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# Memorandum

To Neil Klassen

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CC Mohammad Hoque

Subject Department of Fisheries and Oceans Canada
Prefabricated Building Foundations - Geotechnical Investigation
Gimli, Manitoba

From Saba Ibrahim

Date September 2, 2016

Project Number 60513310 (431)

## 1. Introduction

The Department of Fisheries and Oceans Canada (DFO) retained AECOM Canada Limited (AECOM) to carry out a geotechnical investigation and provide building foundation recommendations for two proposed prefabricated buildings in Gimli, Manitoba.

This memorandum summarizes the results of the geotechnical investigation completed in July 2016 and provides geotechnical recommendations for the building foundations based on the results of the investigation.

## 2. Field Investigation

From July 8 to 9, 2016, two (2) test holes (TH16-01 and TH16-02) were drilled at the approximate locations shown on the test hole location plan, Figure 01 in Appendix A.

Drilling was completed by Maple Leaf Drilling using a truck-mounted Mobile B54X drill rig equipped with 125 mm solid stem augers and 175 mm hollow stem augers. Subsurface conditions observed during drilling were visually classified and documented by AECOM geotechnical personnel. Other pertinent information such as groundwater and drilling conditions were also recorded during drilling. Samples retrieved during the field investigation were tested in AECOM's Materials Testing Laboratory in Winnipeg, Manitoba. Geotechnical samples collected during the investigation included a relatively undisturbed Shelby Tube sample and disturbed grab and split spoon samples.

A detailed test hole log has been prepared for each test hole, and are attached as Appendix B. The test hole logs include description and depth of the soil units encountered, sample type, sample location, results of field and laboratory testing, and other pertinent information such as seepage and sloughing. Laboratory testing was conducted on select soil samples collected during the geotechnical field investigation. The soil testing program included the determination of moisture contents, grain size distributions (hydrometer methods) and Atterberg Limits. The laboratory test results are presented in Appendix C.

Table 2-1 summarizes test hole information including location, and termination depth.

**Table 2-1: Test Hole Summary**

| Test Hole | Northing (m) | Easting (m) | Termination Depth (m) |
|---|---|---|---|
| TH16-01 | 5610731 | 642544 | 24.4 |
| TH16-02 | 5610735 | 642556 | 24.8 |

# 3. Subsurface Conditions

The following sections describe the subsurface conditions encountered during the geotechnical investigation. Subsurface conditions can vary across the site and the information provided in this section is a summary of the findings from the field investigation and laboratory testing program.

## 3.1 Subsurface Profile

In descending order the soil profile consists of:

- Topsoil
- Fill
- Silt and Clay
- Clay
- Glacial Till

These soil units are described separately below. A summary of moisture and Atterberg limit laboratory test results is presented as Figure 02 in Appendix A.

### Topsoil

Topsoil was encountered in TH16-01 immediately below ground surface with a thickness of 0.1 m. The topsoil was black, dry and contained trace roots.

### Fill

Fill was encountered directly beneath the ground surface in TH16-02. The fill comprised of 0.6 m thick of sand fill overlying 0.6 m thick clay fill. The sand fill contained trace gravel and trace cobbles, was dark brown, loose and dry to moist. The clay fill was silty, contained trace sand, trace gravel, trace roots, was dark grey to black, stiff, moist and of intermediate plasticity. Results of one moisture content test performed on the clay fill indicated a moisture content of 29 percent.

### Silt and Clay

A layer of silt and clay was encountered beneath the topsoil in TH16-01 with a thickness of 0.8 m. The silt and clay contained trace sand, was brown, firm, moist, and of intermediate plasticity. Results of one moisture content test performed on the layer indicated a moisture content of 24 percent.

### Clay

A clay layer was encountered beneath the silt and clay in TH16-01 and beneath the fill in TH16-02. The thickness of the layer was 2.1 m. The clay contained some silt to silty, trace sand and trace gravel. The clay was dark greyish-brown to brown, soft to stiff, moist, and of intermediate to high plasticity. A summary of the index properties of the clay is presented in Table 3-1.

**Table 3-1: Summary of Index Properties of Clay**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| **Moisture Content (%)** | 30.6 | 49.8 | 3 |
| **SPT 'N' Blow Counts (uncorrected)** | 9 | | 1 |
| **Atterberg - Plastic Limit (%)** | 14.7 | 20.7 | 2 |
| **Atterberg - Liquid Limit (%)** | 57.8 | 79.8 | 2 |
| **Grain Size - Gravel (%)** | 0.0 | 0.1 | 2 |
| **Grain Size - Sand (%)** | 1.6 | 5.0 | 2 |
| **Grain Size - Silt (%)** | 16.5 | 29.6 | 2 |
| **Grain Size - Clay (%)** | 65.4 | 81.9 | 2 |

## Glacial Till

Glacial till was encountered in both test holes and it was categorized into three different layers based on the major till compositions below:

- - Silt till;
- - Silt and sand till;
- - Sand till

Silt till was encountered beneath the clay layer in TH16-01 with a thickness of 9.1 m. The silt till was sandy, contained some clay and trace gravel, was light brown to greyish-brown, compact to dense, dry to moist, and of low plasticity. A summary index of properties of the silt till is presented in Table 3-2.

**Table 3-2: Summary of Index Properties of Silt Till**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| **Moisture Content (%)** | 7.2 | 10.1 | 6 |
| **SPT 'N' Blow Counts (uncorrected)** | 19 | 49 | 6 |
| **Atterberg - Plastic Limit (%)** | 9.0 | | 1 |
| **Atterberg - Liquid Limit (%)** | 15.6 | | 1 |
| **Grain Size - Gravel (%)** | 8.5 | | 1 |
| **Grain Size - Sand (%)** | 34.9 | | 1 |
| **Grain Size - Silt (%)** | 38.5 | | 1 |
| **Grain Size - Clay (%)** | 18.1 | | 1 |

Sand and silt till was encountered beneath the silt till in TH16-01 and beneath the clay in TH16-02 ranging in thickness from 12.2 m to 10.4 m. The sand and silt till contained some clay, trace to some gravel, was light brown to greyish-brown, compact to dense, dry to moist and of low plasticity. A summary of the index properties of the sand and silt till is presented in Table 3-3.

**Table 3-3: Summary of Index Properties of Sand and Silt Till**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| **Moisture Content (%)** | 9.2 | 11.2 | 13 |
| **SPT 'N' Blow Counts (uncorrected)** | 10 | 37 | 14 |
| **Atterberg - Plastic Limit (%)** | 8.1 | 9.0 | 3 |
| **Atterberg - Liquid Limit (%)** | 13.3 | 13.6 | 3 |
| **Grain Size - Gravel (%)** | 9.6 | 11.9 | 3 |
| **Grain Size - Sand (%)** | 36.5 | 40.5 | 3 |
| **Grain Size - Silt (%)** | 37.0 | 36.5 | 3 |
| **Grain Size - Clay (%)** | 13.4 | 14.6 | 3 |

Sand till was encountered in TH16-02 beneath the sand and silt till with a thickness of 11.1 m measured at test hole termination depth. The sand till was silty, contained some clay and trace gravel, was brownish-grey, compact, dry to moist, and of low plasticity. A summary of index properties of the sand till is presented in Table 3-4.

**Table 3-4: Summary of Index Properties of Sand Till**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| **Moisture Content (%)** | 9.9 | 13.4 | 5 |
| **SPT 'N' Blow Counts (uncorrected)** | 9 | 18 | 5 |
| **Atterberg - Plastic Limit (%)** | 8.8 |  | 1 |
| **Atterberg - Liquid Limit (%)** | 13.8 |  | 1 |
| **Grain Size - Gravel (%)** | 8.4 |  | 1 |
| **Grain Size - Sand (%)** | 54.2 |  | 1 |
| **Grain Size - Silt (%)** | 26.7 |  | 1 |
| **Grain Size - Clay (%)** | 10.7 |  | 1 |

## 3.2 Sloughing and Groundwater Conditions

Groundwater seepage was observed in TH16-02 at a depth between 3.0 m and 4.6 m below ground surface. Sloughing was not observed in either test hole. Where seepage was encountered, further details are provided in the test hole logs in Appendix B. Groundwater monitoring was not performed for this project.

It should be noted that groundwater levels and subsequently sloughing may change seasonally, annually or as a result of construction activities.

## 3.3 Seasonal Frost Penetration

The mean freezing index in the project area is at 2000 °C-days based on the Canadian Foundation Engineering Manual, accordingly the estimated seasonal frost penetration depth is approximately 2.5 m. Factors such as snow cover, vegetation at surface, soil type, and groundwater conditions can all significantly impact the depth of frost penetration.

### 3.4 Soil Chemistry

Electrochemical tests were conducted on two soil samples collected from TH16-01 and TH16-02 to determine water soluble sulphate concentration and resistivity. A summary of the test results, degree of corrosiveness and potential for sulphate attack of the subsurface soils are presented in Table 3-5.

The soil corrosion potential was assessed based on soil resistivity. Based on the resistivity values, the soil is considered to be moderate to severe corrosive. The selection and design of the foundation should take into account the possible corrosion of the steel reinforcement.

The soil's potential for sulphate attack was assessed based on the soluble sulphate content of soil samples collected from two samples at the vicinity of the proposed structures. The soluble sulphate contents indicated the soil has a negligible potential for sulphate attack on concrete.

All concrete in contact with the soil should be made in accordance with CSA Standard A23.1 and A23.2. The use of Type HS (sulphate resistance cement) is recommended to be considered for any concrete in contact with subsurface soils.

**Table 3-5: Summary of Sulphate Content and Resistivity Tests**

| Soil Unit | Sample Depth (m) | Test hole | Sulphate Content in Soil Sample % | Potential for Sulphate Attack | Resistivity (ohm-cm) | Degree of Corrosiveness |
|---|---|---|---|---|---|---|
| **Clay** | **1.5** | **TH16-01** | **0.011** | **Negligible** | **3140** | **Moderate** |
| **Clay** | **2.25** | **TH16-02** | **0.0241** | **Negligible** | **1340** | **Sever** |

## 4. Discussion and Recommendations

### 4.1 General

It is understood that the proposed buildings will be comprised of a prefabricated aluminum frame structure. The intended use of one of the proposed buildings is accommodations, while the other is intended to be used as office space.

### 4.2 Foundations

Generally, the top 3 to 4 m of the soil is comprised of highly plastic clay; underlain by glacial till, and shallow foundation can be considered to support the proposed lightly loaded structure. However, potential vertical movement due to swelling and/or frost heave should be counted for structure future performance.

Shallow footings are considered a suitable foundation system to support the proposed accommodation and office buildings considering the anticipated loading and the shallow depth to bearing stratum. However, during design development, the geotechnical team was notified to consider raft foundation underlain by a 1.0 thick compacted granular pad as the preferred option.

Deep foundations are not considered a cost effective foundation system and therefore will not be discussed further in this memorandum.

### 4.2.1 Shallow Foundation - Square Footing

Shallow footings can be used to support and transfer light loads to the underlying soil at a pressure consistent with the loading requirements and the bearing capacity of the soil. Square footing was considered for this project.

The main concern with shallow foundation design at this site is the requirements for protection against frost heave. Sufficient soil cover or thermal insulation should be provided to protect against frost action. In this regard, if insulation is not considered, the footing should be located at depth not less than 2.5 m, as discussed in section 3.3.

Square footings installed less than 2.5 m below existing grade will require rigid insulation to minimize frost penetration into the soil around and below the footings. A minimum insulation thickness of 50 mm is recommended. Horizontal insulation sheets should be placed over the footings with a minimum soil cover of 0.5 m. The insulation should extend at least 1.2 m past the perimeter of the footings.

Nominal and factored bearing resistance at ultimate limit state (ULS) for a range of square footing dimensions bearing from 1.0 m to 3.0 m below existing ground has been evaluated with footing effective width ranging from 1 to 2.5 m. A resistance factor of 0.5 can be used to derive the factored bearing resistance at ULS. The bearing resistance of a footing is highly influenced by the load inclination, an inclined load of horizontal (H)/vertical (V) = 0.1 would result in reduction of the factored bearing resistance to 88 percent of the value above (i.e 0.88 X Nominal bearing resistance). If the design inclination ratio (H/V) is more than 0.1 then further reduction in bearing resistance will be required.

Recommendations for the bearing resistance at both ULS and SLS are provided on Table 4-1. SLS bearing resistance has been calculated corresponding to settlement of 50 mm.

**Table 4-1: Bearing Resistance at SLS and ULS for Square Footing**

| Footing Depth below Ground Level(m) | Footing Width B** (m) | Nominal Bearing Resistance at ULS (kPa)- Square footing* | Factored Bearing Resistance at ULS (kPa)- Square footing | Bearing Resistance at SLS (kPa)- Square footing |
|---|---|---|---|---|
| 1 | 1 | 224 | 112 | 80 |
| 2 | | 233 | 116 | 110 |
| 3 | | 241 | 120 | 120 |
| 1 | 1.5 | 224 | 112 | 50 |
| 2 | | 233 | 116 | 75 |
| 3 | | 290 | 145 | 120 |
| 1 | 2.0 | 224 | 112 | 40 |
| 2 | | 233 | 116 | 65 |
| 3 | | 356 | 178 | 105 |
| 1 | 2.5 | 224 | 112 | 35 |
| 2 | | 248 | 124 | 60 |
| 3 | | 446 | 223 | 105 |

*H/V =0.0,
Where: H/V ratio of horizontal to vertical load
** B=L , square footing

Different configurations (included footing, thickened edge, shape modification etc.) of spread footings may result in a potential for load superposition and overstressing of the bearing stratum. Under these circumstances modification to the footings configuration or a review of the bearing capacity may be required.

Footings should not be placed on frozen soil, uncontrolled fill, organic or other deleterious soils. The bearing surfaces should be excavated at least 0.3 m into the clay layer. The bearing stratum should be cleaned to remove all disturbed or otherwise affected soil and protected from frost, desiccation and the ingress of free water. The footing excavations must be maintained in a dry condition at all times.

The footing excavations should be backfilled with clay soil in an effort to keep water from infiltrating down beside the footings. The clay should be compacted to about 95 percent of the Standard Proctor maximum dry density within 2 percent of the optimum moisture content.

Soil within the depth of frost penetration can freeze to the foundation developing an uplift force. An adfreeze bond of 65 kPa can be used to estimate the uplift forces. These forces can be resisted by the sustained vertical loads on the footing. If dead load plus sustained live load is insufficient to resist the uplift forces, then a restraining device or uplift resistance measures will be required. A frost non-susceptible material or bond breaker/thermal insulation between the footing and the adjacent soil can be used to protect against adfreeze bond development.

Nominal unit resistance to sliding at ULS conditions can be calculated as the sum of normal sliding resistance and passive sliding resistance. A resistance factor of 0.85 should be applied to the nominal normal sliding resistance which can be taken as the smaller of:

- Clay undrained shear strength = 35 kPa; or
- Provided the footing is supported on at least 150 mm compacted granular, one half the normal stress at the footing/clay interface.

