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Geotechnical Investigation Report – Proposed New Warehouse Structure

1309 Carling Avenue, Ottawa, Ontario

Prepared for

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ACRONYMS AND ABBREVIATIONS

%	Percent
1D	1 Dimensional
CFEM	Canadian Foundation Engineering Manual
ESA	Environmental Site Assessment
Franki Piles	concrete piles
Geosyntec	Geosyntec Consultants International Inc.
In	inches
kg	kilograms
kPa	kiloPascals
LI	Liquidity Index
LL	Liquid Limit
m amsl	meter above mean sea level
m bgs	meters below ground surface
m btoc	metres below top of casing
m	meters
mm	millimeters
MPa	Megapascals
MPa/m	Megapascals per meter
ms/cm	millisiemens per centimeter
mV	millivolts
OBC	Ontario Building Code
OCR	Over Consolidation Ration
OGS	Ohlmann Geotechnical Services
ohm*cm	ohm -centimeter
OHSA	Occupational Health and Safety Act
ON	Ontario
OPSS	Ontario Provincial Standard Specification
PI	Plasticity Index
PL	Plastic Limit

ACRONYMS AND ABBREVIATIONS (CONT'D)

Property	Westgate mall at 1309 Carling Avenue, Ottawa, ON
PVC	polyvinyl chloride
RFP	Request for Proposal
RioCan	RioCan Holdings Inc.
RQD	Rock Quality Designation
sCPT	Seismic Cone Penetration Test
Site	Proposed New Building footprint
SLS	Serviceability Limit State
SPA	Site Plan Application
SPMDD	Standard Proctor Maximum Dry Density
SPT	Standard Penetration Test
UCS	unconfined compressive strength
ULS	Ultimate Limit State
Φ	geotechnical resistance factor
μg/g	microgram per gram

1. INTRODUCTION

Geosyntec Consultants International Inc. (Geosyntec), based in Ottawa, was retained by RioCan Management Inc., an agent of RioCan Holdings Inc. (RioCan), to conduct a geotechnical investigation supporting the redevelopment design and construction of 1309 Carling Avenue, Ottawa, Ontario (ON) for use as a commercial space. Geosyntec was engaged with a scope outlined in Geosyntec's proposal dated February 21, 2025. The scope includes a Geotechnical Investigation Report for a proposed warehouse structure within the existing Westgate Mall footprint. In this report, the overall Westgate Mall property is termed 'The Property' to distinguish between the location of the new building (The Site) and the remaining site area. **Figure 1** shows the Site location.

This report was completed in accordance with the scope and provides the results from the geotechnical investigation. The environmental results and interpretation are provided as a separate report in the Phase Two Environmental Site Assessment (ESA) dated May 12, 2025, prepared by Geosyntec. This report includes:

- Introduction, including background information and project description (Sections 1 and 2)
- Field investigation methodologies (Section 3)
- Laboratory testing methodology (Section 4)
- Factual and interpreted subsurface conditions (Section 5)
- Groundwater observations (Section 6)
- Analysis and recommendations (Section 7)
- General design and construction considerations (Section 8)

2. SITE AND PROJECT CONDITION

The Property is bounded by Carling Avenue to the southwest and east, a hydro easement and Highway 417 to the north and northeast, and Merivale Road from the east to the northeast, an area that is developed with a mix of community, commercial, and residential properties. **Figure 1** shows the Site location.

The Property is currently occupied by the existing Westgate strip mall structure. Based on the available information, the Property was initially used for agricultural purposes and as an oil depot (Sun Oil Company) from 1948 until it was developed as the Westgate Shopping Centre in 1955. Between 1970 and 1997, the overall footprint of the mall increased, and additional stories were constructed over the eastern portion of the Site. RioCan purchased the Site in 1997.

The immediate redevelopment plans for the Site include constructing an approximately 2800 square meter (30,000 square foot, net rentable) commercial building. Geosyntec understands no underground levels are planned for the proposed new building. It will be bordered by the existing Shoppers Drug Mart to the south, which will remain in place, access roads and parking areas to the east and west, and future site development to the north and northwest, once the existing mall building is demolished.

Geosyntec further understands that the designers are considering supporting the new structure on the foundation of the current commercial building. Based on a review of the building renovation drawings dated 1990, the foundation system supporting the renovated part of the Westgate mall is likely comprised of expanded base concrete piles (Franki Piles). The drawings refer to a soil report No. T979 Dated April 9, 1990 prepared by Sarafinshin Associates Ltd. that provides foundation recommendations, but this document was not available to Geosyntec for review. The drawings indicate that the piles must be extended to a soil layer capable of supporting a 100 ton vertical load and that a certain number of piles must be tested to confirm their load capacity. To our knowledge, no other documents related to the construction or testing of these piles exist. Thus, the depth, diameter and load capacity of these piles are unknown. It is also unclear whether the foundation system used for the mall addition and renovation of a section of the mall differs from the original mall structure's foundation system.

At the time of submitting this report, Geosyntec had not received the column loading details for the proposed new structure. The investigation assumes that the development will feature a one-story warehouse-type structure with a maximum floor loading of 12 kiloPascals (kPa). Grade increases at the building site and in the immediate vicinity of the proposed structure are anticipated to be 0.3 meters (m) or less.

The results of the environmental site assessment are provided in a separate report prepared by Geosyntec and titled “Phase Two Environmental Site Assessment” (Geosyntec, 2025a)

3. FIELD INVESTIGATION METHODOLOGY

The objectives of the subsurface site investigation were to collect both geotechnical and environmental data required for the proposed development. Geosyntec provided a borehole location plan in the Request for Proposal (RFP) documents that outlines 11 locations for the combined geotechnical and environmental site assessment, including two interior boreholes. RioCan and its design team reviewed the plan. Eleven locations (25-01 through 25-11) were marked on site by a Geosyntec field representative prior to drilling. Geosyntec then used a private utility locator for the required public and private utility clearance and to scan the interior borehole locations to identify rebar in addition to utilities. Some proposed borehole locations were adjusted due to the presence of underground utilities or other obstructions, such as rebar at interior borehole locations.

Geosyntec retained a borehole drilling subcontractor, Ohlmann Geotechnical Services (OGS) Inc., to complete the borehole investigation and sampling at the site. Geosyntec field staff were present full-time to log the soil and rock samples and record the in -situ testing results. The field investigation was completed between March 11 and 26, 2025, using a truck-mounted CME 75 HT drill rig and a portable Hilti DD 250 Core drill. Five of the proposed 11 boreholes located near or within the footprint of the proposed building are used for geotechnical data gathering and laboratory testing and incorporated in the geotechnical analyses. They were drilled, sampled, and logged to a maximum depth of 20.6 meters below ground surface (m bgs). The remaining six boreholes were used solely for environmental assessments and are not evaluated in detail in this report. However, they are referenced to provide general context regarding property conditions and groundwater levels. Monitoring wells were installed in four of these to an approximate depth of 6 m bgs.

Geosyntec retained Annis O’Sullivan Vollebekk Ltd. (AOV), a professional land surveyor, to conduct a well elevation survey at the Property on April 11, 2025. Easting and northings were provided in MTM Zone 9 NAD83 (Original) and geodetic elevations were provided in reference to the CGVD28 geodetic datum. **T**able 1 summarizes the location, total depth and elevation at each geotechnical boring. A map showing borehole locations is provided in **Figure 2**.

Boreholes 25-01, 25-02, 25-03, 25-06, 25-07, 25-08, 25-09, 25-10, and 25-11 were drilled with the CME rig. Disturbed samples were collected at intervals of 0.8 m and 1.5 m with 50 mm split-spoon samplers in accordance with ASTM D1586 (ASTM International, 2010) by dropping a 63.5 kilograms (kg) hammer approximately 760 mm. For boreholes 25-04 and 25-05, the HILTI DD 250 -CA was used to advance casing with a diamond drilling tool. A 1/3 correction factor was applied to the Standard Penetration Test (SPT) N values relative to the ASTM standard hammer for these boreholes.

Table 1 Borehole and Monitoring Well Summary

Boring ID	Monitoring Well	BH Location	MTM	Easting (m)	Northing (m)	Elevation (m asl)[(1)]	Total Depth (m bgs)
25 -01	N	Exterior BH	9	364627.742	5027683.106	73.84	14.6
25 -02	Y	Exterior BH	9	364645.684	5027656.312	73.79	13.3
25 -03	Y	Exterior BH	9	364692.82	5027788.83	73.79	7.5
25 -04	Y	Interior BH	9	364665.66	5027721.99	74.01	4.9
25 -05	Y	Interior BH	9	364679.23	5027679. 71	74.01	5.6
25 -06	Y	Exterior BH	9	364708.68	5027628.16	73.60	5.8
25 -07	Y	Exterior BH	9	364739.93	5027849.22	74.25	7.5
25 -08	Y	Exterior BH	9	364703.62	5027715.34	73.88	20.6
25 -09	N	Exterior BH	9	364771.63	5027678.26	74.23	3.7
25 -10	N	Exterior BH	9	364599.11	5027648.88	75.02	3.7
25 -11	N	Exterior BH	9	364781.18	5027780.30	74.40	4.3

Notes:

[1] At monitoring well locations, the reported elevations are measured from the top of the polyvinyl chloride (PVC) casing. At boreholes 25-01, 25-09 to 25-11, the elevation is referenced to the ground surface level.

A total of five relatively undisturbed Shelby tube samples were also collected in accordance with ASTM D1587 (ASTM International, 2008).

The results of the penetration tests are provided as Standard Penetration Test (SPT) "N" values on the borehole logs at the corresponding depths. A detailed description of the encountered soil layers is provided in Section 5 of this report and on the borehole logs included in **Appendix A**. The Geotechnical and environmental borehole logs are presented in **Appendix A1** and **Appendix A2,** respectively.

The borehole logs provide details on the monitoring well installation. The boreholes where monitoring wells were not installed were sealed and backfilled with bentonite. The excess drilling cuttings and mud were placed in drums and removed from the Site for disposal.

Groundwater level was measured during the drilling activities and after well installation. One round of groundwater readings was completed as part of the Phase Two ESA.

4. GEOTECHNICAL LABORATORY TESTING

Geotechnical laboratory testing was completed on select soil samples obtained from boreholes. Forty-one (41) samples were tested for moisture content, four samples were subjected to grain size distribution analysis (LS-702/ASTM D-422), and six samples were tested for the Atterberg Limits test (LS-7034/ASTM D-4318). One-dimensional consolidation (1D Consolidation) tests were performed on two samples from Shelby tubes, and three rock cores were tested for unconfined compressive strength (UCS). The tests were completed by GEMTEC Consulting Engineers and Scientists. Test results were used to characterize and describe the subsurface conditions as provided in Section 5 of this report. Test results are presented on the borehole logs included in **Appendix A** and laboratory test reports included in **Appendix B**.

AGAT Laboratories completed corrosivity package testing (Chloride, Conductivity, moisture, pH, Redox Potential, Resistivity, Sulphate and Acid Volatile Sulphides) on two composite samples; one from boreholes 25-01 and one from 25-04. The results are discussed in Section 8.6 of this report.

5. SUBSURFACE CONDITIONS

The subsurface conditions encountered at the borehole locations at the Site indicate that dominant soil units below the surficial asphalt or concrete are: (i) Surficial Fill layer, (ii) silty Clay or clayey Silt, and (iii) Sand and Gravel soil unit. These units were also encountered and documented in available historical subsurface information. The following subsections provide a detailed description of each unit encountered within the geotechnical boreholes 25-01, 25-02, 25-04, 25-05, 25, and 25-08. Subsurface conditions at the remaining boreholes are not discussed in this section; however, they generally exhibited similar characteristics, with variations in soil unit depths and thicknesses.

5.1 Surface Conditions

Asphaltic concrete with a thickness between 100 mm and 150 mm was encountered at all exterior borehole locations. Inside the existing building, concrete with a thickness of 150 mm, and tile and concrete with a combined thickness of 270 mm were encountered at boreholes 25-04 and 25-05, respectively.

5.2 Fill

Fill comprised dominantly of gravel and sand was encountered at all borehole locations with thickness between approximately 0.5 m to 1.5 m in the geotechnical drilled boreholes.

Borings were advanced through the fill without split spoon sampling, except for 25-01. The recorded SPT 'N' values for the fill materials at borehole 25-01 ranged between 6 to 16 blows per 0.3 m of penetration, indicating a loose to compact condition.

The measured moisture content by weight on samples from this material is approximately 8 percent (%) indicating a moist condition.

5.3 Silty Clay/Clayey Silt

A silty Clay to clayey Silt soil unit was encountered at all borehole locations. The characteristics of the unit varied from the interior to the exterior of the existing structures, likely because of consolidation induced by building loads. Additionally, the upper clayey soil unit at the interior borehole locations is classified as silt to clayey silt, whereas at the exterior borehole locations, the upper soil unit is classified as silty clay. It is noted that variation in silt and clay content within this soil unit across the Site and with depth should be expected.

5.3.1 Interior Boreholes

Underlying the fill material, a Silt or sandy Silt soil unit was encountered at interior boreholes 25-04 and 25-05. The thickness of this material was approximately 2.1 m at 25-04 and 2.7 m at 25-05. Beneath the Silt/sandy Silt unit, a silty Clay unit was encountered. The interior boreholes 25-04 and 25-05 were terminated within this soil unit at the approximate depths of 4.9 m bgs and 5.6 m bgs, respectively.

The recorded SPT 'N' values for clayey Silt unit at borehole 25-04 ranged from 2 to 5 blows per 0.3 m of penetration, indicative of soft to firm consistency. At borehole 25 -05, the N values ranged between 6 to 21 blows per 0.3 m of penetration indicating a firm to very stiff consistency. The results of the Atterberg Test completed on one sample of this soil unit indicate the material can be classified as high plasticity Silt (**Table 3**).

The measured moisture contents by weight on samples from clayey silt material generally varied from approximately 15% to 58% with elevated moisture content between depths of 0.5 m bgs to 3.0 m bgs.

The recorded SPT 'N' values for silty clay unit at two interior boreholes are generally in the range of 2 to 5 blows per 0.3 m of penetration, indicative of soft to firm consistency. However, SPT N values do not fully capture the consistency of clayey soils. Therefore, in situ vane shear tests were conducted to determine the undrained shear strength of these soils. Two tests were performed at various depths within the interior borehole locations, with measured peak undrained shear strength of 37 kPa and 40 kPa, while the remolded undrained shear strength were 8 kPa and 18 kPa indicating a sensitivity of 2.2 and 4.4 as presented in **Table 2**. The test results indicate the silty Clay soil unit is firm in consistency.

Table 2 In -Situ Vane Shear Tests in Interior Boreholes

Boring ID	Depth (m bgs)	The Peak Undrained Shear Strength (kPa)	The Remolded Undrained Shear Strength (kPa)	Sensitivity
25 -04	2.7 – 3.0	36.9	8.3	4.4
25 -05	4.4 – 4.7	40.6	18.4	2.2

The measured moisture contents by weight on samples from silty clay material generally varied from approximately 63% to 75% with elevated moisture content between depths of 3 m bgs to 5.5 m bgs.

The Atterberg Limits tests completed on select samples from the clayey silt and silty clay units indicate presence of high plasticity soil unit.

The silty Clay soil unit is considered sensitive based on in -situ shear strength test results and the Liquidity Index (LI) of greater than 1 determined from the Atterberg Test results.

Table 3 Atterberg Limit Laboratory Results in Interior Boreholes

Boring ID	Sample ID	Sample Depth (m bgs)	Moisture Content (%)	Atterberg Limit			
				PL (%)	LL (%)	PI (%)	LI (%)
25 -04	SS4	1.5 – 2.1	26.7	30.8	52.8	22	-0.19
	ST1	3.7 – 4.3	72.3	28.6	56.5	27.9	1.57
25 -05	SS4	1.8 – 2.4	58.8	29.6	56.1	26.5	1.10

5.3.2 Exterior Boreholes

At exterior boreholes, 25-01, 25-02, and 25-08, underlying the fill material, a silty Clay soil unit was encountered. The thickness of the silty Clay material ranges between 5 m and 9 m at these locations. The exterior boreholes penetrated the full thickness of this soil unit and extended further into underlying soil units and bedrock.

The recorded SPT 'N' values for this unit are generally in the range of 0 to 16 blows per 0.3 m of penetration. The recorded zero blow count indicates the layers where the sampler was pushed into the soil using the hammer weight, preventing extended penetration beyond the targeted sampling depth. Low blow counts were recorded between the approximate depths of 3 m bgs to about 6.5 m bgs. As indicated the SPT results do not fully capture the consistency of this soil unit and therefore in -situ field vane test was completed at various borehole locations and varying depths.

Four in situ vane shear tests were conducted at the exterior borehole locations. The peak undrained shear strength ranged between 40 kPa to more than 92 kPa, while the remolded undrained shear strength ranged between 4 kPa and 11 kPa indicating a sensitivity of 5.6 to 10.4 as presented in **Table 4**.

Table 4 In Situ Vane Shear Tests in Exterior Boreholes

Boring ID	Depth (m bgs)	The Peak Undrained Shear Strength (kPa)	The Remolded Undrained Shear Strength (kPa)	Sensitivity
25 -01	3.8 – 4.1	40.6	3.9	10.4
	5.5 – 5.8	> 92(1)	0	High
25 -02	5.5 – 5.8	51.6	9.2	5.6
25 -08	4.1 – 4.4	66.4	11.1	6.0

Notes:

[1] The shear vane reached its maximum limit and failed at a value exceeding its capacity.

The measured moisture contents by weight on samples from silty Clay material generally varied from approximately 30 to 80% with elevated moisture content between depths of 0.5 m bgs to 6 m bgs.

Atterberg Limits tests completed on select samples from this unit indicates a relatively low plasticity clay soil unit. The LI is greater than one and together with the results of the shear vane test indicating presence of sensitive clay soil unit. The details of lab test reports are included in **Appendix B.**

Table 5 Atterberg Limit Laboratory Results in Exterior Boreholes

Boring ID	Sample ID	Sample Depth (m bgs)	Moisture Content (%)	Atterberg Limit			
				PL (%)	LL (%)	PI (%)	LI (%)
25 -01	SS7	4.3 – 4.9	60.6	18.2	40.5	22.3	1.90
25 -02	ST1	4.0 – 4.6	59.7	22.3	43.2	20.9	1.79
25 -08	SS6	5.3 – 5.9	30.7	13.6	25.4	11.8	1.45

Two of the relatively undisturbed Shelby tube samples collected during the geotechnical investigation were subject to 1D consolidation test. The results of these tests are summarized in **Table 6** for both interior and exterior boreholes. The results indicate that both tested soil samples are in an over -consolidated state with an Over Consolidation Ratio (OCR) of 1.3 for the sample tested from borehole 25-04 and an OCR of 2 for the sample tested from borehole 25-02.

Table 6 Consolidation Test Results in Exterior and Interior Borehole Samples

Boring ID	Depth (m bgs)	Effective Stress (kPa)	Initial Moisture Content (%)	Initial Void Ratio	Compression Index Cc	Recompression Index Cr	Preconsolidation Pressure (kPa)
25 -02	4.0 – 4.6	62	60	1.64	1.25	0.04	130
25 -04	3.7 – 4.3	38	71	1.97	0.52	0.07	50

5.4 Gravel and Sand

At exterior borehole locations, 25-01, 25-02, and 25-08, underlying the silty Clay soil unit, a gravelly Sand or sandy Gravel soil unit with trace to some silt and clay were encountered. The sand and gravel soil units were found to have a thickness of 2 m to 10 m starting from approximate depths of 6 m bgs to 9 m bgs. Boulders were also encountered within this layer, which were cored and confirmed during the drilling fieldwork.

