THE NATIONAL TESTING LABORATORIES LIMITED

# GEOTECHNICAL INVESTIGATION AND FOUNDATION ENGINEERING REPORT FOR SINCLAIR PARK COMMUNITY CENTRE

Prepared
for

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THE NATIONAL TESTING LABORATORIES LIMITED

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## 1.0 SUMMARY

The National Testing Laboratories Limited were retained to undertake a geotechnical investigation and provide foundation recommendations for the proposed addition to Sinclair Park Community Centre at 490 Sinclair Street in Winnipeg, Manitoba. Three testholes were drilled to auger refusal within the proposed development footprint on December 4, 2007. The investigation revealed a soil profile of clay fill underlain by silt, clay and silt till. Based upon the soil and groundwater conditions encountered at the site and the anticipated foundation loads, the proposed addition may be supported on cast-in-place concrete friction piles.

## 2.0 INTRODUCTION

### 2.1 Terms of Reference

The National Testing Laboratories Limited were retained to undertake a geotechnical investigation and provide foundation recommendations for the addition to Sinclair Park Community Centre at 490 Sinclair Street in Winnipeg, Manitoba. The scope of work for this project was outlined in our proposal dated September 10, 2007. Authorization to proceed with the geotechnical investigation was received from Bruce Pauls at Harold Funk Architect Inc. on November 14, 2007.

### 2.2 Proposed Development

The proposed development will be located at the southwest corner of Church Avenue and Sinclair Street. It was reported that the Sinclair Park Community Centre was constructed in three phases. The original two phases are to be demolished. It is our understanding that the third phase, which is the mini-gym, is founded on cast-in-place concrete friction piles.

## 3.0 GEOTECHNICAL INVESTIGATION

### 3.1 Testhole Drilling and Soil Sampling

The subsurface drilling and sampling program was conducted on December 4, 2007 with drilling services provided by Subterranean (Manitoba) Ltd. under the supervision of our geotechnical field personnel. The testholes were drilled using a truck-mounted piling rig equipped with 450 mm diameter flight auger. Three testholes were drilled to a depth of approximately 15 m within the proposed development footprint. Auger refusal was encountered on suspected boulders at a depth of 14.9 m in Testhole TH1, and a depth of 14.8 m in Testholes TH2 and TH3. The testhole locations are shown on the attached Testhole Location Plan.

Representative soil samples were obtained directly off the augers at depth intervals ranging from 0.8 to 1.5 m. Upon completion of the drilling, each testhole was examined for evidence of sloughing and groundwater seepage. The soil samples were returned to our soils laboratory for additional examination and testing.

### 3.2 Laboratory Testing

Strength index testing using a torvane device was performed on soil samples obtained from the clay. Water contents were determined for the soil samples. The torvane readings and water contents are shown on the attached testhole logs.

## 4.0 SUBSURFACE CONDITIONS

### 4.1 Soil Profile

The general soil stratigraphy at the site, as interpreted from the testhole logs, consisted of clay fill underlain by silt, clay and silt till. Approximately 90 mm of asphaltic concrete underlain by a 160 mm layer of crushed limestone base course was encountered at the surface of the testholes.

**Clay Fill**

A layer of clay fill was encountered beneath the pavement in the testholes. The thickness of the clay fill was 0.8 m. The clay fill was black, stiff, moist, and of high plasticity, with trace silt, fine gravel, and organic material. Water contents of the clay fill ranged from 22 to 36%.

**Silt**

A layer of silt was encountered beneath the clay fill in the testholes. The silt varied in its thickness from 0.3 to 1.8 m. The silt was tan, soft to firm, moist, and of low plasticity. Water contents of the silt ranged from 23 to 44%.

