Geotechnical Investigation
Proposed Warehouse Construction
524 Lacolle Way
Ottawa, Ontario

Prepared for:

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LRL File No.: 08222

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1 INTRODUCTION

LRL Associates Ltd. (LRL) was retained to perform a geotechnical investigation for a proposed warehouse construction located at 524 Lacolle Way within the City of Ottawa. It is our understanding that the site development plan will consist in the construction of a one to two storey warehouse including office spaces with no basement. The structure would rest over a slab-on-grade and conventional strip and column footings set below frost depth. The new structure will be serviced by municipal water and sewers and would include parking areas and access lanes.

It should be noted that this report is an updated version of a previously completed geotechnical report. No new field work was completed as part of this investigation.

This geotechnical investigation was undertaken to:

a) Establish the geotechnical conditions underlying the site;

b) Make recommendations regarding the most suitable type of foundations, founding depth and the limit state bearing pressures of the founding stratum;

c) Discuss excavation conditions during the construction;

d) Comment on backfilling requirements and the suitability of the on-site soils for backfilling purposes; and

e) Recommend a pavement structure for the access road and parking areas.

This report has been prepared in consideration of the terms and conditions noted above and with the assumption that the design of the project will satisfy any applicable codes and standards. Should there be any changes in the design features, which may relate to the geotechnical considerations, LRL Associates Ltd. shall be advised in order to review the report recommendations.

2 SITE DESCRIPTION

The site under investigation is located at 524, Lacolle Way within the City of Ottawa. It is legally known as Part of Lots 30 and 31, Concession 1 (O.S.) in the geographic Township of Cumberland, being Parts 33 and 34 on Registered Plan 50R6232. It is located on the south side of the street. The property has an irregular shape, fronts approximately 55m on Lacolle Way and has a maximum depth of 160m for an approximate total area of 8,200m^2. The site is located within the Taylor Creek Business

Park (Parcels 19 and 20) and is currently vacant and covered by wild grasses. The terrain is slightly sloping towards the north. It is noted that an easement for municipal services is present along the west property line.

3 FIELDWORK

Prior to any fieldwork, the underground utilities were cleared. The fieldwork for this project comprised of digging six test pits (TP-1 and TP-6). The test pit locations were pre-determined prior to the drilling work by our geotechnical personnel based on the site conditions, the overhead and underground utilities and in a manner that would best characterize the soil conditions of the site.

The fieldwork was performed on May 2nd, 2008. The test pits (TP-1 to TP-6) were dug using a backhoe from a local contractor and under the supervision of LRL technical staff. The undrained shear strength of the cohesive soils was determined using a calibrated Geonor M-3 inspection vane performed at various depths below the ground surface. All soil samples were visually examined, described, logged and stored before being transported to our office for further examination by our geotechnical engineer.

The approximate location of the test pits performed as part of this investigation is presented in **Appendix A.**

4 SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

4.1 Geological Mapping

A review of surficial geology maps provided by the Department of Energy, Mines and Resources Canada suggest that the surficial geological soil deposits underlying this area would be consist of erosional terraces which are mostly composed of silty clay. The overburden drift thickness would range between 15m to 25m.

4.2 Soil Stratigraphy

Table 1 provides a summary of the soils encountered at each test pit location including the depths of each soil interface. For more details, please refer to the attached Test Pit Logs presented in **Appendix B**.

Table 1: Soil Depth Summary

Soil encountered	Depth of soil interface (m)		
	TP-1	**TP-2**	**TP-3**
Topsoil	0.00 – 0.10	0.00 – 0.10	0.00 – 0.10
Clay	0.10 – 4.00	0.10 – 3.60	0.10 – 3.60
End of test pit	4.00	3.60	3.60
	TP-4	**TP-5**	**TP-6**
Topsoil	NE	0.00 – 0.10	NE
Fill	0.00 – 0.60	NE	0.00 – 0.60
Clay	0.60 – 2.40	0.10 – 2.40	0.60 – 2.40
End of test pit	2.40	2.40	2.40

NE: Not Encountered

4.2.1 Topsoil

A thin layer (100mm) of topsoil was encountered at the surface in TP-1, TP-2, TP-3 and TP-5. The topsoil can be described as a dark brown clayey loam. The topsoil was found resting over native clay.

4.2.2 Fill

A layer of fill was encountered at the surface in TP-4 and TP-6, which were performed in the southwest and northeast corners of the property. The fill is composed of disturbed clay with the presence of organics. Some debris (steel pipes and wood debris) were observed in TP-3. The fill was found resting over native clay in both test pits.

4.2.3 Clay

A clay deposit was encountered in all test pits performed as part of this investigation. The clay can be described as silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture down to 3.3m with a massive texture onwards. It has a high plasticity, moist and very stiff (Cu > 120 kPa) in consistency becoming stiff (Cu = 70) with depth. All boreholes were terminated within this soil stratum.

4.2.4 Refusal/Bedrock

All test pits were terminated within the clay deposit at depths of 2.4m to 4.00m below ground surface (bgs) without obtaining refusal.

4.3 Groundwater Conditions

Groundwater infiltration was noted in TP-5 only at a depth of 0.90m. This water table is considered a perched water table flowing within the upper fractured layer of the clay over the more massive impervious clay deposit.

However, it should be noted that groundwater levels could fluctuate with seasonal weather conditions, (i.e.: rainfall, droughts, spring thawing).

5 GEOTECHNICAL CONSIDERATIONS

It is our understanding that the site development plan will consist in the construction of a one to two storey industrial warehouse structure including office spaces with no basement. The structure would rest over a slab-on-grade and conventional strip and column footings set below frost depth.

The new structure will be serviced by municipal water and sewers and would include parking areas and access lanes.

5.1 Foundations

Based on the subsurface soil conditions encountered during the fieldwork, the founding soil stratum would consist of the native silty clay deposit

Based on the results of the test pits conducted, the Serviceability Limit State (SLS) capacity of 100 kPa and an Ultimate Limit State (ULS) bearing capacity of 150 kPa may be used for the design of the foundations for the proposed warehouse construction founded on undisturbed native clay. Should a greater bearing capacity be required, deep boreholes along with consolidation analyses on the clay shall be required to confirm potential settlement. All topsoil and fill material should be removed from the footprint of the footings prior to pouring of the concrete.

The given allowable bearing capacity is based on continuous concrete footings being not less than 0.6m wide or more than 1.5m wide and/or on pad footings not exceeding 3.0m along any side. The bearing capacity is also conditional on a maximum founding depth of 3.0m below the existing ground surface and a maximum grade raise of 1.0m.