Table 7 Soil Grading Laboratory Results

Boring ID	Sample ID	Sample Depth (m bgs)	Soil Unit	Sieve Analysis			
				Gravel (%)	Sand (%)	Silt (%)	Clay (%)
25 -01	SS9	6.9 – 7.5	Gravelly silty sand with clay	24.8	35.3	30.4	9.5
25 -02	SS12	8.8 – 9.5	Silty gravel and sand	39.2	38.0	21.8	1.0
25 -08	SS11	9.1 – 9.7	Gravelly silty sand with clay	22.6	41.1	27.4	8.9
	SS13	13.7 – 14.3	Gravelly sand with some silt	29.5	47.6	18.1	4.8

The recorded SPT 'N' values for this soil unit were in a wide range of 3 to more than 50 blows (Refusal to SPT) per 0.3 m of penetration, indicating a very loose to very dense state of compactness. This soil unit, although having a similar gradation result, likely consists of two separate depositions, one with lower N values (3 to 15) indicating younger deposition history and one with higher N values (30 to more than 50) indicating glacial till type material. The sand and gravel glacial till material was encountered at borehole 25-02 and 25-08 locations and was absent at borehole 25-01 location.

The measured moisture content by weight on samples from this layer was around 5% to 14%, indicating moist to wet condition.

5.5 Bedrock

Bedrock was encountered and confirmed by coring at three borehole locations, 25-01, 25-02, and 25 -08, at approximate depths of 12.4 m bgs, 11.3 m bgs and 17.8 m bgs, respectively.

It is identified as a grey limestone with black shale interbeds. The upper 0.5 to 1.5 m of bedrock was found to be highly weathered and fractured in boreholes 25-01 and 25-08 with Rock Quality Designation (RQD) of zero; however, this highly weathered zone was absent at borehole 25-02 location. At borehole 25 -02 a fractured and very poor quality zone was observed between the approximate depths of 11.8 m bgs and 12.5 m bgs. The rock quality improved with depth within the investigated bedrock zone, with RQD varying between 80% and 95%, indicating good to excellent quality.

The results of the UCS test completed on three core samples selected from boreholes 25 -01, 25-02, and 25-08, between 11 m bgs and 20 m bgs depths, show compressive strengths of 127 to 157 Megapascals (MPa). The results of the UCS test are provided in **Appendix B**.

Boreholes 25-01, 25-02 and 25-08 were terminated within bedrock upon reaching the target depths.

The rock core photologs are presented in **Appendix C**.

6. GROUNDWATER

This report references the four monitoring wells that were installed in the completed geotechnical boreholes located near or within the proposed building footprint and includes the monitoring wells installed as part of the environmental site assessment. These monitoring wells were constructed using flush-threaded, Schedule 40, clean polyvinyl chloride (PVC) casings with slotted well screens. The exterior wells had a diameter of 50 mm (2 inches), except for well 25-02, which had a 38 mm (1.5 inches) diameter PVC casing. The interior wells had a diameter of 31 mm (1.25 inches). The screens ranged from 0.61 to 3.0 (m) in length and were installed to intersect the water table. Detailed information about the installed monitoring wells can be found in the relevant borehole logs in **Appendix A.**

Groundwater levels were measured with a water level tape. The results of the groundwater depth measurements from four boreholes near the proposed building on April 11, 2025, are summarized in **Table 8**. The complete list of groundwater level measurements is presented in the Phase Two ESA report (Geosyntec, May 2025).

Table 8 Groundwater Measurement on 11 April 2025

Boring ID	Depth of Groundwater (m btoc)	Riser Elevation (m amsl)	Groundwater Elevation (m amsl)
25 -02	3.60	73.79	70.19
25 -03	1.59	73.79	72.20
25 -04	0.77	74.02	73.24
25 -05	1.04	74.01	72.97
25 -06	2.73	73.60	70.87
25 -07	2.30	74.25	71.94
25 -08	0.31	73.88	73.57

The groundwater table fluctuates seasonally in response to precipitation and snowmelt events. Geosyntec prepared a hydrogeological memorandum dated June 26, 2025, for this Site (Geosyntec, 2025b) that addresses the dewatering requirements during construction activities, particularly for foundation construction or removal and installation of underground services.

7. ANALYSIS AND RECOMMENDATIONS

The recommendations in Sections 7 and 8 of this report are based on Geosyntec's understanding of the project as discussed in Section 2 and assuming the subsurface conditions encountered in the boreholes are consistent across the Site. Key geotechnical considerations for the design and construction of the proposed structure include:

- **Presence of marine clay:** A sensitive silty clay soil unit was encountered in all advanced borehole locations. This soil unit contains varying amounts of silt and clay across the site and at different depths. It is prone to long -term total and differential settlement which makes shallow foundations unsuitable for supporting structural walls; it can be easily disturbed by construction traffic and activities such as vibratory compaction if exposed during construction. Additionally, it is susceptible to frost and should be protected against freezing temperatures if construction occurs during cold seasons.
- **Depth to bedrock:** Bedrock was cored and confirmed at three exterior borehole locations, with depths ranging from 11 m to 20 m . These variations should be taken into account when designing deep foundations, preparing tender documents, and estimating construction costs.
- **Shallow Groundwater level:** The groundwater level was measured at varying depths between 0.3 m bgs and 3.6 m bgs. The buoyancy effect of these groundwater levels should be taken into account when designing foundations, particularly for pile caps that are expected to be founded at or below the groundwater level.
- **Existing building foundation system:** The foundation system for the proposed building should be designed considering the presence of existing underground utilities and any elements of the existing building foundation that are not removed and their potential impact on differential settlement and performance of new buildings structural components.
- **Reuse of existing deep foundation:** The suitability of the existing deep foundation to support the proposed structure's loads should be further confirmed through load tests, including static load testing, high strain dynamic pile monitoring, and concrete strength testing.
- **Dewatering:** The shallow groundwater level at the site can complicate excavation for underground services and foundation construction. To ensure a dry work environment and prevent subgrade disturbance, temporary construction dewatering is recommended. Additional recommendations are provided in Geosyntec's hydrogeological memorandum (Geosyntec, 2025b).

7.1 Existing Building and Underground Utilities

Geosyntec understands that the existing mall structure will be demolished, and some or all of the existing underground utilities will be removed or grouted in place before the construction of the proposed new building. New foundation components should not be constructed over new or existing underground utilities without proper engineering to minimize the risk of utility or foundation settlement and serviceability issues.

The foundation system for the proposed building should be designed considering the presence of any elements of the existing building foundation that are not removed and their potential impact on differential settlement. Ideally, the existing grade beams and pile caps should be removed. However, if these foundation components are left in place, the slab -on -grade design must be sufficiently rigid to mitigate potential differential settlement across its footprint due to the presence of these rigid structural elements.

7.1.1 Reuse of Existing Deep Foundation

Geosyntec understands that the designers are interested in reusing the existing concrete caissons. To confirm the suitability of the existing deep foundation to support the proposed structure's loads, it is recommended to conduct load testing, such as static load testing (ASTM D1143) and high-strain dynamic pile monitoring (ASTM D4945), as well as concrete strength testing. This will involve exposing the piles and collecting continuous concrete cores from the entire length of the piles for visual inspection and compressive strength testing. The number of load and concrete tests can be determined in consultation with the designers during the detailed design stage of the project if this solution is pursued. However, a concern with this approach is the lack of information regarding the existing pile type, size, and design details of the current foundation.

7.2 Shallow Foundations

Shallow foundations are being evaluated for this project; however, due to the presence of a silty Clay to clayey Silt soil unit that can undergo long-term total and differential settlement greater than the maximum allowable total settlement criteria, these types of foundations are not considered suitable to support structural walls for the proposed building. A slab on grade may be suitable for light to moderate floor loads, provided that structural details allow movement between the wall foundations and the slab. A raft foundation option was not evaluated for this structure, as it is our understanding that a rigid type foundation system is not the Client’s preferred support system.

7.3 Deep Foundations

Based on the encountered subsurface condition, deep foundation options such as driven piles, drilled shafts (caissons) or micropiles socketed in bedrock can be considered to support the walls for the proposed building.

Geosyntec understands that the Client and the designers are interested in deep foundation options founded within the granular sand and gravel soil unit encountered underneath the silty clay to clayey silt soil unit. The sand and gravel soil unit exhibited variable compactness condition ranging from very loose to loose at borehole 25-01 to dense at borehole 25-02 location and loose to dense at borehole 25-08 location. A more detailed assessment of the potential for deep foundations supported within this soil unit would be necessary than what was available within the schedule for this investigation.

7.3.1 Driven Piles

Low-displacement type piles, such as H piles driven onto bedrock, can effectively support the structure and transfer the structural loads to the bedrock. The geotechnical axial capacity of these driven piles should be estimated using static or dynamic load testing. For preliminary design purposes, a typical geotechnical axial capacity of 1000 kN under Ultimate Limit State (ULS) conditions, based on local experience and presence of a highly weathered bedrock surface, can be considered for a H 310 x 110 pile.

It is advisable to conduct Pile Driving Analysis (PDA) on at least 5 % of the piles to verify the capacity of production piles. Re -striking all piles is recommended at this site so that any uplift of adjacent piles due to piling nearby pile installation is properly assessed.

Based on the field investigation study completed for the Site, bedrock depth is expected to vary across the footprint of the proposed building, and therefore, varying bedrock depths should be expected. These variations should be taken into account when designing deep foundations, preparing tender documents, and estimating construction costs.

7.3.2 Drilled Piers (Caisson) Foundation

Drilled piers (caissons) are another option to transfer the structural loads to stronger soil units or bedrock. Based on the encountered subsurface stratigraphy at various borehole locations consisting of silty clay to clayey silt native soil units, end bearing caissons are recommended to be socketed into competent bedrock with the minimum socket depth of one to three times the diameter of the foundation as recommended in Canadian Foundation Engineering Manual (CFEM) 2023. As outlined in CFEM 2023, end bearing piles must have the bottom of the socket excavation thoroughly cleaned and free of loose cuttings and other deleterious materials. This area should then be inspected and approved by geotechnical personnel using industry -standard remote review techniques, such as digital video methods.

For the preliminary design, the factored ultimate end bearing capacity of a single drilled pier socketed a minimum of 1.5 m into bedrock is recommended to be 2000 kPa; higher capacities may be available if the structural capacity of the pile is not exceeded, and bedrock depth and quality is further confirmed through rock probing during detailed design. If fractured or sheared zones similar to those encountered at borehole 25 -02 are found, the socket should be extended beyond the fractured zone. The factored ULS toe bearing capacity determined by utilizing a resistance factor of 0.4 for compression based on the typical understanding of the project (CFEM, 2023).

Alternatively, the drilled pier design can be based on shaft resistance only to avoid rigorous requirements for cleaning the base. A unit shaft resistance of 450 KPa for competent bedrock can be used for drilled piers socketed into bedrock and to determine the length of the socket.

It is expected drilled pier embedded into bedrock will not settle significantly more than the structural elastic deformation of piles/caisson.

The minimum required diameter of the drilled piles is 600 mm. The geotechnical engineer must observe conditions at the base of the drilled shafts prior to placement of concrete to confirm that the bedrock conditions encountered are consistent with the field investigation results.

Casing will be required to prevent caving of the drilled shaft sidewalls due to high groundwater and soft and sensitive clays.

7.3.3 Micropiles

A specialty subcontractor should design micropiles. For the preliminary design of micropiles embedded in competent bedrock, a factored ultimate grout to rock bond capacity of 450 kPa is recommended for a single pile embedded in competent bedrock below the weathered zone. The factored ULS grout to rock bond capacity determined by utilizing a resistance factor of 0.4 for compression based on the typical understanding of the project (CFEM, 2023). The grout and rock bond zone should be situated within the competent bedrock, positioned below the weathered and fractured bedrock zone. Based on the field investigation study completed for the Site, varying bedrock depths should be expected across the footprint of the proposed building.

7.4 Site preparation

Site preparation for foundation construction includes the removal of all fills at foundation locations which is complicated at this site because details of the existing foundation system are unknown and construction records for the existing fill material are unavailable. Best practice would be to remove existing fill and foundation elements above the native silty clays and clayey silts. Some of existing fill material could be recompacted, but some might prove unsuitable.

Temporary groundwater lowering would be required during construction, referring to Section 8.4.2 of this report and the hydrogeological memorandum for more details. In addition, the native silts and clays are subject to significant strength loss if disturbed during construction. Where silty clay or clayey silt material are exposed during construction, it is recommended that a lean concrete slab be used to protect the subgrade from disturbance.

It might be feasible for the owner to leave fill in place and assume the risk of differential settlement, but further analyses and design are required to more clearly assess the risks. Alternatively, the bottom 450 mm of the existing fill material can be left in place, proof rolled, and compacted under the supervision of geotechnical personnel. The remaining fill thickness should be removed and, if deemed suitable as structural fill, re -placed in lifts not exceeding 300 mm of loose thickness and compacted to 100% of its Standard Proctor Maximum Dry Density (SPMDD). Another option would be to use a structural slab instead of a slab -on -grade if the existing fill remains in place and the risks associated with differential settlement are considered undesirable.

7.5 Slab on Grade

Geosyntec understands that the existing mall building consists of a slab on grade structure supported on existing fill material. In discussion with the Client and the design team the slab on grade seem to have been performed satisfactorily without excessive settlement resulting in serviceability issues. Therefore, a slab on grade floor option supported on the existing fill subgrade as encountered in drilled boreholes is the currently preferred option for the design of the proposed new building.

As provided by the designers, a maximum uniform pressure of 12 kPa is assumed in the slab on grade settlement calculations. The Settle3 (v. 5.025) software developed by Rocscience (Rocsience, 2025) is used in settlement assessment of the slab on grade. No point loads were provided by the designers. Installation of racking systems on the slab on grade is planned, however the location and loading of the racking systems were unknown at the time of preparation of this report.

Grade raises are not anticipated for this project and therefore settlement calculation only considers the settlement resulting from the structure loading itself and does not consider settlement due to loading induced by grade raise placed over existing ground surface.

Based on the encountered subsurface condition, the presence of a clay layer with varying thickness is consistent across the site, with a thickness of about 7 m in the deepest drilled borehole (25 -08). The results of the consolidation tests completed on two relatively undisturbed samples are discussed in Section 5.3 and presented in **Appendix B**. The settlement analysis for this site indicates a settlement of 15 mm would be expected for the slab on grade based on the provided uniform slab pressure condition and a compact fill layer below the slab on grade, which meets the maximum allowable total settlement criteria provided that the slab is designed so that it is free to move relative to pile supported walls.

Completed settlement analysis considered a slab area of 45 m by 50 m, supported on a compacted granular fill subgrade. The recommended modulus of subgrade reaction for the design of the slab on grade is 1.2 Megapascals per meter (MPa/m). This value is calculated using Settle3 software and considering the results of the consolidation tests and the subsurface stratigraphy encountered in borehole 25-08.

When installing the racking systems and other structures, they are recommended to be supported either on slab on grade or pile caps exclusively, and not partially on both. This is to avoid the risk of high differential settlements between these two structural components. Pile caps, supported on end bearing or rock socketed piles, are expected to experience minimal to no settlement. In contrast, the slab on grade, supported on soil subgrade, is expected to settle between 15 mm and 25 mm. Consequently, structures partially supported on both systems may exceed the maximum allowable differential settlement under Serviceability Limit State (SLS) conditions.

7.6 Seismic Site Classification

In accordance with OBC 2012 and National Building Code of Canada 2020 (NBC 2020) all structures should be designed for the appropriate seismic loadings as specified in the Code. As per the Code requirements, an appropriate seismic site class can be determined by completing subsurface investigation to the depth of 30 m below the founding elevation of the project. For this project the seismic site classification was completed based on the data collected during the borehole drilling program. To determine the site class the average of the SPT “N” values for granular non -cohesive soils and the average of shear strength of the cohesive soils were calculated using the averaging scheme described in (National Building Code of Canada, 2020) based on the drilled deepest borehole 25-08. The seismic site classification analyses using NBC 2020 methodologies indicate that this site marginally meets Class D requirements. However, if thicker clayey soil units or thicker loose to compact granular soil units are present within the site footprint, the classification will fall within Site Class E. Therefore, it is recommended to use Site Class E for the design of the proposed structure and to further confirm the site classification using geophysical testing methods, such as Multichannel Analyses of Surface Waves (MASW) or a seismic cone penetration test (sCPT), during the detailed design stage of the project.

Liquefaction Potential Screening

A liquefaction potential screening was conducted for the Site using SPT data, grain size distribution, and moisture content results. The analysis indicates that the cyclic resistance ratio (CRR) generally exceeds the cyclic stress ratio (CSR), yielding factors of safety against liquefaction greater than 1.

Atterberg limit test results further suggest that the clayey soils are generally not susceptible to liquefaction, consistent with the criteria proposed by Seed et al. (2003), with one exception. One sample meets the Seed et al. criteria for liquefiable soils; however, field observations indicate a significant clay content. Based on the updated interpretation by Boulanger and Idriss (2006), this sample is expected to behave as a clay-like material and is therefore unlikely to be susceptible to liquefaction.

Nonetheless, it is recommended that additional geophysical testing—such sCPT or MASW—be carried out during the detailed design phase. These tests will help evaluate shear wave velocities, confirm the seismic site classification, and support further liquefaction assessment.

Additionally, a review of the undrained shear strength of the clayey soils for cyclic softening potential indicates that the factors of safety are also generally greater than 1.

8. GENERAL DESIGN AND CONSTRUCTION CONSIDERATIONS

8.1 Requirements for Backfill and Bedding Materials

A general and detailed description of the project site subsurface condition is provided in Section 5 and borehole logs are provided in **Appendix A** of this report. The Fill unit encountered in the completed boreholes consists of sand and gravel and may be suitable for reuse as structural backfill material provided that they are free of any debris, organics, contamination or other unsuitable material and can be compacted to the required levels in the project specifications. It is noted that the fill material characteristics and thickness varied across the site. A fill material containing various amount of silt and clay was also encountered at some borehole locations which would not be suitable for reuse as structural fill. The suitability of the fill material should be reviewed during construction and gradation and proctor laboratory testing may be required during construction to further confirm the suitability of the fill material as structural backfill. Alternatively, structural backfill materials conforming to the requirements of Granular B or Granular A material per Ontario Provincial Standards 1010 (Ontario Provincial Standard Specification, 2013) can be used. Other imported soil material can be used as structural backfill, provided that it is approved by the engineer for structural backfilling purposes, and it meets the imported soil regulations.

The native silty clay to clayey silt soil units is considered frost susceptible, with risk of long -term settlement and constructability challenges, and therefore are not suitable as engineered fill, backfill against foundation walls or bedding material for utilities.

Backfill against foundation walls should consist of free draining of Granular A, Granular B Type I or Type II material. Bedding and cover materials conforming to the requirements of Granular A or Granular B material with 100% passing the 26.5 mm sieve per Ontario Provincial Standard Specification (OPSS) (Latest version available online) should be used and compacted to a minimum of 95% of its SPMDD. The use of clear stone is not recommended as bedding material, as its large void spaces can lead to slow water movement and allow surrounding soil and cover materials to migrate into the voids. This may result in settlement and a loss of structural support for pipes and adjacent infrastructure.

The structural or engineered fill material supporting foundation components or road base/subbase should be compacted to at least 100% of its SPMDD. The backfill against foundation walls and bedding material should be compacted to 98% SPMDD.

Prior to the placement of the backfill material, geotechnical personnel should review the subgrade, proof roll (applicable to large excavations), and clear any organic or other unsuitable materials. Any observed soft spots or unsuitable material should be sub-excavated and backfilled with suitable material. Backfill material should be placed in lifts not exceeding a loose thickness of 250 mm.

8.2 Buoyancy

As discussed in Section 6, for design purposes the groundwater table is considered very shallow. As such, the buoyancy effect of groundwater levels at the Site should be considered in the design of foundations, especially the pile caps that are expected to be founded at or below groundwater level.

It is expected that resistance to foundation uplift will be achieved through the dead weight of the foundation and soil. The dead weights are calculated by the structural engineers. If uplift forces cannot be balanced with the weight of structure and backfill material other options can be micropiles or anchors acting in tension. Geosyntec can provide design recommendations for these type of foundation systems if required.

