Preliminary Geotechnical Investigation
Proposed Residential Development
85 Gemini Way (Lot B) Ottawa, ON

Client:
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Executive Summary

A preliminary geotechnical investigation was undertaken at the site of the proposed multi-use residential/commercial development to be located at 85 Gemini Way (Lot B), Ottawa, Ontario (Figure 1). Term of reference for this project was provided in EXP proposal OTT-24014796-A0 dated November 19, 2024, and authorized by Centurion Appelt (1 Centrepoint) LP via agreement Number 460-4010-001 dated November 21, 2024.

The proposed development will comprise of a six-storey wood frame with up to two levels of underground parking. Design information such as basement floor and finished grades as well as design exterior grades were not available at the time of preparation of this report.

The borehole fieldwork for this geotechnical investigation was undertaken between December 12 and 20, 2024 and comprised the drilling of three boreholes, i.e. Borehole BH-24-01 to BH 24-03 to refusal/termination depths of 12.3 m to 15.8 m below the existing grade. Monitoring wells were installed in the boreholes for long term monitoring of the groundwater table at the site. The borehole fieldwork was supervised on a full-time basis by a representative from EXP

The geotechnical conditions at the site consist of pavement structure/topsoil underlain by sand and gravel to granular fill extending to depths of 1.2 m to 1. 5 m (Elevation 85.2 m to 85.0 m). The fill is underlain by a thick deposit of very stiff to firm clay deposit which extends to depths of 9.8 m to 10.6 m (Elevation 76.5 m to Elevation 75.8 m) overlain by dense silty sand glacial till extending to auger refusal/cored depths ranging between 12.3 m to 13.2 m (Elevation 74.2 m to 73.2 m). Limestone bedrock was proven below the bouldery glacial till in Borehole Nos. 24-3. Groundwater levels range from 4.3 m to 7.2 m (Elevation 82.2m to 79.1m). The groundwater table is subject to seasonal fluctuation and may be at higher depths during wet weather conditions. It is recommended that another set of readings be collected in the spring of 2025.

Based on available data, a preliminary seismic site classification, **Class D** as per Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC) (as amended May 2, 2019) can be taken for this site. An MASW is recommended to be completed to confirm the seismic site classification to be used in the design once design grades are known. The subsurface soils at the sites are not considered to be susceptible to liquefaction during a seismic event

A site grade raise of 1.0 m is considered acceptable for the site for preliminary design considerations.

Based on the geotechnical data collected, it may be feasible to support the six-storey building proposed at 85 Gemini Way (Lot B) with two levels of underground parking on spread/strip footings set on the undisturbed clay deposit at 5 m to 7 m depth below existing grades and designed for an SLS and ULS bearing capacity of 150 and 225 KPa respectively or on piled foundation driven to or into bedrock. It is recommended this office must be consulted for confirmation of the SLS and ULS bearing pressures once the underside of footings and number of underground parking levels are set.

The lowest level floor slabs of the underground parking garage for the proposed building may be designed as slab-on-grade. The slab-on-grade should be set on a bed of well packed 19 mm clear stone at least 200 mm thick placed on an engineered fill pad at least 300 mm thick compacted to 98 percent SPMDD on top of the undisturbed silty clay. The clear stone will prevent the capillary rise of moisture from the underlying soil to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking. The lowest floor slab-on-grade for the proposed building will require perimeter and underfloor drainage systems.

Foundation excavations are anticipated to extend to a maximum depth of 7 m to 8m below the existing ground surface and to 3.7m below the groundwater table.

The excavations at the site may be completed using conventional mechanical equipment and should be in accordance with the Occupational Health and Safety Act (OHSA), Ontario, Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils at the site are considered to be Type 3 soil. As per OHSA, the sidewalls of open cut excavations undertaken within Type 3 soil, must be sloped back at 1H:1V above the groundwater table and at a slope of 2H:1V below the groundwater table. If the above side slopes cannot be achieved due to space restrictions on the sites, the excavations for the proposed buildings would have to be undertaken within the confines of an engineered support system (shoring system).

The need for a shoring system, the most appropriate type of shoring system and the design and installation of the shoring system should be determined by the contractors bidding on this project. The design of the shoring system should be undertaken by a professional engineer experienced in design of shoring systems and the installation of the shoring system should be undertaken by a contractor experienced in the installation of shoring systems. The shoring system should be designed and installed in accordance with latest edition of Ontario Regulation 213/91 under the OHSA and Fifth Edition of the Canadian Foundation Engineering Manual (CFEM, 2023.)

Vibrations should be monitored during construction to prevent damage to adjacent structures. A pre-condition survey of all the structures and services situated within proximity of the site will be required prior to commencement of construction. Monitoring of the shoring system will also be required during subsurface construction.