Where excavation below the underside of the footing is performed, consideration shall be given to support the footings on structural fill. The structural fill must extend 1m beyond the outside edges of the footings and a distance equal to the depth of the structural fill below the footing. The recommended material to be used as structural fill to support the footings shall consist of Granular B Type II crushed stone, or an approved equivalent material.

5.2 Seismic

Based on the results of the geotechnical investigation, the soil at this site is classified as class “E” as per the Site Classification for Seismic Site Response in the latest Ontario Building Code.

5.3 Potential for Soil Liquefaction

Based on the subsurface soil conditions established at this site, soil liquefaction is not considered to be a concern for this site.

5.4 Retaining Walls and Shoring

Table 2 provides the recommended soil parameters for the design of retaining walls and/or shoring systems. For excavations near existing services and structures, the coefficient of earth pressure at rest (K_o) shall be used.

Table 2: Material Properties for Shoring and Permanent Wall Design

Type of Material	Wet Unit Weight (kN/m^3)	Co (kPa)	Effective Stress Parameters		Pressure Coefficient	
			C’ (kPa)	Φ (degrees)	Active (Ka)	At Rest (Ko)
Native soils and Bedrock						
Clay	17	10	10	30	0.45	0.80
Sand	20	0	0	30	0.33	0.50
Fill	20	0	0	32	0.32	0.50
Till	23	0	5	35	0.27	0.50
Backfill Material against permanent wall						
Granular B Type I	20	0	0	30	0.33	0.50
Granular B Type II	23.1	0	0	32	0.31	0.47
Granular A	23.5	0	0	35	0.27	0.43

The given values are given considering a flat surface, a straight wall and a wall friction angle of 0 degree. The designer must consider any difference between these coefficients, and make appropriate corrections for sloped surface, angled wall or wall friction as required. The bearing capacity for the wall would be the same as for the building; 100 kPa SLS and 150 kPa USL.

5.5 Settlement

The estimated total settlement of the foundations, designed using the recommended serviceability limit state capacity value given herein as well as other recommendations will be less than 25mm. The differential settlement between adjacent column footings is anticipated to be 15mm or less. The estimated foundation settlement is considered to be within tolerable and acceptable limits for masonry construction.

5.6 Slab-on-grade Construction

Slab-on-grade construction will be acceptable over native clay only. Therefore, all topsoil and fill material shall be removed from the building's footprint.

Any underfloor fill needed to raise the general floor grade shall consist of Granular B Type I material or an approved equivalent, compacted to 95% of its standard proctor maximum dry density (SPMDD). The final lift shall be compacted to 98% of its SPMDD. A 200 mm layer of Granular A material shall be placed under the slab and compacted to at least 98% of the SPMDD.

In order to further minimize and control cracking, the floor slab shall be provided with wire mesh reinforcement and construction or control joints. The construction or control joints should be spaced equal distance in both directions and should not exceed 4.5 m. The wire mesh reinforcement shall be carried through the joints.

5.7 Frost Protection

Exterior footings and any footings located in unheated portions of the building shall be protected against frost heaving by providing a minimum of 1.5 m of earth cover under snow covered surface or 1.7 m under exposed surfaces (i.e. sidewalks, paved areas, etc.), or its equivalent in insulation protection. LRL shall review the detail design of frost protection with the use of equivalent insulation prior to construction.

In the event that foundations are to be constructed during winter months, foundation soils are required to be protected from freezing temperatures using suitable construction techniques. Therefore, the base of all excavations should be insulated from freezing temperature immediately upon exposure, until the time that heat can be supplied to the building interior and footings have sufficient soil cover to prevent freezing of the subgrade soils.

5.8 Foundation Drainage

Permanent perimeter drainage is not required considering that the building will not contain a basement. In order to prevent the ponding of water adjacent to the foundation walls, the roof water shall be controlled by a roof drainage system and the exterior grade shall be sloped to shed water away from the walls.

5.9 Trees

It should be noted that the silty clay soils at the site may be sensitive to water depletion by trees of high water demand during periods of dry weather. When trees draw water from the clay, the clay undergoes shrinkage which can result in settlement of adjacent structures. Research carried out by the Institute for Research Construction, formerly the Division of Building Research, of the National Research Council of Canada, referenced as CBD-62. Trees and Buildings, published in February 1965, provides the following guideline:

“If trees are already growing on the building site, every effort should be made so to locate the structure such that it conforms to the suggestions in the next paragraph. If this cannot be done then, with natural reluctance trees that are going to be too close to the building must be cut down and their root systems removed. It is far better that this should be done and new trees planted appropriately than that aesthetic claims should over-rule sound judgement with the possibility of damage to the building and the eventual inevitable removal of the trees in any case. Care should be taken that the removed trees have not already desiccated the clay, which may then swell under the changed environment.

If trees are to be planted as a part of the landscaping around the building, a good working rule has been found to be that trees should preferably be planted no nearer a building on shrinkable clay than the eventual height to which the tree may be expected to grow. This rule may require modification if the topography around the building varies. Even in its application, attention must be given to the differing transpiration characteristics of trees”

6 EXCAVATION AND BACKFILLING REQUIREMENTS

6.1 Excavation and Groundwater Control

The overburden soil encountered at this site consists of clay. According to the Ontario's Occupational Health and Safety Act (OHSA), O. Reg. 527/00, the surficial overburden soil encountered at this site can be classified as Type 2. Therefore, shallow temporary excavation in the overburden soil classified as Type 2 shall be sloped at 1 horizontal to 1 vertical for a fully drained excavation deeper than four (4) feet starting at the base of the excavation and as per requirements of the OHSA regulations.

It the event that the aforementioned slopes are not possible to achieve due to space restrictions, the excavation shall be shored according to OHSA Reg. 213/91. A geotechnical engineer shall design and approve the shoring and establish the shoring depth under the excavation profile.

Any excavated material stockpiled near a trench shall be stored at a distance equal to or greater than the depth of the excavated soil within the trench and equipment circulation shall be limited near open excavation. It is expected that any surface groundwater seepage or infiltration entering the excavations can be controlled with an effective sump and pump system. Surface water runoff into the excavation shall be avoided and diverted away from the excavation.

6.2 Trench Backfill

It is anticipated that most of the underground services required as part of this project be founded over native clay. Bedding, thickness of cover material and compaction requirements for sewers and watermains shall conform to the manufacture's design requirements and to the requirements and detail installations outlined in the Ontario Provincial Standard Specifications (OPSS), drawings OPSD 802-030 or 802.031 Class B or Class C for concrete pipes and OPSD 802.01 for flexible pipes as well as any generic standards established by the City of Ottawa.

