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**To:** Anthony Iliouchetchev

**Date:** July 10, 2025

**Project #:** 60668984

**From:** German Leal, M.Eng., P.Eng.
Geotechnical Lead
AECOM ULC

**CC:** Jordan Thompson, Marvin McDonald, and Matthew Brotherston

# Memorandum

**Subject:** **Tache Booster Pumping Station Aqueduct Drain Chamber Raft Foundation Design, Winnipeg, Manitoba**

## Introduction

The City of Winnipeg (the City) engaged AECOM Canada ULC (AECOM) to provide geotechnical services for the design of a new drain chamber at the Branch I Aqueduct within the Tache Booster Pump Station (TBPS) site. This memorandum summarizes the geotechnical findings and raft foundation design for this proposed construction.

As part of AECOM's involvement in the project, a dedicated geotechnical field investigation and memorandum were completed on April 8, 2022. This memorandum, titled "Branch I Aqueduct Drain Chamber and Associated Works - Geotechnical Investigation," specifically reviewed the results of the geotechnical investigation and is included in **Appendix A**.

## Proposed Construction

The project site is located at 138 Rue Messager, Winnipeg, MB, at the Tache Booster Pumping Station. The terrain in this area consists primarily of grass and sparse trees, with residential housing nearby. Test hole TH22-01 is located within the fenced portion of the site, along its east side.

The proposed construction involves a new drain chamber, designed to have a depth of approximately 6.3 meters below ground surface (BGS), resulting in a final floor elevation of approximately 223.46 meters above sea level (ASL). This drain chamber will rest on a raft foundation. Details of the proposed construction of the new drain chamber are illustrated in **Appendix B**.

## Subsurface Conditions

The following sections describe the subsurface conditions encountered during the geotechnical drilling investigation complete by AECOM (2022). The information provided in this section is a summary of the findings from the investigation.

In descending order from grade, the general soil profile consisted of:

- Topsoil
- Clay Fill
- Sand Fill
- Sand
- Clay (CH)

Each of these units are described separately below.

**Topsoil:**

A layer of sand fill 1.1 m thick was encountered beneath the clay fill. The sand fill was gravelly, contained some silt and trace clay, and was dark brown, loose, and moist.

**Clay Fill:**

A layer of clay fill of 0.6 m thick was encountered below the topsoil. The clay fill was silty, contained some sand and some gravel, and was dark brown, frozen at the time of the investigation, and of high plasticity.

**Sand Fill:**

A layer of sand fill 1.1 m thick was encountered beneath the clay fill. The sand fill was gravelly, contained some silt and trace clay, and was dark brown, loose, and moist. A summary of the index properties of the sand fill layer is presented in Table 2-3.

**Sand:**

A layer of sand 1.3 m thick was encountered beneath the sand fill. The sand contained trace to some silt, trace to some clay, and was dark brown and moist.

**Clay (CH):**

A layer of clay was encountered beneath the sand and extended to the test hole termination depth at 10.7 m. The clay layer was silty, contained some sand, and was brown to grey, firm to stiff, moist, and of high plasticity.

# Seepage and Sloughing

Sloughing from the upper sand layers was encountered in test hole TH22-01 at drilling depths below 4.6 m. Seepage was not encountered during drilling. Detailed information about the nature and location of the sloughing and/or seepage are provided on the test hole log included in the memorandum (AECOM, 2022) in **Appendix A**.

One (1) standpipe piezometer was installed in test hole TH22-01 upon completion of the drilling. Short-term monitoring results of the groundwater level (GWL) are provided in **Table 1.**

**Table 1: Piezometer Monitoring Data**

| Test Hole Number | TH22-01 |
|---|---|
| Test Hole Elevation [m] | 229.91 |
| Tip Elevation [m BGS] | 10.36 |
| Tip Elevation [m] | 219.55 |
| Tip Stratum | Clay |
| **Dates** | **GWL Depth Below Ground Surface (Elevation) [m]** |
| January 18, 2022 | Dry |
| March 7, 2022 | 5.86 (224.05) |

It should be noted that groundwater levels, seepage, and sloughing levels in excavations may vary seasonally, annually, or as a result of construction activities.

# Raft Foundations

Calculations for the raft foundation were performed using dimensions of 6.3 m depth and 4.8 m width, obtained from Section A of Consultant Drawing C-4001, dated July 9, 2025, and is shown in **Appendix B**. These parameters apply to raft foundations constructed on clay and may be designed based on the parameters provided on **Table 2**.

**Table 2: Raft Foundation Design Parameters**

| Raft Foundation Bearing Depth | Raft Foundation Bearing Elevation | Factored Bearing Resistance (ULS) | Serviceability Limit Pressure (SLS) | Estimated Modulus of Subgrade Reaction | Uplift Pressure due to Buoyancy |
|---|---|---|---|---|---|
| 6.3 m BGS | 223.5 m ASL | 143 kPa[1] | 113 kPa[2] | 13.5 MPa/m | 62 kPa |

*1. Based on resistance factor of 0.5*

*2. The serviceability limit pressures of the raft foundation were determined using a tolerable limit of settlement of 25 mm.*

As per test hole log (TH22-01) from March 7, 2022, groundwater was observed at a depth of 5.86 m BGS (224.05 m ASL). Additionally, sloughing occurred in test hole TH22-01's upper sand layer at depths below 4.6 m, though no seepage was encountered during drilling. It should be noted that groundwater levels, seepage, and sloughing can vary seasonally, annually, or due to construction activities.

Potential buoyancy of the structures should be checked, particularly during construction when foundation loads will be less than the design loads. The uplift pressure due to buoyancy was calculated with the water table assumed at existing ground surface.

Construction equipment should not be allowed to travel directly on the raft bearing surface. To minimize disturbance of the bearing surface, a flat bucket excavator shall be used at the foundation level. The clay subgrade has a high heave potential, and measures should be taken to prevent changes in soil moisture content at the raft foundation bearing surface. The bearing surface should not be exposed to excessive wetting or drying during construction. A 100 mm thick mud slab (non-reinforced 0.5 MPa concrete slab) shall be provided on the bearing surface upon completion of excavation to minimize exposure to moisture and prevent disturbance of the clay during construction of the raft foundation. The bearing surface shall be inspected by qualified geotechnical personnel prior to placement of the mud slab. All disturbed soils must be removed from the bearing surface for the raft foundation and replaced with a mud slab (non-reinforced 0.5 MPa concrete slab).

The raft foundation is susceptible to movement due to the estimated modulus of subgrade reactions of 13.5 MPa/m, as can be seen in the table above. The 13.5 MPa/m is based on literature review of clay with a shear strength of approximately 25 kPa.

## Closure

This memorandum has outlined the subsurface conditions, including considerations for seepage and sloughing, relevant to the proposed construction of raft foundations. The analysis, based on a single test hole, provides parameters for the raft foundation design. Should any site conditions encountered during construction deviate significantly from those presented, or if design assumptions do not align with the actual project, please notify our office immediately for review and necessary adjustments. Given the inherent variability of soil conditions, a contingency for potential changes should be incorporated into the construction budget.

Sincerely,

**AECOM ULC**

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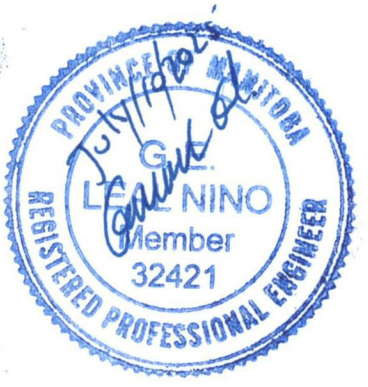
Appendix: Appendix A - Branch I Aqueduct Drain Chamber and Associated Works - Geotechnical Investigation
Appendix B - Drawings



# Appendix A

## Branch I Aqueduct Drain Chamber and Associated Works - Geotechnical Investigation

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**To:** Matthew Skinner, P.Eng.

**Date:** April 8, 2022
**Project #:** 60668984
**From:** Ryan Harras, B.Sc., P.Eng.
Faris Alobaidy, M.Sc., P.Eng.

**CC:** Marv McDonald, C.E.T.

# Memorandum

**Subject:** **Branch I Aqueduct Drain Chamber and Associated Works - Geotechnical Investigation**

## 1. Introduction

### 1.1 General

The City of Winnipeg (the City) has retained AECOM Canada Ltd. (AECOM) to provide geotechnical services in support of the design of a new drain chamber for the Branch I Aqueduct at the Tache Booster Pump Station (TBPS) site. This memorandum summarizes the results of the geotechnical investigation completed in January 2022, including test hole information, laboratory test results, and recommendations related to lateral earth pressures to aid in design of temporary shoring systems.

### 1.2 Scope of Work

The geotechnical scope of work included provision of the following services:

- **Geotechnical Investigation** – Drilling one (1) test hole near the proposed drain chamber at the TBPS site to a maximum depth of 10.7 m, and converting the test hole to a standpipe piezometer upon completion of the drilling.
- **Laboratory Testing** – Completion of laboratory testing on collected samples, including: moisture content, Atterberg Limits, gradation, unconfined compressive strength, and electrochemical tests.
- **Instrumentation Monitoring** – Completion of one (1) post-installation reading of the standpipe piezometer at least 3 weeks following installation.
- **Reporting** – Presentation of all geotechnical investigation results and lateral earth pressure recommendations in a geotechnical memo.

## 2. Geotechnical Investigation

### 2.1 General

On January 18, 2022, one (1) test hole (TH22-01) was drilled at the approximate location of the proposed drain chamber, as shown in the Contract Documents. A job hazard assessment was prepared prior to the field investigation, and utility clearance certificates were obtained by AECOM personnel from representatives of ClickBeforeYouDigMB and DigShaw.

Drilling was completed by Paddock Drilling Ltd. using a track-mounted Mobile B48 drill rig equipped with 125 mm Solid Stem Augers (SSA). Disturbed grab and split-spoon samples and relatively undisturbed Shelby Tube samples were retrieved from test holes at select intervals. Standard penetration tests (SPT's) were also completed at regular intervals within the test hole, and the blows required to advance the split-spoon sampler 300 mm were recorded (SPT 'N' values).

Subsurface conditions observed during drilling were documented by AECOM geotechnical personnel according to the Modified Unified Classification System for soils. Other pertinent information such as groundwater and drilling conditions were also recorded. Samples retrieved during the field investigation were tested in the AECOM and ALS Environmental materials testing laboratories located in Winnipeg, Manitoba.

A test hole log was prepared for the single test hole completed and is attached in **Appendix A**. The log include descriptions and depths of the soil units encountered, sample type, sample location, results of field and laboratory testing, instrumentation installed, and other pertinent information such as seepage and sloughing related to groundwater conditions.