If passive sliding resistance is accounted for in the design, then it should be carefully evaluated for the possibility of future removal of the soil from the front of the wall and the associated displacement to mobilize the maximum passive soil resistance.

### 4.2.2 Raft Foundation

During the design stage, an 18.3 m x 7.3 m raft foundation was selected by the structural engineer as a preferred option to support the office and accommodation building.

A compacted granular fill consisting of 40 mm minus crushed gravel will be required below the foundation underside with a minimum thickness of 1.0 m. The compacted granular fill should be constructed to reduce the thickness of the compressible clay layer below the raft base, and to minimize the long term consolidation settlement accordingly.

The nominal and factored bearing resistance at ultimate limit state (ULS) for the selected footing dimensions bearing at ground surface has been evaluated. A nominal bearing resistance of 255 kPa and a resistance factor of 0.5 can be used to derive the factored bearing resistance at ULS. The bearing resistance of a footing is highly influenced by the load inclination, an inclined load H/V = 0.1 would result in reduction of the bearing resistance to 87 percent of the value above (i.e., 255 x 0.87).

Settlement of the compacted granular fill is expected to be 1% of fill thickness (i.e 10 mm).This settlement will take place during construction. Bearing pressures at SLS of 30 kPa have been estimated for both buildings corresponding to settlement of 60 mm in which 10 mm is immediate and 50 is long term consolidation settlement. 90 % of long term consolidation settlement is expected within 1.5 year following the construction.

Based on the loading conditions and the adopted dimensions, spacing and configurations of the proposed development, a series of settlement analyses were conducted to estimate the anticipated total and differential settlement of the granular fill, clay and till units supporting the raft foundation.

The effects of the overlapping stress bulbs from the proposed adjacent buildings were considered in the stress analysis. It is understood that the space between the proposed two buildings is limited to 2.1 m; therefore differential settlement of about 15 mm is anticipated between the inner side (adjacent to the other building) and the outer side of the building.

It is highly recommended that the area between the proposed buildings is to be sub-excavated to 1.0 m and replaced with same granular fill, in-order to mitigate the risk associated with swelling potential of the soil and a non-uniform heave movement.

Recommendations related to frost depth, protection against frost action and adfreeze is discussed in sections 4.2.1 and 3.3.

Raft foundations for the selected dimensions (18.3 m x 7.3 m), may be designed using modulus of vertical subgrade reaction, ks, of 3250 kN/m$^3$ at ground surface, providing that clay material will be excavated to minimum 1.0 m and will be replaced with granular fill 40 mm minus.

Since a 1.0 m subcut of the clay and replacement with granular material is required, water inflow from surface and rainfall will infiltrate into the granular fill and accumulate at the base without finding a drainage path to drain via overland run-off. Accumulation of water at the interface between the granular fill and the clay layer will result in softening the bearing strata and excessive settlement should be expected. Therefore, a sub-drain/weeping tile system will need to be implemented at the bottom of the sub-cut to capture drainage from the bottom of the granular fill and transport it into the land drainage system. The exposed subgrade should be sloped to drain subsurface water towards permanent drains and sumps. Adequate permanent drainage system and grading should be implemented in-order to drain any water as soon as possible, protect against the ingress of free water and prevent the accumulation of water beside the buildings.

### 4.2.3 Construction Recommendations

Additional design and construction recommendations for shallow foundations are provided below:

1. A foundation preparation should include over-excavation to a depth of 0.5 m below bearing elevations.
2. The over-excavation should extend at least 1 m beyond the exterior footing edges. The excavated soil should be replaced with compacted clean granular fill.

3. A dewatering system (e.g. sump and pump, well points system, etc.) may be required to control groundwater seepage and allow construction in the dry. Seepage was noted during the site investigation, therefore provisions for construction dewatering should be allowed for in the construction budget and schedule.
4. Care should be taken during excavation to ensure that the final bearing surface is not disturbed or subjected to freezing, water inundation or excessive drying. All loose or disturbed soil should be removed from the final bearing surface.
5. Excavations will likely be required to facilitate the construction of the new structure. The method of excavation and safe support of excavation are the responsibility of the contractor and all other necessary measures should be undertaken to protect against adverse impact or undermining the foundation or stability of existing infrastructure/structures.
6. All existing fill and/or silt materials are considered non suitable subgrade and should be removed and replaced with granular fill.
7. The exposed subgrade after removal of the clay material up to minimum 1.0m depth for raft foundation, or to the foundation elevation for square footing should be compacted to 95 percent of Standard Proctor Maximum Dry Density (SPMDD).
8. After compaction, the subgrade should be proof rolled to identify any soft spots. The proof rolling should be performed for the finished subgrade, following the compaction, under the observation of a representative from AECOM.
9. Each successive pass of the equipment used for proof rolling should be offset by not greater than one tire width to provide adequate coverage. The rolling pattern should be completed in a systematic fashion and the results recorded .The proof rolling should cover 100% of the foundation area.
10. If soft spots are encountered after the proof rolling below the exposed subgrade, placement of biaxial geogrid reinforcement (an approved product is Combigrid as supplied by NAUE or approved equivalent) will be required, to provide a stable foundation base.
11. The exposed subgrade surface should be protected from freezing, wetting, drying or disturbance. As such, it may be necessary for the contractor to sequence construction so that only a small portion of the subgrade remains open at a given time and that excavations are backfilled as soon as possible. Where excavations are to be left open overnight, the subgrade surface should be sealed with a smooth drum roller and sloped to a low point in the excavation to facilitate removal of ponded water if necessary.
12. Once the bearing soil at the foundation level has been prepared, it should be evaluated by geotechnical personnel to verify the soil is consistent with the soil identified in this memorandum.
13. It is recommended that a non-woven geotextile be placed directly over the prepared subgrade and at the interface around perimeter drainage layer to provide separation between the subgrade and the granular/drainage layer.
14. The new compacted fill above exposed subgrade should be placed in a maximum loose lift of 200 mm in thickness and compacted to a minimum of 98 percent of SPMDD. Moisture contents should be maintained within ±2 percent of optimum moisture during placement and compaction.
15. The excavation should be capped at grade with a layer of clay and graded at a 2% slope away from the buildings.
16. Raft should be adequately reinforced to allow the structure to settle uniformly and maintain structural integrity.
17. Flexible connections should be provided from the structure to all connected piping to accommodate differential settlements.

## 4.3 Floor Slabs

Generally, fill material can be used to support slabs-on-grade if the fill is placed and compacted in a controlled manner (engineered fill). In this regard, no information is available with respect to the placement and compaction of the existing fill, and therefore, it is considered unsuitable to support slabs-on-grade. The existing fill should be removed and prepared according to the guidelines below before it can be used as subgrade for slab-on-grade.

Floor slabs may be subjected to some vertical deformation due to swelling or shrinkage of the subgrade soil in response to changes in moisture content.

The following are guidelines for design and construction of slab-on-grade:

1. If the soil at subgrade surface does dry out, it should be dampened, scarified, and re-compacted to a minimum of 95 percent of Standard Proctor maximum dry density.
2. Any fill required to bring slab areas to design grade should consist of clean, inorganic material compacted to 95 percent of Standard Proctor maximum dry density.
3. A minimum of 150mm compacted thickness of clean free draining granular fill compacted to 95 percent of Standard Proctor maximum dry density should underlie the slab.
4. A vapour barrier below the slab is recommended to minimize long term moisture change within the subgrade.
5. Adequate slab reinforcement is to be provided.
6. A competent subfloor drainage system is to be provided for any portion of the slab which is constructed below the exterior grade.
7. The slab should be isolated from all fixed structural elements.
8. Light partitions bearing on the slab should be designed to permit vertical movement between the partition and the ceiling to minimize the possibility of damage if the slab heaves.
9. Control joints should be provided in the slab to reduce random cracking.
10. A minimum void space of 150 mm should be provided under the grade beam system to minimize the effect of local soil movement.

## 4.4 Lateral Earth Pressure

Any permanent below grade walls should be designed to resist both hydrostatic pressures and lateral earth pressures as well as any surcharge loading.

The lateral earth pressure can be calculated on the basis of the following conventional relationship which produces a triangular pressure distribution:

$P=K_o(\gamma D + q)$
Where:

P= Lateral earth pressure at depth D (kPa)
$K_o$= At-rest earth pressure coefficient = 0.60
$\gamma$ = Soil/Backfill unit weight =18 (kPa)
D = depth from ground surface to point of pressure calculation (m)
q = surcharge load within distance D from the wall edge (kPa)

Below the groundwater table, the hydrostatic water pressure must be added and the submerged weight of soil/backfill can be used. In this regard, no information is available concerning the long term groundwater table. For design purposes, the groundwater table can be assumed at the ground level.

The base of the walls should be provided with a filter-protected positive drainage system to prevent the buildup of hydrostatic pressure against the wall. Where required, backfill between the walls and the excavated faces should consist of granular material. The backfill should be sufficiently compacted only to minimize settlement of the backfill itself. The backfill should be compacted to 95 percent of Standard Proctor maximum dry density. Placement of the backfill should be undertaken in such a manner to prevent unbalanced forces from acting on the sides of the structure. Compaction by heavy equipment which could cause excessive lateral pressure on the walls should be avoided. All material within 1.5 m from the walls should be compacted using manually operated pad tampers. A 500 mm clay seal at the ground surface is recommended to reduce surface water infiltration. Grading should be maintained to provide positive surface drainage away from the structure. Drainage systems should be installed on the outside of the walls to protect against the accumulation of water behind the walls. Some settlement of the backfill should be expected. If no settlement of the backfill can be tolerated, the backfill types and compaction requirements should be reviewed by AECOM.

## 5. Closure

The findings and recommendations in this memorandum were based on the results of field and laboratory investigations, combined with an interpolation of soil and groundwater conditions between the test hole locations. If conditions are encountered that appear to be different from those shown by the test holes drilled at this site and described in this report, or if the assumptions stated herein are not in keeping with the design, this office should be notified in order that the recommendations can be reviewed and adjusted, if necessary.

Please do not hesitate to contact the undersigned for any questions or further information.

Respectfully Submitted,
AECOM Canada Ltd.

Prepared by:

S. Ibrahim

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Reviewed by:

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Senior Geotechnical Engineer

# Appendix A

Figure 01: Test Hole Location Plan
Figure 02: Summary of Laboratory Test Results

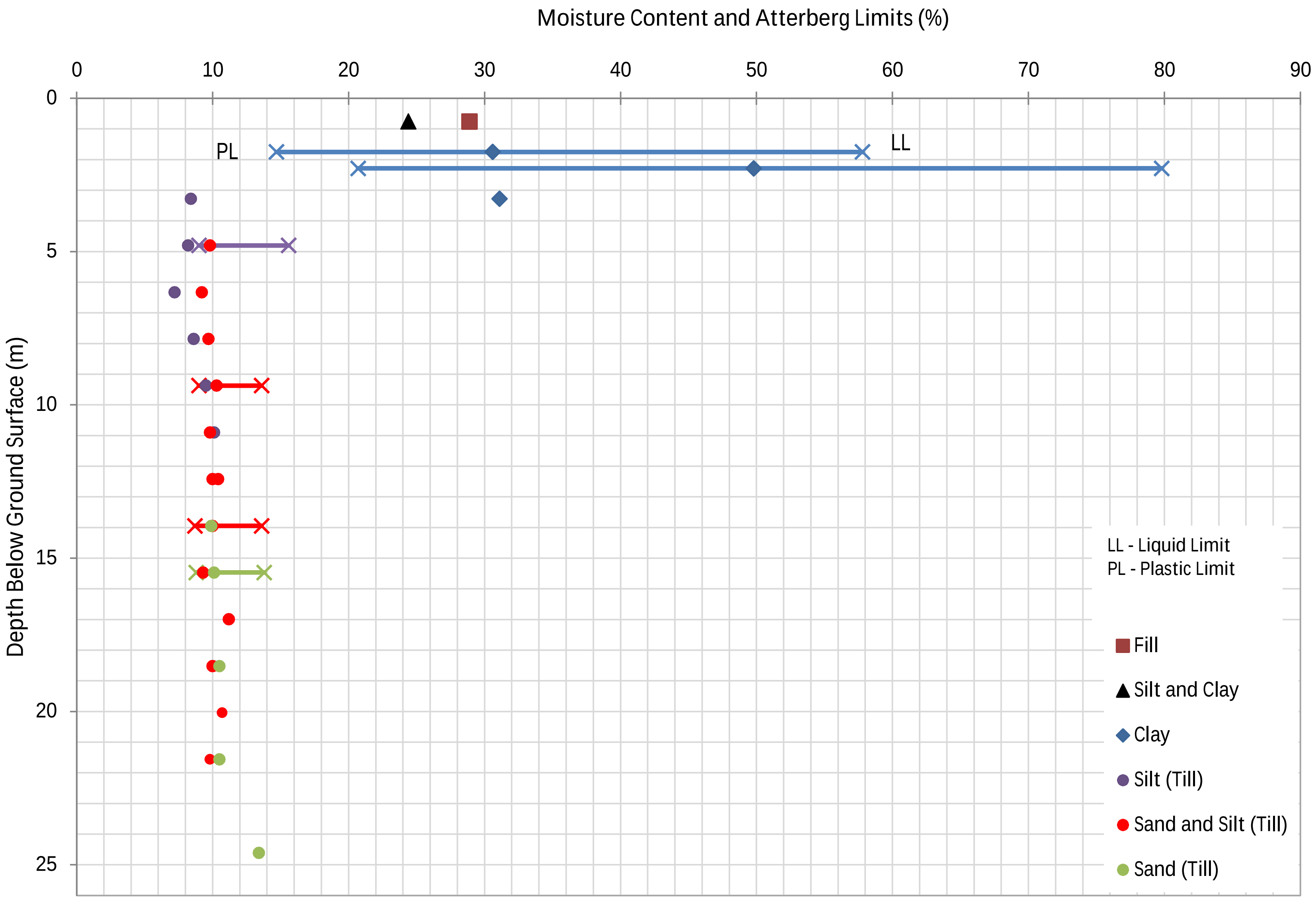


Figure 02 :Summary of Laboratory Test Results

ANSI A 215.9mm x 279.4mm
Approved:
Checked:
Designer:
Project Management Initials:
Last saved by: MAHEC (2016-07-26) Last Plotted: 2013-02-21
Filename: P:\60513310\900-CAD, GIS\920-929 (GIS-GRAPHICS)\B\G001_60513310_01V1_TESTHOLELOCATIONPLAN.MXD