All service trenches shall be backfilled using compactable material, free of organic, debris and large cobbles or boulders. Within the top 1.8m below proposed paved areas, the material shall consist of material similar to that excavated from the trenches in order to prevent differential frost heaving. Such heaving will occur where non-frost-susceptible granular fill is used to backfill trenches through frost-susceptible soils. This material shall be placed in lifts not exceeding 300mm, within ±2% of its optimal moisture content and compacted to at least 95% of its SPMDD.

6.3 Foundation Walls Backfill

Backfill materials against shallow foundation walls shall consist of free draining, non-frost-susceptible granular material (i.e., Granular "C", clean sand) compacted to 90% of its SPMDD using light compaction equipment. The compaction shall be increased to 95% under walkways or paved areas close to the foundation wall. Site grading shall be sloped away from the building area. Where specified, backfilling against foundation walls shall be carried out on both sides of the wall at the same time.

6.4 Suitability of On-site Soils

The existing overburden soils consist mostly of clay and some clayey fill. The clayey fill and clay are frost susceptible and are not recommended for backfilling purposes against foundation walls. However, they could be reused as general backfill material (general landscaping/backfilling), if they can be compacted according to the specifications outlined herein at the time of construction. Any imported material shall conform to OPSS Granular B - Type I.

It shall be noted that the adequacy of a material for reuse as backfill will depend on its water content at the time of its use and on the weather conditions prevailing prior and during that time. Therefore, all excavated materials to be reused shall be stockpiled in a manner that will prevent any significant changes in their moisture content, especially during wet conditions.

It is noted that waste debris (steel pipes and wood debris) were encountered as part of the fill. As a minimum, any waste material shall be sorted from the fill and be transported to an approved landfill or sent to be recycled, if possible.

7 PAVEMENT DESIGN

It is anticipated that the subgrade soils will consist mostly of clay or clayey fill. It is recommended that the fill material be excavated down to the native clay deposits and replaced with compacted select subgrade material. Alternately the pavement structure could be placed over the existing fill. However, it shall be noted that differential settlements are anticipated due to the presence of fill and that some maintenance may be required over short and long term periods depending on the loading. Should the later option be retained, the existing fill shall be compacted and proof rolled using a sheep foot roller with cobbles, boulders and debris being treated as per OPSD 204.010.

The representative soil modulus of the subgrade soils is 31 MPa (4,500 psi). The Granular Base Equivalency (GBE) thickness was calculated at 300mm for the light duty areas and 450mm for the heavy duty areas.

The following **Table 3** presents the recommended pavement structure to be constructed over a stable subgrade along the proposed parking areas and access road.

Table 3: Recommended Pavement Structure

Course	Material	**Thickness (mm)**	
		Light Duty (mm)	**Heavy Duty (mm)**
GBE		300	450
Surface	HL3 A/C	50	40
Binder	HL8 A/C	-	40
Base course	Granular "A"	100	150
Sub base	Granular "B" Type II	300	300
Total:		450	530

The base and sub base granular materials shall conform to OPSS Form 1010 material specifications. The sub base material shall be free draining and not prone to capillary uprising. They shall be tested and approved by a geotechnical engineer prior to delivery to the site and shall be compacted to at least 100% SPMDD.

Asphaltic concrete shall conform to OPSS Form 1150 and be placed and compacted to at least 97% of the Marshall Density. The mix and its constituents shall be reviewed, tested and approved by a geotechnical engineer prior to delivery to the site.

7.1 Paved Areas Subgrade Preparation

The surficial soils should be stripped of vegetation, debris and other obvious objectionable material. Following the backfilling and satisfactory compaction of any underground service trenches up to the subgrade level, the subgrade shall be shaped, crowned and proof-rolled using heavy roller with any resulting soft areas sub-excavated down to an adequate bearing layer and replaced with approved backfill. Any subgrade fill needed should be placed in small lifts and compacted to 95 percent of SPMDD.

The preparation of subgrade shall be scheduled and carried out in manner so that a protective cover of overlying granular material is placed as quickly as possible in order to avoid unnecessary circulation by heavy equipment, except on unexcavated or protected surfaces. Frost protection of the surface shall be implemented, if works are carried out during the winter months.

The performance of the pavement structure is highly dependent on the subsurface groundwater conditions and maintaining the subgrade and pavement structure in a dry condition. To intercept excess subsurface water within the pavement structure granular materials, sub-drains with suitable outlets must be installed below the pavement area's subgrade if adequate overland flow drainage is not provided (i.e. ditches). The surface of the pavement should be properly graded to direct runoff water towards suitable drainage features. It is recommended that the lateral extent of the subbase and base layers not be terminated vertically immediately behind the curb/edge of pavement line but be extended beyond the curb.

8 INSPECTION SERVICES

The use of the limit state bearing pressures contained in this report for the design of spread footings is conditional on footings being constructed on undisturbed soil or suitably prepared structural fill reviewed and approved as such by this firm. As such, a geotechnical construction review program is recommended, whereby the following aspects of construction are reviewed:

a) Inspection of in-situ soil subgrade prior to backfilling.

b) Field density tests during the backfilling program, to ensure that the specified level of compaction has been achieved.

c) Inspection of all bearing surfaces prior to the placement of concrete for the footings.

The completion of a review program of this type will result in the issuance of an engineering report confirming that these works have been completed in accordance with and in compliance with the general intent of the geotechnical recommendations.

9 REPORT CONDITIONS AND LIMITATIONS

The recommendations and data contained in this report are intended for design purpose only. The use of this report as a construction document is neither intended nor authorized by LRL Associates Ltd. Contractors and others involved in the construction of this project are advised to make an independent assessment of the subsurface soil and groundwater conditions for the purpose of establishing quantities, schedules and construction techniques.

The recommendations provided in this report are based on subsurface data obtained at the test locations. Experience indicates that the subsurface soil and groundwater conditions can vary significantly between and beyond the test locations. For this reason, the recommendations given in this report are subject to a field verification of the subsurface soil conditions at the time of construction.

The report recommendations are applicable only to the project described in the report. Any changes will require a review by LRL Associates Ltd., to insure compatibility with the recommendations contained in this project.

We trust that this report will meet your requirements. Should you have any questions or comments, please contact the undersigned.

Yours truly,

LRL Associates Ltd.

Prepared by

Will Ball, B.Sc. Eng.

Approved by

LICENSED PROFESSIONAL ENGINEER
S. LECLERC
90439027
April 22/2013
PROVINCE OF ONTARIO

Stéphane Leclerc, P. Eng.