## 2.2 In-situ and Laboratory Testing

In-situ and laboratory testing were completed at select depths and on select soil samples collected during the geotechnical investigation program. The soil testing program included the determination of index properties such as moisture content, grain size distribution (sieve analysis/hydrometer method), plasticity (Atterberg Limits), undrained shear strength ("Qu/2" unconfined compressive strength method), bulk unit weight, and electrochemical properties (chloride content, resistivity, sulphate content, and pH). The laboratory test results are presented in **Appendix B**. **Table 2-1** summarizes the number of each test completed.

**Table 2-1: Summary of Laboratory Testing**

| Test | Number |
|---|---|
| Moisture Content | 8 |
| Atterberg Limits | 2 |
| Grain Size Distribution (Sieve Analysis/Hydrometer Method) | 2 |
| Undrained Shear Strength (Qu/2) | 1 |
| Bulk Unit Weight | 1 |
| Electrochemical (Chloride, Resistivity, Sulphate, pH) | 2 |

## 2.3 Subsurface Conditions

The following sections describe the subsurface conditions encountered during the geotechnical drilling investigation completed by AECOM. The information provided in this section is a summary of the findings from the investigation and laboratory testing.

In descending order from grade, the general soil profile consisted of:

- Topsoil
- Clay Fill
- Sand Fill
- Sand
- Clay (CH)

Each of these units are described separately below.

**Topsoil**

A layer of topsoil 75 mm thick was encountered at ground surface. The topsoil was black and frozen at the time of drilling.

**Clay Fill**

A layer of clay fill of 0.6 m thick was encountered below the topsoil. The clay fill was silty, contained some sand and some gravel, and was dark brown, frozen at the time of the investigation, and of intermediate plasticity. A summary of the index properties of the clay fill layer is presented in **Table 2-2.**

**Table 2-2: Summary of Index Properties of Clay Fill**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| Atterberg – Plastic Limit (%) | 15 | | 1 |
| Atterberg – Liquid Limit (%) | 33 | | 1 |

**Sand Fill**

A layer of sand fill 1.1 m thick was encountered beneath the clay fill. The sand fill was gravelly, contained some silt and trace clay, and was dark brown, loose, and moist. A summary of the index properties of the sand fill layer is presented in **Table 2-3.**

**Table 2-3: Summary of Index Properties of Sand Fill**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| Moisture Content (%) | 12 | 22 | 2 |
| Grain Size – Gravel (%) | 24 | | 1 |
| Grain Size – Sand (%) | 51 | | 1 |
| Grain Size – Silt (%) | 18 | | 1 |
| Grain Size – Clay (%) | 8 | | 1 |

**Sand**

A layer of sand 1.3 m thick was encountered beneath the sand fill. The sand contained trace to some silt, trace to some clay, and was dark brown and moist. A summary of the index properties of the sand layer is presented in **Table 2-4.**

**Table 2-4: Summary of Index Properties of Sand**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| Moisture Content (%) | 13 | 20 | 2 |

**Clay (CH)**

A layer of clay was encountered beneath the sand and extended to the test hole termination depth at 10.7 m. The clay layer was silty, contained some sand, and was brown to grey, firm to stiff, moist, and of high plasticity. A summary of the index properties of the clay are presented in **Table 2-5**.

**Table 2-5: Summary of Index Properties of Clay (CH)**

| Test | Minimum Value | Maximum Value | Number of Tests |
|---|---|---|---|
| Moisture Content (%) | 32 | 43 | 4 |
| SPT 'N' Blow Count (uncorrected) | 5 | 9 | 3 |
| Atterberg – Plastic Limit (%) | 24 | | 1 |
| Atterberg – Liquid Limit (%) | 54 | | 1 |
| Grain Size – Gravel (%) | 0 | | 1 |
| Grain Size – Sand (%) | 10 | | 1 |
| Grain Size – Silt (%) | 57 | | 1 |
| Grain Size – Clay (%) | 33 | | 1 |
| Undrained Shear Strength (Qu/2) (kPa) | 60 | | 1 |
| Bulk Unit Weight | 18.5 | | 1 |

## 2.4 Seepage, Sloughing, and Heaving

Sloughing from the upper sand layers was encountered in test hole TH22-01 at drilling depths below 4.6 m. Seepage was not encountered during drilling. Detailed information about the nature and location of the sloughing and/or seepage are provided on the test hole log included in **Appendix A**.

One (1) standpipe piezometer was installed in test hole TH22-01 upon completion of the drilling. Short-term monitoring results of the groundwater level (GWL) are provided in **Table 2-6**.

**Table 2-6: Piezometer Monitoring Data**

| Test Hole Number | TH22-01 |
|---|---|
| Test Hole Elevation [m] | 229.91 |
| Tip Depth [m BGS] | 10.36 |
| Tip Elevation [m] | 219.55 |
| Tip Location | Clay |
| **Dates** | **GWL Depth Below Ground Surface (Elevation) [m]** |
| *January 18, 2022 | Dry |
| March 7, 2022 | 5.86 (224.05) |

* Measurement taken immediately following installation

It should be noted that groundwater levels, seepage, and sloughing levels in excavations may vary seasonally, annually, or as a result of construction activities.

## 2.5 Electrochemical Test Results

Electrochemical testing was completed on two (2) soil samples collected from test hole TH22-01 to determine water soluble sulphate in soil, pH of soil, water soluble chloride in soil, and soil resistivity. A summary of the test results is provided in **Table 2-7**.

**Table 2-7: Summary of Electrochemical Test Results**

| Soil Unit | Sample ID / Depth (m) | Water Soluble Sulphate (mg/kg) | pH | Water Soluble Chloride (mg/kg) | Resistivity (ohm*cm) | Corrosivity |
|---|---|---|---|---|---|---|
| Clay Fill | G1A / 0.8 | <20 | 7.58 | <20 | 4950 | Corrosive |
| Clay (CH) | S6 / 6.1 | <20 | 7.62 | <20 | 4240 | Corrosive |

The results of the water-soluble sulphate testing indicate that the clay fill and clay soils tested are classified as moderate (S-3) class of exposure to sulphate attack according to CAN/CSA A23.1-M94 (*Concrete Materials and Methods of Concrete Construction*). However, it is known that soils in the Winnipeg area commonly have a very severe (S-1) class of exposure to sulphate attack.

Based on the results of the resistivity testing, the clay fill and clay soils tested are classified as corrosive to buried metal.

# 3. Temporary Excavations

Temporary excavations will be required to facilitate the construction of the proposed drain chamber at the TPBS site. It is understood that the proposed drain chamber will consist of a 3048 mm diameter precast manhole founded at a depth of approximately 6.7 m below existing grade (Elev. 223.51 m above sea level) which is well below frost depth in Winnipeg area For the proposed infrastructure it is understood that temporary shoring will be required during construction of the proposed drain chamber, and that the Contractor is responsible for design and construction of the temporary shoring system. All excavation work will be required to be performed in accordance with the most recent version of the Workplace Safety and Health Act and Part 26 of the Manitoba Workplace Safety and Health Regulation M.R. 217/2006.

Based on the results of the geotechnical investigation, lateral earth pressure design parameters have been recommended for use by the Contractor in completing the temporary shoring design. The lateral earth pressure distribution will be based on the selected configuration of the shoring system. **Table 3-1** provides a summary of lateral earth pressures for the different soil layers encountered.

**Table 3-1: Lateral Earth Pressure Parameters**

| Soil Type | γ ($kN/m^3$) | Angle of internal friction, Φ (degrees) | Active Earth Pressure Coefficient, $K_a$ | At-rest Earth Pressure Coefficient, $K_o$ | Active Earth Pressure Coefficient, $K_p$ |
|---|---|---|---|---|---|
| Clay Fill | 19.0 | 20 | 0.49 | 0.66 | 2.0 |
| Sand Fill | 20.0 | 27 | 0.38 | 0.55 | 2.7 |
| Sand | 20.0 | 30 | 0.33 | 0.50 | 3.0 |
| Clay | 18.5 | 14 | 0.61 | 0.76 | 1.6 |

Temporary shoring systems are required to be designed for lateral earth pressure, lateral hydrostatic pressures below the groundwater level (when a sub-drainage system is not provided behind the wall), and surcharge loads of equipment adjacent to the shaft. Buoyant soil unit weight should be considered at depths below the groundwater level when a sub-drainage system is not provided behind the wall. A minimum surcharge of 16 kPa at ground surface is recommended to account for traffic acting adjacent to the wall; however, the actual surcharge of the selected construction equipment should be calculated and accounted for in the design of the shoring system (in case it's higher than 16 kPa). The temporary shoring design should be capable of controlling ground movement in accordance with the Contract Documents.

The passive earth pressure parameters provided in **Table 3-1** should be reduced by a factor of 1.5 to account for the partial mobilization of passive resistance that generally occurs with small wall displacements under the applied loads Passive resistance from the soil located in the upper 0.5 m below the excavation level should be ignored.

To attain active earth pressure ($K_a$) conditions, the displacement at the top of the wall should be at least 0.01 times the height of the wall. In the case of an unyielding wall, the at-rest earth pressure ($K_o$) should be used in the design.

# 4. Closure

The findings of this memo were based on the results of field and laboratory investigations at a single test hole location. If conditions are encountered that appear to be different from those shown by the test holes 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 report can be reviewed and adjusted, if necessary.

Soil conditions, by their nature, can be highly variable across a site. The placement of fill and prior construction activities on a site can contribute to the variability especially of near-surface soil conditions. A contingency should be included in the construction budget to allow for the possibility of variation in soil conditions. Such variations may require modifications to the design or construction procedures.

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,
**AECOM Canada Ltd.**

Prepared by:

**For** Ryan Harras, B.Sc. (Civil), P.Eng.
Geotechnical Engineer

Reviewed by:

Faris Alobaidy, M.Sc., P.Eng.
Senior Geotechnical Engineer

# Appendix A

## Test Hole Log

**AECOM Canada Ltd.**

## GENERAL STATEMENT

## NORMAL VARIABILITY OF SUBSURFACE CONDITIONS

The scope of the investigation presented herein is limited to an investigation of the subsurface conditions as to suitability for the proposed project. This report has been prepared to aid in the evaluation of the site and to assist the engineer in the design of the facilities. Our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of earth work, foundations and similar. In the event of any changes in the basic design or location of the structures as outlined in this report or plan, we should be given the opportunity to review the changes and to modify or reaffirm in writing the conclusions and recommendations of this report.

The analysis and recommendations presented in this report are based on the data obtained from the borings and test pit excavations made at the locations indicated on the site plans and from other information discussed herein. This report is based on the assumption that the subsurface conditions everywhere are not significantly different from those disclosed by the borings and excavations. However, variations in soil conditions may exist between the excavations and, also, general groundwater levels and conditions may fluctuate from time to time. The nature and extent of the variations may not become evident until construction. If subsurface conditions differ from those encountered in the exploratory borings and excavations, are observed or encountered during construction, or appear to be present beneath or beyond excavations, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Since it is possible for conditions to vary from those assumed in the analysis and upon which our conclusions and recommendations are based, a contingency fund should be included in the construction budget to allow for the possibility of variations which may result in modification of the design and construction procedures.