**Prefabricated Building Foundations**
**Geotechnical Investigation**
Department of Fisheries and Oceans

**Test Hole Location Plan**

**Figure: 01**

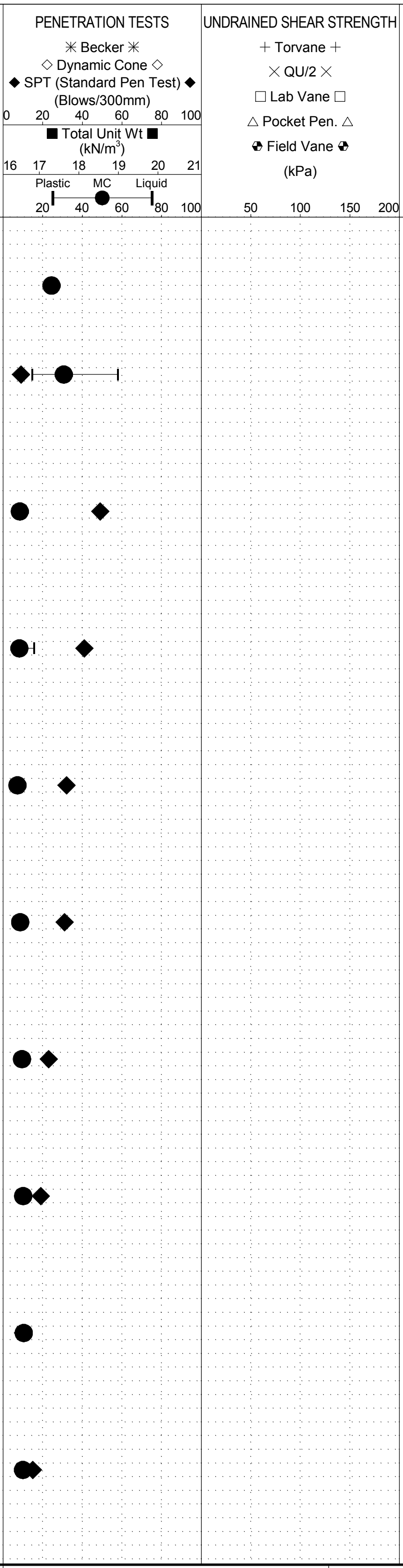
# Appendix B

## Test Hole Logs

PROJECT: Prefab Building Foundation
CLIENT: Department of Fisheries and Oceans
TESTHOLE NO: **TH16-01**
LOCATION: UTM 14 - 5610731 m N, 642544 m E
PROJECT NO.: 60513310
CONTRACTOR: Maple Leaf Drilling
METHOD: Mobile B54 X SSA and HSA
ELEVATION (m): NA

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▐ CORE

| SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE # | SPT (N) | COMMENTS |
|---|---|---|---|---|
| TOPSOIL - black, dry, trace roots | | | | |
| SILT and CLAY - trace sand<br>- brown, firm, moist<br>- intermediate plasticity | ■ | G1 | | |
| CLAY - silty, trace sand<br>- dark greyish-brown, stiff, moist<br>- high plasticity<br>- trace to some silt inclusions | ☒ | S2 | 9 | SPT Blows: [4/3/6], Spoon Recovery 100%, Gravel: 0.0%, Sand: 5.0%, Silt: 29.6%, Clay: 65.4% |
| SILT (Till) - sandy, some clay, trace gravel<br>- light brown, dense, dry<br>- low plasticity | ☒ | S3B | 49 | SPT Blows: [17/22/27], Spoon Recovery 89% |
| | ☒ | S4 | 41 | SPT Blows: [10/17/24], Spoon Recovery 89%, Gravel: 8.5%, Sand: 34.9%, Silt: 38.5%, Clay: 18.1% |
| - greyish-brown below 6.1 m | ☒ | S5 | 32 | SPT Blows: [14/17/15], Spoon Recovery 72% |
| - gravel in tip of spoon at 7.6 m (40 mm diam.) | ☒ | S6 | 31 | SPT Blows: [8/14/17], Spoon Recovery 33% |
| - compact, dry to moist below 9.1 m | ☒ | S7 | 23 | SPT Blows: [7/11/12], Spoon Recovery 28% |
| - gravel in tip of spoon at 10.7 m (25 mm diam.) | ☒ | S8 | 19 | SPT Blows: [6/9/10], Spoon Recovery 33% |
| SAND and SILT (Till) - some clay, trace gravel<br>- greyish-brown, compact, dry to moist<br>- low plasticity | ☒ | S9 | 10 | SPT Blows: [4/5/5], Spoon Recovery 83% |
| - some gravel below 13.7 m | ☒ | S10 | 15 | SPT Blows: [3/7/8], Spoon Recovery 100%, Gravel: 10.2%, Sand: 40.2%, Silt: 36.2%, Clay: 13.4% |



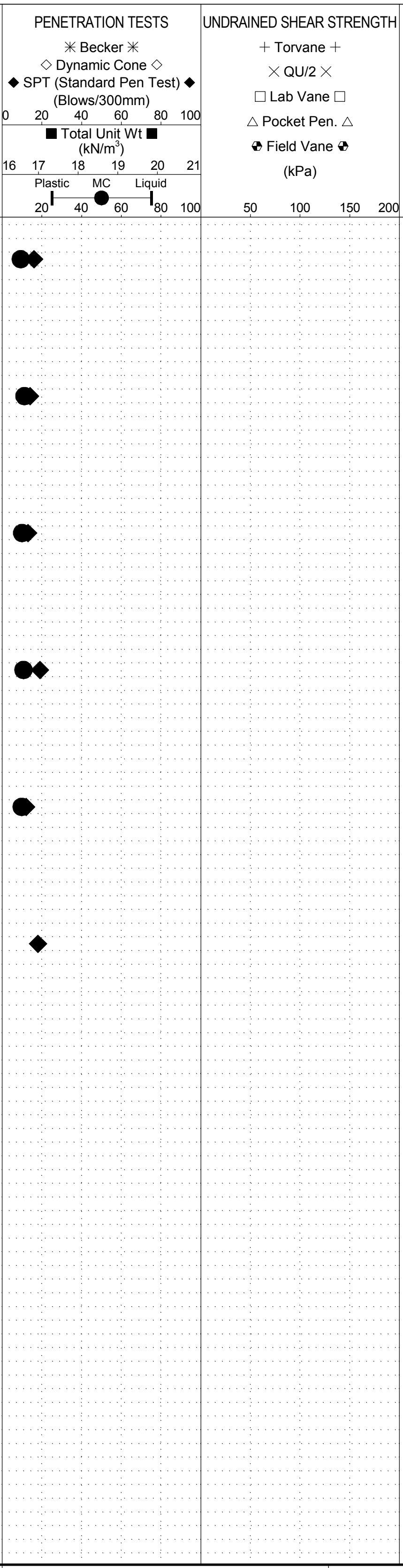
DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

LOGGED BY: Ryan Harras
COMPLETION DEPTH: 24.38 m
REVIEWED BY: Zeyad Shukri
COMPLETION DATE: 7/8/16
PROJECT ENGINEER: Neil Klassen

PROJECT: Prefab Building Foundation
CLIENT: Department of Fisheries and Oceans
TESTHOLE NO: **TH16-01**
LOCATION: UTM 14 - 5610731 m N, 642544 m E
PROJECT NO.: 60513310
CONTRACTOR: Maple Leaf Drilling
METHOD: Mobile B54 X SSA and HSA
ELEVATION (m): NA

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ▨ NO RECOVERY ▌ CORE

| DEPTH (m) | SAMPLE TYPE | SAMPLE # | SPT (N) | COMMENTS |
|---|---|---|---|---|
| 15.5 | ☒ | S11 | 16 | SPT Blows: [7/8/8], Spoon Recovery 72% |
| 17 | ☒ | S12 | 14 | SPT Blows: [4/6/8], Spoon Recovery 100% |
| 18.5 | ☒ | S13 | 13 | SPT Blows: [5/6/7], Spoon Recovery 100% |
| 20 | ☒ | S14 | 19 | SPT Blows: [5/8/11], Spoon Recovery 33%, Gravel: 11.9%, Sand: 36.5%, Silt: 37.0%, Clay 14.6% |
| 21.5 | ☒ | S15 | 12 | SPT Blows: [5/5/7], Spoon Recovery 100% |
| 23 | ☒ | S16 | 18 | SPT Blows: [6/9/9], Spoon Recovery 0% |



SOIL DESCRIPTION

**END OF TEST HOLE AT 24.38 m IN SAND and SILT (Till)**

Notes:
1. Seepage was not observed.
2. Sloughing was not observed.
3. Hole open to 24.38 m upon removal of auger.
4. SSA used to 1.5 m. Switched to HSA below 1.5 m.
5. Test hole backfilled with auger cuttings and bentonite upon completion.

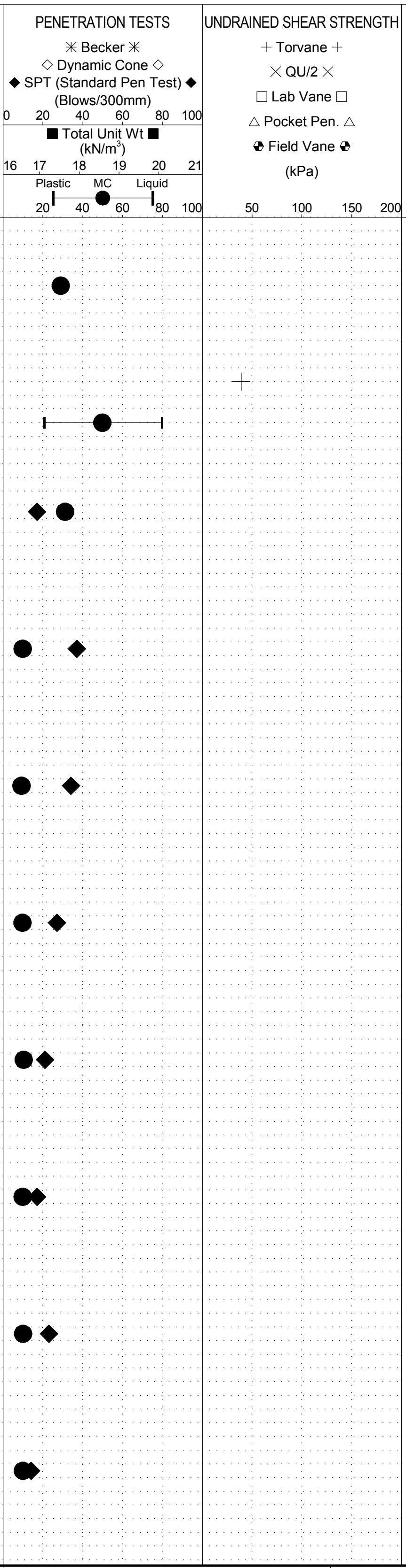
AECOM

LOGGED BY: Ryan Harras
REVIEWED BY: Zeyad Shukri
PROJECT ENGINEER: Neil Klassen
COMPLETION DEPTH: 24.38 m
COMPLETION DATE: 7/8/16

| | | |
|---|---|---|
| PROJECT: Prefab Building Foundation | CLIENT: Department of Fisheries and Oceans | TESTHOLE NO: **TH16-02** |
| LOCATION: UTM 14 - 5610735 m N, 642556 m E | | PROJECT NO.: 60513310 |
| CONTRACTOR: Maple Leaf Drilling | METHOD: Mobile B54 X SSA | ELEVATION (m): NA |

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ▮ CORE

| DEPTH (m) | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE # | SPT (N) | COMMENTS | DEPTH |
|---|---|---|---|---|---|---|---|
| 0 | | SAND (FILL) - trace gravel, trace cobbles<br>- dark brown, loose, dry to moist<br>- medium to coarse grained | | | | | |
| 1 | | CLAY (FILL) - silty, trace sand, trace gravel, trace roots<br>- dark grey to black, stiff, moist<br>- intermediate plasticity | ■ | G17 | | | 1 |
| 2 | | CLAY - silty, trace sand<br>- dark greyish-brown, firm to stiff, moist<br>- intermediate to high plasticity<br>- trace silt inclusions | ▥ | T18 | | Tube Recovery 52% | 2 |
| | | | ■ | G19 | | Gravel: 0.1%, Sand: 1.6%, Silt 16.5%, Clay 81.9% | |
| 3 | | CLAY - some silt, trace sand<br>- brown, soft to firm, moist<br>- high plasticity<br>- trace gravel, trace silt till pockets below 3.0 m | ☒ | S20 | 17 | SPT Blows: [3/9/8], Spoon Recovery 67% | 3 |
| 4 | | SAND and SILT (Till) - some clay, trace gravel<br>- light brown, dense, dry to moist<br>- low plasticity | | | | | 4 |
| 5 | | - gravel in tip of spoon at 4.6 m (25 mm diam.) | ☒ | S21 | 37 | SPT Blows: [11/13/24], Spoon Recovery 67% | 5 |
| 6 | | | ☒ | S22 | 34 | SPT Blows: [13/15/19], Spoon Recovery 67% | 6 |
| 7 | | | | | | | 7 |
| 8 | | - brownish-grey, compact below 7.6 m | ☒ | S23 | 27 | SPT Blows: [12/13/14], Spoon Recovery 61% | 8 |
| 9 | | | ☒ | S24 | 21 | SPT Blows: [10/10/11], Spoon Recovery 50%, Gravel: 9.6%, Sand: 40.5%, Silt: 36.5%, Clay: 13.5% | 9 |
| 10 | | | | | | | 10 |
| 11 | | | ☒ | S25 | 17 | SPT Blows: [6/8/9], Spoon Recovery 83% | 11 |
| 12 | | | ☒ | S26 | 23 | SPT Blows: [6/12/11], Spoon Recovery 67% | 12 |
| 13 | | | | | | | 13 |
| 14 | | SAND (Till) - silty, some clay, trace gravel<br>- brownish-grey, compact, dry to moist<br>- low plasticity | ☒ | S27 | 14 | SPT Blows: [5/7/7], Spoon Recovery 89% | 14 |
| 15 | | | | | | | |



| | |
|---|---|
| LOGGED BY: Ryan Harras | COMPLETION DEPTH: 24.84 m |
| REVIEWED BY: Zeyad Shukri | COMPLETION DATE: 7/9/16 |
| PROJECT ENGINEER: Neil Klassen | |

