	N/A	N/A
4.75 mm	35-55	20-100	20-55	20-100
2 mm	15-40	10-100	10-40	10-100
400 µm	5-22	2-65	5-22	5-95
74 µm	2-8	0-8	0-10	0-25

Reclaimed Concrete Material (RCM)

Granular A and Granular B Type I and Type II may be produced by crushing Reclaimed Concrete Material (RCM) up to 100% by mass; where RCM specifies high-quality aggregates generated through the demolition of Portland cement concrete elements.

Concrete should be separated at the job site and should be free of all associated steel reinforcement (if applicable) and deleterious material such as wood, plastic, and organics. Solid concrete demolition materials such as footings, floor slabs and concrete walls should be pre-approved.

Select Subgrade Material (SSM)

Select Subgrade Material (SSM) should only be produced from natural deposits of non-plastic silt, sand, and gravel material. Reclaimed materials of any type should not be used.

2.1.1 Backfill Placement

Temporary Excavations

Fill should be placed in lifts no thicker than 300 mm and compacted to at least 95% Standard Proctor Maximum Dry Density (SPMDD), as per ASTM D698. For areas where the future land usage is clear, slab-on-grade of foundation, the level of compaction should be increased to 100% SPMDD.

Pipe Excavations

It is recommended that a minimum of 150 mm OPSS Granular A material be placed below the pipe invert as bedding material. Backfill placed above the bedding material to the pipe cover should also consist of OPSS Granular A material. A minimum of 300 mm vertical and side cover should be provided. At the proposed excavation for the upgrade to the Brooke Claxton Wall and reinstatement of concrete slab above the 2183 mm diameter sewer, Granular A should be used up to the underside of the new slab. To protect the sewer from freezing a minimum depth of cover of 2.5 m from the pipe obvert is required. These materials should be compacted to at least 95% of SPMDD.

Areas to be filled should be free of standing water, frost, frozen, or unsuitable material, trash and debris prior to fill placement. Backfill areas should be free from voids that cause settlement. Voids left from removal of service utilities can be filled with non-reinforced low-strength concrete. Backfill material should be placed using methods that do not lead to segregation or deterioration of material.

2.1.2 Adverse Weather Construction

Additional precautions, effort, and measures may be required, when and where construction in undertaken during late fall, winter, and early spring construction when the temperature and climatic conditions have an adverse influence on the standard construction practices or during periods of inclement weather.

With respect to all earthworks activities undertaken during the late fall through to late spring, when less-than-ideal construction conditions may prevail, the following comments are provided:

1. All of the engineered fill should consist of granular materials, including either the crushed rock or imported Granular B or A materials. The use of non-granular fill materials may be considered, but would be extremely problematic.
2. The intended area of fill should be clearly identified in the field prior to commencing the work.
3. Ramps or roads for access (see above for further consideration) should be constructed outside of the limits of intended fill.
4. Fill placement should be inspected by qualified field personnel on a full time basis under the supervision of a geotechnical engineer, with the authority to stop the placement of fill at any time when conditions are considered to be unfavorable.
5. Imported materials that contain ice, snow, or any frozen material should not be accepted for use.
6. Overnight frost penetration may occur, even in granular fill materials, where precipitation and ground surface runoff pools and accumulates, and freezing temperatures exist. Any frozen materials should be removed prior to placing subsequent lifts of engineered fill. Breaking the frost in-situ is not considered acceptable.
7. It may be necessary to stop the placement of engineered fill during periods of cold, where ambient temperatures are -5° C or less, exist.

It should be noted that the placement of engineered fill materials during cold weather conditions requires extra effort beyond that typical when better climatic conditions prevail. At any time where conditions are deemed unfavorable, the engineered fill operation should be suspended.

Additional considerations for heating of concrete, heating of forms and reinforcing steel, protection of concrete from freezing, and similar measures may also be required subject to climatic conditions at the time of construction.

Appropriate scheduling of the work may also require specific consideration and revision from the typical adopted. The scope of work intended may have to be reduced or adjusted, and/or only select construction activities be undertaken during specific climatic conditions. The areas of planned engineered fill may have to be reduced on a daily basis, the extent of excavations may have to be limited, with all excavating and associated backfilling completed without delay.

2.2 TEMPORARY EXCAVATIONS

2.2.1 Sloping Requirements

It is anticipated that perimeter basement and foundation walls/columns will be demolished completely to the basement slab level.