In order to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated, we recommend that all construction operations dealing with earth work and the foundations be observed by an experienced soils engineer. We can be retained to provide these services for you during construction. In addition, we can be retained to review the plans and specifications that have been prepared to check for substantial conformance with the conclusions and recommendations contained in our report.

# EXPLANATION OF FIELD & LABORATORY TEST DATA

The field and laboratory test results, as shown for each hole, are described below.

## 1. NATURAL MOISTURE CONTENT

The relationship between the natural moisture content and depth is significant in determining the subsurface moisture conditions. The Atterberg Limits for a sample should be compared to its natural moisture content and plotted on the Plasticity Chart in order to determine the soil classification.

## 2. SOIL PROFILE AND DESCRIPTION

Each soil stratum is classified and described noting any special conditions. The Modified Unified Classification System (MUCS) is used. The soil profile refers to the existing ground level at the time the hole was done. Where available, the ground elevation is shown. The soil symbols used are shown in detail on the soil classification chart.

## 3. TESTS ON SOIL SAMPLES

Laboratory and field tests are identified by the following and are on the logs:

N - Standard Penetration Test (SPT) Blow Count. The SPT is conducted in the field to assess the in-situ consistency of cohesive soils and the relative density of non-cohesive soils. The N value recorded is the number of blows from a 63.5 kg hammer dropped 760 mm which is required to drive a 51 mm split spoon sampler 300 mm into the soil.

$SO_4$ - Water Soluble Sulphate Content. Expressed in percent. Conducted primarily to determine requirements for the use of sulphate resistant cement. Further details on the water-soluble sulphate content are given in Section 6.

$\gamma_D$ - Dry Unit Weight. Usually expressed in $kN/m^3$.

$\gamma_T$ - Total Unit Weight. Usually expressed in $kN/m^3$.

$Q_U$ - Unconfined Compressive Strength. Usually expressed in kPa and may be used in determining allowable bearing capacity of the soil.

$C_U$ - Undrained Shear Strength. Usually expressed in kPa. This value is determined by either a direct shear test or by an unconfined compression test and may also be used in determining the allowable bearing capacity of the soil.

$C_{PEN}$ - Pocket Penetrometer Reading. Usually expressed in kPa. Estimate of the undrained shear strength as determined by a pocket penetrometer.

The following tests may also be performed on selected soil samples and the results are given on separate sheets enclosed with the logs:

- Grain Size Analysis
- Standard or Modified Proctor Compaction Test
- California Bearing Ratio Test
- Direct Shear Test
- Permeability Test
- Consolidation Test
- Triaxial Test

## 4. SOIL DENSITY AND CONSISTENCY

The SPT test described above may be used to estimate the consistency of cohesive soils and the density of cohesionless soils. These approximate relationships are summarized in the following tables:

**Table 1 Cohesive Soils**

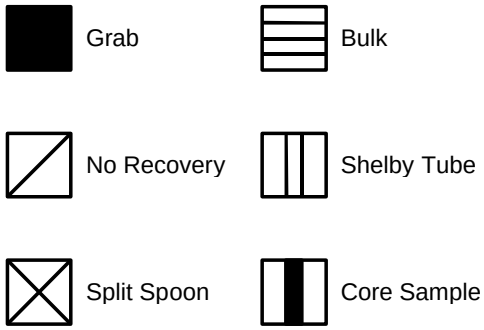
| N | Consistency | $C_u$ (kPa) approx. |
|---|---|---|
| 0 - 1 | Very Soft | <10 |
| 1 - 4 | Soft | 10 - 25 |
| 4 - 8 | Firm | 25 - 50 |
| 8 - 15 | Stiff | 50 - 100 |
| 15 - 30 | Very Stiff | 100 - 200 |
| 30 - 60 | Hard | 200 - 300 |
| >60 | Very Hard | >300 |

**Table 2 Cohesionless Soils**

| N | Density |
|---|---|
| 0 - 5 | Very Loose |
| 5 - 10 | Loose |
| 10 - 30 | Compact |
| 30 - 50 | Dense |
| >50 | Very Dense |

## 5. SAMPLE CONDITION AND TYPE

The depth, type, and condition of samples are indicated on the logs by the following symbols:




## 6. WATER SOLUBLE SULPHATE CONCENTRATION

The following table, from CSA Standard A23.1-14, indicates the requirements for concrete subjected to sulphate attack based upon the percentage of water-soluble sulphate as presented on the logs. CSA Standard A23.1-14 should be read in conjunction with the table.

**Table 3 Requirements for Concrete Subjected to Sulphate Attack***

| Class of exposure | Degree of exposure | Water-soluble sulphate ($SO_4$)† in soil sample, % | Sulphate ($SO_4$) in groundwater samples, mg/L‡ | Water soluble sulphate ($SO_4$) in recycled aggregate sample, % | Cementing materials to be used§†† | Performance requirements§,§§ | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Maximum expansion when tested using CSA A3004-C8 Procedure A at 23 °C, % | | Maximum expansion when tested using CSA A3004-C8 Procedure B at 5 °C, % ††† |
| | | | | | | At 6 months | At 12 months†† | At 18 months‡‡ |
| S-1 | Very severe | > 2.0 | > 10 000 | > 2.0 | HS** ,HSb, HSLb*** or HSe | 0.05 | 0.10 | 0.10 |
| S-2 | Severe | 0.20–2.0 | 1500–10 000 | 0.60–2.0 | HS**, HSb, HSLb*** or HSe | 0.05 | 0.10 | 0.10 |
| S-3 | Moderate (including seawater exposure*) | 0.10–0.20 | 150–1500 | 0.20–0.60 | MS, MSb, MSe, MSLb***, LH, LHb, HS**, HSb, HSLb*** or HSe | 0.10 | | 0.10 |

*For sea water exposure, also see Clause 4.1.1.5.
†In accordance with CSA A23.2-3B.
‡In accordance with CSA A23.2-2B.
§Where combinations of supplementary cementing materials and portland or blended hydraulic cements are to be used in the concrete mix design instead of the cementing materials listed, and provided they meet the performance requirements demonstrating equivalent performance against sulphate exposure, they shall be designated as MS equivalent (MSe) or HS equivalent (HSe) in the relevant sulphate exposures (see Clauses 4.1.1.6.2, 4.2.1.1, and 4.2.1.3, and 4.2.1.4).
**Type HS cement shall not be used in reinforced concrete exposed to both chlorides and sulphates, including seawater. See Clause 4.1.1.6.3.

††The requirement for testing at 5 °C does not apply to MS, HS, MSb, HSb, and MSe and HSe combinations made without portland limestone cement.
‡‡ If the increase in expansion between 12 and 18 months exceeds 0.03%, the sulphate expansion at 24 months shall not exceed 0.10% in order for the cement to be deemed to have passed the sulphate resistance requirement.
§§For demonstrating equivalent performance, use the testing frequency in Table 1 of CSA A3004-A1 and see the applicable notes to Table A3 in A3001 with regard to re-establishing compliance if the composition of the cementing materials used to establish compliance changes.
***Where MSLb or HSLb cements are proposed for use, or where MSe or HSe combinations include Portland-limestone cement, they must also contain a minimum of 25% Type F fly ash or 40% slag or 15% metakaolin (meeting Type N pozzolan requirements) or a combination of 5% Type SF silica fume with 25% slag or a combination of 5% Type SF silica fume with 20% Type F fly ash. For some proposed MSLb, HSLb, and MSe or HSe combinations that include Portland-limestone cement, higher SCM replacement levels may be required to meet the A3004-C8 Procedure B expansion limits. Due to the 18-month test period, SCM replacements higher than the identified minimum levels should also be tested. In addition, sulphate resistance testing shall be run on MSLb and HSLb cement and MSe or HSe combinations that include Portland-limestone cement at both 23 °C and 5 °C as specified in the table.
†††If the expansion is greater than 0.05% at 6 months but less than 0.10% at 1 year, the cementing materials combination under test shall be considered to have passed.

## 7. SOIL CORROSIVITY

The following table, from the Handbook of Corrosion Engineering (Roberge, 1999) indicates the corrosivity rating can be obtained from the soil resistivity, presented on the logs.

**Table 4 Corrosivity Ratings Based on Soil Resistivity**

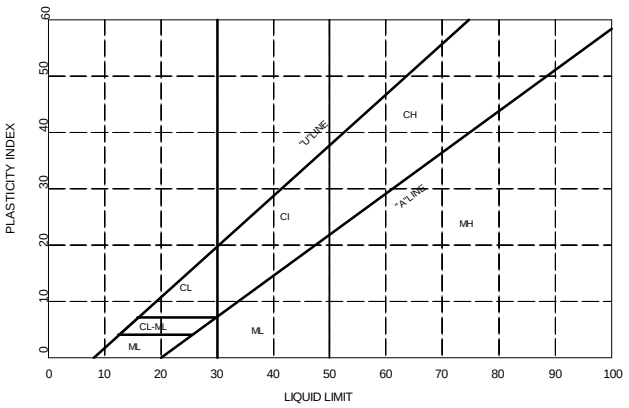
| Soil Resistivity (ohm-cm) | Corrosivity Rating |
|---|---|
| >20,000 | Essentially non-corrosive |
| 10,000 – 20,000 | Mildly corrosive |
| 5,000 – 10,000 | Moderately corrosive |
| 3,000 – 5,000 | Corrosive |
| 1,000 – 3,000 | Highly corrosive |
| <1,000 | Extremely corrosive |

## 8. GROUNDWATER TABLE

The groundwater table is indicated by the equilibrium level of water in a standpipe installed in a testhole or test pit. This level is generally taken at least 24 hours after installation of the standpipe. The groundwater level is subject to seasonal variations and is usually highest in the spring. The symbol on the logs indicating the groundwater level is an inverted solid triangle (▼).

