APPENDIX A

Geotechnical Investigation Report – Labo S.M. inc.
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Public Works and Government Services Canada

GEOTECHNICAL INVESTIGATION REPORT

January, 2015
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Workshop Bathroom Renovation and Site Drainage Project
Cap Tourmente National Wildlife Area
Chemin de la Friponne, Saint-Joachim (Québec)

O/Ref. : F1313256-009

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LABO S.M. INC.

Geotechnical Investigation Report

Workshop Bathroom Renovation and Site Drainage Project
Cap Tourmente National Wildlife Area
Chemin de la Friponne, Saint-Joachim (Québec)

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Table of Contents

1 INTRODUCTION 1

1.1 Mandate and Scope of Work 1
1.2 Existing Reports 1
1.3 Site and Project Description 2

2 METHOD OF INVESTIGATION 2

2.1 Field Work 2
2.1.1 Borehole/Test Pit Location and Leveling 3
2.1.2 Test Pits 3
2.1.3 Vertical Boreholes 3
2.1.4 Standpipes 3
2.2 Laboratory Testing 4

3 SUBSURFACE CONDITIONS 5

3.1 Boreholes (inside building) 5
3.2 Test pits (Around the building) 6

4 GROUNDWATER CONDITIONS 8

5 CONCLUSIONS AND RECOMMANDATIONS 9

5.1 Project Summary and Site Specific Conditions 9
5.2 Discussion 9
5.2.1 Settlement at the Location of the Bathrooms (TF-101-14) 9
5.2.2 Subsoil Conditions of the Original Workshop Building (TF-102-14) 10
5.2.3 Presence of water under the building 10
5.3 Reconstruction of the bathroom's Concrete slab 11
5.3.1 Excavation of the Organic Soils and Ground Slab 11
5.3.1.1 Ground Slab Subgrade Preparation 11
5.3.1.2 Excavation and Dewatering 11
5.3.1.3 Sensitivity of the Native Soils to Disturbance 12
5.3.1.4 Structural Fill 12
5.3.1.5 Granular Base Under the Slab 12
5.3.2 Structural Slab and Pile Foundations 13
5.3.2.1 Pile Capacity 13
5.3.2.2 Structural Slab 13
5.3.2.3 Construction Monitoring 13
5.4 Backfill and Surface Drainage 13
5.5 Permanent Dewatering 14
5.6 Reuse of Local Materials 14
5.7 Specific Precautions 14
5.8 Construction Monitoring 14

6 STAFF 15

7 LIMITATIONS OF THE INVESTIGATION 15

List of Tables

Table 1 Laboratory Analyses 4

Table 2 Stratigraphy Summary 7

Table 3 Laboratory Test Results 7

Table 4 Groundwater Observations 8

Appendices

Appendix I Borehole Location Plan

Appendix II Borehole Reports

Appendix III Laboratory Analysis Results

Appendix IV Site Pictures

1 INTRODUCTION

Please note that this report has been translated to make its reading easier for English-speaking persons. As accurate as the translation may be, the original report in French is the work of reference.

1.1 MANDATE AND SCOPE OF WORK

Public Works and Government Services Canada mandated **Labo S.M. Inc.** to carry out a geotechnical investigation for the the Workshop building bathroom renovation and site drainage project located on the *Cap Tourmente National Wildlife Area* in Saint-Joachim, Québec.

The purpose of the investigation was to complete an assessment of the geotechnical and groundwater conditions beneath the existing Workshop building concrete slab. The observed conditions should provide the necessary information to identify the drainage and settlement problems specifically affecting soils located beneath the bathrooms in the Workshop building. This investigation will provide recommendations for the intended renovations of the Workshop building and site drainage.

This report contains a description of the site and of the project, the methodology used, the results and interpretation of field work and laboratory results, as well as our conclusions, comments and recommendations on the following topics:

- probable causes of the building's drainage problems;
- probable causes for soil settlement beneath for the bathroom area;
- verification of possible settlement problems affecting the original Workshop building;
- site drainage problem;
- rebuilding of the concrete slab in the area of the bathroom;
- reconstruction of the site roadways;
- reuse of existing materials; and
- recommendations for construction monitoring.

1.2 EXISTING REPORTS

A geotechnical investigation was conducted on this site by *Labo S.M. inc.* (O/Réf.: F1313256-006) in September 2014. The investigation concerned the renovation of the western portion of the Workshop building. The findings of that report were taken into account for this investigation.

1.3 SITE AND PROJECT DESCRIPTION

The site is located within the Cap Tourmente National Wildlife Area on *Chemin de la Friponne* in Saint-Joachim, about 150 m east of the intersection with *Chemin du Cap-Tourmente*. Five (5) buildings are present on site; the Workshop building is located in the eastern part of the site. The workshop building is heated and is about 40 m in lengh and 10 m large, was modified in the nineteen eighties with the addition of a building extension.

Renovation work on the western part of the building is scheduled for fall 2014 and winter 2015. These renovations will include the replacement of wooden foundation beams located underneath the building by a steel beam resting on multiple piles. The new foundations will take on the loads of the building's outside walls, including the bathroom walls.

The bathrooms are located in the eastern portion of the building (extension built in the 1980's) were built on a possibly unsupported concrete slab. The concrete slab shows multiple structural problems; the slab and the ceramic tile cover are extensively fissured, specifically at the intersection of the walls and the floors. The fissures were first noticed about 2 years ago. Moreover, a void was observed between the slab and the foundation materials following the coring of the concrete slab prior to this investigation. Consequently, the projected repair work on the Workshop building will include bathroom renovation work and concrete slab reconstruction.

Drainage work is also scheduled on the site. Test pit investigationscompleted in October 2014 along the sides of the Workshop building as part of an archeological study showed important groundwater inflow. Considerable water inflow was observed under the building at a depth of about 0.3 m near the north-west and north-east portions of the building.

Gravel roadways will also be constructed from the access road and the *Hangar à grains* building to the visitor parking located on the eastern portion of the site.

2 METHOD OF INVESTIGATION

2.1 FIELD WORK

The field work was carried out on November 27 and 28, 2014 and consisted of the following items:

- Three (3) test pits with soil sampling, identified PU-101-14 to PU-103-14 and located around the Workshop's building;
- Two (2) vertical boreholes with soil sampling, identified TF-101-14 and TF-102-14 and located respectively in the north-east (bathroom) and north-west (garage) portion of the building;
- The installation of one (1) groundwater observation tube in each of the test pits and boreholes and the measure of the water level at the conclusion of the field investigation ; and
- A recording of test pit and borehole locations and leveling.

2.1.1 BOREHOLE/TEST PIT LOCATION AND LEVELING

The borehole and test pit location implementation was carried out in the field by **Labo S.M. inc** field personnel. A *SX Blue II* GPS, which has a 0.6 m precision (X, Y) was used to determine the location of the test pits. The location of the boreholes was determined with respect to the Workshop building.

The leveling of the boreholes and test pits was also carried out in the field by **Labo S.M. inc** field personnel. The benchmark used, with an arbitrary elevation of 100.00 m, corresponds to the top of the concrete slab. All the elevations mentioned in this report refer to this benchmark and are expressed in meters. The geodetic reference system used in this report is the *Système de coordonnées planes du Québec* (SCOPQ), zone 7. The location of test pits and boreholes in figure 1 is presented in appendix I.

2.1.2 TEST PITS

Test pits were advanced using a hydraulic excavator; the work was done under the constant supervision of a **Labo S.M. inc.** field personnel. Test pits were completed in proximity to the Workshop's building in order to determine the geotechnical and groundwater conditions in the area.

The test pits were advanced to a depth between 1.5 m and 3.1 m and were stopped once apparent bedrock was reached or at a predetermined depth requested by the client. Visual identification of the different materials encountered in the test pits and soil sampling was carried out during advancement of test pits; this information was used to establish local stratigraphy at test pit locations.

2.1.3 VERTICAL BOREHOLES

Vertical boreholes were advanced using a portable drill rig using BW casing (73 mm OD and 60 mm ID) by rotation and flushing (water) of the cuttings. The geotechnical boreholes reached a depth of 3.0 m approximately.

During the advancement of boreholes, continuous sampling (disturbed) of the fill and natural soil deposits was carried out using a standard "B" size split spoon sampler (51 mm OD). Standard Penetration Tests (SPT) were performed with the split spoon in accordance with ASTM D-1586. SPT tests allow the determination of the "N_{spt}" value which indicates the compactness condition of non-cohesive soils and estimates the consistency of cohesive soils. Corrections to the "N_{spt}" value were occasionally made on the values recorded in the field in order to account for the hammer drop height and split spoon sampler diameter.

2.1.4 STANDPIPES

A standpipe used for groundwater observation was installed in each of the following boreholes and test pits: TF-101-14, TF-102-14 and PU-101-14 à PU-103-14. Standpipes are made of standard 19 mm inside diameter rigid plastic (PVC) conduit perforated near the base.

The installation drawings of the standpipes are presented on the borehole reports inserted in appendix II.

2.2 LABORATORY TESTING

Collected soil samples were sent to our soil and material laboratory for classification (geological description) by a geotechnical engineer in order to establish stratigraphy of overburden and adjoining rock, if present. . In order to determine the nature and some physical properties of the collected materials (soils) samples, laboratory tests shown in table 1 were carried out on representative samples.

Table 1 Laboratory Analyses

Quantity	Test name	Standard
4	Particle-Size Analysis of Soils	LC 21-040
3	Hydrometer Analysis	BNQ 2501-025
4	Natural Water Content (w)	LC 21-201

The laboratory tests reports are included in appendix III.

Please note that all materials samples stored at our laboratory that have not been used for testing will be kept until June 2015. Thereafter, the samples will be disposed of unless specified otherwise by the client.

3 SUBSURFACE CONDITIONS

Data collected during the field and laboratory investigations is presented in the following section and summarized in tables 2 and 3.

3.1 BOREHOLES (INSIDE BUILDING)

- **Concrete Slab**

Boreholes TF-101-14 and TF-102-14 were advanced within the Workshop building through a concrete slab of respectively 130 and 200 mm. A ±5 mm thick ceramic tile covered the slab at the location of TF-101-14.

- **Void**

A 70 mm thick void was observed under the concrete slab at the location of TF-101-14 inside the bathroom of the Workshop building. This void was also observed in a slab coring made by the client near the location of TF-101-14.

- **Fill**

The fill encountered within the boreholes consisted of a 100 mm thick layer of clean crushed stone (size 10 mm and 20 mm). At the location of TF-102-14, the clean crushed stone is underlain by a 0.6 m thick layer of loose (« N_{spt} » of 6) sand with traces of silt.

- **Organic Soils**

A layer of organic soil was encountered under the fill at the location of borehole TF-101-14 (bathroom). The organic soil consisted of sand with some silt and traces of gravel as well as an important amount of organic matter including topsoil, roots, rootlets and wood. This organic soil layer is 1.1 m thick and has a very loose compactness with corrected « N_{spt} » values of 2 and 3.