PROJECT: Prefab Building Foundation

CLIENT: Department of Fisheries and Oceans

TESTHOLE NO: **TH16-02**

LOCATION: UTM 14 - 5610735 m N, 642556 m E

PROJECT NO.: 60513310

CONTRACTOR: Maple Leaf Drilling

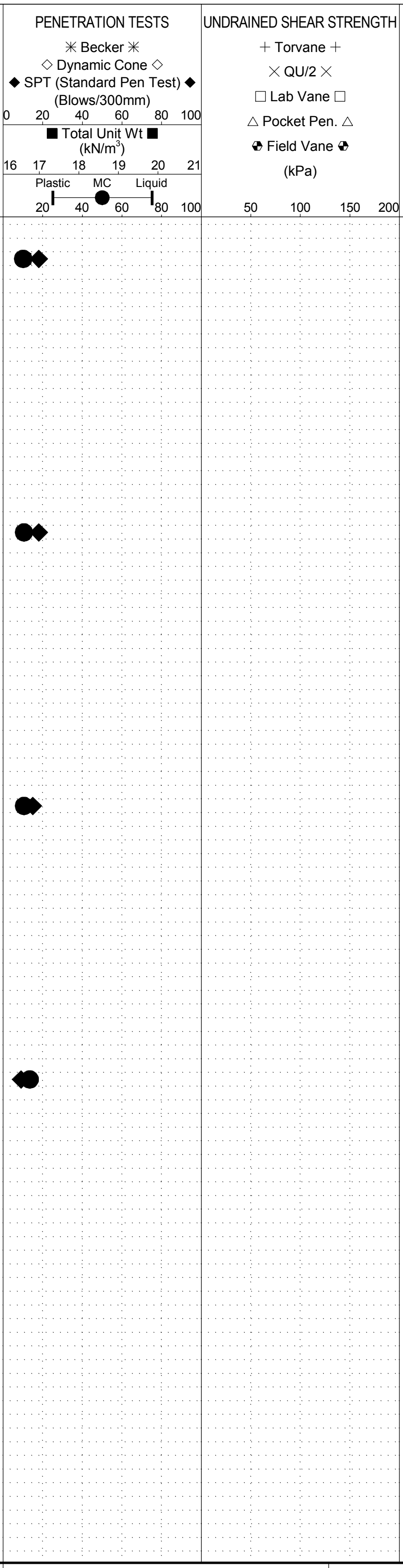
METHOD: Mobile B54 X SSA

ELEVATION (m): NA

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▐ CORE

| DEPTH (m) | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE # | SPT (N) | COMMENTS | DEPTH |
|---|---|---|---|---|---|---|---|
| 15 | | | | | | | |
| | | | ☒ | S28 | 18 | SPT Blows: [5/8/10], Spoon Recovery 78%, Gravel: 8.4%, Sand: 54.2%, Silt: 26.7%, Clay: 10.7% | |
| 16 | | | | | | | 16 |
| 17 | | | | | | | 17 |
| 18 | | | | | | | 18 |
| | | | ☒ | S29 | 18 | SPT Blows: [8/8/10], Spoon Recovery 100% | |
| 19 | | | | | | | 19 |
| 20 | | | | | | | 20 |
| 21 | | | | | | | 21 |
| | | | ☒ | S30 | 15 | SPT Blows: [6/7/8], Spoon Recovery 56% | |
| 22 | | | | | | | 22 |
| 23 | | - moist to wet below 22.9 m | | | | | 23 |
| 24 | | | | | | | 24 |
| | | - loose below 24.4 m | ☒ | S31 | 9 | SPT Blows: [3/4/5], Spoon Recovery 56% | |
| 25 | | **END OF TEST HOLE AT 24.84 m IN SAND (Till)** | | | | | 25 |
| 26 | | | | | | | 26 |
| 27 | | | | | | | 27 |
| 28 | | | | | | | 28 |
| 29 | | | | | | | 29 |
| 30 | | | | | | | |

Notes:
1. Seepage was observed between 3.0 m and 4.6 m.
2. Sloughing was not observed.
3. Hole open to 24.84 m upon removal of auger.
4. Water to 6.7 m upon removal of auger.
5. Test hole backfilled with auger cuttings and bentonite upon completion.



LOGGED BY: Ryan Harras

REVIEWED BY: Zeyad Shukri

PROJECT ENGINEER: Neil Klassen

COMPLETION DEPTH: 24.84 m

COMPLETION DATE: 7/9/16

# Appendix C

## Laboratory Test Results

AECOM

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7
Phone: 204 477 5381 Fax: 204 284 2040

| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | Gimli, MB. | Sample Date: | July 8, 2016 |
| Sample Depth: | Varies | Lab Technician: | EManimbao |
| Sample Number: | Varies | Date Tested: | July 7, 2016 |

# Moisture Content (ASTM D2216-10)

Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

| Location | Sample | Depth (m) | Moisture Content (%) |
|---|---|---|---|
| TH16-01 | G1 | 0.76 - 0.91 m | **24.4%** |
| | S2 | 1.52 - 1.98 m | **30.6%** |
| | S3B | 3.05 - 3.51 m | **8.4%** |
| | S4 | 4.57 - 5.03 m | **8.2%** |
| | S5 | 6.10 - 6.55 m | **7.2%** |
| | S6 | 7.62 - 1.52 m | **8.6%** |
| | S7 | 9.14 - 9.60 m | **9.5%** |
| | S8 | 10.67 - 11.13 m | **10.1%** |
| | S9 | 12.19 - 12.65 m | **10.4%** |
| | S10 | 13.72 - 1.83 m | **10.0%** |
| | S11 | 15.24 - 15.70 m | **9.3%** |
| | S12 | 16.76 - 17.22 m | **11.2%** |
| | S13 | 18.29 - 18.75 m | **10.0%** |
| | S14 | 19.81 - 2.13 m | **10.7%** |
| | S15 | 21.34 - 21.79 m | **9.8%** |
| | S16 | 22.86 - 23.32 m | **-** |
| TH16-02 | G17 | 0.76 - 0.91 m | **28.9%** |
| | T18 | 1.52 - 2.44 m | **-** |
| | G19 | 2.29 - 2.44 m | **49.8%** |
| | S20 | 3.05 - 3.51 m | **31.1%** |
| | S21 | 4.57 - 5.03 m | **9.8%** |
| | S22 | 6.10 - 2.74 m | **9.2%** |
| | S23 | 7.62 - 8.08 m | **9.7%** |
| | S24 | 9.14 - 9.60 m | **10.3%** |
| | S25 | 10.67 - 11.13 m | **9.8%** |
| | S26 | 12.19 - 12.65 m | **10.0%** |
| | S27 | 13.72 - 14.17 m | **9.9%** |
| | S28 | 15.24 - 15.70 m | **10.1%** |
| | S29 | 18.29 - 18.75 m | **10.5%** |
| | S30 | 21.34 - 21.79 m | **10.5%** |
| | S31 | 24.38 - 24.84 m | **13.4%** |

| Location | Sample | Depth (m) | Moisture Content (%) |
|---|---|---|---|

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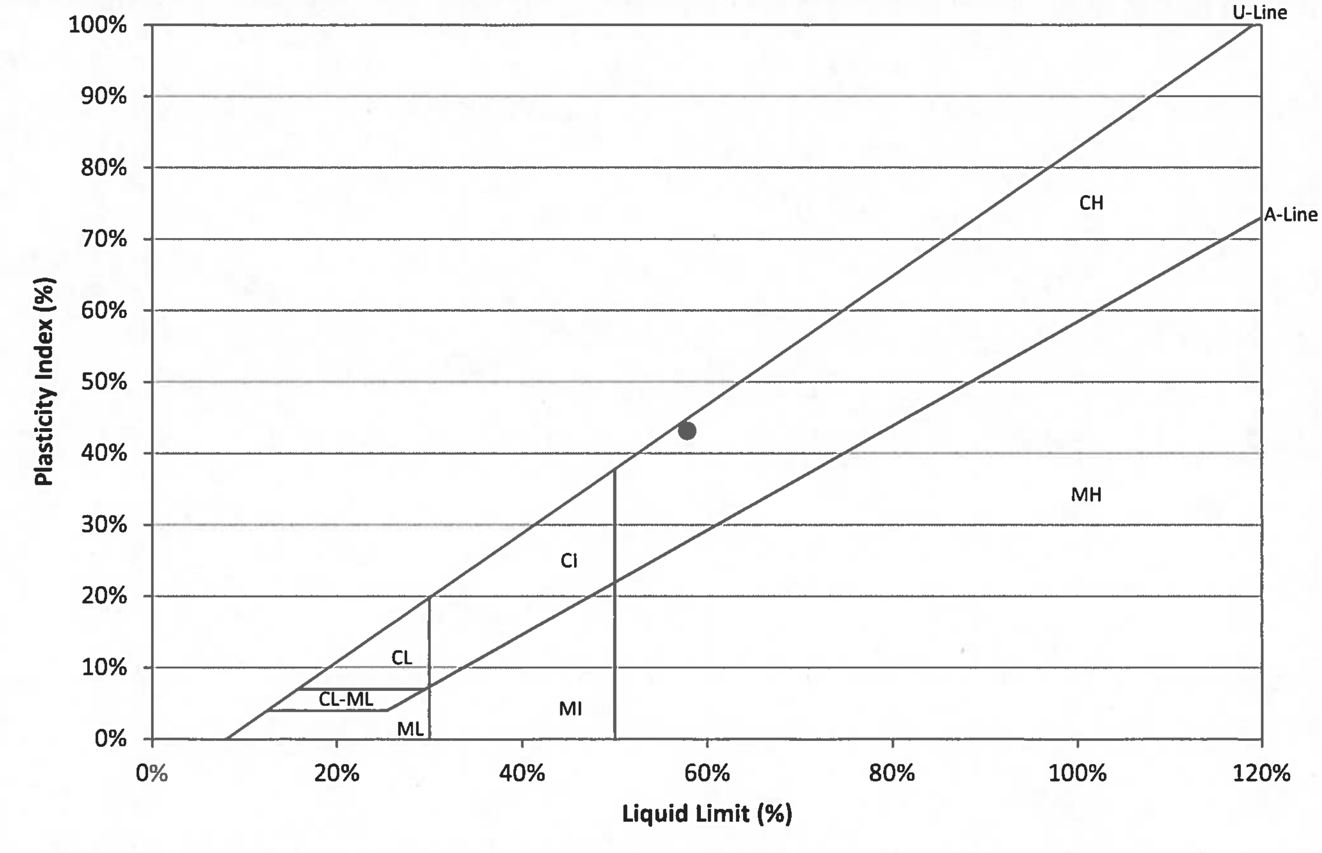
| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | TH16-01 | Sample Date: | July 14, 2016 |
| Sample Depth: | 0.76 - 1.22 m | Lab Technician: | EManimbao |
| Sample Number: | S2 | Date Tested: | July 20, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 34 | 26 | 17 |
| Wet Sample (g) | 7.9 | 7.6 | 7.8 |
| Dry Sample (g) | 5.1 | 4.8 | 4.9 |
| Water Content (%) | 55.7% | 57.4% | 60.5% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 7.7 | 6.9 |
| Dry Sample (g) | 6.7 | 6.0 |
| Water Content (%) | 14.6% | 14.8% |



| | | |
|---|---|---|
| Liquid Limit (%): 57.8% | Plastic Limit (%): 14.7% | Plasticity Index (%): 43.1% |

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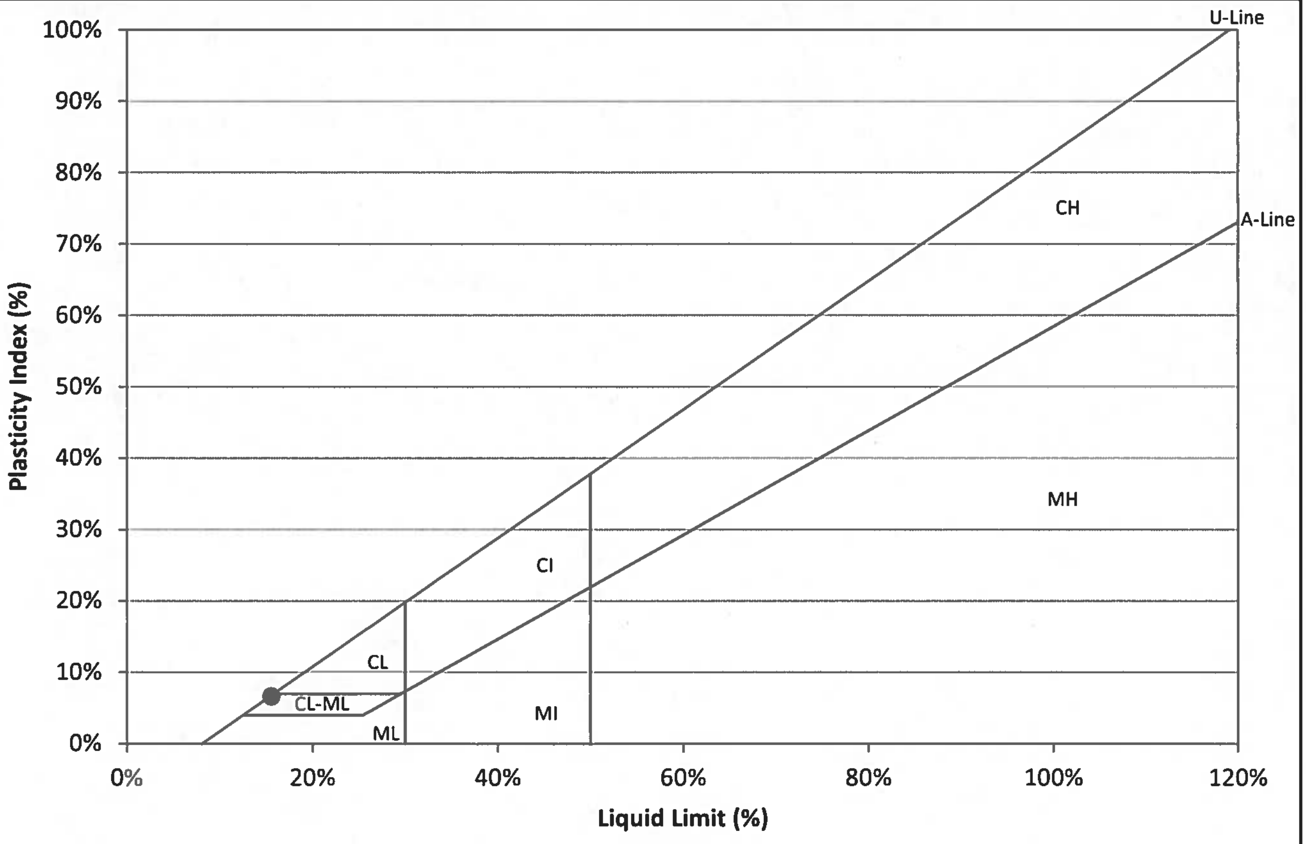
| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | TH16-01 | Sample Date: | July 14, 2016 |
| Sample Depth: | 4.57 - 5.03 m | Lab Technician: | EManimbao |
| Sample Number: | S4 | Date Tested: | July 19, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 34 | 26 | 17 |
| Wet Sample (g) | 9.3 | 10.8 | 8.6 |
| Dry Sample (g) | 8.1 | 9.4 | 7.4 |
| Water Content (%) | 15.2% | 15.6% | 16.4% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 6.3 | 6.2 |
| Dry Sample (g) | 5.8 | 5.7 |
| Water Content (%) | 9.0% | 8.9% |



| | | |
|---|---|---|
| Liquid Limit (%): 15.6% | Plastic Limit (%): 9.0% | Plasticity Index (%): 6.6% |

