Geotechnical Investigation Report

Proposed New Subdivision

0 Chippewa Street, Sault Ste. Marie, Ontario

Prepared for:

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1.0 INTRODUCTION & SCOPE

Down to Earth Geotechnical Engineering (Down To Earth) is pleased to provide our Geotechnical Investigation Report for a proposed new residential subdivision to be located on approximately 37 acres of vacant properties, at the west end of Chippewa Street in Sault Ste. Marie, Ontario. The Site location is shown on Figure 1 in Appendix A.

The geotechnical investigation and engineering evaluation was performed in accordance with Down to Earth's proposed scope of work outlined in our December 21, 2022 Proposal (G22042), which was signed off by Mr. Harjinder Kang of Mamta Homes.

It is understood by Down to Earth that the proposed new residential subdivision will comprise of detached homes, semi-detached homes, town homes, apartments, as well as the associated infrastructure required to develop a residential subdivision.

Since the project is in the early stages of development and there were no structural or architectural drawings available for the proposed apartment buildings, the geotechnical borehole investigation program was performed for the proposed residential houses and associated infrastructure (i.e. roadways, sewers and water services). As such, foundation recommendations for the proposed apartment buildings are not discussed in this report.

In general, the Geotechnical Investigation was required to delineate and evaluate the general subsurface soil and groundwater conditions, and based on the factual information obtained, provide geotechnical engineering design and construction recommendations, as well as provide engineering guidelines on the geotechnical aspects of the project that could influence design and construction decisions from a geotechnical perspective.

This was accomplished by advancing a total of 10 strategically placed exploratory boreholes (BH1 to BH10) and instrumenting 2 of the boreholes (BH9 and BH10) with piezometers (monitoring wells, MW1 and MW2) within the boundaries of the proposed subdivision, while avoiding underground site services. The approximate spatial location of the boreholes/monitoring wells are indicated on Figure 2 in Appendix A.

Based on the results of the geotechnical investigation, soil laboratory testing, and geotechnical engineering analysis, the following geotechnical investigative processes, recommendations and construction considerations are provided:

- Geotechnical Field Investigation and Methodology;
- Geophysical Logging of Subsurface Conditions & Soil Laboratory Test Results;
- General Subsurface Soil and Groundwater Conditions (Soil Stratigraphy);
- Borehole Logs and Location Plan;
- Foundation Type(s) and Soil Bearing Pressures at Serviceability Limit States (SLS) design for Residential Construction;
- Potential Total and Differential Foundation Settlements;
- Soil Subgrade Preparation and Improvement as/if required;
- Foundation Frost Protection Considerations;
- Interior Building Concrete Floor Slab-on-grade Granular Support Material;
- Suitability and Potential Re-use (recycling) of excavated soil as backfill;
- Sewer Pipe Bedding and Trench Backfill requirements;
- Granular Backfill and Compaction Requirements;

- Frost Mitigation Strategies for watermains (i.e. frost protection) using granular backfill and/or equivalent insulation thickness;
- Asphalt Pavement Structure Design Recommendations including subgrade, road base and construction recommendations in accordance with City practice;
- Surface and Subsurface Drainage Requirements (Systems) to enhance the performance and longevity of the pavement structure;
- Geotechnical Design Considerations for Constructability;
    - Open Cut Trench Excavations above and below the estimated groundwater table including the stability of temporary sloped excavations including bracing as/if required; and,
    - Anticipated Groundwater Management (dewatering).

This report contains our factual geotechnical comments and recommendations, based on our understanding of the project scope, our geotechnical field investigation, and previous geotechnical information in the area.

Abbreviations, terminology and principle symbols commonly used throughout the report and appendices are enclosed in Appendix B.

2.0 GEOTECHNICAL FIELD INVESTIGATION AND METHODOLOGY

The geotechnical field investigation consisted of advancing a total of 10 sampled exploratory boreholes (BH1 to BH10) from January 19 to 24, 2023. The boreholes were advanced to between about 4.4 to 5.9 meters (m) below existing grades, where they were terminated within a varved natural silt to silty clay soil deposit. The approximate spatial locations of the boreholes are indicated on Figure 2 in Appendix A.

The boreholes were advanced for the proposed roadway, sewer, water and residential building foundation construction.

To obtain the necessary subsurface geotechnical engineering data, the exploratory boreholes were advanced with conventional geotechnical drilling machinery, equipped with geotechnical soil sampling equipment consisting of 150 mm diameter continuous flight hollow stem augers, 51 mm outside diameter split-spoon sampler, and AW rods.

Soil samples were collected from the flights of the hollow stem augers, as well as from the split-spoon sampler in conjunction with Standard Penetration Tests (SPT), “N” values (ASTM D1586) at regular geotechnical intervals. The SPT “N” values were used to give a qualitative evaluation of the compactness condition of non-cohesive soils (i.e., sands and non-plastic silts) and roughly estimate the consistency of cohesive soils (i.e. plastic silt and clay). Field vane testing was performed in cohesive soils to estimate the materials in-situ undrained shear strength properties in accordance with ASTM D2573-72. We note that the soil stratums were interlayered with silt and clay seams. As such, the field vane measurements may have been performed in a more silty material than what was previously retrieved within the split spoon barrel, which tends to result in higher undrained shear strengths due to the increased silt content.

Upon completion of soil sampling, each borehole was checked for groundwater and then subsequently backfilled with auger cuttings and sealed with Bentonite pellets in accordance with MECP Regulation 903 (as amended).

Boreholes BH9 and BH10 were instrumented with a Casagrande piezometer (monitoring well) to a depth of about 6 m below the ground surface in accordance with MECP Regulation 903 (as amended), in order to measure the stabilized groundwater at a later date.

The borehole drilling operations were supervised fulltime by Down to Earth’s geotechnical engineering staff. Recovered soil samples were evaluated and logged in the field by an experienced geotechnical representative, in accordance with the Modified Unified Soil Classification System (M-USCS). Collected soil samples were sealed into moisture proof bags and transported back to our laboratory for further visual and tactile examination by the geotechnical engineer. Soil laboratory analysis was completed on representative select soil samples to determine natural moisture contents, and particle/grain size distribution.

3.0 GENERAL SUBSURFACE CONDITIONS

3.1 Geophysical Logging & Soil Laboratory Testing

The geophysical loggings of the soil and groundwater conditions were performed to collect geotechnical engineering design information.

The subsurface (soil and groundwater) conditions and laboratory tests performed on select representative soil samples encountered within the boreholes are presented in detail on the borehole logs in Appendix C. The borehole log indicates the subsurface conditions at the specific test location only.

The borehole logs include textural descriptions of the subsoil in accordance with the Modified Unified Soil Classification System (M-USCS) and indicate the soil boundaries inferred from non-continuous sampling and observations during the borehole advancement. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The M-USCS classification is explained in further detail in Appendix B.

Select soil samples collected from the boreholes were submitted to our Materials Testing Laboratory to determine the natural water content and particle size distribution of the soils. Laboratory analytical reports are included in Appendix D.

It is noted that due to the limitations of retrieving soil samples with a 51 mm outside diameter (35 mm inside diameter) split spoon barrel, the particle size distribution results may not be fully representative of the in-situ soil matrix and reflect the larger particles observed by geotechnical personnel in the field. These observations are reflected on the borehole logs and discussed throughout the report.

In addition, testing was performed on disturbed soil samples and is subject to an according degree of error. As such, all geotechnical data requires interpretation by Down to Earth or an experienced geotechnical engineering consultant who is familiar with the local soil types and conditions.

3.2 Subsurface Profile

3.2.1 Duff/Organics

Approximately 50 mm of duff/organics were encountered from the ground surface within all boreholes.

The duff/organics consisted of wild vegetation, such as wild grass, and other vegetative matter, such as leaves, twigs, and etcetera, that overlaid black organics that were wet at the time of the investigation.

3.2.2 Natural Subgrade Soils

The natural subgrade soils encountered below the duff/organics, consisted of transitioning phases/interlayering of varved silty clay to silt, which extended to the borehole termination depths of between about 4.4 and 6 m below existing grades within all boreholes.

The silty clay was brown to grey in colour, damp to wet (below ~ 1.2 m), varved, soft to firm in consistency and of medium to high plasticity. The undrained shear of the material ranged from about 20 to 50 kPa, and increased in strength with depth in a portion of the boreholes. However, it is noted that the silty clay in the area is known to decrease in strength below about 4 to 5 m below grade. It is also noted that some of the higher undrained shear strengths could be a result of performing the field vane measurements in a material that has a higher silt content than observed in the previous soil sample.

The silty clay soil is susceptible to long-term consolidation settlements with an increase in effective stress due to installing earth/granular fill materials above the current grades.

The silt generally contained trace to some clay, was grey in colour, wet and loose to very loose.

Based on previous geotechnical information within the area, the silty clay and silt materials can be expected to extend to a sand soil deposit suspected to be encountered between about 60 to 70 m below grade and possibly more. The sand material is expected to overly glacial till, which overlays sandstone bedrock, which is expected to be encountered between about 80 to 90 m below grade.

3.2.3 Groundwater Observations – Measured and Inferred

2 weeks after the installation of the piezometers within boreholes BH9 and BH10, the natural groundwater was measured at about 1.2 below the ground surface, and is represented on the borehole logs with an inverted triangle

Based on field observations and laboratory testing, the natural groundwater was estimated and/or inferred to be located at approximately 1.2 m below grade in the remaining boreholes.

Upon completion of drilling, all boreholes were wet at the base.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall or in response to a particular precipitation event should be expected, and lower levels occurring during dry weather conditions.

4.0 GEOTECHNICAL GUIDELINES, DESIGN RECOMMENDATIONS, CONSIDERATIONS & COMMENTS

4.1 Residential Foundation Discussion & Recommendations

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from our investigation, and our experience with similar projects. Because the investigation represents a small portion of the subsurface conditions, it is likely that conditions may be encountered during construction that are substantially different than those encountered during our investigation. If these situations are encountered, adjustments to the design may be necessary. A qualified geotechnical representative should be on Site during the foundation preparation and Site development to ensure the subsurface conditions are the same/similar to what was observed during the geotechnical field investigation.

Based on the information obtained from the geotechnical investigation, soil laboratory testing, and geotechnical engineering analysis, the proposed residential structures can be supported by conventional shallow strip and spread footings bearing directly on the undisturbed natural silty clay soil deposit, provided the recommendations outlined in this report are followed.

The natural soil deposits at this site are considered susceptible to frost heave movements during freezing conditions. As such, to mitigate potential foundation frost heave movements, it is typical building practice to establish shallow foundations with a minimum of 1.5 m of soil cover above the underside of the foundation. It is noted that the geotechnical exploratory borehole investigation indicates that the natural subgrade soils tend to become weaker with depth. As such, to support the proposed residential structures on conventional strip and spread footings, the following foundation considerations are provided:

- **Option 1** - Establish the foundations at 1.5 below the existing grade on undisturbed firm silty clay, with strip footing widths not exceeding 0.6 m wide and spread footings not exceeding 1.2 m by 1.2 m, in order to reduce the pressure (stress) on the underlying weaker soil deposit(s);
- **Option 2** - Install the foundations at a higher elevation on undisturbed firm silty clay to reduce the pressure on the underlying weaker soil deposits, and provide a combination of soil cover and rigid insulation to

mitigate possible soil frost heave movements. This option will allow for larger strip and spread footing dimensions; and/or

- **Option 3** - Install the foundations on either a compacted granular engineered fill pad and/or a granular engineered fill pad reinforced with a non-woven geotextile (Terrafix 360R or equivalent product).

For **Option 1**, an approximate unfactored allowable bearing reaction of 75 kPa at Serviceability Limit States (SLS) design may be used at the underside of the proposed foundations. The recommended maximum strip and spread footing widths are to keep the pressure (stress) on the underlying loose silt deposit to 50 kPa or less.

For **Option 2**, an approximate unfactored allowable bearing reaction of 75 kPa at SLS design may be used at the underside of the proposed foundations. However, provided the pressure on the underlying loose silt material is limited to 50 kPa or less, then the strip and spread footing dimensions may be increased accordingly. For example, if the foundations are established 1 m below the existing grade on the undisturbed firm silty clay soil deposit, then strip footing widths can be increased to 0.9 m and spread footings to 1.8 m by 1.8 m. All foundations are to have a minimum of 600 mm of soil cover above the underside of them, and not exceed the aforementioned foundation sizes.

Frost protection with rigid insulation will be a function of the foundation depth below the ground surface.

For **Option 3,** the unfactored allowable bearing reaction can be increased above 75 kPa with various foundation sizes (ex. smaller than outlined in Option 2). The allowable soil bearing reaction would be a function of the foundation sizes and the design of either a compacted granular engineered fill pad and/or a granular engineered fill pad reinforced with a non-woven geotextile (Terrafix 360R or equivalent product), as well as the final thickness of the engineered pad(s). The crux of the design is to keep the majority of the stresses within the engineered fill pad and reduce it on the underlying weaker soil deposits. Should this option is considered, then Down to Earth can provide appropriate design recommendations based on the loading/bearing pressure(s) and foundation sizes proposed by the structural engineer. General engineered fill material specifications and installation requirements are outlined in Section 4.3 of this report.

Any potential grade increases with granular fill materials are to be considered when evaluating the foundation bearing pressures, and the pressure at the underside of the foundation reduced accordingly. For example, should the grade be increased by 0.5 m, and assuming a unit weight of soil of 20 kN/m^3, then the bearing pressure should be reduced by 10 kPa from 75 to 65 kPa at SLS design. Grade increases are to limited to 600 mm of the original elevation of the surface of the natural silty clay soil deposit.

Since a relatively small quantity of boreholes were advanced at the Site compared to the size of the Site, it is noted that there could be pockets of weaker soils that were not encountered. As such, if observed during the excavation works for the foundation installation, then the unfactored allowable bearing reaction at SLS may have to be reduced accordingly. If it is determined that the soil bearing is to be reduced, then we would expect it to **not** be less than about 50 kPa at SLS design. However, the actual allowable soil bearing must be confirmed by a qualified representative at the time that the excavations take place.

The allowable bearing reactions provided also assumes that all footings will be constructed to the minimum sizes outlined in the latest edition of the Ontario Building Code, as well as this report.

The unfactored reaction at SLS is based on an estimated settlement of 25 mm or less with differential settlements of 19 mm or less.

Since the natural soils tend to vary in strength across the site, we recommend that the foundation walls be constructed of poured concrete reinforced with nominal reinforcing steel bars, to mitigate any potential foundation wall cracking versus a concrete block wall.

The recommended design bearing pressure assumes that all geotechnical recommendations outlined in this report are followed.

Depending on the subgrade conditions at the time of construction a 100 to 150 mm thick layer of Granular “A” (OPSS 1010) or a 19 mm diameter Clear Stone gravel (OPSS 1004) may be beneficial to protect the integrity of the natural subgrade soils during the installation and construction of the foundations.

Prior to the installation of the footings, the natural silty clay soil is to be inspected and approved by a certified building inspector or qualified geotechnical representative to ensure that the material conforms with the soil type and consistency observed during the subsurface investigation work. This will either consist of proof roll compaction with minimum 10 tonne non-vibratory steel drum roller, under the direction of geotechnical personnel and/or tactile inspection with a geotechnical probe rod.

4.2 General Shallow Foundation Subgrade Preparation

The natural subgrade soils are sensitive to change in moisture content and can become loose if the soils are subject to excessive precipitation prior to the installation of the foundations. As well, they could be easily disturbed if travelled on during construction. Once they become disturbed, they are no longer considered adequate for the support of shallow foundations. It is noted that the permeability of the silty clay soil is low to very low and should not require significant effort to remove the release of water from within it. To ensure and protect the integrity of the subgrade soil during construction operations, the following is recommended:

- The subgrade should be sloped to promote surface drainage and the collected water pumped out of the excavation. It is critical that water be controlled and the subgrade preparation work commence in the dry. Continuous groundwater control is critical to prevent the soils from becoming loose/soft;
- It is critical that 24 hour groundwater control be performed during the installation of the foundations and until all concrete for the proposed foundations is installed, set and backfilled;
- Construction equipment traffic on the subgrade soils should be avoided;
- The foundations should be installed as soon as practically possible after the excavation subgrade is exposed. The longer the excavated subgrade soil remains open to weather conditions and potential water seepage, the greater the chance for construction problems to occur, and increase compromising the integrity of the subgrade soils; and,
- Once the foundations are installed, they should be backfilled as soon as practically possible.

Should the subgrade soils become disturbed during construction or pockets of unstable or unsuitable areas be encountered, Down to Earth can provide appropriate recommendations at the time, which may include but not be limited to the following:

- Compaction of the subgrade soil;
- Removal of subgrade material and subsequent replacement with engineered fill;
- Placement of a non-woven geotextile;
- Placement of geogrid; and/or,
- Installation of a minimum 75 mm thick low strength (1 MPa) concrete mud slab immediately upon excavation of the exposed soils.

If construction proceeds during freezing weather conditions, the subgrade soils and any potential fill materials must be maintained above freezing or thawed prior to construction works and the installation of concrete.

Prior to installing the foundation form work and/or engineered fill for the foundations, the subgrade soils are to be inspected and approved by a certified building inspector or a qualified geotechnical engineering representative to ensure that the material conforms with the soil type and consistency observed during the subsurface investigation work. If the soils are not consistent with the observations made from within the boreholes or geological information in the area, Down to Earth can provide appropriate recommendations at that time.

4.3 General Engineered Fill Material Specifications and Installation Requirements

If required, the following outlines our general recommendations for the installation of granular engineered fill material, which must be reviewed prior to finalizing any potential foundation construction design.

Any potential granular engineered fill material installed below the foundations should consist of a Granular "A" Ontario Provincial Standard Specification 1010 (OPSS 1010) compacted in maximum 200 mm thick loose lifts to 100% Standard Proctor Maximum Dry Density (SPMDD). The Granular "A" should have a minimum thickness of 100 mm. Below the Granular "A" fill material, either a Granular "B" Type I or Type II can be used to increase the grade above the natural subgrade soils.

A Granular "B" Type I (OPSS 1010), should be placed in maximum 200 mm thick loose lifts and compacted to a minimum of 98% SPMDD.