- **Natural deposit**

The natural soil deposit was encountered beneath the fill material or the organic soils at a depth of 1.4 m and 0.8 m at the location of boreholes TF-101-14 and TF-102-14 respectively. It consists of a silt with traces to some sand and clay. Locally, traces of organic matter, wood and topsoil were observed within the deposit at the location of TF-101-14. A silt and sand layer was encountered at a depth of 2.7 m at the location of TF-102-14. Also, bedrock fragments were observed in the deposit starting at a depth of about 2.7 m. Based on « N_{spt} » values between 5 and 12, the compactness of this deposit is qualified of loose to compact.

- **Refusal**

Refusal on suspected cobble, boulder or bedrock was reached at a depth of 3.0 m in boreholes TF-101-14 and TF-102-14. Without continuous rock coring on a 1.5 m interval or longer, it is not possible to determine precisely the nature of the refusal. However, because rock fragments were observed towards the base of the native deposit and because refusal was reached at the same depth in both boreholes, bedrock is likely to be the cause of the refusal.

3.2 TEST PITS (AROUND THE BUILDING)

- **Topsoil**

Test pits PU-101-14 to PU-103-14 were advanced through the grassy topsoil present on site over a thickness of about 100 mm.

- **Fill**

Heterogeneous fill generally consisting of silt and sand with variable amounts of gravel was encountered underlying the topsoil in all test pits. A quantity of about 10 to 15% cobbles and traces to some organic matter (roots, topsoil, wood) were observed within most of the fill material. A clay drainage pipe was encountered at a depth of 2.2 m in test pit PU-103-14. The fill thickness is 1.0 m and 2.2 m at the location of PU-102-14 and PU-103-14 respectively and is equal or ticker than 1.4 m at the location of PU-101-14.

At the client's request, borehole PU-101-14 was stopped in the fill material at a depth of 1.5 m in order to stay at a safe distance from known underground utilities.

- **Natural Deposits**

Natural soil deposits were encountered at a depth of 1.1 m and 2.3 m at the location of test pits PU-102-14 and PU-103-14 respectively. Sandy silt was observed in PU-102-14 whereas PU-103-14 showed silt with some clay and traces of sand as well as disseminated organic matter.

- **Refusal**

Refusal on presumed bedrock was reached at a depth 3.1 m in both test pits. Based on our field observations and on the fact that refusal was reached at the same depth in both test pits, it is likely that bedrock surface was reached. However, this information cannot be confirmed because of the limited width of the test pit and because of the limited capacity of the excavator.

Table 2 Stratigraphy Summary

Borehole #	Ground elevation (m)	Concrete Slab	Topsoil	Void	Fill	Organic Soils	Natural Soils		Refusal	
		Thickness (m)					Depth (m)	El. (m)	Depth (m)	El. (m)
Boreholes										
TF-101-14	99,96	0,13	-	0,07	0,10	1,12	1,42	98,54	2,95	97,01
TF-102-14	100,00	0,20	-	-	0,61	-	0,81	99,19	2,95	97,05
Test Pits										
PU-101-14	99,79	-	0,10	-	≥1,40	-	≥1,50	≤98,29	-	-
PU-102-14	99,96	-	0,10	-	1,00	-	1,10	98,86	3,10	96,86
PU-103-14	100,14	-	0,10	-	2,20*	-	2,30	97,84	3,10	97,04

** Clay drainage pipe encountered at a depth of 2.2 m.*

Table 3 Laboratory Test Results

Borehole #	Sample #	Depth (m)	Water Content (%)	Particle-Size Distribution (%)			
				Gravel (Ø > 5 mm)	Sand (0,08-5 mm)	Silt (2 - 80 µm)	Clay (Ø < 2 µm)
TF-101-14	CF-4	1,42 – 2,03	41,5	0,0	7,4	72,8	19,8
TF-102-14	CF-3	0,81 – 1,42	36,3	0,0	16,3	67,9	15,8
PU-102-14	EM-3	1,70 – 3,10	33,1	0,0	27,2	72,8	
PU-103-14	EM-4	1,30 - 2,30	26,8	0,0	3,6	81,1	15,3

4 GROUNDWATER CONDITIONS

The groundwater levels were measured in the standpipes on December 4th and 11th, 2014. Table 4 shows the measured water levels:

Table 4 Groundwater Observations

Borehole #	Installation Depth (m)	Ground Elevation (m)	Groundwater (04-12-2014)		Groundwater (11-12-2014)	
			Depth (m)	El . (m)	Depth (m)	El. (m)
TF-101-14	2,95	99,96	1,08	98,88	1,20	98,76
TF-102-14	2,95	100,00	1,40	98,60	1,53	98,47
PU-101-14	1,30	99,79	1,17	98,62	1,16	98,63
PU-102-14	3,10	99,96	3,10	96,86*	3,02	96,94*
PU-103-14	3,10	100,14	1,14	99,00	1,31	98,83

**Values deemed non-representative of in-situ groundwater conditions*

Except for test pit PU-102-14, the groundwater level is generally similar across the site at a depth of 1.1 m to 1.5 m. Note that water inflow was observed in excavation sidewalls at a depth of 0.4 m and 1.3 m in PU-101-14 and PU-103-14 respectively which possibly implies the presence of groundwater in the loose soils located near the ground surface (overburden-bedrock interface).

According to the groundwater observations and local topography, local groundwater flow is likely to the north.

As noted above, the groundwater conditions reported in this document pertain solely to the indicated time and locations and are for informative purposes only considering that they may vary according to seasons, the importance of local rainfall and/or human interventions on site and neighboring properties. Consequently, these groundwater conditions may be different from those observed when performing future construction work.

5 CONCLUSIONS AND RECOMMANDATIONS

5.1 PROJECT SUMMARY AND SITE SPECIFIC CONDITIONS

This investigation was carried out as part of the Workshop building renovation and surrounding site drainage project at the Cap Tourmente National Wildlife Area on Chemin de la Friponne in Saint-Joachim, Québec. Settlement of the soils under the east section of the Workshop building (bathrooms) has occurred; numerous cracks are present along the concrete slab and walls. Considering this problematic, the renovation of the building's bathrooms will be carried out as well as the reconstruction of the concrete slab. Drainage issues were also identified on site and will be addressed during renovation work.

Subsurface conditions encountered in borehole TF-101-14 revealed the presence of a 70 mm void under the concrete slab in the area of the bathroom (east side of the building). Fill was then encountered consisting of a 100 mm thick clean crushed stone layer followed by a very loose layer of organic soils containing a significant amount of topsoil, roots and wood over a thickness of 1.1 m. Natural soils were reached at a depth of 1.4 m and consisted of a loose to compact silt. Within borehole TF-102-14, which was advanced in the garage area (west side of the building), layers of clean crushed stone and sand were encountered directly under the slab with a thickness of 0.6 m. The native soil was reached at a depth 0.8 m and consisted of a loose silt.

Tests pits were advanced around the Workshop building. Heterogeneous fill was encountered in all test pits (PU-101-14 to PU-103-14) and generally consisted of sand and silt with 10 to 15 % cobbles and traces to some organic matter. The thickness of fill encountered in test pits PU-102-14 and PU-103-14 was 1.0 m and 2.2 m respectively; test pit PU-101-14 was interrupted in the fill at a depth of 1.5 m. The natural soil deposit was then reached and generally consisted of a silt. A clay drainage pipe was encountered at a depth of 2.2 m at the location of PU-103-14.

Except for PU-101-14, all boreholes and test pits were interrupted due to refusal on suspected rock surface at a depth of about 3.0 m. Groundwater conditions are relatively similar across the site, except at the location of PU-102-14, with water levels between 1.1 m and 1.5 m.

5.2 DISCUSSION

5.2.1 SETTLEMENT AT THE LOCATION OF THE BATHROOMS (TF-101-14)

The ceramic tile and the concrete slab of the Workshop's bathroom show numerous cracks generally located along the walls and the floors. A separation between the interior bathroom walls and the concrete slab was observed and is shown on Photo #1 (Appendix IV). Significant cracks were also observed along the outside walls, specifically in the area of the bathroom's north wall near the location of TF-101-14 (Photo #2, Appendix IV). A 70 mm thick void was found directly under the concrete slab indicating that the slab is unsupported in the bathroom area.

The void found under the concrete slab may be explained by the presence of a 1.1 m thick layer of very loose organic soil. Such soils are very compressible and organic matter will break down over time.

Consequently, settlement progressively occurred with time within this layer of soil. Moreover, organic soils are susceptible to experience volume changes depending on the groundwater conditions they are subjected to. Finally, the displacement of soil particles within this material is made easy by its low compactness. It is also important to consider that a layer of fill containing voids and an important amount of brick and wood debris as well as cobbles was observed along the Workshop building in a previous investigation done by Labo S.M. (September 2014, ref : F1313256-006). This mediocre quality fill material is also subjected to settlement and particle displacement by water flow, especially considering the existence of voids within the fill.

A site visit was done on December 16th 2014 during the site preparation for scheduled piling work of the building's foundations. At the time of the visit, an excavation of about 300 mm deep had been completed around the building's foundations. The open excavation allowed us to determine that the outside wall at the north end of the bathrooms (area omitted in the previous investigation) seems to be supported by a concrete beam or a strip footing about 600 mm in height (Photo #3, Appendix IV). Cracks observed along this specific wall section seem to be caused by the differential displacement between this foundation and the building's concrete slab. The interior concrete slab cracks on its perimeter because of the settlement of the supporting ground but the outside wall does not show obvious signs of displacement. Consequently, the separation between the inside wall and the interior concrete slab is explained by the fact that the inside wall is attached to the roof trusses which sit on the outside walls.

The cracking problematic is not as extensive on the building's south wall (Photo #4, Appendix IV). An increased concrete thickness was observed at the base of this wall but no foundation structure was seen, as found in the previous investigation. Also, the differential settlement issue seems to be less important in that portion of the building. Note that the bathroom's east wall appears to be sitting on a wooden beam which rests at its ends on concrete pillars.

5.2.2 SUBSOIL CONDITIONS OF THE ORIGINAL WORKSHOP BUILDING (TF-102-14)

Borehole TF-102-14, which was advanced in the north-west portion of the original building, showed that the garage's concrete slab correctly rests on granular fill material made of clean crushed stone underlain by a layer of sand. This fill material was found directly on top of the loose native material which is free of organic matter. Moreover, the renovations planned for the building will provide support for the outside walls as they will be sitting on pile foundations resting on rock. Even if the compactness of the soils located under the garage's concrete slab is relatively low, no significant differential settlement problems are expected to occur since it only carries small structural loads. Moreover, no major defects were found on the garage's concrete slab.

According to our observations, the problematic affecting the bathrooms was not found in the original part of the building (office and garage).