8.3 Frost Penetration Depth

The frost penetration depth for the investigated site is estimated to be 1.8 m based on Ontario Provincial Standard Drawing 3090.101 (Ontario Provincial Standards, 2010). Accordingly, the underside of all proposed footings, pile caps, and/or any other elements of the heated structure should be provided with at least 1.5 m of earth cover for frost protection or equivalent insulation. All unheated or isolated structure components such as building aprons, loading dock retaining walls (if applicable) should be provided with 1.8 m of frost cover or equivalent insulation.

As indicated the native soil units at the Site within the expected excavation depth are considered frost susceptible. Therefore, if construction proceeds during freezing weather conditions, appropriate temporary frost protection measurements for the footing bases and concrete must be considered to avoid adverse effect of the frost/cold weather on the construction.

8.4 Excavation and Groundwater Control

8.4.1 Excavation

Construction excavations are the responsibility of the contractor and must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects. These regulations designate four general soil classifications with respect to appropriate measures for excavation safety. The deepest excavations at the Site are expected to be mainly associated with the construction of pile caps and underground utilities to depths varying between 1.5 m for foundation components and 2.5 m for utilities. Considering the shallow groundwater level and the native soils consisting of silty clay to clayey silt material with various consistencies, the soils within the excavation depths are recommended to be considered as Type 4 soils.

Deep excavations are not anticipated for this site. If deeper excavations become necessary or proper sloping cannot be achieved, engineered shoring systems may be required. In such cases, Geosyntec should be contacted to provide the necessary geotechnical soil parameters for the design of these systems.

8.4.2 Groundwater Control

Groundwater levels at this site are anticipated to be at or higher than the anticipated depths of excavation for foundation construction, removal, and/or installation of new underground services.

A hydrogeological memorandum prepared by Geosyntec should be reviewed in conjunction with this report. As outlined in the memorandum, both surface water and groundwater seepage into excavations should be anticipated, and temporary construction dewatering will be required. The hydrogeological memorandum provides additional details on groundwater management during construction (Geosyntec, 2025b).

The memorandum also recommends installing low-permeability plugs at 20-metre intervals along underground service routes to prevent the formation of preferential groundwater flow paths (Geosyntec, 2025b).

8.5 Permanent Drainage

For structures without an underground level that are designed to resist buoyant uplift and are set above the surrounding ground surface (typically 0.2 to 0.3 m above adjacent access roads), underfloor and perimeter drainage systems are generally not required.

Since permanent drainage systems are not planned, long-term impacts on groundwater conditions from the construction of this structure are not anticipated. However, any future redevelopment of the site—unrelated to this structure—may influence overall groundwater conditions and should be assessed separately at that time.

8.6 Corrosivity and Sulphate Attack

Corrosivity and sulphate laboratory testing was completed on two soil samples. The tests were completed by AGAT Laboratories. The results of the corrosivity and sulphate tests are summarized in **Table 9** and included in **Appendix C**.

Table 9 Corrosivity Test Results

Sample ID	Depth (m bgs)	pH	Resistivity (ohm*cm)	Redox Potential 1 (mV)	Redox Potential 2 (mV)	Redox Potential 3 (mV)	Sulfides (µg/g)	Electrical Conductivity (ms/cm)	Chloride (µg/g)	Sulphate (µg/g)
25 -01, SS4	1.83 – 2.44	8.19	239	238	265	234	200	4.18	2,120	72
25 -04, SS5	2.13 – 2.74	8.67	5,810	180	171	173	<100	0.172	13	37

Notes:

The values shown in red signifies the values impacting the potential for corrosivity of the soil.

The results show that the submitted sample from borehole 25-01 is considered to be corrosive to cast iron pipes as per American National Standards Institute/American Water Works Association document C105/A21.5-99 (American Water Works Association).

The results for both test samples show that the sulphate content indicates negligible potential for sulphate attack on concrete structures at tested locations per Canadian Standards Association document A23.1-14/A23.2-14 (CSA Group, 2014).

The result of the corrosivity test completed on a sample selected from an exterior borehole indicates high chloride content and low resistivity that are expected where soils are subject to salt application during winter seasons such as access road and parking areas. Therefore, designers should consider the presence of high chloride content in selecting proper cement type.

8.7 Tree Planting

The following recommendations are intended to guide planning and preliminary design. Landscaping design should align with the City of Ottawa's tree planting requirements for areas with sensitive marine clay soils.

As outlined in Section 5 of this report, a silty clay to clayey silt marine deposit was encountered in the completed boreholes. These deposits are susceptible to long-term settlement due to moisture depletion, particularly from the water demand of nearby trees. Structures supported on shallow foundations are generally more vulnerable to this effect than those on deep foundations; however, slab-on-grade buildings, access roads, and parking areas may also be impacted.

To mitigate this risk, it is generally recommended that the distance between trees and building foundations exceed the mature height of the trees. Additionally, the use of tree species with lower water demand is advisable for sites underlain by sensitive marine silty clay. For this site, this recommendation applies specifically to the setback between trees and the proposed slab-on-grade structure.

The City of Ottawa's *Tree Planting in Sensitive Marine Clay Soils – 2017 Guidelines* provides specific recommendations for managing existing trees and planting new ones on City property. The guidelines focus on small (mature height up to 7.5 m) and medium (7.5 m to 14 m) tree species and particularly for structures supported on shallow foundations. Landscape architects may refer to this document for further guidance if required.

For parking lots and access roads, in addition to selecting low water-demand tree species, the potential impact of trees can be managed through risk assessment and consideration of more frequent maintenance strategies.

8.8 Pavement Design

Subsurface conditions within the parking lot and pavement areas may vary across the site but are generally expected to consist of existing surficial fill overlying native silty clay to clayey silt soils. These native soils are sensitive and can experience significant strength loss if disturbed during construction or exposed to precipitation and freezing temperatures. As such, excavation and construction of access roads and parking areas should be avoided during the winter season. Construction planning should also account for the potential impact of heavy precipitation on subgrade stability and performance.

The performance of the pavement depends on proper subgrade preparation. Any topsoil, loose or unsuitable fill or other deleterious materials should be removed from beneath the pavement areas. The subgrade must be properly prepared and contoured to prevent ponding of water during the construction and promote rapid drainage of the subbase and base course materials. Prior to placement of the pavement granular courses, the subgrade should be compacted and proofrolled using a loaded dump truck in the presence of qualified geotechnical personnel. Any loose, soft, or unstable areas thus identified during proofrolling should be subexcavated and replaced with existing or imported material meeting the requirements of OPSS subgrade select material (SSM).

Geosyntec anticipates light and heavy traffic loads and recommends, as general guidance, the pavement structures for flexible pavement options in Error! Reference source not found..

Table 10 Suggested Asphalt Pavement Structure

Pavement Layer	Compaction Requirements	Minimum Thickness (Light Duty)	Minimum Thickness (Heavy Duty)
Surface Course: SP12.5, Traffic Category B, PG58-34 ASPHALT	OPSS 310	60 mm	40 mm
Binder Course: SP19, Traffic Category B, PG58-34 ASPHALT	OPSS 310	-	50 mm
Base Course: Granular A, (OPSS 1010)	100% SPMDD	150 mm	150 mm
Subbase Course: Granular B Type II (OPSS 1010)	100% SPMDD	300 mm	450 mm

Acronyms:

mm: millimeters

SPMDD: Standard Proctor Maximum Dry Density

The gradation of the Granular “A” and Granular B Type II materials should meet the requirement of OPSS 1010.

Drainage of the pavement will be critical to ensuring long-term performance. All pavement surfaces should be properly graded to direct run-off water towards the drainage paths.

Where new pavement ties into existing pavement, longitudinal transitions or tapers should be incorporated beyond the construction limits. At these junctions, the new granular layers are recommended to be tapered at a 5 horizontal to 1 vertical (5:1) slope to ensure a smooth structural transition.

These recommendations are for end-use purposes only. Increasing the thickness of the granular road subbase is necessary to provide additional subgrade support for construction traffic.

8.9 Construction Monitoring and Testing

Depending on the final design grades, the conditions may change at the site. Therefore, during the construction the preparation of the subgrade and the fill compaction should be monitored to confirm material quality, thickness and to check compaction adequacy.

Qualified Geotechnical personnel should observe and test subgrade surfaces during construction. Specifically, they should check that the materials and conditions exposed at the subgrade depth comply with the ones reported in this geotechnical report. In addition, qualified geotechnical personnel should provide materials testing services prior to and during foundation preparation and construction (i.e., subgrade proof rolling, compaction testing, concrete testing, pile load testing, etc.). Should soil conditions be encountered that vary from those described in this report, our Engineers should be informed immediately to consider proper reassessments.

9. LIMITATIONS

This report is prepared for Riocan (Client) in support of the aforementioned project. The material provided in this report represents our best understanding and judgment of the site conditions based on the information available to us at the time of preparation of this report. This document should be read in its entirety and no portion of it may be used as a separate section.

The recommendations made herein are in accordance with our current understanding of the project and site conditions. We anticipate that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction or observed subsurface conditions should differ from that discussed in this report.

It is emphasized that a soil investigation is a random sampling of a site, and the comments are based on the results obtained at the location of the eleven boreholes completed during this investigation. 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 borehole location(s), we request that we be notified in order to complete the assessment of our recommendations.

10. CLOSURE

We anticipate that this report meets your current needs and requirements.

Respectfully submitted,

Geosyntec Consultants International, Inc.

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Senior Staff Professional

Rick Sisson, Ph.D., P.Eng (AB, BC)
Senior Consultant

Bahareh Vazhbakht, MASc., P.Eng (ON, NWT/NU)
Senior Professional

LICENSED PROFESSIONAL ENGINEER
TR1363B
July 10, 2025
B. VAZHBAKHT
100171356
PROVINCE OF ONTARIO

11. REFERENCES

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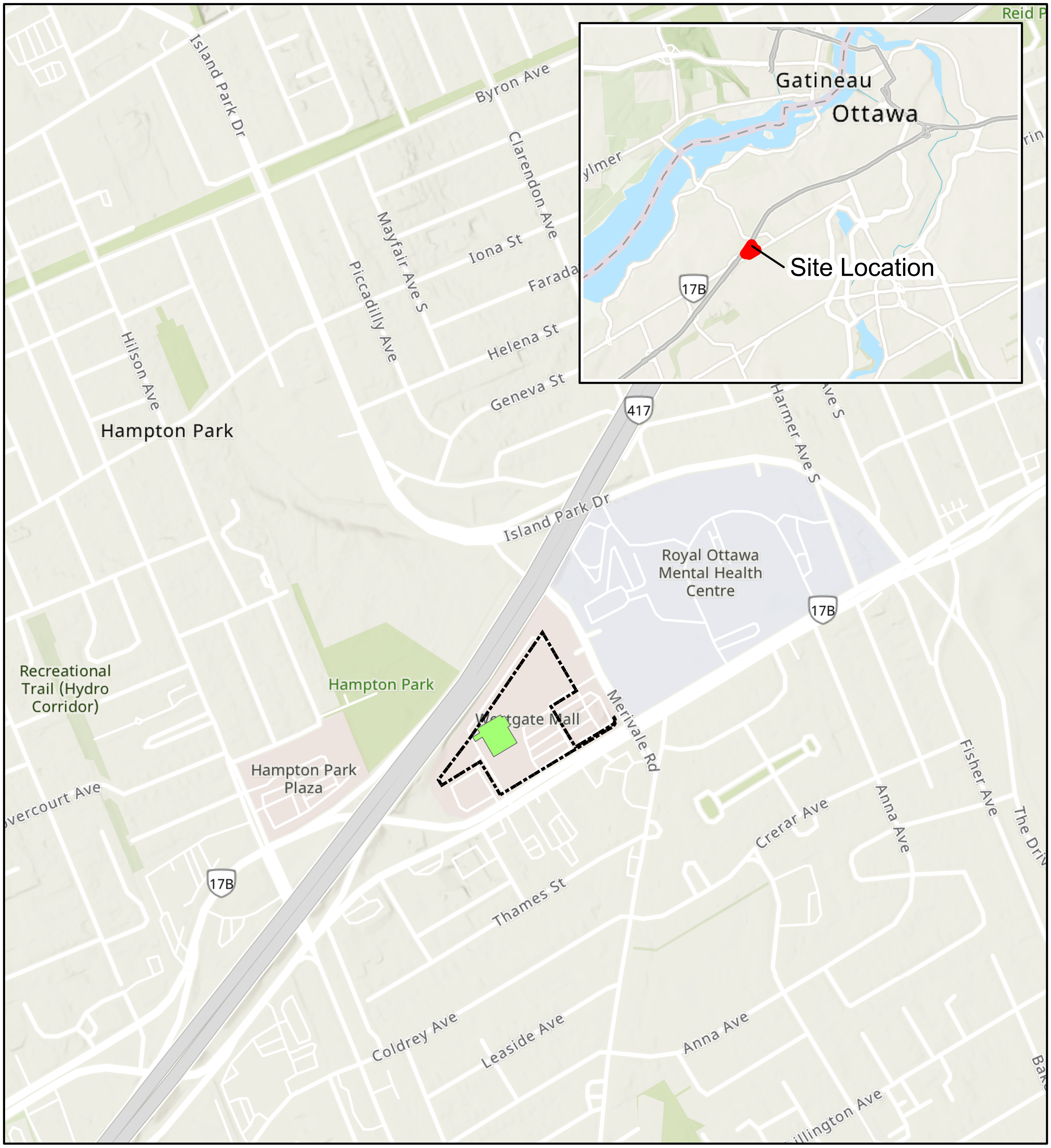
Figures



Legend:

⬚ Phase Two Property Boundary

🟩 Building Footprint - Geotechnical Investigation Target Area

FIGURE 1

PROPERTY LOCATION MAP

1309 CARLING AVENUE,
OTTAWA, ONTARIO

Notes:
1) Map Projection: NAD 1983 CSRS UTM Zone 18N
2) Imagery Credits: World Topographic Map: Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Ville de Gatineau, Esri Canada, Esri, TomTom, Garmin, SafeGraph,

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OFFICE LOCATION
WATERLOO

DATE PLOTTED
30-Apr-2025

DATE REVISED
30-Apr-2025

APPROX. SCALE
1:10,000

PAGE SIZE
8.5 x 11 in

REVISION
00

REVIEWED
PH

CHECKED
EN

DRAWN
JK

Geosyntec
consultants

TRUE NORTH

0 100 200 300 m

Path: P:\GIS\TR1363B Westgate Carling Ottawa\ArcPro\Westgate_Carling\Westgate_Carling.aprx /Figure 1 - Site Location geotechnical   Last Revised: 4/30/2025   Author: jkasunic

Legend:

- ● Borehole (Geosyntec)
- ● Monitoring Well (Geosyntec)
- ⌖ Previous Borehole (Golder)
- ● Previous Monitoring Well (Golder)
- ● Unlocatable Previous Monitoring Well (Golder)
- ▭ Phase Two Property Boundary
- ▭ Building Footprint (approximate)

Notes:
1) Map Projection: NAD 1983 MTM 9
2) Imagery Credits: Streets and Basemap - City of Ottawa, 2021

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FIGURE 2

BOREHOLE LOCATION PLAN - PHASE TWO ESA AND GEOTECHNICAL INVESTIGATION

1309 CARLING AVENUE
OTTAWA, ONTARIO

OFFICE LOCATION OTTAWA		REVISION 00
DATE PLOTTED 01-May-2025	DATE REVISED 01-May-2025	REVIEWED BV
		CHECKED EN
APPROX. SCALE 1:1,100	PAGE SIZE 11 x 17 in	DRAWN JK

Geosyntec
consultants

TRUE NORTH

0 10 20 30 Meters

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Appendix A1

Geotechnical Borehole Logs

Geosyntec consultants

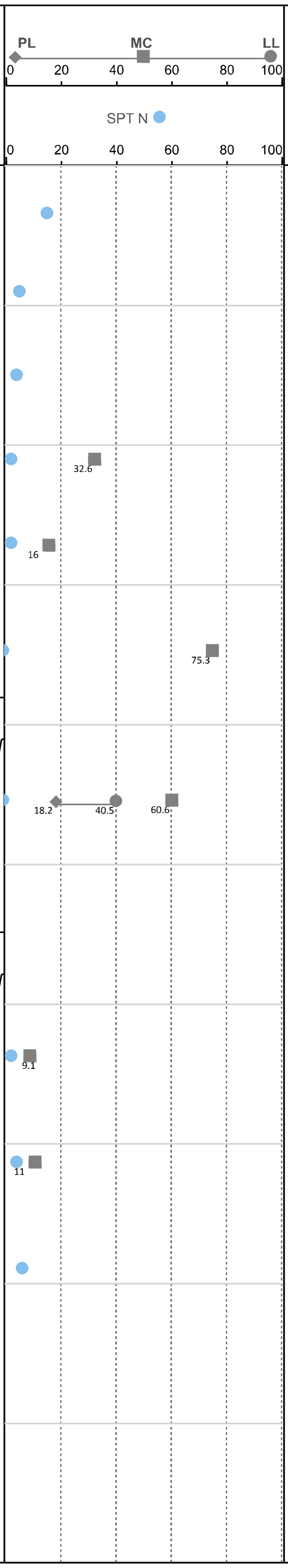
Borehole No: 25-01

Coordinate System : EPSG:32189
Easting : 364627.74
Northing : 5027683.11
RL : 73.838(m)
Total Depth : 14.63 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 23/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment :

Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	SS	SPT	Recovery	Shear Vane
0.1	Split Spoon		ASPHALT					
0.64		GP	FILL, granular fill, some sand, black to grey, compact, wet	W	SS1	12,8,8,4/90mm (N=16)	50%	
1.22		SM	FILL, silty sand, some gravel and some clay, black to grey, loose, wet	W	SS2	5,3,3,4 (N=6)	40%	
1.82		CI	SILTY CLAY, with some sand and gravel, brown to grey, firm, wet	W	SS3	1,2,3,3 (N=5)	100%	
2.43		CI	soft	W	SS4	3,2,1,1 (N=3)	100%	
3.2	Hollow Stem Auger	GP	SANDY GRAVEL, with trace silt, black to brown, very loose, wet	W	SS5	1,2,1,2 (N=3)	100%	
6.1		CI	SILTY CLAY, grey, stiff, wet	W	SS6 SS7	0, 0, 0, 0 0, 0, 0, 0	100% 100%	SV 40.6 - 3.7 kPa SV >92 - 0 kPa
6.86		SM	GRAVELLY SILTY SAND, with clay, grey, very loose, wet	W	SS8	1,1,2,3 (N=3)	5%	
8.84		SM	trace clay, loose	W	SS9 SS10	2,2,3,2 (N=5) 2,3,4,3 (N=7)	60% 80%	
		SM	boulder, grey, wet	W				



Geosyntec consultants

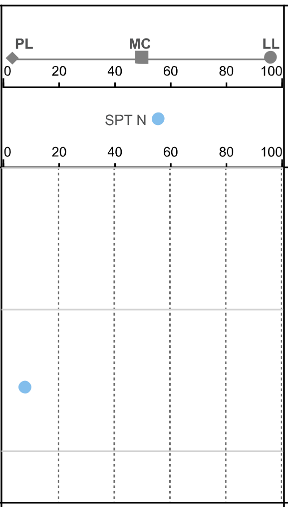
Borehole No: 25-01

Coordinate System : EPSG:32189
Easting : 364627.74
Northing : 5027683.11
RL : 73.838(m)
Total Depth : 14.63 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 23/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment :

Depth (ft)	Depth (m)	Elevation (m amsl)	Drilling Method	Graphic Log	Classification Code	Material Description	Moisture	Sample Type	Samples SS	SPT	Recovery	Shear Vane	Water	Well Diagram
34 35 36 37	11 11.28	63.0	Hollow Stem Auger		SM	boulder, grey, wet (continued)	W							
38 39 40	12 12.37	62.0			SM	less sand and fines	W	⧗	SS11	5,3,6,10 (N=9)	20%			
						Commenced Coring at 12.37m								



Geosyntec consultants

Borehole No: 25-01

Coordinate System	**: EPSG:32189**	**Driller Rig**	**: CME 75 HT**	**Job Number**	**: TR1363B**
Easting	**: 364627.74**	**Driller Supplier**	**: OGS**	**Client**	**: RioCan**
Northing	**: 5027683.11**	**Logged By**	**: EN, TK**	**Project**	**: RioCan Westage - 1309 Carling Ave**
RL	**: 73.838(m)**	**Reviewed By**	**: BV**	**Location**	**: 1309 Carling Avenue, Ottawa, ON, Canada**
Total Depth	**: 14.63 m**	**Date**	**: 23/03/2025**	**Loc Comment**	**:**

Depth (ft)	Depth (m)	Elevation (m masl)	Drilling Method	Classification Code	Graphic Log	Material Description	Stratigraphy	Samples	RQD% and TCR%	RQD 0 20 40 60 80 100	Water	Well Diagram	Remarks / Observations
34 35 36 37 38 39 40	11 12	63.0 62.0				**Commenced Coring at 12.37m**							
41 42 43	13 13.2	61.0	NMLC Coring	LIMST		LIMESTONE: grey limestone with black shale bedding, highly weathered and fractured, fine grained, thinly to medium bedded, very poor quality	Bedrock		RQD = 0%				
44 45 46 47	14	60.0		LIMST		excellent quality, very strong			RQD = 95%				
						25-01 Terminated at 14.63m (upon reaching target depth. Backfilled with bentonite.)							