Appendix A

Test Pit Location Plan

LRL
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PROJECT

GEOTECHNICAL INVESTIGATION
PROPOSED WAREHOUSE STRUCTURE
524 LACOLLE WAY
OTTAWA, ONTARIO

DRAWING TITLE

TEST PIT LOCATIONS

CLIENT

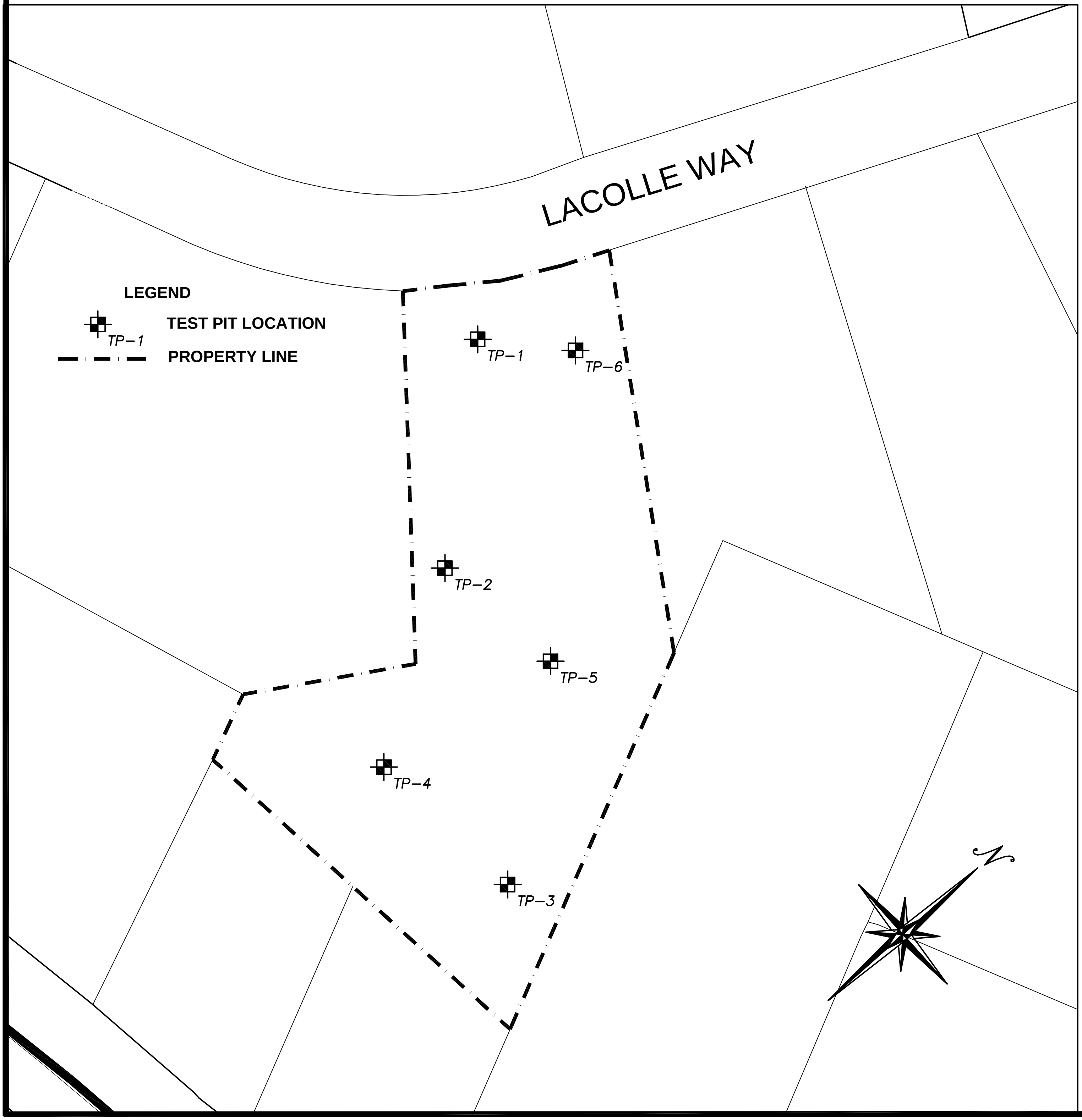
Mr. Patrice Houle

DATE

MAY 2008

PROJECT

08222



Appendix B

Test Pit Logs

LEVAC ROBICHAUD LECLERC ASSOCIATES LTD.
Project Managers and Consulting Engineers