5.2.3 PRESENCE OF WATER UNDER THE BUILDING

The excavations completed around the building's foundations showed groundwater inflow at shallow depths. Standpipes installed in the boreholes and test pits showed relatively similar groundwater conditions under the Workshop building and in the surrounding area. The presence of groundwater may be explained by the general slope of the site which is oriented towards the building but also by the slope

of the relatively impervious natural deposit which favors the accumulation of water in the loose and locally organic soils located under the building. Moreover, the absence of a perimeter drainage system around the foundations limits the drainage of the water into the fill material.

The clay drainage pipe encountered in test pit PU-103-14 was inspected by the client. The pipe was in good condition and was filled with water. According to the client, this pipe, which seems to be connected to the Workshop building, may be a source for the water found underneath the building. However, it was not possible to confirm this hypothesis since the inspection of the pipe was only completed on a length of about 3 m in the direction of the building due to the presence of materials in the pipe. Also, a drain located on the building's floor was inspected and found to be not functional (crushed).

5.3 RECONSTRUCTION OF THE BATHROOM'S CONCRETE SLAB

Given the aforementioned information, the reconstruction of the bathroom's concrete slab (total area of about 6 m x 10 m) will have to be completed. According to the results of our investigation, the required work should consist of the excavation of the organic soils and the construction of a new concrete ground slab installed on a properly prepared subgrade. Another option is the construction of a structural slab supported by pile foundations.

5.3.1 EXCAVATION OF THE ORGANIC SOILS AND GROUND SLAB

The reconstruction of the concrete ground slab on the organic soils found on site is not recommended. Excavations of a depth of 1.4 m or more are required to remove the organic soils before reconstructing the bathroom's concrete ground slab.

5.3.1.1 Ground Slab Subgrade Preparation

All the existing fill materials, the organic, disturbed, frozen or unstable native soils present under the final grade of the ground slab should be completely removed until the undisturbed native soil deposit free of organic matter is reached everywhere beneath the slab footprint. Prepared subgrade surfaces should be inspected by a geotechnical engineer or his representative to make sure that all the problematic materials have been removed and that the subgrade is stable.

The placement of a structural fill on the undisturbed native soils may be necessary. Placement of the structural fill should follow the recommendations found in section 5.3.1.4 of this report.

5.3.1.2 Excavation and Dewatering

The excavations will reach a depth of 1.4 m and will be advanced through fill material and native soils mostly consisting of silt.

Groundwater levels measured in the standpipes are generally located above the subgrade level; water inflow is expected within the excavations. Groundwater inflow, precipitations and runoff should be drained out of the excavations in order to keep the subgrade well drained and stable.

Considering that drainage recommendations are followed, temporary excavations in the soils should be sloped at 1.0 m vertical to 1.2 m horizontal from the base of the excavation. The excavation side-slopes should be properly protected against erosion, for example with the help of tarps.

The sloping recommendations stated above should only be used as guidelines, since the responsibility regarding the stability of temporary excavation slopes and the workers safety lies with the contractor.

Due to the limited space available on the work site, the excavation sloping may be problematic. An appropriate support system designed and stamped by an engineer should then be considered. The temporary support system should be designed according to the site specific geotechnical conditions and should also take in account groundwater conditions, meteorological conditions and the presence of nearby structures and infrastructures.

All excavations should be carried out in accordance with the latest regulations of the *Commission de la santé et de la sécurité du travail du Québec* (CSST) in order to provide the workers a safe work environment.

5.3.1.3 Sensitivity of the Native Soils to Disturbance

Native soils found at the projected subgrade elevation are generally silty and show a water content of about 40 %. Consequently, these soils will be easily disturbed; unstable soils should be expected if precipitation occurs or if the subgrade is not properly drained. If the subgrade soil becomes unstable, it should be removed and replaced with class “A” or “B” materials bearing a water content value lower than the optimum Proctor test value found for the chosen material.

Prepared subgrade surfaces should be inspected and adequate monitoring of the unstable soil replacement should be carried out by a representative of the quality control laboratory.

5.3.1.4 Structural Fill

Structural fill to be placed on the subgrade should be composed of class “A” or “B” materials in which the maximum amount fine particles (Ø < 80 µm) must be 20%. This fill material should be placed in 300 mm thick lifts and compacted to at least 95% Modified Proctor maximum dry density.

The placement and compaction of the structural fill should be monitored by a quality control laboratory to confirm its performance with respect to the recommended bearing capacity.

5.3.1.5 Granular Base Under the Slab

A 200 mm thick granular base composed of MG-20 should be placed immediately beneath the concrete ground slab for leveling and support purposes. This base material should be compacted to at least 95% Modified Proctor maximum dry density

5.3.2 STRUCTURAL SLAB AND PILE FOUNDATIONS

The construction of a structural slab supported by pile foundations may be considered and would save the excavation of the material beneath the existing concrete slab. Driven piles or screw piles constitute viable foundation options; limited space inside the building must be kept in mind if this method is chosen.

5.3.2.1 Pile Capacity

Driven piles should be installed until refusal on bedrock is reached. The ultimate bearing capacity should be large enough to achieve a factor of safety equal or higher than 2.0 with respect to the allowable bearing capacity. Note that our field investigation showed a refusal depth of about 3.0 m.

If screw piles are chosen, the helices must be located within the native soil deposit. The number and the diameter of the helices, the diameter of the central shaft and the required torque should be chosen in order for the ultimate bearing capacity to achieve a factor of safety of 2.0 with respect to the desired allowable bearing capacity.

5.3.2.2 Structural Slab

The structural slab should be designed by a structural engineer according to the pile spacing and the required capacity.

5.3.2.3 Construction Monitoring

We recommend that the installation of the pile foundations be closely monitored by a quality control laboratory in order to guarantee the quality of the materials and the proper installation of the piles (verticality, accuracy as to alignment, torque, etc.). A visual inspection of all the piles should be conducted to make sure that they are in a good condition.

Finally, we also recommend that a specialized pile contractor be retained in order to guarantee that the work is carried out professionally and according to the highest standards.

5.4 BACKFILL AND SURFACE DRAINAGE

Backfilling of the foundation walls should be done with a pervious material containing less than 10% of particles passing the 80 microns sieve, such as MG 112 or a class “A” material. These precautions will prevent excessive lateral thrust on the wall and heave caused by the effect of frost on fine soils. It is also recommended to change the general site profile (e.g. creating a slope from the building) in order to channel the precipitation and runoff water away from the building.

The installation of rigid insulation panels placed horizontally around the building should be considered to limit frost heave effect.

5.5 PERMANENT DEWATERING

In order to drain the perched water table located in the soils under the building, a dewatering trench should be constructed around the building down to a minimal depth of 800 mm (elevation 99.2 m). The trench may consist of a perforated pipe wrapped in clean crushed stone and a geotextile; the pipe should run to a ditch or a catch basin.

5.6 REUSE OF LOCAL MATERIALS

According to the investigation, the organic soils or the silty native soils excavated from beneath the bathroom concrete slab cannot be reused under or in the immediate periphery of the Workshop building because they contain organic matter and a too high proportion of fine particles. These materials may be reused where no requirements regarding compaction and drainage are required.

The reuse of fill material is subjected to the MDDELCC environmental rules and regulations.

5.7 SPECIFIC PRECAUTIONS

All granular materials used beneath the proposed building shall be of good quality, free of organic matter and/or of potentially swelling materials. These materials shall be approved by an engineer before use.

Unless otherwise specified, excavations shall be conducted in such a way that all native subgrade material, especially at the location of a projected structure, are intact (undisturbed), free of organic matter and frozen soils and are well drained.

5.8 CONSTRUCTION MONITORING

In light of the projected work to be carried out on site, we recommend a continuous quality control program for the subgrade inspections as well as for the monitoring of the structural fill and granular base placement.

We also recommend a quality control program to verify the quality and the placement of the concrete of the foundations, the slab and the structural elements. Quality control of the concrete should include monitoring the concrete during pouring for the following parameters: temperature, slump, air content mixed into the fresh concrete. Testing the compressive strength of the hardened concrete should also be done. Special attention should be brought to the placement and setting of the concrete since these factors are decisive regarding the quality and lastingness of the structure, particularly if the works are carried out during the winter or in periods of intense heat.

6 STAFF

The fieldwork was carried out by Mr. Andrew Cavanagh, technician, and Mr. Nicolas Tremblay, Engineer. Mr. Marc-André Carrier, Engineer, has written this report (reference # F1313256-009) which was verified and approved by Mr. Ghislain Houde, Engineer.

7 LIMITATIONS OF THE INVESTIGATION

The results of this geotechnical investigation are applicable only if considering the hypotheses and data collected during this study and the limits of the exploration techniques. Consequently, if the geotechnical conditions encountered during the construction phase of the project are different than those found in this study, they should be verified by a geotechnical engineer who will determine the effects of the new conditions on the project and, if needed, issue new recommendations.