**Clay**

Clay was encountered below the silt in the testholes. The clay extended to depths of 10.5 to 11.6 m below grade. The clay was brown, firm to stiff, moist, and of high plasticity with trace silt inclusions. The clay was grey below a depth of 3.7 m. Gypsum inclusions were encountered below a depth of 6.4 m in Testhole TH1, and below a depth of 6 m in Testholes TH2 and TH3. Fine gravel inclusions were found below a depth of 6.4 m in Testhole TH1 and below a depth of 7.6 m in Testhole TH2 and TH3. Water contents of the clay ranged from 43 to 61%.

**Silt Till**

Silt till was encountered beneath the clay in the testholes. The glacial till was composed predominantly of silt with clay, fine gravel and cobbles. The silt till was grey to tan, soft to firm, moist to saturated, and of low plasticity. The silt till became dense to very dense below a depth of 12.5 m. Water contents of the silt till ranged from 9 to 19%.

### 4.2 Groundwater

Minor groundwater seepage was observed from the silt at a depth of 3 m in Testhole TH2. Sloughing occurred within the silt till below a depth of 13.7 m in Testholes TH1 and TH2. No significant accumulation of groundwater was observed in the testholes upon the completion of drilling. It should be noted that only short-term seepage and sloughing conditions were observed and ground water levels will normally fluctuate during the year and will be dependent upon precipitation and surface drainage.

## 5.0 DESIGN RECOMMENDATIONS AND COMMENTS

### 5.1 Foundations

Based upon the soil and groundwater conditions encountered at the site and the anticipated foundation loads, the proposed structure may be supported on cast-in-place concrete friction piles. A foundation system with cast-in-place concrete friction piles is the preferred foundation system because the existing structure is supported on cast-in-place concrete friction piles. Differential movements between the existing building and proposed building will not be significant if the proposed building is supported on cast-in-place concrete friction piles. Due to the presence of clay fill and silt at a shallow depth and the potential for foundation movement, a shallow foundation system such as spread footings is not recommended for the proposed structure.

Cast-in-place concrete friction piles are suitable for light to moderate foundation loads and may be designed based upon the allowable skin friction values shown in the following table:

| Pile Depth below Final Grade (m) | Allowable Skin Friction (kPa) |
|---|---|
| 0 to 3 | 0 |
| 3 to 8 | 14 |
| 8 to 10 | 11 |

The allowable skin friction value is applied to the pile circumference within the clay stratum only. Due to the presence of clay fill and silt, which extended to a depth of 3 m below grade on the site and the potential for soil drying and shrinkage near the ground surface, the frictional support should be excluded in the calculation of the pile capacity for a depth of 3 m measured from the final grade. The contribution from end-bearing should also be ignored in pile capacity calculations. Minimum pile spacing should be three pile diameters, measured centre to centre.

Piles located in unheated and heated areas should have minimum pile lengths of 8 m and 6 m, respectively, measured from final grade. All piles in unheated areas should be provided with steel reinforcement to at least 8 m below grade to prevent frost jacking due to adfreeze forces. Pile holes should be poured with concrete as soon as they are drilled to minimize any potential problems of soil sloughing and ground water seepage. Temporary steel sleeves should be available in the event that ground water seepage or sloughing of the pile holes is encountered during pile installation. Groundwater, if encountered in the pile holes, should be removed prior to concrete placement.

It is recommended that the pile depth below existing grade not exceed 10 m to avoid penetration of the silt till and potential water seepage below this depth. A minimum void space of 200 mm should be provided beneath all pile-supported structural elements to accommodate potential heave of the high plasticity clay. Pile settlements are expected to be negligible with the use of cast-in-place concrete friction piles.

### 5.2 Foundation Concrete

The clay soils in the Winnipeg area contain sulphates that will cause deterioration of concrete. The Class of Exposure for concrete in contact with clay soil in the Winnipeg area is considered to be severe (S-2 in CSA A23.1-04 Table 3) which requires the use of type HS cement, a maximum water-to-cementing materials ratio of 0.45, an air content of 4% to 7% and 32 MPa design strength for the concrete mix.

