GEOTECHNICAL INVESTIGATION

PHASE 1 CONSTRUCTION OF NEW FACILITY FOR ICE RIVER SUSTAINABLE SOLUTIONS ECO PARKWAY DUNDALK, ONTARIO (TRITON REFERENCE A4181A)

CMT Project 21-061.R01

Prepared for:

Triton Engineering Services Limited

February 14, 2022

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

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Triton Engineering Services Limited
105 Queen Street West, Unit 14
Fergus, Ontario
N1M 1S6

Attention: Mr. Paul Ziegler, C.E.T.

Dear Sir:

Re: Geotechnical Investigation
Phase 1 Construction of New Facility
For Ice River Sustainable Solutions
Eco Parkway
Dundalk, Ontario
(Triton Reference A4181A)

As requested, CMT Engineering Inc. conducted a geotechnical investigation at the above-referenced site, and we are pleased to present the enclosed report.

We trust that this information meets your present requirements, and we thank you for allowing us to undertake this project. Should you have any questions, please do not hesitate to contact our office.

Yours truly,

Brittany Lingelbach, C.Tech., rcji

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1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Mr. Paul Ziegler of Triton Engineering Services Limited to conduct a geotechnical investigation for Phase 1 of the proposed new facility for Ice River Sustainable Solutions to be located on the northwest side of Eco Parkway in Dundalk, Ontario. The location of the site is shown on Drawing 1.

It is understood that Phase 1 of the project will involve the construction of a new industrial building as well as associated entrances and parking areas. Based on the site grading plan, the building will be approximately 60.96 m (200.0 ft) by 91.44 m (300.0 ft), with a finished floor elevation of 511.10 m. A stormwater management pond is also proposed to be constructed southwest of the Phase 1 facility. It is expected that the new industrial development will be serviced by municipal utilities.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the test pits. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding the estimated geotechnical resistance (bearing capacity); estimated serviceability limit states (anticipated settlement); dewatering considerations; site classification for seismic site response; recommendations for site grading, site servicing, excavations and backfilling; recommendations for slab-on-grade construction; pavement design/drainage; and soil design properties.

The recommendations provided in this report are based solely on the information obtained from the test pits advanced on the subject site.

2.0 EXISTING SITE CONDITIONS

Currently, the site comprises vacant land covered in low-lying vegetation. A shallow creek was noted along the western portion of the site, and much of the site is within the regulation limits of the Grand River Conservation Authority (GRCA). Although the proposed Phase 1 facility is not within the regulation limit, the majority of the proposed future building additions are, including part of the future development within the estimated floodplain area.

The site is generally surrounded by vacant land, with Eco Parkway to the southeast and residential properties to the west. The general site topography slopes gradually to the southwest, down towards the existing creek.

At the time of the investigation, most of the topsoil had been stripped from within the proposed Phase 1 building footprint, and large topsoil stockpiles were located to the northwest, in the area of the future proposed Phase 4 facility. Additionally, imported sand and gravel was being placed at the entrance of the site to provide an access driveway from Eco Parkway.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on February 9, 2022 and comprised the advancement of four (4) test pits (referenced as Test Pits 1 to 4) utilizing a mini-excavator provided by the client. Due to the limitations of the mini-excavator, as well as caving conditions of the soils, the test pits could only be advanced to depths ranging from approximately 2.29 m to 2.44 m (7.5 ft to 8.0 ft) below the existing ground surface. In order to minimally disturb the native soils around the building envelope for the proposed building as well as future buildings, the test pits were advanced outside of the four corners of the proposed Phase 1 building. The contractor was advised to use compactive effort when backfilling the test pits to minimize the presence of soft, disturbed soils in potential founding areas. It is recommended that supplementary geotechnical investigation(s) which include the advancement of boreholes and Standard Penetration Testing (SPT) and sampling be carried out prior to the construction of any future building phases.

Technical staff from CMT Inc. observed the excavation and collected and logged the recovered soil samples. A small portion of each sample was placed in a sealed, marked jar for moisture content determinations.

The test pit logs are provided in Appendix A.

The ground surface elevations at the test pit locations were surveyed by CMT Inc. personnel, using laser surveying equipment. Geodetic spot elevations noted on the Preliminary Site Grading Plan were used as temporary benchmark locations. The ground surface elevations at the test pit locations ranged from approximately 507.94 m to 510.12 m. The approximate locations of the test pits are shown on Drawing 2.

4.0 SUBSOIL CONDITIONS

The soils encountered in the test pits are described briefly below with a more detailed stratigraphic description provided on the test pit logs in Appendix A. The following paragraphs have been simplified into terms of major soil strata. The soil boundaries indicated have been inferred from non-continuous samples and observations of sampling and drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, the subsurface conditions are anticipated to vary between and beyond the test pit locations.

4.1. Topsoil

Loose, moist, dark brown silty topsoil was encountered at the surface of all test pits, ranging in thickness from approximately 310 mm to 510 mm (average 390 mm). The topsoil thickness is anticipated to vary throughout the site. Materials noted as topsoil in this report were classified based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out.

4.2. Sandy Silt

The predominant soil encountered underlying the topsoil in all test pits appeared to be a loose to compact, brown sandy silt, with some clay and trace to some gravel. The sandy silt was considered to be moist to wet, with moisture contents ranging from about 10.9% to 29.0% (average 17.8%).

4.3. Groundwater

Accumulated groundwater was observed in the test pits upon completion, at depths ranging from about 1.1 m to 1.6 m below the existing ground surface, which corresponds with elevations of approximately 506.64 m to 508.52 m. Groundwater conditions (particularly perched water) are generally dependent on the time of year, weather conditions, amount of precipitation, as well as site grading and other measures in place to control surface water drainage, and can fluctuate significantly in elevation and volume over time.

Recommendations with respect to dewatering conditions are provided in Section 5.8 of this report.

5.0 DISCUSSION AND RECOMMENDATIONS

It is understood that Phase 1 of the project will involve the construction of a new industrial building as well as associated entrances, parking areas and stormwater management facilities. It is anticipated that the new industrial development will be serviced by municipal utilities.