Seepage of surface and sub-surface water into the excavations should be anticipated. However it should be possible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps. The needs for high-capacity pumps should not be overlooked. A hydrogeological study is required to be completed as part of the final design to quantify the anticipated water to be required to be pumped so appropriate permit can be obtained.

The basement walls of the proposed building should be backfilled with free draining material, such as OPSS 1010 Granular B Type II and equipped with perimeter and underfloor drainage system to prevent the buildup of hydrostatic pressure behind the walls and under the floor slab. The subsurface walls should be designed to resist lateral static and dynamic (seismic) earth forces.

It is recommended that additional boreholes be completed at the site to collect supplementary data on the shear strength of the clay and depth of bedrock once designs grades are established.

A hydrogeological study should be completed at the site as part of the additional studies for the proposed development.

The above and other related considerations are discussed in greater detail in the main body of this report.

This executive summary is a brief synopsis of the report and should not be read in lieu of reading the report in its entirety.

1.0 Introduction

A preliminary geotechnical investigation was undertaken at the site of the proposed multi-use residential/commercial development to be located at the site of 85 Gemini Way (lot B), Ottawa, Ontario (Figure 1). Terms of reference for this project were provided in EXP proposal OTT-24014796-A0 dated November 19, 2024 and authorized by Centurion Appelt (1 Centrepoint) LP via agreement Number 460-4010-001 dated November 21, 2024.

The proposed development will comprise of a six storey wood framed building with up to two levels of underground parking to be located at site of 85 Gemini (Lot B), Ottawa, Ontario. Design information such as basement floor and finished grades as well as design exterior grades for the proposed building were not available at the time of preparation of this report.

The preliminary geotechnical investigation was undertaken to:

(a) Establish subsurface soil and groundwater conditions at three borehole locations drilled at the site.,

(b) Discuss grade Raise restrictions,

(c) Provide preliminary foundation alternatives available including founding depth, Serviceability Limit State (SLS) bearing pressure, and factored geotechnical resistance at Ultimate Limit State (ULS) of the founding strata for the proposed building.,

(d) Discuss anticipated total and differential settlements for different foundation options.,

(e) Provide preliminary Classification of the sites for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (as amended May 2, 2019) and assess the potential for liquefaction of the subsurface soils during a seismic event.,

(f) Discuss slab-on-grade floor construction.,

(g) Discuss Static and seismic earth forces on basement walls.,

(h) Comment on excavation conditions anticipated and dewatering requirements during construction.,

(i) Discuss backfilling requirements and the suitability of the on-site soil for backfilling purposes, and

(j) Comment on subsurface concrete requirements.

The comments and recommendations given in this report are preliminary in nature and are for the guidance of design engineers. It is recommended that additional geotechnical investigations should be undertaken at the sites for construction purposes once the design concepts have been finalized to supplement the information contained in this preliminary investigation report.

2.0 Site Description

The site of the proposed development is currently used as surface parking faciliy and is bounded by a parking lot and office building on the west side, Baseline Road on the north side, a high rise building under construction on the east side and Gemini Way on the south side.

Available information indicates that the fourteen-storey building located just east of the proposed building at 85 Gemini Way is founded on the bedrock with a finished floor and underside footing elevation of 86.10 m and 73.15 m respectively. Borehole data, i.e. depth/elevation to bedrock collected from this site are plotted on the site plan.

The ground surface elevations at the borehole locations ranged between Elevation 86.50 m to 86.32 m.

3.0 Procedure

3.1 Fieldwork

The borehole fieldwork for this geotechnical investigation was undertaken between December 12 and 20, 2024 and consisted drilling of three boreholes to termination/auger refusal depths ranging between 12.3 m to 15.8 m and supervised on a full-time basis by a representative from EXP. The locations and the geodetic elevations of the boreholes were established on site by EXP and are shown on the Borehole Location Plan, Figure 2.

The borehole locations were cleared of private and public underground services, prior to the start of drilling by USL-1 Underground Service Locators acting as sub-contractor to exp.

The boreholes were drilled with a CME-75 truck-mounted drill rig equipped with continuous flight hollow-stem auger equipment and rock coring capabilities. Standard penetration tests (SPTs) were performed in all the boreholes and soil samples obtained on a continuous basis and at 0.75 m and 1.5 m depth intervals. In situ vane tests were completed in the cohesive soils to establish its undrained shear strength and sensitivity. The presence of the bedrock was proven in Borehole No. 24-03 by conventional coring techniques using NQ-size core barrel. A record of wash water return, colour of wash and any sudden drop of the drill rods were kept during rock coring operations.

The boreholes were equipped with 38 mm to 50 mm monitoring well (with screened section), for long-term monitoring of the groundwater levels. The installation configuration of each monitoring well is documented on the respective borehole log.