Should surface or groundwater be an issue during construction, then a non-woven geotextile, such as a Terrafix 270R (or equivalent product) should be installed directly over the natural subgrade soils combined with the installation of 150 mm of 19 mm diameter Clear Stone gravel (OPSS 1004) for drainage purposes and controlling the water. The Clear Stone should contain a minimum of 50% crushed particles. The Clear Stone will help distribute footing pressures and protect the integrity of the subgrade soils during the construction. Water collected within the stone should be controlled through sumps and filtered pumps. The subgrade soils should be graded to drain to appropriate drainage areas and pumped away from the excavation if necessary.

The Clear Stone and the Granular "B" Type II should be vibratory compacted to a compact state, compacted in maximum 200 mm thick loose lifts. If Clear Stone is used to support foundations, then it should not exceed a thickness of 300 mm.

All engineered fill material installed below the underside of the foundations should extend a minimum horizontal distance of 300 mm beyond the outside face of the foundations and slope down at 1H:1V to ensure the foundation loads are properly transferred to the underlying undisturbed natural subgrade soils.

All individual spread footings are to bear entirely on natural soils or engineered fill, and not a combination of both.

Prior to the installation of a granular engineered fill pad, all deleterious materials and organics must be removed to a suitable undisturbed natural subgrade soil.

A qualified geotechnical engineering representative should be on site to observe fill placement operations and perform field density tests at select locations throughout each lift, to ensure the specified compaction is being achieved.

For Granular "A" and Granular "B" Type I material, a nuclear density gauge should be used for each lift to ensure that the material is compacted to the recommended SPMDD. For Granular "B" Type II and Clear Stone material, routine visual and tactile inspections should be performed during the placement of the material to ensure adequate compaction is achieved. Prior to the start of the project, a sample of each material type is required for laboratory testing to determine the materials' SPMDD and/or grain size distribution for conformance with OPS Specifications.

Provided the engineered fill is prepared as outlined in this section, it should be capable of supporting a net allowable bearing reaction of 75 kPa or more at SLS design.

The recommended design bearing pressures assume that the groundwater is adequately controlled and the natural soil does not become loose during construction due to basal heave.

4.4 Vertical Transition of Strip Footings

Where strip footings are founded at different elevations, the subgrade soil is to have a maximum slope of 2H:1V, with a maximum rise of 600 mm and a minimum run of 600 mm between each step footing, as detailed in the latest edition of the Ontario Building Code.

4.5 Foundation Offsets

To avoid stress bulb interaction between footings, any potential parallel strip footings are to be spaced a minimum distance of one and half times the footing width apart from each other, and individual spread footings are to be spaced a minimum distance of one and a half times the largest footing width apart from one another. This assumes the footings are at the same elevation.

Foundations which are to be placed at different elevations in soils or near service trenches should be located such that the footings are separated by a minimum slope of 2H:1V with an imaginary line drawn from the underside of the lower foundation or bottom of the service trench to the outside bottom edge of the foundation facing each other.

4.6 Shallow Foundation Estimated Settlements

Foundations installed in accordance with the recommendations as outlined in the previous sections are not expected to exceed total settlements of 25 mm and differential settlements of 20 mm.

4.7 Soil Frost Susceptibility and Shallow Foundation Frost Protection

Where the interior of the building is heated to 18 degrees Celsius or more, perimeter shallow foundations are provided with a minimum of 1.5 m of soil cover frost protection above the underside of the foundation, and for unheated areas, 1.8 m of soil cover frost protection is typically provided.

Where the above cannot be achieved for perimeter foundations, an equivalent combination of soil cover and rigid insulation is installed above the underside of the foundation to mitigate possible soil frost heave movements.

For unheated foundations, a rigid insulation may be placed below the underside of the footing in combination with a frost free granular backfill material, provided the rigid insulation satisfies the required compressive strength requirements to withstand the foundation bearing pressure. All insulation material is to be installed in accordance with the manufactures recommendations.

4.8 Foundation Wall Backfill for Frost Protection & Drainage

To assist in maintaining the proposed residential buildings dry from surface water seepage, it is recommended that exterior grades around the building be sloped away at a 2% gradient or more, for a distance of at least 2.0 m. Roof drains should discharge a minimum of 1.5 m away from the buildings to a drainage swale or appropriate storm drainage system so that surface water is diverted away from the foundation to mitigate soil frost adhesion.

For residential buildings, exterior perimeter foundation drains are also to be installed. The foundation drains should consist of a minimum 100 mm diameter fabric wrapped perforated drainage tile surrounded by 19 mm diameter Clear Stone (OPSS 1004) with a minimum cover of 100 mm on top and sides and 50 mm below the drainage tile. The water collected from the weeping tile should be directed away from the building to appropriate drainage areas, either through gravity flow or interior sump pump systems. All subsurface walls should be damp proofed above the water table and water proofed below the water table.

To minimize potential frost movements from soil frost adhesion, the exterior foundation wall backfill should consist of a free-draining non-frost susceptible granular material, such as a Granular “B” Type I or a Granular “B” Type II (OPSS 1010). The backfill is to extend a minimum lateral distance of 600 mm beyond the outside face of the wall.

The backfill material used against the foundation must be placed so that the allowable lateral capacity is not exceeded. Ideally, during backfilling operations, all backfill material should be placed on each side of the foundation wall in equal lifts not exceeding 200 mm, compacted to a minimum of 97% SPMDD.

4.9 Concrete Floor Slab-on-Grade (Heated Areas Only)

The following recommendations assume that the residential floor slab is not connected to any load bearing walls or columns, and the floor slab is lightly loaded.

The concrete floor slab-on-grade is to be established on a minimum of 150 mm of engineered fill material, consisting of 19 mm Clear Stone (OPSS 1004), combined with an appropriate moisture barrier. The clear stone is to be compacted to a compact state with a vibratory plate tamper.

Prior to the installation of any engineering fill material, all deleterious and organic materials are to be removed down to the undisturbed natural subgrade soils.

Where subgrade soils are wet, it may be necessary to place a non-woven geotextile (Terrafix 270R or equivalent) prior to placing any fill material to act as a separation medium. The geotextile will also minimize the underlying fine grained natural soils from pumping up into the engineered fill due to construction traffic.

4.10 General Reuse of Excavated Material

The natural soils contain a significant amount of silt sized particles, which are considered highly frost susceptible and shouldn't be used as engineered backfill material against any foundation walls.

They may be used for general landscaping purposes, provided they are deemed environmentally safe to do so by a qualified environmental engineering firm.

4.11 Underground Service Pipes

4.11.1 Bedding and Cover Materials for Flexible and Rigid Pipes

Service pipes require an adequate base to ensure proper pipe connection and positive flow is maintained post construction. As such, pipe bedding material is to be of uniform thickness, compactness and shaped to receive the bottom of the pipe. In general, the pipe bedding and backfilling materials are to conform to OPSD 802.010 specifications for flexible pipes.

The pipe bedding material should consist of a minimum thickness of 150 mm Granular A (OPSS 1010) below the pipe and extend up the sides to the spring line. In certain situations, the bedding thickness may have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered. The backfill material surrounding the pipe from the spring line up should consist of a stone free Granular B Type I (OPSS 1010) placed in maximum 200 mm thick loose lifts, at the same elevation on both sides of the pipe and extend to a minimum of 300 mm above the top of the pipe. The granular backfill should be compacted to 98% of SPMDD.

The bedding material, pipe, and cover material should be installed as soon as practically possible after the excavation subgrade is exposed. The longer the excavated subgrade soil remains open to weather conditions and groundwater seepage, the greater the chance for construction problems to occur.

Although not anticipated, where it is difficult to stabilize the subgrade due to groundwater or the material is at a higher than optimum moisture content, a Granular "B" Type II material may be required. Alternatively, if constant groundwater infiltration becomes an issue, then an approximate 150 mm thick granular pad consisting of 19 mm Clear Stone gravel (OPSS 1004) wrapped in a non-woven geotextile (Terrafix 270R or equivalent) should be considered to maintain the integrity of the natural subgrade soils. The clear stone should contain a minimum of 50% crushed particles. An additional 150 mm of Granular "A" installed over the clear stone may also be beneficial for unstable subgrade conditions. Water collected within the stone should be controlled through filtered sumps and pumps.

Provided the subgrade soils remain undisturbed, they will provide adequate support of buried services on conventional granular bedding as dictated by local good ground conditions.

Prior to the installation of any granular fill material, all organics and deleterious materials are to be removed down to the natural undisturbed subgrade soils.

4.11.2 Trench Backfill

Above the pipe cover material to the underside of the pavement structure, the trench can be backfilled by re-using the excavated fill and natural soils matching the materials exposed on the sides of the trenches, provided they are environmentally safe to do so. The soils should be placed to the underside of the granular subbase of the pavement structure, and be compacted in maximum 300 mm thick lifts to 95% SPMDD within 4% of optimum moisture content. This is recommended to provide soil compatibility and help minimize potential abrupt differential frost heave between the local soils and another type of backfill material.

The material must be free of organics or other deleterious material. If it contains deleterious material or it is not utilized, then it should be removed and properly disposed of in accordance with current environmental regulations if/as required.

All stockpiled material should be protected from deleterious materials, additional moisture and be kept from freezing.

Quality control will be of the utmost importance when selecting the material. The selection of the material should be done as early in the contract as possible to allow sufficient time for gradation and proctor testing on representative samples to ensure it meets the projects specifications.

Where the natural soils will be exposed, adequate compaction may prove difficult if the material becomes wet (i.e., above the optimum moisture content). Depending on the moisture content of the natural materials at the time of construction, they may either require moisture to be added or stockpiled and left to dry to achieve moisture content within 4% of optimum. This will be the case for soils excavated below the groundwater table.

Heavy construction equipment and truck traffic should not cross any pipe until at least 1 m of compacted soil is placed above the top of the pipe, or as recommended by the manufacture.

Post compaction settlement of finer grained soils can be expected, even when placed to compaction specifications. As such, fill material should be installed as far in advance as possible before finishing the roadway for best grade integrity.

4.11.3 Water Main Frost Protection

A frost penetration depth of up to 1.8 m can occur in open areas in the Sault Ste. Marie area without snow cover. The underlying natural subgrade soils are considered to have a high frost susceptibility. As such, there is a potential for the water pipes to freeze, heave and move due to frost action, should they be installed with inverts at or higher than about 1.8 m below grade(s). As such, Down to Earth recommends the following possible soil cover frost protection:

- 2.1 m to the spring line of the water main or lower, where the water main has continuous water flow, does not have service connections, and it is not dead-end; and,
- 2.1 m to the top of the pipe for all water mains that have service connections and are dead-end.

If the above cannot be achieved, then the pipe should be insulated with a rigid polystyrene insulation (DOW Styrofoam HI40, or equivalent) or a pre-insulated pipe be utilized.

The insulation design configuration may either consist of placing horizontal insulation to a specified design distance beyond the outside edge of the pipe or an inverted “U” surrounding the top and sides of the pipe. Any method chosen requires suitable design and installation in accordance with the manufactures recommendations. To accommodate the placement of horizontal insulation a wider excavation trench may be required.

4.12 Asphalt Pavement Structure Design

4.12.1 General

The following sections outline the recommended pavement structure design for an asphalt pavement structure.

An estimated functional Design Life of 20 years has been used for the pavement structure design. This is based on an estimated Service Life of 14 to 18 years, which represents the estimated number of years to the first major rehabilitation, e.g. asphalt overlay or resurfacing. The functional Design Life and Service Life assumes regular maintenance, such as, crack sealing, pothole repairs, and etcetera.

All design recommendations assume that no organics are present below the pavement structure. If organics are encountered during excavations, they should be removed to the underlying organic free natural subgrade soil to a maximum depth of about 1.5 m. Below this depth, it is likely cost prohibitive to remove the organics, unless it is at relatively small discrete locations or the majority of them are being removed during the installation of the sewer and water systems.

4.12.2 Asphalt Pavement Structure

The pavement structure design recommendations presented in the following table are based on the information obtained from our geotechnical investigation. The following table presents an asphalt pavement design structure for an Average Annual Daily Traffic (AADT) of 1000 to 2000, and 2000 to 3000 with 10% traffic comprising commercial.

[i] Pavement Material Layer	Compaction Requirements	Pavement Design Thickness AADT 1000 to 2000	Pavement Design Thickness AADT 2000 to 3000
Asphalt Surface Course: Hot Mix Asphalt HL-3 or HL4 (OPSS 1150)	92 to 97% MRD as per OPSS 310	50 mm	40 mm
Asphalt Base Course: Hot Mix Asphalt HL4 or HL-8 (OPSS 1150)	92 to 97% MRD as per OPSS 310	-	50 mm
Base Course: Granular A (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Subbase Course: Granular B Type I (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM D698)	600 mm	600 mm
Non-woven geotextile (Terrafix 270R or equivalent) over subgrade soils			

Notes:

i) If a Granular B Type I (OPSS 1010) is replaced with the Granular B Type II (OPSS 1010), then the thickness of the subbase can be decreased by 100 mm for a crushed quarried bedrock product, or an air cooled blast furnace slag product (nut slag); and,

ii) Prior to placing the pavement structure, the fill and/or natural subgrade soils are to be proof rolled compacted with a minimum 10 tonne non-vibratory steel drum roller, under the direction of geotechnical personnel; and,

iii) If the subgrade soils are dry at the time of construction, a non-woven geotextile (Terrafix 270R or equivalent product) is not required to be installed over the subgrade soils prior to installing any granular fill material. This assumes good construction practices.

4.13.3 Granular B Type I (OPSS 1010) Specifications

Should a Granular B Type I be used within the pavement structure, it is recommended that it contain at least 25% material retained on the No. 4 (4.75 mm) sieve size. Of the 25% of the material retained, a minimum of 10% of the material should have particle sizes between 25 to 150 mm. The material passing the 4.75 mm sieve size is to conform to OPPSS 1010 for a Granular B Type I material.

The above, modified Granular B Type I (OPSS 1010) will provide better performance over a Granular B Type I, that is predominantly comprised of sand material, (i.e. passing the 4.75 mm sieve size).

4.13.4 Granular B Type II (OPSS 1010) Specifications

Should a Granular B Type II be used within the pavement structure, it is recommended that it be obtained from crushing quarried bedrock, or air-cooled blast furnace slag (nut slag). Steel slag and reclaimed materials shall not be used in the production of Granular B Type II.

4.13.5 Pavement Structure Existing Subbase and Subgrade Preparation

The proper placement of base and subbase fill materials becomes very important in addressing the proper load distribution to provide a durable pavement structure.

In general, the natural soils are sensitive to change in moisture content and can become loose/soft if they are subject to additional water exposure or precipitation. Furthermore, they could be easily disturbed if travelled on during construction. As such, where the natural soil will be exposed, it is recommended that the non-woven geotextile and engineered fill be placed immediately upon excavation to protect the integrity of the soil.

The first layer of granular fill should be placed at a minimum thickness of 300 mm (loose) prior to compaction to mitigate disturbance of the underlying natural subgrade soils.

If localized weaker (non-compacted) areas are encountered, these areas should be remediated under the guidance of a geotechnical engineering consultant to help ensure the longevity of the pavement structure.

Depending on the condition of the exposed natural subgrade soils, at the time of construction, Down to Earth can provide recommendations at the time, which may include but not be limited to the following:

- Compaction of the subgrade soil;
- Removal of subgrade material and subsequent replacement with engineered fill; and,
- Placement of geotextile and geogrid.

A geotechnical engineer should be on Site to review the subgrade material and to ensure fill specifications and compaction requirements are achieved. Once the subgrade is approved, it can then be backfilled with the recommended pavement structure materials.

Where underground services will be within the roadway granular fill materials, frost heave tapers as outlined in Section 4.13.7 of this report are to be constructed.

Post compaction settlement of fine-grained soils can be expected, even when placed to compaction specifications. As such, fill material should be installed as far in advance as possible before finishing the roadways for best grade integrity.

4.13.6 Compaction Requirements & Width of Granular Materials

The Granular “A” base and Granular “B” subbase material is to be compacted in maximum 200 mm thick lifts to 100% Standard Proctor Maximum Dry Density (SPMDD). All granular and asphalt materials are to conform to OPSS 1010, 1150 and the City of Sault Ste. Marie specifications.

All granular materials are to be placed full width unless otherwise specified.

4.13.7 Transition Treatment

Should the subgrade material types differ below the underside of the pavement structure, the transition between the materials should be sloped as per frost heave taper OPSD 205.060.

4.13.8 Drainage

Control of surface water is a critical factor in achieving good pavement structure life. The pavement thickness designs are based on a drained pavement subgrade via sub-drains or ditches.

Sub-drains should consist of 150 mm diameter fabric wrapped perforated drainage tile surrounded by 19 mm diameter clear stone (OPSS 1004) with a minimum cover of 150 mm on top and sides and 50 mm below the drainage tile. Since the in-situ soils contain a significant amount of silt sized particles, the clear stone gravel should be wrapped in a non-woven geotextile (Terrafix 270R or equivalent). Any potential ditching should have inverts of at least 500 mm below the underside of the subbase.

The surface of the roadway should be free of depressions. They should be sloped at a minimum grade of 1% in order to drain to appropriate drainage areas. Subgrade soils should slope a minimum grade of 3% toward subdrains or ditches. Positive slopes are very important for the proper performance of the drainage system. The granular base and subbase material should extend horizontally to subdrains and/or ditches.

In addition, routine maintenance of the drainage systems will assist with the longevity of the pavement structure, and should be regularly cleared of debris.

4.13.9 Pavement End Treatment & Tack Coat

The joints between any potential new and previously installed asphalt should be constructed in accordance to OPSS 310.07.11. Tack coating should be applied to the vertical joint surface. The tack coat should follow OPSS 308 and SSP 308S01.

4.14 Site Grade Increases

The natural silty clay soil deposits are susceptible to long-term consolidation settlements with net changes in effective stress caused by increasing the loads on the materials from installing earth/granular fill materials above the current grades.

Provided the existing site grades are not increased by more than 600 mm with earth/granular fill materials, then long-term excessive consolidation settlements of the soils are not expected to be an issue. Any proposed grade increases above the aforementioned will require specific design and potentially additional geotechnical investigation work via borehole drilling.

