
SUBSURFACE INVESTIGATION REPORT

201 NIPPISSING COURT, OTTAWA, ON, K2T 0N7

Abstract

This report presents the findings of a Subsurface Investigation completed at a portion of the 201 Nippissing Court parcel, in the City of Ottawa, ON, K2T 0N7, shown in figure 1 in page 9 and issue recommendations for a proposed Proposed Place of Worship development. It provides geotechnical information about the subsurface conditions at 11 borehole locations compiled from field sampling and testing. The borehole locations are shown in figure 1 in page 9. It was found that 6 to 6.6 m of overburden soils are underlain by bedrock. The overburden soils consist of compact to dense sandy silt beneath 5 cm or less of surface organic topsoil as the site had been recently stripped. The information reviewed also includes readily available geologic information from the Geological Survey of Canada (GSC) and local climate data from Environment Canada.

YURI MENDEZ M. ENG., P. ENG.



Report number: 93-BAPS-R0¹
July 07, 2026



MENDEZ &
ASSOCIATES
LTD.

SINCE 2013

COMPACTION TESTS, GEOTEC.
ENGINEERING, INSPECTION
OTTAWA, ON.

PO Box 74087
RPO BEECHWOOD
OTTAWA, ON, K1M 2H9

Phone: 613-899-0834
e-mail: yuri@ymendez.ca

¹For the account of Bochasanwasi Shri Akshar Purushottam Swaminarayan Sanstha (BAPS) as per proposal in email dated May 23, 2026..

Report 93-BAPS-R0
This page is intentionally left blank

Contents

1	Introduction	7
I	Investigation	7
2	Sampling and Testing	7
II	Findings	8
3	Physical Settings, Strata and Topography	8
4	Surface and Subsurface Materials	8
	Test Hole Locations Plan	9
4.1	Sandy Silt	10
4.2	Material Properties	10
4.3	Groundwater and Moisture	11
4.4	Freezing Index, Frost Depth and Frost Susceptibility	11
III	Recommendations	11
5	Foundations General	12
5.1	Bearing Capacity of Strip and/or Pad Footings	12
5.2	Retaining Walls	12
5.3	Settlements	13
5.4	Frost Protection for Foundations	13
5.5	Foundation Insulation	13
5.5.1	Creep Deformation of Insulation	13
5.6	Foundation Wall Dampproofing and Drainage	14
6	Rates of Infiltration, Percolation and Permeability	14
7	Site Class for Seismic Design	14
8	Roadbed Soils and Pavement Structure	14
9	Excavations, Open Cuts, Trenches and Safety	15
9.1	Conditions Requiring Engineered Shoring	16
10	Reinstatement of Excavated Soils	16
11	Water Inflow Within Excavations and Water Takings	17
11.1	Use of Clay Seals in Service Trenches	17
11.2	Water Takings and Permits	17

11.3 Impacts to Adjacent Buildings and Infrastructure from Water Takings	18
12 Underground Corrosion	18
13 Potential of Sulphate Attack to Concrete	19
14 Stripping, Excavation to Undisturbed Soils and rock, Earth and Rock Fill Placement. Asphalt Placement and Compaction	19
14.1 Winter Construction	19
Disclaimer	19
15 Limitations	20
User Agreement	20
 IV Appendices	 23
A Borehole Logs	25
B Resistivity, PH and Soluble Salts Test	35
B.1 Resistivity Tests Results	36
C Pavement	37
C.1 Traffic Classes and Pavement Catalog	37
C.2 Frost Heave in Pavements	37
C.3 Frost Protection for Manholes, Catch Basins and Others	39
D Foundation Drainage	41
D.1 Foundation Drainage Components	42
E Construction Recommendations for Stripping, Earth and Rock Excavation to Undisturbed Soils, Earth and Rock Fill Placement, Asphalt Placement and Compaction	43
E.1 Removal of Water	43
E.2 Earth Excavation	43
E.2.1 Suitability of Earth Materials	43
E.2.2 Striping	43
E.2.3 Excavation to Undisturbed Soil Surface	44
E.3 Foundations Placement	44
E.4 Retaining Wall Foundations	44
E.5 Imported Materials	44
E.5.1 Granular Earthfill Placement	44
E.5.1.1 Moisture for Granular Earthfill	44

E.5.1.2	Compacted Lifts Thicknesses Equipment and Passes for Granular Eathfill	44
E.5.2	Compaction Guide for Passes and Level of Compaction . .	45
E.6	Compaction General	45
E.7	Compaction Specific	45
E.7.1	Compaction Along Basement Walls, Retaining Walls and Structures	45
E.7.2	Self Compacting Materials	47
E.7.3	Settlement Allowance and Overfill	47
E.7.4	Compaction Quality Control	47
E.8	Asphalt Pavement	47
E.8.1	Surface Preparation for Asphalt Pavement	47
E.8.2	Proof Rolling Prior to Asphalt Pavement	47
E.8.3	Asphalt compaction	48

Report 93-BAPS-R0
This page is intentionally left blank

1 Introduction

This document reports the findings of subsurface investigation 93-BAPS-R0 completed at 201 Nippissing Court, in the City of Ottawa, ON for the purpose of development of a Proposed Place of Worship having extents and geometry shown in figure 1 in page 9.

The investigation was carried out by advancing 11 boreholes through overburden soils using available exploration techniques for engineering purposes. The information reviewed also includes readily available geologic information from the Geological Survey of Canada (GSC).

Key information about the subsurface conditions across the proposed development area is presented and includes design and construction recommendations and also the physical and mechanical properties of the geotechnical material encountered.

The site was found to be underlain by a sandy silt deposit. The overburden soils are approximately 6 to 6.6 m in thickness.

Part I Investigation

2 Sampling and Testing

The field and laboratory program set out in our proposal is guided by the following standards:

- ASTM D 420-98 Standard Guide to Site Characterization for Engineering Design and Construction Purposes,
- ASTM D5434 - 12 Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock,
- ASTM D1586 - 11 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils,
 - The ASTM D1586 tests were completed using an “auto safety” hammer rated at 80% energy.
- ASTM D1586 - 11 based Dynamic Cone Penetration Test (DCPT),
- AASHTO T 11 Materials Finer Than No. 200 (75um) Sieve in Mineral Aggregates by Washing,
 - Caution is applied in the interpretation of these tests due to deficiencies in sampling using SPT sampler. The sample is disturbed from sampling and the water in the sampler drops out of the sampler when the extraction is below the water table. Thus, some sample material

is flushed out and the more likely material to be lost in this process is the finer portion.

- ASTM C-136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates,
 - Caution is applied in the interpretation of these tests due to deficiencies in sampling using SPT sampler. The sample is disturbed from sampling and the water in the sampler drops out of the sampler when the extraction is below the water table. Thus, some sample material is flushed out and the more likely material to be lost in this process is the finer portion.

The field program consisted in sampling the subsurface profile using boreholes located as shown in fig. 1 in page 9 along with field review, assessments and classification of samples.

The elevation of the boreholes were estimated based on their location within available survey plans showing elevations and are shown in the Test Hole Locations Plan in fig. 1 in page 9. The program included in addition a laboratory review of samples recovered from the field and one sample submitted to a local laboratory to investigate soluble ions concentration, PH and resistivity to estimate rates of corrosion.

The soil sampling and field testing at each location are shown in the soil profile testing and sampling logs (BH) in the appendices.

Part II

Findings

3 Physical Settings, Strata and Topography

The site consist of the nearly flat, recently stripped of topsoil 201 Nippissing Court parcel within a block surrounded by streets in the City of Ottawa, ON. Figure 1 in page 9 shows a plan view of the site displaying the approximate borehole locations and depth.

The geology data base by Belanger J. R. 1998 suggests 10 to 15 m m of overburden soils underlain by interbedded limestone and shale bedrock at this site.

4 Surface and Subsurface Materials

The site surface had been recently stripped of topsoil. The arrangement of strata found in our investigation is shown in the borehole logs in appendix A.