3.2 Laboratory Testing Program

On completion of the fieldwork, the soil and rock samples were transported to the EXP laboratory in Ottawa. The soil and rock samples were visually examined in the laboratory by a senior geotechnical engineer and logs of boreholes prepared. All soil and rock samples were classified in accordance with the Unified Soil Classification System (USCS) and the modified Burmister Soil Classification System (2006 Fourth Edition of the Canadian Foundation Engineering Manual (CFEM)).

The geotechnical engineer also assigned the laboratory testing program which is summarized in Table I.

Table I: Summary of Laboratory Testing Program	
Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	35
Grain Size Analysis	4
Atterberg Limit Determination	4
Corrosion Analysis (pH, sulphate, chloride and resistivity)	2
Rock Samples	
Unconfined Compressive Strength	2
Unit Weight Determination	2

4.0 Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface conditions and groundwater levels from the boreholes are given on the attached Borehole Logs, Figure Nos. 3 to 5. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

Boreholes were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

It should be noted that the soil and rock boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling operations. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "note on Sample Descriptions" preceding the borehole logs form an integral part of this report and should be read in conjunction with this report.

A review of the borehole logs indicates the following subsurface conditions with depth and groundwater level measurements.

4.1 Asphaltic Concrete/Pavement Structure

A 25 mm to 50 mm asphaltic concrete underlain by 700 mm to 725 mm granular material was encountered at the surface in Borehole Nos. 24-01 and 24-02 . At Borehole No. 24-03, a 50 mm topsoil was contacted at ground surface.

4.2 Fill

The topsoil in Borehole 24-03 and pavement structure in the remaining boreholes are underlain by compact to loose sand and gravel to silty clay fill which extends to depths of 1.2 m to 1.5 m (Elevation 85.2 m to Elevation 85.0 m). The natural moisture content of the fill ranges from 4 percent to 25 percent.

4.3 Silty Clay to Clay

The fill in all the boreholes is underlain by a deposit of clay which extends to depths of 9.8 m to 10.6 m (Elevation 76.5 m to Elevation 75.8 m). The clay is brown in the upper 3 to 4 m and becomes grey below these depths and contains silty sand seams or pockets. Its undrained shear strength ranges from 192 kPa to 43 kPa indicating a very stiff to firm consistency. The natural moisture content of this deposit ranges from 33 percent to 54 percent.

The results from the grain-size analysis/hydrometer and Atterberg limits determination of three (3) samples of the clay deposit are summarized in Table II. The grain-size distribution curves are shown in Figures 6 to 8.

Table II Summary of Results from Grain-Size Analysis and Atterberg Limit Determination – Clay

Borehole No. (BH) – Sample No. (SS)	Depth (m)	Grain-Size Analysis (%)				Atterberg Limits (%)				Soil Classification (USCS)	Soil Classification Burmister Soil Classification System
		Gravel	Sand	Silt	Clay	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index		
24-1 SS4	2.3-2.9	0	5	33	62	43	61.7	19.0	42.8	Clay of High Plasticity (CH)	Silt and Clay, trace sand
24-1 SS9	7.6 – 8.3	0	20	43	37	54	30.9	12.2	18.7	Clay of low to medium Plasticity (CL)	Silt and Clay, some sand

24-3-SS6	4.6-5.2	0	8	54	38	55	43.9	10 9	24.0	Clay of low to medium plasticity (CL)	Silt and clay, trace sand

Based on a review of the results of the grain-size analysis, the clay deposit at the site may be classified as a clay of low to high plasticity (CL to CH) in accordance with the USCS Soil Classification (USCS) and as a silt and clay, trace to some sand in accordance with the Burmister Soil Classification System.

4.4 Glacial Till

The clay deposit in all the boreholes is underlain by glacial till layer which extends to auger refusal/cored depths contacted at depths of 12.3 m to 13.2 m in all the boreholes (Elevation 74.2 m to 73.2 m). The glacial till contains varying amounts of gravel, sand, silt and clay as well as cobbles and boulders. The glacial till is dense and has a natural moisture content ranging between 8 and 21 percent.

The results from the grain-size analysis conducted on one (1) sample of the glacial are summarized in Table III. The grain-size distribution curve is shown in Figure 10.

Table III Summary of Results from Grain-Size Analysis – Glacial Till Samples							
Borehole No. (BH) – Sample No. (SS)	Depth (m)	Grain-Size Analysis (%)				Soil Classification (USCS)	Soil Classification Burmister Soil Classification System
		Gravel	Sand	Silt	Clay		
BH 24-1-SS11	10.7-11.3	13	37	40	10	Silty sand with gravel (SM)	Silty sand, some gravel, trace clay

Based on a review of the results of the grain-size analysis, the glacial till may be classified as a silty sand with gravel (SM) in accordance with the USCS Soil Classification (USCS) and as a silty sand, some gravel, trace to some clay in accordance with the Burmister Soil Classification System. The glacial till contains cobbles, boulders and shale fragments.