Borehole No: 25-02

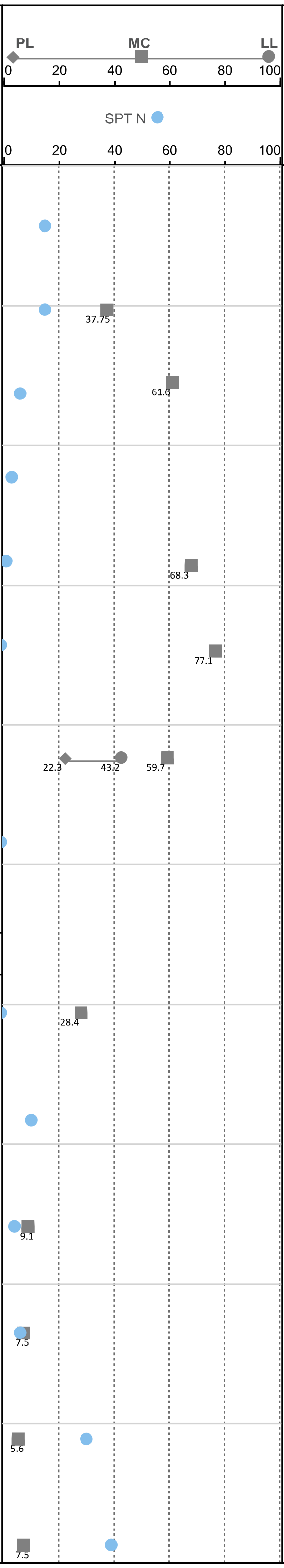
Coordinate System : EPSG:32189
Easting : 364645.68
Northing : 5027656.31
RL : 73.791(m)
Total Depth : 13.33 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 17/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment : Elevation is Top of PVC Casing (GCVD28)

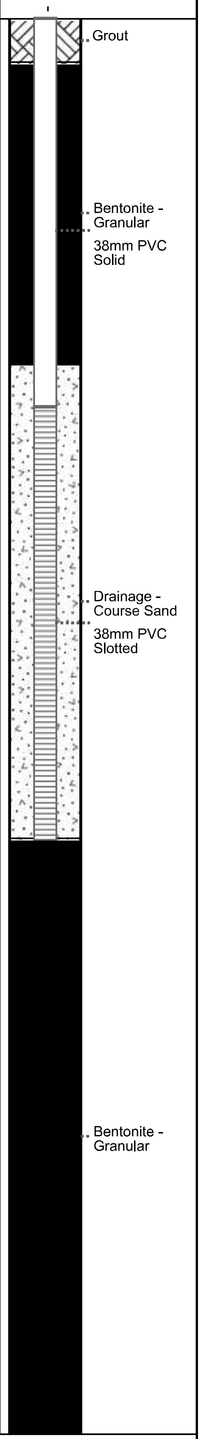
Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	Samples SS	SPT	Recovery	Shear Vane
0.13	Split Spoon		ASPHALT					
0.46		GP	FILL, granular fill, grey	M	SS1	10,7,9,11 (N=16)	30%	
0.762		CI	SILTY CLAY, trace gravel, trace sand, brown, stiff, moist	M				
1.37		CI	frozen and brittle	M	SS2	8,10,6,5 (N=16)	50%	
1.98		CI	brown to grey, firm	M	SS3	5,4,3,3 (N=7)	100%	
2.59		CI	wet	W	SS4	3,2,2,1 (N=4)	65%	
3.2		CI	grey, very soft	W	SS5	1,1,1,1 (N=2)	50%	
	Hollow Stem Auger	CI	stiff	W	SS6	0, 0, 0, 0	100%	
					SS7	0, 0, 0, 0	100%	
								SV 51.6 - 9.2
6.56					SS8	0, 0, 0, 0	100%	
7.31		CI	with some gravel and some sand, brown to grey, stiff	W	SS9	1,4,7,4 (N=11)	45%	
		CI	firm	W	SS10	2,1,4,3 (N=5)	50%	
8.84					SS11	0,2,5,9 (N=7)	40%	
9.6		GM	SILTY GRAVEL and SAND, grey, dense, wet	W	SS12	8,14,17,15 (N=31)	25%	
		GM	black to grey	W	SS13	34,19,21,17 (N=40)	50%	

Depth (ft): 1 – 32; Elevation (m amsl): 73.0, 72.0, 71.0, 70.0, 69.0, 68.0, 67.0, 66.0, 65.0, 64.0



Water: 3.60 m Water Level

Well Diagram



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Geosyntec consultants

Borehole No: 25-02

Coordinate System : EPSG:32189
Easting : 364645.68
Northing : 5027656.31
RL : 73.791(m)
Total Depth : 13.33 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 17/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment : Elevation is Top of PVC Casing (GCVD28)

Depth (ft)	Depth (m)	Elevation (m amsl)	Drilling Method	Graphic Log	Classification Code	Material Description	Moisture	Sample Type	Samples SS	SPT	Recovery	Shear Vane	PL ◆ MC ■ LL ● 0 20 40 60 80 100 SPT N ● 0 20 40 60 80 100	Water	Well Diagram
34 35 36	11 11.28	63.0	Hollow Stem Auger		GM	black to grey (continued)	W	⧓	SS13	34,19,21,17 (N=40)	50%				Bentonite - Granular
						Commenced Coring at 11.28m									

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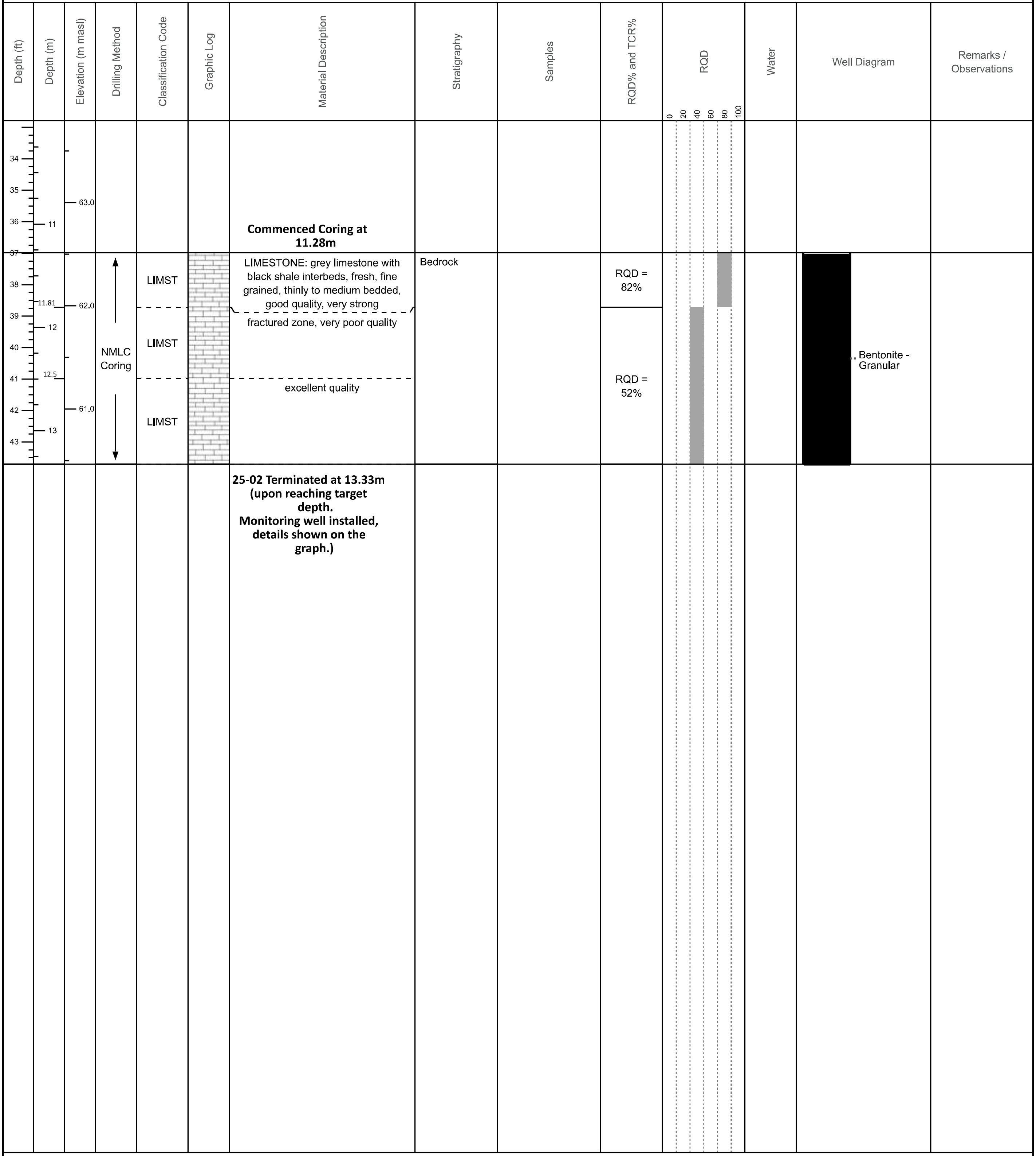
Borehole No: 25-02

Coordinate System	**: EPSG:32189**	**Driller Rig**	**: CME 75 HT**	**Job Number**	**: TR1363B**
Easting	**: 364645.68**	**Driller Supplier**	**: OGS**	**Client**	**: RioCan**
Northing	**: 5027656.31**	**Logged By**	**: EN, TK**	**Project**	**: RioCan Westage - 1309 Carling Ave**
RL	**: 73.791(m)**	**Reviewed By**	**: BV**	**Location**	**: 1309 Carling Avenue, Ottawa, ON, Canada**
Total Depth	**: 13.33 m**	**Date**	**: 17/03/2025**	**Loc Comment**	**: Elevation is Top of PVC Casing (GCVD28)**



Commenced Coring at 11.28m

LIMESTONE: grey limestone with black shale interbeds, fresh, fine grained, thinly to medium bedded, good quality, very strong

fractured zone, very poor quality

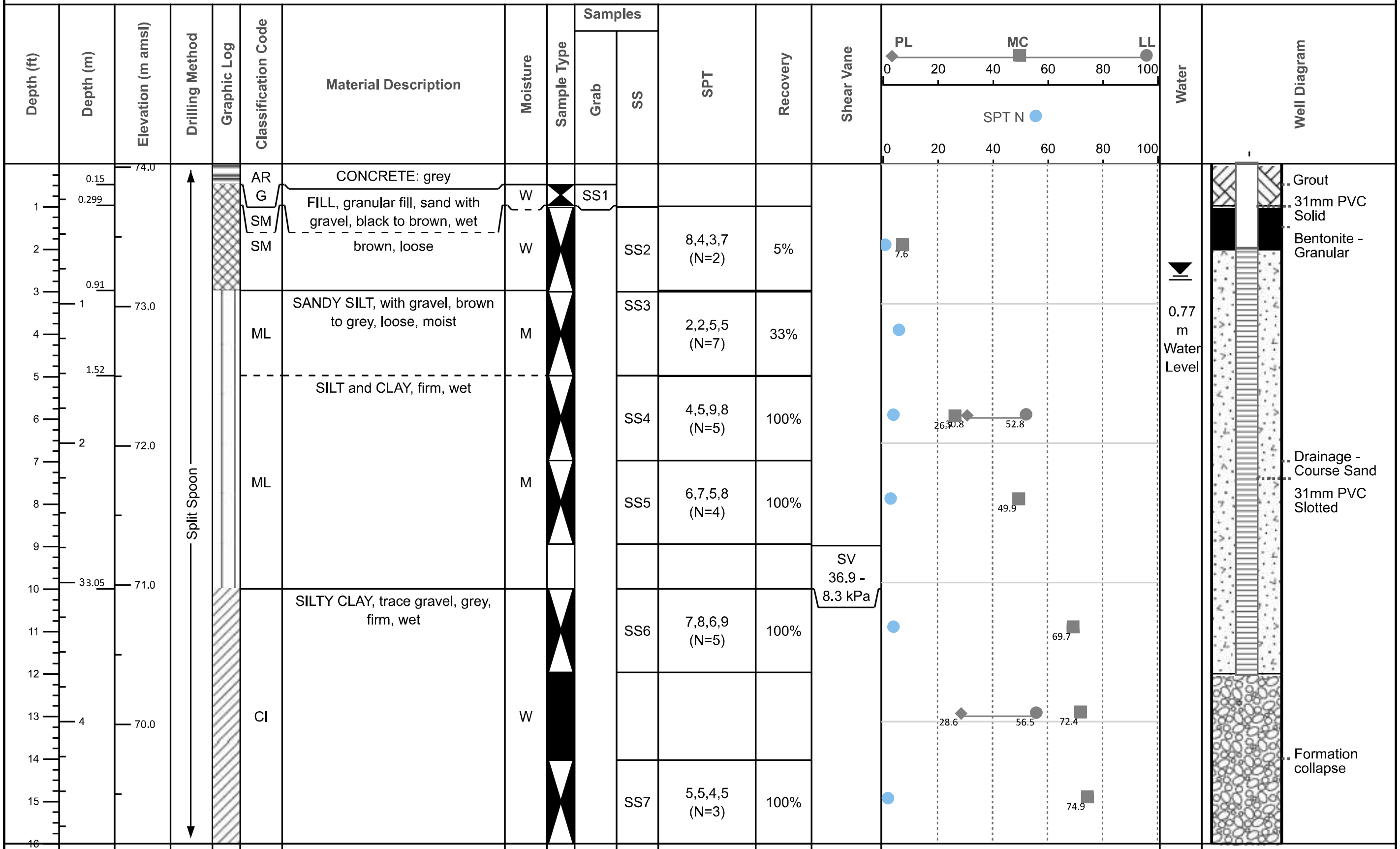
excellent quality

25-02 Terminated at 13.33m (upon reaching target depth. Monitoring well installed, details shown on the graph.)

Geosyntec consultants

Borehole No: 25-04

Coordinate System	: EPSG:32189	**Driller Rig**	: Hilti DD250	**Job Number**	: TR1363B
Easting	: 364665.65	**Driller Supplier**	: OGS	**Client**	: RioCan
Northing	: 5027721.99	**Logged By**	: TK	**Project**	: RioCan Westage - 1309 Carling Ave
RL	: 74.015(m)	**Reviewed By**	: BV	**Location**	: 1309 Carling Avenue, Ottawa, ON, Canada
Total Depth	: 4.88 m	**Date**	: 24/03/2025	**Loc Comment**	: Elevation is Top of PVC Casing (GCVD28)



Depth (m)	Classification Code	Material Description	Moisture
0.15	AR	CONCRETE: grey	
0.299	G SM	FILL, granular fill, sand with gravel, black to brown, wet	W
0.91	SM	brown, loose	W
1.52	ML	SANDY SILT, with gravel, brown to grey, loose, moist	M
3.05	ML	SILT and CLAY, firm, wet	M
	CI	SILTY CLAY, trace gravel, grey, firm, wet	W

Grab	SS	SPT	Recovery	Shear Vane
SS1				
	SS2	8,4,3,7 (N=2)	5%	
	SS3	2,2,5,5 (N=7)	33%	
	SS4	4,5,9,8 (N=5)	100%	
	SS5	6,7,5,8 (N=4)	100%	
				SV 36.9 - 8.3 kPa
	SS6	7,8,6,9 (N=5)	100%	
	SS7	5,5,4,5 (N=3)	100%	

25-04 Terminated at 4.88m (upon reaching target depth. Monitoring well installed.)

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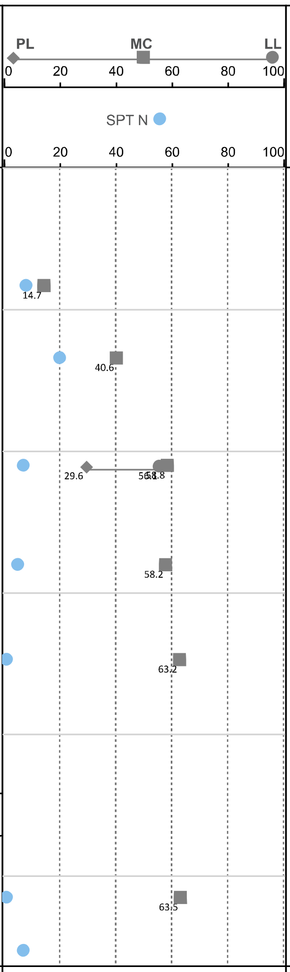
Geosyntec consultants

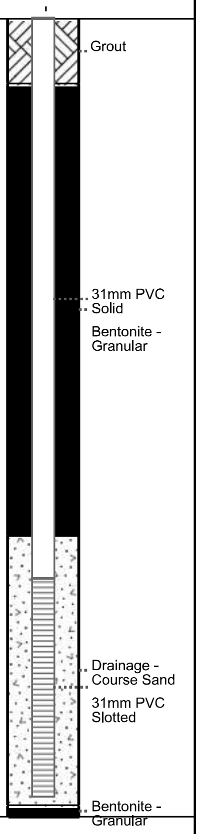
Borehole No: 25-05

Coordinate System	**: EPSG:32189**	**Driller Rig**	**: Hilti DD250**	**Job Number**	**: TR1363B**
Easting	**: 364679.23**	**Driller Supplier**	**: OGS**	**Client**	**: RioCan**
Northing	**: 5027679.71**	**Logged By**	**: TK**	**Project**	**: RioCan Westage - 1309 Carling Ave**
RL	**: 74.01(m)**	**Reviewed By**	**: BV**	**Location**	**: 1309 Carling Avenue, Ottawa, ON, Canada**
Total Depth	**: 5.64 m**	**Date**	**: 25/03/2025**	**Loc Comment**	**: Elevation is Top of PVC Casing (GCVD28)**

Depth (m)	Elevation (m amsl)	Drilling Method	Classification Code	Material Description	Moisture	Samples: Grab	Samples: SS	SPT	Recovery	Shear Vane	Water
0–0.27	74.0	Split Spoon	AR G	TILE and CONCRETE							
0.27–0.46			SM	FILL, granular fill, silty sand with gravel, brown, dense, moist	M	SS1					
0.46–1.07			ML	SILT, brown, compact, moist	M		SS2	7,12,14,32 (N=9)	66%		
1.07–1.83	73.0		ML	CLAYEY SILT	M		SS3	21,25,38,34 (N=21)	90%		1.03 m Water Level
1.83–3.2	72.0		ML	SILT and CLAY, brown, firm, wet			SS4	8,11,13,15 (N=8)	100%		
	71.0						SS5	5,8,9,12 (N=6)	80%		
3.2–4.88	70.0		CI	SILTY CLAY, brown to grey, soft, wet.	W		SS6	3,2,5,7 (N=2)	100%	SV 40.6 - 18.4 kPa	
4.88–5.49	69.0		CI	trace sand, grey	W		SS7	5,4,3,5 (N=2)	100%		
5.49–5.64			CI	trace sand and trace gravel, firm	W		SS8	12 (N=8)	100%		

25-05 Refusal at 5.64m (Monitoring well installed.)