AECOM

| MAJOR DIVISION | | | LOG SYMBOLS | UCS | TYPICAL DESCRIPTION | LABORATORY CLASSIFICATION CRITERIA | |
|---|---|---|---|---|---|---|---|
| COARSE GRAINED SOILS | GRAVELS (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm) | CLEAN GRAVELS (LITTLE OR NO FINES) | | GW | WELL GRADED GRAVELS, LITTLE OR NO FINES | $C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$ | |
| | | | | GP | POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES | NOT MEETING ABOVE REQUIREMENTS | |
| | | GRAVELS WITH FINES | | GM | SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES | CONTENT OF FINES EXCEEDS 12% | ATTERBERG LIMITS BELOW 'A' LINE $W_p$ LESS THAN 4 |
| | | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES | | ATTERBERG LIMITS ABOVE 'A' LINE $W_p$ MORE THAN 7 |
| | SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm) | CLEAN SANDS (LITTLE R NO FINES) | | SW | WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES | $C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$ | |
| | | | | SP | POORLY GRADED SANDS, LITTLE OR NO FINES | NOT MEETING ABOVE REQUIREMENTS | |
| | | SANDS WITH FINES | | SM | SILTY SANDS, SAND-SILT MIXTURES | CONTENT OF FINES EXCEEDS 12% | ATTERBERG LIMITS BELOW 'A' LINE $W_p$ LESS THAN 4 |
| | | | | SC | CLAYEY SANDS, SAND-CLAY MIXTURES | | ATTERBERG LIMITS ABOVE 'A' LINE $W_p$ MORE THAN 7 |
| FINE GRAINED SOILS | SILTS (BELOW 'A' LINE NEGLIGIBLE ORGANIC CONTENT) | $W_L < 50$ | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY | CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW) | |
| | | $W_L > 50$ | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS | | |
| | CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT) | $W_L < 30$ | | CL | INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS | WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER 'F'. E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY | |
| | | $30 < W_L < 50$ | | CI | INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS | | |
| | | $W_L > 50$ | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS | | |
| | ORGANIC SILTS & CLAYS (BELOW 'A' LINE) | $W_L < 50$ | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY | | |
| | | $W_L > 50$ | | OH | ORGANIC CLAYS OF HIGH PLASTICITY | | |
| HIGHLY ORGANIC SOILS | | | | Pt | PEAT AND OTHER HIGHLY ORGANIC SOILS | STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE | |
| BEDROCK | | | | BR | SEE REPORT DESCRIPTION | | |
| FILL | | | | FILL | SEE REPORT DESCRIPTION | | |




NOTE:
1. BOUNDARY CLASSIFICATION POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%

SOIL COMPONENTS

| FRACTION | | SIEVE SIZE (mm) | | DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS | |
|---|---|---|---|---|---|
| | | PASSING | RETAINED | PERCENT | IDENTIFIER |
| GRAVEL | COARSE | 75 | 19 | 50 - 35 | AND |
| | FINE | 19 | 4.75 | | |
| SAND | COARSE | 4.75 | 2.00 | 35 – 20 | _____Y |
| | MEDIUM | 2.00 | 0.425 | | |
| | FINE | 0.425 | 0.080 | 20 – 10 | SOME |
| SILT (non-plastic) or CLAY (plastic) | | 0.080 | | 10 - 1 | TRACE |
| OVERSIZE MATERIALS | | | | | |
| ROUNDED OR SUB-ROUNDED COBBLES 75 mm TO 200 mm BOULDERS >200 mm | | ANGULAR ROCK FRAGMENTS ROCKS > 0.75 m3 IN VOLUME | | | |

# MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

August 2015

| | | |
|---|---|---|
| PROJECT: TBPS Drain Chamber DD | CLIENT: City of Winnipeg | TESTHOLE NO: TH22-01 |
| LOCATION: UTM 14 - 5528960 m N, 634380 m E | | PROJECT NO.: 60668984 |
| CONTRACTOR: Paddock Drilling | METHOD: Mobile B48 - 125 mm SSA | ELEVATION (m): 229.91 |

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

| DEPTH (m) | USC | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE # | SPT (N) | COMMENTS | ELEVATION |
|---|---|---|---|---|---|---|---|
| 0 | OR | TOPSOIL (75 mm) - black, frozen | | | | | |
| | FILL | CLAY (Fill) - silty, some sand, some gravel<br>- dark brown, frozen | | G1A<br>G1B | | (G1B): Gravel 23.9%, Sand 50.8%, Silt 17.8%, Clay 7.5% | 229 |
| 1 | FILL | SAND (Fill) - gravelly, some silt, trace clay<br>- dark brown, loose, moist<br>- intermediate plasticity | | | | | |
| | | - some clay below 1.5 m | | S2A<br>S2B | 7 | SPT Blows: [3/3/4], Spoon Recovery: 11% | 228 |
| 2 | | SAND - trace silt, trace clay<br>- dark brown, moist | | G3 | | | |
| | SP | - some clay, some silt below 2.6 m | | | | | 227 |
| 3 | | CLAY - silty, some sand<br>- brown, firm, moist<br>- high plasticity | | S4 | 5 | SPT Blows: [2/3/2], Spoon Recovery: 11% | |
| 4 | | | | | | | 226 |
| | | - stiff from 4.6 m to 7.6 m | | T5 | | Tube Recovery: 75%, (T5): Gravel 0.0%, Sand 10.0%, Silt 57.0%, Clay 33.0% | |
| 5 | | | | | | | 225 |
| 6 | | - brown mottled grey from 6.1 m to 7.6 m | | S6 | 9 | SPT Blows: [3/3/6], Spoon Recovery: 100% | 224 |
| 7 | CH | | | | | | 223 |
| | | - grey, firm below 7.6 m | | S7 | 7 | SPT Blows: [2/3/4], Spoon Recovery: 100% | |
| 8 | | | | | | | 222 |
| 9 | | | | T8 | | Tube Recovery: 8% | 221 |
| 10 | | | | | | | 220 |
| | | END OF TEST HOLE AT 10.67 m IN CLAY | | G9 | | | |
| 11 | | Notes:<br>1. Seepage not observed during augering.<br>2. Sloughing observed at depths below 4.6 m during augering.<br>3. Test hole backfilled with sand from 10.7 m to 9.8 m, bentonite from 9.8 m to 9.1 m, auger cuttings from 9.1 m to 0.6 m, and sand from 0.6 m to 0.3 m. Flush-mount cover installed.<br>7. Groundwater monitoring:<br>- January 18, 2022 - Dry<br>- March 7, 2022 at elev. 224.05 m (5.86 m bgs) | | | | | 219 |
| 12 | | | | | | | 218 |
| 13 | | | | | | | 217 |
| 14 | | | | | | | 216 |

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ ($kN/m^3$) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | □ Lab Vane □ | △ Pocket Pen. △ | ⬘ Field Vane ⬘ (kPa) 50 100 150 200

AECOM

| | |
|---|---|
| LOGGED BY: Ryan Harras | COMPLETION DEPTH: 10.67 m |
| REVIEWED BY: Faris Alobaidy | COMPLETION DATE: 1/18/22 |
| PROJECT ENGINEER: Marv McDonald | Page 1 of 1 |

LOG OF TEST HOLE 60668984 - TEST HOLE LOGS - TBPS.GPJ UMA WINN.GDT 3/8/22

# Appendix B

## Laboratory Test Results

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Winnipeg, MB R3E 3G5
Office: (204) 632-8637 ; (204) 697-3854

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# SOIL SAMPLES TEST SUMMARY

| | | | |
|---|---|---|---|
| CLIENT: | AECOM Canada Ltd. | PROJECT No.: | 112-2202 |
| | 99 Commerce Drive | Date Sampled: | 18-Jan-22 |
| | Winnipeg MB R3P 0Y7 | Date Received: | 21-Jan-22 |
| ATTENTION: | Ryan Harris | Sampled By: | Client |
| PROJECT: | TBPS Drain Chamber | Date Tested: | Jan 27 to Feb 11, 2022 |
| | Job No. 60668984 | | |

| Lab No. | | | | Testing Required | | | | | | | | | Soil Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hole No. | Sample No. | Depth | Sampling Method | Moisture Content (%) | Particle Size Analysis | | | | Atterberg Limits | | | Unconfined Compressive Strength Qu (kPa) | |
| | | | | | Gravel | Sand | Silt | Clay | Liquid Limit | Plastic Limit | Plastic Index | | |
| TH22-01 | G1 | 2.5 | Auger | 11.9 | 23.9 | 50.8 | 17.8 | 7.5 | 33 | 15 | 19 | | CLAY (FILL) |
| 11% rec. | S2 | 5 | Split Spoon | 22.4 | | | | | | | | | SAND |
| | G3 | 7.5 | Auger | 13.4 | | | | | | | | | |
| 11% rec. | S4 | 10 | Split Spoon | 19.5 | | | | | | | | | CLAY |
| | T5 | 15 | Shelby Tube | 32.0 | | 10.0 | 57.0 | 33.0 | 54 | 24 | 30 | 118.9 | |
| | S6 | 20 | Split Spoon | 36.4 | | | | | | | | | |
| | S7 | 25 | Split Spoon | 42.0 | | | | | | | | | |
| | T8 | 30 | Shelby Tube | | | | | | | | | | |
| 8% rec. | G9 | 35 | Auger | 43.3 | | | | | | | | | |

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# MOISTURE CONTENT OF SOIL ( ASTM D2216 )

| | | | |
|---|---|---|---|
| CLIENT: **AECOM** | TEST NO: | PROJECT NO: | **112-2202** |
| PROJECT: **TBPS Drain Chamber** | DATE SAMPLED: Jan. 18, 2022 | SAMPLED BY: | **Client** |
| PROJECT CONTACT: **R. Harras** | DATE TESTED: Jan. 27, 2022 | TESTED BY: | **E. Santiago** |

| Test Hole No. **22-01** | **G1** | **S2** | **G3** | **S4** | **S6** |
|---|---|---|---|---|---|
| Depth | **2.5'** | **5'** | **7.5'** | **10'** | **20'** |
| Tare No. | | | | | |
| Wt Wet Sample + Tare | 177.7 | 194.6 | 182.5 | 169.6 | 155 |
| Wt Dry Sample + Tare | 159.2 | 159.9 | 161.4 | 142.7 | 114.8 |
| Wt Water | 18.5 | 34.7 | 21.1 | 26.9 | 40.2 |
| Wt Tare | 4.3 | 4.7 | 4.3 | 4.6 | 4.3 |
| Wt Dry Sample | 154.9 | 155.2 | 157.1 | 138.1 | 110.5 |
| **Moisture Content (%)** | **11.9** | **22.4** | **13.4** | **19.5** | **36.4** |

| Test Hole No. **22-01** | **S7** | **G9** | | | |
|---|---|---|---|---|---|
| Depth | **25'** | **35'** | | | |
| Tare No. | | | | | |
| Wt Wet Sample + Tare | 174.7 | 166.4 | | | |
| Wt Dry Sample + Tare | 124.3 | 117.4 | | | |
| Wt Water | 50.4 | 49.0 | | | |
| Wt Tare | 4.4 | 4.3 | | | |
| Wt Dry Sample | 119.9 | 113.1 | | | |
| **Moisture Content (%)** | **42.0** | **43.3** | | | |

| Test Hole No. | | | | | |
|---|---|---|---|---|---|
| Depth | | | | | |
| Tare No. | | | | | |
| Wt Wet Sample + Tare | | | | | |
| Wt Dry Sample + Tare | | | | | |
| Wt Water | | | | | |
| Wt Tare | | | | | |
| Wt Dry Sample | | | | | |
| **Moisture Content (%)** | | | | | |

| Test Hole No. | | | | | |
|---|---|---|---|---|---|
| Depth | | | | | |
| Tare No. | | | | | |
| Wt Wet Sample + Tare | | | | | |
| Wt Dry Sample + Tare | | | | | |
| Wt Water | | | | | |
| Wt Tare | | | | | |
| Wt Dry Sample | | | | | |
| **Moisture Content (%)** | | | | | |