4.5 Refusal and Limestone Bedrock

Refusal was encountered in all the boreholes at depths ranging between 12.5 m to 12.8 m (Elevation 74.2 m to 73.5 m). Washboring and core drilling techniques used to advance Borehole No. 24-03 beyond refusal depth revealed that refusal was met on bouldery till overlain by shaley limestone bedrock. The bedrock is grey with a Total Core Recovery (TCR) of ranging from 88 percent to 100 percent and Rock Quality Designation (RQD) ranging from 78 percent to 79 percent. The RQD value indicates a good quality bedrock. The results of a unit weight and unconfined compressive strength test undertaken on two (2) samples of the intact rock are given on Table IV.

Table IV: Unit Weight and Unconfined Compressive Strength of Rock Cores			
Borehole #	Depth (m)	Unit Weight (kN/m^3)	Unconfined Compressive Strength (MPa)
BH 24-3 - Run 2	14.1 – 14.3	26.2	83.4
BH 24-3 Run 3	14.8 – 14.9	26.5	118.2

On the basis of its unconfined compressive strength, the rock may be described as strong to very strong. Photographs of the rock core are shown in Figure 10.

4.6 Groundwater

A summary of the groundwater level measurements taken in the open boreholes upon completion of drilling and equipped with monitoring wells on January 10, 2025 are shown in Table V. The monitoring wells in three of the boreholes were inaccessible on January 10, 2024 at the time of the site visit.

Table V: Summary of Groundwater Level Measurements

Borehole No. (BH)	Ground Surface Elevation (m)	December 7, 2022		March 22, 2023	
		Elapsed Time in Days from Date of Installation	Depth Below Ground Surface (Elevation), m	Elapsed Time in Days from Date of Installation	Depth Below Ground Surface (Elevation), m
BH 24-1	86.47	Completion	4.3 (82.2)	29 days	Inaccessible
BH 24-2	86.32	Completion	4.3 (82.0)	29 days	7.2 (79.1)
BH 24-3	86.36	Completion	4.7 (81.7)	21 days	Inaccessible

The above table indicates the groundwater level to ranges from 3.3 m to 7.2m depths (Elevation 82.2 m to Elevation 79.1 m). It is recommended that another set of reading be collected in the spring of 2025.

The groundwater levels were determined in the boreholes at the time and under the condition stated in this report. Note that fluctuations in the level of groundwater may occur due to a seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

5.0 Seismic Site Classification

The geotechnical conditions at the site comprised of shallow deposit of fill underlain by very stiff to firm, loose to compact glacial bouldery till and limestone bedrock contacted at depths of 12.3 m to 13.2 m

A preliminary seismic **Class D** for seismic site response in accordance with Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC), as amended May 2, 2019, may be taken for the proposed six storey wood framed building with one or two levels of underground parking. It is recommended that an MASW should be completed to confirm the seismic site class to be used in the design once the design grades are known.

The on-site soils are not considered liquefiable in a seismic event.

6.0 Grade Raise Restrictions

For preliminary design purposes the permissible maximum grade raise at the sites for the proposed buildings may be taken as 1.0 m.

7.0 Foundation Considerations

7.1 Lot B- 85 Gemini Way, Proposed six Storey Wood Framed Building

Borehole 24-01 to 24-03 drilled at 85 Gemini (Lot B) revealed the subsurface condition to comprise of shallow deposit of fill underlain by very stiff to firm clay to depths of 9.8 m to 10.6m (Elevation 76.5m to 75.8m) over glacial till and limestone bedrock contacted at an inferred depth of 12.3m to 13.2m (Elevation 74.2m to 73.2m). As indicated previously, the fourteen storey building located just east of the proposed building at 85 Gemini Way is founded on bedrock with a finished floor and underside footing elevation of 86.10m and 73.15m respectively.

Based on the available data, the proposed six storey wood framed building with two levels of underground parking may be supported on strip and spread footings or on piled foundation with each option discussed in the section below.

7.1.1 Strip and Spread Footing on Silty Clay

Based on a review of the borehole information, it is considered feasible to support the proposed six story wood framed building with up to two levels of underground parking on spread and strip footing footings founded on the stiff to very stiff silty clay. Strip footing with up to 3 m wide and pad footing up to 5 m wide, placed on undisturbed silty clay between 5 m to 7m depth may be designed for a bearing pressure at serviceability limit state (SLS) of 150 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 225 kPa. The factored ULS value includes a geotechnical resistance value of 0.5. The SLS and factored ULS values are valid provided the maximum permissible site grade raise of 1.0 m using approved soil fill is respected. The settlements of the proposed building designed for the above SLS value and properly constructed are expected to be within the normally tolerable limits of 25 mm total settlement and 19 mm differential settlement. It is recommended this office must be consulted for confirmation of the SLS and ULS bearing pressures once the underside of footings and number of underground parking levels are set.