The following sections of the report provides CMT Inc.'s interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the work should make their own independent interpretation of the factual subsurface information provided as it affects their proposed construction means and methods, equipment selection, scheduling, pricing, and the like.

Utilizing the information gathered during the geotechnical investigation and assuming that the test pit information is representative of the subsoil conditions throughout the Phase 1 area of the site, the following comments and recommendations are provided.

5.1. Serviceability and Ultimate Limit Pressure

Based on the information obtained from the test pits, the native soils encountered underlying the topsoil are estimated to be suitable to support conventional foundations designed with a net allowable bearing capacity of 75 kPa (1,500 psf) at SLS and 100 kPa (2,000 psf) at ULS.

As per the Preliminary Site Grading Plan provided by the client, the finished floor elevation for the proposed Phase 1 facility is to be 511.10 m. Therefore, the use of conventional foundation walls with a height of 1.2 m (4.0 ft) would have a founding elevation of approximately 509.90 m, which is above the existing ground surface elevation throughout most of the building footprint area. As such, structural fill will be required in order to achieve the design founding grades.

The serviceability limit pressure for good quality granular structural fill placed on approved subgrade soils and compacted in accordance with Section 5.4.4 of this report is estimated to be at least 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS. It is imperative that the founding soils be assessed at the time of construction by qualified geotechnical personnel in order to confirm their suitability. Should wet to soils be encountered during excavation, it is recommended that widened footings are considered for the support of the structure.

With respect to the Serviceability Limit State (SLS), the total and differential footing settlements are not expected to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively.

Due to the varying depth of wet soils encountered, particularly in the northwestern extent of the site, the founding soils must be assessed at the time of construction by qualified geotechnical personnel in order to confirm their founding suitability.

It is recommended that structural foundation drawings be cross-referenced with site servicing drawings to ensure that service pipes do not conflict with building foundations (including the zone of influence down and away from the footings).

All exterior foundations must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation (sufficient thermal insulation is required to protect all footings and slab-on-grades during construction until such a time that the structure is heated) in order to provide protection against frost action.

5.2. Seismic Site Classification

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30.0 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 2.29 m to 2.44 m of strata. Based on the information gathered in the geotechnical field

investigation, the site classification for seismic site response would be considered Site Class D (stiff soils) for structures founded on the native soils or on structural fill placed in accordance with Section 5.4.4 of this report. The structural engineer responsible for the design of the structure should review the earthquake loads and effects.

5.3. Soil Design Parameters

The following table provides estimated soil design parameters for imported granular fill, as well as the existing soils encountered on-site. It should be noted that earth pressure coefficients (Ka, Kp, Ko) provided are for flat ground surface conditions and will differ for areas with slopes or embankments.

The estimated soil design parameters can be utilized for the design of perimeter shoring, foundations and retaining walls, as required:

Soil Type	Soil Density (kg/m^3)	Friction Angle (Degree)	Coefficient of Active Pressure (K_a)	Coefficient of Passive Pressure (K_p)	Coefficient of At-Rest Pressure (K_o)	Coefficient of Friction (μ)	Cohesion (Undrained) (kPa)
Imported Granular 'A'/ Granular 'B' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Sandy Silt	1,750	30°	0.33	3.00	0.5	0.38	0

5.4. Site Preparation

The site preparation for Phase 1 of the proposed industrial facility is anticipated to consist of the stripping of the existing topsoil/vegetation, followed by the removal/relocation of any existing services (if applicable), followed by the placement of structural fill and site grading, as required.

5.4.1. Topsoil Stripping/Vegetation Grubbing

All existing topsoil and vegetation (including roots and all loose/disturbed soils associated with the roots) must be removed from within any proposed building envelope and parking areas and entrances to expose approved competent subgrade soils. The topsoil may be used in landscaped areas where some settlement can be tolerated; otherwise, it should be properly disposed of off-site.

The volume of topsoil removed during the stripping process is also relative to the equipment utilized for the stripping process as well as the moisture conditions at the time of stripping. If an excavator with a smooth bucket is utilized for stripping, there would generally be less potential for topsoil to become intermixed with the underlying relatively loose subsoil and therefore less concern of over-excavation to remove all topsoil. If the topsoil is stripped with wheeled equipment or bulldozers, then there is an increased potential for the topsoil and subsoil to become intermixed, subsequently requiring additional excavation to remove all topsoil. This is further influenced by rutting which can occur during wet conditions.

5.4.2. Removal/Relocation of Existing Buried Piping

Any existing servicing that may be located within the proposed building envelope must be removed/relocated. This includes any existing field drainage tiles or subdrains that may be present. Any piping that is left in place that is no longer active must be completely sealed with watertight mechanical covers, concrete or grout at termination points to prevent the migration of soils into pipe voids, which may result in potential settlement. All existing trench backfill material associated with any existing buried pipes must be subexcavated and the subsequent excavation must be backfilled with approved soils placed in accordance with Section 5.4.4 of this report.

5.4.3. Subgrade Preparation

At the time of the investigation, the earthworks contractor had generally completed the removal of surficial topsoil and subsoils throughout most of the proposed Phase 1 building footprint. Stripping of the topsoil had not yet been completed along the southwestern and northeastern extents of the building footprint.

The subgrade soils appeared to consist of brown sandy silt, with some clay and gravel. The soils were generally considered moist, although some very moist subgrade soils were noted along the northwestern extent of the proposed building. Additionally, it should be noted that the subgrade soils were in a frozen state at the time of inspection.

During the inspection, CMT Inc. personnel observed the movement of construction equipment (bulldozer) over the subgrade. Minimal deflection was noted, although it is recommended that all construction equipment travel and foot traffic on the sensitive soils should be minimized. Once they become disturbed, they may no longer be considered adequate to support the placement of structural fill.

The subgrade soils must be assessed by qualified geotechnical personnel prior to the placement of structural fill in order to confirm their suitability, with particular attention paid to the northwestern extent of the building footprint.