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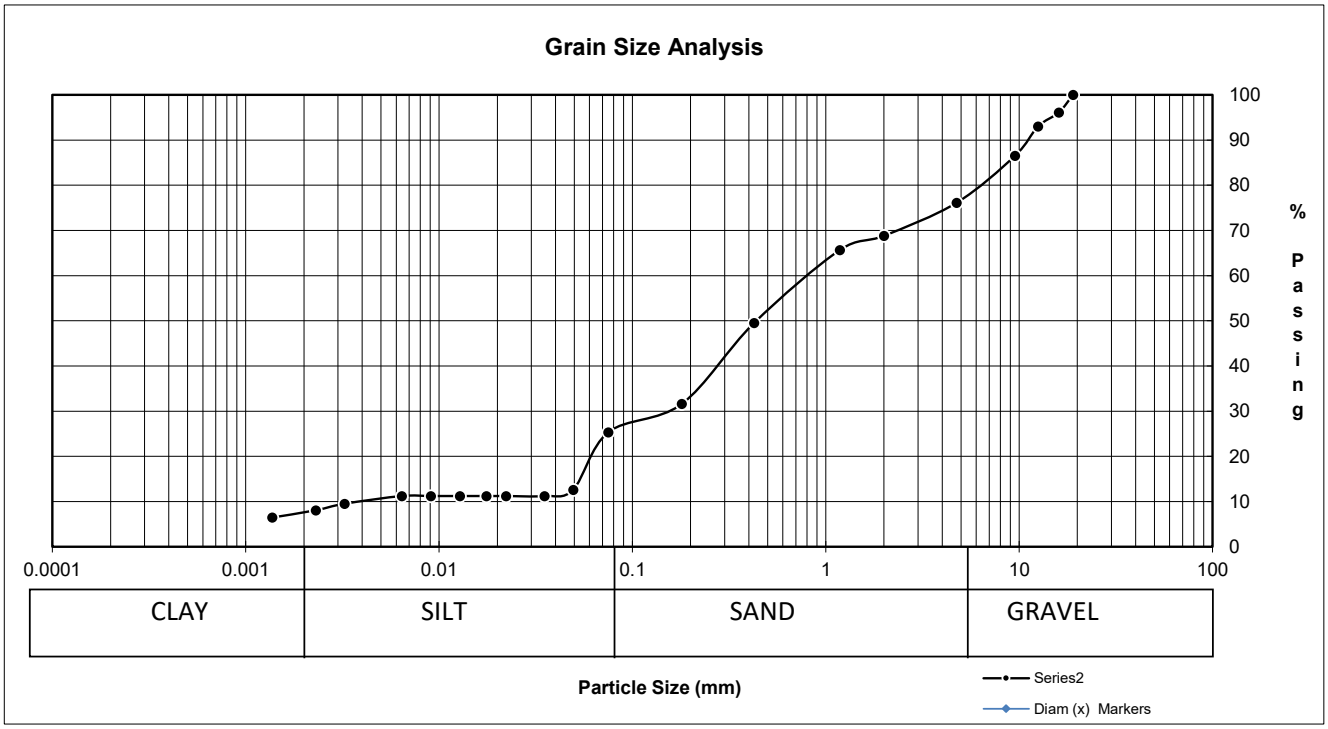
# PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

| | | | |
|---|---|---|---|
| CLIENT: | AECOM Canada Ltd. | PROJECT No.: | 112-2202 |
| | 99 Commerce Drive | PSA Test No.: | 1 |
| | Winnipeg MB R3P 0Y7 | LAB No.: | HM 004A-1 |
| ATTENTION: | Ryan Harras | | |
| PROJECT: | TBPS Drain Chamber<br>Winnipeg, MB | | |

| | | | |
|---|---|---|---|
| Date Sampled: | Jan. 18, 2022 | Date Received: | 21-Jan-22 |
| Sampled By: | Client | Date Tested: | 01-Feb-22 |
| Material Identification | | | |
| B.H./T.H. No. | | **TH22-01-G1** | |
| Depth | | **2.5 FT.** | |
| Sample Source | | | |
| Specific Gravity of Material: | | 2.65 | |

| Sieve Analysis | | Hydrometer Analysis | |
|---|---|---|---|
| Sieve (mm) | % Passing | Diameter | % Finer |
| 50.00 | 100.0 | | |
| 37.50 | 100.0 | | |
| 25.00 | 100.0 | | |
| 19.00 | 100.0 | | |
| 16.00 | 96.1 | | |
| 12.50 | 93.0 | 0.0493 | 12.6 |
| 9.50 | 86.5 | 0.0351 | 11.2 |
| 4.75 | 76.1 | 0.0222 | 11.2 |
| 2.00 | 68.8 | 0.0175 | 11.2 |
| 1.18 | 65.6 | 0.0128 | 11.2 |
| 0.425 | 49.5 | 0.0091 | 11.2 |
| 0.180 | 31.6 | 0.0064 | 11.2 |
| 0.075 | 25.3 | 0.0014 | 6.5 |




| % Composition | | | |
|---|---|---|---|
| 23.9 | Gravel | D10 | 0.00365 |
| 50.8 | Sand | D30 | 0.15500 |
| 17.8 | Silt | D60 | 0.79500 |
| 7.5 | Clay | Cu | 217.81 |
| | | Cc | 8.28 |

Remarks: Test Method: ASTM D7928, D2216, D4318

Technician: E. Santiago

P. Bevel

Reviewed by: Paul Bevel

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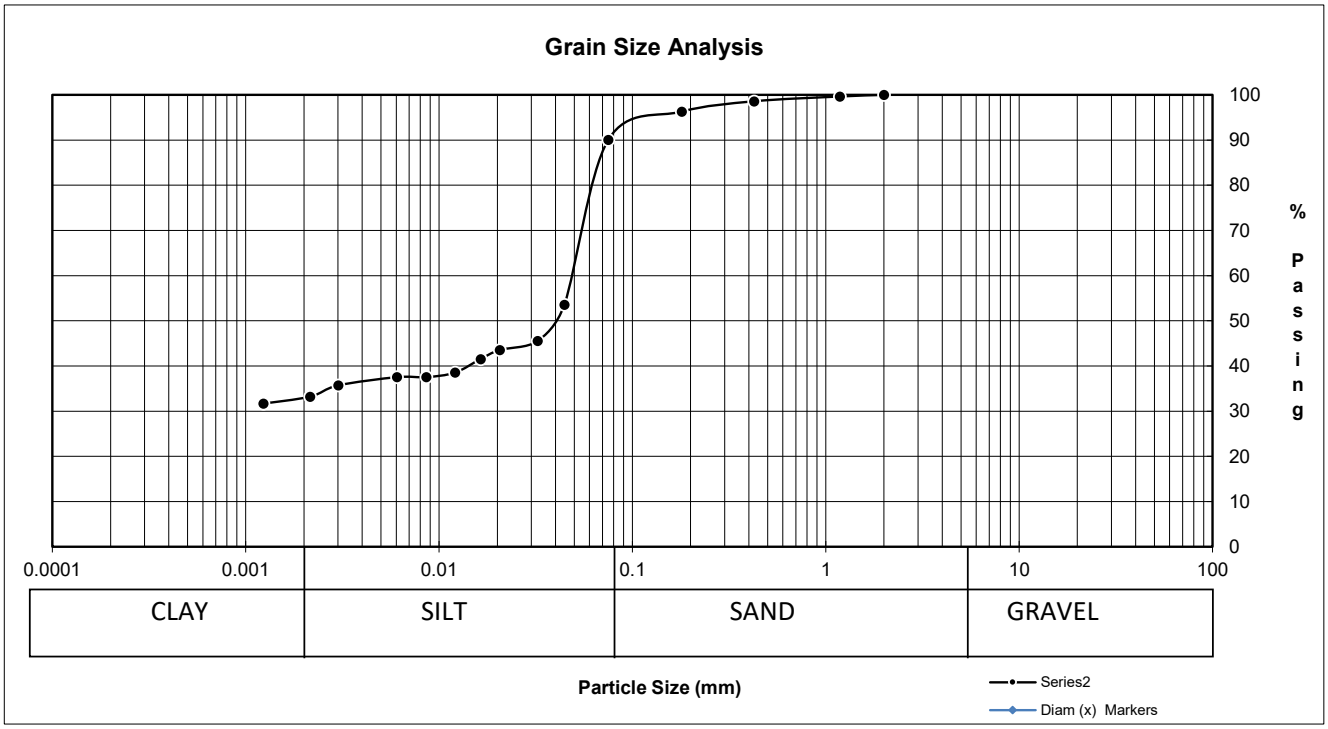
# PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

| | | | |
|---|---|---|---|
| CLIENT: | AECOM Canada Ltd. | PROJECT No.: | 112-2202 |
| | 99 Commerce Drive | PSA Test No.: | 2 |
| | Winnipeg MB R3P 0Y7 | LAB No.: | HM 004A-2 |
| ATTENTION: | Ryan Harras | | |
| PROJECT: | TBPS Drain Chamber<br>Winnipeg, MB | | |

| | | | |
|---|---|---|---|
| Date Sampled: | Jan. 18, 2022 | Date Received: | 21-Jan-22 |
| Sampled By: | Client | Date Tested: | 11-Feb-22 |
| Material Identification | | | |
| B.H./T.H. No. | | **TH22-01-T5** | |
| Depth | | **15 FT.** | |
| Sample Source | | | |
| Specific Gravity of Material: | | 2.65 | |

| Sieve Analysis | | Hydrometer Analysis | |
|---|---|---|---|
| Sieve (mm) | % Passing | Diameter | % Finer |
| 50.00 | 100.0 | | |
| 37.50 | 100.0 | | |
| 25.00 | 100.0 | | |
| 19.00 | 100.0 | | |
| 16.00 | 100.0 | | |
| 12.50 | 100.0 | 0.0444 | 53.5 |
| 9.50 | 100.0 | 0.0323 | 45.5 |
| 4.75 | 100.0 | 0.0206 | 43.5 |
| 2.00 | 100.0 | 0.0164 | 41.5 |
| 1.18 | 99.6 | 0.0121 | 38.5 |
| 0.425 | 98.6 | 0.0086 | 37.5 |
| 0.180 | 96.3 | 0.0061 | 37.5 |
| 0.075 | 90.0 | 0.0012 | 31.7 |




| % Composition | | | |
|---|---|---|---|
| | Gravel | D10 | N/A |
| | | D30 | N/A |
| 9.96 | Sand | D60 | 0.05100 |
| 57.08 | Silt | Cu | |
| 32.96 | Clay | Cc | |