All the footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces are capable of supporting the design bearing pressure and that the footing beds have been properly prepared.

For footings founded directly on the silty clay, the exposed subgrade will be susceptible to disturbance due to worker foot traffic, construction equipment and the prevailing weather conditions during construction. To prevent disturbance to the soil subgrade, it is recommended that the approved footing beds be covered with a 50 mm thick concrete mud slab on the day of approval.

A minimum of 1.5 m of earth cover should be provided to the footings to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity. If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 2.4 m. Rigid insulation thermally equivalent to the required soil cover may be used instead of the soil cover. Alternatively, a combination of rigid insulation and soil cover may be used to achieve the required frost protection for the footings.

The recommended bearing at SLS and the factored geotechnical resistance at ULS have been calculated by EXP from the borehole information for the preliminary design stage only.

It is recommended that additional boreholes be completed at the site to collect additional data on the clay strength as well as the bedrock depths once design grades, i.e. underside of footing and finished floor elevations are known.

7.1.2 Piles Foundation

If the above recommended bearing pressure is not sufficient, the six storey building may be supported on concrete filled steel pipe piles driven to practical refusal on limestone bedrock contacted below 12.3m to 13.2m below existing grade (Elevation 74.2m to 73.2m.)

The factored geotechnical resistance at ULS for various pile sections is shown on table VI. The factored geotechnical resistance values at ULS are based on steel piles with a yield strength of 350 MPa and concrete compressive strength of

35 MPa and includes a geotechnical resistance factor of 0.4. Since the piles are expected to meet refusal within the shale bedrock, the factored geotechnical resistance at ULS will govern the design, since the bearing pressure at SLS for 25 mm of settlement will be greater than the factored geotechnical resistance at ULS.

Table VI: Factored Geotechnical Resistance at Ultimate Limit State (ULS) for Steel Pipe and H-Piles

Pile Section	Pile Section Size	Factored Geotechnical Resistance at ULS (kN)
Steel Pipe	245 mm O.D. by 10 mm wall thickness	1275
	245 mm O.D. by 12 mm wall thickness	1445
	324 mm O.D. by 12 mm wall thickness	2120

Total settlement of piles designed for the above recommended factored geotechnical resistance at ULS are expected to be less than 10 mm.

To achieve the capacity given previously, the pile driving hammer must seat the pile into limestone bedrock without overstressing the pile material. For guidance purposes, it is estimated that a hammer with rated energy of 54 kJ to 70 kJ (40,000 to 52,000 ft. lbs.) per blow would be required to drive the piles to practical refusal in the bedrock. Practical refusal is considered to have been achieved at a set of 5 blows for 6 mm or less of pile penetration. However, the driving criteria for a particular hammer-pile system must be established at the beginning of the project. This may be achieved with a Pile Driving Analyzer.

The glacial till is expected to contain cobbles and boulders. It is therefore recommended that the pile tips should be reinforced with a 25-mm thick steel plate and equipped with a driving shoe in accordance with Ontario Provincial Standard Drawing (OPSD) 3001.100, Type II, dated November 2017.

A number of test piles should be monitored with the Pile Driving Analyzer (PDA) during the initial driving and re-striking at the beginning of the project and 3 percent of the piles tested should be subjected to CAPWAP analysis. This monitoring will allow for the evaluation of transferred energy into the pile from the hammer, determination of driving criteria and an evaluation of the geotechnical resistance at ULS of the piles. Depending on the results of the pile driving analysis, the pile capacity may have to be proven by at least one pile load test for each pile type before production piling begins. If necessary, the pile load test should be performed in accordance with American Society for Testing and Materials (ASTM) D 1143.

Closed-end pipe piles tend to displace a relatively large volume of soil. When driven in a cluster or group, they may tend to jack up the adjacent piles in the group. Consequently, the elevation of the top of each pile in a group should be monitored immediately after driving and after all the piles in the group have been driven. This is to ensure that the piles are not heaving. Any piles found to heave more than 3 mm should be re-tapped.

Piles driven at the site may be subject to relaxation, i.e. loss of load carrying capacity with time. Therefore, it is recommended that the piles should be re-struck, minimum of 24 hours after initial driving to determine if the piles have relaxed. If relaxation is observed, this procedure should be repeated every 24 hours until it can be proven that relaxation is no longer a problem.

The installation of the piles at the site should be monitored on a full-time basis by a geotechnician working under the direction and supervision of a qualified geotechnical engineer to verify that the piles are driven in accordance with the project specifications.