### 5.3 Floor Slab

Due to the presence of high plasticity clay at this site, the potential exists for heave of a soil-supported floor. Soil moisture contents will typically increase after construction which causes swelling of clay soils. The magnitude of heave for soil-supported floor slabs in the Winnipeg area is typically in the range of 20 to 60 mm but may be as high as 100 mm. Heave is generally higher on sites where trees are removed prior to construction or in situations where leaking water supply or sewer lines or poor drainage lead to increased moisture contents. Potential heave for a soil-supported floor slab on the proposed site is expected to be less than 60 mm due the presence of silt and clay fill at a shallow depth. To accommodate movement of a soil-supported floor slab, slip joints between grade beams and any structural unit supported through piles should be provided. A structural floor system is recommended in areas where floor movement cannot be tolerated. A structural floor should be provided with a minimum 200 mm void space between the soil and the underside of the slab to accommodate potential heave of the underlying clay.

Construction of a soil-supported floor slab should proceed as follows:

- remove all topsoil and organic materials to expose the clay fill.
- proof roll the exposed clay fill to identify soft or weak areas.
- where soft or weak material is encountered it should be excavated and replaced with crushed limestone sub-base.
- place crushed limestone sub-base material, as required to fill excavated and low lying areas on the site. The crushed limestone sub-base material should be placed in maximum 200 mm lifts on the subgrade and compacted to at least 100% of the maximum dry density (Standard Proctor). The final elevation of the crushed limestone sub-base should be 150 mm below the bottom of the concrete slab.
- place a 150 mm layer of crushed limestone base course and compact to at least 100% of the maximum dry density (Standard Proctor).

The minimum requirement for granular fill material beneath a soil-supported floor slab is 150 mm of crushed limestone base course material. Additional materials required to meet the design elevations should consist of crushed limestone sub-base material. The grading limits for the crushed limestone base course and sub-base materials for a soil-supported floor slab are shown in the table below.

| Canadian Metric Sieve Size | % Passing | |
|---|---|---|
| | Base Course | Sub-base |
| 50 000 | | 100 |
| 20 000 | 100 | – |
| 5 000 | 40 - 70 | 25 - 80 |
| 2 500 | 25 - 60 | – |
| 315 | 8 - 25 | – |
| 80 | 6 - 17 | 5 - 18 |

Sieve analysis and compaction testing of the crushed limestone base course and sub-base materials should be conducted to ensure that the materials supplied and the compaction comply with the design specifications.

### 5.4 Pavements

It is anticipated that the primary traffic for the parking lots will be light duty vehicles such as passenger vehicles and pickup trucks. The following pavement sections are recommended.

| Material | Light Duty Pavement | Heavy Duty Pavement |
|---|---|---|
| Asphaltic Concrete | 60 mm | 100 mm |
| Base Course | 100 mm | 100 mm |
| Sub-Base | 200 mm | 350 mm |

The light duty pavement section should be used where traffic loading will consist of passenger vehicles and light duty trucks. The heavy duty pavement section should be used for pavements subjected to heavy truck traffic. Additional materials, if required to meet the design elevation for the pavement, should consist of crushed limestone sub-base material. Construction of the sub-base and base course for the parking lots should comply with The City of Winnipeg Standard Construction Specification CW 3110. Materials for the asphaltic concrete pavement should comply with the requirements of CW 3410. Sieve analysis and compaction testing of the crushed limestone base course and sub-base materials should be conducted to ensure that the materials and compaction comply with the design specifications. For the hot mix asphaltic concrete, compaction testing and Marshall analysis of the paving mix during construction should be undertaken. This will confirm that the asphaltic concrete has been supplied and installed in accordance with the project specifications.

### 5.5 Drainage

All roof downspouts should be directed away from the building and the ground surface around the addition should be graded to prevent water from ponding adjacent to it. Final site grading should ensure that all surface runoff is directed away from the foundation using a minimum gradient of 2%.