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Borehole No: 25-08

Coordinate System : EPSG:32189	**Driller Rig** : CME 75 HT	**Job Number** : TR1363B
Easting : 364703.62	**Driller Supplier** : OGS	**Client** : RioCan
Northing : 5027715.34	**Logged By** : EN, TK	**Project** : RioCan Westage - 1309 Carling Ave
RL : 73.884(m)	**Reviewed By** : BV	**Location** : 1309 Carling Avenue, Ottawa, ON, Canada
Total Depth : 20.57 m	**Date** : 11/03/2025	**Loc Comment** : Elevation is Top of PVC Casing

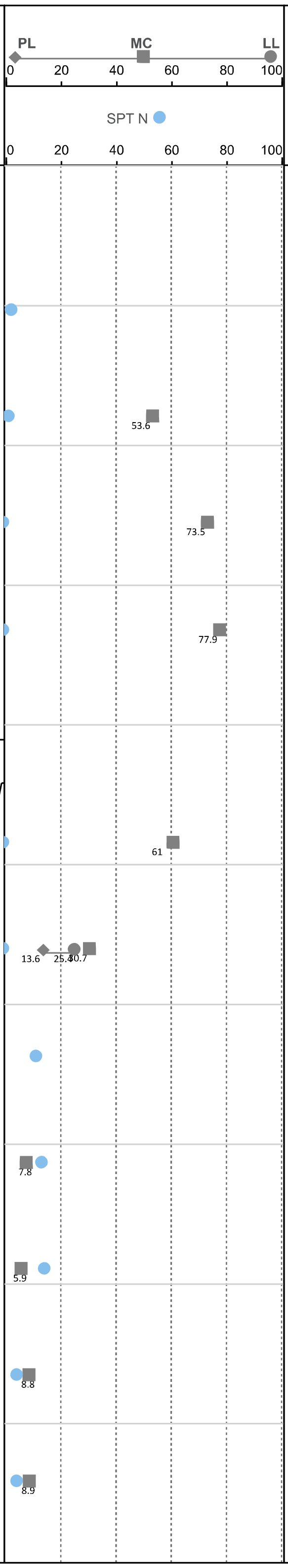
Drilling Method: Hollow Stem Auger

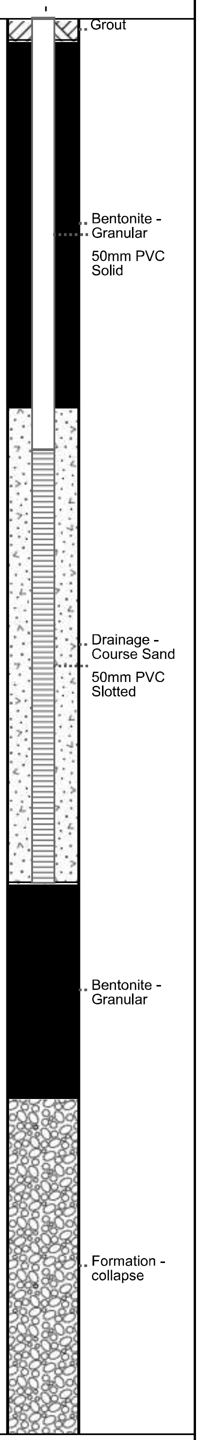
Depth (m)	Classification Code	Material Description	Moisture
0.0914		ASPHALT	
	GP	FILL, granular fill, grey	M
0.762	CI	SILTY CLAY, grayish brown, firm, moist	M
1.524	CI	gray, stiff	M
5.334	CI	some to trace organic	M
6.096	CI	with some gravel	M
6.858	SM	GRAVELLY SILTY SAND, with clay, grey, compact, moist	M
7.62	SM	trace clay	M
8.382	SM	loose	M

Samples SS	SPT	Recovery
SS1	4,1,2,4 (N=3)	85%
SS2	1,1,1,1 (N=2)	100%
SS3	0, 0, 0, 0	100%
SS4	0, 0, 0, 0	100%
SS5	0, 0, 0, 0	100%
SS6	0, 0, 0, 5	100%
SS7	2,8,4,12 (N=12)	100%
SS8	7,7,7,7 (N=14)	40%
SS9	7,7,8,9 (N=15)	37%
SS10	5,2,3,3 (N=5)	50%
SS11	1,2,3,4 (N=5)	25%

Shear Vane: SV 66.4 - 11.1 kPa

Water: 0.31 m Water Level





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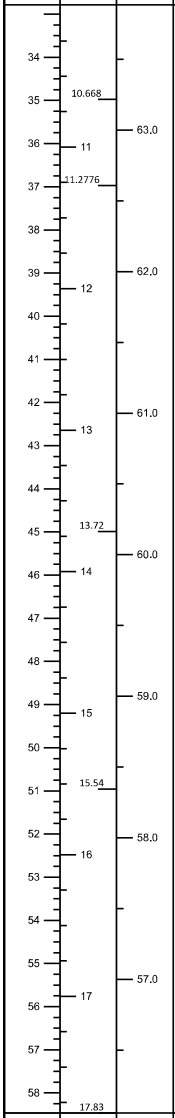
Borehole No: 25-08

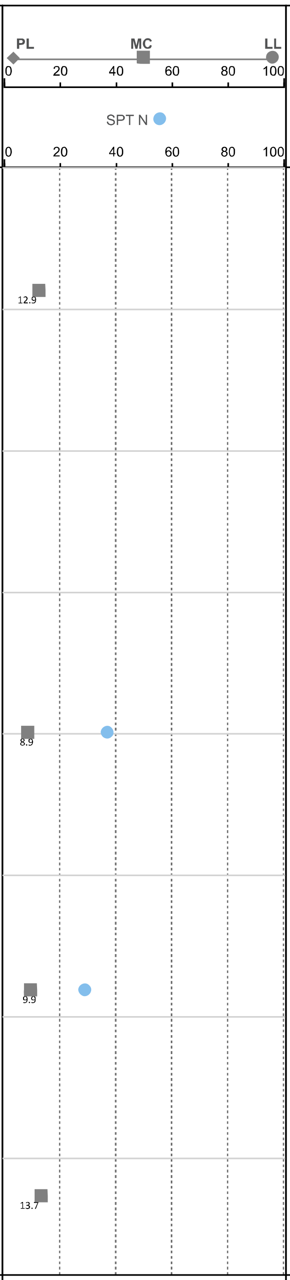
Coordinate System : EPSG:32189
Easting : 364703.62
Northing : 5027715.34
RL : 73.884(m)
Total Depth : 20.57 m

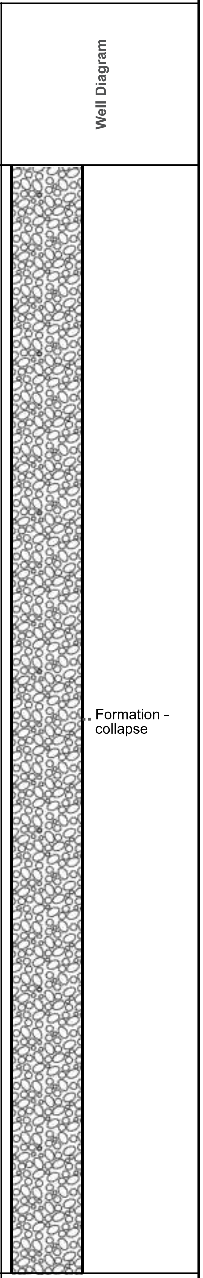
Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 11/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment : Elevation is Top of PVC Casing



Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	Sample Type (SS)	SPT	Recovery	Shear Vane	Water
to 10.668	Hollow Stem Auger	SM	loose (continued)	M					
10.668 – 11.2776		SM	compact, wet	W	SS12	4,9,12 (N=R)	60%		
11.2776 – 13.72		SM	boulder	W					
13.72 – 15.54		SM	GRAVELLY SAND, with some silt and trace clay, grey, dense, wet	W	SS13	18,16,22,8 (N=38)	40%		
15.54 – 17.83		SM	more gravel and less sand	W	SS14	8,11,19,17 (N=30)	25%		
					SS15	15,19,33 (N=R)	50%		
17.83			**Commenced Coring at 17.83m**						





Borehole No: 25-08

Coordinate System : EPSG:32189
Easting : 364703.62
Northing : 5027715.34
RL : 73.884(m)
Total Depth : 20.57 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 11/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment : Elevation is Top of PVC Casing

Depth (ft): 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65
Depth (m): 11, 12, 13, 14, 15, 16, 17, 18, 19, 19.35
Elevation (m masl): 63.0, 62.0, 61.0, 60.0, 59.0, 58.0, 57.0, 56.0, 55.0, 54.0
RQD: 0, 20, 40, 60, 80, 100

Commenced Coring at 17.83m

Depth (m)	Elevation (m masl)	Drilling Method	Classification Code	Graphic Log	Material Description	Stratigraphy	Samples	RQD% and TCR%	RQD	Water	Well Diagram	Remarks / Observations
17.83	56.0	NMLC Coring	LIMST		LIMESTONE: grey limestone with shale interbeds, highly weathered and fractured, fine grain, thinly to medium bedded, very poor quality			RQD = 0%			Formation - collapse	
19.35			LIMST		good quality, very strong			RQD = 80%				

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Geosyntec consultants

Borehole No: 25-08

Coordinate System	: EPSG:32189	Driller Rig	: CME 75 HT	Job Number	: TR1363B
Easting	: 364703.62	Driller Supplier	: OGS	Client	: RioCan
Northing	: 5027715.34	Logged By	: EN, TK	Project	: RioCan Westage - 1309 Carling Ave
RL	: 73.884(m)	Reviewed By	: BV	Location	: 1309 Carling Avenue, Ottawa, ON, Canada
Total Depth	: 20.57 m	Date	: 11/03/2025	Loc Comment	: Elevation is Top of PVC Casing

Depth (ft)	Depth (m)	Elevation (m masl)	Drilling Method	Classification Code	Graphic Log	Material Description	Stratigraphy	Samples	RQD% and TCR%	RQD 0 20 40 60 80 100	Water	Well Diagram	Remarks / Observations
67			NMLC Coring	LIMST		good quality, very strong (continued)			RQD = 80%			Formation - collapse	
						25-08 Terminated at 20.57m (upon reaching target depth Monitoring well installed.)							

Appendix A2

Environmental Borehole Logs

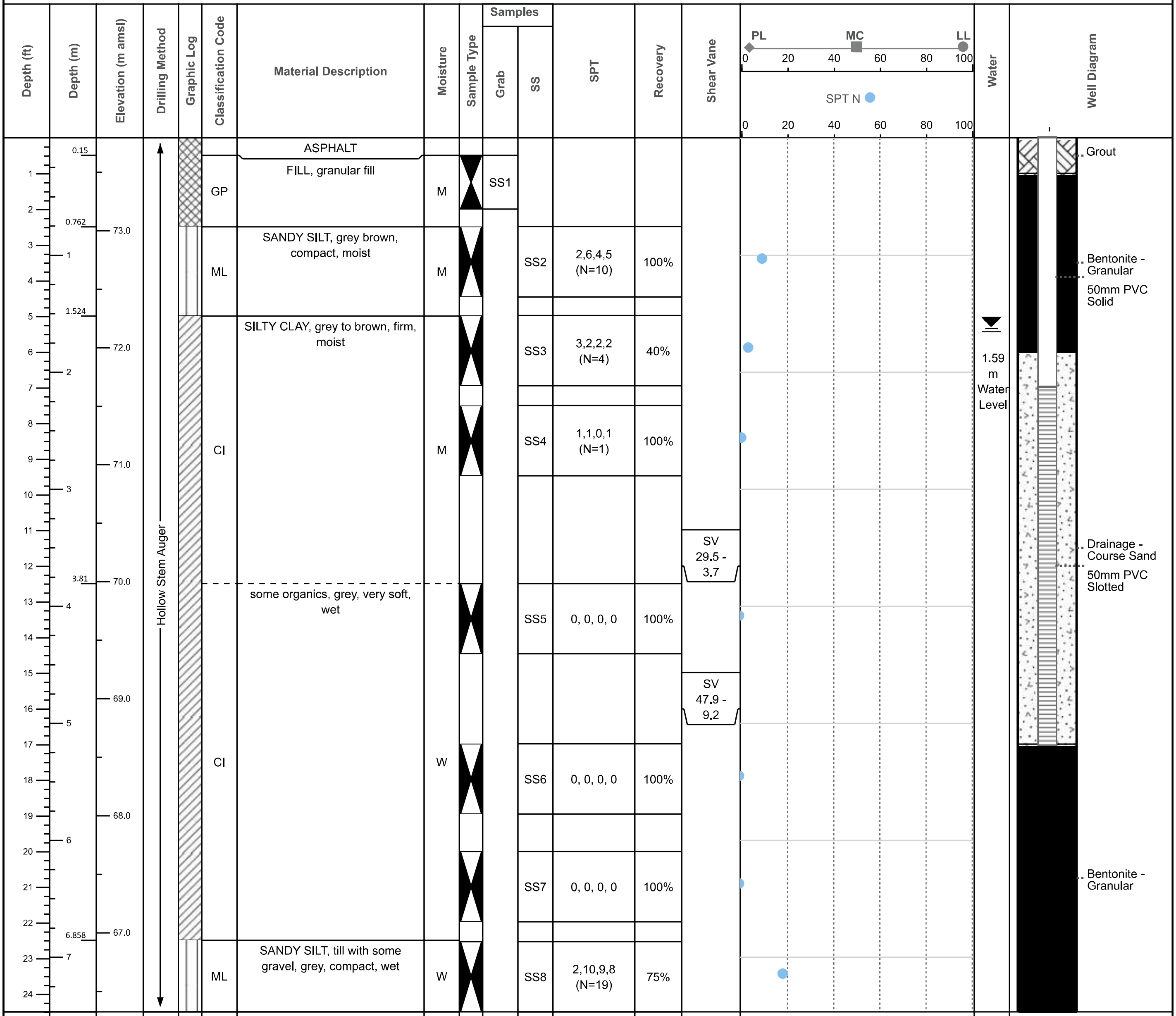
Geosyntec consultants

Borehole No: 25-03

Coordinate System : EPSG:32189
Easting : 364692.82
Northing : 5027788.83
RL : 73.793(m)
Total Depth : 7.47 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 26/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment : Elevation is Top of PVC Casing (GCVD28)



Depth (m)	Classification Code	Material Description	Moisture
0.15		ASPHALT	
0.762	GP	FILL, granular fill	M
1.524	ML	SANDY SILT, grey brown, compact, moist	M
3.81	CI	SILTY CLAY, grey to brown, firm, moist	M
6.858	CI	some organics, grey, very soft, wet	W
	ML	SANDY SILT, till with some gravel, grey, compact, wet	W

Grab	SS	SPT	Recovery	Shear Vane
SS1				
	SS2	2,6,4,5 (N=10)	100%	
	SS3	3,2,2,2 (N=4)	40%	
	SS4	1,1,0,1 (N=1)	100%	
				SV 29.5 - 3.7
	SS5	0, 0, 0, 0	100%	
				SV 47.9 - 9.2
	SS6	0, 0, 0, 0	100%	
	SS7	0, 0, 0, 0	100%	
	SS8	2,10,9,8 (N=19)	75%	

25-03 Terminated at 7.47m (upon reaching target depth. Monitoring well installed.)

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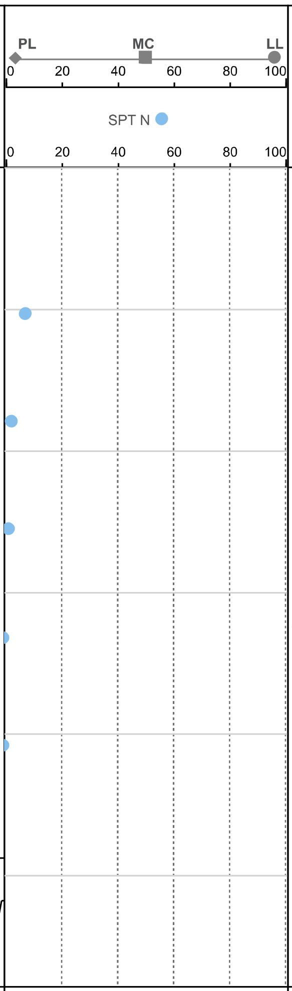
Borehole No: 25-06

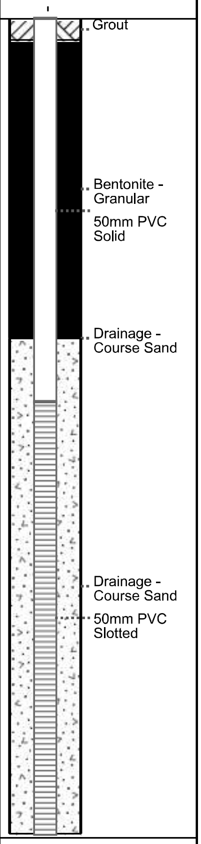
Coordinate System : EPSG:32189
Easting : 364708.68
Northing : 5027628.16
RL : 73.599(m)
Total Depth : 5.79 m

Driller Rig : CME 75 HT
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 20/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment : Elevation is Top of PVC Casing (GCVD28)

Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	Samples Grab	Samples SS	SPT	Recovery	Shear Vane	Water
0.18	Hollow Stem Auger		ASPHALT							
0.76		GP	FILL, granular fill, brown	M	SS1					
1.524		CI	SILTY CLAY, some gravel and some sand, grey, firm, moist	M		SS2	4,3,5,5 (N=8)	50%		
2.286		CI	trace gravel and trace sand, soft, wet	W		SS3	2,1,2,2 (N=3)	50%		
		CI	very soft	W		SS4	1,1,1,1 (N=2)	100%		2.73 m Water Level
						SS5	1, 0, 0, 0	90%		
						SS6	0, 0, 0, 0	100%		
									SV 55.3 - 11.1	
						SS7	1,2,6 (N=R)	60%		





25-06 Refusal at 5.79m (Monitoring well installed.)