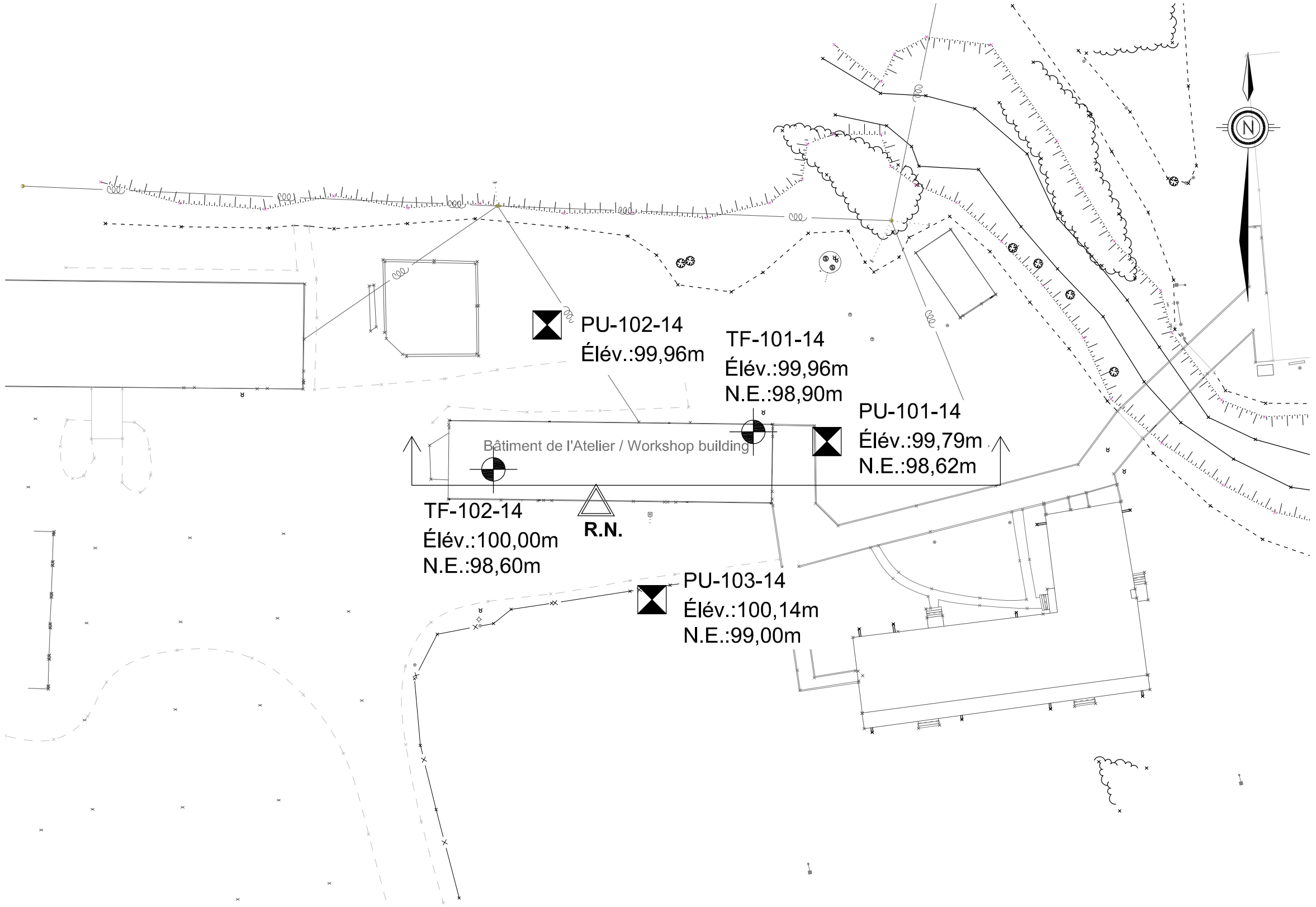
The groundwater conditions reported in this document pertain solely to the indicated time and locations and are for informative purposes only considering that they may vary according to seasons, the importance of local rainfall and/or human interventions on site and neighboring properties. Consequently, these groundwater conditions may be different from those observed when performing future construction work.

All factual data, interpretations and recommendations found in this report pertain solely to the project which is the object of this investigation and do not apply to other projects or sites. This report was only prepared for the benefit of our client. We decline all responsibilities and obligations resulting from the use of this report by a third party. The consequences of any decision made by a third party based on this report is the third party's responsibility.

If changes were brought to the elevation, the location, the conception or the nature of the project, the conclusions and recommendations found in this report should not be considered valid until the impacts of the changes are reviewed and taken into account by **Labo S.M. inc.**, and that the report's conclusions be modified or kept in writing. The realization of a complementary field investigation and report may be required.

Appendix I

BOREHOLE LOCATION PLAN



COORDONNÉES MTM NAD 83 FUSEAU 7 / COORDINATES NAD 83 MTM ZONE 7		
No SONDAGE: / TEST PIT #:	NORD (Y)/NORTH (Y)	EST (X)/EAST (X)
PU-101-14	5 214 090,2	282 448,3
PU-102-14	5 214 103,9	282 415,5
PU-103-14	5 214 071,7	282 427,8

LÉGENDE / *LEGEND*:

- TF–XX–14 — FORAGE / *BOREHOLE*
- PU–XX–14 — PUITS D'EXPLORATION / *TEST PIT*
- Élév.:XX,XX — ÉLÉVATION DU TERRAIN / *GROUND ELEVATION*
- N.E.:XX,XX — ÉLÉVATION DU NIVEAU D'EAU / *GROUNDWATER ELEVATION* (mesuré le 4 décembre 2014) (measured December 4th 2014)
- R.N. — REPÈRE NIVELLEMENT / *BENCHMARK*
- SENS D'ÉCOULEMENT DES EAUX SOUTERRAINES / *DIRECTION OF GROUNDWATER FLOW*

NOTE:
Le repère de nivellement utilisé, dont l'élévation arbitraire est de 100,0m, correspond au–dessus de la dalle de béton du bâtiment à l'étude.
Toutes les élévations se réfèrent à ce niveau de base et sont exprimées en mètres. /
The benchmark used, which arbitrary elevation is 100,0m, is defined as the top of the workshop building's concrete slab. All elevations refer to this benchmark and are expressed in meters.

SMi LABO S.M. INC.
1200, St–Jean Baptiste, local 116, Québec (Québec) G2E 5E8
(418) 871–9330 Fax: (418) 871–9343 www.groupesm.com

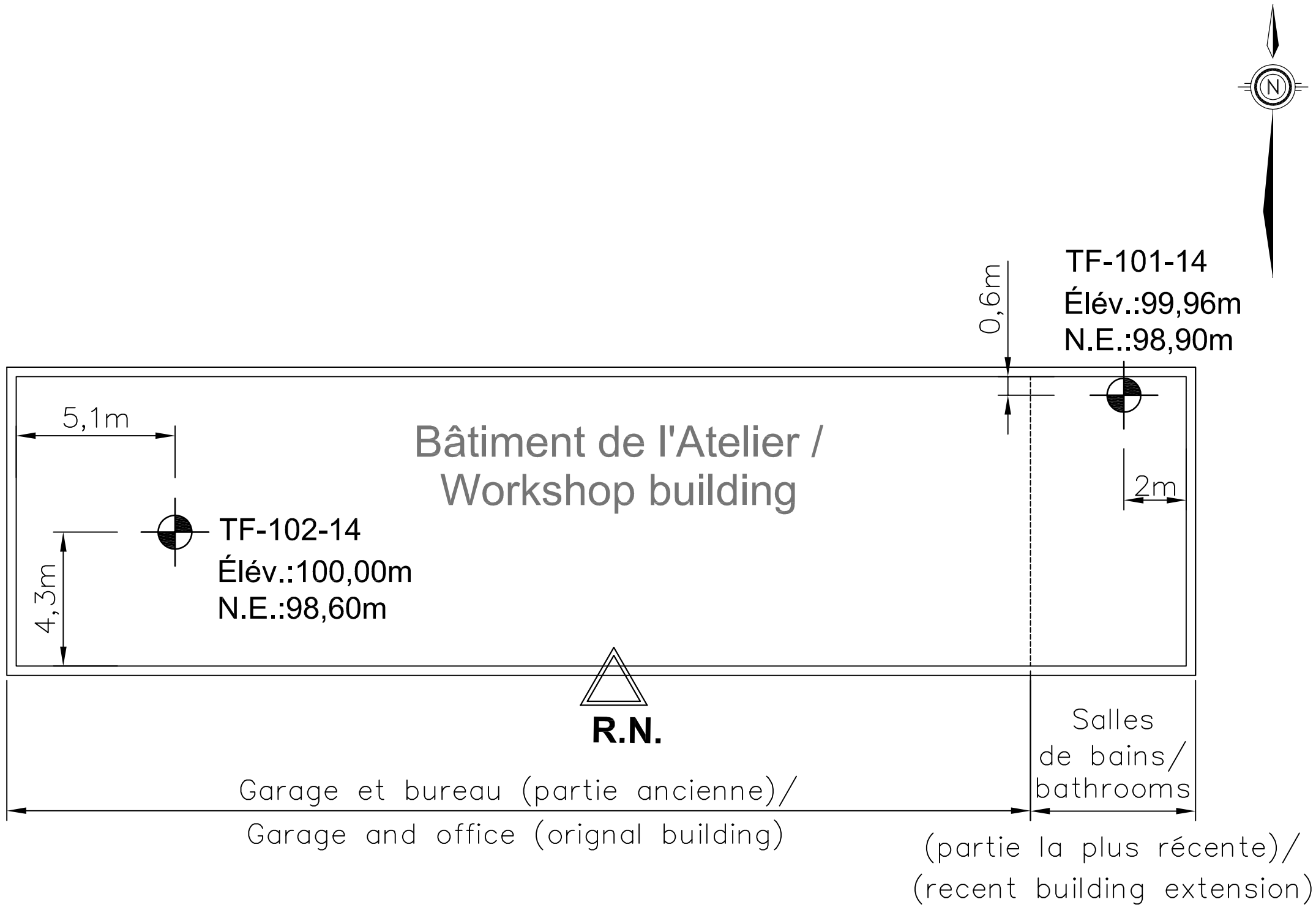
CLIENT:
Travaux publics et Services gouvernementaux Canada / Public Works and Government Services Canada

PROJET / *PROJECT*:
ÉTUDE GÉOTECHNIQUE / *GEOTECHNICAL INVESTIGATION*
Rénovation des salles de bain de l'Atelier et drainage du site
Réserve national de la faune du Cap Tourmente / Renovation of the workshop's bathrooms and site drainage
Cap Tourmente National Wildlife Area
Chemin de la Friponne, St–Joachim (Québec)

TITRE / *TITLE*:
LOCALISATION DES SONDAGES
BOREHOLE/TEST PIT LOCATION PLAN

DESSINÉ PAR / *DRAWN BY*: S. BORDELEAU dess. (init.)	PROJETÉ PAR / *PROJECTED BY*: M–A. CARRIER ing./eng. (init.)
VÉRIFIÉ PAR / *VERIFIED BY*: M–A. CARRIER ing./eng. (init.)	APPROUVÉ PAR / *APPROVED BY*: S. GRAVELINE ing./eng. (init.)
ÉCHELLE / *SCALE*: 1:500	DATE: 11/12/2014
	FICHIER DAO / *DAO FILE*: 13256009K001.dwg

DESSIN NO / *DRAWING NO*: F13132560009K001 — RÉV. – A



LÉGENDE / *LEGEND*:

TF–XX–14	FORAGE / *BOREHOLE*
Élé.:XX,XX	ÉLÉVATION DU TERRAIN / *GROUND ELEVATION*
N.E.:XX,XX	ÉLÉVATION DU NIVEAU D'EAU / *GROUNDWATER ELEVATION* (mesuré le 4 décembre 2014) (measured December 4th, 2014)
R.N.	REPÈRE NIVELLEMENT / *BENCHMARK*

NOTE:
Le repère de nivellement utilisé, dont l'élévation arbitraire est de 100,0m, correspond au–dessus de la dalle de béton du bâtiment à l'étude.
Toutes les élévations se réfèrent à ce niveau de base et sont exprimées en mètres. /
The benchmark used, which arbitrary elevation is 100,0m, is defined as the top of the workshop building's concrete slab.
All elevations refer to this benchmark and are expressed in meters.