## 6.0 CLOSURE

Professional judgements and recommendations are presented in this report. They are based partly on evaluation of the technical information gathered during our site investigation and partly on our general experience with subsurface conditions in the area. We do not guarantee the performance of the project in any respect other than that our engineering work and judgment rendered meet the standards and care of our profession. It should be noted that the testholes may not represent potentially unfavourable subsurface conditions between testholes. If during construction soil conditions are encountered that vary from those discussed in this report, we should be notified immediately in order that we may evaluate effects, if any, on foundation performance. The recommendations presented in this report are applicable only to this specific site. These data should not be used for other purposes.

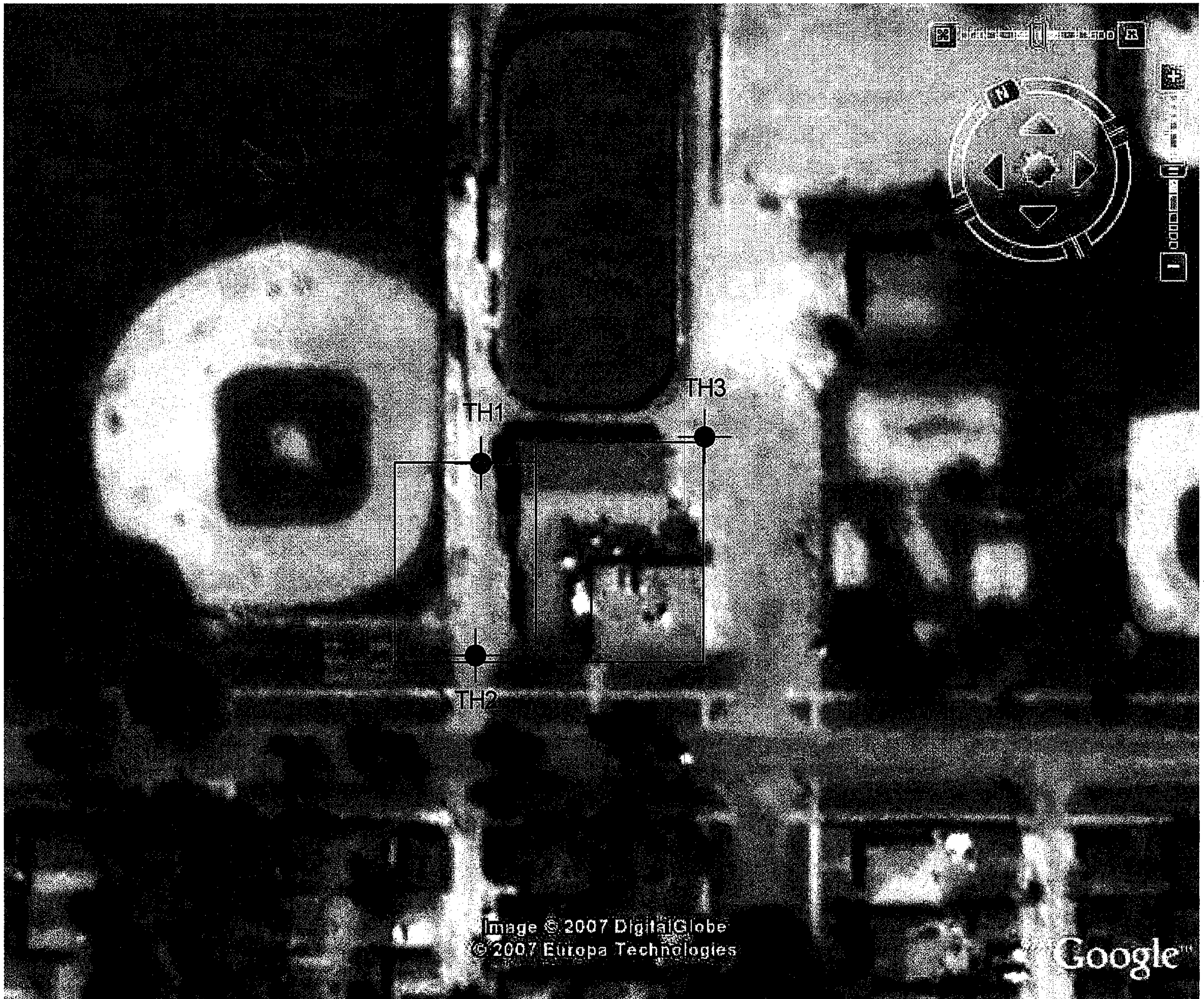
We appreciate the opportunity to assist you in this project. Please call me if you have any questions regarding this report.