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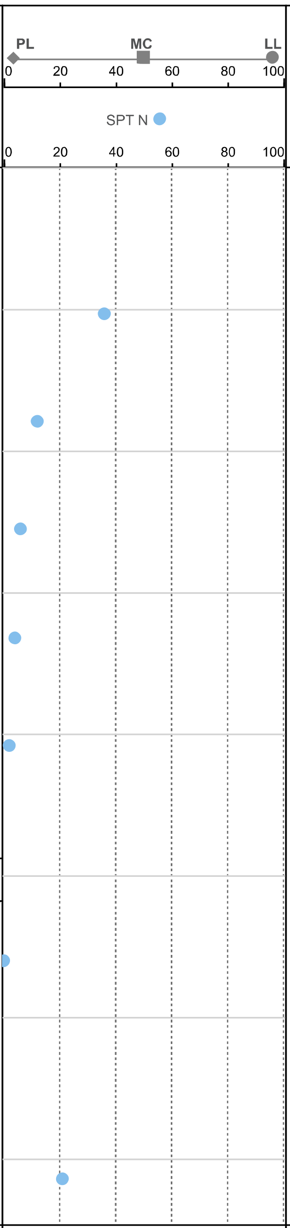
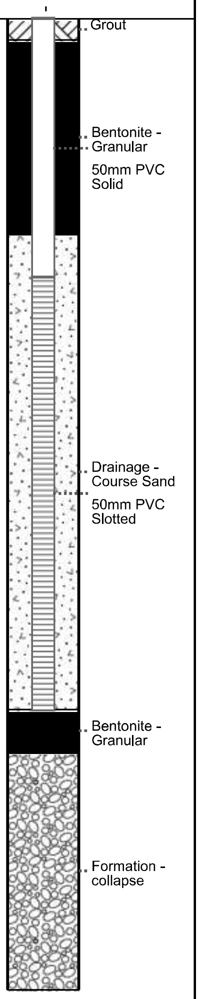
Geosyntec consultants

Borehole No: 25-07

Coordinate System	: EPSG:32189	**Driller Rig**	: CME 75 HT	**Job Number**	: TR1363B
Easting	: 364739.93	**Driller Supplier**	: OGS	**Client**	: RioCan
Northing	: 5027849.22	**Logged By**	: EN, TK	**Project**	: RioCan Westage - 1309 Carling Ave
RL	: 74.246(m)	**Reviewed By**	: BV	**Location**	: 1309 Carling Avenue, Ottawa, ON, Canada
Total Depth	: 7.47 m	**Date**	: 14/03/2025	**Loc Comment**	: Elevation is Top of PVC Casing (GCVD28)

Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	Samples: Grab	Samples: SS	SPT	Recovery	Shear Vane	Water
0.15	Hollow Stem Auger		ASPHALT							
0.76		GP	FILL, granular fill	M	SS1 (grab)					
1.524		GP		M			30,26,11,6 (N=37)	25%		
2.286		ML	SANDY SILT, brown, compact, moist	M		SS2	5,5,8,9 (N=13)	50%		
3.048		ML	some clay	M		SS3	2,3,4,2 (N=7)	90%		2.30 m Water Level
3.81		CI	SILTY CLAY, brown to grey, firm, moist	M		SS4	2,3,2,2 (N=5)	100%		
6.86		CI	soft, wet	W		SS5 SS6	1,2,1,1 (N=3) 1,0,1,0 (N=1)	100% 100%	SV 44.3 - 5.5	
		CI	SANDY CLAY, till, very stiff, moist	W		SS7	3,8,14,15 (N=22)	60%		





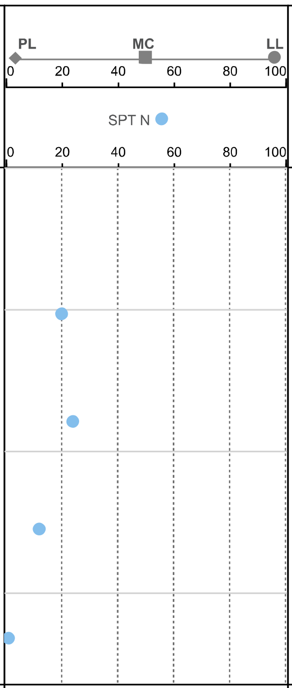
25-07 Terminated at 7.47m (upon reaching the target depth. Monitoring well installed.)

Geosyntec consultants

Borehole No: 25-09

Coordinate System :	**EPSG:32189**	**Driller Rig**	**: CME 75 HT**	**Job Number**	**: TR1363B**
Easting	**: 364771.63**	**Driller Supplier**	**: OGS**	**Client**	**: RioCan**
Northing	**: 5027678.26**	**Logged By**	**: EN, TK**	**Project**	**: RioCan Westage - 1309 Carling Ave**
RL	**: 74.227(m)**	**Reviewed By**	**: BV**	**Location**	**: 1309 Carling Avenue, Ottawa, ON, Canada**
Total Depth	**: 3.65 m**	**Date**	**: 20/03/2025**	**Loc Comment :**	

Depth (m)	Elevation (m amsl)	Drilling Method	Classification Code	Material Description	Moisture	Samples: Grab	Samples: SS	SPT	Recovery
0.19	74.0	Split Spoon		ASPHALT					
0.76			GP	FILL, granular fill, some silt and some clay, brown, moist	M	SS1			
1.524	73.0		CI	SILTY CLAY, some gravel and some sand, brown to grey, very stiff, moist	M		SS2	6,11,10,10 (N=21)	75%
2.286	72.0		CI	trace organic	M		SS3	6,10,15,14 (N=25)	80%
3.048			CI	trace gravel and trace sand, stiff	M		SS4	6,6,7,6 (N=13)	10%
	71.0		CI	trace organic, firm	W		SS5	2,1,1,1 (N=2)	100%



25-09 Terminated at 3.65m (upon reaching the target depth. Borehole backfilled with bentonite.)

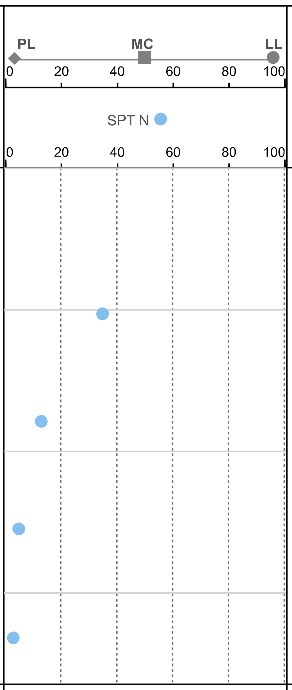
This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

Borehole No: 25-10

Coordinate System	: EPSG:32189	Driller Rig	: CME 75 HT
Easting	: 364599.11	Driller Supplier	: OGS
Northing	: 5027648.88	Logged By	: EN, TK
RL	: 75.018(m)	Reviewed By	: BV
Total Depth	: 3.65 m	Date	: 21/03/2025

Job Number	: TR1363B
Client	: RioCan
Project	: RioCan Westage - 1309 Carling Ave
Location	: 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment	:

Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	Sample Type	SS	SPT	Recovery	Shear Vane	Water	Well Diagram
0.05	Hollow Stem Auger		ASPHALT								
0.76		GP	FILL: granular fill, brown, loose, moist	M							
1.52		CI	SILTY CLAY, grey, hard, moist	M	⧗	SS1	12,22,14,8 (N=36)	100%			
2.29		CI	grey to brown, stiff	M	⧗	SS2	4,6,8,9 (N=14)	100%			
3.05		CI	firm	M	⧗	SS3	1,3,3,4 (N=6)	80%			
		CI	grey, wet	W	⧗	SS4	1,2,2,1 (N=4)	80%			



25-10 Terminated at 3.65m (upon reaching target depth. Backfilled with bentonite.)

Geosyntec consultants

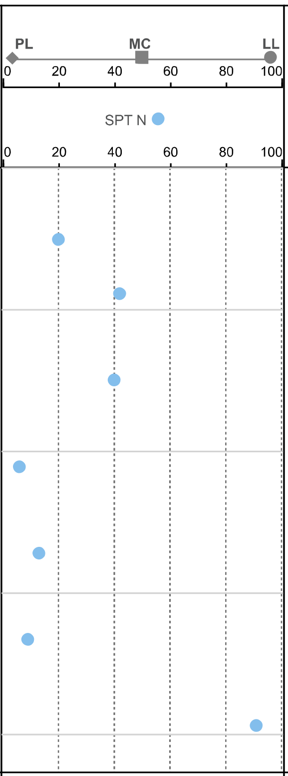
Borehole No: 25-11

Coordinate System : EPSG:32189
Easting : 364781.18
Northing : 5027780.30
RL : 74.404(m)
Total Depth : 4.27 m

Driller Rig : Hilti DD250
Driller Supplier : OGS
Logged By : EN, TK
Reviewed By : BV
Date : 21/03/2025

Job Number : TR1363B
Client : RioCan
Project : RioCan Westage - 1309 Carling Ave
Location : 1309 Carling Avenue, Ottawa, ON, Canada
Loc Comment :

Depth (m)	Drilling Method	Classification Code	Material Description	Moisture	Samples SS	SPT	Recovery
0.061	Hollow Stem Auger		ASPHALT				
0.61		GP	FILL: granular fill gravel with sand, grey, compact, wet	W	SS1	14,21,0 (N=21)	75%
1.219		SW	FILL: silty sand, some gravel, brown, dense, moist	M	SS2	20,9,34,30 (N=43)	33%
1.829		SW	trace clay	M	SS3	18,22,19,5 (N=41)	50%
2.44		SW	with asphalt, brown to balck, loose	M	SS4	3,3,4,3 (N=7)	33%
3.05		SM	SANDY SILT, some gravel, brown, compact, moist	M	SS5	3,7,7,21 (N=14)	20%
3.661		SM	some clay, brown to grey	M	SS6	4,4,6,9 (N=10)	33%
		SM	grey, dense, wet	W	SS7	17,50,42,24 (N=92)	25%



Shear Vane | Water | Well Diagram

25-11 Terminated at 4.27m (upon reaching target depth. Backfilled with bentonite.)

Appendix B

Geotechnical Laboratory Test Results

GEMTEC
CONSULTING ENGINEERS
AND SCIENTISTS

Client Geosyntec Consultants
Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508
Project #: 100590008

Moisture Content and Density

Borehole / Testpit	Depth	Sample	Description	Date/Time Sampled	Moisture Content, %	Sample Volume, mm³	Wet Density, kg/m³	Dry Density, kg/m³
25-01		SS04		25/03/28 1:22:00 PM	32.60			
25-01		SS05		25/04/10 1:23:00 PM	16.03			
25-01		SS06		25/04/10 1:23:00 PM	75.32			
25-01	4.26-4.87	SS07		25/04/10 1:23:00 PM	60.62			
25-01		SS08		25/03/28 1:35:00 PM	9.08			
25-01	6.86-7.47	SS09		25/04/10 1:35:00 PM	10.95			
25-02	0.76-1.37	SS02		25/04/10 1:44:29 PM	37.74			
25-02		SS03		25/04/10 1:44:29 PM	61.61			
25-02		SS05		25/04/10 1:44:29 PM	68.29			
25-02		SS06		25/04/10 1:44:29 PM	77.07			
25-02		SS08		25/04/10 1:44:29 PM	28.42			
25-02		SS10		25/04/10 1:44:29 PM	9.06			
25-02		SS11		25/04/10 1:44:29 PM	7.51			
25-02	8.84-9.45	SS12		25/04/10 1:44:00 PM	5.56			
25-02		SS13		25/04/10 1:44:29 PM	7.48			
25-02	3.96-4.57	ST1		25/04/10 1:44:29 PM	59.69			
25-04		SS02		25/04/10 1:35:00 PM	7.56			
25-04	1.52-2.13	SS04		25/04/10 1:35:00 PM	26.68			
25-04		SS05		25/04/10 1:35:00 PM	49.88			

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Client Geosyntec Consultants

Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508

Project #: 100590008

Moisture Content and Density

Borehole / Testpit	Depth	Sample	Description	Date/Time Sampled	Moisture Content, %	Sample Volume, mm³	Wet Density, kg/m³	Dry Density, kg/m³
25-04		SS06		25/04/10 1:35:00 PM	69.72			
25-04		SS07		25/04/10 1:35:00 PM	74.86			
25-04	3.66-4.26	ST1		25/04/10 1:44:29 PM	72.35			
25-05		SS02		25/03/28 1:44:00 PM	14.69			
25-05		SS03		25/04/10 1:44:29 PM	40.57			
25-05	1.83-2.44	SS04		25/04/10 1:44:29 PM	58.81			
25-05		SS05		25/04/10 1:44:29 PM	58.21			
25-05		SS06		25/04/10 1:44:00 PM	63.17			
25-05		SS07		25/04/10 1:44:00 PM	63.47			
25-08		SS02		25/04/10 1:35:00 PM	53.61			
25-08		SS03		25/04/10 1:35:00 PM	73.53			
25-08		SS04		25/04/10 1:35:00 PM	77.86			
25-08		SS05		25/04/10 1:35:00 PM	60.99			
25-08	5.33-5.94	SS06		25/04/10 1:35:00 PM	30.66			
25-08		SS08		25/04/10 1:35:00 PM	7.84			
25-08		SS09		25/04/10 1:35:00 PM	5.93			
25-08		SS10		25/04/10 1:35:35 PM	8.77			
25-08	9.14-9.75	SS11		25/04/10 1:35:35 PM	8.85			
25-08		SS12		25/04/10 1:35:35 PM	12.85			

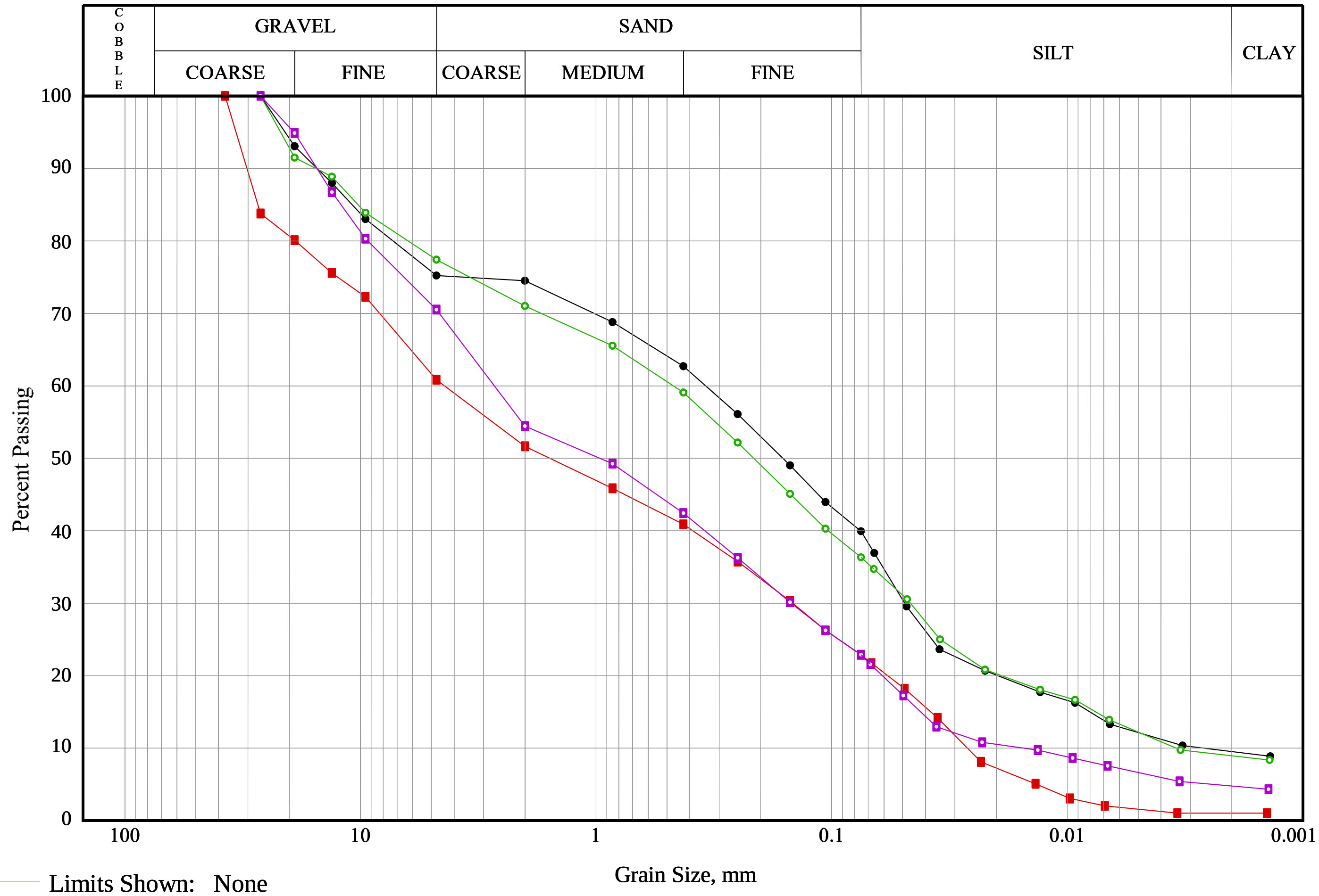
GEMTEC Consulting Engineers and Scientists	Client Geosyntec Consultants Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508 Project #: 100590008	Moisture Content and Density

Borehole / Testpit	Depth	Sample	Description	Date/Time Sampled	Moisture Content, %	Sample Volume, mm³	Wet Density, kg/m³	Dry Density, kg/m³
25-08	13.71-14.32	SS13		25/04/10 1:35:35 PM	8.93			
25-08		SS14		25/04/10 1:35:35 PM	9.86			
25-08		SS15		25/04/10 1:35:35 PM	13.66			

GEMTEC
CONSULTING ENGINEERS
AND SCIENTISTS

Client: Geosyntec Consultants
Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508
Project #: 100590008

Soils Grading Chart
(LS-702/
ASTM D-422)



Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—		25-01	SS09	6.86-7.47	24.8	35.3	30.4	9.5
—■—		25-02	SS12	8.84-9.45	39.2	38.0	21.8	1.0
—○—		25-08	SS11	9.14-9.75	22.6	41.1	27.4	8.9
—▣—		25-08	SS13	13.71-14.32	29.5	47.6	18.1	4.8

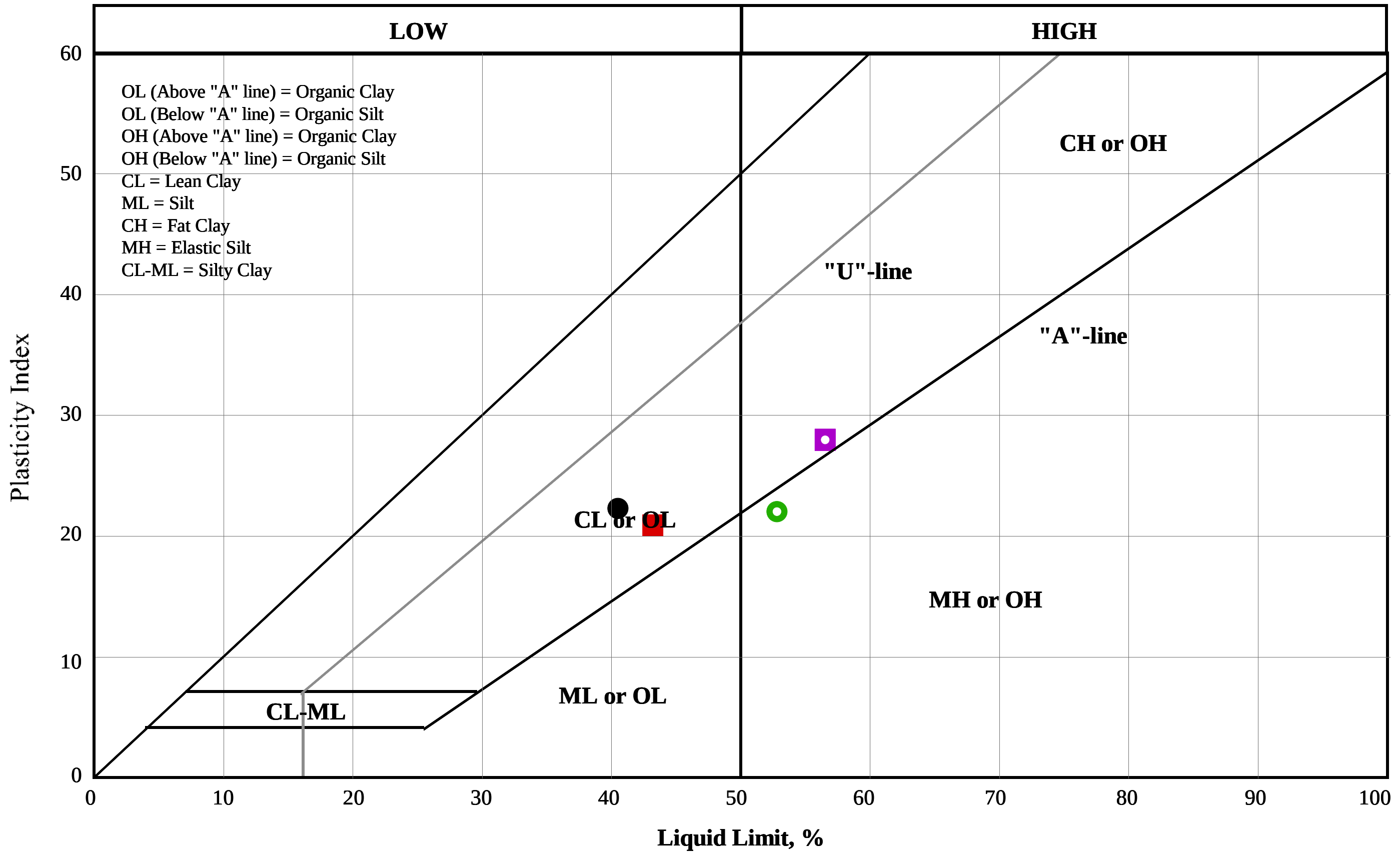
Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Gravelly silty sand , trace clay	N/A	0.003	0.008	0.05	0.16	0.34	10.85	30.4
—■—	Silty gravel and sand , trace clay	N/A	0.027	0.038	0.15	1.57	4.40	27.21	21.8
—○—	Gravelly silty sand , trace clay	N/A	0.003	0.008	0.05	0.21	0.47	10.24	27.4
—▣—	Gravelly sand , some silt , trace clay	N/A	0.016	0.042	0.15	0.96	2.70	12.09	18.1