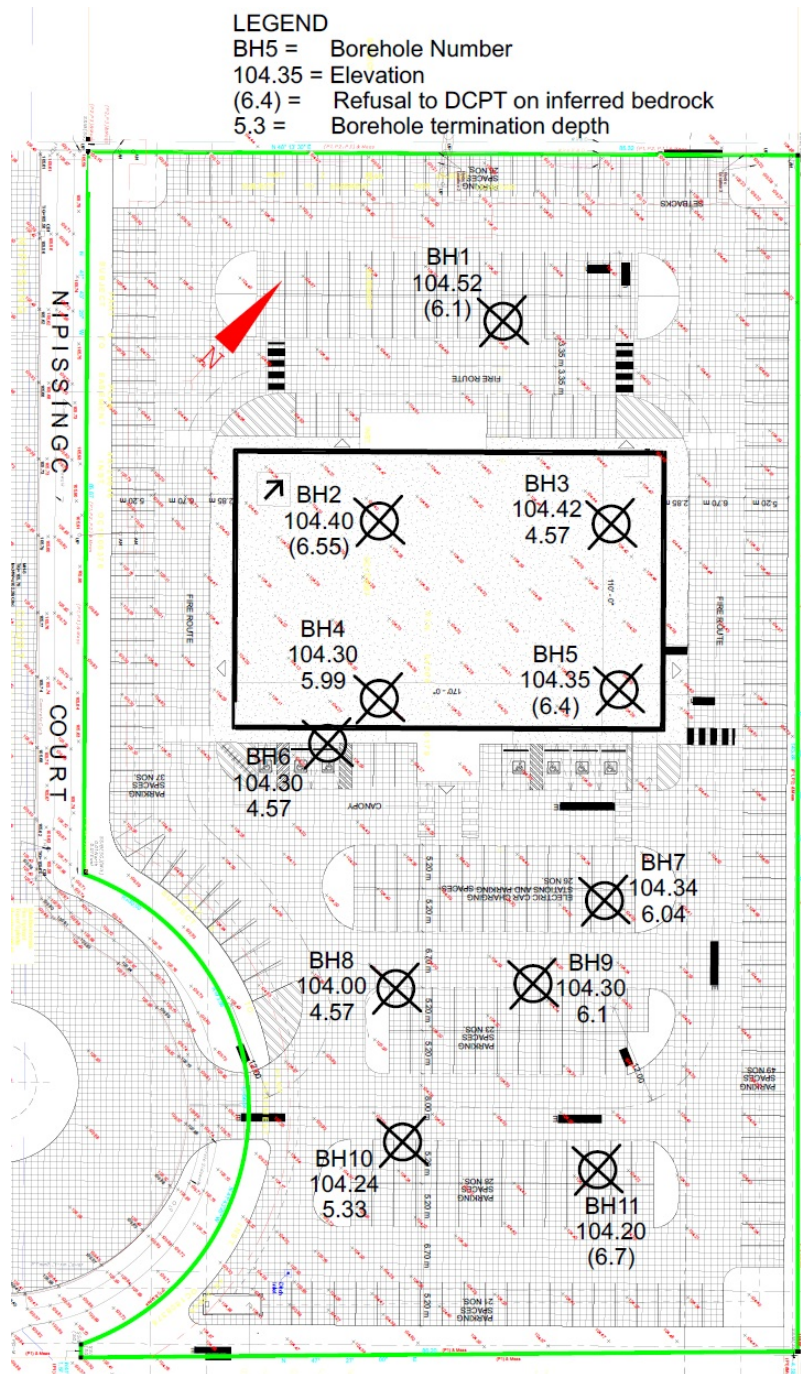


Figure 1: Test hole Locations Plan

It can be seen in the borehole logs that at boreholes 1, 2, 5 and 11, bedrock is inferred from DCPT or sampler refusal at approximately 6 m depth. Throughout the depth profile at all borehole locations dense sandy silt was found in all boreholes. The site is covered with less than 0.05 cm of topsoil.

4.1 Sandy Silt

Gradation testing indicates that the silt encountered has 54, 58 and 20% content of sand finer than 0.18 mm in samples BH6 SS2, BH8 SS4 and BH2 SS5, respectively.

Sandy silt is very susceptible to caving onto excavations exceeding the high water table encountered at this site. Refer to the excavation/open-cut section for guidance. Recent observations at properties located to the northeast of this site strongly suggest that problems of cave-ins will not be present for excavations as deep as 3 meters. During the construction of the development, water inflow was not observed for excavations up to 3 m depth.

Water retention in sandy silt is high and thus frost susceptible. Due to the high water retention a significant degree of cohesion (or suction) can be considered for open excavation cuts *only* above the water table or where water has been drained.

4.2 Material Properties

The material properties in table 1 in page 10 can be considered for the materials found at this site:

Material		Density kg/m ³	Friction Angle	Cohesion kPa	Und. St. kPa/ mPa)	Shear UCS
Sandy Silt		2,000	34		N/A	
Granular Type 2	B	2,200	40			
Granular Type 1	B	2,000	34			
Granular A		2,100	38			

Table 1: Material Properties

Refer to the borehole logs in appendix A for specific details at each location.

Sandy silt and/or sand with high silt content is not susceptible to liquefaction.

4.3 Groundwater and Moisture

Assessments completed during field sampling and testing indicate very shallow water conditions at all borehole locations. These assessments suggest a 1.8 m depth to the water table.

The water level was measured at BHs 5 and 11 at 1.9 and 1.8 m depth respectively during our June 29, 2026 measurement.

Company experience in this area strongly suggests that during construction development, the water table will be found at depths greater than 2.5 m. Moisture contents vary above the ground water table. Water retention is relatively high for the sandy silt materials encountered at this site.

4.4 Freezing Index, Frost Depth and Frost Susceptibility

It is generally assumed that the frost depth for the 1,000 degree Celsius-days freezing index applicable to Ottawa will reach no deeper than 1.8 m on bare ground (snow free) or pavement. It is also assumed that frost depth will reach no deeper than 1.5 m on snow covered ground.

The soil materials encountered at this site are frost susceptible and thus will heave upon exposure to freezing temperatures. Heaving destroys the mechanical properties of soils so that any soil which has been frozen is considered disturbed.

Part III

Recommendations

The following set of the recommendations result from sampling and testing outlined in section 2 and from geotechnical engineering evaluation and assessments.

Based on the investigation findings and company experience in this area, the presence of cave-susceptible sandy silt poses significant challenges for any excavation or any construction exceeding 2.5 to 3 m depth. M & A recommends implementation of dewatering using well points along the perimeter of any excavation exceeding 3 m in depth. Well points are simple wells that are placed along lines following the outside perimeter of proposed excavations to form a barrier. Along the line of wells the water table is lowered to allow excavation. Spacing of wells is approximately 1.2 to 2 m. Wells can be easily installed by lowering casing via water jets or using drilling equipment.

Implementation of basements at depths greater than 2.2 from the existing grades is discouraged at this site. Because a basement would be under the water table, the basement would have to be waterproof. A waterproof basement at this site will face the following unfavourable, costly and potentially destructive conditions:

- Waterproofing also involves the structural requirements that the water uplift pressure would have to be withstood throughout the basement slab.

If a basement is 1 m under the water table, the uplift is 10 kPa, as an example.

- Where the above requirement is met, an accidental breach of the waterproofing barrier can cause serious foundation damage as the materials will cave in along with any water rushing into a breach.
- A completely waterproof basement on soils can be very expensive and very difficult to implement.

Buildings with foundation drainage as deep as 2.2 m can also be implemented if low impact development measures do not limit de-watering at this depth.

Shallow spread footings for a building of slab on grade construction can be considered at this site.

5 Foundations General

Generally speaking, code compliant Part 9 and Part 4 commercial buildings proposed at this site can be founded on shallow foundations using the bearing capacities for spread footings provided below.

5.1 Bearing Capacity of Strip and/or Pad Footings

Based on the findings of this investigation and geotechnical assessments, the following bearing capacity can be used *for strip footings up to 1 m wide and pad footings up to 2 m wide placed on undisturbed dense sandy silt soils and/or engineered fill placed on undisturbed dense fine sand soils encountered in the testholes.:*

- 150 kPa at service limit (SLS).
- 225 kPa for factored loads (ULS).