To ensure and protect the integrity of the native subgrade soils during construction operations, particularly during subzero weather conditions, the following is recommended:

- The entire building envelope area should not be stripped of topsoil until the contractor is ready to start structural fill placement operations. As such, fill operations should be isolated to small working areas and cold weather protection is to be utilized;

- Any frozen soils as well as accumulated snow and ice must be removed prior to the placement of structural fill;

- During construction, the exposed subgrade should be sloped/ditched to a sump (as required) located outside the building footprint (if feasible) in the excavation to promote surface drainage of rainwater or seepage and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions.

Due to the fine-grained nature of the native sandy silt subgrade soils, they can be easily disturbed and subject to strength losses, making travel on this material somewhat difficult with conventional rubber-tired construction equipment such as dump trucks and even smooth drum vibratory compactors. Conditions should be expected to worsen if the subgrade soils are in a wet condition. Therefore, it is recommended that construction traffic be minimized, where possible, from driving on the subgrade soils. During the investigation, a haul road was being constructed using imported granular soils.

5.4.4. Site Grading/Structural Fill

Based on the Preliminary Site Grading Plan provided by the client, the finished floor elevation for the proposed Phase 1 facility is to be 511.10 m. Therefore, conventional foundation walls of 1.2 m (4.0 ft) would have a founding elevation of approximately 509.90 m. Given that the existing, exposed subgrade throughout the area of the proposed building ranged in elevation from approximately 508.0 m to 509.1 m, it would be estimated that structural fill in the order of 0.8 m to 1.9 m may be required to achieve the design founding elevation.

Following the recommendations for subgrade preparation, as noted above, any fill materials required to achieve the design site grades should be placed according to the following procedures:

- Prior to placement of any structural fill or bulk fill, the subgrade must be prepared large enough to accommodate a 1:1 slope commencing a distance of 1.0 m beyond the outside edge of the proposed building foundations down to the approved competent subgrade soils;

- Soils approved for use as structural fill must be placed in loose lifts not exceeding 0.3 m (12") in depth for imported granular soils (recommended fill material) and 0.2 m (8") in depth for the existing, fine-grained soils (not recommended for this application), or the capacity of the compactor (whichever is less);

- Approved imported granular fill materials (OPSS 1010 Type III Granular 'B' recommended for this application) can be compacted utilizing adequate heavy vibratory smooth drum or padfoot compaction equipment;

- Fine-grained silt and clay soils (not recommended) must be compacted utilizing adequate heavy padfoot vibratory compaction equipment;

- **Fine-grained soils such as a native sandy silt typically expand upon freezing and are therefore NOT recommended for use as structural fill at this time;**

- The contractor should closely monitor the structural fill materials for freezing and/or frozen masses. All frozen material must be removed from the fill prior to compaction;

- Approved fill materials must be at suitable moisture contents (at or near to the optimum moisture content as determined by laboratory Proctor testing) to achieve the specified compaction. Soil moisture will also be dependent on weather conditions at the time of construction. Granular soils may require the addition of water in order to achieve the specified compaction. Given the relatively high moisture contents, the native sandy silt soils are NOT recommended for use as structural fill at this time;

- Approved structural fill materials that will support structures (including building foundations, retaining walls, interior slab-on-grades, sidewalks, large expansive exterior slabs and decks) must be compacted to a minimum of 100% standard Proctor maximum dry density (SPMDD). If clean granular fill soils are allowed to freeze on a daily basis, they must first be compacted to a minimum of 100% SPMDD;

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading, bulk fill for parking areas and entrances) must be compacted to a minimum 95% SPMDD. It would be expected that the existing on-site native sandy silt soils, free of any deleterious materials, will likely require air-drying in order to achieve the specified density. Since this cannot typically be achieved during the winter months, imported granular fill would be recommended for use as bulk fill;

- Granular 'B' subbase and Granular 'A' base materials for any proposed parking areas or entrances must be compacted to 100% SPMDD.

5.5. Foundation Preparation

To ensure and protect the integrity of the founding soils during construction operations, the following is recommended:

- During construction, the founding soils should be sloped/ditched to a sump (if required) located outside the footprint of any foundations (if feasible) in the excavation to promote surface drainage of rainwater or seepage and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the foundation preparation commence in dry conditions;

- If the soils at the design founding elevation in the proposed building envelope will comprise wet soils, a granular drainage layer constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC), may be required. Alternatively, a lean mix concrete mud mat may be placed over top of the founding soils to provide a stable base;

- Construction equipment travel and foot traffic on the founding soils should be minimized;

- If construction is to be undertaken during subzero weather conditions, the founding soils must be maintained above freezing, as frozen soils often contain frost lenses that can result in settlement upon thawing. The placement of straw or insulated tarps can typically be utilized for frost protection;

- Prior to placing concrete for the footings, the founding soils must be cleaned of all disturbed or caved materials;

- The foundation formwork and concrete should be placed as soon as practical following the excavation, inspection and approval of the founding soils. The longer that the excavated soils remain open to weather conditions and groundwater seepage, the greater the potential for construction problems to occur;

- If it is expected that the founding soils will be left open to exposure for an extended period of time, it is recommended that a 75 mm concrete mud slab be placed in order to protect the structural integrity of the founding soils.

If wet soils are encountered at the founding elevations, pumping from properly constructed and filtered sumps located in the base of the excavation and outside of the bearing areas of any footings may be required to remove water from the excavation.

5.6. Slab-on-Grade/Modulus of Subgrade Reaction

Prior to the placement of the granular base for the slab-on-grade construction, the subgrade/fill soils should be proof-rolled. Any soft or weak zones, as well as the unsuitable soils in the subgrade, should be subexcavated and backfilled with approved fill materials (see Sections 5.4.4 and 5.10 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for imported granular fill, as well as the native soils encountered on-site:

Soil Type	Estimated Modulus of Subgrade Reaction (k)
Imported Sand and Gravel (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Sandy Silt	33,900 kN/m^3 (125 lb/in^3)

Floor slabs can be founded on a minimum thickness of 150 mm (6") of coarse, clean granular material (19 mm clear crushed stone) containing not more than 10% of material that will pass a 4 mm sieve in accordance with the current OBC. The use of 19 mm clear crushed stone assists in creating a moisture barrier by reducing/preventing capillary rise of moisture from the subgrade. Compactive effort is required to consolidate the clear stone. The 19 mm clear crushed stone should meet the physical property and gradation requirements of OPSS 1004.