Remarks: Test Method: ASTM D7928, D2216, D4318

Technician: E. Santiago

P. Bevel

Reviewed by: Paul Bevel

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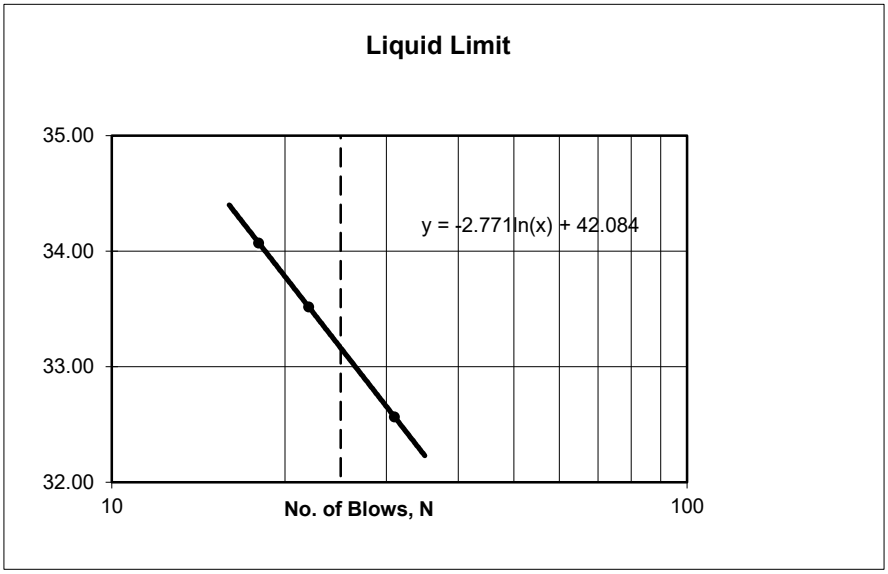
# Atterberg Limits (ASTM D4318)

| | | | |
|---|---|---|---|
| Client: | AECOM Canada Ltd.<br>99 Commerce Drive<br>Winnipeg MB R3P 0Y7 | PROJECT No.: | 112-2202 |
| | | PI Test No.: | 1 |
| | | LAB No.: | HM 004B-1 |
| Attention.: | Ryan Harras | Date Received: | Jan., 21, 2022 |
| Project: | TBPS Drain Chamber<br>Winnipeg, MB | Date Tested / By: | 2022-1-30/G. Manalo |

## Liquid Limit Determination

| Dish No.: | 1 | 2 | 3 | | Liquid Limit 25 Blows |
|---|---|---|---|---|---|
| Wet Soil + Dish: | 11.89 | 11.62 | 10.93 | | |
| Dry Soil + Dish: | 10.05 | 9.81 | 9.24 | | |
| Moisture: | 1.84 | 1.81 | 1.69 | | |
| Dish: | 4.4 | 4.41 | 4.28 | | |
| Dry Soil: | 5.65 | 5.4 | 4.96 | | |
| % Moisture: | 32.57 | 33.52 | 34.07 | | |
| No. of Blows: | 31 | 22 | 18 | | |
| Liquid Limit: | | | | | 33 |




**Material Identification:**

**TH 22-01**

Depth: **G1 @ 2.5 ft.**

Liquid Limit, %: **33**
Plastic Limit, %: **15**
Plasticity Index: **19**
( LL-PL )

## Plastic Limit Determination

| Dish No.: | 1 | 2 | 3 | | |
|---|---|---|---|---|---|
| Wet Soil + Dish: | 10.35 | 10.55 | 11.09 | | |
| Dry Soil + Dish: | 9.6 | 9.75 | 10.27 | | |
| Moisture: | 0.75 | 0.80 | 0.82 | | |
| Dish: | 4.28 | 4.27 | 4.81 | | |
| Dry Soil: | 5.32 | 5.48 | 5.46 | | |
| % Moisture: | 14.10 | 14.60 | 15.02 | | |
| Average: | | | | | **15** |

Test Method : ASTM: D4318, D2216

P. Bevel

Reviewed by: Paul Bevel

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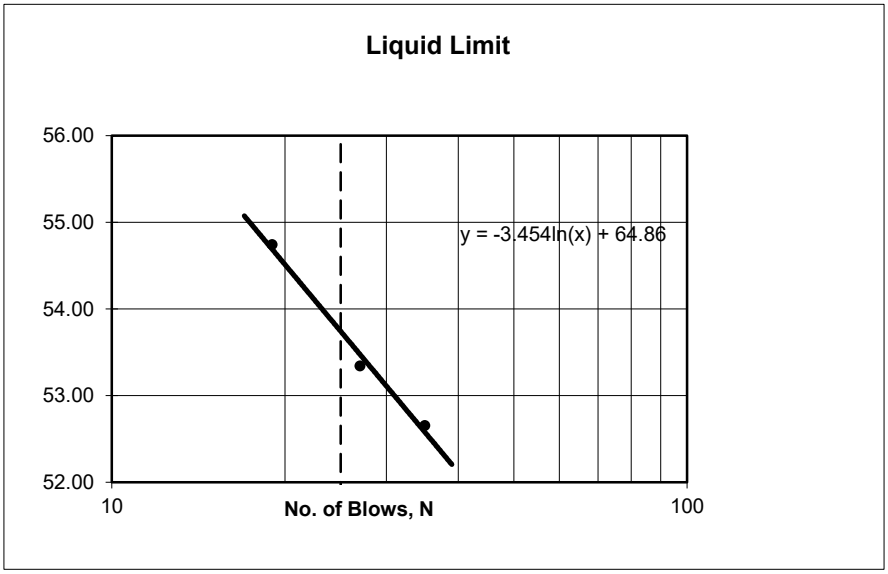
# Atterberg Limits (ASTM D4318)

| | | | |
|---|---|---|---|
| Client: | AECOM Canada Ltd.<br>99 Commerce Drive<br>Winnipeg MB R3P 0Y7 | PROJECT No.: | 112-2202 |
| | | PI Test No.: | 2 |
| | | LAB No.: | HM 004B-2 |
| Attention.: | Ryan Harras | Date Received: | Jan., 21, 2022 |
| Project: | TBPS Drain Chamber<br>Winnipeg, MB | Date Tested / By: | 2022-2-11/G. Manalo |

## Liquid Limit Determination

| Dish No.: | 1 | 2 | 3 | | Liquid Limit |
|---|---|---|---|---|---|
| Wet Soil + Dish: | 14.29 | 13.28 | 13.37 | | 25 Blows |
| Dry Soil + Dish: | 10.82 | 10.17 | 10.14 | | |
| Moisture: | 3.47 | 3.11 | 3.23 | | |
| Dish: | 4.23 | 4.34 | 4.24 | | |
| Dry Soil: | 6.59 | 5.83 | 5.9 | | |
| % Moisture: | 52.66 | 53.34 | 54.75 | | |
| No. of Blows: | 35 | 27 | 19 | | |
| Liquid Limit: | | | | | 54 |




**Material Identification:**

**TH 22-01**

Depth: **T5 @ 15 ft.**

Liquid Limit, %: **54**
Plastic Limit, %: **24**
Plasticity Index: **30**
( LL-PL )

## Plastic Limit Determination

| Dish No.: | 1 | 2 | 3 | | |
|---|---|---|---|---|---|
| Wet Soil + Dish: | 10.08 | 10.15 | 10.68 | | |
| Dry Soil + Dish: | 8.99 | 9 | 9.50 | | |
| Moisture: | 1.09 | 1.15 | 1.18 | | |
| Dish: | 4.27 | 4.22 | 4.61 | | |
| Dry Soil: | 4.72 | 4.78 | 4.89 | | |
| % Moisture: | 23.09 | 24.06 | 24.13 | | |
| Average: | | | | | **24** |

Test Method : ASTM: D4318, D2216

P. Bevel

Reviewed by: Paul Bevel

H. MANALO CONSULTING LTD.
1402 Notre Dame Ave., Winnipeg, MB R3E
Phone: 204 697 3854 Cell: 204 997-1355
hermie@hmanalo.ca

# UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

CLIENT: AECOM
99 Commerce Drive
Winnipeg MB R3P 0Y7
ATTENTION: Ryan Harris
PROJECT: TBPS Drain Chamber (60668984)

PROJECT NO.: 112-2202
Qu Test No.: 1
Lab No.: HM 04

Date Sampled: 18-Jan-22 Date Received: 22-Jan-22
Sampled By: Client Date Tested: 07-Feb-22
Sample ID: TH 22-01 T5 (15')

**Test Result: Unconfined Compressive Strength 118.9 kPa**

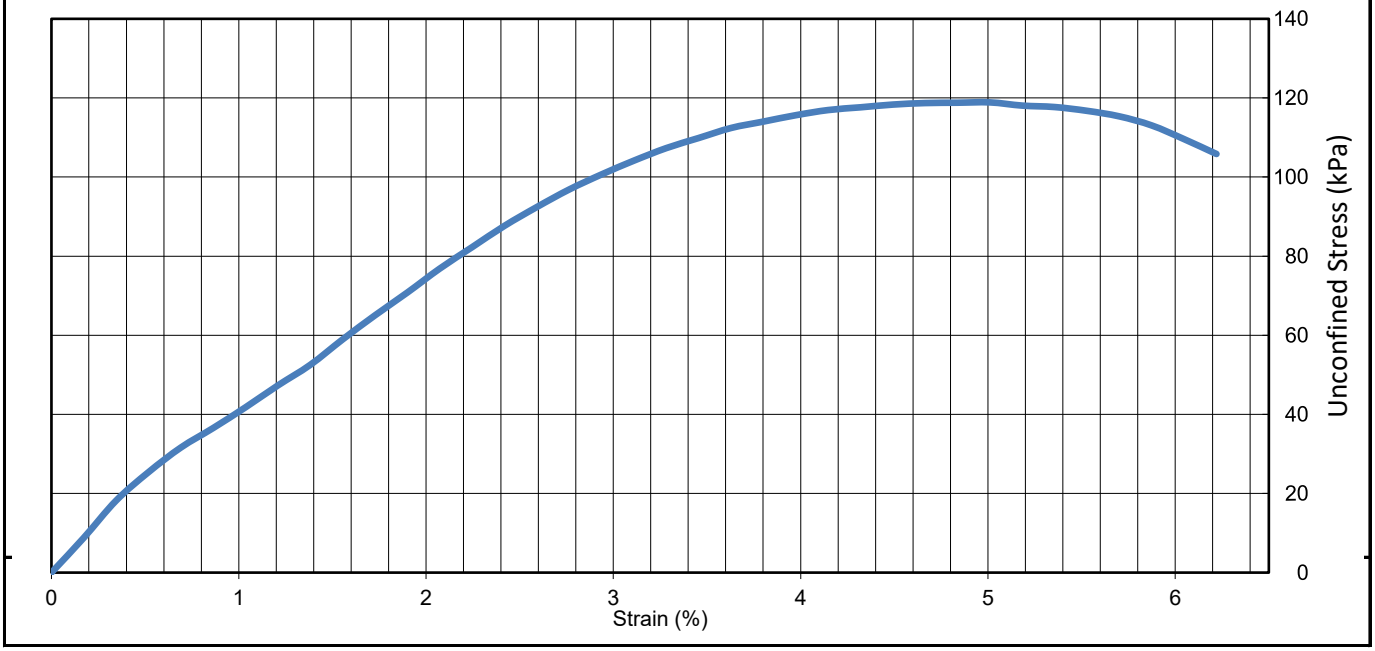
**Test Sample Data**

| Sample Mass (g) | Average Height (m) | Average Diameter (m) | Moisture Content % | Wet Density (kg/m3) | Dry Density (kg/m3) | Strain rate (%/min) |
|---|---|---|---|---|---|---|
| 1150.9 | 0.1470 | 0.0724 | 32.0 | 1885 | 1428 | 1.0 |