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CLIENT:
Travaux publics et Services gouvernementaux Canada / Public Works and Government Services Canada

PROJET / *PROJECT*:

ÉTUDE GÉOTECHNIQUE / *GEOTECHNICAL INVESTIGATION*
Rénovation des salles de bain de l'Atelier et drainage du site
Réserve national de la faune du Cap Tourmente / Renovation of the Workshop's bathrooms and site drainage
Cap Tourmente National Wildlife Area
Chemin de la Friponne, St–Joachim (Québec)

TITRE / *TITLE*:

LOCALISATION DES FORAGES INTÉRIEURS
BOREHOLE LOCATION PLAN (INDOORS)

DESSINÉ PAR / *DRAWN BY*: S. BORDELEAU dess. — init.	PROJETÉ PAR / *PROJECTED BY*: M–A. CARRIER ing./eng. — init.
VÉRIFIÉ PAR / *VERIFIED BY*: M–A. CARRIER ing./eng. — init.	APPROUVÉ PAR / *APPROVED BY*: S. GRAVELINE ing./eng. — init.
ÉCHELLE / *SCALE*: 1:150	DATE: 11/12/2014
	FICHIER DAO / *DAO FILE*: 13256009K001.dwg

DESSIN NO / *DRAWING NO*: F13132560009K002 — RÉV. — A

Appendix II

BOREHOLE REPORTS

Labo S.M. Inc.

BOREHOLE REPORT

Project:	Geotechnical Investigation - Renovation of the Workshop's Bathrooms and Site Drainage	Location:	See borehole/test pit location plan
Client:	PWGSC	X:	282448.3
Site:	Cap Tourmente National Wildlife Area	Y:	5214090.2
O./ref.:	F1313256-009	Type of survey:	BOREHOLE
Figure:	F1313256009K001	Equipment used:	Backhoe
		Casing:	Split spoon or core size:

Report # :	PU-101-14
Page:	1 of 1
Starting date:	2014-11-28
Technician:	N. Tremblay, Eng.
Depth:	1.50m
Elevation (arbitrary):	99.79m

SAMPLING METHOD

SS	Split spoon
CSC	Continuous samping casing
CR	Diamond corer
TM	Thin-walled casing
TA	Auger
TS	Shelby casing
EM	Manual sampling

QUALITATIVE TERMS

Clay	< 0,002 mm
Silt	0,002 - 0,08 mm
Sand	0,08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMS

Trace	< 10 %
Some	10 - 20 %
Adjective(...uous)	20 - 35 %
and(ex: and sand)	> 35 %
First word	Dominant fraction

SYMBOLS

Nspt	Penetration index standard (BNQ 2501-140)
Ncorr	Corrected N for nonstandard diameter
Nc	Cone penetration index (BNQ 2501-145)
RQD	Rock quality designation (%)

GROUNDWATER LEVEL

	Date	Depth
Reading 1	2014-12-04	1.17m
Reading 2	2014-12-11	1.16m

Remark:

SAMPLE CONDITION

- Remoulded
- Intact (thin-walled casing)
- Lost
- Rock core

MECHANICAL PROPERTIES OF SOILS

COMPACITY	"N" Index	STIFFNESS	Cu or Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALITY	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

DISCONTINUITY SPACING

Extremely close	< 20 mm
Very close	20 - 60 mm
Close	60 - 200 mm
Moderately close	200 - 600 mm
Wide	600 - 2000 mm
Very wide	2000 - 6000 mm
Extremely wide	> 6000 mm

STRATIGRAPHY

DEPTH (m)	DEPTH (ft)	ELEVATION (m) / DEPTH (m)	SOILS AND ROCK DESCRIPTION
		99.79	
		0.00	Topsoil.
		99.69	
		0.10	Fill: Silt, some sand and gravel; brown. Traces of roots 10% of pebbles.
		99.19	
		0.60	Sand, traces of silt and gravel; brown.
		98.89	
1		0.90	Gravelly sand, some silt, gray-brown.
		98.49	
		1.30	Silt, some sand and gravel; gray. Traces of organic matter (wood).
		98.29	
	5	1.50	END OF TEST PIT
2			
3	10		

SAMPLES

SYMBOL	CONDITION	TYPE AND #	CALIBER	RECUPERATION (%)	N - Nc - RQD	STANDARD PENTRATION TEST BLOW/150 mm
		EM-1				
		EM-2				
		EM-3				
		EM-4				

WATER LEVEL / WATER FLOW: 98.62

LAB/ IN SITU RESULTS

LAB TEST

AG	: Particle size analysis :
S	Sedimentometry
C	: Oedo. consolidation
W	: Water content
WL	: Liquid limit
Wp	: Plastic limit
VB	: Methylene blue
k	: Permeability
f'c	: Simple compression
MD	: Micro-deval
AC	: Chemical analysis

GRAPH

- × : N (Stand. pen.)
- ▽ : Nd (Dyn. pen.):
- ■ Intact Cu
- □ : Remoulded Cu
- ◆ : Intact Su
- ◇ : Remoulded Su

Wp W WL

20 40 60 80

REMARKS

General remarks: **Voluntary stop of the test pit at the depth of 1.5m (customer's request due to the potential presence of a private underground utility).**

Verified by: M-A. Carrier, Eng.

Date: 2015-01-12

Labo S.M. Inc.

BOREHOLE REPORT

Project:	Geotechnical Investigation - Renovation of the Workshop's Bathrooms and Site Drainage	Location:	See borehole/test pit location plan	Report # :	PU-102-14
		X:	282415.5	Page:	1 of 1
Client:	PWGSC	Y:	5214103.9	Starting date:	2014-11-28
Site:	Cap Tourmente National Wildlife Area	Type of survey:	BOREHOLE	Technician:	N. Tremblay, Eng.
O./ref.:	F1313256-009	Equipment used:	Backhoe	Depth:	3.10m
Figure:	F1313256009K001	Casing:	Split spoon or core size:	Elevation (arbitrary):	99.96m

SAMPLING METHOD

SS	Split spoon
CSC	Continuous samping casing
CR	Diamond corer
TM	Thin-walled casing
TA	Auger
TS	Shelby casing
EM	Manual sampling

QUALITATIVE TERMS

Clay	< 0,002 mm
Silt	0,002 - 0,08 mm
Sand	0,08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMS

Trace	< 10 %
Some	10 - 20 %
Adjective(...uous)	20 - 35 %
and(ex: and sand)	> 35 %
First word	Dominant fraction

SYMBOLS

Nspt	Penetration index standard (BNQ 2501-140)
Ncorr	Corrected N for nonstandard diameter
Nc	Cone penetration index (BNQ 2501-145)
RQD	Rock quality designation (%)

GROUNDWATER LEVEL

	Date	Depth
Reading 1	2014-12-04	3.10m
Reading 2	2014-12-11	3.02m

Remark:

SAMPLE CONDITION

- Remoulded
- Intact (thin-walled casing)
- Lost
- Rock core

MECHANICAL PROPERTIES OF SOILS

COMPACITY	"N" Index	STIFFNESS	Cu or Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALITY	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

DISCONTINUITY SPACING

Extremely close	< 20 mm
Very close	20 - 60 mm
Close	60 - 200 mm
Moderately close	200 - 600 mm
Wide	600 - 2000 mm
Very wide	2000 - 6000 mm
Extremely wide	> 6000 mm

STRATIGRAPHY

DEPTH (m)	DEPTH (ft)	ELEVATION (m) / DEPTH (m)	SOILS AND ROCK DESCRIPTION
		99.96	
		0.00	Topsoil.
		99.86	
		0.10	Fill: Silt, some gravel and sand; brown. Traces of organic material (roots and wood).
1		98.86	
		1.10	Natural soil: Sandy silt, traces to some gravel; gray. Presence of 10% pebbles on a 0.6m thick interval.
	5		
2			
3	10	96.86	
		3.10	REFUSAL ON SUSPECTED BOULDER OR BEDROCK

SAMPLES

SYMBOL	CONDITION	TYPE AND #	CALIBER	RECUPERATION (%)	N - Nc - RQD	STANDARD PENTRATION TEST BLOW/150 mm
		EM-1				
		EM-2				
		EM-3				

WATER LEVEL / WATER FLOW: 96.86

LAB/ IN SITU RESULTS

LAB TEST

AG	: Particle size analysis :
S	Sedimentometry
C	: Oedo. consolidation
W	: Water content
WL	: Liquid limit
Wp	: Plastic limit
VB	: Methylene blue
k	: Permeability
f'c	: Simple compression
MD	: Micro-deval
AC	: Chemical analysis

AG, W

GRAPH

× : N (Stand. pen.)
▽ : Nd (Dyn. pen.):
■ Intact Cu
□ : Remoulded Cu
◆ : Intact Su
◇ : Remoulded Su

Wp W WL

20 40 60 80

33.1

REMARKS

General remarks:

Verified by: M-A. Carrier, Eng.

Date: 2015-01-12

Labo S.M. Inc.

BOREHOLE REPORT

Project:	Geotechnical Investigation - Renovation of the Workshop's Bathrooms and Site Drainage	Location:	See borehole/test pit location plan
Client:	PWGSC	X:	282427.8
Site:	Cap Tourmente National Wildlife Area	Y:	5214071.7
O./ref.:	F1313256-009	Type of survey:	BOREHOLE
Figure:	F1313256009K001	Equipment used:	Backhoe
		Casing:	Split spoon or core size:

Report # :	PU-103-14
Page:	1 of 1
Starting date:	2014-11-28
Technician:	N. Tremblay, Eng.
Depth:	3.10m
Elevation (arbitrary):	100.14m

SAMPLING METHOD

SS	Split spoon
CSC	Continuous samping casing
CR	Diamond corer
TM	Thin-walled casing
TA	Auger
TS	Shelby casing
EM	Manual sampling

QUALITATIVE TERMS

Clay	< 0,002 mm
Silt	0,002 - 0,08 mm
Sand	0,08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMS

Trace	< 10 %
Some	10 - 20 %
Adjective(...uous)	20 - 35 %
and(ex: and sand)	> 35 %
First word	Dominant fraction

SYMBOLS

Nspt	Penetration index standard (BNQ 2501-140)
Ncorr	Corrected N for nonstandard diameter
Nc	Cone penetration index (BNQ 2501-145)
RQD	Rock quality designation (%)

GROUNDWATER LEVEL

	Date	Depth
Reading 1	2014-12-04	1.14m
Reading 2	2014-12-11	1.31m

Remark:

SAMPLE CONDITION

- Remoulded
- Intact (thin-walled casing)
- Lost
- Rock core

MECHANICAL PROPERTIES OF SOILS

COMPACITY	"N" Index	STIFFNESS	Cu or Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALITY	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

DISCONTINUITY SPACING

Extremely close	< 20 mm
Very close	20 - 60 mm
Close	60 - 200 mm
Moderately close	200 - 600 mm
Wide	600 - 2000 mm
Very wide	2000 - 6000 mm
Extremely wide	> 6000 mm