5.2 Retaining Walls

The following can be considered for the design of retaining walls:

- Generally in Ottawa, a horizontal PGA of 0.2 is used for seismic design of free-standing retaining walls;
- generally the at-rest factor of 0.5 is used for nonyielding walls such as basements;
- the Mononobe Okabe method is often used for seismic design;
- YME recommends that foundations for retaining walls be placed on a 15 cm compacted granular B-type 2 or similar crushed granular fill placed at USF on undisturbed soils. This is due to low friction for footings placed directly on native soils;

- Where the above recommendation is applied, 0.55 friction δ can be used at this site. Otherwise, use $\delta = 0.35$
- use $\delta = 0.4$ for granular fill on formed concrete;
- if the angle of native soils cut behind a retaining wall slopes at 45 degrees or more use $\phi = 30$. If it is less than 45 use $\phi = 38$ for clean granular fill.
- use 20 kN/m^3 unit weight for soils and 22 kN/m^3 for granular fill.
- ensure proper foundation drainage via available means such as crushed stone, drainage pipes, weep holes, etc.
- compaction within 0.9 m of a retaining wall is very light with light equipment;
- additional recommendations in section 14 are applicable.

5.3 Settlements

For the footing loads provided in section 5.1 building settlements for foundations on undisturbed sandy silt are not to exceed service limit values (SLS) of 25 mm and 20 mm total and differential settlements respectively at this site.

5.4 Frost Protection for Foundations

Shallow foundations on frost susceptible soils which may be required on the perimeter of the building for canopies or other structures are considered to be frost protected when placed at sufficient depth to prevent supporting soils from freezing. Foundations in the perimeter of heated buildings where snow is not cleared are considered frost protected at 1.5 m depth (as having a soil cover of 1.5 m). Foundations away from heated buildings or in areas where snow is cleared, need to be at about 1.8 m depth to be frost protected. On the alternative frost protection can be provided by using foundation insulation for shallower foundations.

5.5 Foundation Insulation

To meet the required frost protection in section 5.4 for foundations for canopies or other structures in the perimeter of the building and in unheated areas in otherwise heated buildings 50 mm of extruded polystyrene insulation (XPS) type V, VI or VII meet foundation insulation requirements for the freezing index in the Ottawa area.

5.5.1 Creep Deformation of Insulation

Service loads on foundation insulation must be kept at no more than 1/3 of its rated capacity. Creep deformations occur on insulation at loads exceeding 1/3 of its rated capacity. The rated capacity is at 10 % strains.

5.6 Foundation Wall Dampproofing and Drainage

Foundation walls dampproofing and foundation drainage are not required for foundations serving buildings of slab-on-grade construction not having floor levels lower than the finished grade on the perimeter for the conditions encountered at this site.

Elevator pits deeper than the exterior grade of buildings do require foundation drainage.

Appendix D.1 presents page 2 of NRC Construction Evaluation Reports CCMC 12658-R showing dampproofing and foundation wall drainage system details satisfying the provisions under OBC 2012 and suitable for the conditions found at this site. Other available similar systems having the components shown in CCMC 12658-R may be used. Foundation drainage must be provided to daylight or a positive outlet, or sump.

6 Rates of Infiltration, Percolation and Permeability

Values of permeability, infiltration and percolation which could be associated² to the sandy silt encountered at this site are the following:

- Permeability of 1×10^{-4} cms/sec
- Percolation of 12 min/cm
- Infiltration of 15 cm/hr

7 Site Class for Seismic Design

At this site, the geotechnical testing completed along with the estimated soil properties via Dynamic Cone Penetration (DCPT) conducted in all boreholes are indicative of a $V_s(30)$ exceeding 360 m/s. As such, site class C is assigned under the provisions in section 4.1.8.4 of the Ontario Building Code 2012 (OBC 2012) for seismic design.

8 Roadbed Soils and Pavement Structure

The flexible pavement structures supplied in this report follow the guidelines set out in AASHTO 1993 Guide for Design of Pavement Structures (AASHTO) for climatic Region III. Under AASHTO pavements are designed to withstand 20 year accumulated design Equivalent Single Axle 80 kN (18,000 pounds) load applications (ESALs). ESALs are a measure of mix traffic loads including vehicle

²MMAH Supplementary Standard SB-6 and approximate relationship between the permeability and infiltration rate

loads and truck loads. The number of ESALs applications depend on traffic class and use.

Roadbed denotes the materials beneath pavement structures. The term pavement is used to denote the layered structure that forms a road carriage-way or vehicle parking. *The general quality of the near surface undisturbed soil to serve as foundation for pavement structure (Roadbed soil) at this site are assumed to be very poor* as defined in the AASHTO guide. It is hence recommended to refer to the following information in appendix C:

- *M&A's pavement catalog in appendix C.1 to select pavement structures* for traffic classes on the very poor roadbed soils encountered at this site.
- Appendix C.2 for guidelines regarding frost heave.
- Appendix C.3 for frost protection recommendations for manholes and catch basin construction.

9 Excavations, Open Cuts, Trenches and Safety

Typically, the main concern when excavating soils or rock is the stability of the sides of excavations. The stability of the sides is achieved by either cutting the sides to safe slopes or by providing shoring. It is also an issue of safety because of imminent hazards to the safety of workers and to property. As such, excavations are governed by the provisions in the Occupational Health and Safety Act of Ontario (O. Reg. 213/91). The application of O. Reg. 213/91 requires a classification of soils in one or several of four types (type I to type IV).

At this site, due to the presence of caving sandy silt and the high water table, soil type IV applies for excavations deeper than the water table encountered at construction time. Company experience suggests that at construction time the water table elevation may be as deep as 2.5 m. Soil type 2 is applicable for excavations shallower than the water table at construction time. Pumping from open sumps does not remedy the caving of soils. The following thus stems from this limitation:

At this site for all excavations to a 2.5 m depth and for all excavations for which the water table has been lowered to an elevation lower than the bottom of the excavation via well points, soils can be considered type II under O. Reg. 213/91 and type IV for excavations deeper than 2.5 m depth *and* for which well points de-watering has not been implemented. As such, the following key aspects of O. Reg. 213/91 are applicable to this site:

1. For excavations in soil type II:
 - Safe open cut is 1 vertical to 1 horizontal.
 - Within 1.2 m of the bottom of open cut areas or trenches, the soil can be cut vertical.
2. For excavations in soil type IV:

- implement well points de-watering along the perimeter of excavations to apply the provisions for soil type II.
3. Where the safe open cut in item 1 and/or 2 are not provided, either the shoring systems described in O. Reg. 213/91 or engineered shoring systems need be used.

Information regarding physical and mechanical properties of subsurface materials which will be required for shoring design are provided in this report.

9.1 Conditions Requiring Engineered Shoring

It is to be understood that at this site, if shoring is used for deep excavations, it is to be used in conjunction with proper de-watering as described in the previous section.

O. Reg. 213/91 describe the conditions in which engineered shoring systems are required. Some key aspects of O.Reg. 213/91 regarding the conditions in which an engineered shoring system is required are:

- Where soils are type I to III and the prescribed safe open cuts are not provided and
 - The excavation is not a trench or
 - The excavation is a trench either deeper than 6 m or wider than 3.6 m or both
- For trench excavations or open cut, where soils are type IV and the safe open cuts are not provided.

Note that along with the descriptions in O. Reg. 213/91 for soils type IV, any difficult soil having significant seepage and/or strength loss upon excavation such as caving soils can be rendered as type IV.

Note also that since excavation and safety are usually in control of the contractor, *shoring design and construction is done by the contractor.*

10 Reinstatement of Excavated Soils

As stated in appendix E the suitability of material for specific purposes is determined by the geotechnical engineer. To the extent they are needed, suitable material from the excavations can be used in the construction of required permanent earthfill or rockfill.

Excavated sandy silt soils may be used to build up the subgrade under parking and pavement *only if* closely supervised by a geotechnical engineer. Otherwise soils must be hauled out or could *only be used for landscaping areas where no structures or pavement will be built.*

11 Water Inflow Within Excavations and Water Takings

Water inflow within excavations in soils is influenced by the depth of excavations relative to the water table and flow behavior of water in soils as controlled by the permeability of soils. Section 6 provides estimated values of permeability, infiltration, and percolation which can be used for calculations in connection with water behavior at this site.

In view of the assessments under section 4.3, the company's experience in this area and information seen in the borehole logs, water inflow in excavations is expected to be significant at depths greater than 2.5 m. In addition, sandy silt encountered at this site is susceptible to caving.