The concrete grade beams and pile caps for heated structures should be protected from frost action by providing the beams and caps with 1.5 m of earth cover. For non-heated structures, the pile caps and beams should be provided with 2.4 m of earth cover in areas where the snow will be removed and 2.1 m of cover in areas where the snow will not be removed. Alternatively, frost protection may be provided by rigid insulation or a combination of earth cover and rigid insulation.

Consideration should be given to drill additional boreholes throughout the site to provide additional data on the bedrock elevations to the contractors bidding on this project and to prevent/reduce potential of claims for extras.

8.0 Floor Slab and Drainage Requirements

The lowest level floor of the proposed building may be designed as a slab-on-grade placed on a well packed 200 mm thick 19 mm sized clear stone bed underlain by a minimum of 300 mm thick engineered fill pad set on the approved silty clay subgrade. The clear stone would minimize the capillary rise of moisture from the sub-soil to the floor slab.

Alternatively, the clear stone may be replaced with a 200 mm thick bed of OPSS Granular A compacted to 98 percent overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking.

It is recommended that perimeter as well as underfloor drains should be provided for proposed building with two levels of underground parking. The underfloor drainage system may consist of 150 mm diameter perforated pipe or equivalent placed in parallel rows at 5 m to 6 m centres and set at least 300 mm below the underside of the floor slab. The drain should be set on 100 mm of pea-gravel and covered on top and sides with 150 mm of pea-gravel and 300 mm of CSA Fine Concrete Aggregate. The CSA Fine Concrete Aggregate may be replaced by an approved porous geotextile membrane, such as Terrafix 270R or equivalent. The perimeter drains may also consist of 150 mm diameter perforated pipe set on the footings and surrounded with 150 mm of pea-gravel and 300 mm of CSA Concrete Aggregate. The perimeter and underfloor drains should be connected to separate sumps so that at least one system would be operational should the other fail. This office must be consulted once design grades, i.e. underside of footings and number of underground parking levels are set.

The finished exterior grade should be sloped away from the structures to prevent surface ponding of water close to the structures.

9.0 Lateral Earth Pressures Against Subsurface Walls

The subsurface basement walls of the proposed building should be backfilled with free draining material, such as OPSS Granular B Type II compacted to 95 percent SPMDD and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces. The expressions below assume free draining backfill material, a perimeter drainage system, level backfill surface behind the wall and vertical face on the back side of the wall.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation:

$$P = K_0\, h\, (\tfrac{1}{2}\, \gamma h + q)$$

where P = lateral earth thrust acting on the subsurface wall, kN/m

K_0 = lateral earth pressure at rest coefficient, assumed to be 0.5 for Granular B Type II backfill material

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3

h = depth of point of interest below top of backfill, m

q = surcharge load stress, kPa

The lateral dynamic thrust may be computed from the equation given below:

$$\Delta_{Pe} = \gamma H^2 \frac{a_h}{g} F_b$$

where Δ_{Pe} = dynamic thrust in kN/m of wall

H = height of wall, m

γ = unit weight of backfill material = 22 kN/m^3

$\frac{a_h}{g}$ = earth pressure coefficient = 0.32 for Ottawa area

F_b = thrust factor = 1.0

The dynamic thrust does not take into account the surcharge load. The resultant force acts approximately at 0.63H above the base of the wall.

All subsurface walls should be properly waterproofed.

10.0 Subsurface Concrete Requirements

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on two (2) soil samples. A summary of the results is shown in Table VII. The laboratory certificate of analysis is shown in Appendix A.

Table VII: Corrosion Test Results on a Selected Soil Samples

Borehole – Sample No.	Depth (m)	Soli Type	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
BH 24-2- SS7	4.6 – 5.2	Clay	7.63	0.0123	0.05	826
BH 24-2- SS11	10.7 – 11.3	Glacial Till	8.14	0.0209	0.08	709
Threshold			< 5	>0.1	>0.04	<750

A review of Table VII indicates that the concentration of sulphates in the overburden soil is less than 0.1 percent. This concentration of sulphates in the soil will have a negligible potential of sulphate attack on subsurface concrete.

The electrical resistivity results indicate that the on-site soils are severely corrosive to extremely corrosive to bare buried steel. A corrosion specialist should be consulted to provide measures to protect buried steel at the site.

The concentration of water-soluble chlorides in the soil at the site varies from 0.05 percent to 0.08 percent and exceeds the threshold value of 0.04%. Therefore, special measures would be required when designing the concrete mix to minimize the potential of chloride attack on reinforcing steel in the subsurface concrete.

The concrete should meet the requirements of CSA A23.1 including Clauses 4.1.1.1 to 4.1.1.11 and 7.5, Tables 1 to 4 and 19.