To keep the loading down, a polystyrene lightweight fill material may also be considered in lieu of earth/granular fill materials, which will also provide insulation frost protection for frost susceptible services should they happen to be in the area where grade increases are required. If this option is considered it would require additional geotechnical engineering review.

5.0 GEOTECHNICAL DESIGN CONSIDERATIONS FOR CONSTRUCTIBILITY

5.1 Open Cut Excavations

5.1.1 General

Where workers must enter trench excavations advanced within unconsolidated overburden soils cut deeper than 1.2 m, the trench excavations should be suitably sloped, braced and/or supported in accordance with the current Ontario Occupational Health and Safety Act (OHSA).

The OHSA recognizes four soil types, which are classified as Type 1, 2, 3 or 4 and associated safe side slopes for unsupported trench excavations cut 1.2 m or deeper, and to a maximum of 6 m:

The stability of the excavations may be affected by surcharge loads, stockpiles of material, as well as groundwater seepage conditions, and as such, must be considered when excavating and designing any potential lateral support systems.

5.1.2 Unconsolidated Soil

It is anticipated that open cut excavations will potentially extend up to approximately 3 to 4 m below the existing grades to accommodate the installation of the sewers.

Based on the subsurface information obtained from within the boreholes, it is anticipated that the excavated overburden material will predominantly consist of silty clay to silt soils.

Based on the OHSA, the in-situ soils may be classified as Type 3 soils above the groundwater table and Type 4 soils below the groundwater table. Temporary excavation side slopes in Type 3 soils should remain stable at a slope of 1H:1V and at 3H:1V in Type 4 soils.

If narrower excavation limits are required, then steel sheet piles, closed shoring, bracing or trench boxes can be used to support the excavations as dictated by ground conditions.

All excavated soils and surcharge loads should be kept a minimum horizontal distance away from the excavation equal to 2 times the depth of the excavation, unless a support system is designed to allow for surcharge loads.

In addition to compliance with the OHSA, the excavation procedures must also be in compliance to any potential other regulatory authorities, such as federal and municipal safety standards.

The in-situ soils can be excavated using conventional earthmoving equipment.

5.2 General Anticipated Groundwater Management (Temporary)

Prior to commencing excavations, it is critical that all existing surface water and potential surface water is controlled and diverted away from the work area to prevent infiltration and subgrade weakening. At no time should excavations be left open for a period of time that will expose them to precipitation and cause subgrade weakening.

It is noted that the permeability of the silty clay to silt material is low to very low and should not require significant effort to remove the release of water from within it.

Unless the groundwater level is controlled, excavations advanced below the water table will experience loosening and sloughing of the base and sides to 3H:1V or flatter. If this scenario occurs the soil bearing capacity will be significantly reduced.

Excavation side slopes and stability below the groundwater will be a function of the contractor’s methodology and ability to effectively dewater the excavation.

It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. The method used should not adversely impact any nearby structures. The contractor should submit their proposal to the prime consultant for review and approval prior to construction. The use of steel sheet piles may be required, and should be considered by the contractor while developing an appropriate dewatering system. A permit to take water may be required from the Ministry of the Environment if the quantity of pumped water exceeds 50,000 L/day. It is the responsibility of the contractor to make this application as required. If required, Down to Earth can help with the application process.

To ensure a stable subgrade and adequate working conditions, it is recommended that the following conditions be fulfilled when dewatering excavations:

- The groundwater control should be maintained until services are installed and backfilled to at least 600 mm above the natural groundwater elevation;
- Until the backfilling is completed, the groundwater is to be kept under full control 24 hours a day, 7 days a week, to avoid base instability and compromised subgrade support soils;
- Effective filters are to be provided, as required to prevent loss of ground;
- Any potential precipitation or seepage entering the excavations should be pumped away immediately (not allowed to pond). It is critical that water be controlled and the subgrade preparation work commence in the dry;
- Additional sump pumps (i.e. backup pumps) and power supply(s) should be readily available to control the groundwater at all times;
- Pumping methods be adopted for groundwater lowering that will not lead to damage of adjacent structures, such as by settlement;
- All collected water is to discharge a sufficient distance away from the excavation to prevent re-entry; and,
- Sediment control measures, such as a silt fence should be installed at the discharge point of the dewatering system; and,
- The utmost care should be taken to avoid any potential impacts on the environment.

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated. As such, depending on the groundwater at the time of the excavation works, a more involved dewatering system may be required.

The soil types should be assessed and confirmed in the field as the excavation works progress by a qualified representative.

The dewatering and excavations should only be performed by competent contractors, that are familiar with this type of construction, and dewatering challenges.

6.0 SITE SUPERVISION & QUALITY CONTROL

It is recommended that all geotechnical aspects of the project be reviewed and confirmed under the appropriate geotechnical supervision, to routinely check such items. This includes but is not limited to inspection and confirmation of the undisturbed natural subgrade soil prior to backfilling, subgrade preparation, engineered fill installation to ensure that the actual conditions are not markedly different than what was observed at the borehole locations and geotechnical components are constructed as per our recommendations. Compaction quality control of engineered fill material is recommended as standard practice, as well as sampling and testing of aggregates, to ensure it meets the physical characteristics for compliance during installation and satisfies all specifications presented within this report.

If appropriate routine geotechnical inspections and quality control are not provided by a Down to Earth representative, then Down to Earth accepts no responsibility for the performance or non-performance of geotechnical components, even if they are ostensibly constructed in accordance with the design recommendations within this report.

7.0 DESIGN REVIEW

Development or design plans and specifications should be reviewed by Down to Earth, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etcetera), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the design team responsible for the project. Down to Earth should be retained to review our recommendations as the design nears completion to ensure that the final design is in general agreement with the assumptions on which our recommendations are based.

8.0 LIMITATIONS

This Geotechnical Investigation report was performed for our Client and their design consultants. The use of this report is subject to the Report Limitations and Guidelines for Use in Appendix E. It is the responsibility of the Client(s), and its agents to review the Report Limitations and Guidelines for Use within.

9.0 CLOSURE

We trust that the foregoing information is satisfactory for your present requirements. Should you have any questions about the report or require additional information, please contact the undersigned.

Yours truly,

Maurice Corriveau, P.Eng.
Principal Engineer
mcorriveau@downtoearthge.com

Steven Hoffman, Civil Eng. Technician
Geotechnical Specialist
shoffman@downtoearthge.com

APPENDIX A

FIGURES

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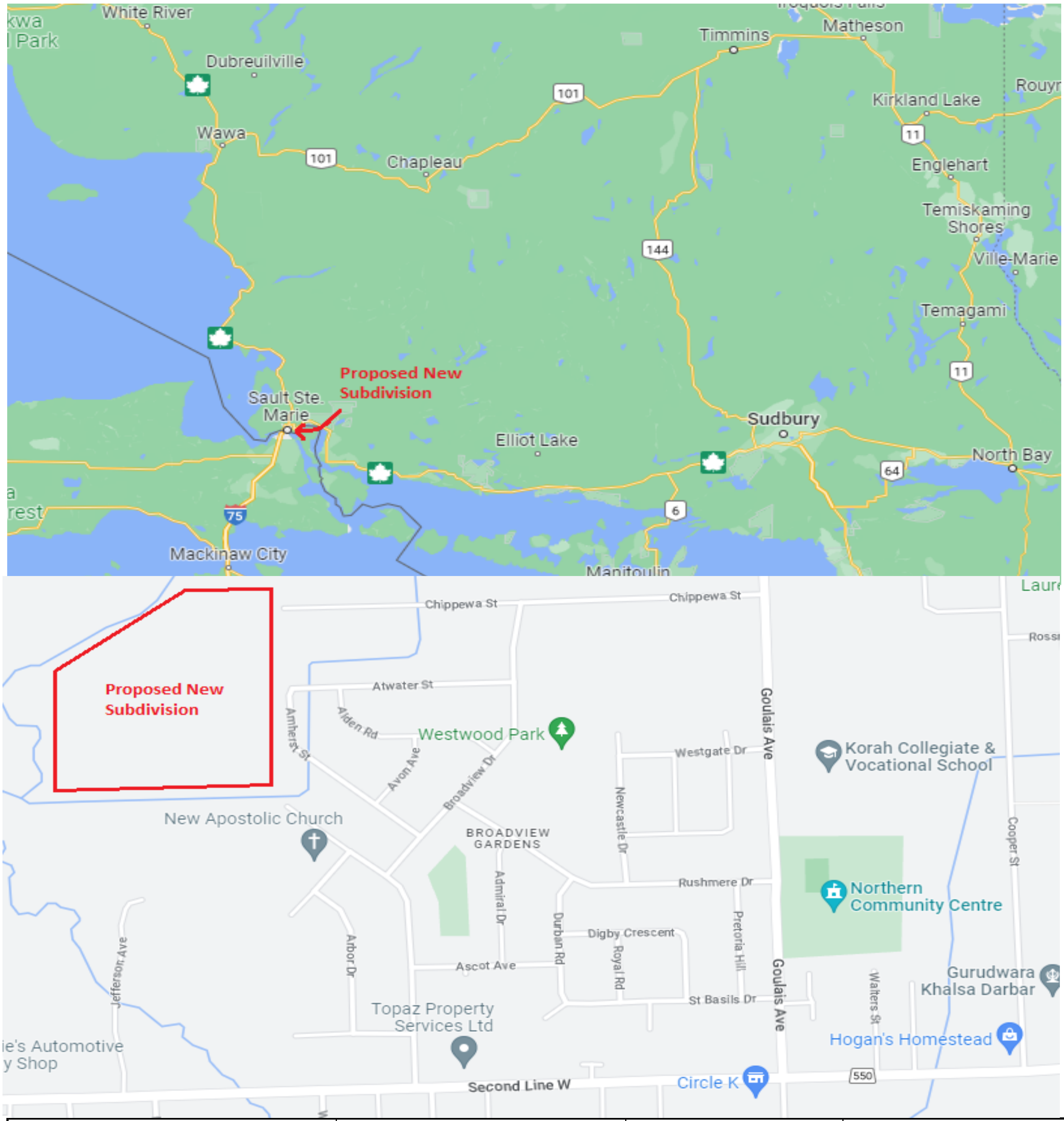

CLIENT	FIGURE NAME	PROJECT NO.	FIGURE NO.
Mamta Homes	General Location Plan	G22042	1
PROJECT	**PROJECT LOCATION**	**DATE**	**SCALE**
Proposed New Subdivision	Chippewa St. Sault Ste Marie, ON	January, 2023	NTS

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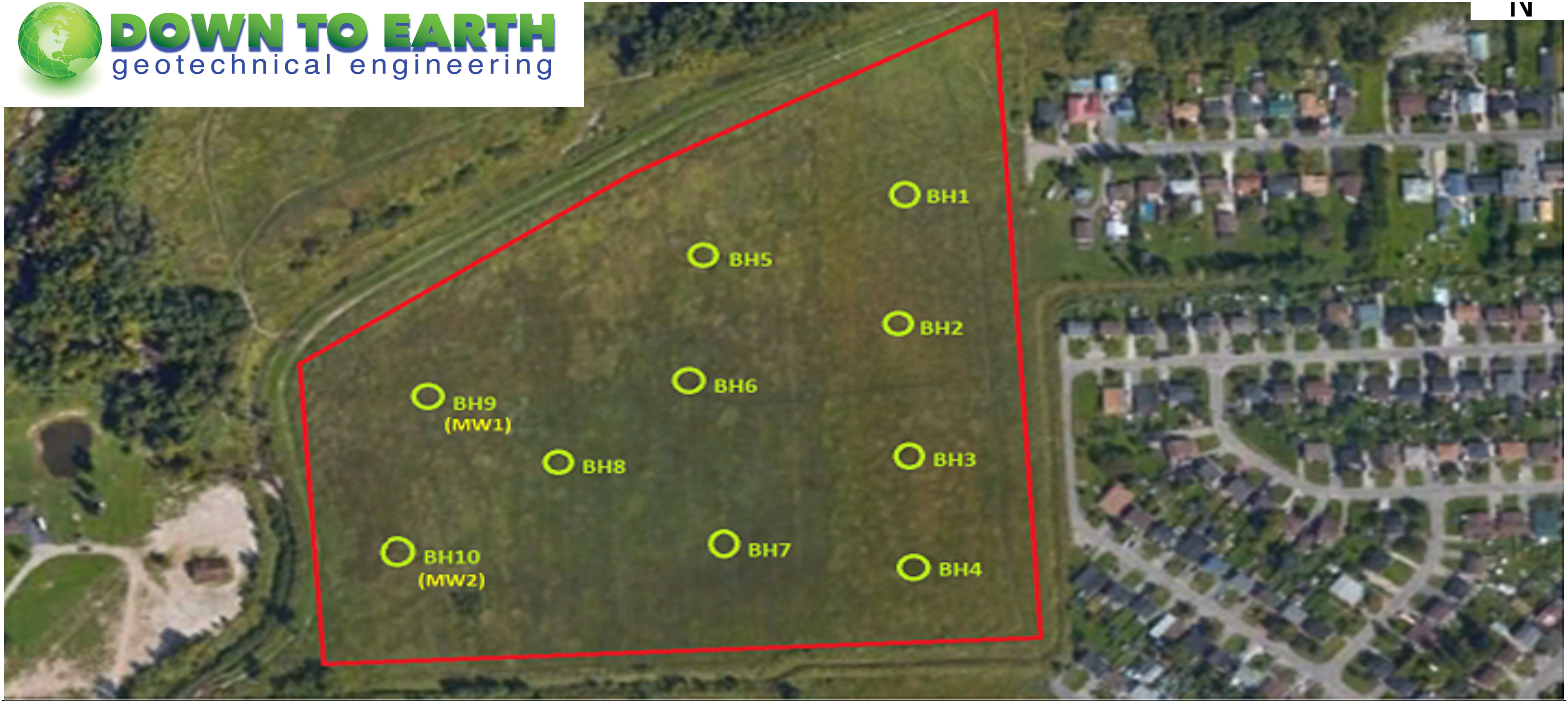

CLIENT	**FIGURE NAME**	**PROJECT NO.**	**FIGURE NO.**
Mamta Homes	Borehole Location Plan (BH 1 - 10)	G22042	2
PROJECT	**PROJECT LOCATION**	**DATE**	**SCALE**
Proposed New Subdivision	Chippewa St. Sault Ste Marie, ON	January, 2023	NTS

APPENDIX B

SYMBOLS USED IN REPORT AND BOREHOLE LOGS

SYMBOLS & TERMS USED IN REPORT, BOREHOLE & TEST PIT LOGS

Soil Descriptions

The soil descriptions and classifications are based on the modified Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained, fine grained, and highly organic soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 76 mm.

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris, etc.) is based upon the proportion of these materials present:

Terminology	Proportion
Trace	Less than 10%
Some	10% to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And	35 to 50%

Notes:

- Soil properties, such as strength, gradation, plasticity, structure, etcetera, dictate the soils engineering behavior over grain size fractions;
- With the exception of soil samples tested for particle size distribution or plasticity, all soil samples have been classified based on visual and tactile observations. The accuracy of visual and tactile observation is not sufficient to differentiate between changes in soil classification or precise grain size and is therefore an approximate description.

The Standard Penetration Test SPT, N-value is used to interpret the compactness condition of cohesionless soils. A relationship between the compactness condition and N-Value is provided in the following table.

Cohesionless Soil	
Compactness Condition	**SPT N-Index (blows per 300 mm)**
Very Loose	<4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

The undrained shear strength as measured by in-situ vane tests, penetrometer tests, or unconfined compression tests, is used to describe the consistency of cohesive soils related to undrained shear strength. A relationship between the undrained shear strength and the SPT, N-value is provided in the following table.

Cohesive Soil		
Consistency	**Undrained Shear Strength (kPa)**	**SPT N-Index (blows per 300 mm)**
Very soft	<12	<2
Soft	12 to 25	2 to 4
Firm	25 to 50	5 to 8
Stiff	50 to 100	9 to 15
Very Stiff	100 to 200	16 to 30
Hard	>200	>30

Note: Utilizing the SPT, N-Index value to correlate the consistency and undrained shear strength of cohesive soils is only very approximate and needs to be used with caution.

Sampling Method

AS	Auger Sample
SS	Split Spoon Sample
ST	Thin Walled Shelby Tube
BS	Block Sample
w	Washed Sample
HQ	Rock Core (63.5 mm diam.)
NQ	Rock Core (47.5 mm diam.)
BQ	Rock Core (36.5 mm diam.)

Rock Coring

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section is broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum.