Refer to the excavations/open-cut section 9 for guidance for excavation on difficult soils. Pumping from open sumps does not prevent the caving of soils into excavations. In general, section 9 recommends to use well points dewatering at depths greater than 2.5 m and apply the provisions for type 2 soils.

11.1 Use of Clay Seals in Service Trenches

In order to prevent long term de-watering through service trenches, clay seals are recommended. The City of Ottawa detail "Clay seal for Pipe Trenches" S8 can be used at each 100 m interval within service trenches. The moisture content for compaction of clay is generally less than 22%. Clay placement can be with several passes of jumping jack type equipment or sheep-foot rollers. Proctor dry density percent can be approximately 95% of its Proctor Standard Density.

11.2 Water Takings and Permits

Water takings from the environment, including groundwater in excavations, are regulated under Ontario Water Resources Act, R.S.O. 1990, c. O.40. (OWRA). The OWRA is enforced by the Ministry of Environment (MOE). Under the OWRA, a Permit to Take Water (PTTW) is required for pumping from excavations exceeding 400 cubic meters per day. Along with the consideration of ground water from excavations, PTTW applications require in addition the consideration of precipitation.

Where construction phase ground and surface water is estimated to be between 50,000 to 400,000 L/day, it is a requirement to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

Section 6 provides estimates of infiltration, permeability, and percolation rates which could be used in the context of the EASR registry and/or the PTTW.

Based on estimates a registration under the EASR for volumes between 50,000 to 400,000 L/day will be required. In addition, it is recommended to reduce groundwater takings by phasing construction in sections.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

11.3 Impacts to Adjacent Buildings and Infrastructure from Water Takings

Water takings induce water table draw-down.

Water table draw-down can impact neighboring buildings and infrastructure in particularly sensitive soil conditions. Soil conditions that can be considered sensitive are lightly overconsolidated clays and very loose soils. The soils encountered at this site are not considered sensitive.

Development induce short term draw-down during construction and long term via service trenches and foundation drainage.

Because the soil conditions at this site are not considered sensitive, short term negative impacts for neighboring buildings are not foreseeable at this time, however, to reduce long-term water table draw-down which may affect the area on a larger scale, are expected to be minimal because the water table will not be drawn down by foundation drainage and because service trenches are to have clay seals to reduce ground water lowering. Long term impacts in the greater scale are also reduced via the implementation of an infiltration gallery.

12 Underground Corrosion

For the resistivity, PH and soluble ions concentrations found at this site and shown in the Paracel Laboratories certificate of analysis in appendix B.1, the soils are non corrosive. Resistivity, PH and soluble ions testing was completed in a representative sample at 1.8 m depth in BH1. After Romanoff (1957)³, the following corrosion rates can be used:

1. For carbon steel:
 - 11 $\mu\text{m}/\text{year}$ for the first 2 years,
 - 8 $\mu\text{m}/\text{year}$, thereafter.
2. For galvanized metal:
 - 3.6 $\mu\text{m}/\text{year}$ for the first 2 years,

³Romanoff's work for the U. S. National Bureau of Standards is authoritative in underground corrosion

- 2.25 $\mu\text{m}/\text{year}$ until depletion of zinc,
- 8 $\mu\text{m}/\text{year}$ for carbon steel.

13 Potential of Sulphate Attack to Concrete

For the sulphate content less than 0.1% in soil encountered at this site, there are no restrictions to the cement type which can be used for underground structures. This refers to restrictions associated with sulphate attack only.

14 Stripping, Excavation to Undisturbed Soils and rock, Earth and Rock Fill Placement. Asphalt Placement and Compaction

Appendix E presents recommended geotechnical specifications and guidelines for stripping, earth and rock excavation to undisturbed surfaces, earth and rock fill placement, asphalt placement, compacted lifts thicknesses for equipment type and compaction for different placements.

14.1 Winter Construction

Winter construction is not recommended. Many construction practices are inadequate to provide protection for all the details and geometries which could allow exposure of frost susceptible soils to freezing temperatures rendering them disturbed.

In situations where M&A is required for guidance and inspections during winter, M&A will provide its best approach with the resources available for protections during construction in real time and its expected that the contractors will act in real time to provide the protections. M&A has insufficient control of the contractor operations and and/or the construction tasks and/or the method of protection to provide any warranties in those situations. Irresponsive contractors add great potential to induce damage.

Disclaimer

Bochasanwasi Shri Akshar Purushottam Swaminarayan Sanstha BAPS and other professionals understand that soils and groundwater information in this report has been collected in boreholes guided by standards and practice guidelines generally accepted for engineering characterization of ground conditions in Ontario and in no case borehole data and their interpretation warrant understanding of conditions away from the borehole locations. BAPS accepts that as development will have spread away from the boreholes other designers will need the best opinion from the geotechnical consultant based on the findings

of the investigation so that any statements which could be implicitly or explicitly depart from the conditions at borehole may be given to fulfill this need in good faith as best available opinion with the information available at the time without any warranties.

15 Limitations

This report was prepared by M & A Ltd. for the account of Bochasanwasi Shri Akshar Purushottam Swaminarayan Sanstha (BAPS), for review by its designated consultants, financial institutions, and government agencies.

The content of the report reflects the judgment of Yuri Mendez P.Eng., in light of the information available to him at the time of preparation.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering.

Geotechnical reports are written before or during the early stages of the design period, and they may contain several alternative treatments to address site conditions as reasonably foreseeable at the time of writing. The reports may also contain recommendations presented for consideration by developers, designers and managers. As such, recommendations presented in geotechnical reports may or may not be incorporated into the final project design. The reports may also have been prepared prior to revisions to the project size and/or scope, so they may not reflect changes to the project.

User Agreement

Acknowledgment of Duties

In this 93-BAPS-R0 report, Mendez & Associates Ltd. (M&A) has pursued to fulfill every aspect of the obligations of professional engineers. As a part of those duties, from field work, operations, testing, analyses, application of knowledge and report, M&A has ensured that it meets a high standard of Geotechnical engineering practice and care in the province of Ontario. Obligations under R.R.O. 1990, Reg. 941: Professional Engineers Act, R.S.O. 1990, c. P.28, further referred to as Reg. 941 which are of immediate interest to this service are:

- “77. 7. A practitioner shall,
- i. act towards other practitioners with courtesy and good faith,
 - ii. not accept an engagement to review the work of another practitioner for the same employer except with the knowledge of the other practitioner or except where the connection of the other practitioner with the work has been terminated,
 - iii. not maliciously injure the reputation or business of another practitioner,
8. A practitioner shall maintain the honour and integrity of the practitioner’s profession and without fear or favour expose before the proper tribunals unprofessional, dishonest or unethical conduct by any other practitioner.”

Communications

93-BAPS-R0 is to be used solely in connection with the Proposed Place of Worship by Bochasanwasi Shri Akshar Purushottam Swaminarayan Sanstha (BAPS) and thus subject of communications amongst other professionals (OP), government bodies and authorities, and BAPS for that purpose. M&A demands great care in precluding damage to the integrity

of this professional work which may arise from careless communications from engineers of Canada. OP and BAPS acknowledge understanding that where any such communication occur in connection with this report, they are bound by this agreement as an extension to the standard of care embodied in R.R.O. 1990, Reg. 941 and thus accept that any correspondence from OP or the public seen to add any bad connotations to the breadth, depth, typesetting, typography, formal semantics and scope of this report or otherwise diminish the breadth of services and knowledge delivered in this report which in any way raise concerns or insecurities to the qualities and/or the *reasonable completeness* delivered to BAPS in this report will be forwarded to M&A.