It is recommended that areas of extensive exterior slab-on-grade be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to promote rapid drainage and reduce the effects of frost heaving. This is particularly critical at barrier-free access points and at the location of out-swinging doors. Alternatively, structural frost slabs could be designed and constructed, or sufficient thermal insulation could be provided, at all door entrances and areas of barrier-free access.

5.7. Excavations

All excavations must be carried out in accordance with Ontario Regulation 213/91 (Reg 213/91) of the Occupational Health and Safety Act and Regulations for Construction Projects.

Type 3 Soils - In general, the existing native sandy silt soils encountered in the test pits, in a drained state (not wet or saturated), would be classified as Type 3 soils under Reg 213/91. The Type 3 soils must be sloped from the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, any wet to saturated soils would be classified as Type 4 soils under Reg 213/91. Type 4 soils must be sloped from the bottom of the excavation at a minimum gradient of 3 horizontal to 1 vertical.

If it is not practical to excavate according to the above requirements, then a trench support system (designed in accordance with the Ontario Health and Safety Act Regulations) may be utilized. When using a temporary trench support system consisting of trench boxes to reduce the lateral extent of the excavations, it should be noted that the support system is intended primarily to protect workers as opposed to controlling lateral soil movement. Any voids between the excavation walls and the support system should be immediately filled to reduce the potential for loss of ground and to provide support to existing adjacent utilities and structures, and it is recommended that the excavation be carried out in short sections, with the support system installed immediately upon excavation completion.

Sloughing/caving of the excavation walls should be expected when excavating into non-cohesive or wet to saturated soils. As such, it may be necessary to increase the proposed width of the excavations to accommodate the sloughing/caving soils.

5.8. Construction Dewatering Considerations

Wet soil conditions were encountered at all test pit locations and should be expected to be encountered during excavations throughout the site. It should be noted that groundwater levels (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. As such, provisions for site dewatering should be part of the site development and construction process.

Seepage control requirements during construction will depend upon the area of work on the site, the depth of the excavations, the time of year, the amount of precipitation and the control of surface water. As required, seepage should generally be adequately controlled using conventional construction dewatering techniques such as pumping from sump pits.

However, if heavy seepage occurs, it may be necessary to increase the number of pumps during construction.

Dewatering should be performed in accordance with OPSS 517 and the control of water must be in accordance with OPSS 518. It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. Collected water should discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures must be installed at the discharge point of the dewatering system to avoid any potential adverse impacts on the environment.

5.9. Service Pipe Bedding

The existing native soils that are free of any organics or deleterious materials are generally considered suitable for indirect support of the site service pipes. Relatively high groundwater levels were observed throughout the site and instability due to wet soil conditions should be anticipated. It may be necessary to increase the thickness of the granular base and utilize 19 mm clear stone to create an adequate supporting base for the service pipes and/or manholes. Pipe embedment, cover and backfill for both flexible and rigid pipes should be in accordance with all current and applicable OPSD, OPSS and OBC standards and guidelines and as follows.

Flexible Pipes – The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.031. The trench excavations should be symmetrical with respect to the centreline of the pipe. The granular material placed under the haunches of the pipe must be compacted to 95% SPMDD prior to the continued placement and compaction of the embedment material. The homogeneous granular material used for embedment should be placed and compacted uniformly around the pipe. Should wet conditions be encountered at the base of the trench, then the pipe bedding should consist of 19 mm clear stone (meeting OPS Specifications) wrapped completely in a geotextile fabric such as Terrafix 270 or equivalent.

Rigid Pipes - In general, the pipe installation recommendations for rigid pipes are the same as those for flexible pipes, except that the minimum bedding depth below a rigid pipe should be 0.15*D* (where *D* is the pipe diameter). In no case should this dimension be less than 150 mm or greater than 300 mm.

Any service pipes that are not provided with sufficient frost coverage must be protected with the necessary equivalent thermal insulation. The general contractor is responsible to protect service piping from damage by heavy equipment.

5.10. Perimeter Building Drainage, Foundation Wall Backfill and Trench Backfill

In order to assist in maintaining dry buildings with respect to surface water seepage, it is recommended that exterior grades around the proposed new facilities be sloped down and away at a 2% gradient or more, for a distance of at least 1.5 m. Any surface discharge rainwater leaders must be constructed with solid piping that discharges with positive drainage at least 1.5 m away from the building foundations and/or beyond external slab-on-grades to a drainage swale or appropriate storm drainage system.

In order to reduce the effects of surficial frost heave in areas that will be hard surfaced, it is recommended that the exterior foundation backfill consist of free-draining granular material such as imported sand or Granular 'B' Type I, Type II or Type III (OPSS 1010), with a maximum aggregate size not exceeding 100 mm, and that it extend a minimum lateral distance of 600 mm out from the foundation walls and/or beyond perimeter sidewalks and entranceway slabs. It is critical that particles greater than 100 mm in diameter are not in contact with the foundation wall to prevent point loading and overstressing. The backfill material used against the foundation walls must be placed so that the allowable lateral capacities of the foundation walls are not exceeded. Where only one side of a foundation wall will be backfilled, and the height of the wall is such that lateral support is required, or where the concrete strength has not been achieved, the wall must be braced or laterally supported prior to backfilling. In situations where both sides of the wall are backfilled, the backfill should be placed in equal lifts, not exceeding 200 mm differential on each side during backfill operations and the backfill should be compacted to a minimum of 100% SPMDD.

The native mineral soils, as well as fill soils which are free of any organics or deleterious materials, are generally considered suitable for reuse as trench backfill and bulk fill in the parking areas and entrances. As noted above, air-drying cannot typically be achieved during winter construction; therefore, depending on the time of year that construction takes place, it may be more feasible to utilize an imported granular fill for this project (keeping in mind that frost tapers would be recommended to minimize differential frost heave at transitions from granular fill to frost-susceptible soils).