Don Flatt

Don Flatt, M. Eng., P. Eng.,
Senior Geotechnical Engineer

PROVINCE OF MANITOBA
D. G. FLATT
Jan 22/08
REGISTERED ENGINEER

APEGM
Certificate of Authorization
The National Testing Laboratories Limited
No. 690 Date: JAN 22/08

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|---|---|---|---|
| THE NATIONAL TESTING LABORATORIES LIMITED *Established in 1923* | Project No.: LAV-702 | Drawn by: KK | Figure: 1 |
| | Date: Dec. 19, 2007 | Reviewed by: DF | Scale: NTS |

Testhole Location Plan
Sinclair Park Community Centre
490 Sinclair Street
Winnipeg, Manitoba

# TESTHOLE TH1

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**Project Name:** Sinclair Park Community Centre
**Client:** Lavergne Draward & Associates
**Drilling Contractor:** Subterranean (Manitoba) Ltd.
**Drilling Method:** Piling Rig, 18" dia. auger

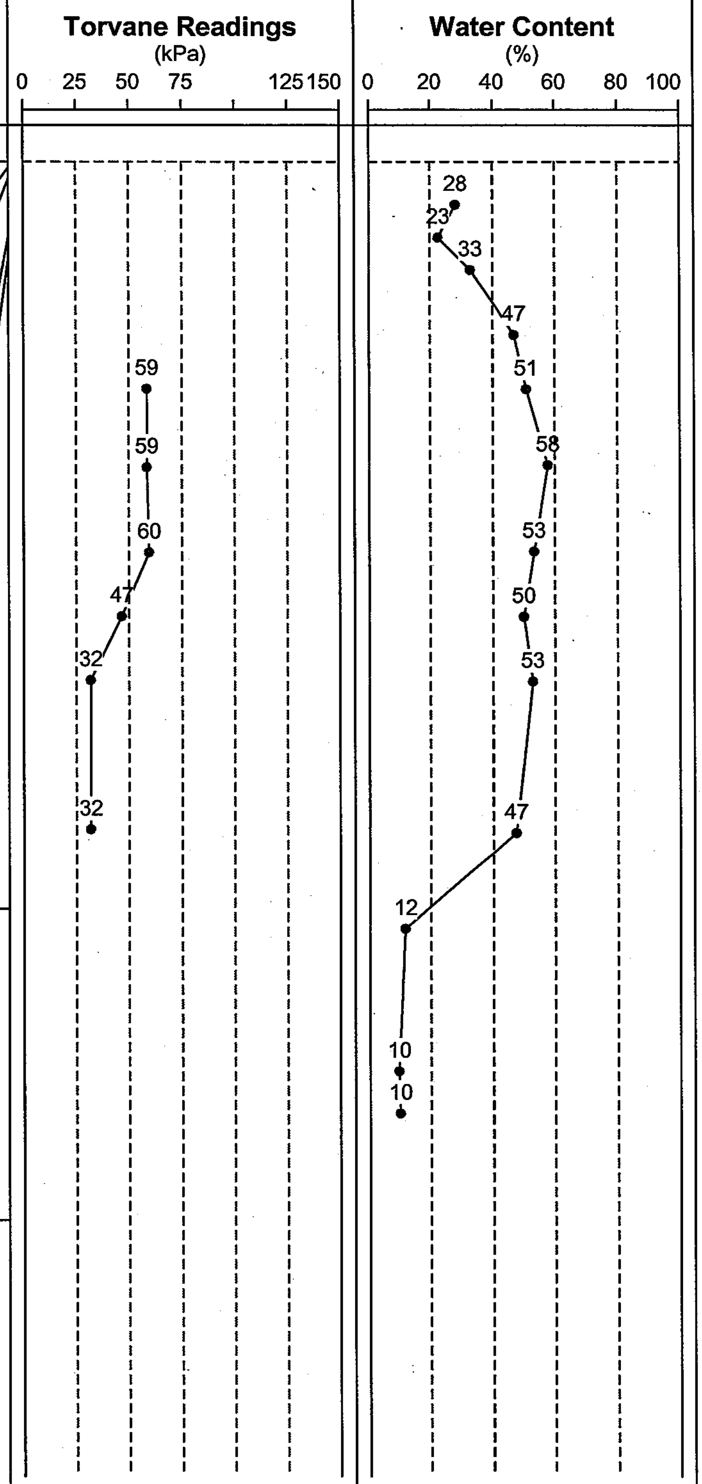
**Date Drilled:** Dec. 4, 2007
**Depth of Testhole:** 14.9 m
**Logged by:** Kurtis Kulchyski
**Reviewed by:** Don Flatt