Reasonable Completeness

Within the limitation of budget OP and Bochasanwasi Shri Akshar Purushottam Swaminarayan Sanstha acknowledge understanding that said care and said standard has been applied equality to the reasonable completeness of this report relative to the information available from the field program and acknowledge understanding that is neither feasible nor possible to convey geotechnical information in this report that would cover for every possible consideration by OP and/or BAPS and that upon issuance it will be subject to reviews which may trigger the need to add information which at the discretion of M&A will be added when considered within the practice obligations under Reg. 941. The geotechnical information here provided is thus envisioned as to cover for the scope and breadth of design figures and assessments generally foreseeable as needed by other designers at the time of issuance and which could be amended as needed within the context of services provided by other designers. M&A agrees to issue revised versions of this 93-BAPS-R0 report by adding R# to each revision where # is the number of the revision. OP covenant to conduct all communications in connection with these reviews following great care to preclude the suggestion of a breach to the reasonable completeness acknowledged herein. Written communications which may trigger reviews under this agreement will be acknowledged as requests for “review under the 93-BAPS-R0 report user agreement”. This reasonable completeness is also relative to the scope of services generally accepted in geotechnical engineering work in Ontario

Errors

Where errors are found during reviews under the 93-BAPS-R0 report user agreement, OP covenant great care in communications to preclude the suggestion of a breach to the duties acknowledge herein which could induce damages to M&A. Communications triggered by errors or any such communication which would render the person doing the request in a position of technical authority above the author implies an unauthorized review and constitute a serious breach of the code of ethics under Reg. 941 and damages to M&A and so subject to disciplinary measures and/or liability for damages to M&A. BAPS is thus acquainted that correction of errors will be made and acknowledged by M&A as they may arise in any professional work but in no way OP will purport or render such corrections as omissions departing away from the correction of errors set forth in this agreement. Where communications in connection with the correction of errors process set forth in this agreement raise concerns or insecurities to the qualities and/or the reasonable completeness delivered to BAPS in this report occur, BAPS covenants to inform M&A. BAPS is acquainted that such corrections are part of the natural processes associated with the applied sciences nature of this report and so typified explicitly in this agreement to protect M&A from inappropriate manipulation of those processes by OP and others.

Disclaimer

BAPS and OP understand that soils and groundwater information in this report has been collected in boreholes guided by standards and practice guidelines generally accepted for engineering characterization of ground conditions in Ontario and in no case borehole data and their interpretation warrant understanding of conditions away from the borehole locations.

BAPS accepts that as development will have spread away from the boreholes other designers will need the best opinion from the geotechnical consultant based on the findings of the investigation so that any statements which could be implicitly or explicitly depart from the conditions at borehole may be given to fulfill this need in good faith as best available opinion with the information available at the time without any warranties.

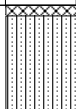
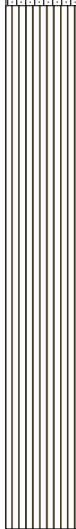
Part IV

Appendices

A Borehole Logs

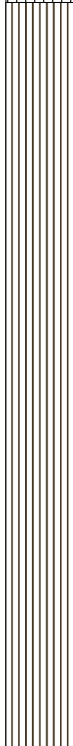
Report 93-BAPS-R0
This page is intentionally left blank

Project:		Proposed Place of Worship						M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH1 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	M&A MELENZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values Blows/Ft			Shear Strength (kPa)		Laboratory Tests		
								25	50	75	48	68	Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.52															
104.4	0	<													

Project:		Proposed Place of Worship						M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH2 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	 MENDEZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values Blows/Ft			Shear Strength (kPa)		Laboratory Tests		
								25	50	75	48	68	Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.4															
104.1	0		Top soil Brown, loose to compact, sandy, SILT.		SS 1	10									
	0.25														
	0.5														
103.6	0.75														
	1														
103.1	1.25														
	1.5														
102.6	1.75														
	2														
102.1	2.25														
	2.5														
101.6	2.75														
	3														
101.1	3.25														
	3.5														
100.6	3.75														
	4														
100.1	4.25		DCPT testing in inferred sandy silt		SS 6	13									
	4.5														
99.6	4.75														
	5														
99.1	5.25														
	5.5														
98.6	5.75														
	6														
98.1	6.25														
	6.5														
Borehole terminated on inferred bedrock															
S = Sample for lab review and moisture content															
 Water Elevation Interpreted															

Project:				Proposed Place of Worship				M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH3 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	M&A MELENZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values			Shear Strength (kPa)		Laboratory Tests		
								Blows/Ft 25 50 75			48 68		Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.42															
	0			Top soil											
104.1	0.25			Brown, loose to compact, sandy, SILT.		SS 1	8								
	0.5														
103.6	0.75														
	1					SS 2	11								
103.1	1.25														
	1.5														
102.6	1.75					SS 3	8								
	2			Gray, loose to compact, sandy, silt											
102.1	2.25														
	2.5					SS 4	7								
101.6	2.75														
	3														
101.1	3.25					SS 5	9								
	3.5														
100.6	3.75														
	4					SS 6	6								
100.1	4.25														
	4.5														
Borehole terminated on sandy silt.															
</															

Project:		Proposed Place of Worship						M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH4 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	 MENDEZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values Blows/Ft			Shear Strength (kPa)		Laboratory Tests		
								25	50	75	48	68	Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.3															
	0			Top soil											
104	0.25			Brown, loose to compact, sandy, SILT.		G1									
	0.5														
103.5	0.75														
	1														
	1.25					SS 2	20								
103	1.5			Gray, loose to compact, sandy, silt											
	1.75														
102.5	2					SS 3	19								
	2.25														
102	2.5														
	2.75					SS 4	16								
101.5	3			DCPT testing in inferred sandy silt			4								
	3.25						24								
101	3.5						17								
	3.75						20								
100.5	4						37								
	4.25						34								
100	4.5						42								
	4.75						26								
99.5	5						27								
	5.25						39								
99	5.5						66								
	5.75														
98.5															
Borehole terminated on inferred sandy silt.															
S = Sample for lab review and moisture content															
Water Elevation Interpreted															

Project:			Proposed Place of Worship					M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct			Client: BAPS					Test Hole No.: BH5 of 11							
Job No.: 93-BAPS			Test Hole Type: 8 1/4" OD					Date: 6/8/2026							
8 and 1/4" OD			SPT Hammer Type: Safety auto hammer					Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	 MENDEZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values			Shear Strength (kPa)		Laboratory Tests		
								Blows/Ft 25 50 75			48 68		Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.35															
	0			Top soil		SS 1	7								
104.1	0.25			Brown, loose to compact, sandy, SILT.											
	0.5														
103.6	0.75														
	1			Gray, loose to compact, sandy, silt		SS 2	11								
103.1	1.25														
	1.5														
102.6	1.75														
	2			DCPT testing in inferred sandy silt		SS 3	7								
	2														
102.1	2.25														
	2.5														
101.6	2.75					SS 4	7								
	3														
101.1	3.25														
	3.5														
100.6	3.75														
	4														
100.1	4.25														
	4.5														
	4.75														
99.6	5														
	5.25														
99.1	5.5														
	5.75														
98.6	6														
	6.25														
98.1															
Borehole terminated on inferred bedrock															
S = Sample for lab review and moisture content															
 Water Elevation Interpreted															

Project:				Proposed Place of Worship						M&A Mendez & Associates Ltd.					
Location:201 Nipissing Ct				Client:BAPS						Test Hole No.: BH6 of 11					
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD						Date: 6/8/2026					
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer						Logged By: Yuri Mendez					
Elevation (m)	Depth (m)	Lithology and color	M&A MELENZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values Blows/Ft			Shear Strength (kPa)		Laboratory Tests		
								25	50	75	48	68	Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.3															
104.1	0	XXXXXX		Top soil											
	0.25			Brown, loose to compact, sandy, SILT.		SS 1	10								
	0.5														
103.6	0.75														
	1					SS 2	26								
103.1	1.25														
	1.5														
102.6	1.75			Gray, loose to compact, sandy, silt	▼	SS 3	19								
	2														
102.1	2.25														
	2.5					SS 4	16								
101.6	2.75														
	3														
101.1	3.25					SS 5	19								
	3.5														
100.6	3.75														
	4					SS 6	45								
100.1	4.25														
	4.5														
				Borehole terminated on sandy silt.											
S = Sample for lab review and moisture content															▼ Water Elevation Interpreted