Backfilling operations should be carried out with the following minimum requirements:

- Adequate heavy padfoot vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil;

- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for silt soils or the capacity of the compactor (whichever is less);

- The soils must NOT be frozen and must be at suitable moisture contents to achieve compaction to a minimum 95% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD;

- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved;

- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials;

- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

Any wet soils will likely require significant air-drying in order to achieve the specified compaction of 100% SPMDD in building envelopes (including 1:1 as required) and 95% SPMDD for bulk fill for any parking areas and entrances. Utilizing the existing native soils during backfilling may be more achievable if work is completed during the typically drier summer months. It should be noted, however, that due to the nature of some soils, during hot dry weather, the addition of water might be required in order to achieve the specified compaction. Reuse of excavated soils on-site will be subject to approval from qualified geotechnical personnel.

5.11. Pavement Design/Drainage

Based on the Preliminary Site Grading Plan provided, it is understood that the new facility will include new parking areas and entrances, as well as loading docks to the south of the proposed building.

It is generally recommended to either subexcavate all existing loose native materials, utilize a reinforcing geotextile/geogrid, and/or provide further consolidation with vibratory compaction equipment in order to prepare a proper, stable base for the pavement structure. Prior to placement of the granular base, the subgrade soils must be proof-rolled, and any soft or unstable areas observed should be subexcavated and replaced with suitable materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward the drainage outlet or curb line. When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.9 and 5.10 of this report.

Rapid drainage of the pavement structure is critical to ensure long-term performance. As such, it is recommended to install subdrains for this project (provided gravity drainage to a suitable outlet can be provided). Subdrains should be designed and installed in accordance with OPSS 405 and OPSD 216.021. If 19 mm clear stone (OPSS 1004) is utilized as bedding for the subdrain (recommended for this application), then the bedding material must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent) and a factory installed filter sock is not required. Installation of rigid subdrains allows for better grade control and less potential for damage during installation

or service. Positive drainage through grade control of subdrains is critical, as improperly installed subdrains can turn drainage systems into reservoirs, which can fuel frost action. The subdrains will hasten the removal of water, thereby reducing the risk and effects of frost heaving and load transfer in saturated conditions. It is suggested that subdrains be installed at regular intervals (to be designed based on layout of catch basins and storm sewers) through paved driveways and parking areas. It is also recommended to install subdrains through any areas that cannot tolerate differential frost heave such as ramps or sidewalks. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The existing subgrade soils are highly sensitive to changes in moisture content and can become loose or soft if the soils are subject to inclement weather and seepage or severe drying. Furthermore, the subgrade soils could be easily disturbed if traveled on during construction. As such, where this material will be exposed, it is recommended that the granular subbase be placed immediately upon completion of the subgrade preparation to protect the integrity of the subgrade soils.

Should wet soil conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement base. These options may include subexcavation of loose/soft soils, increasing the thickness of the granular base, the use of reinforcing geotextiles or geogrids, or a combination of all.

It is expected that the parking areas and entrances will experience mostly heavy traffic (heavy trucks, maintenance and delivery vehicles), as well as some light traffic (personal vehicles). The location of the parking lot entrances suggest that heavy truck traffic may be experienced throughout most of the proposed parking lot area.

Based on the anticipated vehicle loading and frost-susceptibility of the subgrade soils, the following pavement design is provided:

Material	**Recommended Thickness for Light Traffic**	**Recommended Thickness for Heavy Traffic**
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")	HL3 - 50 mm (2.0") HL4 or HL8 - 75 mm (3.0")
Granular 'A' Base (OPSS 1010)	150 mm (6.0")	150 mm (6.0")
Granular 'B' Subbase (OPSS 1010)	400 mm (16.0")	600 mm (24.0")

It should be noted that if the subgrade soils for the proposed pavement structures are composed of free-draining materials (such as imported granular fill used to raise the overall grade of the site), the Granular 'B' subbase could be reduced to 400 mm in thickness for areas where a heavy traffic pavement structure will be utilized. This should be assessed by qualified geotechnical personnel at the time of construction.

Construction joints in the surface and intermediate binder asphalt must be offset a minimum of 150 mm to 300 mm (6" to 12") from construction joints in the binder asphalt so that longitudinal joints do not coincide.

Should any new asphalt be joined into existing asphalt, it is recommended that the existing asphalt be sawcut in a straight line prior to being milled to a depth of 40 mm and a width of 150 mm as per OPSD 509.010. It is recommended that a tackcoat in conformance with OPSS 308 be applied to the edge and surface of all milled asphalt prior to placement of new asphalt.

The granular base and subbase materials must conform to the physical property and gradation requirements of OPSS 1010 and must be compacted to 100% SPMDD. Asphaltic concrete should be supplied, placed and compacted to a minimum 92.0% Marshall maximum relative density, in accordance with OPSS 1150 and OPSS 310.

The pavement should be designed to ensure that water will not pond on the pavement surface. If the surface asphalt is not placed within a reasonable time following placement of the binder asphalt, it is recommended that the catch basin lids are set at a lower elevation or apertures provided to allow surface water to drain into the catch basins and not accumulate around the catch basins. The strength of the pavement structure relies on all of the components to be in place in order to provide the design strength; therefore, it is strongly recommended that the surface asphalt and intermediate binder asphalt be placed shortly after placement of the binder asphalt so as to avoid undue stress on the binder asphalt by not having the complete pavement structure in place.

It should be noted that, currently, asphalt mixes tend to be more flexible and, as such, there is a tendency for damage to occur from vehicles turning their steering wheels or applying excessive brake pressure. The condition is further intensified during hot weather. In high traffic areas or areas subjected to frequent turning of heavy vehicles, it is recommended that rigid Portland cement pavement be considered.

5.12. Radon

According to information provided by Health Canada, radon is a radioactive gas that is naturally formed through the breakdown of uranium in soil, rock and water. When radon escapes the earth in the outdoors, it mixes with fresh air, resulting in concentrations that are too low to be of concern. However, when radon enters an enclosed space, such as a building, high concentration of radon can accumulate and become a health concern. Health Canada indicates that most buildings and homes have some level of radon in

them. Unfortunately, it is not possible to predict before construction whether or not a new building will have high radon levels as radon can only be detected by radon measurement devices, which would be installed in a building, post construction. Section 9.13.4.1 Soil Gas Control of the current 2012 Ontario Building Code (OBC) states that *"Where methane or radon gases are known to be a problem, construction shall comply with the requirements for soil gas control in MMAH Supplementary Standard SB-9, Requirements for Soil Gas Control"*.