The soils encountered during the demolition of basement and foundation walls/columns generally consisted of granular fill over a till deposit and/or bedrock. The overburden soils should be classified as Type 3 soil as defined by the Occupational Health and Safety Act and Regulations for Construction Projects. Within Type 3 soils, open cut excavations must be sloped no steeper than one (1) horizontal to one (1) vertical from the bottom of the trench. The stability of the wall may be affected by surcharge loads, stockpiles, building foundations as well as groundwater seepage conditions. Sloped open cut excavation is not recommended for soil excavations deeper than 5 m below ground surface. Soil excavations deeper than 5 m should be supported with a shoring system.

Excavation side slopes in bedrock can be sloped at vertical, provided the trench sides are cleared of loose rock prior to workers entering the trench.

2.2.2 Site Constraints

Based on existing background information, it is assumed that the Brooke Claxton Building foundations are founded on bedrock. If the building is not founded on bedrock, unsupported excavations below the underside of existing foundation should not extend into the influence zone of the foundation. The influence zone is defined as the line drawn at 1 horizontal to 1 vertical downward and outward from the edge of the footing.

2.2.3 Supported Excavations

Table 2.3 provides soil parameters to be used for the design of a shoring system. It is the responsibility of the contractor to select and design the excavation and support method.

Stantec recommends that any successful bidder submits an excavation/shoring plan. The plan should address how existing foundations and underground services such as the 2183 mm diameter sewer and service tunnel will be protected.

When designing supported excavations, earth pressures will need to be considered. For shoring systems that are designed to allow rotation, active earth pressure may be used for design. For rigidly tied structures, the at-rest pressure should be used for design, unless the wall can deflect enough (approximately 0.05% of the retained height) to establish the active pressure. Recommended unfactored soil parameters are provided in Table 2.3.

The total thrusts due to earth pressure can be calculated using the following equations:

$$P_A = \frac{1}{2} K_a \gamma H^2$$

$$P_o = \frac{1}{2} K_o \gamma H^2$$

$$P_p = \frac{1}{2} K_p \gamma H^2$$

where K_a, K_o and K_p are the earth pressure coefficients corresponding to active, at rest and passive conditions, respectively, and P_A, P_o and P_p are the corresponding thrusts. H is the height of the wall. The thrust typically acts at a point one-third up the height of the wall. However, the wall type and material will dictate the actual pressure distribution.

Table 2.3: Design Parameters for Shoring Systems

Parameters	Granular Fill	Native Till
Unit Weight (kN/m^3)	21	22
Angle of Internal Friction, φ	32°	34°
Coefficient of Active Earth Pressure, K_a (Horizontal Backslope)	0.31	0.28
Coefficient of Passive Earth Pressure, K_p (Horizontal Backslope)	3.25	3.54
Coefficient of Earth Pressure at Rest, K_o	0.47	0.44

2.3 LATERAL PRESSURE FROM BACKFILL (CAP DESIGN)

It is anticipated that a cap will be designed and constructed to cover the tunnel that will be cut at south west of the EHC building. This section provides parameters for earth pressure design against the above mentioned cap.

For shoring systems that are designed to allow rotation, active earth pressure may be used for design. For rigidly tied structures, the at-rest pressure should be used for design, unless the wall can deflect enough (approximately 0.05% of the retained height) to establish the active pressure. Recommended unfactored soil parameters are provided in Table 2.4.

The total thrusts due to earth pressure can be calculated using the following equations:

$$P_A = ½ K_a \gamma H^2$$

$$P_o = ½ K_o \gamma H^2$$

$$P_p = ½ K_p \gamma H^2$$

where K_a, K_o and K_p are the earth pressure coefficients corresponding to active, at rest and passive conditions, respectively, and P_A, P_o and P_p are the corresponding thrusts. H is the height of the wall. The thrust typically acts at a point one-third up the height of the wall.

Table 2.4: Design Parameters for the Earth Pressure Design against Cap

Parameters	Engineered Backfill		SSM
	Granular A	Granular B Type I/II RCM	
Unit Weight (kN/m^3)	22.8	21.2	20
Angle of Internal Friction, φ	35°	32°	33°
Coefficient of Active Earth Pressure, K_a (Horizontal Backslope)	0.27	0.31	0.29
Coefficient of Passive Earth Pressure, K_p (Horizontal Backslope)	3.69	3.25	3.39
Coefficient of Earth Pressure at Rest, K_o	0.43	0.47	0.46

We recommend using free draining material such as Granular A or Granular B Type I or II material.