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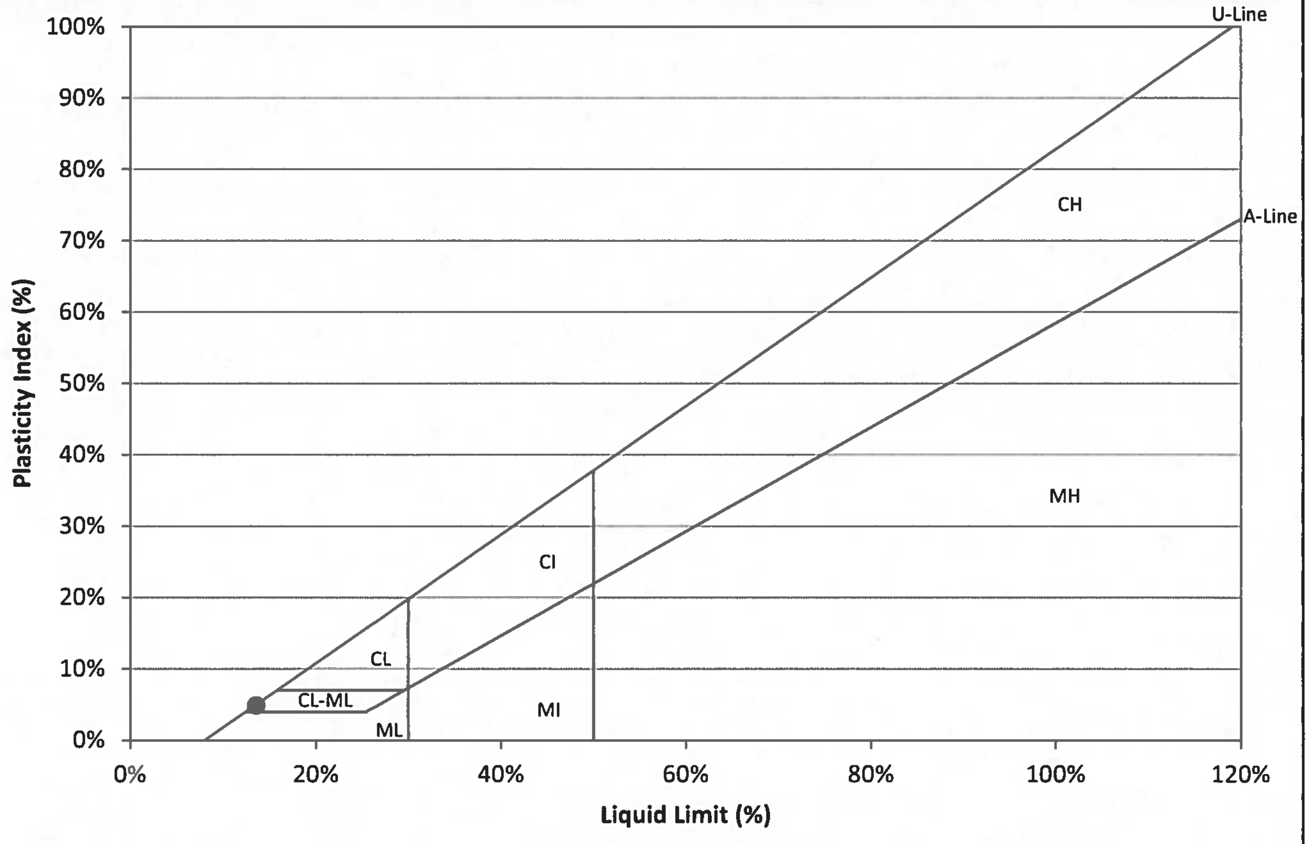
| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | TH16-01 | Sample Date: | July 14, 2016 |
| Sample Depth: | 13.72 - 14.17 m | Lab Technician: | EManimbao |
| Sample Number: | S10 | Date Tested: | July 19, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 26 | 22 | 18 |
| Wet Sample (g) | 12.7 | 8.8 | 10.6 |
| Dry Sample (g) | 11.2 | 7.8 | 9.3 |
| Water Content (%) | 13.6% | 13.9% | 14.2% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 7.3 | 6.2 |
| Dry Sample (g) | 6.7 | 5.7 |
| Water Content (%) | 8.6% | 8.8% |



| | | |
|---|---|---|
| Liquid Limit (%): 13.6% | Plastic Limit (%): 8.7% | Plasticity Index (%): 4.9% |

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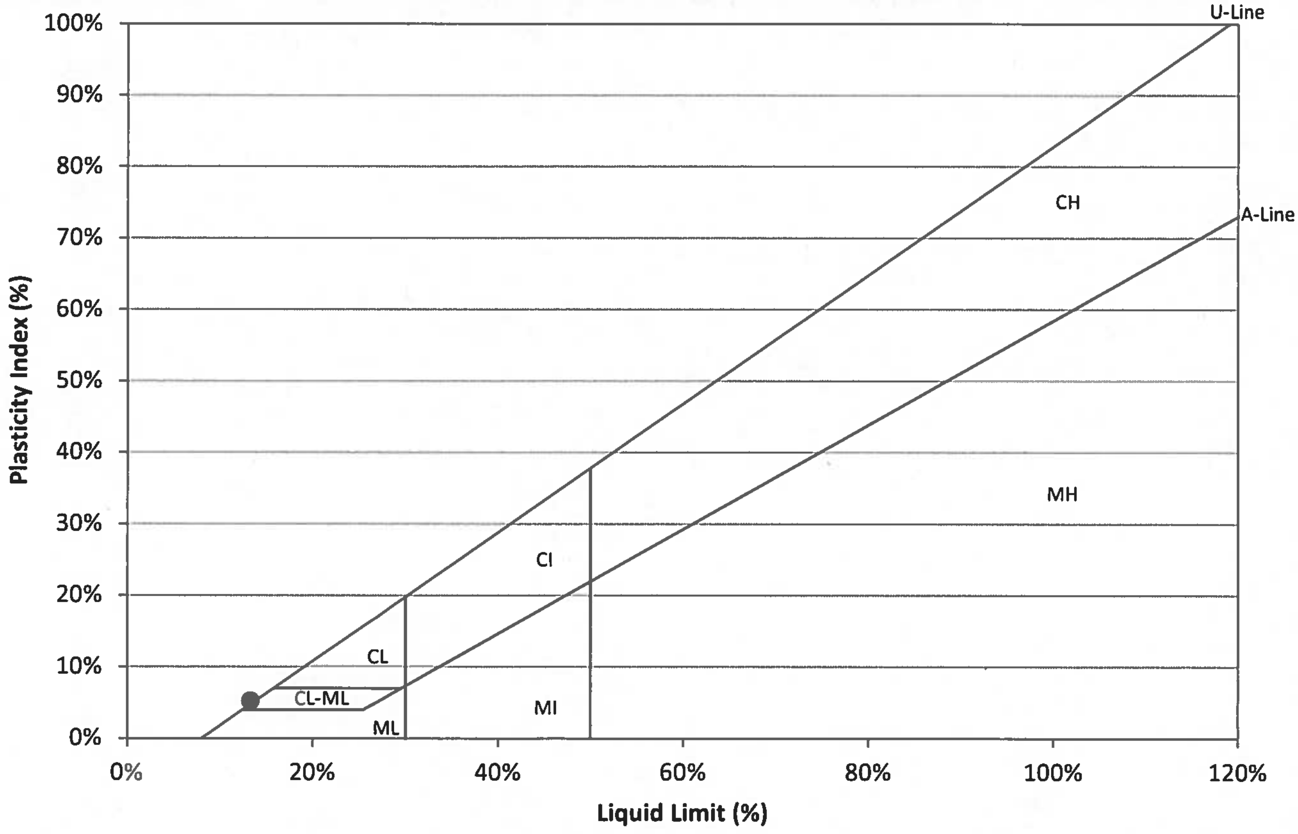
| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | TH16-01 | Sample Date: | July 14, 2016 |
| Sample Depth: | 19.81 - 20.27 m | Lab Technician: | EManimbao |
| Sample Number: | S14 | Date Tested: | July 20, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 27 | 20 | 16 |
| Wet Sample (g) | 13.2 | 7.8 | 9.1 |
| Dry Sample (g) | 11.7 | 6.8 | 8.0 |
| Water Content (%) | 13.2% | 13.8% | 14.2% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 6.6 | 6.3 |
| Dry Sample (g) | 6.1 | 5.8 |
| Water Content (%) | 8.1% | 8.1% |



| | | |
|---|---|---|
| Liquid Limit (%): 13.3% | Plastic Limit (%): 8.1% | Plasticity Index (%): 5.2% |

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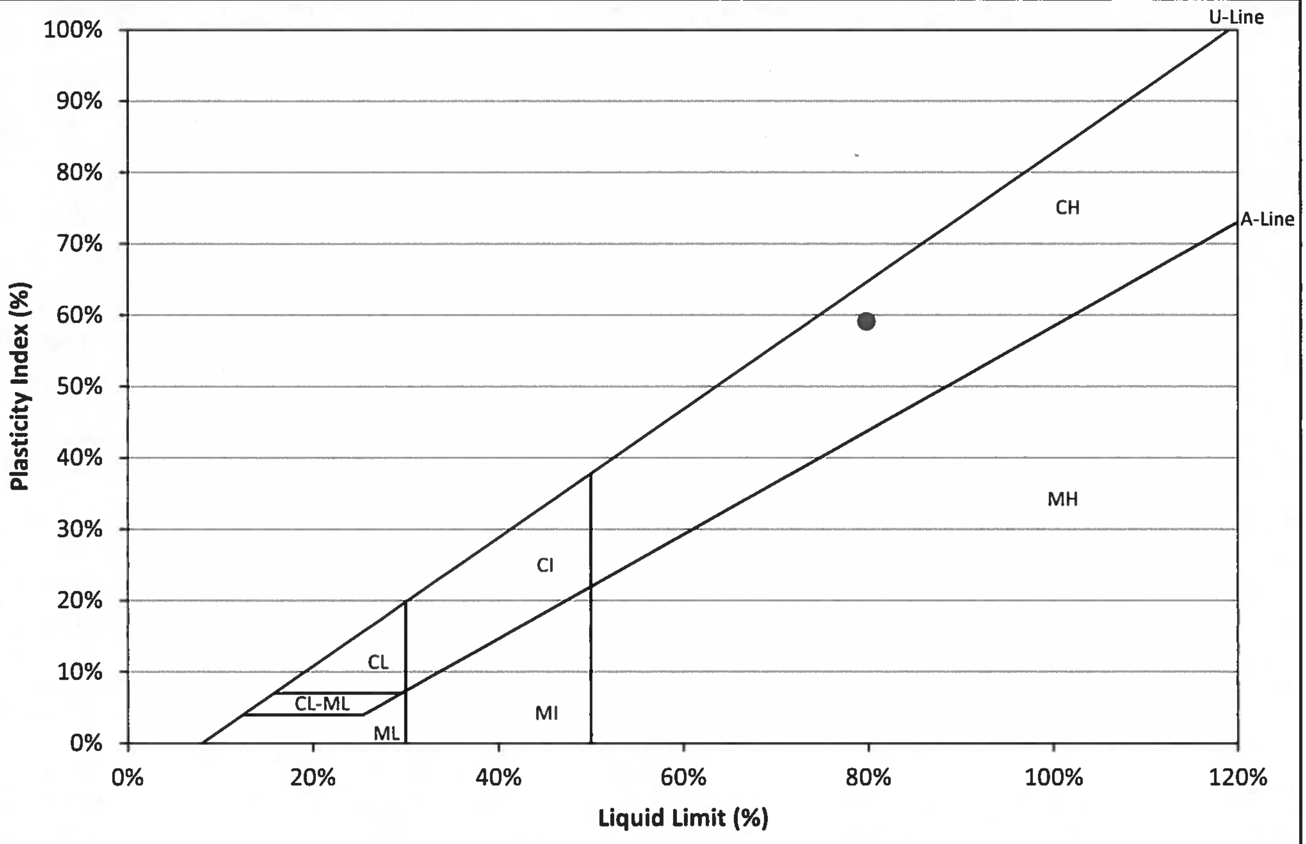
| | | | | |
|---|---|---|---|---|
| Project Name: | Prefab Building Foundation | | Supplier: | AECOM |
| Project Number: | 60513310 | | Specification: | N/A |
| Client: | DFO Gimli | | Field Technician: | RHarras |
| Sample Location: | TH16-02 | | Sample Date: | July 14, 2016 |
| Sample Depth: | 2.29 - 2.44 m | | Lab Technician: | EManimbao |
| Sample Number: | G19 | | Date Tested: | July 20, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 35 | 29 | 20 |
| Wet Sample (g) | 8.4 | 7.3 | 7.3 |
| Dry Sample (g) | 4.7 | 4.1 | 4.0 |
| Water Content (%) | 77.6% | 78.8% | 81.6% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 6.9 | 7.2 |
| Dry Sample (g) | 5.7 | 6.0 |
| Water Content (%) | 20.8% | 20.6% |



| | | |
|---|---|---|
| Liquid Limit (%): 79.8% | Plastic Limit (%): 20.7% | Plasticity Index (%): 59.1% |

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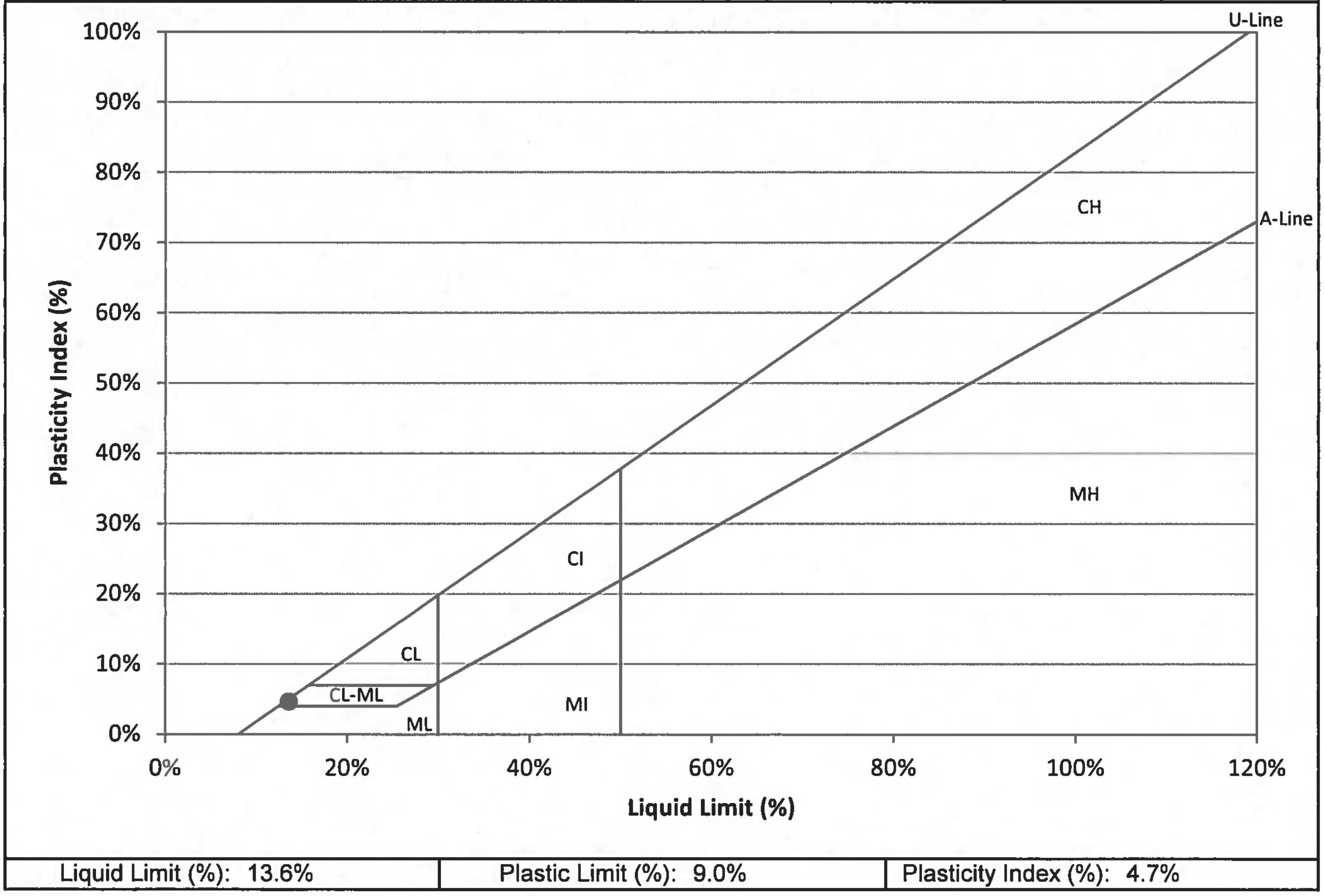
| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | TH16-02 | Sample Date: | July 14, 2016 |
| Sample Depth: | 9.14 - 9.60 m | Lab Technician: | EManimbao |
| Sample Number: | S24 | Date Tested: | July 19, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 29 | 23 | 17 |
| Wet Sample (g) | 11.8 | 11.1 | 10.0 |
| Dry Sample (g) | 10.4 | 9.7 | 8.7 |
| Water Content (%) | 13.3% | 13.9% | 14.5% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 6.3 | 6.2 |
| Dry Sample (g) | 5.8 | 5.6 |
| Water Content (%) | 9.0% | 9.0% |



| | | |
|---|---|---|
| Liquid Limit (%): 13.6% | Plastic Limit (%): 9.0% | Plasticity Index (%): 4.7% |