The following is the Classification of Rock with Respect to RQD Value:

RQD Classification	RQD Value (%)
Very poor quality	<25
Poor quality	25 to 50
Fair quality	50 to 75
Good quality	75 to 90
Excellent quality	90 to 100

APPENDIX C

BOREHOLE LOGS

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BOREHOLE LOG BH1

(Page 1 of 1)

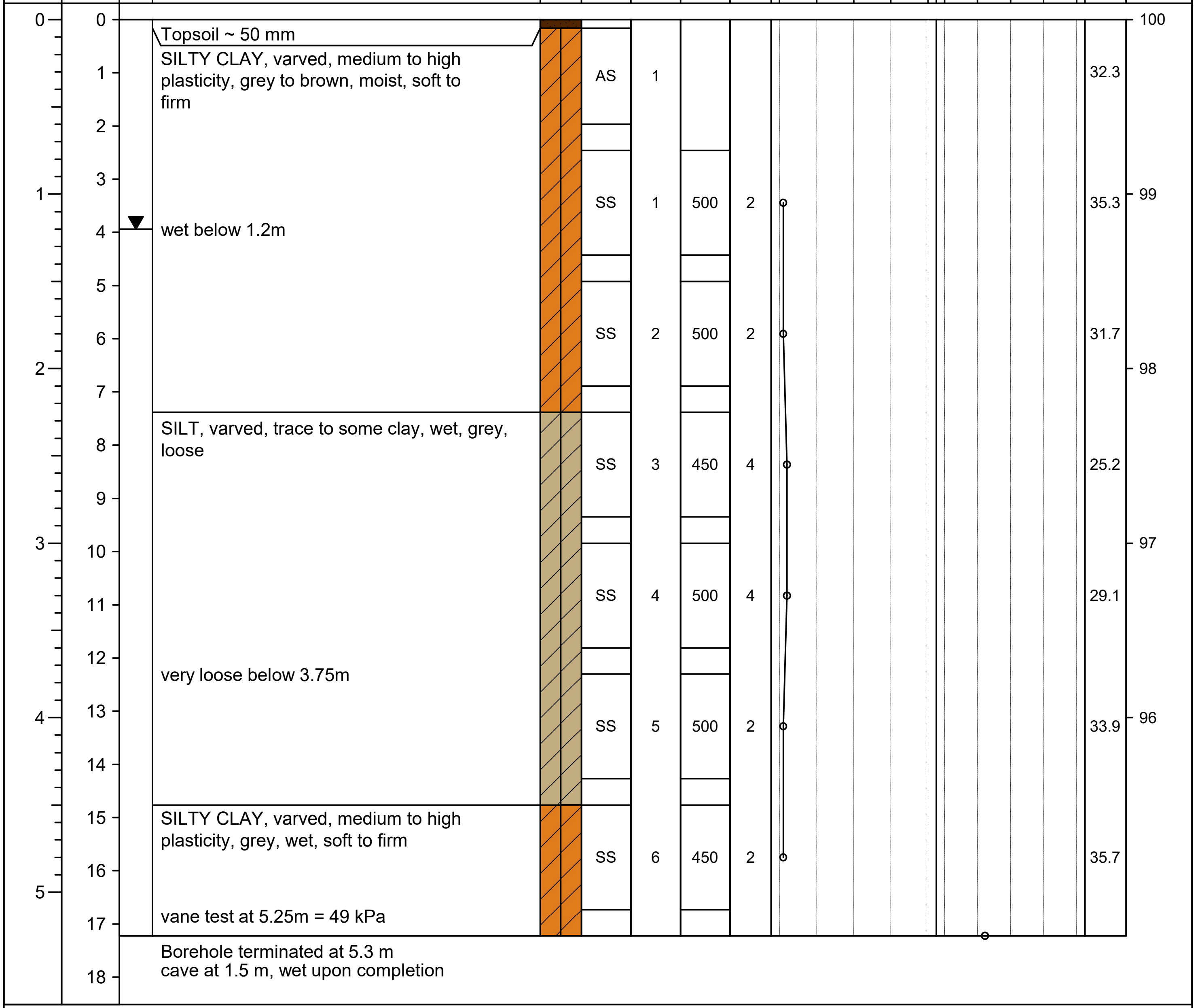
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT : Proposed Subdivision
Date Completed : Jan. 19, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon
Project Location : Chippewa St.
Borehole Location : See Fig.2
Company Rep. : A. Waboose
Surface Elev. : Local

Groundwater Level
▼ Inferred Level
▽ Measured



MATERIAL DESCRIPTION

Topsoil ~ 50 mm

SILTY CLAY, varved, medium to high plasticity, grey to brown, moist, soft to firm

wet below 1.2m

SILT, varved, trace to some clay, wet, grey, loose

very loose below 3.75m

SILTY CLAY, varved, medium to high plasticity, grey, wet, soft to firm

vane test at 5.25m = 49 kPa

Borehole terminated at 5.3 m
cave at 1.5 m, wet upon completion

Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
AS	1			32.3
SS	1	500	2	35.3
SS	2	500	2	31.7
SS	3	450	4	25.2
SS	4	500	4	29.1
SS	5	500	2	33.9
SS	6	450	2	35.7

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH2

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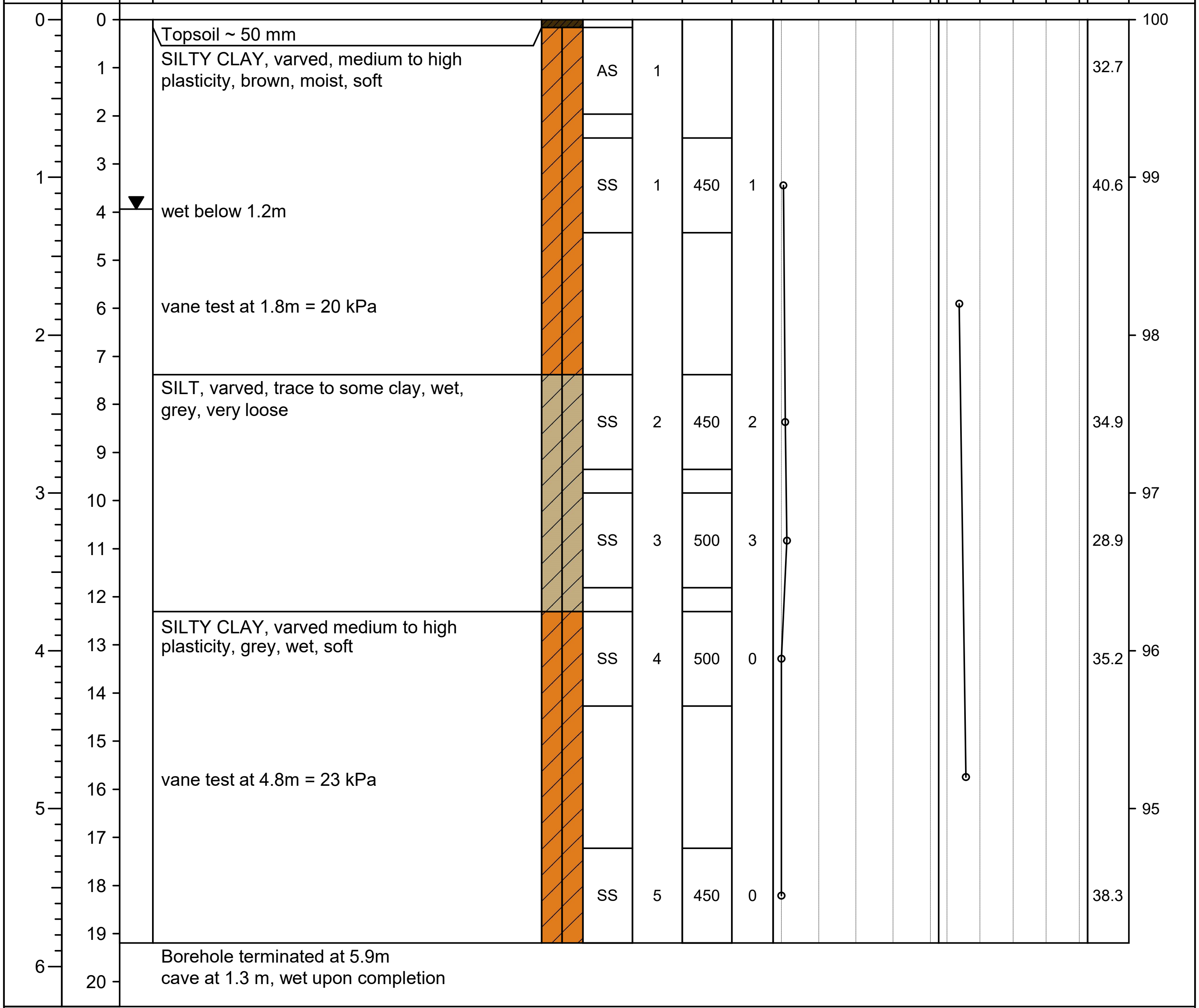
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT : Proposed Subdivision
Date Completed : Jan. 19, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon
Project Location : Chippewa St.
Borehole Location : See Fig.2
Company Rep. : A. Waboose
Surface Elev. : Local

Groundwater Level
▼ Inferred Level
▽ Measured



Water Level	MATERIAL DESCRIPTION	Strata Plot	Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
	Topsoil ~ 50 mm						
	SILTY CLAY, varved, medium to high plasticity, brown, moist, soft		AS	1			32.7
			SS	1	450	1	40.6
▼	wet below 1.2m						
	vane test at 1.8m = 20 kPa						
	SILT, varved, trace to some clay, wet, grey, very loose		SS	2	450	2	34.9
			SS	3	500	3	28.9
	SILTY CLAY, varved medium to high plasticity, grey, wet, soft		SS	4	500	0	35.2
	vane test at 4.8m = 23 kPa						
			SS	5	450	0	38.3

Borehole terminated at 5.9m
cave at 1.3 m, wet upon completion

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH3

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Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

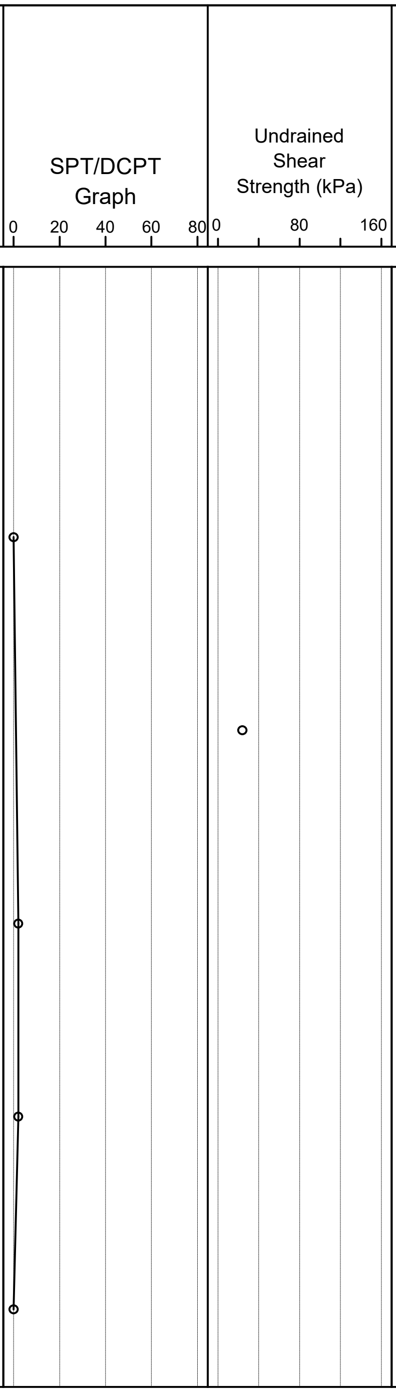
Geotechnical Investigation

PROJECT NO. G22042

PROJECT : Proposed New Subdivision
Date Completed : Jan. 19, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon
Project Location : Chippewa St.
Borehole Location : See Fig.2
Company Rep. : A. Waboose
Surface Elev. : Local

Groundwater Level
▼ Inferred Level
▽ Measured

Depth in Meters	Depth in Feet	Water Level	MATERIAL DESCRIPTION	Strata Plot	Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)	Surf. Elev. (m) 100
0	0		Topsoil ~ 50 mm	■						100
	1		SILTY CLAY, varved, medium to high plasticity, brown, moist, soft	▨	AS	1			37.2	
1	3			▨	SS	1	400	0	36	99
	4	▼	wet below 1.2m	▨						
	6		vane test at 1.8m for 24 kPa	▨						
2	7			▨						98
	8		SILT, varved, trace to some clay, grey, wet, very loose	▨	SS	2	450	2	35.3	
3	10			▨						97
	11			▨	SS	3	500	2	31.4	
4	13		SILTY CLAY, varved, medium to high plasticity, brown, wet, soft	▨	SS	4	500	0	35.7	
	15		Borehole terminated at 5.4m cave at 1.3 m, wet upon completion							



This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH4

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Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

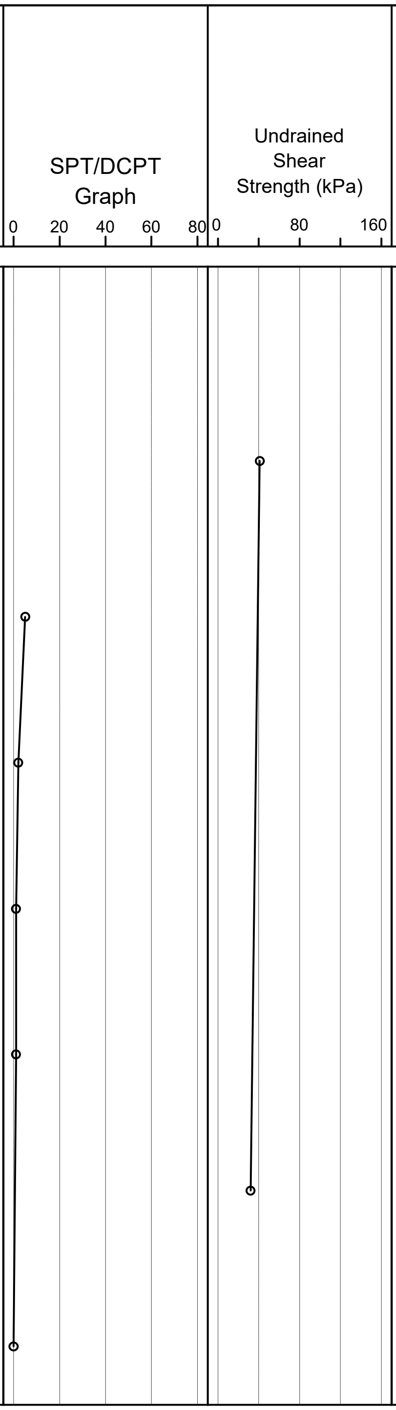
PROJECT NO. G22042

PROJECT : Proposed New Subdivision
Date Completed : Jan. 20, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon
Project Location : Chippewa St.
Borehole Location : See Fig.2
Company Rep. : A. Waboose
Surf. Elev. : Local

Groundwater Level
▼ Inferred Level
▽ Measured

Water Level	MATERIAL DESCRIPTION	Strata Plot	Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
	Topsoil ~ 50 mm						
	SILTY CLAY, medium to high plasticity, brown, moist, firm	▨	AS	1			27.9
	vane at 1m = 41 kPa	▨					
▼	wet below 1.2m	▨					
	SILT, trace to some clay, grey, wet, loose	▨	SS	1	450	5	28
	very loose below 2.3m	▨	SS	2	450	2	36
		▨	SS	3	500	1	27.2
	SILTY CLAY, medium to high plasticity, brown, wet, firm	▨	SS	4	500	1	40.5
	vane at 4.8m = 32 kPa	▨					
		▨	SS	5	500	0	47.1

Borehole terminated at 5.9m
cave at 1m, wet upon completion



This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

DOWN TO EARTH
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BOREHOLE LOG BH5

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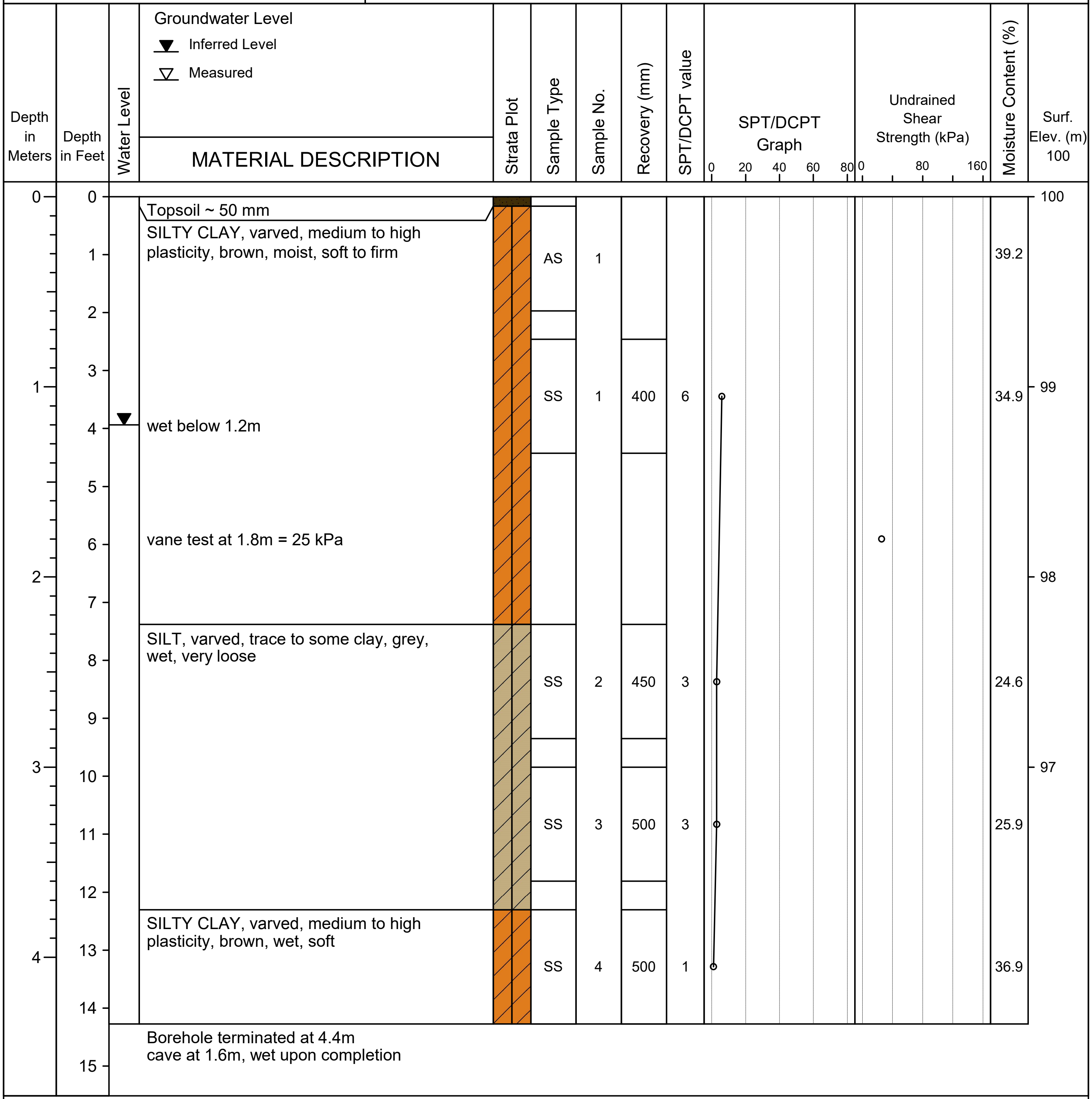
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT : Proposed New Subdivision
Date Completed : Jan. 20, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon
Project Location : Chippewa St.
Borehole Location : See Fig.2
Company Rep. : A. Waboose
Surface Elev. : Local