STRATIGRAPHY

DEPTH (m)	DEPTH (ft)	ELEVATION (m) / DEPTH (m)	SOILS AND ROCK DESCRIPTION
		100.14	
		0.00	Topsoil.
		100.04	
		0.10	Fill:
			Silt, some sand, traces of gravel; brown.
		99.84	
		0.30	Some organic material (roots and wood).
			Sand, some silt and gravel; brown. 10% pebbles.
		99.44	
		0.70	Silt, some sand and traces of gravel; gray-black. Some organic material (roots, wood, topsoil) 10% of pebbles.
1			
		98.84	
		1.30	Silt, some clay and traces of sand; gray.
	5		
2			
		97.84	Clay drainage pipe at 2.2m depth.
		2.30	Natural soil: Silt, some clay, traces of sand; gray. Traces of disseminated organic matter
3	10	97.04	
		3.10	REFUSAL ON SUSPECTED BOULDER OR BEDROCK

SAMPLES

SYMBOL	CONDITION	TYPE AND #	CALIBER	RECUPERATION (%)	N - Nc - RQD	STANDARD PENTRATION TEST BLOW/150 mm
		EM-1				
		EM-2				
		EM-3				
		EM-4				
		EM-5				

WATER LEVEL / WATER FLOW: 99.00

LAB/ IN SITU RESULTS

LAB TEST

AG	: Particle size analysis :
S	Sedimentometry
C	: Oedo. consolidation
W	: Water content
WL	: Liquid limit
Wp	: Plastic limit
VB	: Methylene blue
k	: Permeability
f'c	: Simple compression
MD	: Micro-deval
AC	: Chemical analysis

AG, W, S

GRAPH

× : N (Stand. pen.)
▽ : Nd (Dyn. pen.):
■ Intact Cu
□ : Remoulded Cu
◆ : Intact Su
◇ : Remoulded Su

Wp W WL

20 40 60 80

26.8

REMARKS

General remarks:

Verified by: M-A. Carrier, Eng.

Date: 2015-01-12

Labo S.M. Inc.

BOREHOLE REPORT

Project: Geotechnical Investigation - Renovation of the Workshop's Bathrooms and Site Drainage	Location: See borehole/test pit location plan	Report # :	TF-101-14
	X:	Page:	1 of 1
Client: PWGSC	Y:	Starting date:	2014-11-27
Site: Cap Tourmente National Wildlife Area	Type of survey: BOREHOLE	Technician:	A. Cavanagh, tech.
O./ref.: F1313256-009	Equipment used: Portable drill	Depth:	2.95m
Figure: F1313256009K002	Casing: BW Split spoon or core size: B and N	Elevation (arbitrary):	99.96m

SAMPLING METHOD		QUALITATIVE TERMS		QUANTITATIVE TERMS		SYMBOLS	
SS	Split spoon	Clay	< 0,002 mm	Trace	< 10 %	Nspt	Penetration index standard (BNQ 2501-140)
CSC	Continuous samping casing	Silt	0,002 - 0,08 mm	Some	10 - 20 %	Ncorr	Corrected N for nonstandard diameter
CR	Diamond corer	Sand	0,08 - 5 mm	Adjective(...uous)	20 - 35 %	Nc	Cone penetration index (BNQ 2501-145)
TM	Thin-walled casing	Gravel	5 - 80 mm	and(ex: and sand)	> 35 %	RQD	Rock quality designation (%)
TA	Auger	Cobbles	80 - 200 mm	First word	Dominant fraction		
TS	Shelby casing	Boulders	> 200 mm				
EM	Manual sampling						

GROUNDWATER LEVEL

	Date	Depth
Reading 1	2014-12-04	1.06m
Reading 2	2014-12-11	1.20m

Remark:

SAMPLE CONDITION

- Remoulded
- Intact (thin-walled casing)
- Lost
- Rock core

MECHANICAL PROPERTIES OF SOILS

COMPACITY	"N" Index	STIFFNESS	Cu or Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALITY	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

DISCONTINUITY SPACING

Extremely close	< 20 mm
Very close	20 - 60 mm
Close	60 - 200 mm
Moderately close	200 - 600 mm
Wide	600 - 2000 mm
Very wide	2000 - 6000 mm
Extremely wide	> 6000 mm

STRATIGRAPHY

DEPTH (m)	DEPTH (ft)	ELEVATION (m) / DEPTH (m)	SOILS AND ROCK DESCRIPTION
		99.96	
		0.00	Ceramic tile and concrete slab.
		99.83	
		0.13	Stratigraphic void.
		99.76	Fill:
		0.20	Clean crushed stone (10 mm).
		99.66	
		0.30	Organic fill:
			Sand, some silt, traces of gravel; black.
1			Significant presence of organic matter (topsoil, roots, rootlets, wood).
		98.54	
		1.42	Natural soil:
	5		Silt, traces to some sand and clay; gray.
			Some traces of disseminated organic material (wood, topsoil and roots).
2			
			Presence of rock fragments.
		97.01	
3		2.95	REFUSAL ON SUSPECTED BOULDER OR BEDROCK
	10		

SAMPLES

SYMBOL	CONDITION	TYPE AND #	CALIBER	RECUPERATION (%)	N - Nc - RQD	STANDARD PENTRATION TEST BLOW/150 mm
		CR-1		100		
		CF-2	N	0	6	4-4-2-2
		CF-3	B	79	4	2-2-2-2
		CF-4	B	50	9	8-5-4-4
		CF-5	B	79	12	2-4-8-26
		CF-6	B	100		27-50 /50mm

WATER LEVEL / WATER FLOW: 98.90

LAB/ IN SITU RESULTS

LAB TEST

- AG : Particle size analysis :
- S : Sedimentometry
- C : Oedo. consolidation
- W : Water content
- WL : Liquid limit
- Wp : Plastic limit
- VB : Methylene blue
- k : Permeability
- f'c : Simple compression
- MD : Micro-deval
- AC : Chemical analysis

AG, W, S

GRAPH

- × : N (Stand. pen.)
- ▽ : Nd (Dyn. pen.):
- ■ Intact Cu
- □ : Remoulded Cu
- ◆ : Intact Su
- ◇ : Remoulded Su

Wp W WL

20 40 60 80

41.5

REMARKS

Nc=3

Nc=2

General remarks: **Nc: Index adjusted for the hammer drop height.**

Verified by: M-A. Carrier, Eng.

Date: 2015-01-12

Labo S.M. Inc.

BOREHOLE REPORT

Project: Geotechnical Investigation - Renovation of the Workshop's Bathrooms and Site Drainage	Location: See borehole/test pit location plan	Report # :	TF-102-14
	X:	Page:	1 of 1
Client: PWGSC	Y:	Starting date:	2014-11-28
Site: Cap Tourmente National Wildlife Area	Type of survey: BOREHOLE	Technician:	A. Cavanagh, tech.
O./ref.: F1313256-009	Equipment used: Portable drill	Depth:	2.95m
Figure: F1313256009K002	Casing: BW Split spoon or core size: B and N	Elevation (arbitrary):	100.00m

SAMPLING METHOD

SS	Split spoon
CSC	Continuous samping casing
CR	Diamond corer
TM	Thin-walled casing
TA	Auger
TS	Shelby casing
EM	Manual sampling

QUALITATIVE TERMS

Clay	< 0,002 mm
Silt	0,002 - 0,08 mm
Sand	0,08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMS

Trace	< 10 %
Some	10 - 20 %
Adjective(...uous)	20 - 35 %
and(ex: and sand)	> 35 %
First word	Dominant fraction

SYMBOLS

Nspt	Penetration index standard (BNQ 2501-140)
Ncorr	Corrected N for nonstandard diameter
Nc	Cone penetration index (BNQ 2501-145)
RQD	Rock quality designation (%)

GROUNDWATER LEVEL

	Date	Depth
Reading 1	2014-12-04	1.40m
Reading 2	2014-12-11	1.53m

Remark:

SAMPLE CONDITION

- Remoulded
- Intact (thin-walled casing)
- Lost
- Rock core

MECHANICAL PROPERTIES OF SOILS

COMPACITY	"N" Index	STIFFNESS	Cu or Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALITY	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

DISCONTINUITY SPACING

Extremely close	< 20 mm
Very close	20 - 60 mm
Close	60 - 200 mm
Moderately close	200 - 600 mm
Wide	600 - 2000 mm
Very wide	2000 - 6000 mm
Extremely wide	> 6000 mm

STRATIGRAPHY

DEPTH (m)	DEPTH (ft)	ELEVATION (m) / DEPTH (m)	SOILS AND ROCK DESCRIPTION
		100.00	
		0.00	Concrete slab.
		99.80	
		0.20	Fill:
		99.70	Clean crushed stone (20mm).
		0.30	Sand, trace of silt; brown.
		99.19	
1		0.81	Natural soil: Silt, traces to some sand and clay; gray.
	5		
2			
		97.26	
		2.74	Silt and sand, traces of gravel; gray. Presence of rock fragment.
		97.05	
3		2.95	REFUSAL ON SUSPECTED BOULDER OR BEDROCK
	10		

SAMPLES

SYMBOL	CONDITION	TYPE AND #	CALIBER	RECUPERATION (%)	N - Nc - RQD	STANDARD PENTRATION TEST BLOW/150 mm
		CR-1		100		
		CF-2	N	46	6	5-3-3-2
		CF-3	B	42	8	1-1-7-2
		CF-4	B	92	5	2-3-2-3
		CF-5	B	92	8	2-3-5-8
		CF-6	B	100		9-50 /50mm

WATER LEVEL / WATER FLOW: 98.60

LAB/ IN SITU RESULTS

LAB TEST

AG	: Particle size analysis :
S	Sedimentometry
C	: Oedo. consolidation
W	: Water content
WL	: Liquid limit
Wp	: Plastic limit
VB	: Methylene blue
k	: Permeability
f'c	: Simple compression
MD	: Micro-deval
AC	: Chemical analysis

AG, W, S

GRAPH

× : N (Stand. pen.)
▽ : Nd (Dyn. pen.):
■ Intact Cu
□ : Remoulded Cu
◆ : Intact Su
◇ : Remoulded Su

Wp W WL

20 40 60 80

36.3

REMARKS

General remarks:

Verified by: M-A. Carrier, Eng.