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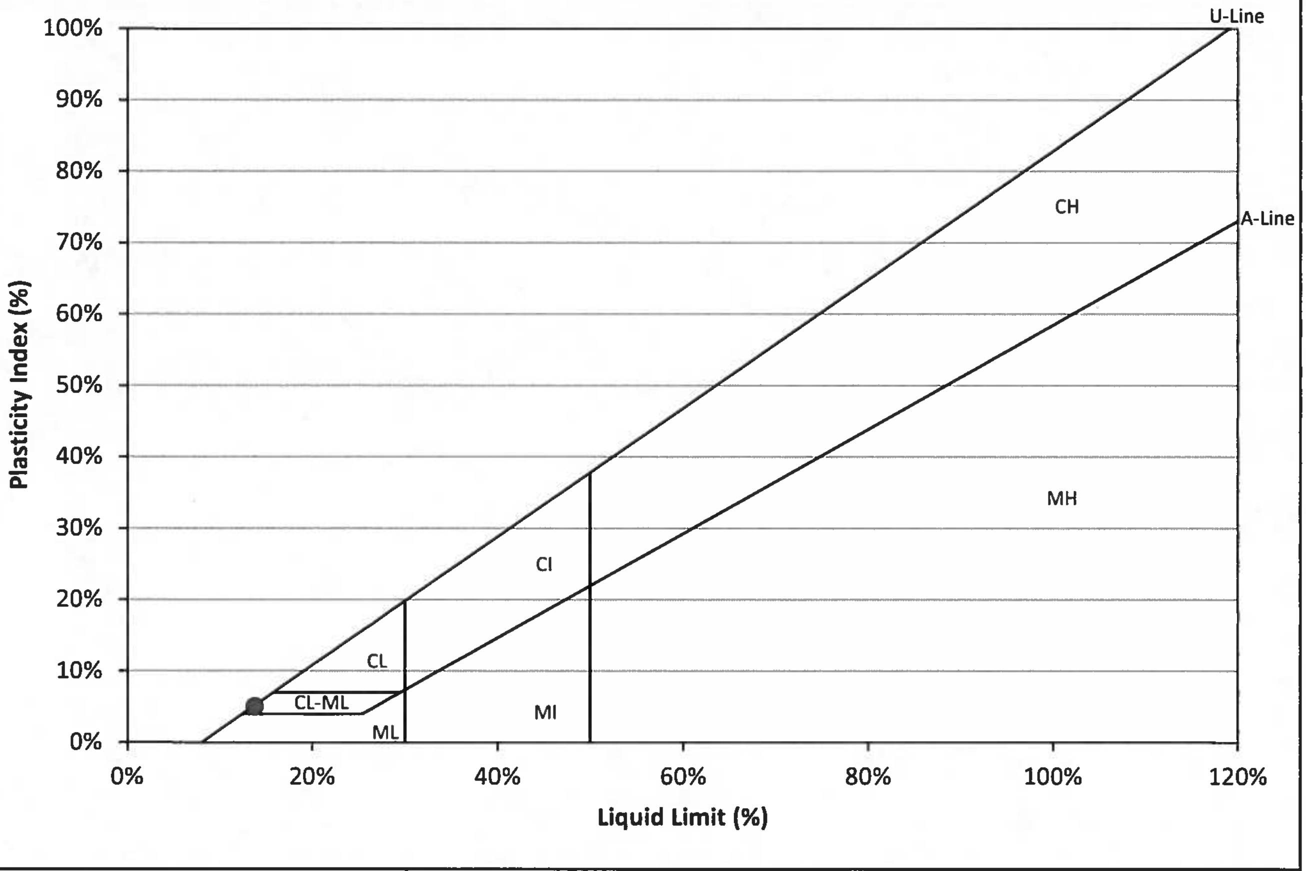
| | | | |
|---|---|---|---|
| Project Name: | Prefab Building Foundation | Supplier: | AECOM |
| Project Number: | 60513310 | Specification: | N/A |
| Client: | DFO Gimli | Field Technician: | RHarras |
| Sample Location: | TH16-02 | Sample Date: | July 14, 2016 |
| Sample Depth: | 15.24 - 15.70 m | Lab Technician: | EManimbao |
| Sample Number: | S28 | Date Tested: | July 19, 2016 |

# Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

| Liquid Limit | | | |
|---|---|---|---|
| Blows | 35 | 21 | 18 |
| Wet Sample (g) | 8.9 | 9.9 | 10.6 |
| Dry Sample (g) | 7.9 | 8.6 | 9.2 |
| Water Content (%) | 13.2% | 14.2% | 14.6% |

| Plastic Limit | | |
|---|---|---|
| Trial | 1 | 2 |
| Wet Sample (g) | 6.3 | 6.5 |
| Dry Sample (g) | 5.8 | 6.0 |
| Water Content (%) | 8.8% | 8.7% |



| | | |
|---|---|---|
| Liquid Limit (%): 13.8% | Plastic Limit (%): 8.8% | Plasticity Index (%): 5.0% |

AECOM Canada Ltd.
ATTN: SABA IBRAHIM
99 Commerce Drive
Winnipeg MB R3P 0Y7

Date Received: 12-AUG-16
Report Date: 18-AUG-16 12:02 (MT)
Version: FINAL

Client Phone: 204-477-5381

# Certificate of Analysis

Lab Work Order #: L1812916
Project P.O. #: NOT SUBMITTED
Job Reference: 60513310
C of C Numbers:
Legal Site Desc:

Gail Hill, B.Sc.
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L1812916-1 TH 16-01; S2 | | | | | | | |
| Sampled By: CLIENT | | | | | | | |
| Matrix: Soil | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| % Moisture | 17.6 | | 0.10 | % | 16-AUG-16 | 17-AUG-16 | R3527287 |
| Resistivity | 3140 | | 1.0 | ohm*cm | | 18-AUG-16 | |
| Sulphate | 109 | | 20 | mg/kg | 16-AUG-16 | 16-AUG-16 | R3527666 |
| Conductivity | 0.318 | | 0.0040 | mS/cm | | 18-AUG-16 | R3528371 |
| L1812916-2 TH 16-01; G19 | | | | | | | |
| Sampled By: CLIENT | | | | | | | |
| Matrix: Soil | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| % Moisture | 33.7 | | 0.10 | % | 16-AUG-16 | 17-AUG-16 | R3527287 |
| Resistivity | 1340 | | 1.0 | ohm*cm | | 18-AUG-16 | |
| Sulphate | 241 | | 20 | mg/kg | 16-AUG-16 | 16-AUG-16 | R3527666 |
| Conductivity | 0.746 | | 0.0040 | mS/cm | | 18-AUG-16 | R3528371 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

# Reference Information

## Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| EC-WT | Soil | Conductivity (EC) | MOEE E3138 |

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| MOISTURE-WT | Soil | % Moisture | Gravimetric: Oven Dried |
| RESISTIVITY-CALC-WT | Soil | Resistivity Calculation | APHA 2510 B |

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| RESISTIVITY-CALC-WT | Soil | Resistivity Calculation | MOECC E3138 |

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| SO4-WT | Soil | Sulphate | EPA 300.0 |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

*The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:*

| Laboratory Definition Code | Laboratory Location |
|---|---|
| WT | ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA |

**Chain of Custody Numbers:**

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Environmental**

# Quality Control Report

Workorder: L1812916 Report Date: 18-AUG-16

Client: AECOM Canada Ltd.
99 Commerce Drive
Winnipeg MB R3P 0Y7
Contact: SABA IBRAHIM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **EC-WT** | **Soil** | | | | | | | |
| **Batch R3528371** | | | | | | | | |
| **WG2370236-1 LCS** | | | | | | | | |
| Conductivity | | | 99.4 | | % | | 90-110 | 18-AUG-16 |
| **WG2370069-1 MB** | | | | | | | | |
| Conductivity | | | <0.0040 | | mS/cm | | 0.044 | 18-AUG-16 |
| **MOISTURE-WT** | **Soil** | | | | | | | |
| **Batch R3527287** | | | | | | | | |
| **WG2368557-2 LCS** | | | | | | | | |
| % Moisture | | | 99.9 | | % | | 90-110 | 17-AUG-16 |
| **WG2368557-1 MB** | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 17-AUG-16 |
| **SO4-WT** | **Soil** | | | | | | | |
| **Batch R3527666** | | | | | | | | |
| **WG2368454-4 CRM** | | **AN-CRM-WT** | | | | | | |
| Sulphate | | | 96.5 | | % | | 60-140 | 16-AUG-16 |
| **WG2368454-3 DUP** | | **L1812916-1** | | | | | | |
| Sulphate | | 109 | 105 | | mg/kg | 4.2 | 30 | 16-AUG-16 |
| **WG2368454-2 LCS** | | | | | | | | |
| Sulphate | | | 99.3 | | % | | 70-130 | 16-AUG-16 |
| **WG2368454-1 MB** | | | | | | | | |
| Sulphate | | | <20 | | mg/kg | | 20 | 16-AUG-16 |

**Legend:**

---

| | |
|---|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

**Hold Time Exceedances:**

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

---

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

L1812916

**ALS Environmental**
www.alsglobal.com

# Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1812916-COFC

COC Number: 14 - 453199

Page ___ of ___

RUSH!

**Report To**
Company: AECOM
Contact: SABA IBRAHIM
Address: 99 COMMERCE DRIVE
WINNIPEG, MB R3P 0Y7
Phone:

**Report Format / Distribution**
Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ Yes ☐ No
☐ Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Saba.Ibrahim@aecom.com
Email 2

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
R ☐ Regular (Standard TAT if received by 3pm)
P ☐ Priority (2-4 business days if received by 3pm)
E ☑ Emergency (1-2 business days if received by 3pm)
E2 ☐ Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Specify Date Required for E2,E or P:

**Invoice To**
Same as Report To ☑ Yes ☐ No
Copy of Invoice with Report ☑ Yes ☐ No
Company: AECOM
Contact: SABA IBRAHIM

**Invoice Distribution**
Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Saba.Ibrahim@aecom.com
Email 2

**Project Information**
ALS Quote #:
Job #: 60513310
PO / AFE:
LSD:

**Oil and Gas Required Fields (client use)**
Approver ID:
Cost Center:
GL Account:
Routing Code:
Activity Code:
Location:

**ALS Lab Work Order # (lab use only)**
**ALS Contact:**
**Sampler:**

**Analysis Request**
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | SULPHATE | RESISTIVITY | | | | | | | | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TH16-01; S2 | | | SOIL | ✓ | ✓ | | | | | | | | | | | | |
| | TH16-02; G19 | | | SOIL | ✓ | ✓ | | | | | | | | | | | | |
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RUSH

**Drinking Water (DW) Samples[1] (client use)**
Are samples taken from a Regulated DW System?
☐ Yes ☐ No
Are samples for human drinking water use?
☐ Yes ☐ No

**Special Instructions / Specify Criteria to add on report (client Use)**
25.1°C

**SAMPLE CONDITION AS RECEIVED (lab use only)**
Frozen ☐
SIF Observations Yes ☐ No ☐
Ice packs Yes ☐ No ☐
Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

| INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | |
|---|---|---|---|---|---|
| | | | | | |

**SHIPMENT RELEASE (client use)**
Released by:
Date:
Time:

**INITIAL SHIPMENT RECEPTION (lab use only)**
Received by: A.K.
Date: Aug 12/16
Time: 3:55

**FINAL SHIPMENT RECEPTION (lab use only)**
Received by:
Date:
Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326e v08 Front/03 October 2013

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

# GRAIN SIZE DISTRIBUTION
**(ASTM D422-63)**

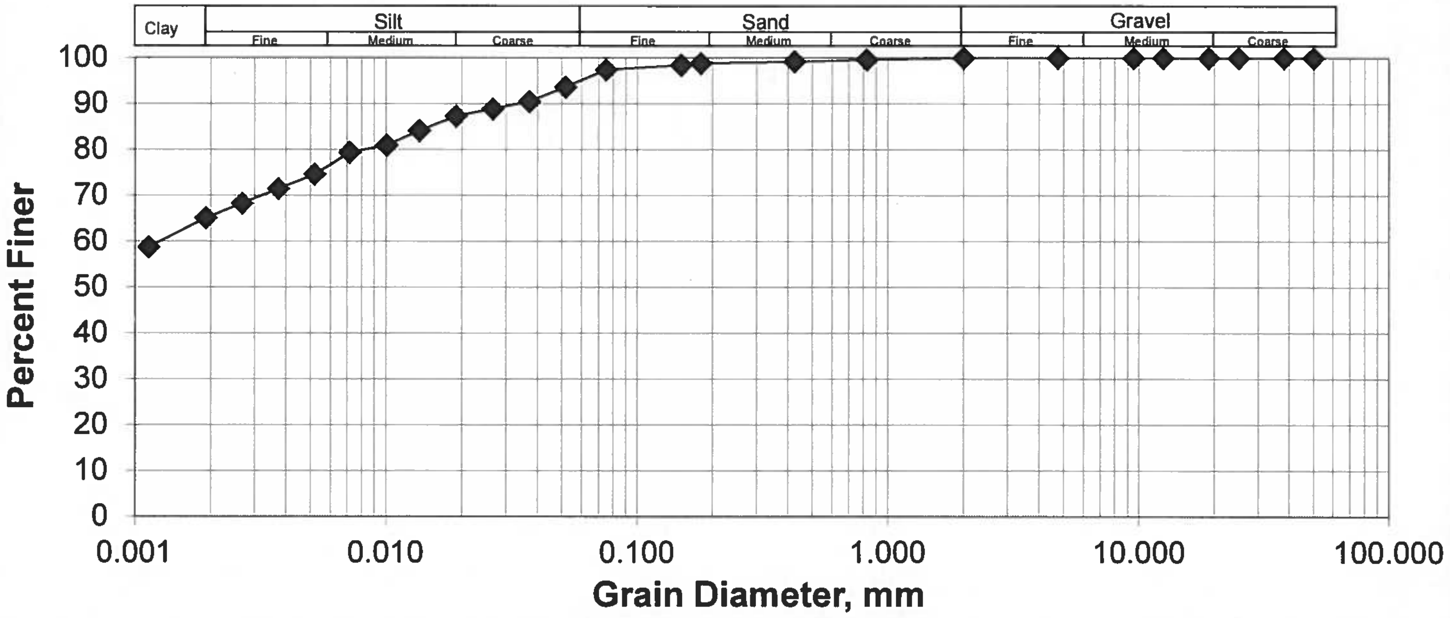
AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 fax (204) 284-2040