Test Pit: TP-1

Project No: 08222

Date: May 2, 2008

Project: Geotechnical Investigation

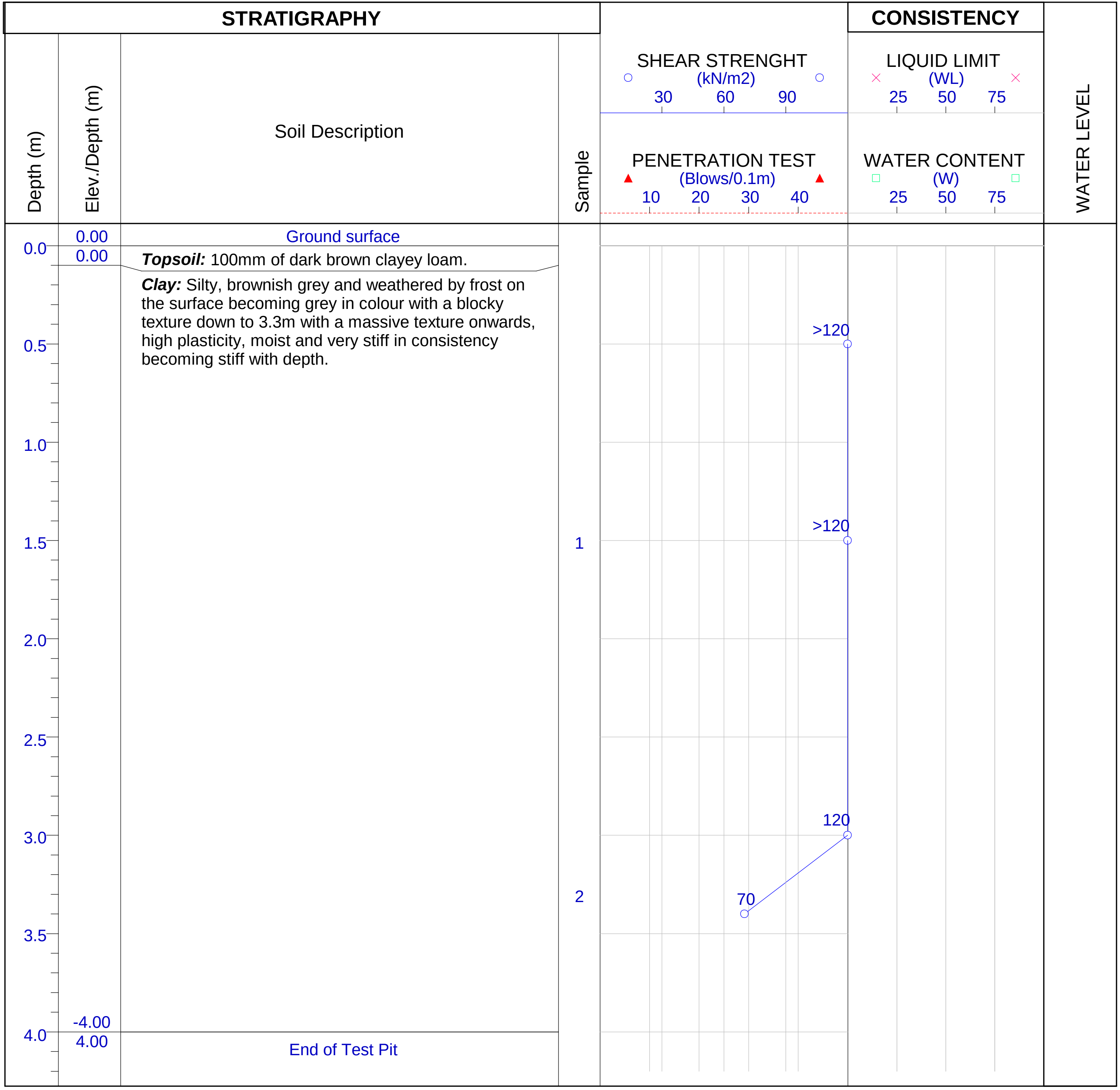
Technician: Amy Cardiff

Client: Patrice Houle

Datum: Not Applicable

Location: 520 Lacolle Way, Orleans, Ontario

Equipment: Backhoe



Ground surface

Topsoil: 100mm of dark brown clayey loam.

Clay: Silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture down to 3.3m with a massive texture onwards, high plasticity, moist and very stiff in consistency becoming stiff with depth.

End of Test Pit

LEVAC ROBICHAUD LECLERC ASSOCIATES LTD.
Project Managers and Consulting Engineers

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Test Pit: TP-2

Project No: 08222

Date: May 2, 2008

Project: Geotechnical Investigation

Technician: Amy Cardiff

Client: Patrice Houle

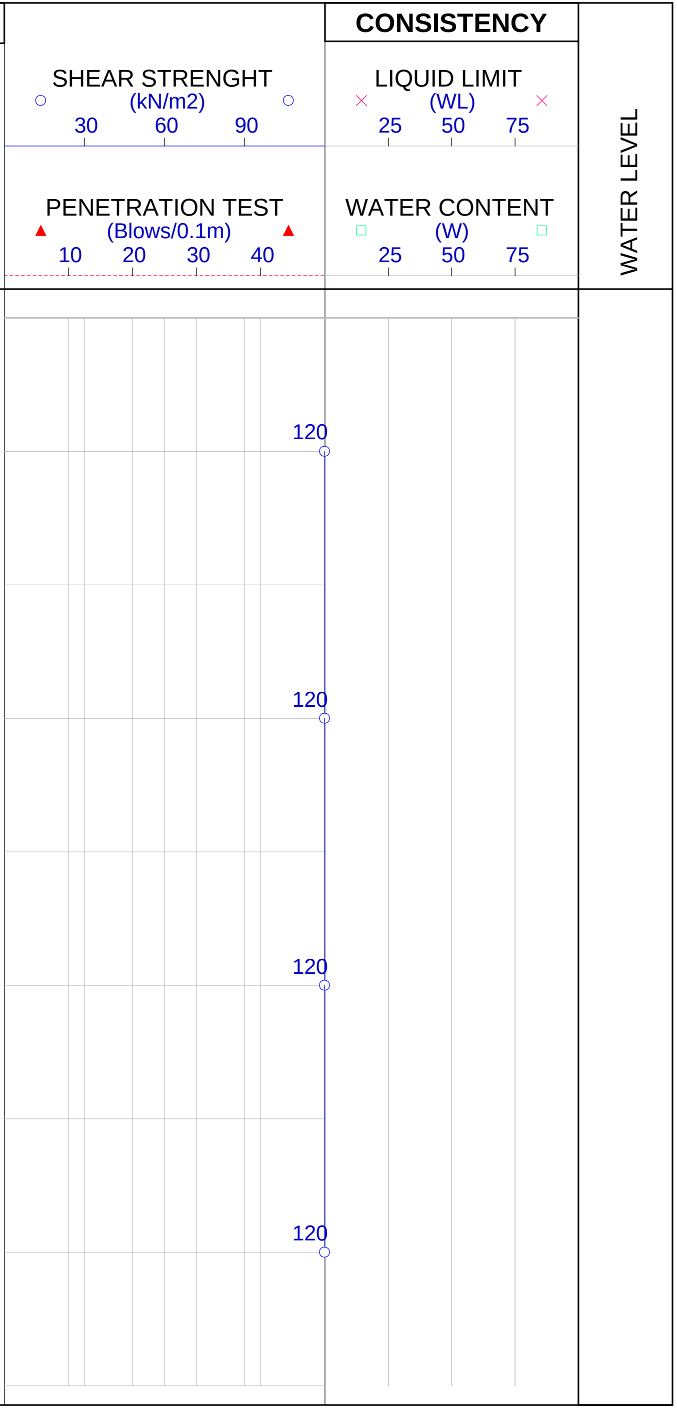
Datum: Not Applicable

Location: 520 Lacolle Way, Orleans, Ontario

Equipment: Backhoe

STRATIGRAPHY

Depth (m)	Elev./Depth (m)	Soil Description	Sample
	0.00	Ground surface	
0.0	0.00	***Topsoil:*** 100mm of dark brown clayey loam.	
		Clay: Silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture down to 3.3m with a massive texture onwards, high plasticity, moist and very stiff in consistency.	
0.5			
1.0			
1.5			
2.0			
2.5			
3.0			
3.5	-3.60 3.60	End of Test Pit	
4.0			



LEVAC ROBICHAUD LECLERC ASSOCIATES LTD.
Project Managers and Consulting Engineers