**Test Sample Visual Description**

CLAY, silty, trace gravel, dark brown, stiff, moist, trace silt pockets

**Unconfined Stress (kPa) vs Strain (%)**




Remarks: Test Method: ASTM D2166
Technician: PB

P. Bevel

Reviewed by: Paul Bevel

AECOM Canada Ltd.
ATTN: RYAN HARRAS
99 Commerce Drive
Winnipeg MB R3P 0Y7

Date Received: 24-JAN-22
Report Date: 02-FEB-22 13:21 (MT)
Version: FINAL

Client Phone: 204-477-5381

# Certificate of Analysis

## Lab Work Order #: L2680746

Project P.O. #: 60668984
Job Reference: WINNIPEG, MB
C of C Numbers:
Legal Site Desc:

Hua Wo
Chemistry Laboratory Manager

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L2680746-1 TH22-01-G1@2.5' | | | | | | | |
| Sampled By: CLIENT on 20-JAN-22 | | | | | | | |
| Matrix: SOIL | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| % Moisture | 17.4 | | 0.25 | % | 26-JAN-22 | 26-JAN-22 | R5709237 |
| Chloride | <20 | | 20 | mg/kg | 31-JAN-22 | 31-JAN-22 | R5712341 |
| Resistivity | 4950 | | 1.0 | ohm*cm | | 01-FEB-22 | |
| Sulphate | <20 | | 20 | ug/g | 31-JAN-22 | 01-FEB-22 | R5712699 |
| Conductivity | 0.202 | | 0.0040 | mS/cm | | 28-JAN-22 | R5711483 |
| pH | 7.58 | | 0.10 | pH units | | 26-JAN-22 | R5708728 |
| L2680746-2 TH22-01-S6@20' | | | | | | | |
| Sampled By: CLIENT on 20-JAN-22 | | | | | | | |
| Matrix: SOIL | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| % Moisture | 24.4 | | 0.25 | % | 26-JAN-22 | 26-JAN-22 | R5709237 |
| Chloride | 33 | | 20 | mg/kg | 31-JAN-22 | 31-JAN-22 | R5712341 |
| Resistivity | 4240 | | 1.0 | ohm*cm | | 01-FEB-22 | |
| Sulphate | <20 | | 20 | ug/g | 31-JAN-22 | 01-FEB-22 | R5712699 |
| Conductivity | 0.236 | | 0.0040 | mS/cm | | 28-JAN-22 | R5711483 |
| pH | 7.62 | | 0.10 | pH units | | 26-JAN-22 | R5708728 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| CL-WT | Soil | Chloride in Soil | EPA 300.0 |
| 5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography. | | | |
| 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). | | | |
| MOISTURE-WT | Soil | % Moisture | CCME PHC in Soil - Tier 1 (mod) |
| PH-WT | Soil | pH | MOEE E3137A |
| A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode. | | | |
| 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). | | | |
| RESISTIVITY-CALC-WT | Soil | Resistivity Calculation | APHA 2510 B |
| "Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended. | | | |
| SO4-WT | Soil | Sulphate | EPA 300.0 |
| 5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography. | | | |

** 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.*

# Quality Control Report

Workorder: L2680746 Report Date: 02-FEB-22 

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

Contact: RYAN HARRAS

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **CL-WT** | **Soil** | | | | | | | |
| **Batch R5712341** | | | | | | | | |
| **WG3690759-4 CRM** | | **AN-CRM-WT** | | | | | | |
| Chloride | | | 93.4 | | % | | 70-130 | 31-JAN-22 |
| **WG3690759-3 DUP** | | **L2680746-1** | | | | | | |
| Chloride | | <20 | <20 | RPD-NA | mg/kg | N/A | 30 | 31-JAN-22 |
| **WG3690759-2 LCS** | | | | | | | | |
| Chloride | | | 101.4 | | % | | 80-120 | 31-JAN-22 |
| **WG3690759-1 MB** | | | | | | | | |
| Chloride | | | <20 | | mg/kg | | 20 | 31-JAN-22 |
| **EC-WT** | **Soil** | | | | | | | |
| **Batch R5711483** | | | | | | | | |
| **WG3689972-2 IRM** | | **WT SAR4** | | | | | | |
| Conductivity | | | 106.4 | | % | | 70-130 | 28-JAN-22 |
| **WG3690327-1 LCS** | | | | | | | | |
| Conductivity | | | 95.2 | | % | | 90-110 | 28-JAN-22 |
| **WG3689972-1 MB** | | | | | | | | |
| Conductivity | | | <0.0040 | | mS/cm | | 0.004 | 28-JAN-22 |
| **MOISTURE-WT** | **Soil** | | | | | | | |
| **Batch R5709237** | | | | | | | | |
| **WG3689411-2 LCS** | | | | | | | | |
| % Moisture | | | 100.6 | | % | | 90-110 | 26-JAN-22 |
| **WG3689411-1 MB** | | | | | | | | |
| % Moisture | | | <0.25 | | % | | 0.25 | 26-JAN-22 |
| **PH-WT** | **Soil** | | | | | | | |
| **Batch R5708728** | | | | | | | | |
| **WG3688991-1 LCS** | | | | | | | | |
| pH | | | 7.03 | | pH units | | 6.9-7.1 | 26-JAN-22 |
| **SO4-WT** | **Soil** | | | | | | | |
| **Batch R5712699** | | | | | | | | |
| **WG3690988-3 CRM** | | **AN-CRM-WT** | | | | | | |
| Sulphate | | | 114.2 | | % | | 60-140 | 01-FEB-22 |
| **WG3690988-2 LCS** | | | | | | | | |
| Sulphate | | | 103.2 | | % | | 70-130 | 01-FEB-22 |
| **WG3690988-1 MB** | | | | | | | | |
| Sulphate | | | <20 | | ug/g | | 20 | 01-FEB-22 |

# Quality Control Report



**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 |

**Sample Parameter Qualifier Definitions:**

| Qualifier | Description |
|---|---|
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

**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.

12 - 1329 Niakwa Rd. E.
Winnipeg, Manitoba R2J 3T4
Tel: (204) 255-9720
Fax: (204) 255-9721
Toll Free: 1 800 607 7555

L2680746-COFC

# n of Custody / Analytical Request Form

WORK ORDER NO: _____

**FOR LABORATORY USE ONLY (SHA**

Sample Condition Upon Receipt: ☐ ACCEPTABLE ☐ NON ACCEPTABLE

☐ Frozen ☐ Cold ☐ Ambient ☐ Broken ☐ Leakage ☐ Incorrect Sample Container

COMMENT: _____

LAB NO.: _____

DATE RECEIVED: 24/1/22

TIME RECEIVED: 9:25am

BY: O.A. TEMP: 7.4°C

Date Sampled: JAN 17 → 20, 2022 Time: ~ : ~ A.M. ☐ P.M. ☐

Date Required: JAN 24, 2022

Location: WINNIPEG, MB
(Town, Community, City)

**Submitter's Name Printed:** RYAN HARRAS

**Sample Submitted By:** RYAN HARRAS

Community Code Number: _____

Rural Municipality/LGC/UVD: _____

## SAMPLE TYPE

**DRINKING WATER**

- ☐ Untreated Well
- ☐ Treated Well
- ☐ Treated Municipal
- ☐ Non-Treated Municipal
- ☐ Water-Surface-Raw
- ☐ Water-Surface-Treated

**NON-DRINKING WATER**

- ☐ Sewage/Waste Water
- ☐ Lake/River
- ☐ Swimming Pool
- ☐ Whirl Pool
- ☑ Other: SOIL

PURPOSE OF TEST

☐ Private ☐ Real Estate ☐ Water Main

## PLEASE PRINT & PRESS FIRMLY

**NOTES & CONDITIONS**

1. Quote number **MUST BE** provided to insure proper pricing.
2. Failure to properly complete all portions of this form may delay analysis.
3. ALS's liability limited to cost of analysis.

**SERVICE REQUESTED**

☑ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHARGE) ☐ SAME DAY (200% SURCHARGE)

| LAB NUMBER | SAMPLE IDENTIFICATION |
|---|---|
| | TH22-01 - G1 @ 2.5' |
| | TH22-01 - G6 @ 20' |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

*ALS CUSTOMER #:* _____ *QUOTE #:* _____

**REPORT TO BE SENT TO**

NAME: RYAN HARRAS
COMPANY: AECOM
ADDRESS: 99 COMMERCE DR
CITY/TOWN: WINNIPEG / PROV.: MB
POSTAL CODE: R3P 0Y7
PHONE: 204-981-2796
*BY:* *MAIL* ☐ *FAX* ☑ _____ (FAX NUMBER)
*E-MAIL* ☑ RYAN.HARRAS@AECOM.COM (EMAIL ADDRESS)

**CC**

NAME: _____
ADDRESS: _____
CITY/TOWN: _____ / PROV.: _____
POSTAL CODE: _____
PHONE: _____
*BY:* *MAIL* ☐ *FAX* ☐ _____ (FAX NUMBER)
*E-MAIL* ☐ _____ (EMAIL ADDRESS)

**Analyses required** SOIL RESISTIVITY/CONDUCTIVITY, PH, SULPHATE CONTENT, CHLORIDE CONTENT

**BILLING ADDRESS** SAME AS REPORT TO ☑

NAME: _____
COMPANY: _____
ADDRESS: _____
CITY/TOWN: _____ / PROV.: _____
POSTAL CODE: _____

**SAMPLING INSTRUCTIONS ON REVERSE SIDE**
**ALS ENVIRONMENTAL**
12 - 1329 Niakwa Rd. E., Winnipeg, MB Canada R2J 3T4
**Phone: +1 204 255 9720** Fax: +1 204 255 9721 **www.alsglobal.com**
*A Campbell Brothers Limited Company*