Groundwater Level
▼ Inferred Level
▽ Measured



MATERIAL DESCRIPTION	Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
Topsoil ~ 50 mm					
SILTY CLAY, varved, medium to high plasticity, brown, moist, soft to firm	AS	1			39.2
	SS	1	400	6	34.9
wet below 1.2m					
vane test at 1.8m = 25 kPa					
SILT, varved, trace to some clay, grey, wet, very loose	SS	2	450	3	24.6
	SS	3	500	3	25.9
SILTY CLAY, varved, medium to high plasticity, brown, wet, soft	SS	4	500	1	36.9

Borehole terminated at 4.4m
cave at 1.6m, wet upon completion

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BORHOLE LOG BH6

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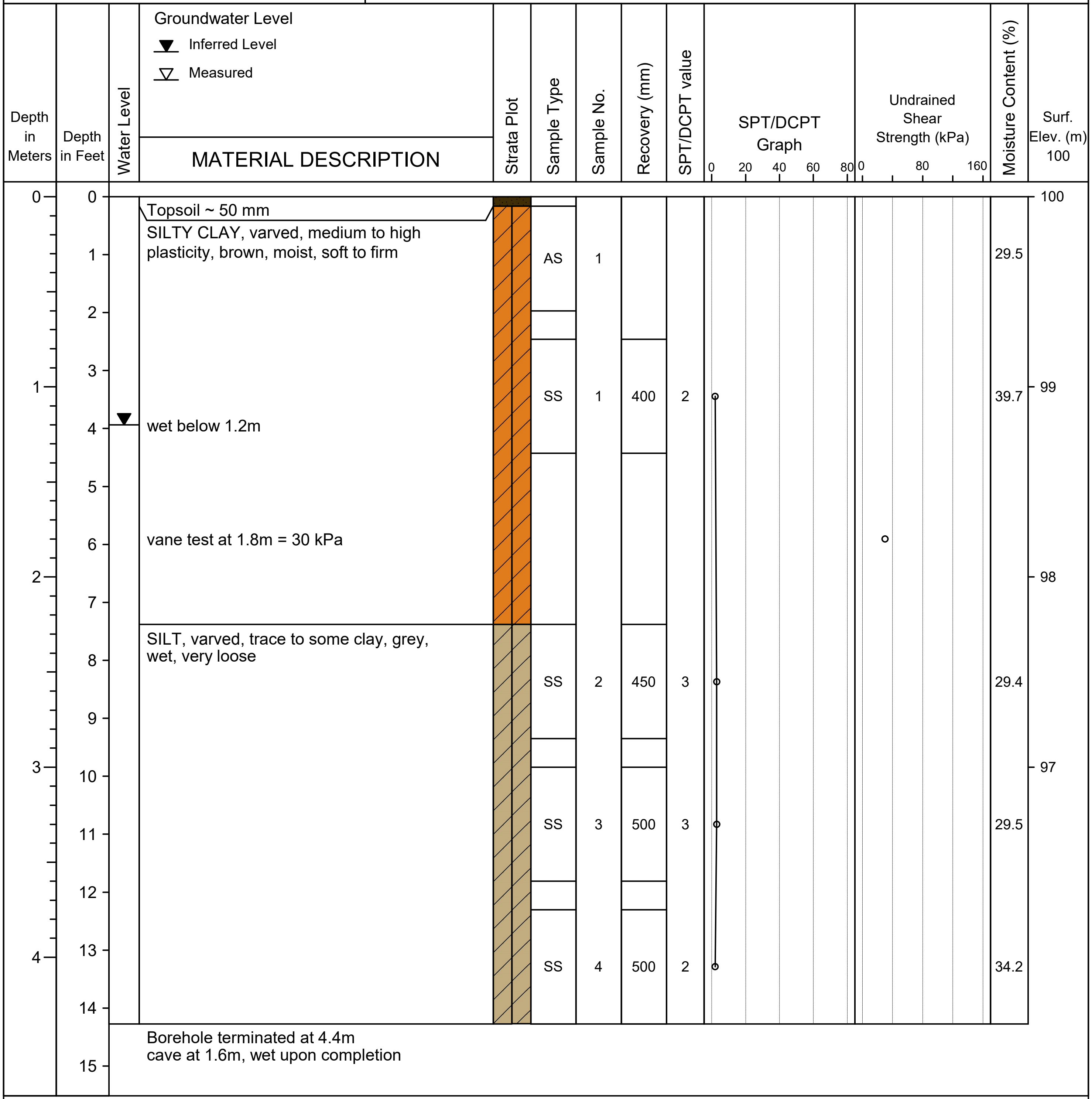
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT	: Proposed New Subdivision		
Date Completed	: Jan. 20, 2023	Project Location	: Chippewa St.
Hole Diameter	: 150 mm	Borehole Location	: See Fig.2
Drilling Method	: Hollow Stem Auger	Company Rep.	: A. Waboose
Sampling Method	: Split Spoon	Surface Elev.	: Local

Groundwater Level
▼ Inferred Level
▽ Measured



Topsoil ~ 50 mm

SILTY CLAY, varved, medium to high plasticity, brown, moist, soft to firm

wet below 1.2m

vane test at 1.8m = 30 kPa

SILT, varved, trace to some clay, grey, wet, very loose

Borehole terminated at 4.4m
cave at 1.6m, wet upon completion

Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
AS	1			29.5
SS	1	400	2	39.7
SS	2	450	3	29.4
SS	3	500	3	29.5
SS	4	500	2	34.2

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH7

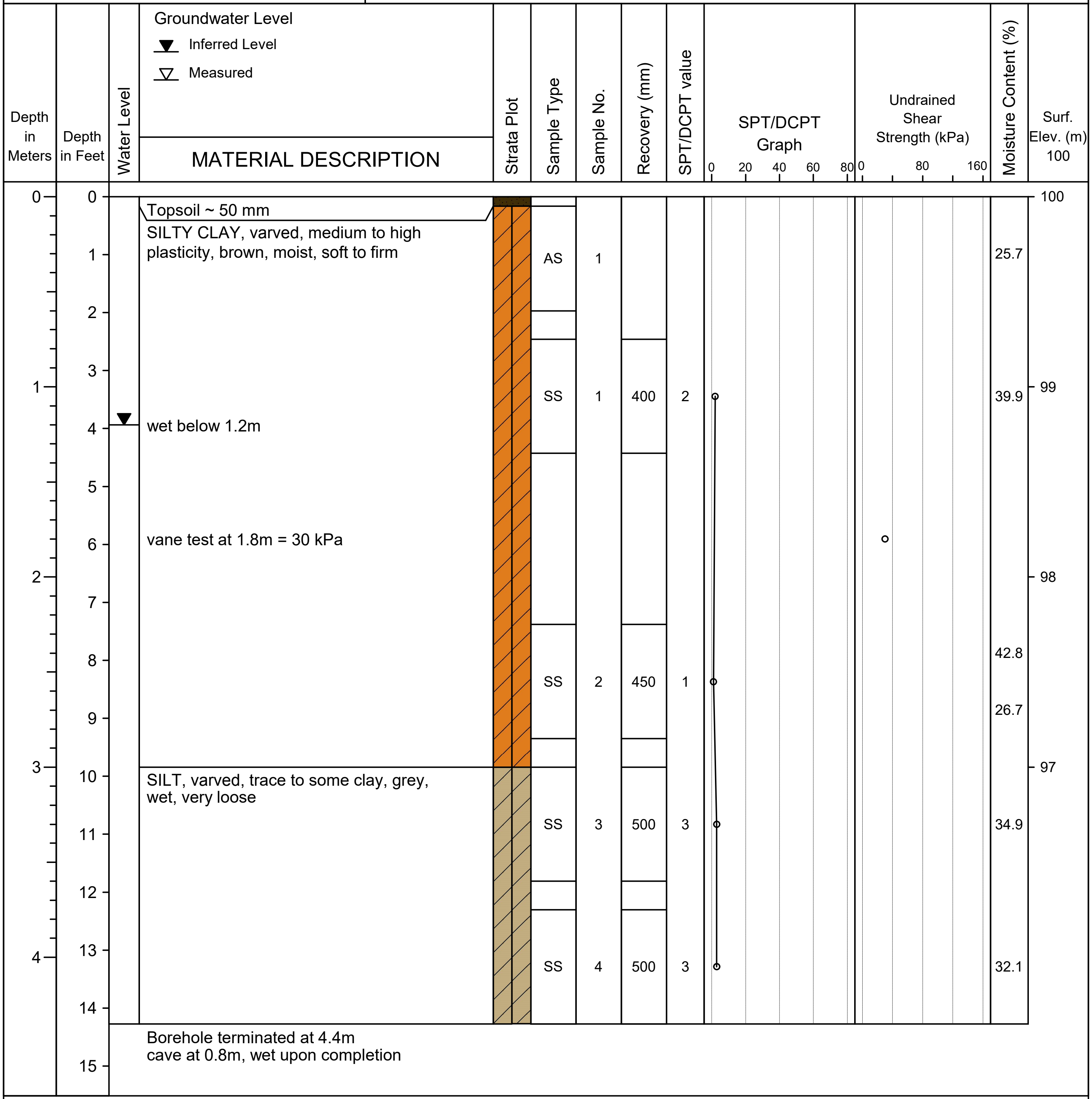
(Page 1 of 1)

Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT	: Proposed New Subdivision		
Date Completed	: Jan. 23, 2023	Project Location	: Chippewa St.
Hole Diameter	: 150 mm	Borehole Location	: See Fig.2
Drilling Method	: Hollow Stem Auger	Company Rep.	: A. Waboose
Sampling Method	: Split Spoon	Surface Elev.	: Local



Depth in Meters	MATERIAL DESCRIPTION	Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
0	Topsoil ~ 50 mm					
	SILTY CLAY, varved, medium to high plasticity, brown, moist, soft to firm	AS	1			25.7
		SS	1	400	2	39.9
	wet below 1.2m					
	vane test at 1.8m = 30 kPa					
		SS	2	450	1	42.8 26.7
3	SILT, varved, trace to some clay, grey, wet, very loose	SS	3	500	3	34.9
		SS	4	500	3	32.1

Borehole terminated at 4.4m
cave at 0.8m, wet upon completion

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH8

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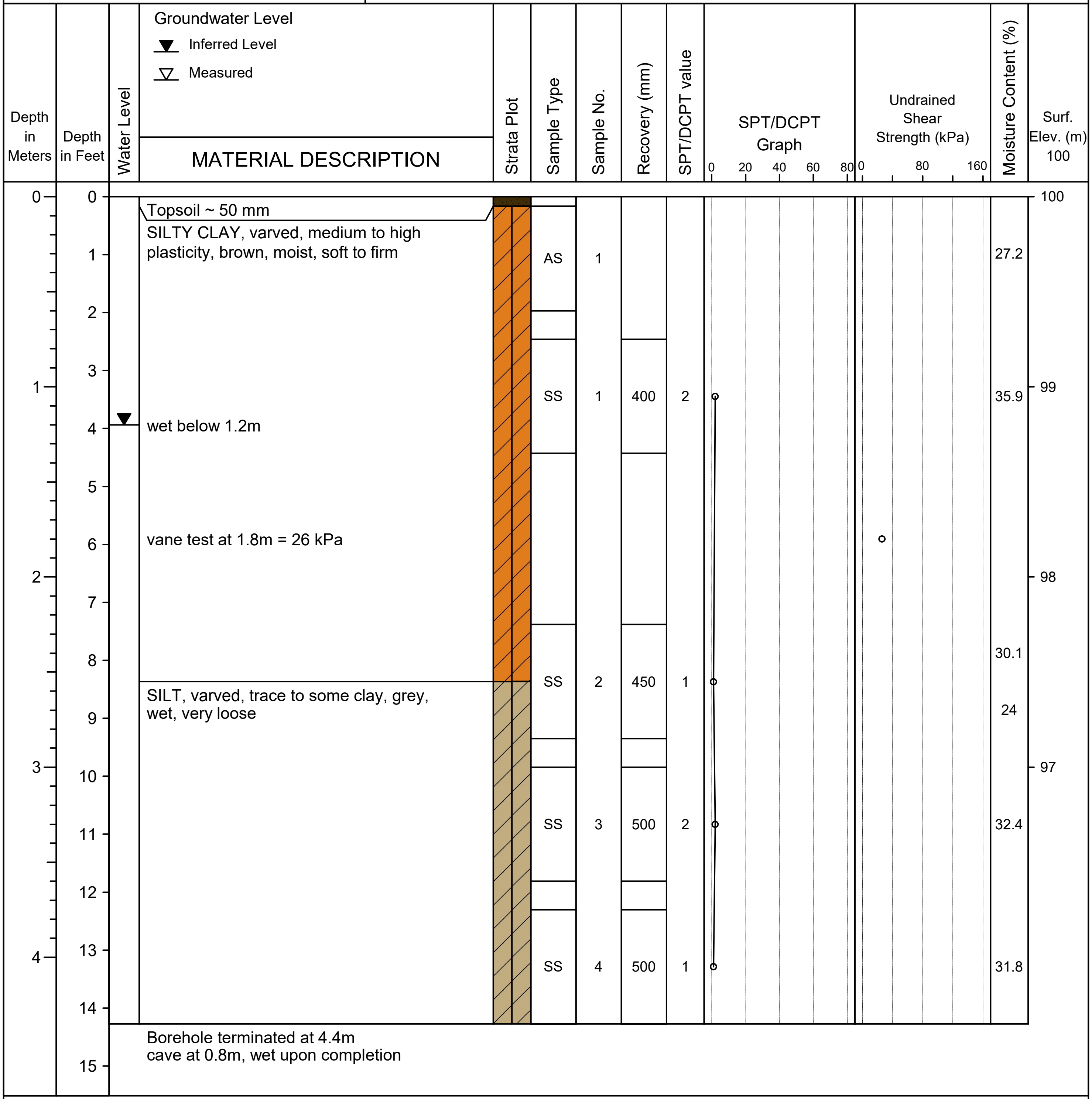
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT : Proposed New Subdivision
Date Completed : Jan. 23, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon
Project Location : Chippewa St.
Borehole Location : See Fig.2
Company Rep. : A. Waboose
Surface Elev. : Local

Groundwater Level
▼ Inferred Level
▽ Measured



MATERIAL DESCRIPTION

Topsoil ~ 50 mm

SILTY CLAY, varved, medium to high plasticity, brown, moist, soft to firm

wet below 1.2m

vane test at 1.8m = 26 kPa

SILT, varved, trace to some clay, grey, wet, very loose

Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
AS	1			27.2
SS	1	400	2	35.9
SS	2	450	1	30.1 24
SS	3	500	2	32.4
SS	4	500	1	31.8

Borehole terminated at 4.4m
cave at 0.8m, wet upon completion

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH9 (MW1)

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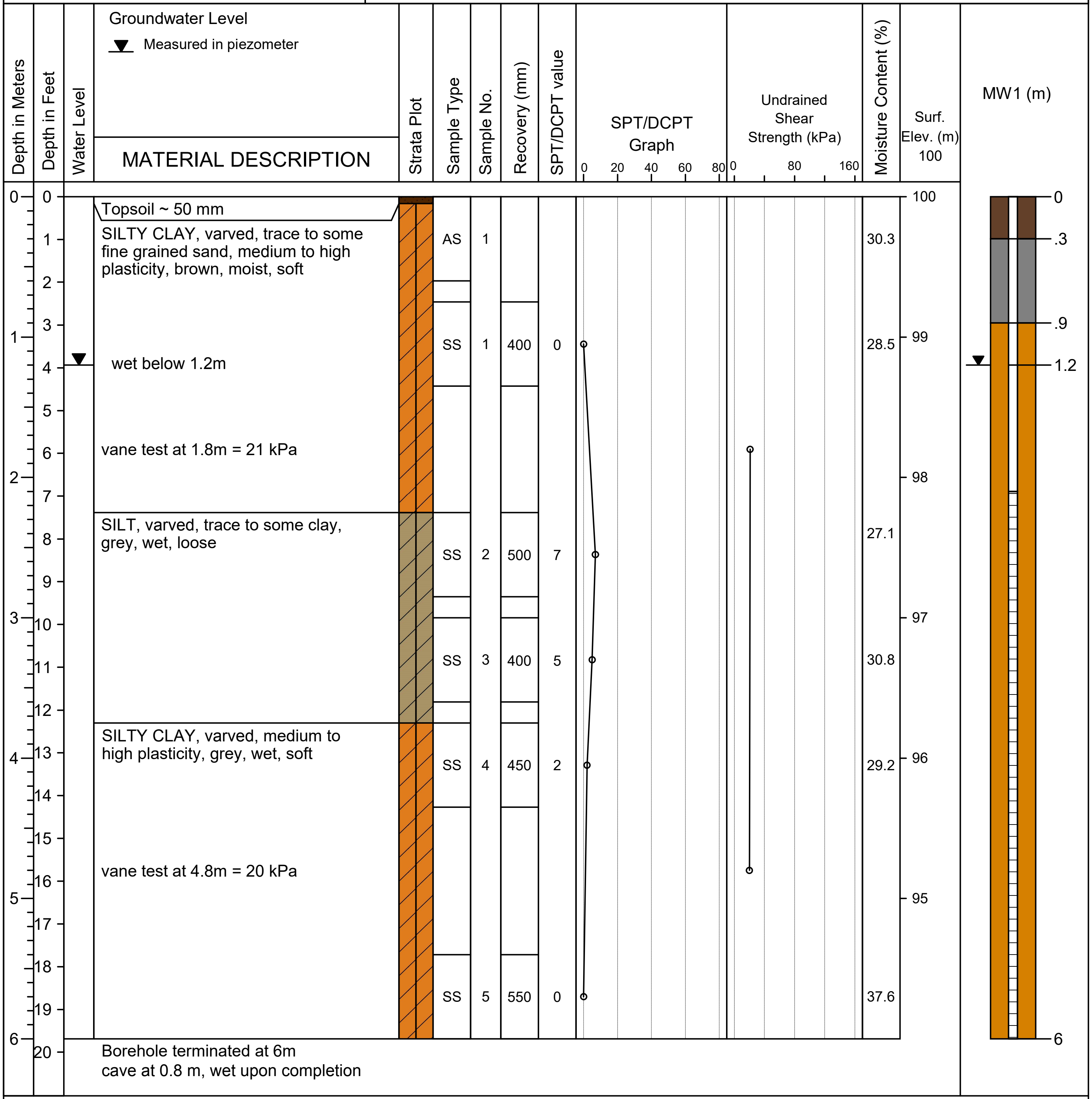
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT	: Proposed New Subdivision		
Date Completed	: Jan, 24, 2023	Project Location	: Chippewa St.
Hole Diameter	: 150 mm	Borehole Location	: See Figure No.2
Drilling Method	: Hollow Stem Auger	Company Rep.	: A. Waboose
Sampling Method	: Split Spoon	Surface Elev.	: local