Project:		Proposed Place of Worship					M&A Mendez & Associates Ltd.								
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH7 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	M&A MELENDEZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values			Shear Strength (kPa)		Laboratory Tests		
								Blows/Ft 25 50 75			48 68		Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.34															
	0			Top soil											
104	0.25			Brown, loose to compact, sandy, SILT.		G1									
	0.5														
103.5	0.75														
	1														
	1.25														
103	1.5														
	1.75			Gray, loose to compact, sandy, silt											
102.5	2					SS 2	9								
	2.25														
102	2.5														
	2.75					SS 3	8								
101.5	3			DCPT testing in inferred sandy silt											
	3.25						8								
101	3.5						8								
	3.75						7								
100.5	4						14								
	4.25						10								
100	4.5														
	4.75						17								
99.5	5						6								
	5.25						5								
99	5.5						6								
	5.75														
98.5	6						5								
				Borehole terminated on inferred sandy silt.											
S = Sample for lab review and moisture content															
▼ Water Elevation Interpreted															

Project:				Proposed Place of Worship				M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH8 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	M&A MELENDEZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values			Shear Strength (kPa)		Laboratory Tests		
								Blows/Ft 25 50 75			48 68		Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104															
	0			Top soil											
103.7	0.25			Brown, loose to compact, sandy, SILT.		SS 1	5								
	0.5														
103.2	0.75														
	1					SS 2	4								
102.7	1.25			Gray, loose to compact, sandy, silt											
	1.5				▼										
102.2	1.75					SS 3	4								
	2														
101.7	2.25														
	2.5					SS 4	1								
101.2	2.75														
	3														
100.7	3.25					SS 5	1								
	3.5														
100.2	3.75														
	4					SS 6	1								
99.7	4.25														
	4.5														
Borehole terminated on sandy silt.															

Project:		Proposed Place of Worship					M&A Mendez & Associates Ltd.								
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH9 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	M&A MELENZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values			Shear Strength (kPa)		Laboratory Tests		
								Blows/Ft 25 50 75			48 68		Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.3															
	0			Top soil											
104	0.25			Brown, loose to compact, sandy, SILT.											
	0.5														
103.5	0.75														
	1														
103	1.25														
	1.5														
102.5	1.75			Gray, loose to compact, sandy, silt			3								
	2			DCPT testing in inferred sandy silt			3								
102	2.25						10								
	2.5						10								
101.5	2.75						8								
	3						4								
101	3.25						3								
	3.5						9								
100.5	3.75						14								
	4						10								
100	4.25						5								
	4.5						8								
99.5	4.75						12								
	5						27								
99	5.25						36								
	5.5														
98.5	5.75														
	6														
				Borehole terminated on inferred sandy silt.											
S = Sample for lab review and moisture content															
Water Elevation Interpreted															

Project:				Proposed Place of Worship				M&A Mendez & Associates Ltd.							
Location: 201 Nipissing Ct				Client: BAPS				Test Hole No.: BH10 of 11							
Job No.: 93-BAPS				Test Hole Type: 8 1/4" OD				Date: 6/8/2026							
8 and 1/4" OD				SPT Hammer Type: Safety auto hammer				Logged By: Yuri Mendez							
Elevation (m)	Depth (m)	Lithology and color	M&A MELENZ & ASSOCIATES LTD. SINCE 2013	Material Description	Water elevation measurement	Symbols	Samples or Blows/Ft	SPT N-Values			Shear Strength (kPa)		Laboratory Tests		
								Blows/Ft 25 50 75			48 68		Moisture Content (%)	Rock Quality RQD %	Other Lab Tests
104.24															
	0			Top soil											
	0.25			Brown, loose to compact, sandy, SILT.		SS 1	14								
103.8	0.5														
	0.75														
103.3	1					SS 2	9								
	1.25			Gray, loose to compact, sandy, silt											
102.8	1.5														
	1.75					SS 3	3								
102.3	2														
	2.25														
101.8	2.5					SS 4	1								
	2.75														
101.3	3														
	3.25					SS 5	1								
100.8	3.5														
	3.75														
100.3	4					SS 6	2								
	4.25														
99.8	4.5														
	4.75					SS7	2								
99.3	5														
	5.25														
Borehole terminated on sandy silt.															
S = Sample for lab review and moisture content															
Water Elevation Interpreted															

Appendix

B Resistivity, PH and Soluble Salts Test

Certificate of Analysis

Client: Geoseismic

Client PO:

Report Date: 18-Jun-2026

Order Date: 15-Jun-2026

Project Description: 201NIPISSING

Client ID:		BH6 SS2							
Sample Date:		09-Jun-26 09:00							
Sample ID:		2625073-01							
Matrix:		Soil							
MDL/Units									

Physical Characteristics									
% Solids	0.1 % by Wt.	82.4	-	-	-	-	-	-	-
General Inorganics									
pH	0.05 pH Units	7.88	-	-	-	-	-	-	-
Resistivity	0.1 Ohm.m	149	-	-	-	-	-	-	-
Anions									
Chloride	10 ug/g	<10	-	-	-	-	-	-	-
Sulphate	10 ug/g	<10	-	-	-	-	-	-	-

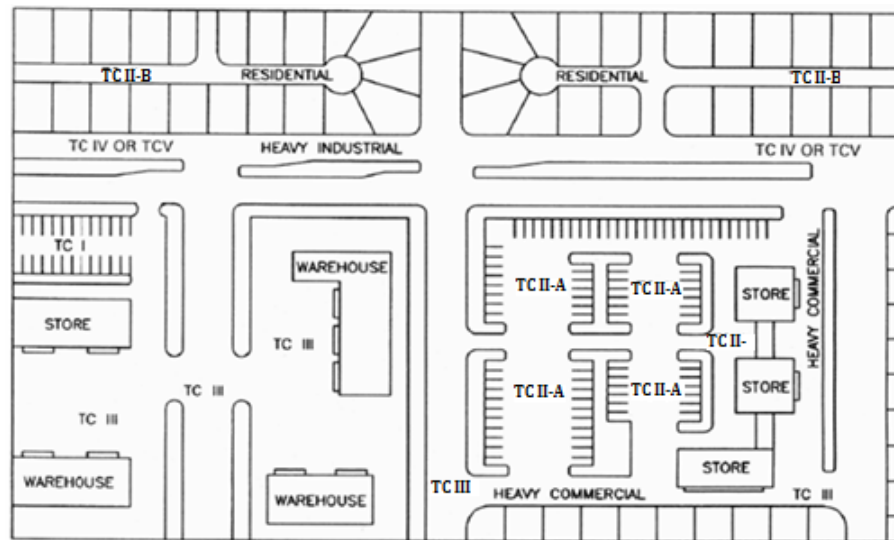


Figure 2: Traffic Classes

Appendix

C Pavement

C.1 Traffic Classes and Pavement Catalog

Figure 2 in page 37 presents a schematic site plan differentiating example uses for five traffic classes developed by the Wisconsin Asphalt Pavement Association and presented in their Design Guide May, 2001.

1. Refer to figure 2 in page 37 to differentiate pavement classes for the proposed Proposed Place of Worship.
2. Refer to table 2 in page 38 for additional information and design ESALs.
3. Refer to Tables 3, 4 and 5 in page 38 to select pavement structures for each traffic class on very poor soils encountered at this site.

Consult Yuri Mendez Engineering for pavement structures on roadbed consisting of newly placed engineered fill, underground parking or as required, where the roadbed is not the near surface very poor soil encountered at this site.

C.2 Frost Heave in Pavements

Frost heave of founding materials for pavement induces reduction (serviceability losses) of the performance period (along with traffic ESALs) for which the

Ontario Category	Classes	ESALs	Uses
A	I	50,000	Residential dead end and parking lots 50 stalls or less.
A	II-A	100,000	Parking lots 51 to 500 stalls.
A	II-B	200,000	Residential streets, parking lots more than 500 stalls.
B	III	600,000	Minor collectors, local streets and light industrial lots.
B	IV	900,000	Collector Streets and heavy industrial parking lots.
B	V	2,200,000	Minor Arterial.