**SUBMITTER COPY**

**PAYMENT PARTICULARS (CASH NOT ACCEPTED)**

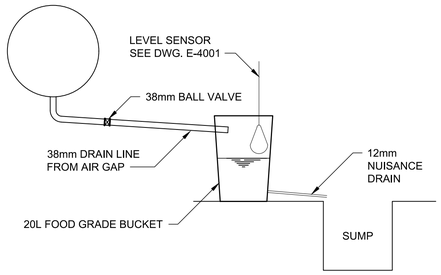
☑ INVOICE NEEDED / CLIENT'S P.O. NO. 60668984
☐ INTERAC
☐ CHEQUE Subtotal $ _____
☐ VISA G.S.T. $ _____
☐ MASTERCARD Total $ _____

* OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT

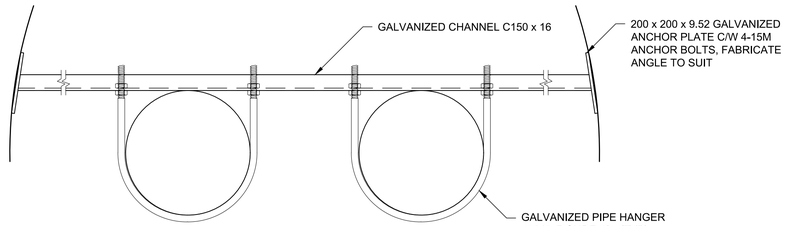
***ENTERED IN LIMS BY:*** _____

# Appendix B

## Drawings

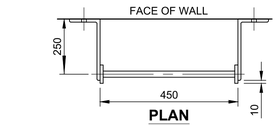



**4 | DETAIL**
AIR GAP MONITOR

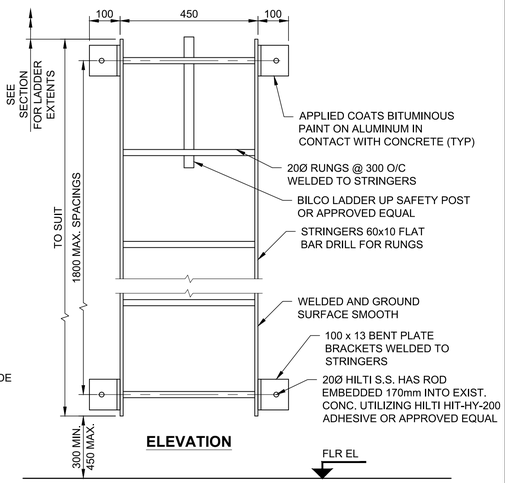



**2 | DETAIL**
PIPE SUPPORT

0 250 500 mm




**PLAN**



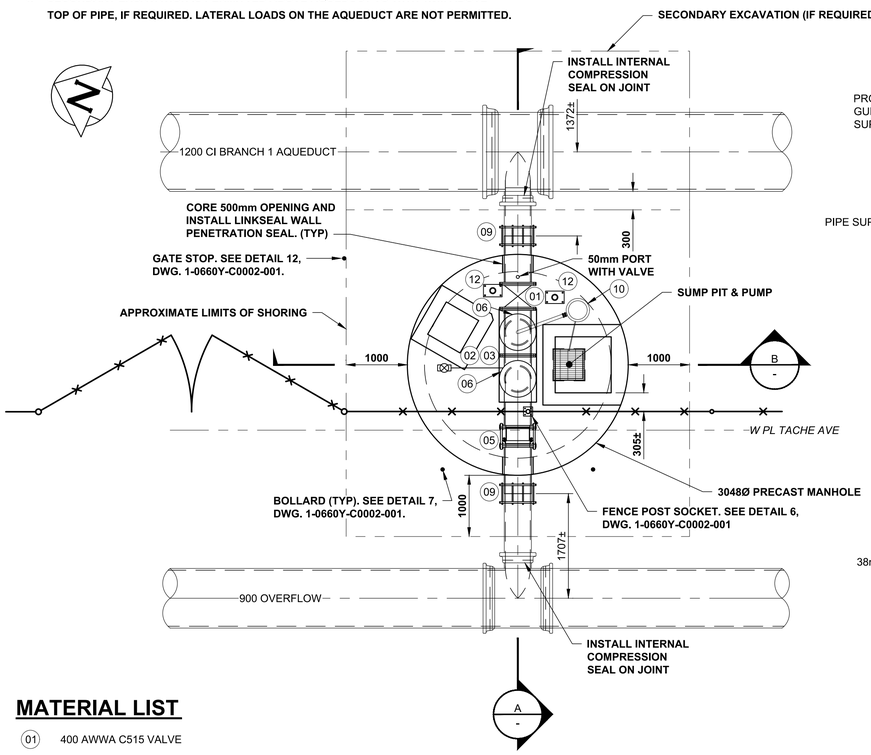

**ELEVATION**

**3 | DETAIL**
ALUMINUM LADDER

0 250 500 mm

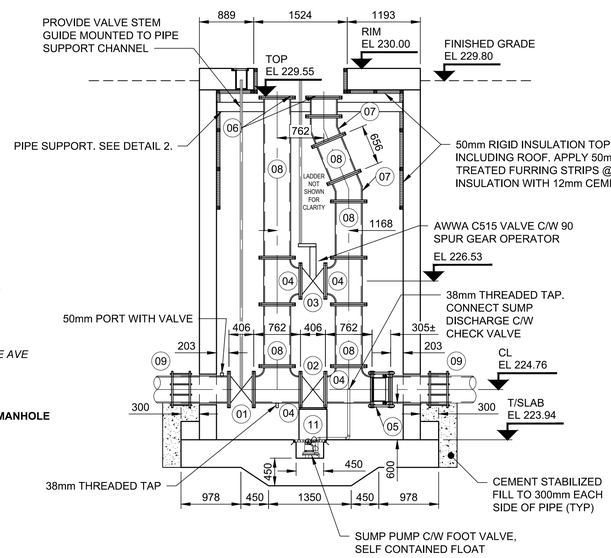
**EXCAVATION AND SHORING NOTES:**

1. EXPOSE SIDES OF PIPELINES BY HYDRO EXCAVATION PRIOR TO INSTALLING PILES
2. PRE BORE PILES TO BELOW INVERT OF PIPELINES
3. MINIMUM OFFSET FROM CLOSEST EDGE OF PILE/SHORING TO PIPELINES IS 300mm
4. SECONDARY EXCAVATION IS PERMITTED ABOVE AQUEDUCT TO WITH 1.0m ABOVE TOP OF PIPE, IF REQUIRED. LATERAL LOADS ON THE AQUEDUCT ARE NOT PERMITTED.



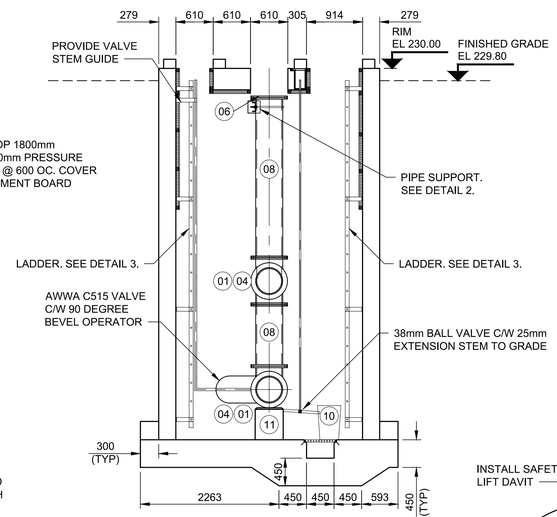

**1 | DETAIL**
1-0660Y-G0001-001 PLAN

0 1250 2500 mm
1:50



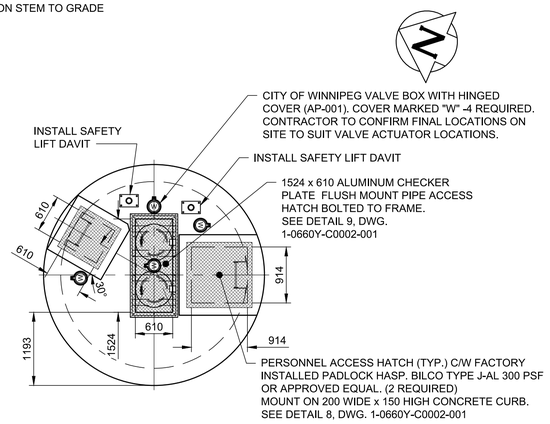

**A | SECTION**

0 1250 2500 mm
1:50




**B | SECTION**

0 1250 2500 mm
1:50




**DETAIL**
ROOF PLAN

0 1250 2500 mm
1:50

## MATERIAL LIST

| | |
|---|---|
| 01 | 400 AWWA C515 VALVE |
| 02 | 400 AWWA C515 VALVE C/W BEVEL GEAR OPERATOR |
| 03 | 400 AWWA C515 VALVE C/W SPUR GEAR OPERATOR |
| 04 | 400x400x400 AWWA C110 CAST IRON TEE (FLxFLxFL) |
| 05 | 400 DISASSEMBLY COUPLER |
| 06 | AWWA C115 BLIND FLANGE CL 150 |
| 07 | 22.5° BEND |
| 08 | SPOOL PIECE (FLxFL LENGTH TO SUIT) |
| 09 | SLEEVE COUPLER (AWWA C219) |
| 10 | AIR GAP MONITOR (SEE DETAIL 4) |
| 11 | VALVE BASE BLOCK (SEE DETAIL 5, DWG. 1-0660Y-S0001-001) |
| 12 | SAFETY LIFT DAVIT (CONTRACTOR TO CONFIRM FINAL LOCATIONS ON SITE) |

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

ENGINEERS GEOSCIENTISTS MANITOBA
Certificate of Authorization
AECOM Canada ULC
No. 4671

**FOR INDEX SEE 1-0660Y-D0002-001**

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE _____ DATE _____

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

CONSTRUCTION COMPLETION DATE: YYYY MM DD

| NO. | REVISIONS | DATE | BY |
|---|---|---|---|
| 0 | ISSUED FOR TENDER | 25/07/09 | ADL |

AECOM

| | | | |
|---|---|---|---|
| DESIGNED BY | TB/MGM | CHECKED BY | |
| DRAWN BY | ADL | APPROVED BY | |
| SCALE: HORIZONTAL | AS NOTED | RELEASED FOR CONSTRUCTION | |
| VERTICAL | N/A | | |
| DATE | 2025 07 09 | DATE | |

PLOT DATE: 2025 07 09

ENGINEER'S SEAL

CONSULTANT DRAWING NUMBER
C-4001

Tender No: 639-2025

Winnipeg

# THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT
ENGINEERING SERVICES DIVISION

TACHE BOOSTER PUMPING STATION
AQUEDUCT DRAIN CHAMBER
SECTIONS & DETAILS

SHEET 04 OF 07

CITY DRAWING NUMBER
1-0660Y-C0001-001

FILE PATH: C:\Users\leippla\AppData\Local\Temp\AcPublish_15572\
FILE NAME: 60668984-SHT-30-TBPS-C-4001_C-4002.dwg