MATERIAL DESCRIPTION

Topsoil ~ 50 mm

SILTY CLAY, varved, trace to some fine grained sand, medium to high plasticity, brown, moist, soft

wet below 1.2m

vane test at 1.8m = 21 kPa

SILT, varved, trace to some clay, grey, wet, loose

SILTY CLAY, varved, medium to high plasticity, grey, wet, soft

vane test at 4.8m = 20 kPa

Borehole terminated at 6m
cave at 0.8 m, wet upon completion

Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
AS	1			30.3
SS	1	400	0	28.5
SS	2	500	7	27.1
SS	3	400	5	30.8
SS	4	450	2	29.2
SS	5	550	0	37.6

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

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BOREHOLE LOG BH10 (MW2)

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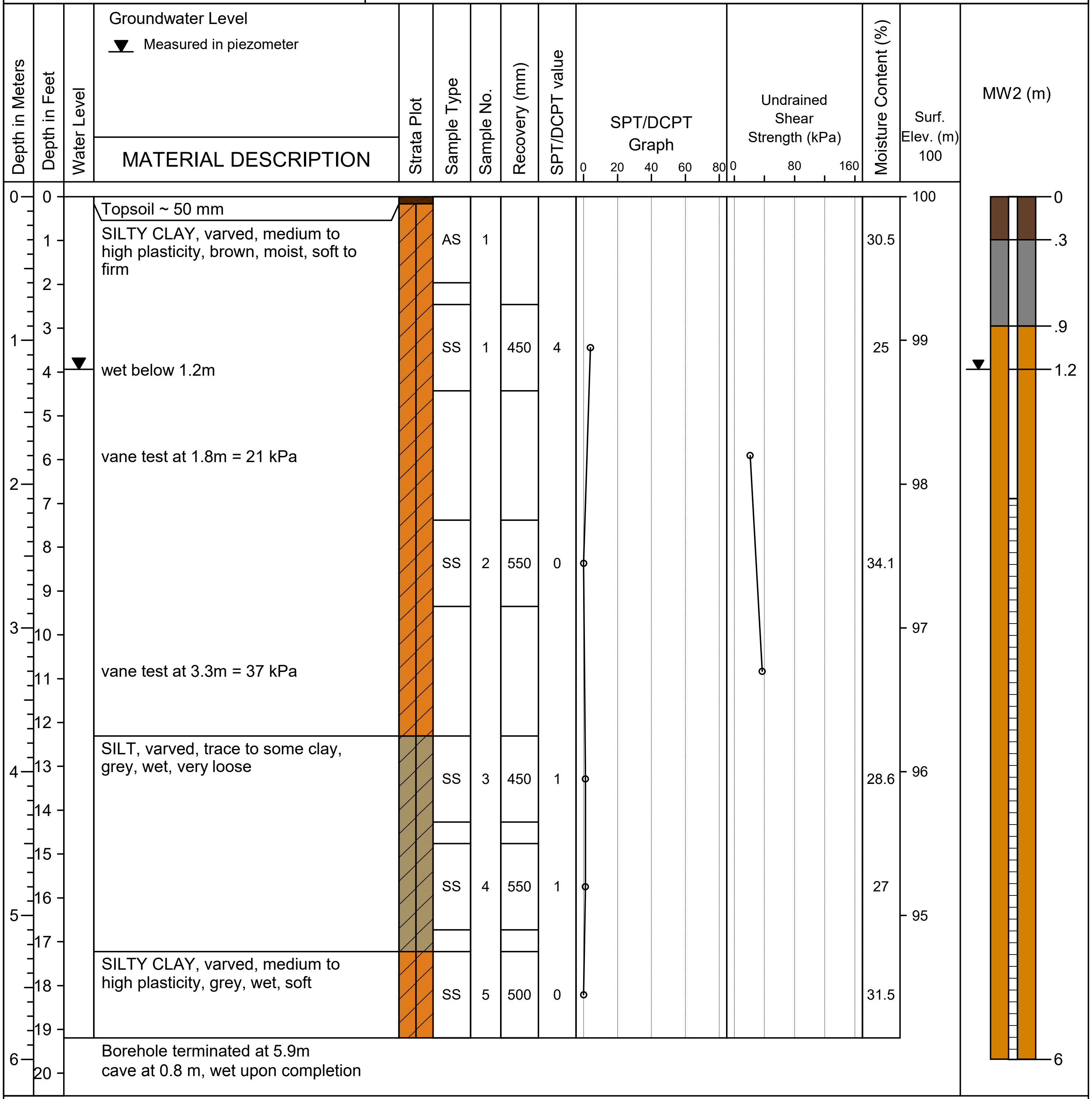
Proposed New Subdivision
0 Chippewa Street
Sault Ste. Marie, ON

Geotechnical Investigation

PROJECT NO. G22042

PROJECT : Proposed Subdivision
Date Completed : Jan, 24, 2023
Hole Diameter : 150 mm
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Project Location : Chippewa St.
Borehole Location : See Figure No.2
Company Rep. : A. Waboose
Surface Elev. : local



MATERIAL DESCRIPTION

Topsoil ~ 50 mm

SILTY CLAY, varved, medium to high plasticity, brown, moist, soft to firm

wet below 1.2m

vane test at 1.8m = 21 kPa

vane test at 3.3m = 37 kPa

SILT, varved, trace to some clay, grey, wet, very loose

SILTY CLAY, varved, medium to high plasticity, grey, wet, soft

Borehole terminated at 5.9m
cave at 0.8 m, wet upon completion

Sample Type	Sample No.	Recovery (mm)	SPT/DCPT value	Moisture Content (%)
AS	1			30.5
SS	1	450	4	25
SS	2	550	0	34.1
SS	3	450	1	28.6
SS	4	550	1	27
SS	5	500	0	31.5

This information pertains to this boring only, and subsurface conditions may differ throughout the investigated area(s).

AS = Auger Sample, SS = Split Spoon Sample, ST = Shelby Tube, GS = Grab Sample, RC= Rock Core

APPENDIX D

LABORATORY SOIL TESTING REPORTS

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253 Old Garden River Road
Sault Ste. Marie, ON
P6B 5A7

MOISTURE CONTENTS

Tested in accordance with LS-701 (ASTM D 2216)

Project:	Proposed Subdivision		Contract Number:	G22042
Location:	0 Chippewa Street		Client:	Mamta Homes
Date Sampled:	Monday, January 23, 2023		Sampled By:	A. Waboose
Date Tested:	Tuesday, January 31, 2023		Tested By:	A. Waboose

BOREHOLE NUMBER	**BH 1**	**BH 1**	**BH 1**	**BH 1**	**BH1**	**BH1**	**BH1**	
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**	**SS6**	
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**1.8**	**2.6**	**3.3**	**4.1**	**4.8**	
MASS OF WET SOIL + TARE (g)	147.5	129.1	133.7	187.0	216.1	146.0	138.4	
MASS OF DRY SOIL + TARE (g)	134.2	120.3	124.8	168.1	189.2	132.4	126.3	
MASS OF TARE (g)	93.0	95.4	96.7	93.1	96.8	92.3	92.4	
WATER CONTENT (%)	**32.3%**	**35.3%**	**31.7%**	**25.2%**	**29.1%**	**33.9%**	**35.7%**	

BOREHOLE NUMBER	**BH 2**	**BH 2**	**BH 2**	**BH 2**	**BH2**	**BH2**		
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**		
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.6**	**3.3**	**4.1**	**5.6**		
MASS OF WET SOIL + TARE (g)	147.5	133.1	159.5	147.7	156.9	196.4		
MASS OF DRY SOIL + TARE (g)	134.4	121.6	142.1	135.5	139.9	168.1		
MASS OF TARE (g)	94.3	93.3	92.2	93.3	91.6	94.2		
WATER CONTENT (%)	**32.7%**	**40.6%**	**34.9%**	**28.9%**	**35.2%**	**38.3%**		

BOREHOLE NUMBER	**BH3**	**BH3**	**BH3**	**BH3**	**BH3**	**BH3**	**BH3**	**BH3**
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**			
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.6**	**3.3**	**4.1**			
MASS OF WET SOIL + TARE (g)	161.3	147.6	156.4	140.7	168.4			
MASS OF DRY SOIL + TARE (g)	142.9	133.0	140.2	129.0	148.9			
MASS OF TARE (g)	93.4	92.4	94.3	91.7	94.3			
WATER CONTENT (%)	**37.2%**	**36.0%**	**35.3%**	**31.4%**	**35.7%**			

BOREHOLE NUMBER	**BH4**	**BH4**	**BH4**	**BH4**	**BH4**	**BH4**		
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**		
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.8**	**2.4**	**3.3**	**4.1**	**5.6**		
MASS OF WET SOIL + TARE (g)	145.5	136.3	112.5	186.2	147.4	154.1		
MASS OF DRY SOIL + TARE (g)	134.1	126.7	107.5	166.0	132.1	133.8		
MASS OF TARE (g)	93.3	92.4	93.6	91.8	94.3	90.7		
WATER CONTENT (%)	**27.9%**	**28.0%**	**36.0%**	**27.2%**	**40.5%**	**47.1%**		

Comments:

MOISTURE CONTENTS

Tested in accordance with LS-701 (ASTM D 2216)

Project:	Proposed Subdivision	Contract Number:	G22042
Location:	0 Chippewa Street	Client:	Mamta Homes
Date Sampled:	Monday, January 23, 2023	Sampled By:	A. Waboose
Date Tested:	Tuesday, January 31, 2023	Tested By:	A. Waboose

BOREHOLE NUMBER	**BH5**	**BH5**	**BH5**	**BH5**	**BH5**			
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**			
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.6**	**3.3**	**4.1**			
MASS OF WET SOIL + TARE (g)	119.1	121.1	165.9	133.9	159.9			
MASS OF DRY SOIL + TARE (g)	111.1	112.7	151.4	124.3	143.2			
MASS OF TARE (g)	90.7	88.6	92.5	87.3	97.9			
WATER CONTENT (%)	**39.2%**	**34.9%**	**24.6%**	**25.9%**	**36.9%**			

BOREHOLE NUMBER	**BH6**	**BH6**	**BH6**	**BH6**	**BH6**			
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**			
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.6**	**3.3**	**4.1**			
MASS OF WET SOIL + TARE (g)	238.8	250.1	303.6	295.9	333.2			
MASS OF DRY SOIL + TARE (g)	229.1	236.3	282.4	282.7	309.0			
MASS OF TARE (g)	196.2	201.5	210.4	238.0	238.2			
WATER CONTENT (%)	**29.5%**	**39.7%**	**29.4%**	**29.5%**	**34.2%**			

BOREHOLE NUMBER	**BH7**	**BH7**	**BH7**	**BH7**	**BH7**	**BH7**		
SAMPLE NUMBER	**AS1**	**SS1**	**SS2a**	**SS2b**	**SS3**	**SS4**		
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.4**	**2.7**	**3.3**	**4.1**		
MASS OF WET SOIL + TARE (g)	197.6	151.3	164.9	106.5	160.8	164.5		
MASS OF DRY SOIL + TARE (g)	175.7	133.4	143.2	102.5	143.1	148.2		
MASS OF TARE (g)	90.6	88.5	92.5	87.5	92.4	97.4		
WATER CONTENT (%)	**25.7%**	**39.9%**	**42.8%**	**26.7%**	**34.9%**	**32.1%**		

BOREHOLE NUMBER	**BH8**	**BH8**	**BH8**	**BH8**	**BH8**	**BH8**		
SAMPLE NUMBER	**AS1**	**SS1**	**SS2a**	**SS2b**	**SS3**	**SS4**		
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.4**	**2.7**	**3.3**	**4.1**		
MASS OF WET SOIL + TARE (g)	166.4	260.6	274.6	275.9	324.5	340.6		
MASS OF DRY SOIL + TARE (g)	151.0	243.6	259.8	268.8	303.4	317.1		
MASS OF TARE (g)	94.3	196.2	210.7	239.2	238.3	243.3		
WATER CONTENT (%)	**27.2%**	**35.9%**	**30.1%**	**24.0%**	**32.4%**	**31.8%**		

Comments:

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MOISTURE CONTENTS

Tested in accordance with LS-701 (ASTM D 2216)

Project:	Proposed Subdivision
Location:	0 Chippewa Street
Date Sampled:	Monday, January 23, 2023
Date Tested:	Tuesday, January 31, 2023

Contract Number:	G22042
Client:	Mamta Homes
Sampled By:	A. Waboose
Tested By:	A. Waboose

BOREHOLE NUMBER	**BH9**	**BH9**	**BH9**	**BH9**	**BH9**	**BH9**		
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**		
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.4**	**3.3**	**4.1**	**5.7**		
MASS OF WET SOIL + TARE (g)	183.9	170.7	124.1	116.4	132.3	149.9		
MASS OF DRY SOIL + TARE (g)	162.8	154.0	118.4	111.2	123.3	136.1		
MASS OF TARE (g)	93.2	95.4	97.4	94.3	92.5	99.4		
WATER CONTENT (%)	**30.3%**	**28.5%**	**27.1%**	**30.8%**	**29.2%**	**37.6%**		

BOREHOLE NUMBER	**BH10**	**BH10**	**BH10**	**BH10**	**BH10**	**BH10**		
SAMPLE NUMBER	**AS1**	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**		
LAB NUMBER								
DEPTH OF SAMPLE (m)	**0.3**	**1.1**	**2.6**	**4.1**	**4.8**	**5.6**		
MASS OF WET SOIL + TARE (g)	155.0	276.3	179.0	170.0	170.7	152.2		
MASS OF DRY SOIL + TARE (g)	139.3	261.3	156.0	152.8	154.1	138.1		
MASS OF TARE (g)	87.8	201.4	88.6	92.7	92.6	93.3		
WATER CONTENT (%)	**30.5%**	**25.0%**	**34.1%**	**28.6%**	**27.0%**	**31.5%**		

BOREHOLE NUMBER								
SAMPLE NUMBER								
LAB NUMBER								
DEPTH OF SAMPLE (m)								
MASS OF WET SOIL + TARE (g)								
MASS OF DRY SOIL + TARE (g)								
MASS OF TARE (g)								
WATER CONTENT (%)								

BOREHOLE NUMBER								
SAMPLE NUMBER								
LAB NUMBER								
DEPTH OF SAMPLE (m)								
MASS OF WET SOIL + TARE (g)								
MASS OF DRY SOIL + TARE (g)								
MASS OF TARE (g)								
WATER CONTENT (%)								

Comments:

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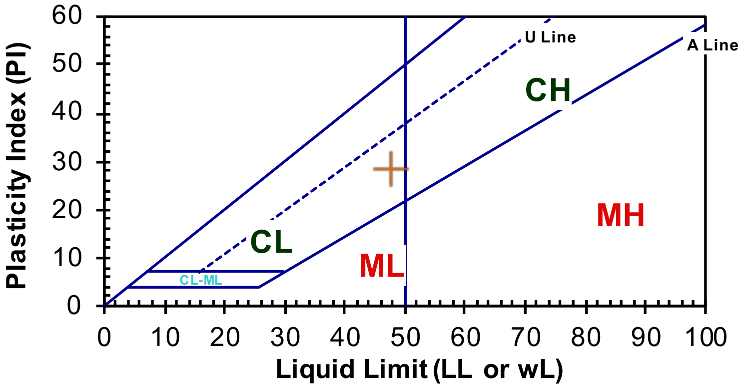
ATTERBERG LIMITS

Tested in accordance with LS-703/704 (ASTM D4318)

Project:	Proposed Subdivision, 0 Chipewa St.	Contract Number:	G22042
Sample Number:	BH1, SS1	Sample Depth:	0.8 m - 1.4 m
Date Sampled:	19-Jan-23	Sampled By:	S.Hoffman
Date Tested:	08-Feb-23	Tested By:	S.Hoffman

TEST			PLASTIC LIMIT				LIQUID LIMIT			
Variable	NO		1	2	3	4	1	2	3	4
	Var.	Units								
Number of Blows	N	blows					16	20	31	
Can Number	---	---	A	B	C		E	G	J	
Mass of Empty Can	M_C	(g)	13.59	13.67	13.62		13.62	13.66	13.70	
Mass Can & Soil (Wet)	M_{CMS}	(g)	18.01	17.26	18.05		30.03	27.40	28.92	
Mass Can & Soil (Dry)	M_{CDS}	(g)	17.29	16.67	17.34		24.70	23.00	24.01	
Mass of Soil	M_S	(g)	3.70	3.00	3.72		11.08	9.34	10.31	
Mass of Water	M_W	(g)	0.72	0.59	0.71		5.33	4.40	4.91	
Water Content	*w*	(%)	19.5	19.7	19.1		48.1	47.1	47.6	

Liquid Limit (LL or w_L) (%):	47.6
Plastic Limit (PL or w_P) (%):	19.4
Plasticity Index (PI) (%):	28.2
USCS Classification:	



PI at "A" Line = 0.73(LL-20)

One Point Liquid Limit Calculation:

$LL = w_n (N/25)^{0.12}$

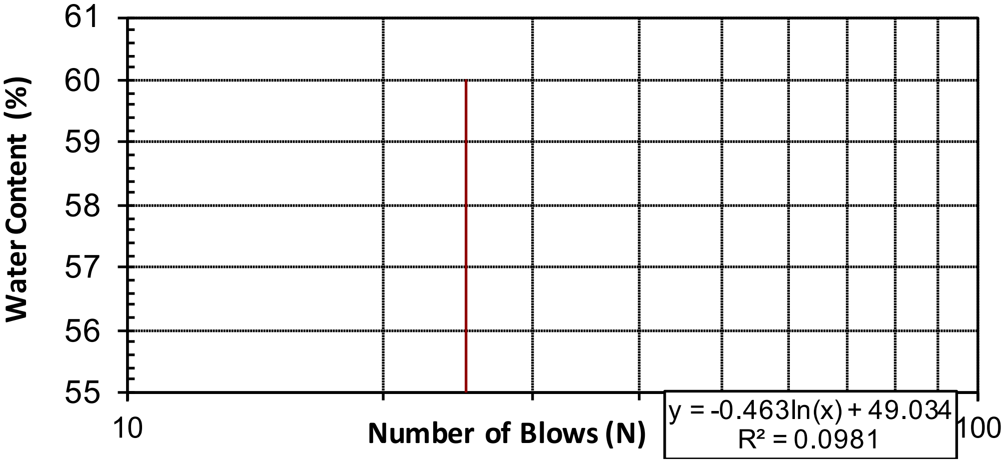
PROCEDURE USED

☐ **Wet Preperation**

☒ **Dry Preperation**

☐ **Procedure A Multipoint**

☐ **Procedure B One-Point**



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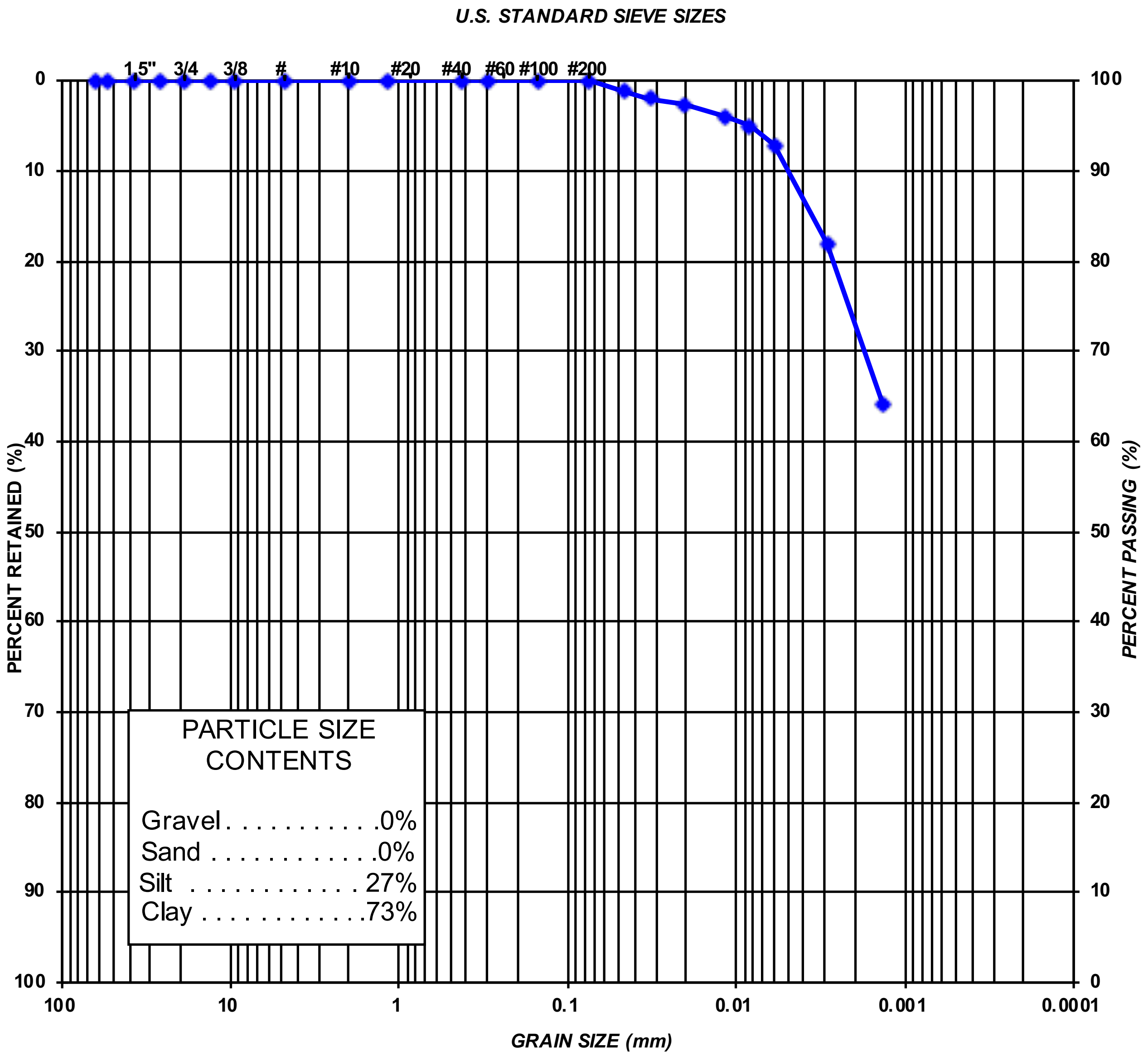
PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

Tested in accordance with LS-702

Project: Proposed Subdivision, 0 Chipewa St.
Lab Number:
Source: BH 1, SS2
Date Sampled: January 19, 2023
Date Tested: February 9, 2023

Contract Number: G22042
Material: Silty Clay
Sample Depth (m): 1.5 - 2.1
Sampled By: S. Hoffman
Tested By: S. Hoffman

PARTICLE SIZE



PARTICLE SIZE CONTENTS

Gravel 0%
Sand 0%
Silt 27%
Clay 73%

UNIFIED SYSTEM	COARSE	FINE	COARS	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

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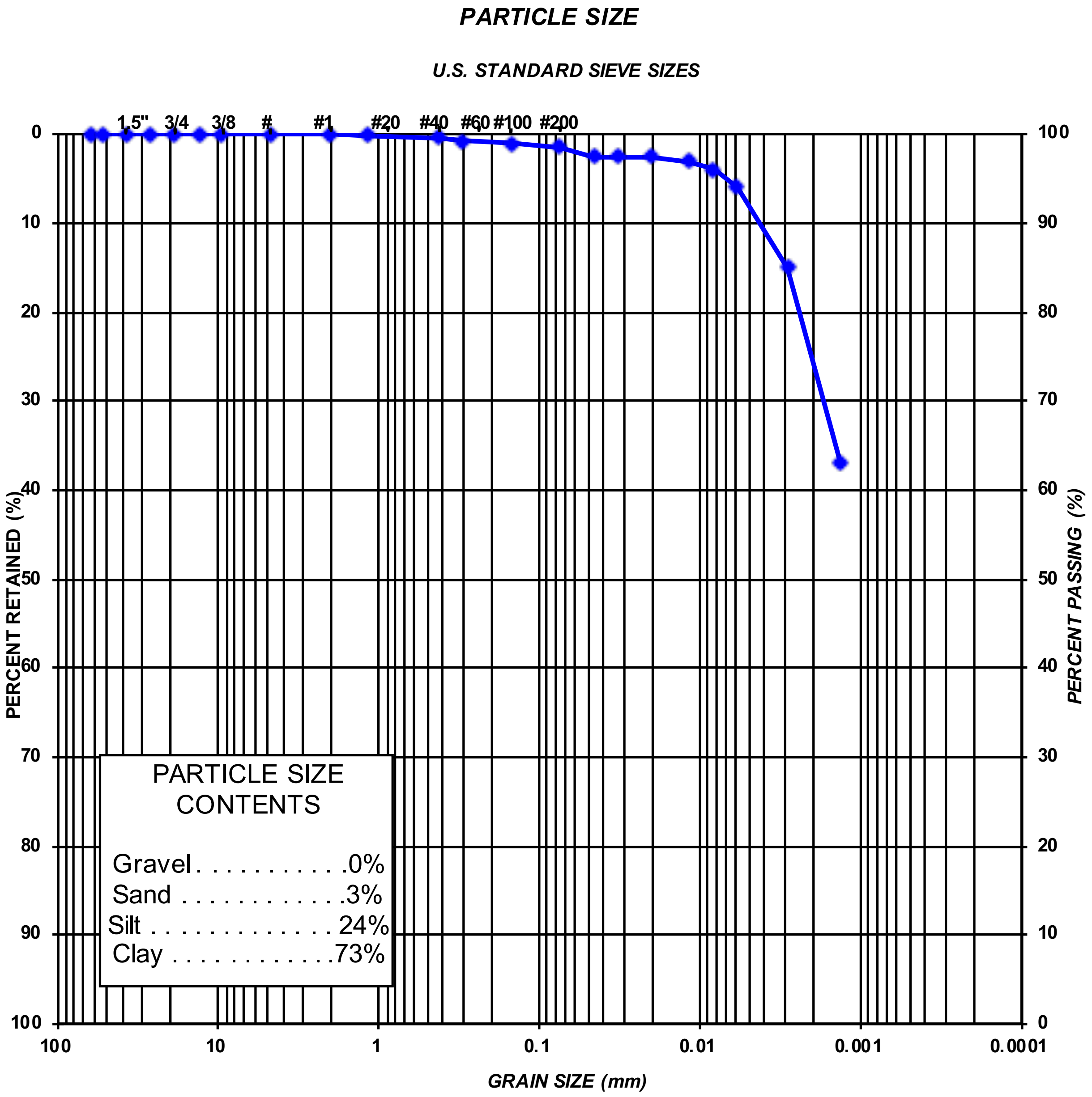
PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

Tested in accordance with LS-702

Project: Proposed Subdivision, 0 Chipewa St.
Lab Number:
Source: BH 2 - SS1
Date Sampled: January 24, 2023
Date Tested: February 10, 2023

Contract Number: G22042
Material: Silty Clay, trace fine sand
Sample Depth (m): 0.8 - 1.4
Sampled By: S. Hoffman
Tested By: S. Hoffman



PARTICLE SIZE CONTENTS

Gravel 0%
Sand 3%
Silt 24%
Clay 73%

UNIFED SYSTE M	COARSE	FINE	COAR	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

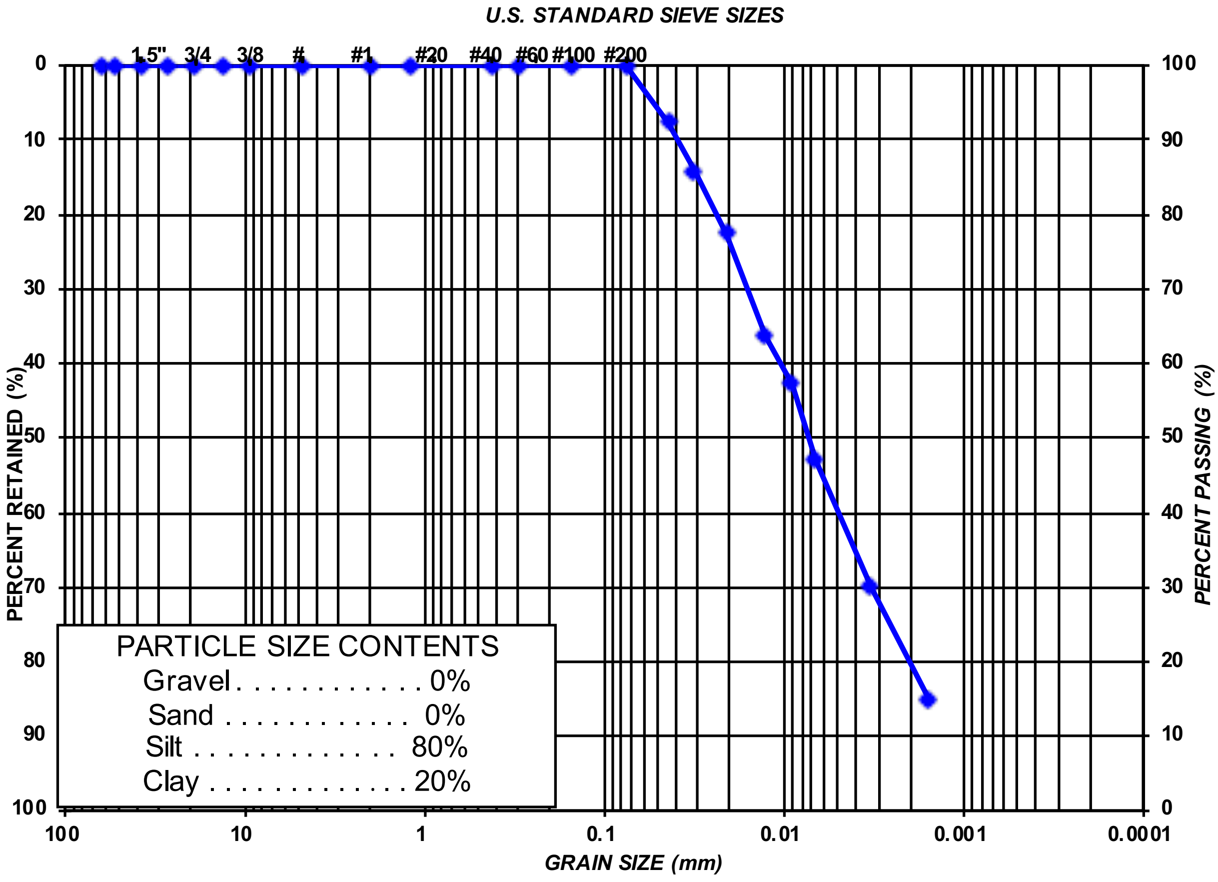
PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

Tested in accordance with LS-702

Project: Proposed Subdivision, 0 Chipewa St
Lab Number:
Source: BH2, SS2
Date Sampled: January 19, 2023
Date Tested: February 9, 2023

Contract Number: G22042
Material: Silt, some clay
Sample Depth (m): 2.3 - 2.9
Sampled By: S. Hoffman
Tested By: S. Hoffman

PARTICLE SIZE



UNIFIED SYSTEM	COARSE	FINE	COAR	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

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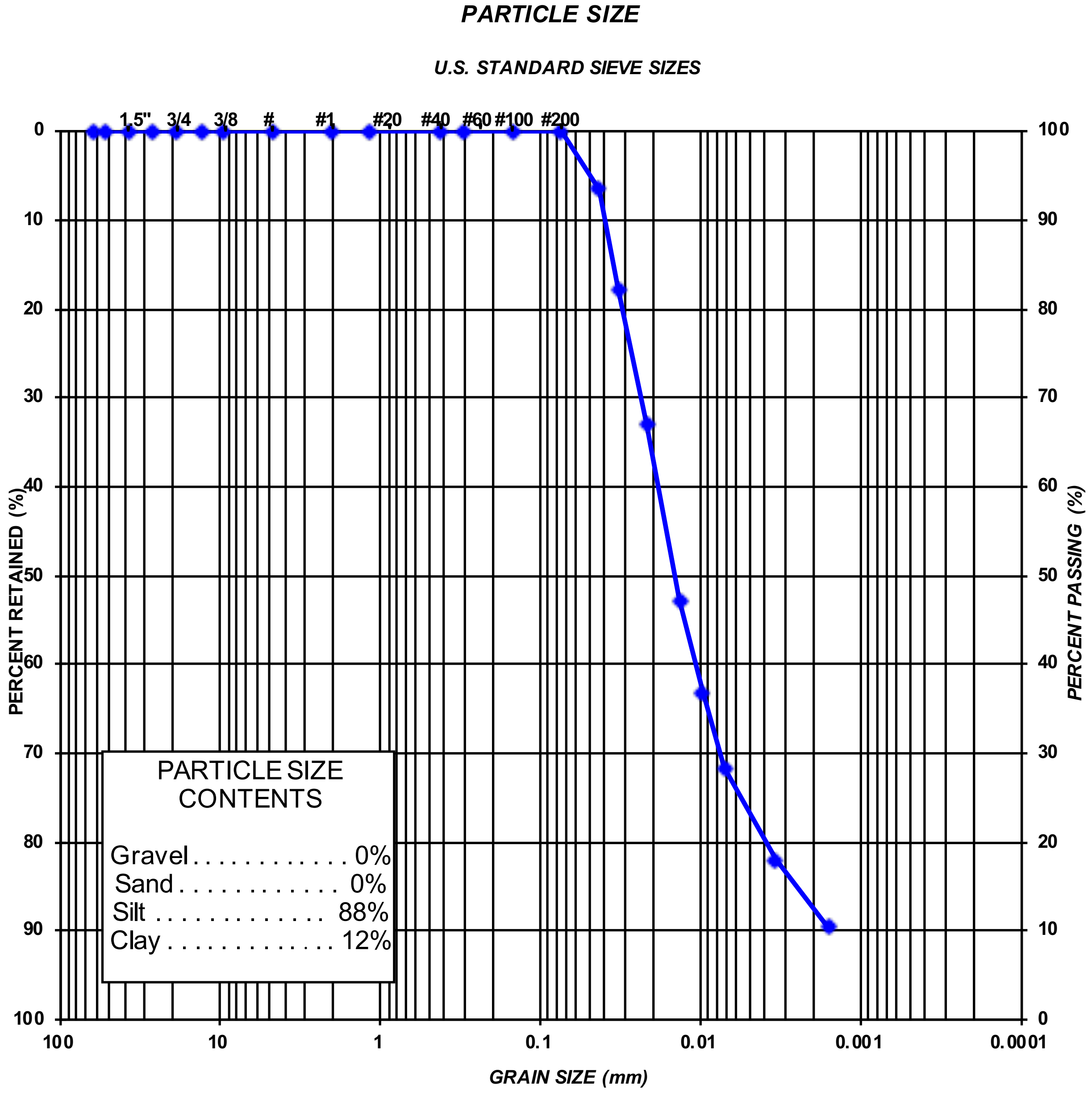
PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

Tested in accordance with LS-702

Project: Proposed Subdivision, 0 Chippewa St.	Contract Number: G22042
Lab Number:	Material: Silt, some Clay
Source: BH4, SS1	Sample Depth (m): 1.5 - 2.1
Date Sampled: January 20, 2023	Sampled By: S. Hoffman
Date Tested: February 9, 2023	Tested By: S. Hoffman



UNIFIED SYSTEM	COARSE	FINE	COAR	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