Note: More information available upon request

GEMTEC
Consulting Engineers and Scientists
Ottawa, ON

Client: Geosyntec Consultants
Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508
Project #: 100590008

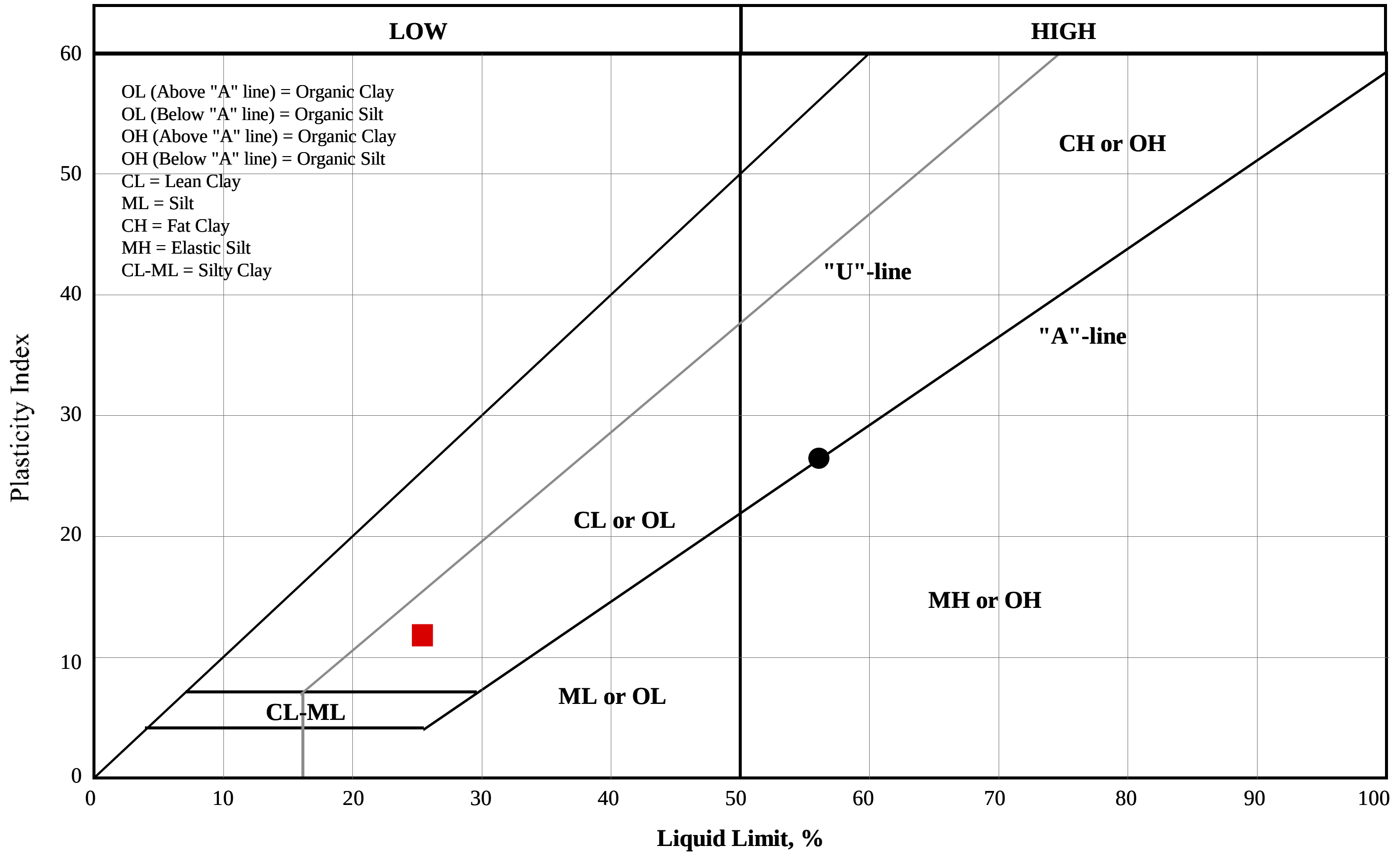
Plasticity Chart
(LS-7034/ASTM D4318)



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	25-01	SS07	4.26-4.87	40.5	18.2	22	N/A	60.6
■	25-02	ST1	3.96-4.57	43.2	22.3	21	N/A	59.7
○	25-04	SS04	1.52-2.13	52.8	30.8	22	N/A	26.7
▣	25-04	ST1	3.66-4.26	56.5	28.6	28	N/A	72.3

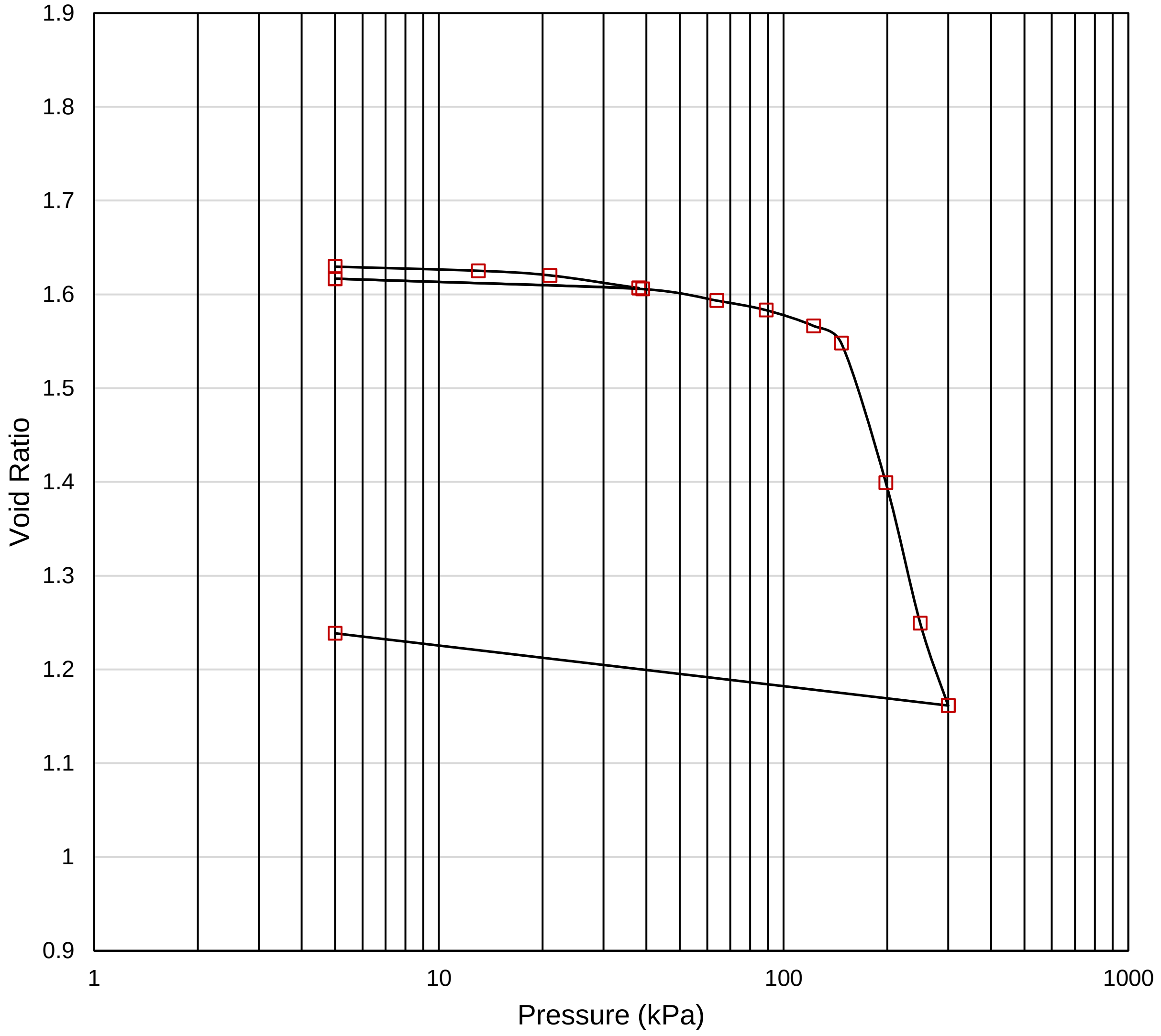
Note: More information available upon request

GEMTEC Consulting Engineers and Scientists Ottawa, ON	Client: Geosyntec Consultants Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508 Project #: 100590008	Plasticity Chart (LS-7034/ASTM D4318)



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	25-05	SS04	1.83-2.44	56.1	29.6	26	N/A	58.8
🟥	25-08	SS06	5.33-5.94	25.4	13.6	12	N/A	30.7
							N/A	
							N/A	

Note: More information available upon request



Borehole/Sample Number	25-02 ST1
Sample Depth (m)	3.96-4.57
Initial Water Content (%)	60
Existing Effective Overburden Pressure (kPa)	
Probable Preconsolidation Pressure (kPa)	
Compression Index (Cc)	
Recompression Index (Cr)	

CONSOLIDATION TEST RESULTS

GEMTEC
Consulting Engineers and Scientists

Date:	25/04/04	MATERIAL: CL	
Entry:	K.Neil	PROJECT NAME: TR1363B	
Check:	K.Smith	PROJECT NO.	100590.008
Review:	A. Meacoe	FIGURE NO.	**1**

OEDOMETER CONSOLIDATION SUMMARY

SAMPLE IDENTIFICATION

Project Number	100590.008		
Borehole/Sample Number	25-02 ST1	Sample Depth, m	3.96-4.57

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Date Started	25/04/04		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, mm	25.49	Unit Weight, kN/m^3	16.68
Sample Diameter, mm	63.15	Dry Unit Weight, kN/m^3	10.45
Area, cm^2	31.32	Specific Gravity, Measured	2.81
Volume, cm^3	79.84	Degree of Saturation, %	102.36
Water Content, %	59.59		

TEST DATA

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	2.549	1.635	2.549	0			
5.00	2.549	1.630	2.549	25.60263	5.38E-02	3.83E-04	2.02E-06
13.00	2.545	1.625	2.547	25.59213	5.37E-02	2.09E-04	1.10E-06
21.00	2.540	1.620	2.542	2991.859	4.58E-04	2.34E-04	1.05E-08
38.00	2.527	1.607	2.533	75.37338	1.81E-02	3.02E-04	5.35E-07
5.00	2.537	1.617	2.532	0			
39.00	2.526	1.606	2.531	1320.242	1.03E-03	1.24E-04	1.25E-08
64.00	2.514	1.593	2.520	2696.084	4.99E-04	1.87E-04	9.14E-09
89.00	2.504	1.583	2.509	2107.427	6.33E-04	1.55E-04	9.61E-09
122.00	2.488	1.566	2.496	1276.166	1.03E-03	1.92E-04	1.95E-08
147.00	2.470	1.548	2.479	18.38129	7.09E-02	2.80E-04	1.95E-06
198.00	2.326	1.399	2.398	57526.78	2.12E-05	1.11E-03	2.30E-09
249.00	2.181	1.249	2.253	61060.79	1.76E-05	1.11E-03	1.92E-09
300.00	2.095	1.162	2.138	1849.478	5.24E-04	6.54E-04	3.36E-08
5.00	2.170	1.239	2.133	0			

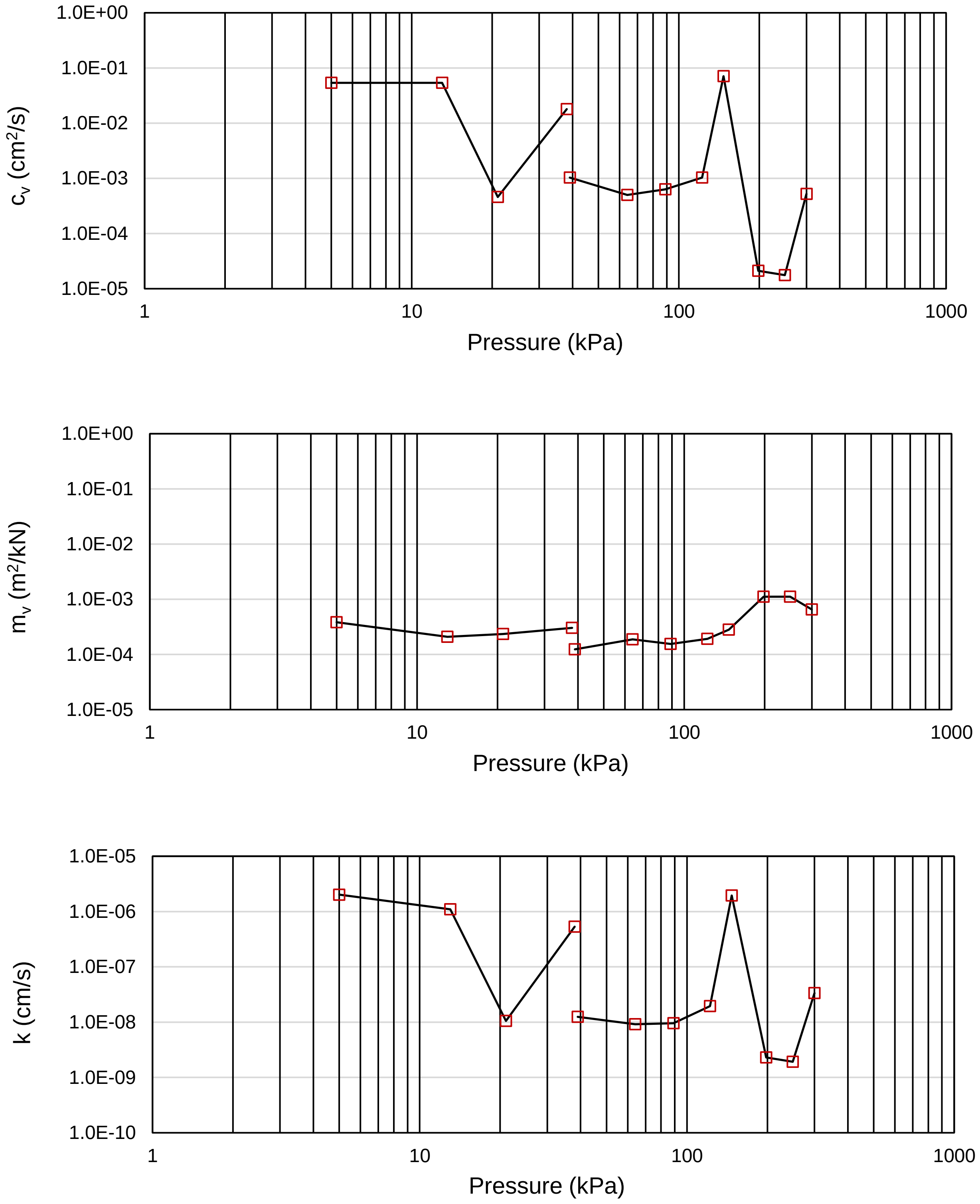
Note: k calculated using c_v based on t_{90} values.

SAMPLE PROPERTIES - FINAL

Water Content, %	19.42	Unit Weight, kN/m^3	18.04
Specific Gravity, Measured	2.81	Dry Unit Weight, kN/m^3	15.10

GEMTEC

Consulting Engineers
and Scientists



GEMTEC
Consulting Engineers
and Scientists

Date:	25/04/04		
Entry:	K.Neil	PROJECT NAME: TR1363B	
Check:	K.Smith	PROJECT NO.	100590.008
Review:	A. Meacoe	**FIGURE NO.**	**1**