5.13. Chemical Analysis/Excess Soil Management

5.13.1. Chemical Testing was NOT Undertaken

As per Ontario Regulation 406/19, if surplus/excess soils are to be exported off-site, it is typically necessary to undertake some environmental reporting and chemical analysis of the soils. Chemical analysis was not undertaken as part of this geotechnical investigation. Should chemical analysis tests be required, the required tests vary and will be dependent on the disposal site utilized by the general contractor.

5.13.2. Leachate Testing Requirement

If soils are transported to a landfill facility, additional chemical testing in accordance with Ontario Regulation 347, Schedule 4, as amended to Ontario Regulation 558/00, dated March 2001, leaching testing will be required. When transporting soils off-site, the following is recommended:

- All chemical analyses and environmental assessment reports must be fully disclosed to the receiving site owners/authorities, whom must agree to receive the material;
- An environmental consultant must confirm the land use at the receiving site is compatible to receive the material;
- An environmental consultant must monitor the transportation and placement of the materials to ensure that the material is placed appropriately at the preapproved site;
- The excess materials may not be transported to a site that has previously had a Record of Site Condition (RSC) filed, unless the material meets the criteria outlined in the RSC.

It should be noted that landfill sites will generally only accept laboratory test results that have been completed within 30 days of exporting. Therefore, it is recommended that provisions for chemical analysis be included in the tender documents. It should also be noted that the laboratory testing generally takes five (5) working days to process with a regular turnaround time.

6.0 SITE INSPECTION

Qualified geotechnical personnel should supervise excavation inspections as well as compaction testing for structural filling, site grading and site servicing. This will ensure that footings are founded in the proper strata and that proper material and techniques are used and the specified compaction is achieved. CMT Engineering Inc. would be pleased to review the design drawings and provide an inspection and testing program for the construction of the proposed industrial development.

7.0 LIMITATIONS OF THE INVESTIGATION

This report is intended for the Client named herein and for their Client. The report should be read in its entirety, and no portion of this report may be used as a separate entity. 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 such third parties.

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. This geotechnical investigation was carried out in conjunction with a hydrogeological study completed by GM BluePlan Engineering Limited as well as an environmental study by Rubicon Environmental Inc, both provided under separate cover.

The samples obtained during the geotechnical investigation will be stored for a period of three months, after which time they will be disposed of unless alternative arrangements are made.

We trust that this report meets with your present requirements. Should you have any questions, please do not hesitate to contact our office.

Prepared by: Reviewed by:

LICENSED PROFESSIONAL ENGINEER
2022/02/17
N. J. CHORTOS
100210851
PROVINCE OF ONTARIO

Brittany Lingelbach, C. Tech., rcji Nathan Chortos, P.Eng.
Senior Geotechnical Engineer

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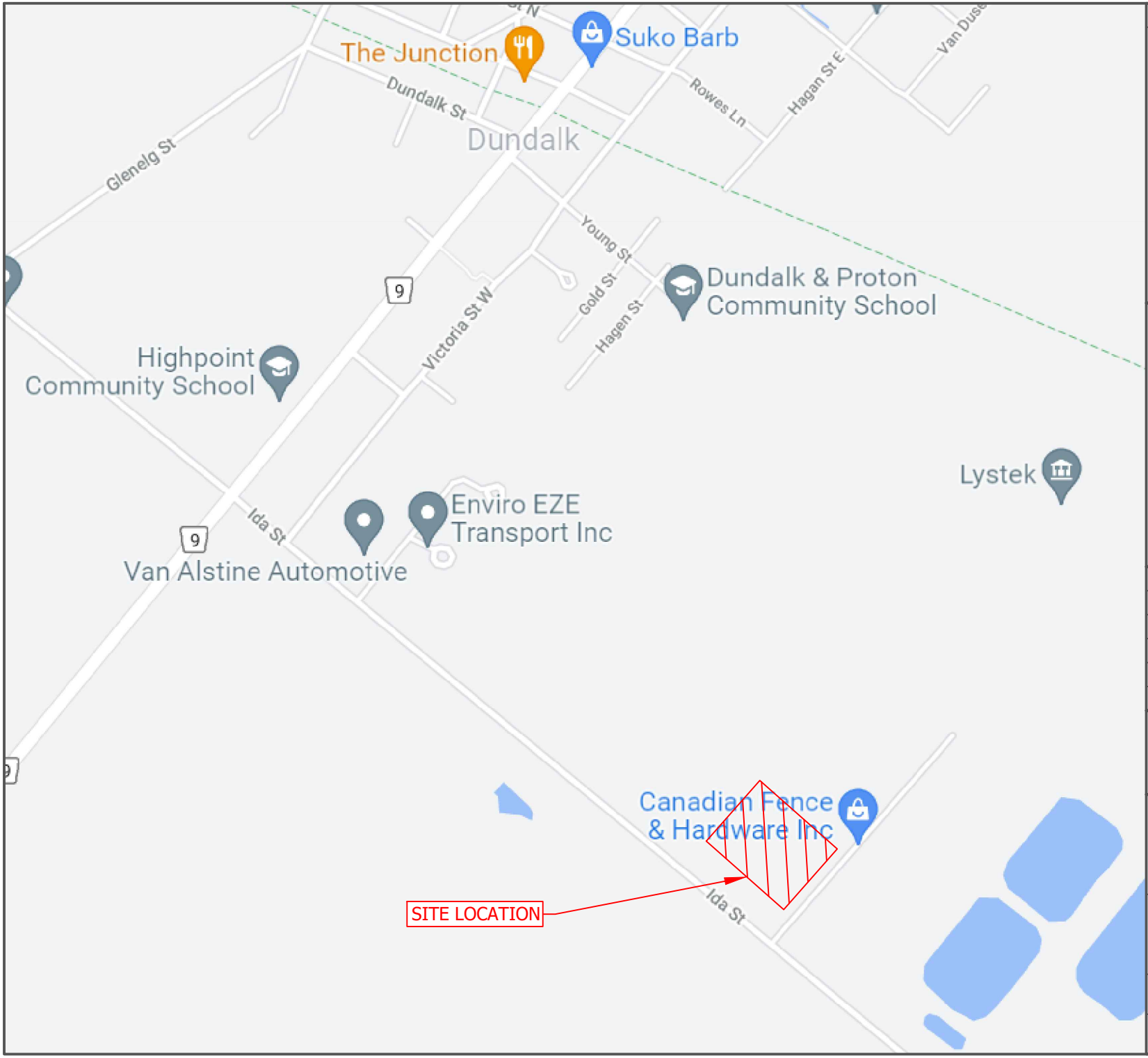


NOTES:

Base map provided by Google.