Test Pit: TP-3

Project No: 08222

Date: May 2, 2008

Project: Geotechnical Investigation

Technician: Amy Cardiff

Client: Patrice Houle

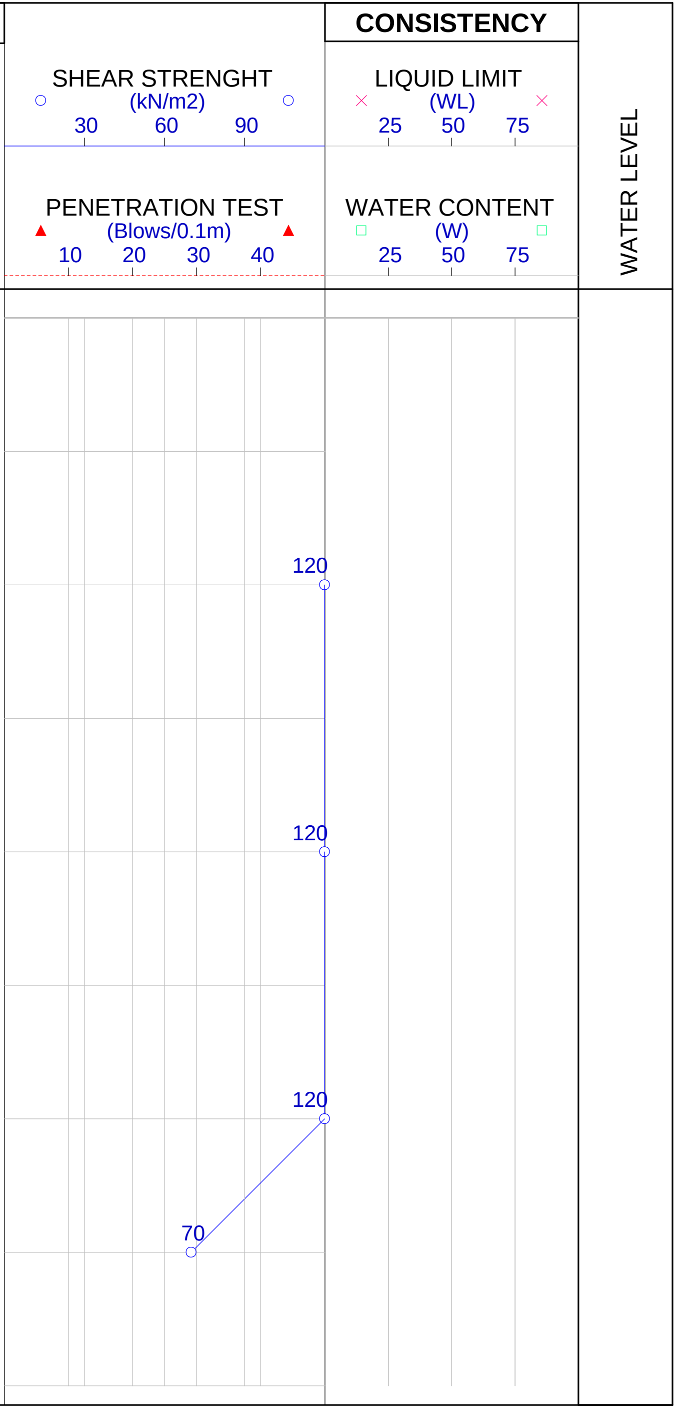
Datum: Not Applicable

Location: 520 Lacolle Way, Orleans, Ontario

Equipment: Backhoe

STRATIGRAPHY

Depth (m)	Elev./Depth (m)	Soil Description	Sample
	0.00	Ground surface	
0.0	0.00	***Topsoil:*** 100mm of dark brown clayey loam.	
		Clay: Silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture down to 3.3m with a massive texture onwards, high plasticity, moist and very stiff in consistency becoming stiff with depth.	
0.5			
1.0			1
1.5			
2.0			
2.5			
3.0			2
3.5	-3.60		
	3.60	End of Test Pit	
4.0			



LEVAC ROBICHAUD LECLERC ASSOCIATES LTD.
Project Managers and Consulting Engineers