Date: 2015-01-12

Appendix III

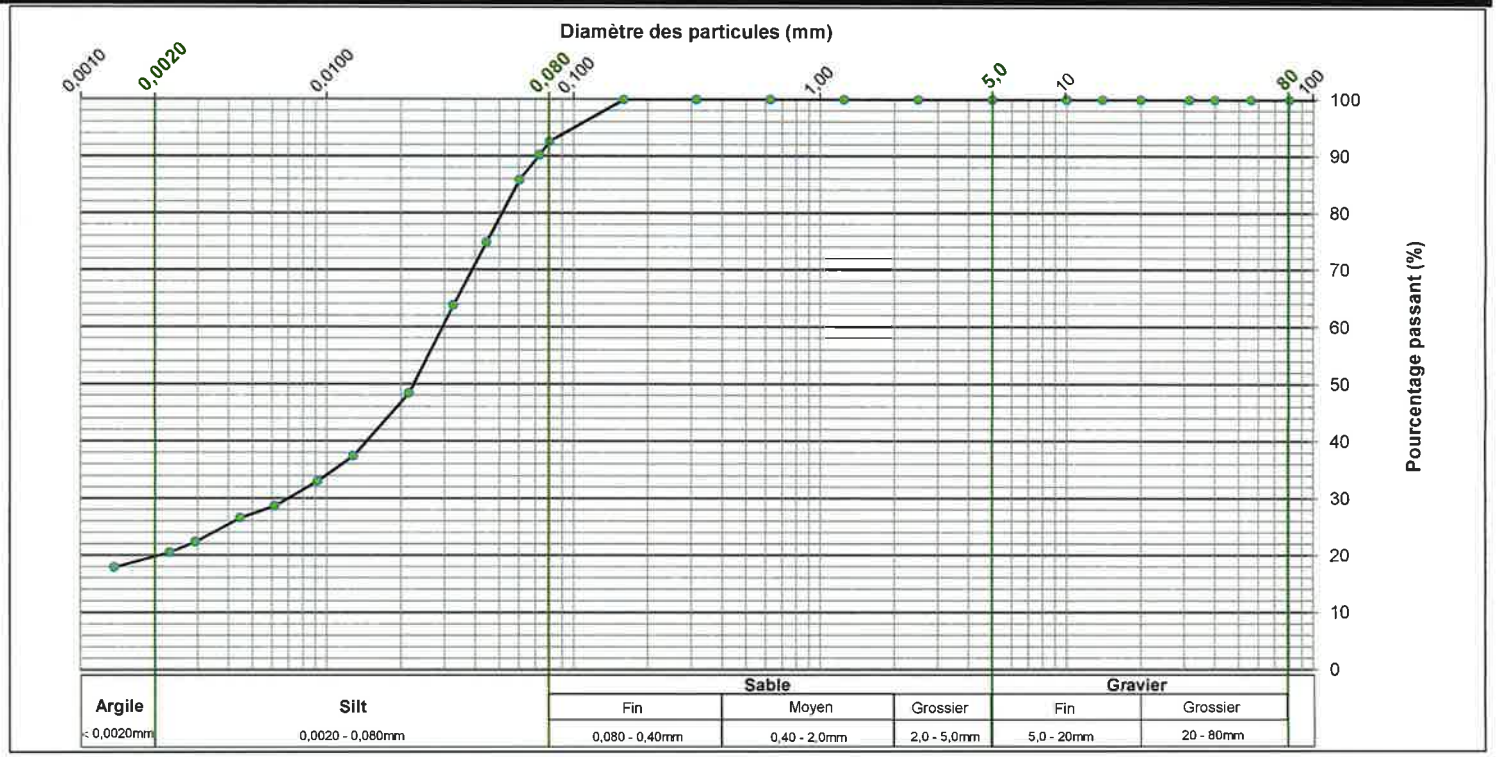
LABORATORY ANALYSIS REPORTS

LABO S.M. INC.

Rapport no. : ***1405830-3***
Laboratoire no. : ***14-35452***

Analyse granulométrique par tamisage LC 21-040
Analyse granulométrique par sédimentation BNQ 2501-025

Diamètre (mm)	Passant (%)
112	100
80	100
56	100
40	100
31,5	100
20	100
14	100
10	100
5	100
2,5	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	92,6
0,0729	90,2
0,0605	85,8
0,0444	74,8
0,0326	63,8
0,0216	48,4
0,0128	37,5
0,0092	33,1
0,0062	28,7
0,0045	26,6
0,0029	22,4
0,0023	20,5
0,0014	18,0
% Gravier:	0
% Sable:	7,4
% Silt*:	72,8
% Argile:	19,8
Cu:	
Cc:	
D10:	
D15:	
D30:	0,0070
D50:	0,0225
D60:	0,0294
D85:	0,0591



Propriétés physiques et mécaniques

Analyses	Norme	Résultats
Détermination de la teneur en eau (G2A)	LC 21-201	41,50%

N° Dossier:	**F1313256-009**	**Sondage:**	TF-101-14	**Description:**	Silt, un peu d'argile, traces de sable
Client:	**Travaux publics et Services gouvernementaux Canada**	**Échantillon:**	CF-4		
Projet:	Etude géotechnique - rénovation des salles de bain et drainage du site	**Profondeur:**	1,42m @ 2,03m	**Remarques:**	
		Prélevé par:	Nicolas Tremblay, ing.		
Site:	Réserve nationale de la faune du Cap Tourmente	**Prélevé le :**	2014-11-14	*Inclus le pourcentage d'argile lorsque ce dernier n'est pas précisé	

Vérifié par : _____ **Date:** 2014-12-10 **Approuvé par :** _____ **Date:** 14/12/15

Caroline Desfossés, chef de laboratoire — Marc-André Carrier, ing.

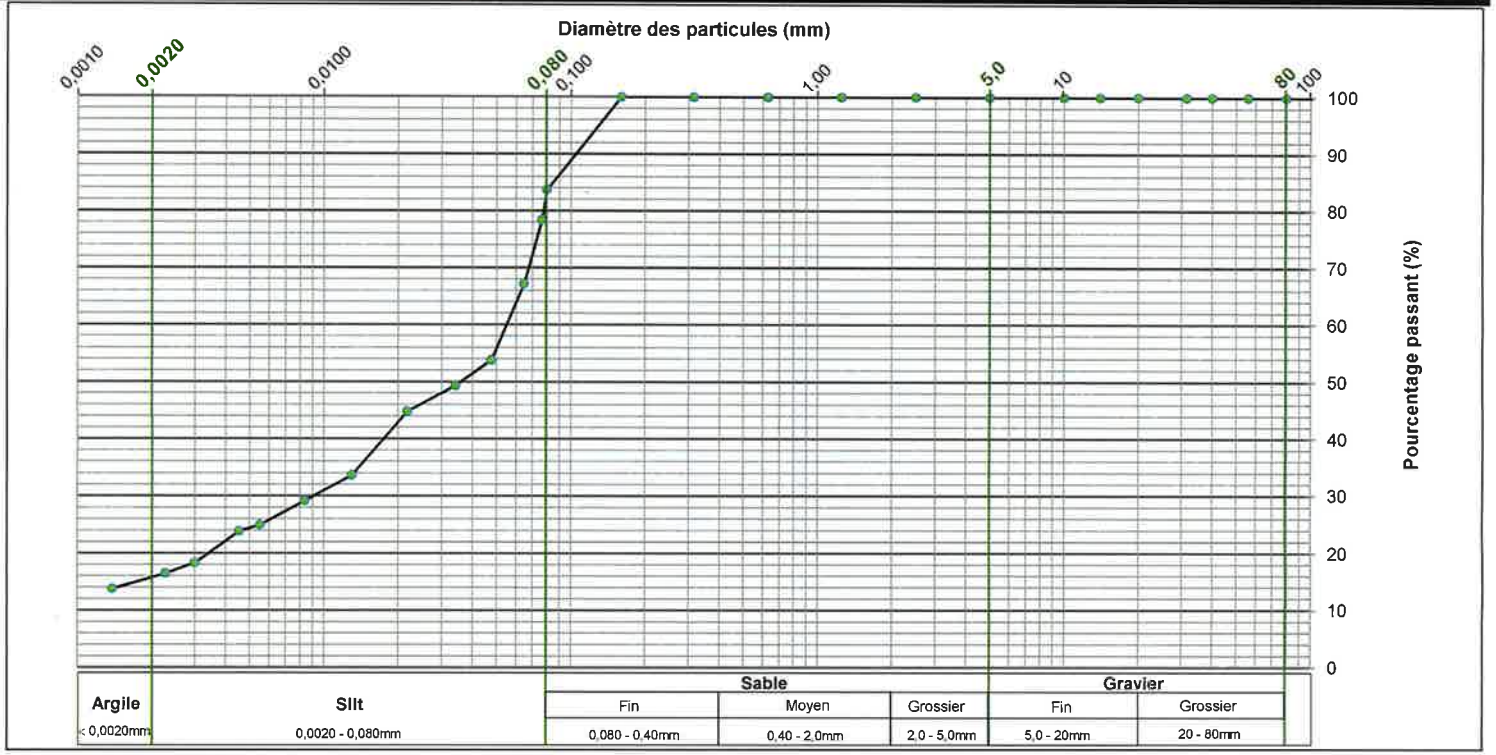
FLG-210 (09-2012) rev.0

LABO S.M. INC.

Rapport no. : ***1405830-4***
Laboratoire no. : ***14-35453***

Analyse granulométrique par tamisage LC 21-040
Analyse granulométrique par sédimentation BNQ 2501-025

Diamètre (mm)	Passant (%)
112	100
80	100
56	100
40	100
31,5	100
20	100
14	100
10	100
5	100
2,5	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	83,7
0,0764	78,4
0,0647	67,3
0,0476	53,8
0,0341	49,3
0,0218	44,9
0,0130	33,7
0,0084	29,2
0,0055	25,0
0,0045	23,9
0,0030	18,4
0,0023	16,5
0,0014	13,8
% Gravier:	0
% Sable:	16,3
% Silt*:	67,9
% Argile:	15,8
Cu:	
Cc:	
D_{10}:	
D_{15}:	0,0017
D_{30}:	0,0091
D_{50}:	0,0358
D_{60}:	0,0548
D_{85}:	0,0845



Propriétés physiques et mécaniques

Analyses	Norme	Résultats
Détermination de la teneur en eau (G2A)	LC 21-201	36,25%

N° Dossier:	**F1313256-009**	**Sondage:**	TF-102-14	**Description:**	Silt un peu de sable et d'argile
Client:	**Travaux publics et Services gouvernementaux Canada**	**Échantillon:**	CF-3		
Projet:	Etude géotechnique - rénovation des salles de bain et drainage du site	**Profondeur:**	0,81m @ 1,42m	**Remarques:**	
		Prélevé par:	Nicolas Tremblay, ing.		
Site:	Réserve nationale de la faune du Cap Tourmente	**Prélevé le :**	2014-11-14	*Inclus le pourcentage d'argile lorsque ce dernier n'est pas précisé	

Vérifié par : _____ **Date:** 2014-12-10 **Approuvé par :** _____ **Date:** 14/12/15

Caroline Desfossés, chef de laboratoire — Marc-André Carrier, ing.