Table 2: Design ESALs (20 years) and uses for traffic classes

Material Class	Specification	Thicknesses			
		Class I		Class II-A	
		mm	in	mm	in
Surface course	OPSS 1151 Superpave 9.5	50.8	2	50.8	2
Surface course	OPSS 1151 Superpave 12.5				
Binder course	OPSS 1151 Superpave 19.0				
Base	OPSS 1010 Granular A	152.4	6	152.4	6
Subbase	OPSS 1010 Granular B Type II	228.6	9	279.4	11
Subgrade	Undisturbed In situ Soil				

Table 3: Flexible Pavement Structure Classes I and II-A

Material Class	Specification	Thicknesses			
		Class II-B		Class III	
		mm	in	mm	in
Surface course	OPSS 1151 Superpave 9.5				
Surface course	OPSS 1151 Superpave 12.5	63.5	2.5	76.2	3
Binder course	OPSS 1151 Superpave 19.0				
Base	OPSS 1010 Granular A	152.4	6	152.4	6
Subbase	OPSS 1010 Granular B Type II	330.2	13	406.4	16
Subgrade	Undisturbed In situ Soil				

Table 4: Flexible Pavement Structure Classes II-B and III

Material Class	Specification	Thicknesses			
		Class IV		Class V	
		mm	in	mm	in
Surface course	OPSS 1151 Superpave 9.5	31.8	1.25		
Surface course	OPSS 1151 Superpave 12.5				
Binder course	OPSS 1151 Superpave 19.0	57.2	2.25		
Base	OPSS 1010 Granular A	152.4	6		
Subbase	OPSS 1010 Granular B Type II	457.2	18		
Subgrade	Undisturbed In situ Soil				

Table 5: Flexible Pavement Structure Classes IV and V

structure was designed. Generally speaking, AASHTO 1993 does not provide for an increase in thicknesses (structural number) for reduction of losses, as such increase has very small influence in the detrimental effects of frost heave. Frost heave affects pavements by roughness induced by differential frost heave, i.e., if the longitudinal vertical alignment is all equally frost susceptible, there is negligible detrimental effect. This is difficult to achieve in urban developments in which service trenches are backfilled with non frost susceptible materials. For long lasting pavements on frost susceptible soils, the general guideline is, where possible; ensure that all soils serving as pavement foundation are equally frost susceptible. This could be achieved by providing frost susceptible backfill within 1.4 m of the pavement foundation in service trenches. Where measures to mitigate the effect of frost heave are not undertaken, decrease of the performance period is accepted to occur.

C.3 Frost Protection for Manholes, Catch Basins and Others

Manholes and catch basin type structures provide a cold bridge to a deeper portion of the soil profile and create localized areas prompt to pavement failure by excessive frost heave roughness in frost susceptible soils. This can be prevented by providing insulation extending downward around the structure and horizontally outward to create a transition from the varying pavement elevation to the more stable catch basin elevation. On the alternative, non frost susceptible backfill can be provided tapered outward from the structure to the surrounding pavement.

Report 93-BAPS-R0
This page is intentionally left blank

Appendix

D Foundation Drainage

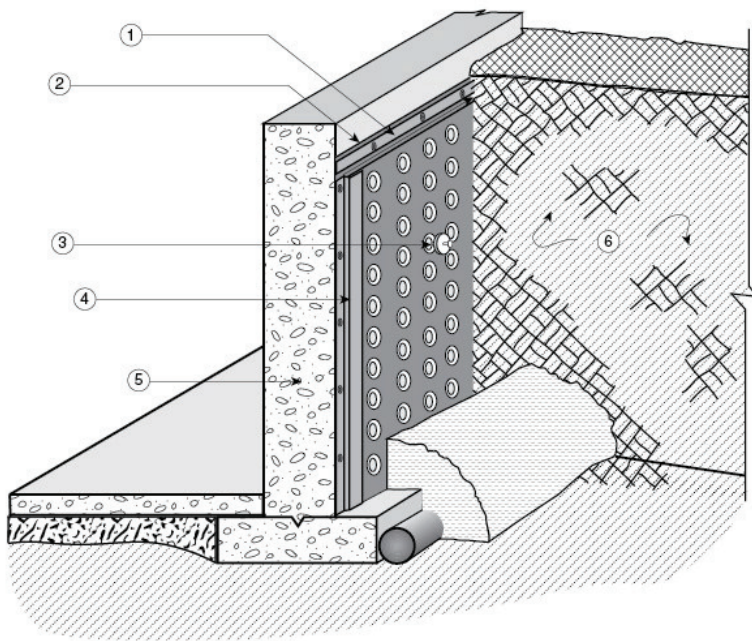


Figure 1. “Cosella-Dörken DELTA®-MS and DELTA®-MS CLEAR Dampproofing Membranes” – face in contact with the soil

1. termination bar
2. caulking (behind membrane)
3. fastener
4. mould strip
5. concrete foundation
6. backfill

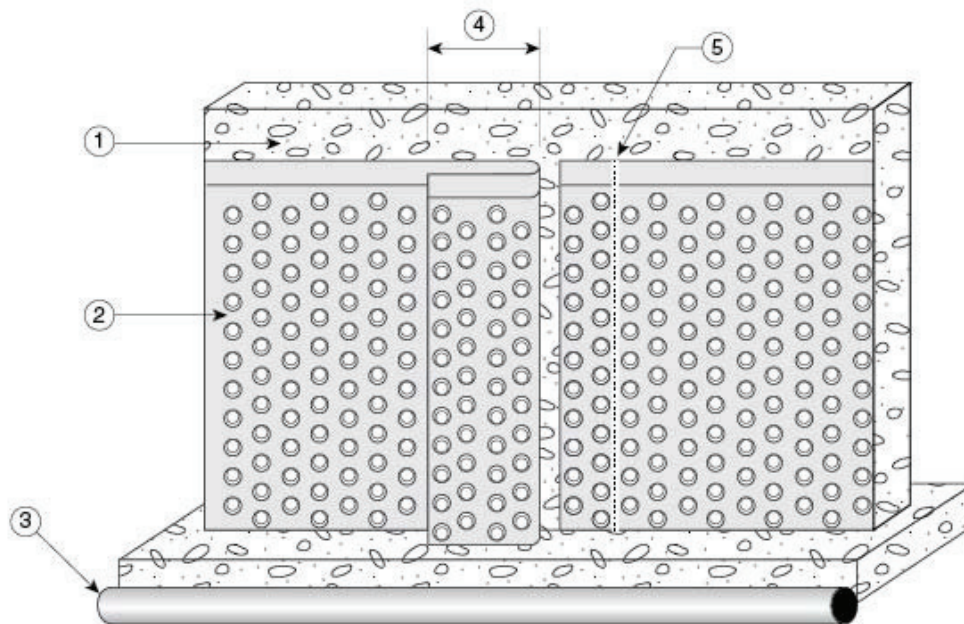


Figure 2. “Cosella-Dörken DELTA®-MS and DELTA®-MS CLEAR Dampproofing Membranes” – face in contact with the wall

1. concrete foundation
2. membrane
3. drainage tile
4. minimum 6" overlap
5. caulking

Appendix

E Construction Recommendations for Stripping, Earth and Rock Excavation to Undisturbed Soils, Earth and Rock Fill Placement, Asphalt Placement and Compaction

In the event that any of the following recommendations conflict with municipal and or provincial specifications, the most restrictive applies. For the case when products involving ground conditions are used, the manufacturer's specifications take precedence.

The contractor shall be prepared to proceed as directed by the geotechnical consultant within the framework of these recommendations. Construction methods will abide to these recommendations and/or be discussed and agreed upon with the consultant on site in real time or as expressed in writing.

E.1 Removal of Water

Removal and diversion of surface water and ground water will be planed prior to all earthwork within the scope of these recommendations. All surfaces in which to commence construction will be maintained dry and free of muddy conditions.

E.2 Earth Excavation

Earth excavations are subject to the provisions in O. Reg. 213/91: Construction Projects under Occupational Health and Safety Act. Refer to section 9 for key aspect of O. Reg. 213/91 applicable to the findings in testholes at this site.

For the purpose of these recommendations earth materials will be refer to as one or more of the general material classes: topsoil and organic soils, non engineered fill, granular fill, native soils and rock. Topsoil and organic soils and non engineered fill are the subject of striping in subsection E.2.2.

E.2.1 Suitability of Earth Materials

The suitability of material for specific purposes is determined by the geotechnical engineer. To the extent they are needed, suitable material from the excavations can be used in the construction of required permanent earthfill or rockfill.

E.2.2 Striping

Topsoil and/or organic soils and/or existing fill must be removed from the perimeter of all proposed structures, including retaining wall, buildings, pavement, parking areas and earth or fill banks for grading.