DOWN TO EARTH
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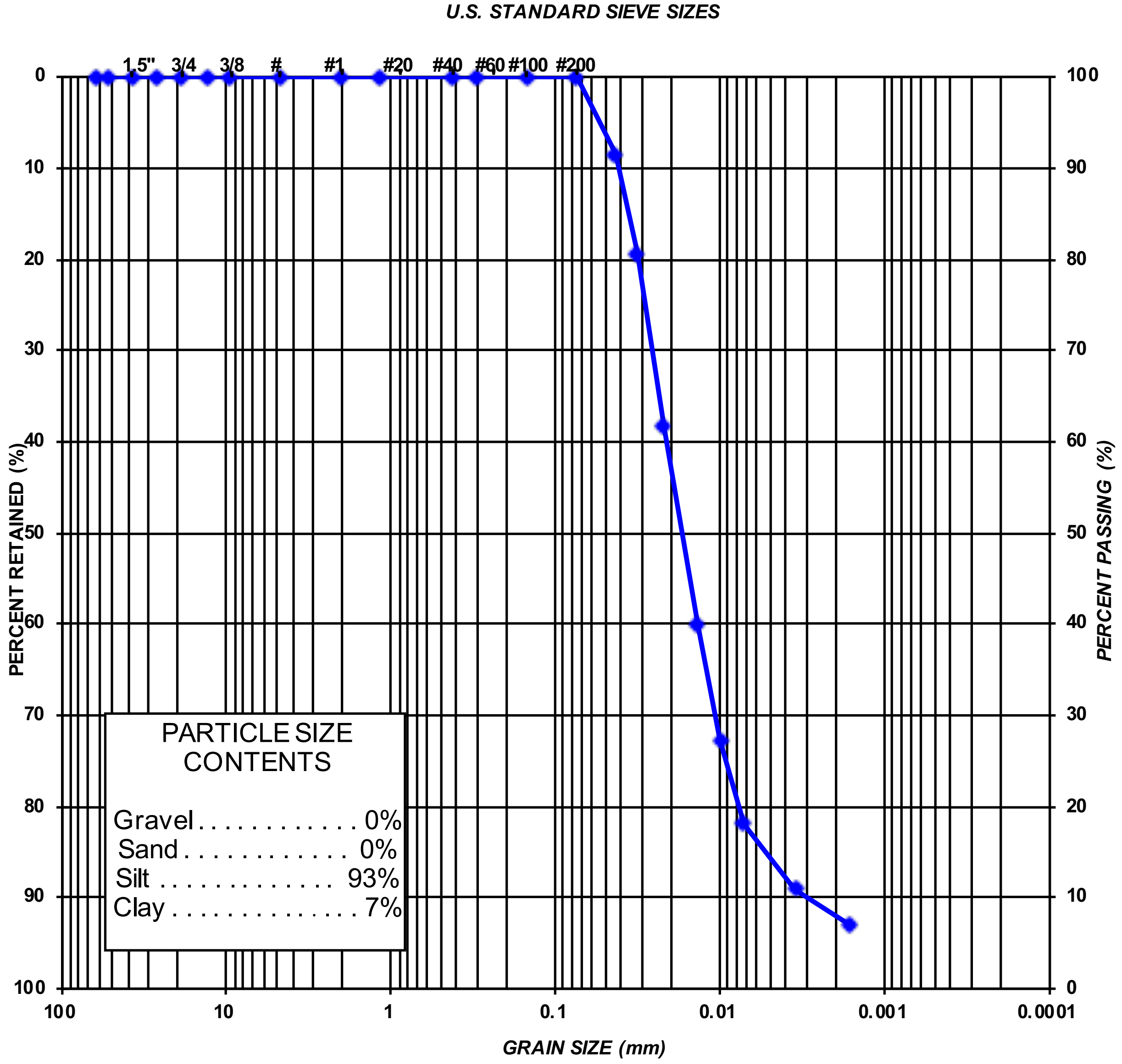
253 Old Garden River Road
Sault Ste. Marie, ON
P6B 5A7
Ph. 705.257.0571

PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

Tested in accordance with LS-702

Project: Proposed Subdivision, 0 Chippewa St	Contract Number: G22042
Lab Number:	Material: Silt, trace Clay
Source: BH6, SS3	Sample Depth (m): 2.3 - 2.9
Date Sampled: January 20, 2023	Sampled By: S. Hoffman
Date Tested: February 9, 2023	Tested By: S. Hoffman

PARTICLE SIZE



UNIFIED SYSTEM	COARSE	FINE	COAR	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

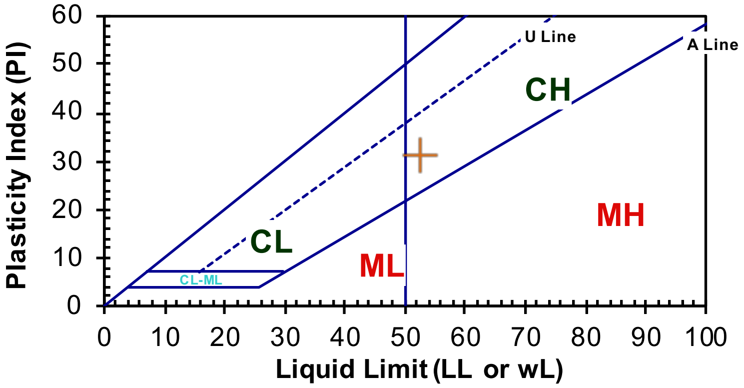
ATTERBERG LIMITS

Tested in accordance with LS-703/704 (ASTM D4318)

Project:	Proposed Subdivision, 0 Chipewa St.		Contract Number:	G22042
Sample Number:	BH10, SS2		Sample Depth:	2.3 m - 2.9 m
Date Sampled:	19-Jan-23		Sampled By:	S.Hoffman
Date Tested:	08-Feb-23		Tested By:	S.Hoffman

TEST			PLASTIC LIMIT				LIQUID LIMIT			
Variable	NO Var.	Units	1	2	3	4	1	2	3	4
Number of Blows	N	blows					17	21	30	
Can Number	---	---	A	B	C		E	G	J	
Mass of Empty Can	M_C	(g)	13.64	13.65	13.75		13.65	13.64	13.69	
Mass Can & Soil (Wet)	M_{CMS}	(g)	18.03	17.33	18.05		30.60	28.18	29.40	
Mass Can & Soil (Dry)	M_{CDS}	(g)	17.24	16.69	17.29		24.82	23.20	23.89	
Mass of Soil	M_S	(g)	3.60	3.04	3.54		11.17	9.56	10.20	
Mass of Water	M_W	(g)	0.79	0.64	0.76		5.78	4.98	5.51	
Water Content	w	(%)	21.9	21.1	21.5		51.7	52.1	54.0	

Liquid Limit (LL or w_L) (%):	52.6
Plastic Limit (PL or w_P) (%):	21.5
Plasticity Index (PI) (%):	31.1
USCS Classification:	



PI at "A" Line = 0.73(LL-20)

One Point Liquid Limit Calculation:

$LL = w_n (N/25)^{0.12}$

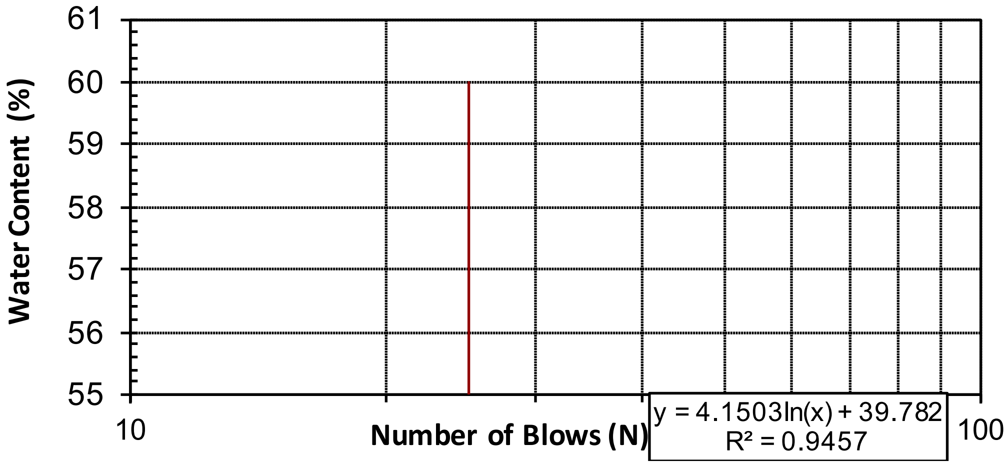
PROCEDURE USED

☐ **Wet Preperation**

☒ **Dry Preperation**

☐ **Procedure A Multipoint**

☐ **Procedure B One-Point**



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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

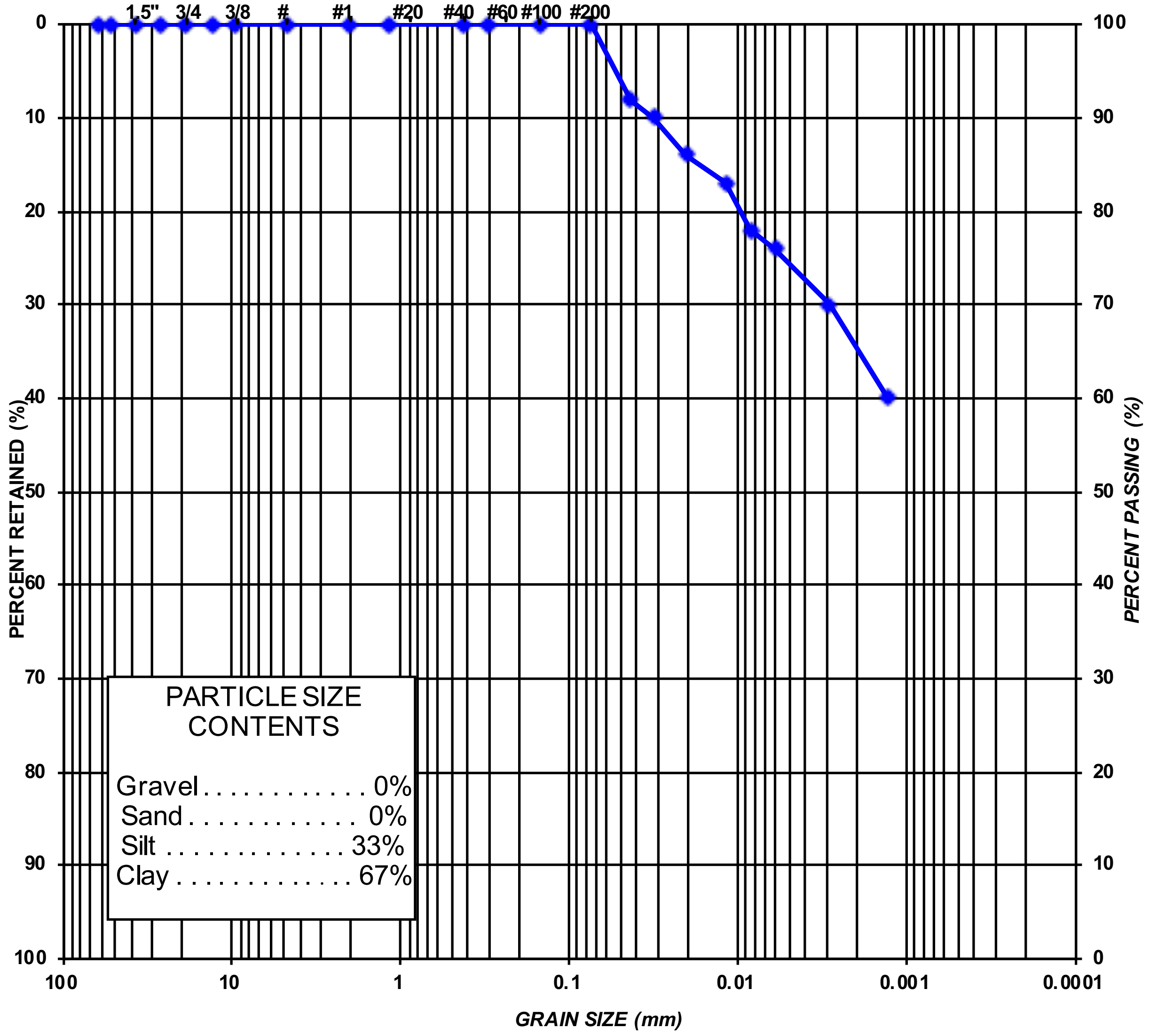
Tested in accordance with LS-702

Project: Proposed Subdivision, 0 Chippewa St.
Lab Number:
Source: BH10, SS5
Date Sampled: January 24, 2023
Date Tested: February 10, 2023

Contract Number: G22042
Material: Silty Clay
Sample Depth (m): 5.3 - 5.9
Sampled By: S.Hoffman
Tested By: S. Hoffman

PARTICLE SIZE

U.S. STANDARD SIEVE SIZES



PARTICLE SIZE
CONTENTS

Gravel 0%
Sand 0%
Silt 33%
Clay 67%

UNIFIED SYSTE M	COARSE	FINE	COAR	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

APPENDIX E

REPORT LIMITATIONS AND GUIDELINES FOR USE

REPORT LIMITATIONS & GUIDELINES FOR USE

This report is intended to reduce, but not eliminate, uncertainty regarding the subsurface conditions at the Site(s), and recognizes reasonable limits on time and cost. There are risks associated with any and all subsurface investigation work, which must be reasonably recognized by the Client.

The following information has been provided to help manage and mitigate any potential risks that could arise with the misuse of this report.

USE OF THIS REPORT

This report has been prepared for the exclusive use and sole benefit of the Client or its authorized agent(s) and may not be used by any third party without the express written consent of Down to Earth Geotechnical Engineering and the Client. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of third parties. This report is not to be construed as legal advice. Down to Earth Geotechnical Engineering disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranty is expressed or implied.

Misinterpretation of this report by other design team members or contractors could result in significant financial and safety issues. Retaining Down to Earth Geotechnical Engineering to confer with the appropriate members of the design team can substantially lower those potential issues. To minimize those issues, Down to Earth Geotechnical Engineering should be retained to review pertinent elements of the design team's plans and specifications. Retaining Down to Earth Geotechnical Engineering to participate in prebid and preconstruction meetings can further reduce these issues. All retainer fees will be based on our professional engineering rates and disbursements at that time.

BASIS OF THE REPORT

The information, opinions, and/or recommendations made in this report are in accordance with Down to Earth Geotechnical Engineering's present understanding of the Site specific project as described by the Client. The applicability of these is restricted to the Site conditions encountered at the time of the investigation or study. If the proposed Site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Down to Earth Geotechnical Engineering is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE

Based on the limitations of the scope of work, schedule, and budget, the preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care for the specific professional service provided to the Client. The geotechnical engineering discussions that have been presented are based on the factual data obtained from this investigation. No other warranty is expressed or implied.

INTERPRETATION OF SITE CONDITIONS

Soil, rock, groundwater or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Down to Earth Geotechnical Engineering at the time of the work, and at the specific testing and/or sampling locations. Classifications and statements of condition(s) have been made in accordance with commonly accepted practices, which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in-situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and Site use. No warranty or other conditions, expressed or implied, should be understood.

VARYING OR UNEXPECTED CONDITIONS:

Regardless how exhaustive a geotechnical investigation is performed, the investigation cannot identify all the subsurface conditions, which may differ from the conditions encountered at the test locations at the time of our investigation. Further, subsurface conditions can change with time due to natural and direct or indirect human impacts at or away from the Site. As such, no warranty is expressed or implied that the entire Site is representative of the subsurface information obtained at the specific locations of our investigation, which may also change with time. Groundwater conditions are especially susceptible to variations with time and space, and as such, comments regarding the anticipated groundwater management procedures outlined within this report may not be applicable, and appropriated groundwater control should be based on the groundwater conditions at the time of construction.

Should any Site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Down to Earth Geotechnical Engineering must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Down to Earth Geotechnical Engineering will not be responsible to any party for damages incurred as a result of failing to notify Down to Earth Geotechnical Engineering that differing Site or subsurface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, AND CONSTRUCTION

If there are any changes in the project scope or development features, which may affect our assessment, the information obtained during the investigation may be inadequate. In this case, Down to Earth Geotechnical Engineering should be retained to review the project changes to evaluate if the changes will affect the conclusions and recommendations within our report, and if additional field investigation work, as well as reporting is required as part of the reassessment.

Development or design plans and specifications should be reviewed by Down to Earth Geotechnical Engineering, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etcetera), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer. Down to Earth Geotechnical Engineering cannot be responsible for site work carried out without being present.

This report is not intended to direct the contractor's procedures, methods, schedule or management of the work Site. The contractor is solely responsible for job Site safety and for managing construction operations to minimize risks to on-Site personnel and to adjacent properties. It is ultimately the contractor's responsibility that the Ontario Occupational Health and Safety Act is adhered to, and Site conditions satisfy all other acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities, which may affect construction costs, techniques, equipment and scheduling.

This report does not alleviate the contractor, owner, or any other parties of their respective responsibilities.

ENVIRONMENTAL DISCLAIMER

This report is geotechnical in nature and was not performed in accordance with any environmental sampling guidelines or procedures to identify any potential soil or groundwater contaminants. Any mention of visual or olfactory contamination evidence that may have been presented within this report is only to bring to the Client's attention that there could be possible issues with contaminants and/or environmental concerns. As such, any environmental comments are very preliminary in nature. Further, if contaminates or environmental concerns were not presented within the report it does not mean that they will not be encountered or observed during future Site developments or construction works. Accordingly, the scope of services do not include any interpretations, recommendations, findings, or conclusions regarding the, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project. It is the responsibility of the Client to decide, if an appropriate environmental assessment of the Site should or should not be performed to further delineate any mentioned or potential contaminates.

The term "contamination/contaminates" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their byproducts.

FINANCIAL DISCLAIMER

Down to Earth will not be responsible for any consequential or indirect damages. Down to Earth will only be held liable for damages resulting from the negligence of Down to Earth. Down to Earth will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered within the meaning of the Limitations Act, 2002 (Ontario), to commence legal proceedings against Down to Earth to recover such losses or damage. Any liability resulting from negligence of Down to Earth Geotechnical Engineering and its officers shall be limited to the lesser of fees paid and/or actual damages incurred by the Client.

LEGAL DISCLAIMER

Down to Earth Geotechnical Engineering makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters that could be construed within this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and these interpretations may change over time.