## Subsurface Profile

| Depth (m) | Description |
|---|---|
| 0 | Ground Surface |
| 0 – ~0.2 | **Asphaltic Concrete** |
| ~0.2 – ~1.3 | **Limestone Base Course** |
| | **Clay Fill** - black, firm to stiff, moist, high plasticity, trace organics, silt, and fine gravel |
| | **Silt** - tan, firm, moist, low plasticity |
| ~1.3 – ~10.5 | **Clay** - brown, firm, moist, high plasticity, trace silt inclusions to 2.1 m - stiff below 2.1 m - grey below 3.7 m - firm below 6.0 m - trace gypsum and fine gravel inclusions below 6.4 m |
| ~10.5 – 14.9 | **Silt Till** - grey/tan, firm, saturated, low plasticity, with clay, some gravel and cobbles - tan, dense, moist below 12.5 m - very dense below 13.4 m |

- Sloughing was observed from the till below a depth of 13.7 m upon completion of drilling.
- No groundwater seepage was observed during or after drilling.
- Auger refusal on suspected boulder occured at 14.9 m.

## Laboratory Testing



# TESTHOLE TH2

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**Project Name: Sinclair Park Community Centre**
**Client: Lavergne Draward & Associates**
**Drilling Contractor: Subterranean (Manitoba) Ltd.**
**Drilling Method: Piling Rig, 18" dia. auger**