11.0 Excavations

11.1 Excess Soil Management

Ontario Regulation 406/19 specifies protocols that are required for the management and disposal of excess soils. As set forth in the regulation, specific analytical testing protocols need to be implemented and followed based on the volume of soil to be managed and the requirements of the receiving site. The testing protocols are specific as to whether the soils are stockpiled or in situ. In either scenario, the testing protocols are far more onerous than have been historically carried out as part of standard industry practices. These decisions should be factored in and accounted for prior to the initiation of the project-defined scope of work. EXP would be pleased to assist with the implementation of a soil management and testing program that would satisfy the requirements of Ontario Regulation 406/19.

11.2 Excavations

Excavations at the site are expected to extend to a maximum depth of 7 m to 8 m below the existing street level. These excavations will extend through the fill and silty clay. . Excavations in the overburden may be undertaken by conventional heavy mechanical equipment capable of removing debris, cobbles and boulders present within the overburden.

The excavation within the subsurface soils should comply with the most recent Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). Based on the definitions contained in OHSA, the subsurface soils at the site are classified as Type 3 soil and sidewalls of open cut excavations must be cut back at 1H:1V from the bottom of the excavation. Below the groundwater table, the excavation side slopes are expected to slough and will eventually stabilize at a slope of 2H:1V to 3H:1V.

If the above slopes cannot be achieved, the excavation would need to be supported using a shoring system. The most appropriate type of shoring system and the design and installation of the shoring system should be determined by the contractors bidding on this project. The design of the shoring system should be undertaken by a professional engineer experienced in shoring design and the installation of the shoring system should be undertaken by a contractor experienced in the installation of shoring systems. The shoring system should be designed and installed in accordance with latest edition of Ontario Regulation 213/91 under the OHSA and the Fourth Edition of the Canadian Foundation Engineering Manual (CFEM 2024). The shoring system as well as adjacent settlement sensitive structures (buildings) and infrastructure should be monitored for movement on a periodic basis during construction operations.

Vibration monitoring should also be carried out on the adjacent structures and infrastructure, and safe vibration limits need to be established prior to construction. It is recommended that the vibration monitoring is carried out with real-time alerts so that any activities which have potential to cause damage can be immediately halted.

A pre-construction condition survey of buildings and infrastructure within the influence zone of the construction should be undertaken prior to start of construction activities.

Many geologic materials deteriorate rapidly upon exposure to meteorological elements. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from moisture, desiccation, and frost action throughout the course of construction.

Soldier Pile and Timber Lagging System

A conventional steel H soldier pile and timber lagging shoring system must be designed to support the lateral earth pressure given by the expression below:

$$P = k(\gamma h + q)$$

where P = the pressure, at any depth, h, below the ground surface

k = applicable earth pressure coefficient; active lateral earth pressure coefficient = 0.33 where some movements can be tolerated and "at rest' lateral earth pressure coefficient = 0.50 where movements cannot be tolerated.

γ = unit weight of soil to be retained, estimated at 22 kN/m^3

h = the depth, in metres, at which pressure, P, is being computed

q = the equivalent surcharge acting on the ground surface adjacent to the shoring system

The pressure distribution assumes that drainage is permitted between the lagging boards and that no build-up of hydrostatic pressure may occur.

As previously indicated, the shoring system as well as adjacent settlement sensitive structures and infrastructure should be monitored for movement (deflection) on a periodic basis during construction operations.

11.3 De-Watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to remove any water entering the excavations by collecting it in perimeter ditches and pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated and will require high-capacity pumps to keep the excavation dry.

For construction dewatering, an Environmental Activity and Sector Registry (EASR) approval may be obtained for water takings greater than 50 m^3 and less than 400 m^3 per day. If more than 400 m^3 per day of groundwater are generated for dewatering purposes, then a Category 3 Permit to Take Water (PTTW) must be obtained from the Ministry of the Environment, Conservation and Parks (MECP). A Category 3 PTTW would require a complete hydrogeological assessment and would take at least 90 days for the MECP to process once the application is submitted.

Although this investigation has estimated the groundwater levels at the time of the fieldwork, and commented on dewatering and general construction problems, conditions may be present which are difficult to establish from standard boring and excavating techniques and which may affect the type and nature of dewatering procedures used by the contractor in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile, thin layers of soil with large or small permeabilities compared with the soil mass, etc. Only carefully controlled tests using pumped wells and observation wells will yield the quantitative data on groundwater volumes and pressures that are necessary to adequately engineer construction dewatering systems. A hydrogeological study should be completed at the site as part of the additional studies for the proposed development.

It is anticipated that the excavation for the foundations will extend below the groundwater table and therefore there is a potential of impacting adjacent structures due to de-watering of the subject sites. It is therefore recommended that the potential of having an adverse impact on adjacent structures or services should be assessed prior to commencement of construction so that appropriate remedial measures can be implemented.