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

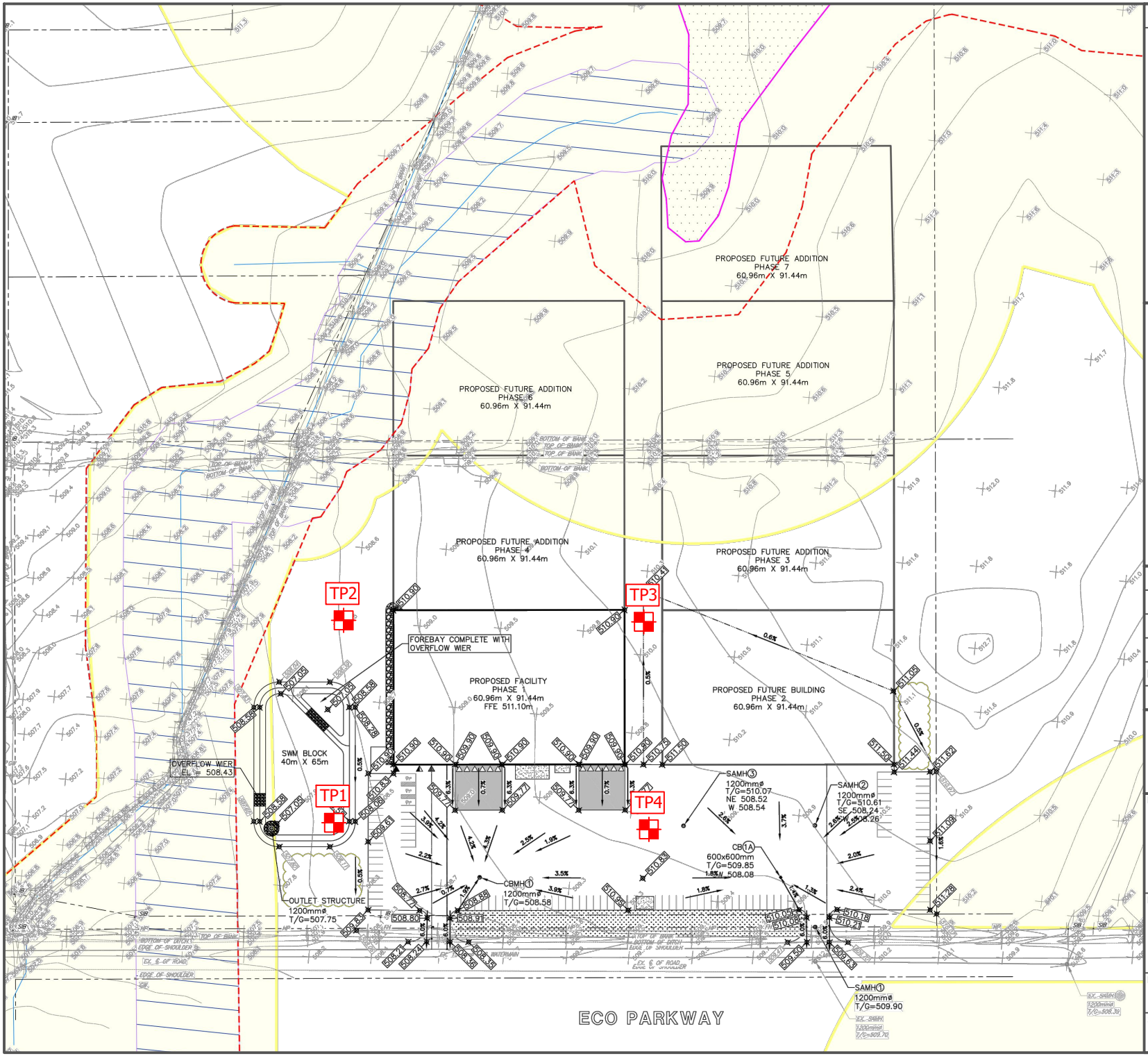
PROJECT:

Phase 1 Facility for
Ice River Sustainable Solutions
Eco Parkway
Dundalk, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.:	DATE:
22-061	February 14, 2022
SCALE:	DRAWING NO.
N.T.S.	1



NOTES:

This drawing is for information purposes only. Locations are approximate only, and should not be used for construction.

Base map provided by Client.

Legend

CMT Test Pit

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

PROJECT:

Phase 1 Facility for
Ice River Sustainable Solutions
Eco Parkway
Dundalk, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
TEST PIT LOCATIONS

PROJECT NO.:	DATE:
22-061	February 14, 2022
SCALE:	DRAWING NO.
N.T.S.	2

APPENDIX A

TEST PIT LOGS

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

TEST PIT NUMBER TP1

PROJECT: Phase 1 Facility for Ice River Sustainable Solutions
PROJECT ADDRESS: Eco Parkway
PROJECT NUMBER: 22-061
PROJECT LOCATION: Dundalk, Ontario
EXCAVATION DATE: 22-2-9
GROUND ELEVATION: 507.94 m
EXCAVATION CONTRACTOR: N/A
LOGGED BY: BL
EXCAVATION EQUIPMENT: Excavator
SAMPLING METHOD: GS

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	POCKET PENETROMETER (kPa) 90 180 270 360 / MOISTURE CONTENT (%) 12 24 36 48
		TOPSOIL: Loose, dark brown silty topsoil, moist	0.00, 507.94		
		SANDY SILT: Loose to compact, brown sandy silt, some clay and gravel, moist	0.36, 507.58		
1				GB 1	15
		becoming wet	1.07, 506.87		
2				GB 2	16.3

Bottom of test pit at 2.29 m, Elevation 505.65 m.