Job No.: 60513310
Client: DFO Gimli
Project : Prefab Building Foundation
Date Tested: 18-Jul-16
Tested By: EManimbao

Hole No.: TH16-01
Sample No.: S2
Depth: 0.76 - 1.22 m
Date Sampled: Varies
Sampled By: AECOM

| GRAVEL SIZES | | SAND SIZES | | FINES | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 100.0 | 0.0750 | 97.4 |
| 38.0 | 100.0 | 0.83 | 99.6 | 0.0517 | 93.6 |
| 25.0 | 100.0 | 0.43 | 99.2 | 0.0372 | 90.5 |
| 19.0 | 100.0 | 0.18 | 98.8 | 0.0265 | 88.9 |
| 12.5 | 100.0 | 0.15 | 98.4 | 0.0189 | 87.3 |
| 9.5 | 100.0 | 0.075 | 97.4 | 0.0136 | 84.1 |
| 4.75 | 100.0 | | | 0.0101 | 80.9 |
| 2.00 | 100.0 | | | 0.0072 | 79.3 |
| | | | | 0.0052 | 74.6 |
| | | | | 0.0037 | 71.4 |
| | | | | 0.0027 | 68.2 |
| | | | | 0.0019 | 65.1 |
| | | | | 0.0011 | 58.7 |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **0.00%** | **Silt** | **29.57%** |
| **Sand** | **5.02%** | **Clay** | **65.41%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

# GRAIN SIZE DISTRIBUTION
**(ASTM D422-63)**

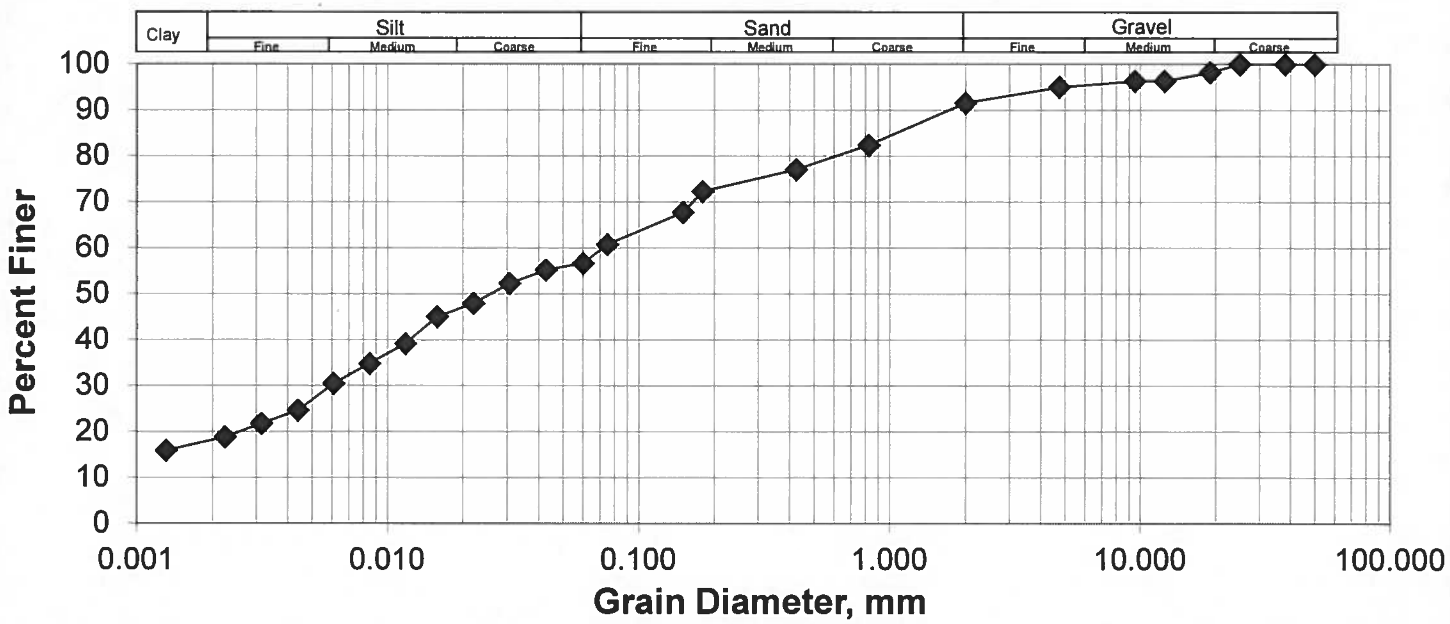
AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
**tel** (204) 477-5381 **fax** (204) 284-2040

Job No.: 60513310
Client: DFO Gimli
Project : Prefab Building Foundation
Date Tested: 18-Jul-16
Tested By: EManimbao

Hole No.: TH16-01
Sample No.: S4
Depth: 4.57 - 5.03 m
Date Sampled: Varies
Sampled By: AECOM

| GRAVEL SIZES | | SAND SIZES | | FINES | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 91.5 | 0.0750 | 60.8 |
| 38.0 | 100.0 | 0.83 | 82.4 | 0.0601 | 56.6 |
| 25.0 | 100.0 | 0.43 | 77.1 | 0.0428 | 55.2 |
| 19.0 | 98.2 | 0.18 | 72.3 | 0.0306 | 52.3 |
| 12.5 | 96.3 | 0.15 | 67.7 | 0.0221 | 47.9 |
| 9.5 | 96.3 | 0.075 | 60.8 | 0.0158 | 45.0 |
| 4.75 | 95.0 | | | 0.0118 | 39.2 |
| 2.00 | 91.5 | | | 0.0085 | 34.8 |
| | | | | 0.0061 | 30.5 |
| | | | | 0.0044 | 24.7 |
| | | | | 0.0031 | 21.7 |
| | | | | 0.0022 | 18.8 |
| | | | | 0.0013 | 15.9 |
| | | | | | |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **8.48%** | **Silt** | **38.54%** |
| **Sand** | **34.90%** | **Clay** | **18.08%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

# GRAIN SIZE DISTRIBUTION

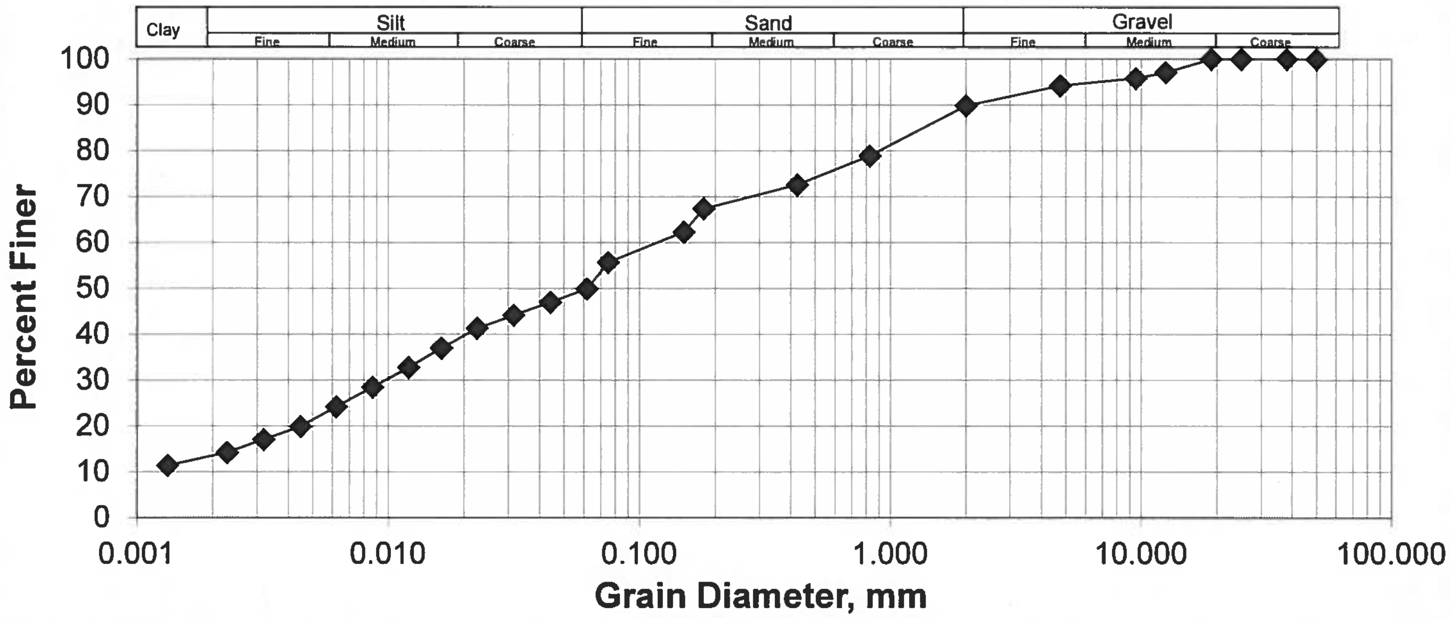
**(ASTM D422-63)**

AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
**tel** (204) 477-5381 **fax** (204) 284-2040

| | | | |
|---|---|---|---|
| Job No.: | 60513310 | Hole No.: | TH16-01 |
| Client: | DFO Gimli | Sample No.: | S10 |
| Project : | Prefab Building Foundation | Depth: | 13.72 - 14.17 m |
| Date Tested: | 18-Jul-16 | Date Sampled: | Varies |
| Tested By: | EManimbao | Sampled By: | AECOM |

| GRAVEL SIZES | | SAND SIZES | | FINES | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 89.8 | 0.0750 | 55.7 |
| 38.0 | 100.0 | 0.83 | 78.9 | 0.0617 | 49.9 |
| 25.0 | 100.0 | 0.43 | 72.6 | 0.0441 | 47.0 |
| 19.0 | 100.0 | 0.18 | 67.4 | 0.0316 | 44.2 |
| 12.5 | 97.1 | 0.15 | 62.3 | 0.0226 | 41.3 |
| 9.5 | 95.8 | 0.075 | 55.7 | 0.0162 | 37.0 |
| 4.75 | 94.2 | | | 0.0121 | 32.8 |
| 2.00 | 89.8 | | | 0.0087 | 28.5 |
| | | | | 0.0062 | 24.2 |
| | | | | 0.0045 | 19.9 |
| | | | | 0.0032 | 17.1 |
| | | | | 0.0023 | 14.2 |
| | | | | 0.0013 | 11.4 |
| | | | | | |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **10.19%** | **Silt** | **36.22%** |
| **Sand** | **40.22%** | **Clay** | **13.38%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

# GRAIN SIZE DISTRIBUTION
**(ASTM D422-63)**

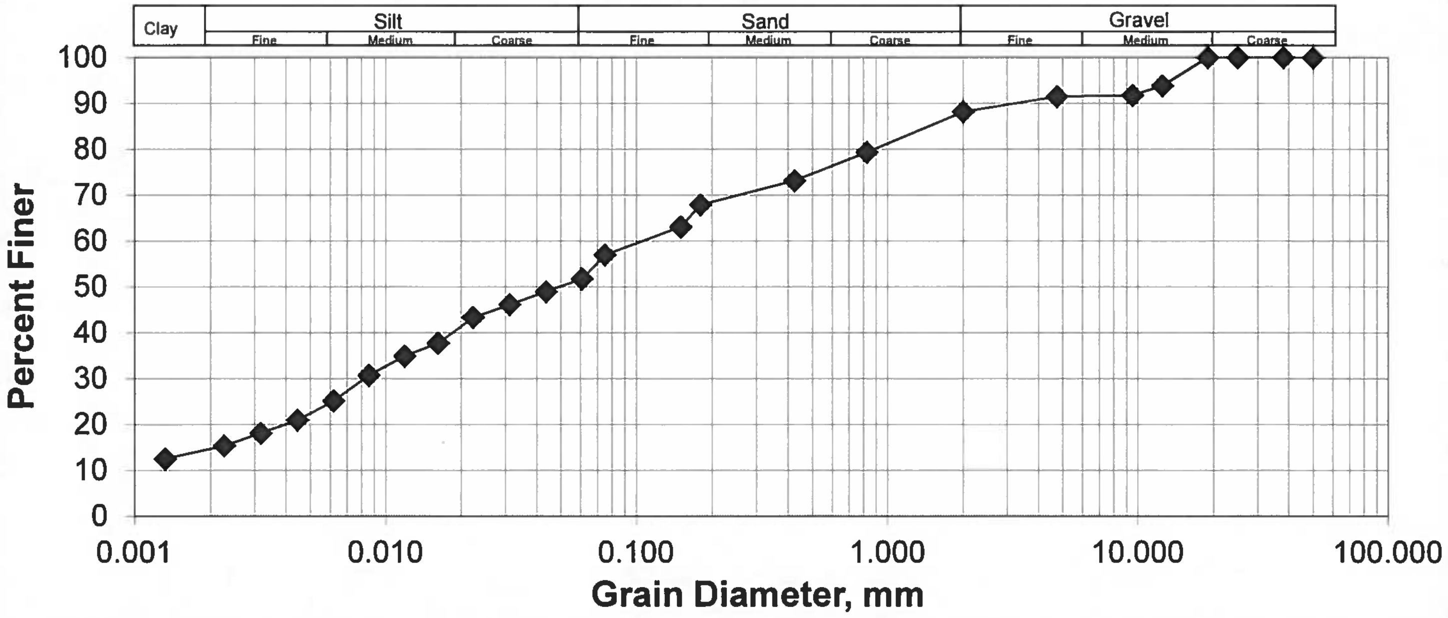
AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
**tel** (204) 477-5381 **fax** (204) 284-2040

Job No.: 60513310
Client: DFO Gimli
Project : Prefab Building Foundation
Date Tested: 18-Jul-16
Tested By: EManimbao