Test Pit: TP-4

Project No: 08222

Date: May 2, 2008

Project: Geotechnical Investigation

Technician: Amy Cardiff

Client: Patrice Houle

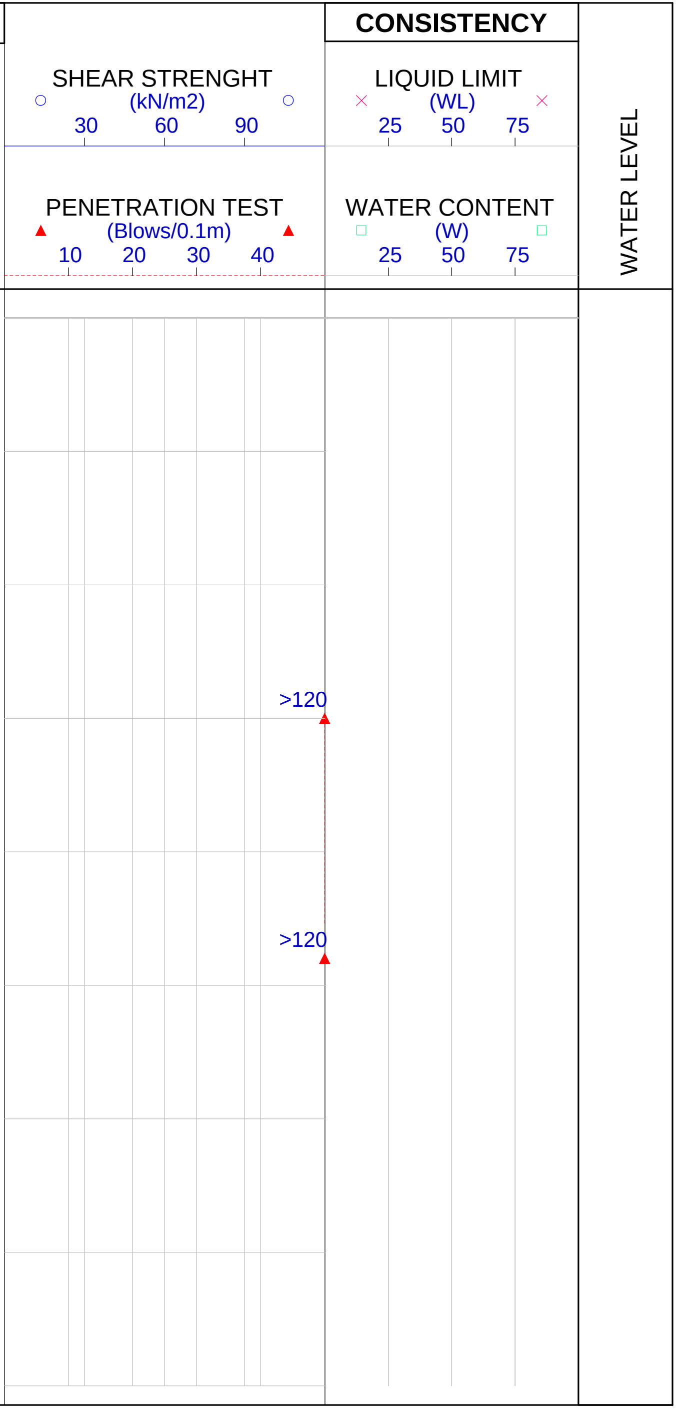
Datum: Not Applicable

Location: 520 Lacolle Way, Orleans, Ontario

Equipment: Backhoe

STRATIGRAPHY

Depth (m)	Elev./Depth (m)	Soil Description	Sample
0.0	0.00	Ground surface	
	0.00 -0.60	***Fill:*** Disturbed clay with presence of organics and debris (steel pipes and wood debris), brown in colour.	
0.5	0.60 -2.40	***Clay:*** Silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture, high plasticity, moist and very stiff in consistency.	
1.0			
1.5			
2.0			
2.5	2.40	End of Test Pit	
3.0			
3.5			
4.0			



LEVAC ROBICHAUD LECLERC ASSOCIATES LTD.
Project Managers and Consulting Engineers

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Test Pit: TP-5

Project No: 08222

Date: May 2, 2008

Project: Geotechnical Investigation

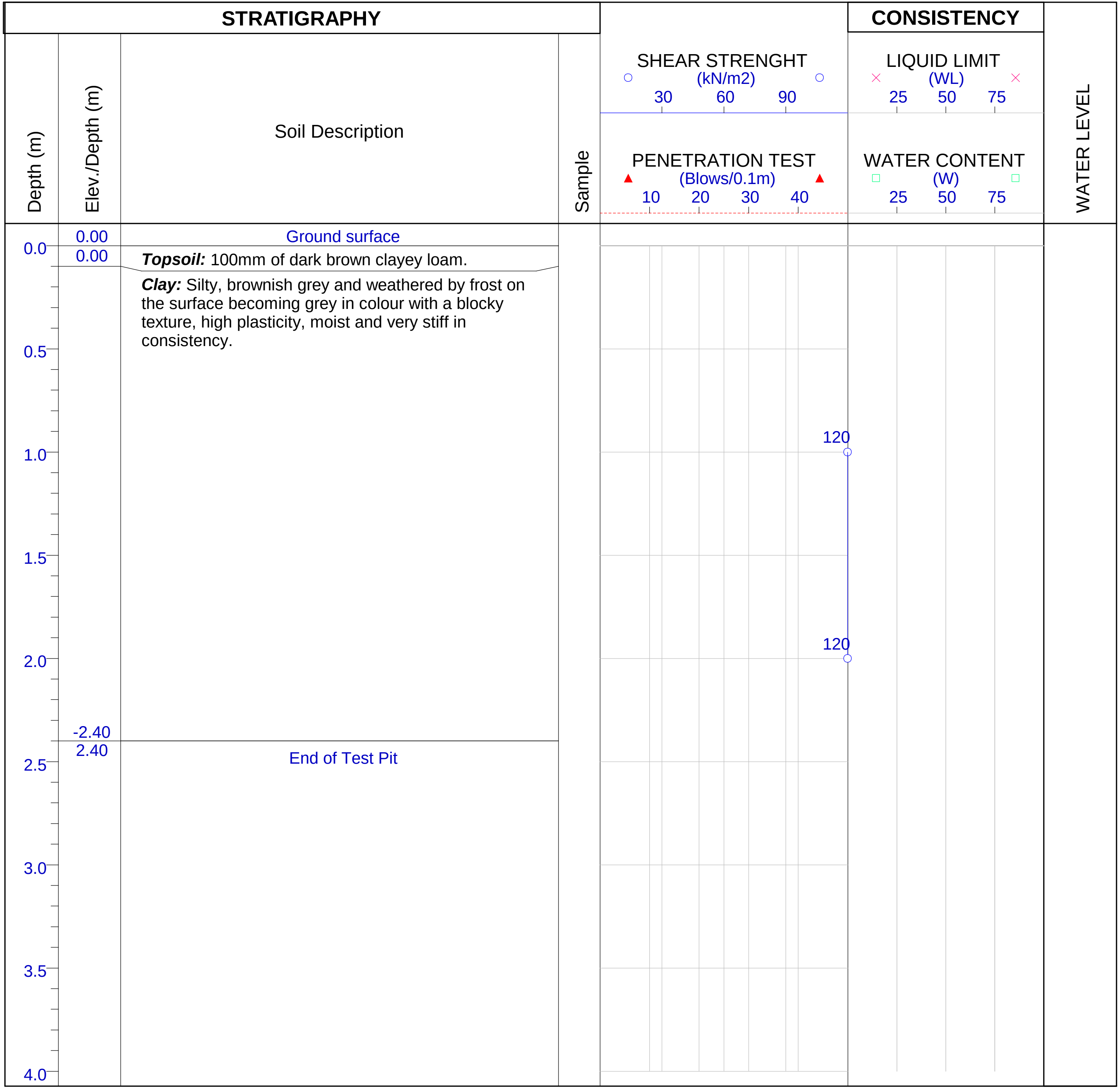
Technician: Amy Cardiff

Client: Patrice Houle

Datum: Not Applicable

Location: 520 Lacolle Way, Orleans, Ontario

Equipment: Backhoe



Ground surface

Topsoil: 100mm of dark brown clayey loam.

Clay: Silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture, high plasticity, moist and very stiff in consistency.