Test pit walls caved throughout.

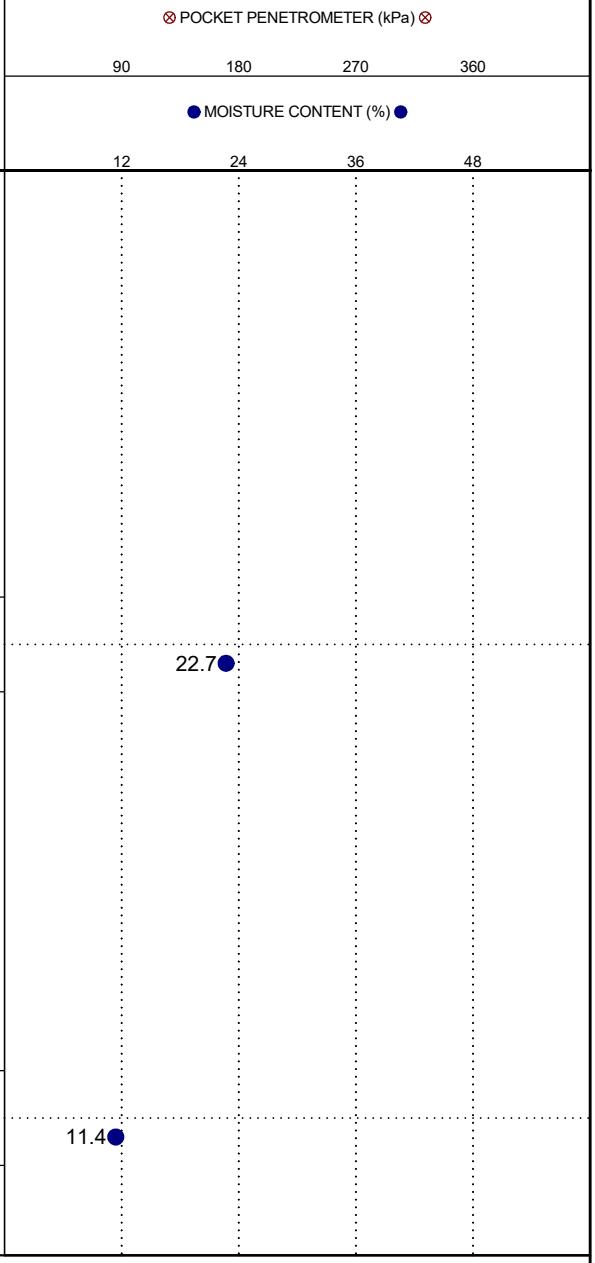
Accumulated groundwater encountered at about 1.3 m below existing ground surface.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

TEST PIT NUMBER TP2

PROJECT: Phase 1 Facility for Ice River Sustainable Solutions
PROJECT ADDRESS: Eco Parkway
PROJECT NUMBER: 22-061
PROJECT LOCATION: Dundalk, Ontario
EXCAVATION DATE: 22-2-9
GROUND ELEVATION: 508.20 m
EXCAVATION CONTRACTOR: N/A
LOGGED BY: BL
EXCAVATION EQUIPMENT: Excavator
SAMPLING METHOD: GS

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER
		TOPSOIL: Loose, dark brown silty topsoil, moist	0.00, 508.20	
		SANDY SILT: Loose to compact, brown sandy silt, some clay, trace gravel, moist	0.31, 507.89	
		becoming some gravel, very moist to wet	0.56, 507.64	
1				GB 1
2				GB 2



Bottom of test pit at 2.29 m, Elevation 505.91 m.

Test pit walls caved throughout.

Accumulated groundwater encountered at about 1.1 m below existing ground surface.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

TEST PIT NUMBER TP3

PROJECT: Phase 1 Facility for Ice River Sustainable Solutions
PROJECT ADDRESS: Eco Parkway
PROJECT NUMBER: 22-061
PROJECT LOCATION: Dundalk, Ontario
EXCAVATION DATE: 22-2-9
GROUND ELEVATION: 510.12 m
EXCAVATION CONTRACTOR: N/A
LOGGED BY: BL
EXCAVATION EQUIPMENT: Excavator
SAMPLING METHOD: GS

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	POCKET PENETROMETER (kPa) 90 180 270 360 / MOISTURE CONTENT (%) 12 24 36 48
		TOPSOIL: Loose, dark brown silty topsoil, moist	0.00, 510.12		
		SANDY SILT: Loose to compact, brown sandy silt, some clay and gravel, moist	0.38, 509.74		
1		becoming wet	0.97, 509.15	GB 1	29
2				GB 2	14.4

Bottom of test pit at 2.44 m, Elevation 507.68 m.

Test pit walls caved throughout.

Accumulated groundwater encountered at about 1.6 m below existing ground surface.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

TEST PIT NUMBER TP4

PROJECT: Phase 1 Facility for Ice River Sustainable Solutions
PROJECT ADDRESS: Eco Parkway
PROJECT NUMBER: 22-061
PROJECT LOCATION: Dundalk, Ontario
EXCAVATION DATE: 22-2-9
GROUND ELEVATION: 509.64 m
EXCAVATION CONTRACTOR: N/A
LOGGED BY: BL
EXCAVATION EQUIPMENT: Excavator
SAMPLING METHOD: GS

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	POCKET PENETROMETER (kPa) 90 180 270 360 / MOISTURE CONTENT (%) 12 24 36 48
		TOPSOIL: Loose, dark brown silty topsoil, moist	0.00, 509.64		
		SANDY SILT: Loose to compact, brown sandy silt, some clay and gravel, moist	0.51, 509.13		
1				GB 1	10.9
		becoming wet	1.37, 508.27		
2				GB 2	22.9

Bottom of test pit at 2.44 m, Elevation 507.20 m.

Test pit walls caved throughout.

Accumulated groundwater encountered at about 1.3 m below existing ground surface.