E.2.3 Excavation to Undisturbed Soil Surface

All soil surfaces in which to commence construction for all structures are to be preserved in undisturbed condition (Undisturbed Soil Surface (USS)). Native soil surfaces exposed to the weather for a period exceeding 72 hours are considered disturbed. Where rainy weather and/or equipment operation and/or labor make impractical or difficult the preservation of USS a working-leveling granular pad may be used. Use the compaction requirements and materials in Table 6.

Except as otherwise indicated for select earthfill materials at this site, re-instatement of excavated soil is not allowed. When excavation exceeds the depth of the proposed USS, a granular pad using the compaction requirements and materials in Table 6.

It can be assumed that it is impractical to conduct excavations to an even USS. In such case a granular pad not less than 150mm thick must be used to remedy for irregularities caused by the operation of equipment.

E.3 Foundations Placement

Native soil surfaces exposed to the weather for a period exceeding 72 hours are considered disturbed. Place foundations on a OPSS.MUNI 1010 granular B type 2 granular pad that is at least 150 mm thick placed on undisturbed soils.

E.4 Retaining Wall Foundations

Retaining wall foundations are to be placed on a OPSS.MUNI 1010 granular B type 2 granular pad that is at least 150 mm thick.

E.5 Imported Materials

Materials to be imported are subject to prior approval by the geotechnical engineer. The exceptions are granular materials having 12 % or less fines including clean sands. Fines are materials passing the # 200 sieve (70 μm).

E.5.1 Granular Earthfill Placement

E.5.1.1 Moisture for Granular Earthfill

For granular earthfill it is to be assumed that moisture will be added for placement. Compaction in wet of optimum condition is preferred for granulars.

E.5.1.2 Compacted Lifts Thicknesses Equipment and Passes for Granular Earthfill

Compacted lifts will not exceed 250 mm. Subject to test trials a maximum compacted lift of 300 mm may be accepted provided vibratory compaction equipment rated at 60,000 lb-f (27,300 kg-f) of dynamic force is used.

For road construction passes are to overlap by 300 mm for full coverage.

Where non vibratory pneumatic compactors with ballast an tire pressure of 100 psi (7 kg/cm²) are used (9 or 13 ply) the compacted lift thicknesses will not exceed 150 mm for granular.

For services and culvert trenches, when using rammers and light vibratory plates weighing less than 115 kg (250 lbs) the compacted lift thicknesses will not exceed 100 and 125 mm respectively. For heavier trench equipment the compacted lifts will not exceed 250 mm.

No heavy equipment will be operated above the crown of pipes or culverts unless 1.2 m of fill has been placed or the subgrade elevation has been reached.

For all trenches below the water table, trench foundation not less than 200 mm will be provided as per materials and specification in Table 6 in page 46.

Materials lift placement beneath foundations, slabs or any placement not specified above must abide to the above specifications as they relate to the equipment being used.

E.5.2 Compaction Guide for Passes and Level of Compaction

The contents of this section are provided as guidelines for construction. The resulting compaction densities and compacted lift thicknesses can only be verified by actual testing and field trials respectively.

For equipment passes the contractor may consider not less than 4, 5 or 6 passes for 95, 98 or 100 % Proctor Standard compaction.

For granular materials loose lifts may be approximately 150, 175 and 235 mm for compacted lift thicknesses 125, 150 and 200 mm respectively.

For select earthfill materials loose lifts may be approximately 125 and 190 mm for compacted lift thicknesses 100 and 150 mm respectively.

E.6 Compaction General

It is to be assumed that water will be added for compaction and that the required maximum grain size shall be 3/4 of the compacted lift thickness.

Obtain the approximate loose lift thickness by dividing the compacted lift by 0.88. Compacted lifts are approximately 12% less than the loose lift thickness.

Each lift shall be compacted by the specified number of passes of the approved type and weight of roller or other equipment.

Table 6 in page 46 presents Proctor Standard (PS) compaction requirements for specified placement and materials.

E.7 Compaction Specific

E.7.1 Compaction Along Basement Walls, Retaining Walls and Structures

No heavy compaction equipment is to be operated within 0.9 m of any structure. The consolidation zone is defined as the zone within 0.9 m of the exterior edge of basements or the interior edge of retaining walls or any structure. Only light

Material Placement	Material Description	% PS
Base	OPSS.MUNI 1010 Granular A	100
Subbase	OPSS.MUNI 1010 Granular B Type II	100
Subgrade	Granular earthfill (with 12 % or less fines) and 100% passing 106 mm sieve	95
	Select earthfill	95
Backfill for trenches under pavement	Granular earthfill (with 12 % or less fines) and 100% passing 106 mm sieve.	95
	Select earthfill	95
Under sidewalks top 200 mm	Any OPSS.MUNI 1010 Granular specification for which 100% passes the 26.5 mm sieve	95
Under foundations	OPSS.MUNI 1010 Granular B type 2 with 12% or less fines and for which 100% passes the 106 mm sieve	98
Backfill under slabs on grade	Cohesionless (with 12 % or less fines) and 100% passing 106 mm sieve.	100
	Select earthfill	100
Top 100 mm under slabs	Crushed stone 9.5 to 19 mm (use one or several sizes).	90
Pipe bedding and cover (150 mm for bedding to 150 mm above the crown)	Any OPSS.MUNI 1010 Granular specification for which 100% passes the 26.5 mm sieve	95
Trench foundation (stabilization minimum 200 mm)	Any OPSS 1010.MUNI Granular specification for which 100% passes the 106 mm sieve except Granular B Type I	95
Backfill for non building, non traffic and/or non parking areas	Granular (with 12 % or less fines) and 100% passing 106 mm sieve	90
	Select earthfill	90
Placement not specified above	Granular (with 12% or less fines) and 100% passing 106 mm sieve	95
	Select earthfill	95

Table 6: Proctor Standard (PS) compaction requirements for specified placement and materials.

to very light compaction is to be applied along the consolidation zone with no more than 2 passes of light vibratory equipment.

E.7.2 Self Compacting Materials

There are no self compacting materials. Total fill thickness of 200 mm of granular materials consisting of more than 90% of one nominal size referred to as crushed stone are acceptable without compaction under concrete slabs.

E.7.3 Settlement Allowance and Overfill

The settlement (consolidation) of lightly compacted earthfill can be excessive. Overfill to compensate for settlement allowance will be discussed with the geotechnical engineer.

E.7.4 Compaction Quality Control

Provide moisture density relationships for Standard Proctor compaction for the proposed materials and source. Conduct one in situ test at randomly selected locations per 60 m³ of fill. This is approximately one test, each 300 m² of lift in place. Nuclear or non-nuclear density probes testing can be used. Density probes will only measure the density within 0.12 m depth at the point of the measurement.

E.8 Asphalt Pavement

Place asphalt mix only when base course, or previous course is dry and air temperature is 7 degrees C and increasing.

Asphalt pavement mix temperatures at the time of placement will be within the range of 120 to 160 degrees C.

Do not place asphalt on a surface which is wet or covered by snow or ice or if the ground is frozen.

E.8.1 Surface Preparation for Asphalt Pavement

It is to be assumed that rough grading and fine grading shall take place before asphalt placement. Rough grading will be completed to within ± 25 mm of the underside of asphalt and tested to meet the specified density. Fine grading and rolling will be completed by the paving contractor. The granular material for fine grading will meet OPSS.MUNI 1010 Granular M.

E.8.2 Proof Rolling Prior to Asphalt Pavement

Conduct proof rolling using a single pass of a tandem-axle dump truck or a tri-axle dump truck with the third axle raised loaded to a minimum gross vehicle weight of 26 metric tons at walking speed. Rutting in excess of 25 mm is considered failure. Where proof rolling reveals areas of defective subgrade,

Remove base, Sub-base and subgrade material to depth and extent and width that will allow reconstruction using the available equipment or as directed by the Consultant.

E.8.3 Asphalt compaction

The compacted lifts are accepted to be 80% of the loose lift thickness (the loose lift reduces thickness by 20% when compacted). Divide the compacted lift thickness by 0.8 to obtain the thickness of the loose lift.

Compaction will consist on at least three passes at approximately walking speed (5.4 km/hr) as follows: *break down rolling* using a vibratory steel drum roller, *intermediate rolling* with a static (non-vibrating) roller or a pneumatic roller and *finish rolling* with a smooth static roller.