Hole No.: TH16-01
Sample No.: S14
Depth: 19.81 - 20.27 m
Date Sampled: Varies
Sampled By: AECOM

| **GRAVEL SIZES** | | **SAND SIZES** | | **FINES** | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 88.1 | 0.0750 | 56.9 |
| 38.0 | 100.0 | 0.83 | 79.3 | 0.0609 | 51.7 |
| 25.0 | 100.0 | 0.43 | 73.1 | 0.0436 | 48.9 |
| 19.0 | 100.0 | 0.18 | 67.9 | 0.0312 | 46.1 |
| 12.5 | 93.9 | 0.15 | 63.1 | 0.0223 | 43.3 |
| 9.5 | 91.7 | 0.075 | 56.9 | 0.0162 | 37.7 |
| 4.75 | 91.5 | | | 0.0119 | 34.9 |
| 2.00 | 88.1 | | | 0.0086 | 30.7 |
| | | | | 0.0062 | 25.1 |
| | | | | 0.0044 | 20.9 |
| | | | | 0.0032 | 18.1 |
| | | | | 0.0023 | 15.3 |
| | | | | 0.0013 | 12.5 |
| | | | | | |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **11.87%** | **Silt** | **37.03%** |
| **Sand** | **36.54%** | **Clay** | **14.55%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

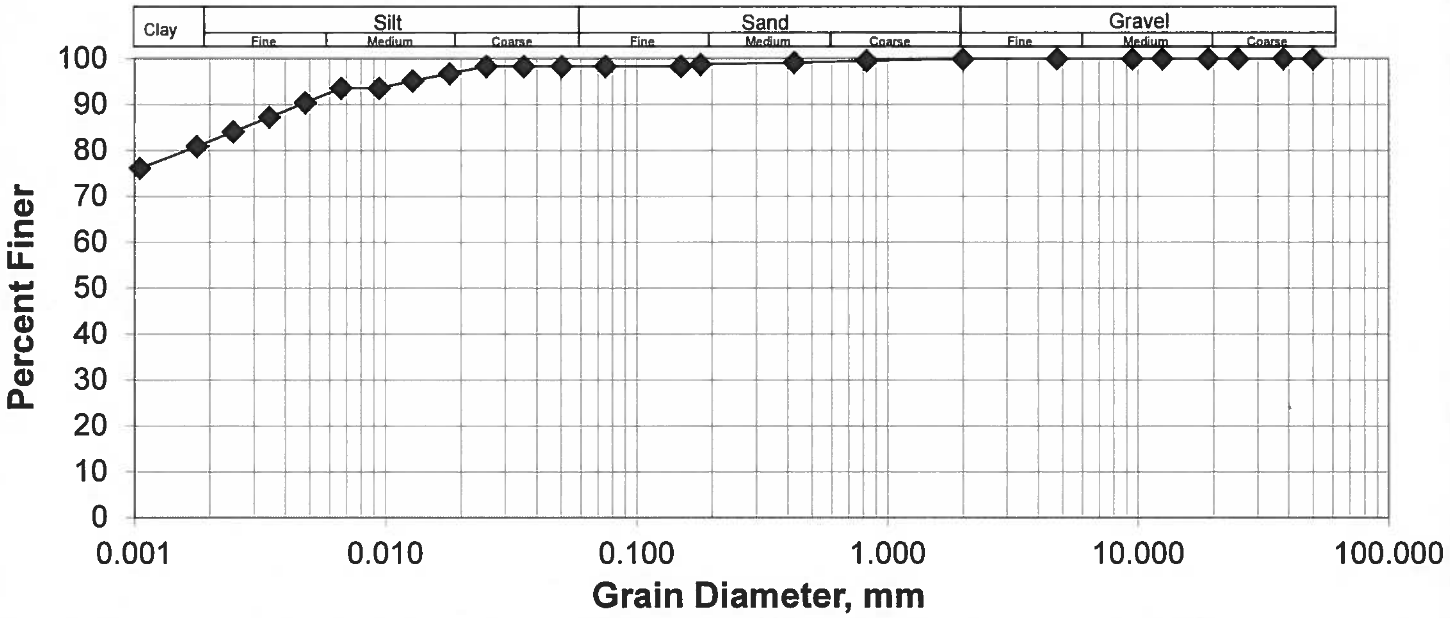
# GRAIN SIZE DISTRIBUTION
**(ASTM D422-63)**

AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
**tel** (204) 477-5381 **fax** (204) 284-2040

| | | | |
|---|---|---|---|
| Job No.: | 60513310 | Hole No.: | TH16-02 |
| Client: | DFO Gimli | Sample No.: | G19 |
| Project : | Prefab Building Foundation | Depth: | 2.29 - 2.44 m |
| Date Tested: | 18-Jul-16 | Date Sampled: | Varies |
| Tested By: | EManimbao | Sampled By: | AECOM |

| GRAVEL SIZES | | SAND SIZES | | FINES | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 99.9 | 0.0750 | 98.3 |
| 38.0 | 100.0 | 0.83 | 99.5 | 0.0503 | 98.3 |
| 25.0 | 100.0 | 0.43 | 99.1 | 0.0356 | 98.3 |
| 19.0 | 100.0 | 0.18 | 98.7 | 0.0252 | 98.3 |
| 12.5 | 100.0 | 0.15 | 98.3 | 0.0180 | 96.8 |
| 9.5 | 100.0 | 0.075 | 98.3 | 0.0128 | 95.2 |
| 4.75 | 100.0 | | | 0.0094 | 93.6 |
| 2.00 | 99.9 | | | 0.0067 | 93.6 |
| | | | | 0.0048 | 90.4 |
| | | | | 0.0035 | 87.2 |
| | | | | 0.0025 | 84.1 |
| | | | | 0.0018 | 80.9 |
| | | | | 0.0011 | 76.1 |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **0.07%** | **Silt** | **16.47%** |
| **Sand** | **1.59%** | **Clay** | **81.86%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

# GRAIN SIZE DISTRIBUTION
**(ASTM D422-63)**

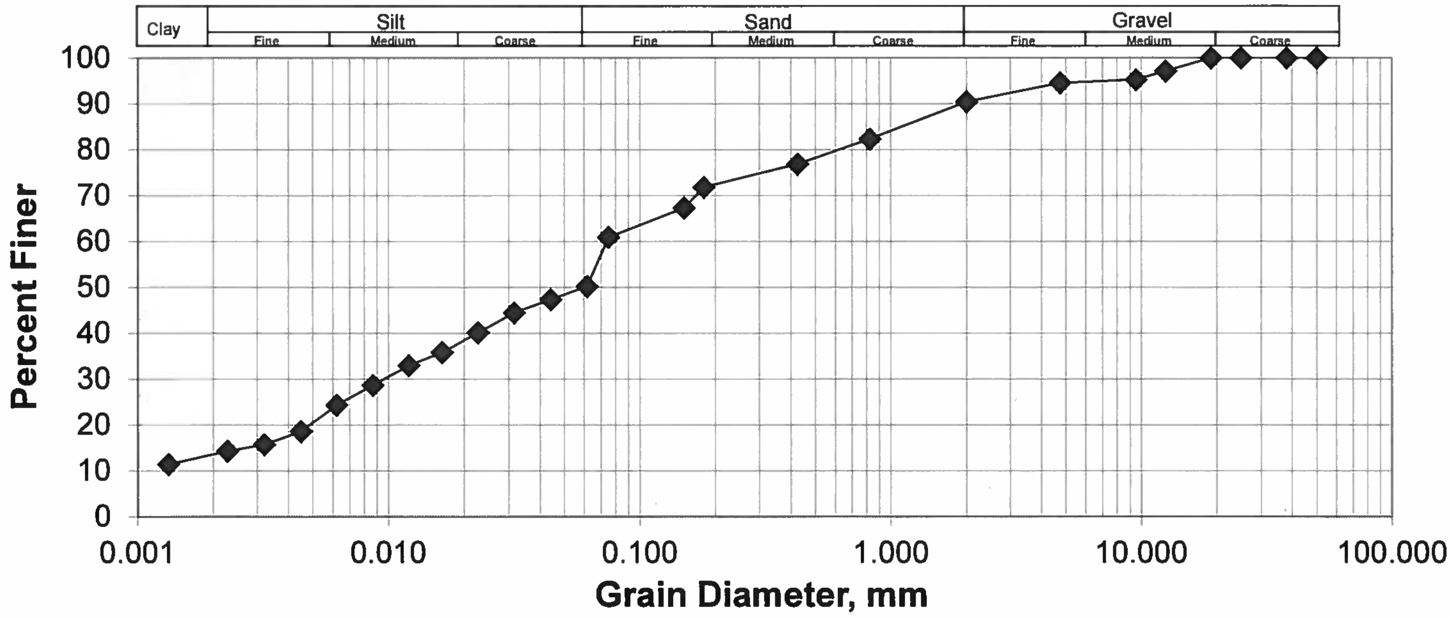
AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
**tel** (204) 477-5381 **fax** (204) 284-2040

Job No.: 60513310
Client: DFO Gimli
Project : Prefab Building Foundation
Date Tested: 18-Jul-16
Tested By: EManimbao

Hole No.: TH16-02
Sample No.: S24
Depth: 9.14 - 9.60 m
Date Sampled: Varies
Sampled By: AECOM

| GRAVEL SIZES | | SAND SIZES | | FINES | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 90.4 | 0.0750 | 60.9 |
| 38.0 | 100.0 | 0.83 | 82.3 | 0.0617 | 50.2 |
| 25.0 | 100.0 | 0.43 | 76.9 | 0.0441 | 47.3 |
| 19.0 | 100.0 | 0.18 | 71.8 | 0.0316 | 44.5 |
| 12.5 | 97.1 | 0.15 | 67.3 | 0.0227 | 40.2 |
| 9.5 | 95.2 | 0.075 | 60.9 | 0.0163 | 35.8 |
| 4.75 | 94.6 | | | 0.0121 | 33.0 |
| 2.00 | 90.4 | | | 0.0087 | 28.7 |
| | | | | 0.0062 | 24.4 |
| | | | | 0.0045 | 18.6 |
| | | | | 0.0032 | 15.7 |
| | | | | 0.0023 | 14.3 |
| | | | | 0.0013 | 11.4 |
| | | | | | |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **9.58%** | **Silt** | **36.47%** |
| **Sand** | **40.49%** | **Clay** | **13.47%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

# GRAIN SIZE DISTRIBUTION

**(ASTM D422-63)**

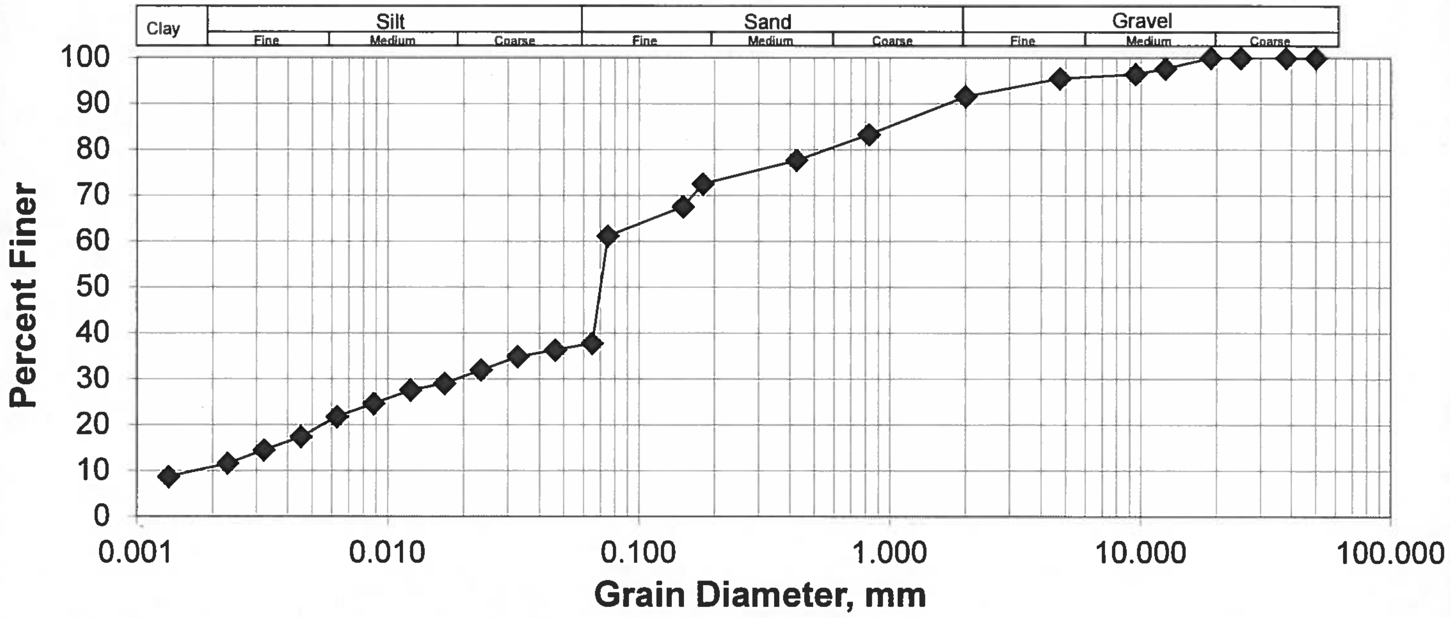
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
**tel** (204) 477-5381 **fax** (204) 284-2040

Job No.: 60513310
Client: DFO Gimli
Project : Prefab Building Foundation
Date Tested: 18-Jul-16
Tested By: EManimbao

Hole No.: TH16-02
Sample No.: S28
Depth: 15.24 - 15.70 m
Date Sampled: Varies
Sampled By: AECOM

| GRAVEL SIZES | | SAND SIZES | | FINES | |
|---|---|---|---|---|---|
| Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing | Grain Size (mm.) | Total Percent Passing |
| 50.0 | 100.0 | 2.00 | 91.6 | 0.0750 | 61.2 |
| 38.0 | 100.0 | 0.83 | 83.3 | 0.0650 | 37.8 |
| 25.0 | 100.0 | 0.43 | 77.6 | 0.0462 | 36.3 |
| 19.0 | 100.0 | 0.18 | 72.5 | 0.0329 | 34.8 |
| 12.5 | 97.7 | 0.15 | 67.6 | 0.0235 | 31.9 |
| 9.5 | 96.5 | 0.075 | 61.2 | 0.0168 | 29.0 |
| 4.75 | 95.5 | | | 0.0123 | 27.6 |
| 2.00 | 91.6 | | | 0.0088 | 24.7 |
| | | | | 0.0063 | 21.8 |
| | | | | 0.0045 | 17.4 |
| | | | | 0.0032 | 14.5 |
| | | | | 0.0023 | 11.6 |
| | | | | 0.0013 | 8.7 |
| | | | | | |

## GRAIN SIZE DISTRIBUTION CURVE



| | | | |
|---|---|---|---|
| **Gravel** | **8.44%** | **Silt** | **26.69%** |
| **Sand** | **54.20%** | **Clay** | **10.67%** |

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).