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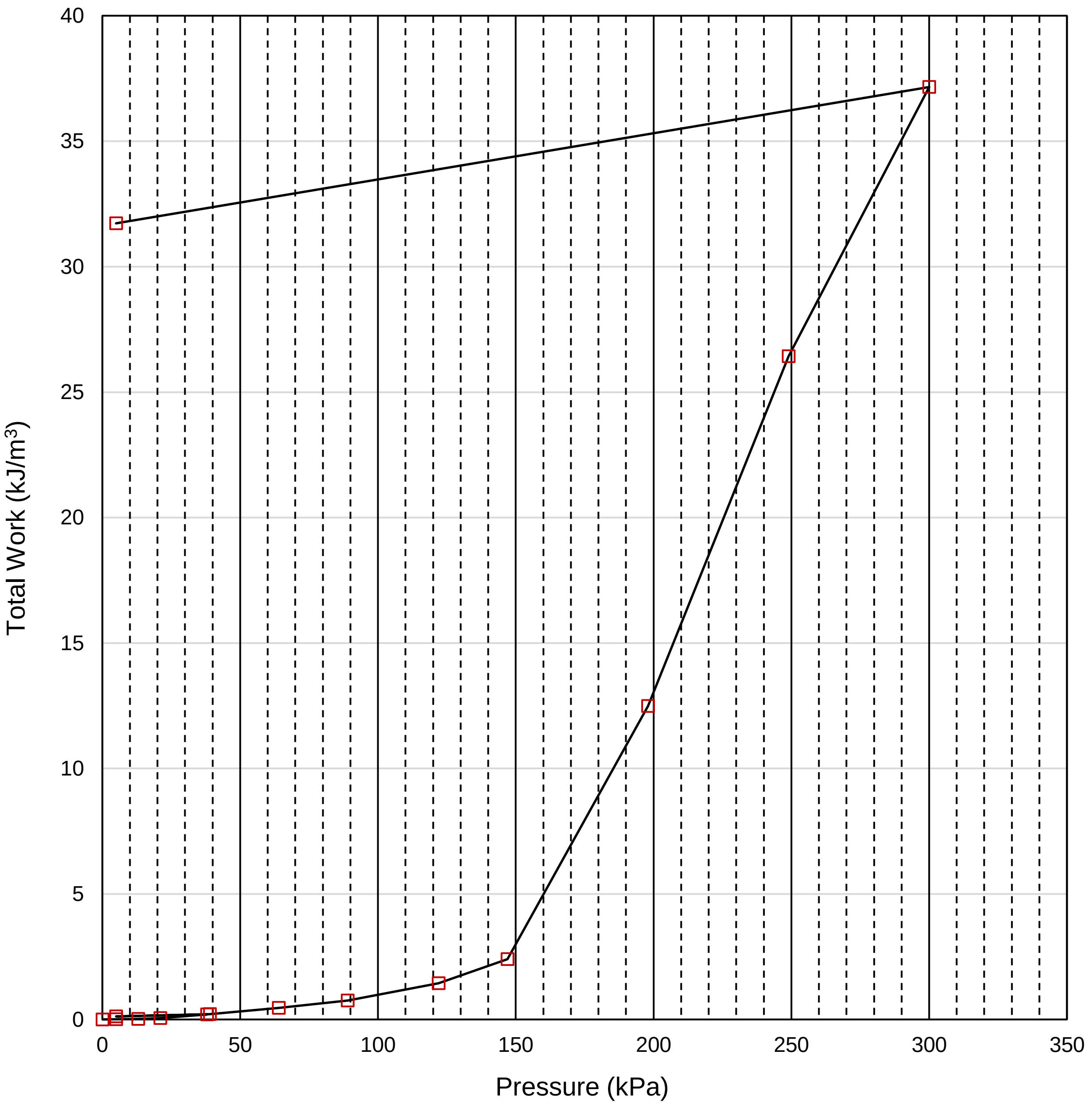
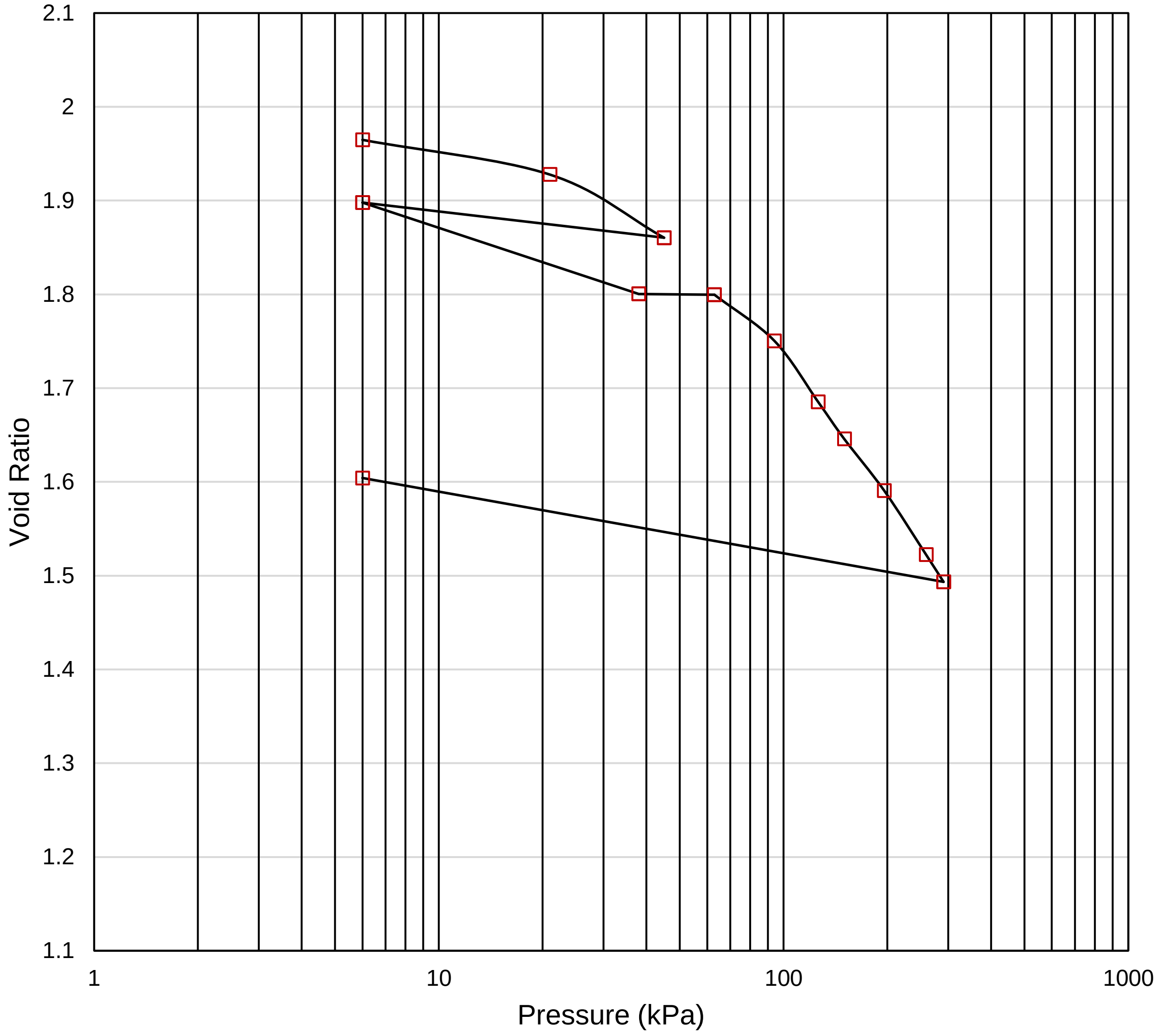


Borehole/Sample Number	25-02 ST1
Sample Depth (m)	3.96-4.57

CONSOLIDATION TEST RESULTS - WORK

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Date:	25/04/04		
Entry:	K.Neil	PROJECT NAME: TR1363B	
Check:	K.Smith	PROJECT NO.	100590.008
Review:	A.Meacoe	**FIGURE NO.**	**1**



Borehole/Sample Number	25-04 ST1
Sample Depth (m)	3.65-4.26
Initial Water Content (%)	71
Existing Effective Overburden Pressure (kPa)	
Probable Preconsolidation Pressure (kPa)	
Compression Index (Cc)	
Recompression Index (Cr)	

CONSOLIDATION TEST RESULTS

GEMTEC
Consulting Engineers and Scientists

Date:	25/04/04	MATERIAL: CH	
Entry:	K.Neil	PROJECT NAME: TR1363B	
Check:	K.Smith	PROJECT NO.	100590.008
Review:	A. Meacoe	FIGURE NO.	**1**

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OEDOMETER CONSOLIDATION SUMMARY

SAMPLE IDENTIFICATION

Project Number	100590.008		
Borehole/Sample Number	25-04 ST1	Sample Depth, m	3.65-4.26

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Date Started	25/04/04		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, mm	12.67	Unit Weight, kN/m^3	15.77
Sample Diameter, mm	44.37	Dry Unit Weight, kN/m^3	9.20
Area, cm^2	15.46	Specific Gravity, Measured	2.79
Volume, cm^3	19.59	Degree of Saturation, %	100.91
Water Content, %	71.40		

TEST DATA

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	1.267	1.974	1.267	0			
6.00	1.265	1.965	1.266	166.341	2.04E-03	5.23E-04	1.05E-07
21.00	1.249	1.928	1.257	58.98499	5.68E-03	8.31E-04	4.63E-07
45.00	1.221	1.860	1.235	77.94461	4.15E-03	9.43E-04	3.83E-07
6.00	1.237	1.898	1.229	0			
38.00	1.195	1.800	1.216	47.6303	6.58E-03	1.02E-03	6.61E-07
63.00	1.195	1.800	1.195	0			
94.00	1.174	1.750	1.184	8663.346	3.43E-05	5.33E-04	1.79E-09
126.00	1.146	1.685	1.160	851.5343	3.35E-04	6.86E-04	2.25E-08
150.00	1.129	1.646	1.138	363.271	7.55E-04	5.53E-04	4.09E-08
196.00	1.106	1.590	1.117	5790.582	4.57E-05	4.03E-04	1.81E-09
259.00	1.076	1.522	1.091	1078.014	2.34E-04	3.63E-04	8.34E-09
291.00	1.064	1.493	1.070	624.807	3.89E-04	3.05E-04	1.16E-08
6.00	1.111	1.604	1.088	0			

Note: k calculated using c_v based on t_{90} values.

SAMPLE PROPERTIES - FINAL

Water Content, %	11.89
Specific Gravity, Measured	2.79

Unit Weight, kN/m^3	17.17
Dry Unit Weight, kN/m^3	15.34

GEMTEC
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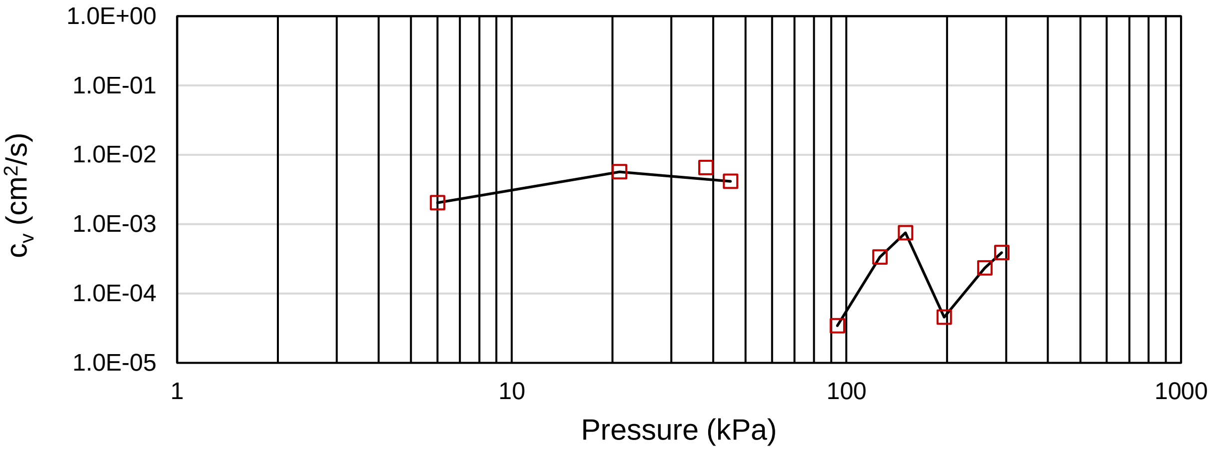

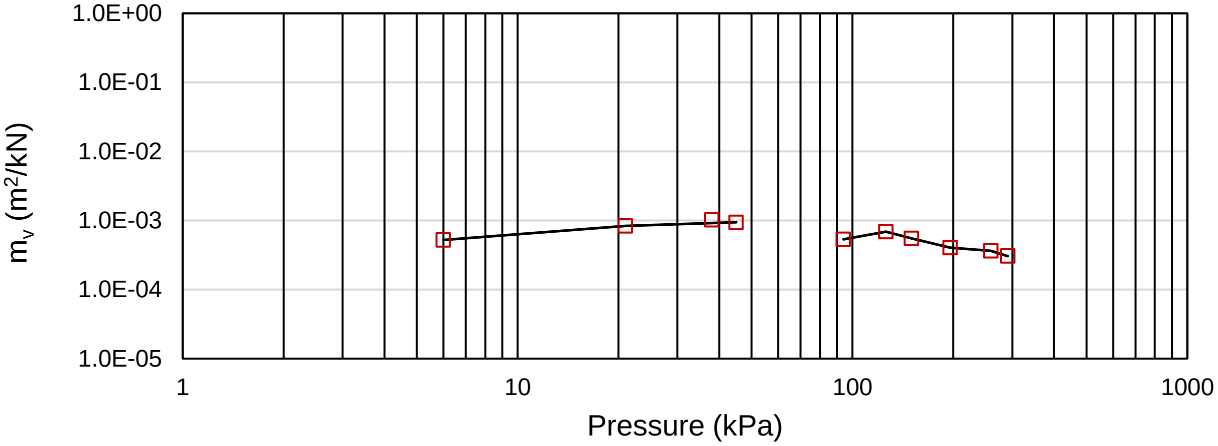

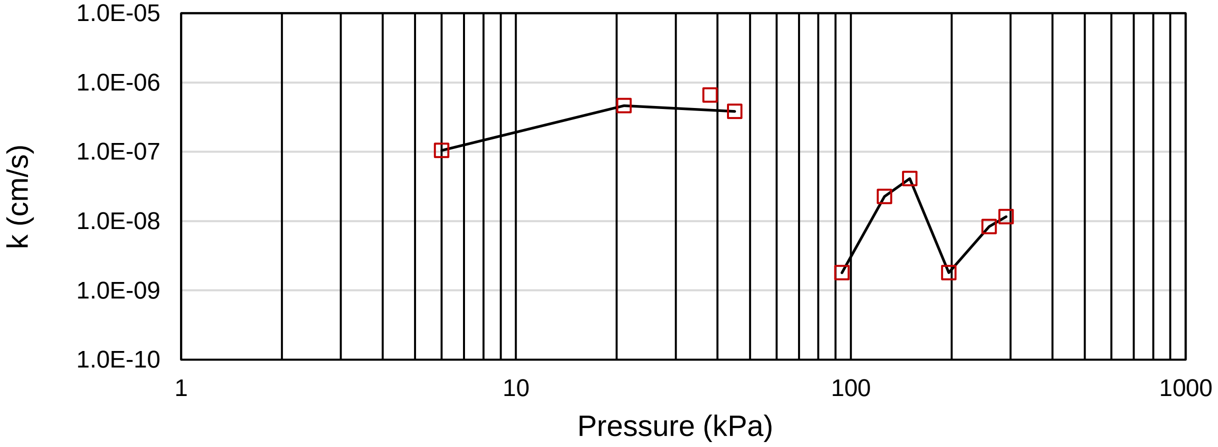

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Date:	25/04/04		
Entry:	K.Neil	PROJECT NAME: TR1363B	
Check:	K.Smith	PROJECT NO.	100590.008
Review:	A.Meacoe	**FIGURE NO.**	**1**

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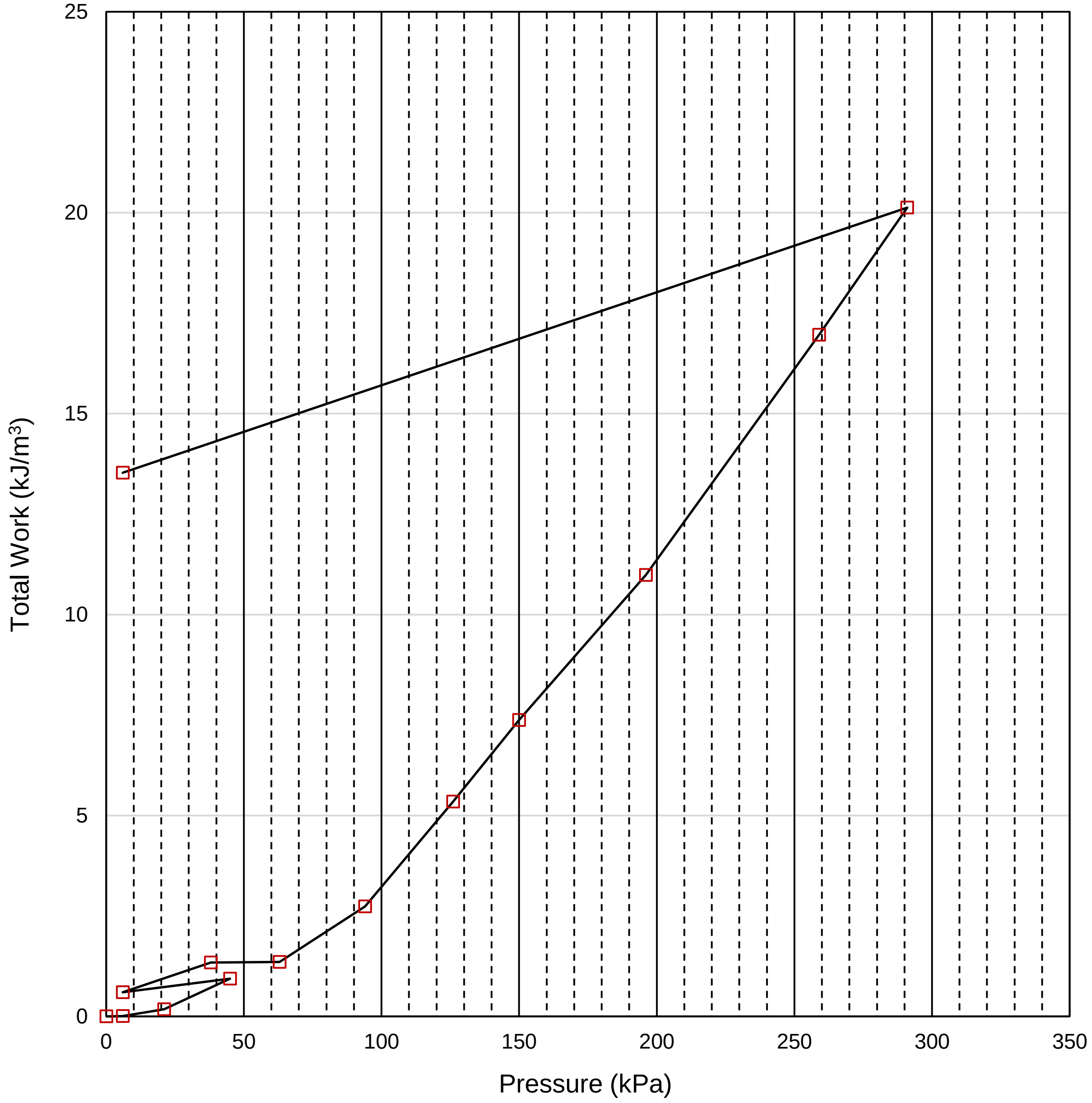


Borehole/Sample Number	25-04 ST1
Sample Depth (m)	3.65-4.26

CONSOLIDATION TEST RESULTS - WORK

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Date:	25/04/04		
Entry:	K.Neil	PROJECT NAME: TR1363B	
Check:	K.Smith	PROJECT NO.	100590.008
Review:	A.Meacoe	**FIGURE NO.**	**1**

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Client: Geosyntec Consultants
Project: Laboratory Testing, TR1363B, PO No. TR1363B-6508
Project #: 100590008

Rock Core Compressive Strength

Date/Time Sampled: 25/03/28 3:53:00 PM

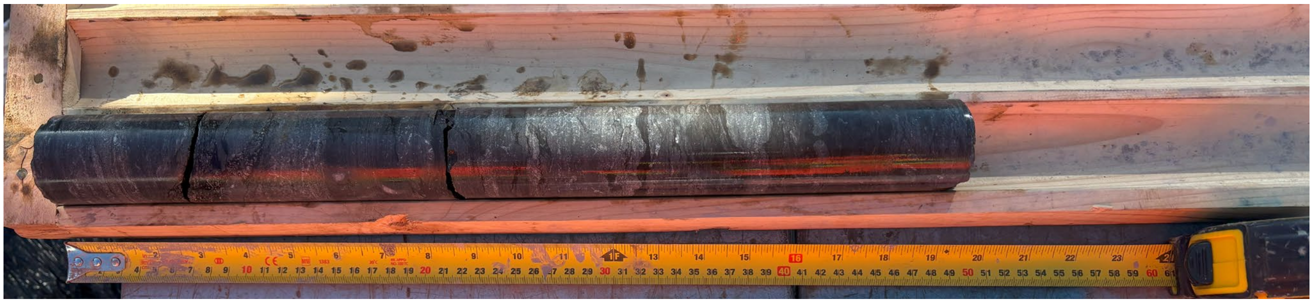
Date/Time Tested: 25/04/10 3:53:57 PM

BH	Sample No	Depth	Description	Diameter, mm	Area, mm²	Length After Capping, mm	L/D	Load, kN	Comp. Str., MPa
25-01	Run 4	13.32-13.65		47.5	1772	98	2.06	278.400	157.1
25-02	Run 1	11.28-11.81		47.4	1765	99	2.09	224.310	127.1
25-08	Run 3	19.35-20.57		47.4	1765	103	2.17	252.110	142.9

Appendix C
Rock Core Photo Logs

Borehole 25-01	Depth: 12.4 m – 13.2 m	Bedrock, Run1, RQD 0%

Borehole 25-01	Depth: 13.2 m – 14.6 m	Bedrock, Run2, RQD 95%



Borehole 25-02	Depth: 11.3 m – 11.8 m	Bedrock, Run1, RQD 82%

Borehole 25-02	Depth: 11.8 m – 13.3 m	Bedrock, Run2, RQD 52%

Borehole 25-08	Depth: 17.8 m – 19.4 m	Bedrock, Run1, RQD 0%

Borehole 25-08	Depth: 19.4 m – 20.6 m	Bedrock, Run2, RQD 80%