2.4 SUBSURFACE GROUNDWATER DRAINAGE

Readings obtained on December 7, 2015 show that borehole BH15-1 was dry. The Arcadis Supplemental Phase III ESA Report titled "Tunney's Environmental Health Centre Building #8 DFRP #50064, Version 4, dated January 6, 2016 measured the groundwater level at about elevation 57.4 m to 58.2 m (MW15-1 and MW15-5). The groundwater levels may fluctuate seasonally; it has been noted that groundwater typically follows the bedrock profile and could be higher. The excavation depth is anticipated to be about elevation 56.6 m, suggesting a high probability that groundwater will be encountered during construction. It is anticipated that conventional sumps and pumps will be sufficient (if applicable) to control groundwater during the demolition work.

Assuming a building excavation covering an area of 4,000 m^2 and extending 1.5 m below the groundwater level, under static condition the excavation storage capacity would be 6,000,000 litres of water. If one percent of the storage capacity enters the excavation daily the requirement for a permit to take water would apply. It recommended that a Category III Ontario Ministry of the Environment and Climate Change (MOECC) Permit to Take Water (PTTW) be considered a requirement for temporary dewatering of excavations at this site. A hydrogeological study should be carried to support the PTTW application and to confirm this requirement.

The quality of groundwater that may be removed during the construction activities should be assessed at that time to determine if it may be disposed of directly to the local sanitary/storm sewer without treatment, under a permit that would be required from the City of Ottawa Sewer Use Program. Construction contractor has the responsibility to obtain a permit under the City of Ottawa Sewer Program and testing/discharge of water to sanitary or storm sewer.

Any structures which are anticipated to be constructed beneath the water table, will need to be designed to be watertight or alternatively to be drained with an appropriate sump and drainage system. An undrained watertight design would need to consider uplift resistance. A drained design would need to consider the potential of contaminant impacted groundwater being directed from the site.

Contaminated water (surface and ground water) should be prevented from running off onto adjacent lands and/or demolish site (if applicable).

2.5 VIBRATION CONSIDERATION

The required demolition activities will generate some vibrations that will be perceptible to the nearby residences. The vibrations are expected to be greatest during excavation and material placement. It is recommended that pre-construction surveys be carried out, the pre-construction survey should also include inspection of the sanitary sewer. Table 2.5 provides vibration limits intended to prevent cracking and other structural problems.

Table 2.5: Suggested Peak Vibration Limits at Nearby Structures/Services

Frequency Range (Hz)	<10	10 to 40	>40
Peak Particle Velocity (mm/sec)	5	5 to 50 (sliding scale)	50

If heritage buildings are present, the limits may need to be revised.

3.0 CLOSURE

Use of this report is subject to the Statement of General Conditions appended to this Memorandum. It is the responsibility of Public Works and Government Services Canada who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd should any of these 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

Respectfully submitted,

STANTEC CONSULTING LTD.

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Geotechnical Engineering

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Geotechnical Engineer

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Attachments: Statement of General Conditions

4.0 REFERENCES

Arcadis "Supplemental Phase III ESA – Tunney's Environmental Health Centre Building #8, DFRP #50064, Version 4" dated January 6, 2016.

ASTM4.08. Standard D422-63: Standard Test Method for Particle-Size Analysis of Soils.

ASTM4.08. Standard D1586-99: Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM4.08. Standard D2216-98: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

ASTM4.08. Standard D2487-00: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

OPSS1010. Material Specification for Aggregates - base, subbase, select subgrade, and backfill material

OPSS 501 Construction Specification for compacting

The best practices Guide for Recycling Aggregate by The Toronto Area Road Builders Association (TARBA) and The Ontario Stone, Sand & Gravel Association (OSSGA).

Boring report No. 2324 from Subsurface investigation for National Health and Welfare Headquarters Building, Tunny's Pasture, Ottawa, Ontario, dated September 1960.

Detail of boring, Public Works of Canada, Environmental Health Centre, Ottawa, Ontario, Plan 2130 dated October 1957.

Golder Associates investigation titled, "Geotechnical Site Characterization Tunny's Pasture Complex, Ottawa, Ontario" dated November 2009.

Sewer Design Guidelines, Second Edition, October 2012 SDG002, W.R. Newell, P.Eng., General Manager, Infrastructure services.

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 Consulting Ltd. 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 Consulting Ltd.'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 Consulting Ltd. 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.

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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 Consulting Ltd. 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 Consulting Ltd. 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 Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. 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 Consulting Ltd., 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 Consulting Ltd. cannot be responsible for site work carried out without being present.