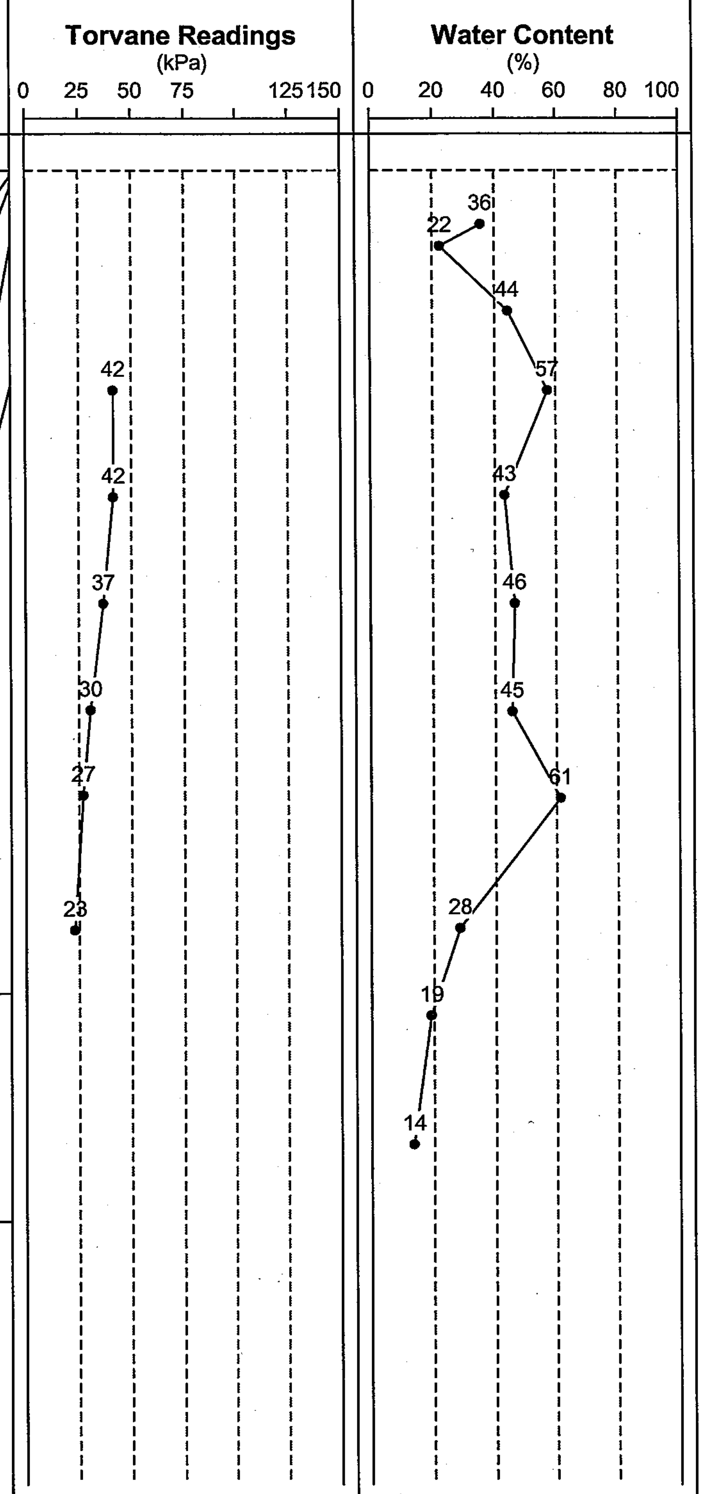
**Date Drilled: Dec. 4, 2007**
**Depth of Testhole: 14.8 m**
**Logged by: Kurtis Kulchyski**
**Reviewed by: Don Flatt**

## Subsurface Profile

| Depth (m) | Symbol | Description |
|---|---|---|
| 0 | | Ground Surface |
| 0–0.3 | | **Asphaltic Concrete** |
| 0.3–1 | | **Limestone Base Course** |
| 1–3 | | **Clay Fill**<br>- black, firm to stiff, moist, high plasticity, trace organics, silt, and fine gravel |
| 3–11.6 | | **Silt**<br>- tan, soft, moist to saturated, low plasticity<br>**Clay**<br>- brown, stiff/firm, moist, high plasticity, with silt inclusions<br>- grey below 3.9 m<br>- firm below 6.0 m<br>- trace gypsum inclusions below 6.1m<br>- trace fine gravel inclusions below 7.6 m |
| 11.6–14.8 | | **Silt Till**<br>- grey, firm, saturated, low plasticity, with clay, some gravel and cobbles<br>- tan below 13.1 m |

- Sloughing was observed from the till below a depth of 13.7 m. Sloughing was also observed from the silt during drilling.
- Minor groundwater seepage was observed within the silt at 3 m during drilling.
- Auger refusal on suspected boulder occured at 14.8 m.

## Laboratory Testing



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# TESTHOLE TH3

**Project Name: Sinclair Park Community Centre**
**Client: Lavergne Draward & Associates**
**Drilling Contractor: Subterranean (Manitoba) Ltd.**
**Drilling Method: Piling Rig, 18" dia. auger**

**Date Drilled: Dec. 4, 2007**
**Depth of Testhole: 14.8 m**
**Logged by: Kurtis Kulchyski**
**Reviewed by: Don Flatt**