End of Test Pit

Test Pit: TP-6

Project No: 08222

Date: May 2, 2008

Project: Geotechnical Investigation

Technician: Amy Cardiff

Client: Patrice Houle

Datum: Not Applicable

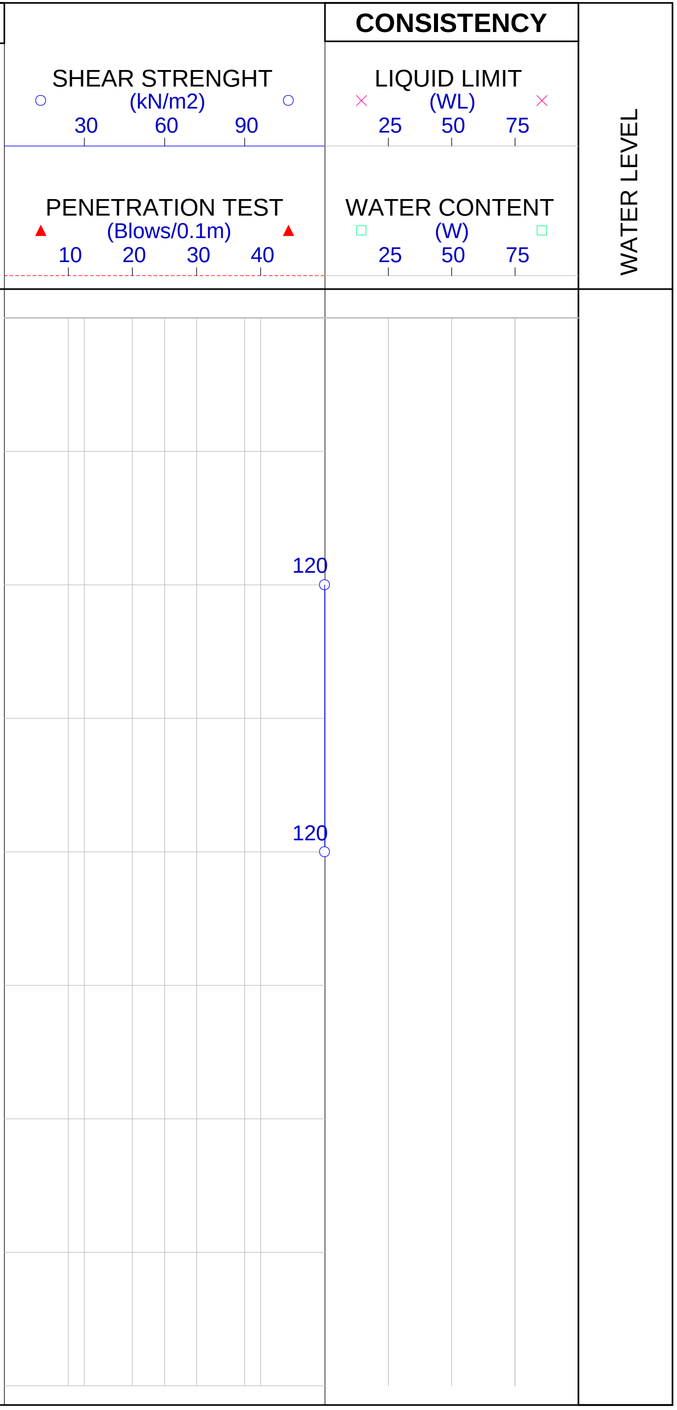
Location: 520 Lacolle Way, Orleans, Ontario

Equipment: Backhoe

STRATIGRAPHY

Depth (m)	Elev./Depth (m)	Soil Description	Sample
0.0	0.00	Ground surface	
	0.00	***Fill:*** Disturbed clay with presence of organics, brown in colour.	
0.5	-0.60		
	0.60	***Clay:*** Silty, brownish grey and weathered by frost on the surface becoming grey in colour with a blocky texture, high plasticity, moist and very stiff in consistency. Note: Some water infiltration observed at a depth 0.9 m.	
1.0			
1.5			
2.0			
	-2.40		
2.5	2.40	End of Test Pit	
3.0			
3.5			
4.0			

CONSISTENCY



Appendix C

Symbols and Terms Used in Test Pit logs

Symbols and Terms Used on Borehole and Test Pit Logs

The following explains the data presented in the borehole and test pit logs.

1. Soil Description

The soil descriptions presented in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves some judgement and LRL Associates Ltd. does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice. Boundaries between zones on the logs are often not distinct but transitional and were interpreted.

a. Proportion

The proportion of each constituent part, as defined by the grain size distribution, is denoted by the following terms:

Term	Proportions
"trace"	1% to 10%
"some"	10% to 20%
prefix (i.e. "sandy" silt)	20% to 35%
"and" (i.e. sand "and" gravel)	35% to 50%

b. Compactness and Consistency

The state of compactness of granular soils is defined on the basis of the Standard Penetration Test. See Section 2c for more details. The consistency of clayey or cohesive soils is based on the shear strength of the soil, as determined by field vane tests and by a visual and tactile assessment of the soil strength.

The state of compactness of granular soils is defined by the following terms:

State of Compactness Granular Soils	Standard Penetration Number "N"
Very loose	0 – 4
Loose	4 – 10
Compact or medium	10 - 30
Dense	30 - 50
Very dense	over - 50

The consistency of cohesive soils is defined by the following terms:

Consistency Cohesive Soils	Undrained Shear Strength (Cu) (kPa)
Very soft	under 10
Soft	10 - 25
Medium or firm	25 - 50
Stiff	50 - 100
Very stiff	100 - 200
Hard	over - 200

2. Sample Data

a. Elevation depth

This is a reference to the geodesic elevation of the soil or to a benchmark of an arbitrary elevation at the location of the borehole or test pit. The depth of geological boundaries is measured from ground surface.

b. Type

Symbol	Type	Letter Code
⌇	Auger	AU
⧗	Split spoon	SS
‖	Shelby tube	ST
▮	Rock Core	RC

c. Sample Number

Each sample taken from the borehole is numbered in the field as shown in this column.

LETTER CODE (as above) – Sample Number

d. Blows (N) or RQD

This column indicates the Standard Penetration Number (N) as per ASTM D-1586. This is used to determine the state of compactness of the soil sampled. It corresponds to the number of blows required to drive 300 mm of the split spoon sampler using a 622 kg*m/s^2 hammer falling freely from a height of 760 mm. For a 600 mm long split spoon, the blow counts are recorded for every 150 mm. The “N” index is obtained by adding the number of blows from the 2nd and 3rd count. Technical refusal indicates a number of blows greater than 50.

In the case of rock, this column presents the Rock Quality Designation (RQD). The RQD is calculated as the cumulative length of rock pieces recovered having lengths of 10 cm or more divided by the length of coring. The qualitative description of the bedrock based on RQD is given below.

Rock Quality Designation (RQD) (%)	**Description of Rock Quality**
0 –25	very poor
25 – 50	poor
50 – 75	fair
75 – 90	good
90 – 100	excellent

e. Recovery (%)

For soil samples this is the percentage of the recovered sample obtained versus the length sampled. In the case of rock, the percentage is the length of rock core recovered compared to the length of the drill run.

3. General Monitoring Well Data