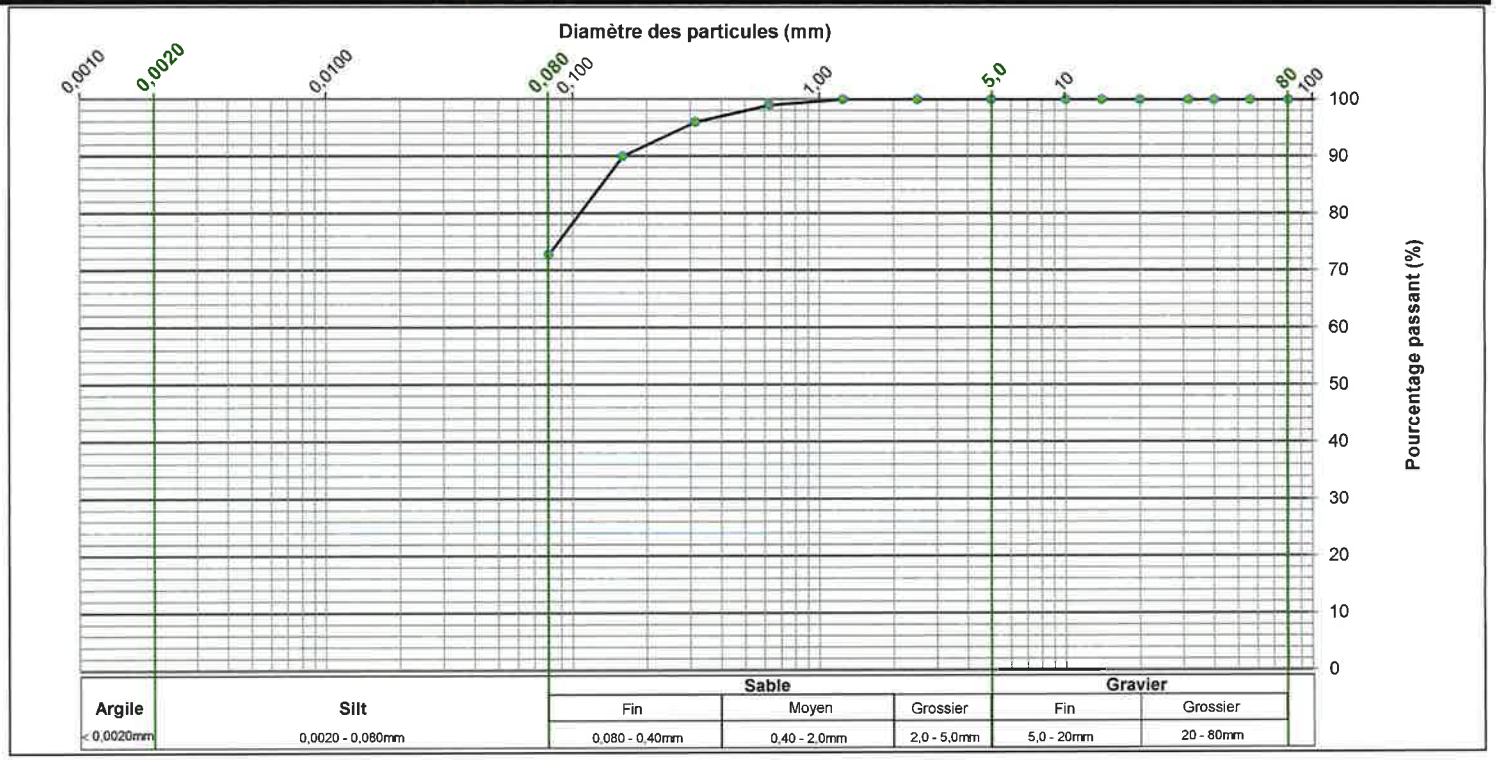
FLG-210 (09-2012) rev.0

LABO S.M. INC.

Rapport no. : ***1405830-1***
Laboratoire no. : ***14-35449***

Analyse granulométrique par tamisage LC 21-040
Analyse granulométrique par sédimentation BNQ 2501-025

Diamètre (mm)	Passant (%)
112	100
80	100
56	100
40	100
31,5	100
20	100
14	100
10	100
5	100
2,5	100
1,25	100
0,630	99
0,315	96
0,160	90
0,080	72,8



% Gravier:	0
% Sable:	27,2
% Silt*:	72,8
% Argile:	
Cu:	
Cc:	
D_{10}:	
D_{15}:	
D_{30}:	
D_{50}:	
D_{60}:	
D_{85}:	0,1308

Propriétés physiques et mécaniques

Analyses	Norme	Résultats
Détermination de la teneur en eau (G2A)	LC 21-201	33,08%

N° Dossier:	**F1313256-009**	**Sondage:**	PU-102-14	**Description:**	
Client:	**Travaux publics et Services gouvernementaux Canada**	**Échantillon:**	EM-3		
Projet:	Etude géotechnique - rénovation des salles de bain et drainage du site	**Profondeur:**	1,7m @ 3,1m	**Remarques:**	
		Prélevé par:	Nicolas Tremblay, ing.		
Site:	Réserve nationale de la faune du Cap Tourmente	**Prélevé le :**	2014-11-14	*Inclus le pourcentage d'argile lorsque ce dernier n'est pas précisé	

Vérifié par : _____ **Date:** 2014-12-04 **Approuvé par :** _____ **Date:** 14/12/15

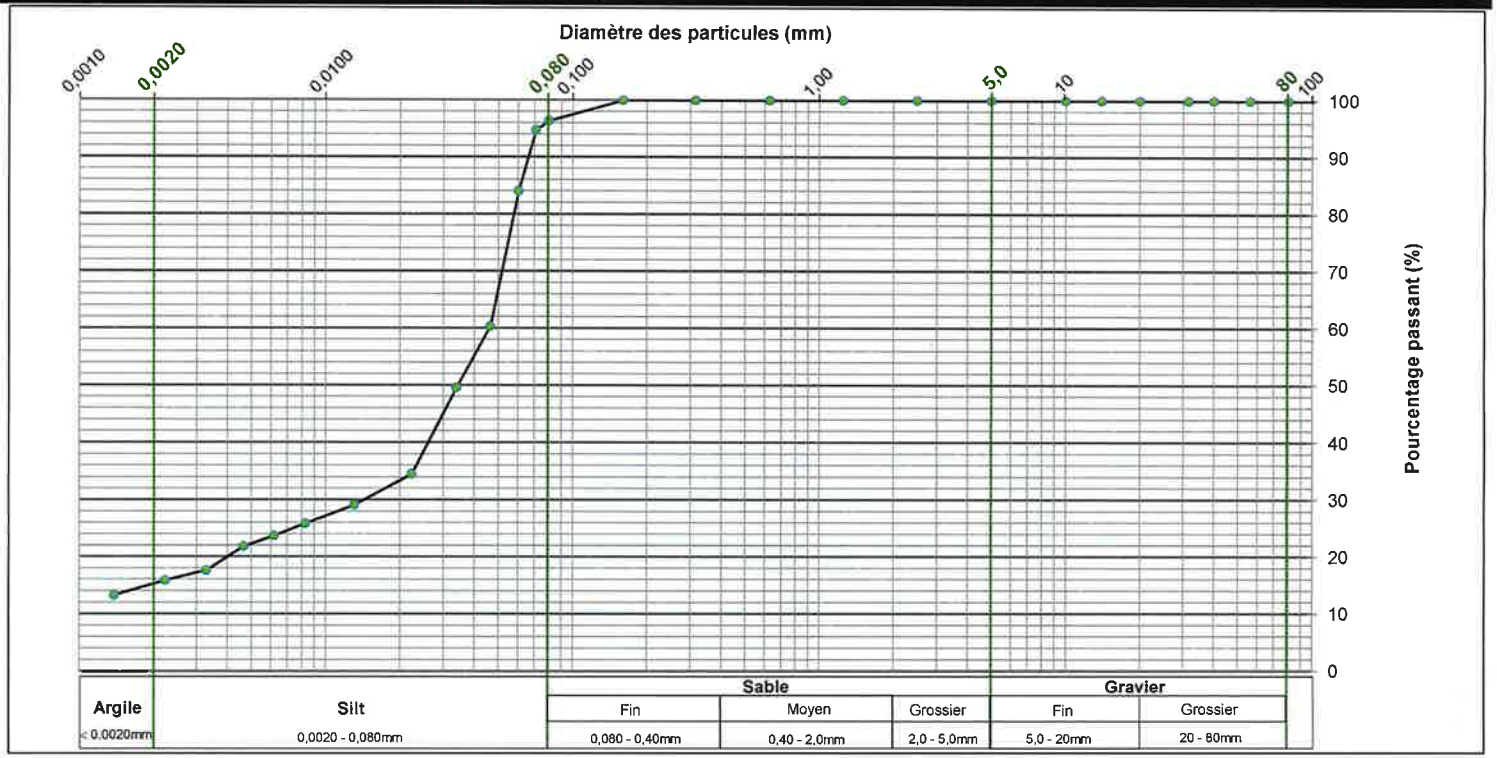
Caroline Desfossés, chef de laboratoire — Marc-André Carrier, ing.

LABO S.M. INC.

Rapport no. : 1405830-2
Laboratoire no. : 14-35451

Analyse granulométrique par tamisage LC 21-040
Analyse granulométrique par sédimentation BNQ 2501-025

Diamètre (mm)	Passant (%)
112	100
80	100
56	100
40	100
31,5	100
20	100
14	100
10	100
5	100
2,5	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	96,4
0,0711	94,8
0,0605	84,0
0,0464	60,3
0,0339	49,6
0,0224	34,5
0,0131	29,1
0,0083	25,9
0,0062	23,7
0,0047	21,9
0,0033	17,7
0,0022	15,9
0,0014	13,3
% Gravier:	0
% Sable:	3,6
% Silt*:	81,1
% Argile:	15,3
Cu:	
Cc:	
D_{10}:	
D_{15}:	0,0019
D_{30}:	0,0143
D_{50}:	0,0343
D_{60}:	0,0460
D_{85}:	0,0614



Propriétés physiques et mécaniques

Analyses	Norme	Résultats
Détermination de la teneur en eau (G2A)	LC 21-201	26,75%

N° Dossier:	**F1313256-009**	**Sondage:**	PU-103-14	**Description:**	Silt un peu d'argile, traces de sable
Client:	**Travaux publics et Services gouvernementaux Canada**	**Échantillon:**	EM-4		
Projet:	Etude géotechnique - rénovation des salles de bain et drainage du site	**Profondeur:**	1,30m @ 2,30m	**Remarques:**	
		Prélevé par:	Nicolas Tremblay, ing.		
Site:	Réserve nationale de la faune du Cap Tourmente	**Prélevé le :**	2014-11-14	*Inclus le pourcentage d'argile lorsque ce dernier n'est pas précisé	

Vérifié par : _____ **Date:** 2014-12-10
Caroline Desfossés, chef de laboratoire

Approuvé par : _____ **Date:** 14/12/15
Marc-André Carrier, ing.

Appendix IV

SITE PICTURES

Photo 1 – Separation between the ground slab and the bathroom's interior wall.

Photo 2 – Crack in the concrete ground slab along the bathroom's north wall.

Photo 3 – Northeast corner of the bathroom building (a section of the exposed foundations is shown)

Photo 4 – Junction between the ground slab and the south bathroom wall

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