12.0 Backfilling Requirements and Suitability of On-site Soils for Backfilling Purposes

The materials that will be excavated include asphaltic concrete, fill, silt and clay and glacial till as well as bedrock. These materials are not considered suitable for use as backfill at the site.

It is anticipated that the majority of the fill required would have to be imported and should conform to Ontario Provincial Standard Specifications (OPSS) for Granular A and Granular B Type II, depending on their use at the site.

13.0 General Comments

The comments given in this report are preliminary in nature and are intended only for the guidance of design engineers. It is recommended that additional geotechnical investigations should be undertaken on the sites once the design concepts have been finalized to supplement and confirm the preliminary recommendations.

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Geotechnical & Materials Services
Earth and Environment

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Senior Geotechnical Engineer
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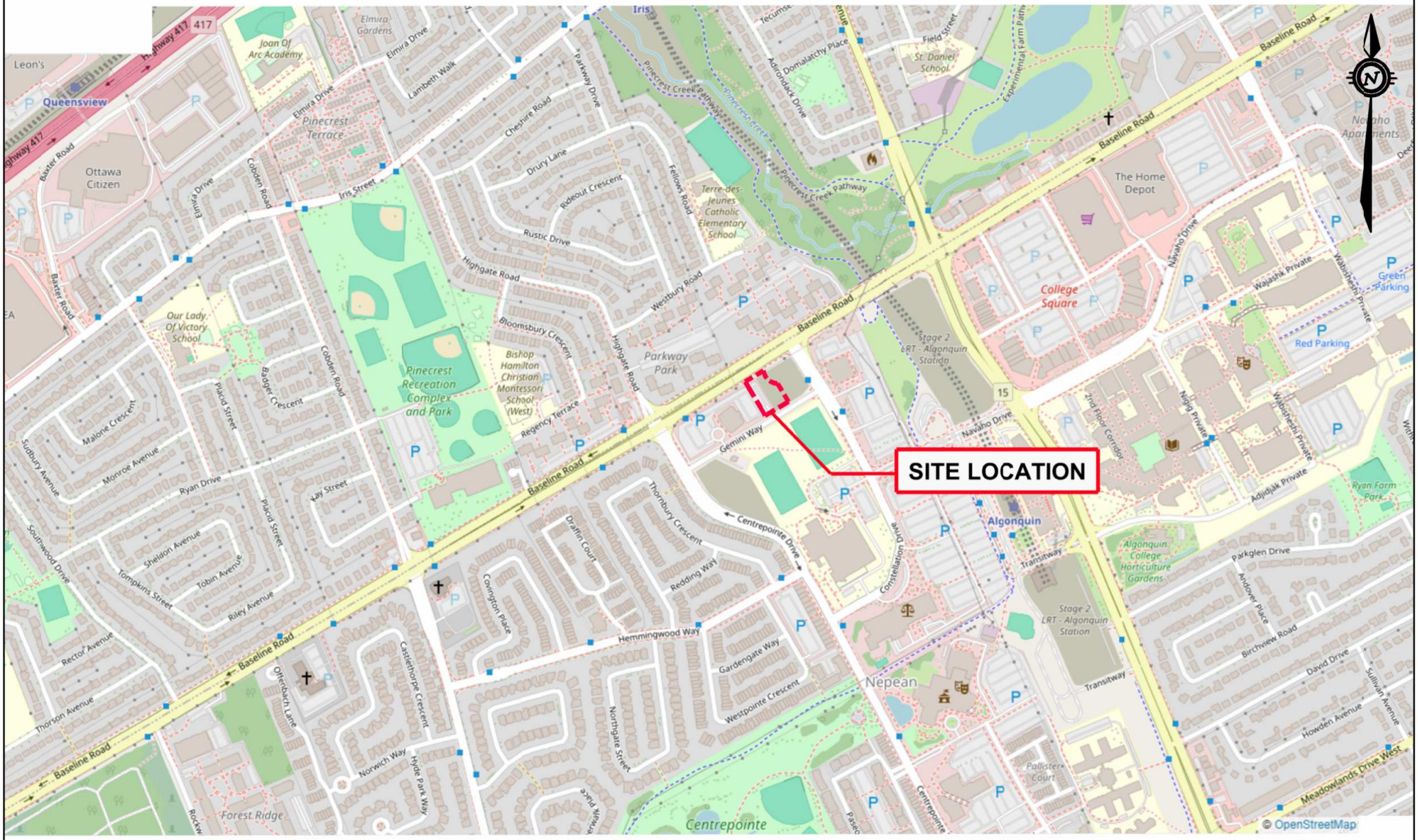
Figures



Source Map: *Open Street Map*, 2024

ORIGINAL SHEET SIZE = 11" X 8.5"

0 100m 200m 400m

HORIZONTAL 1:10,000

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Ottawa, ON K2B 8H6
www.exp.com

DESIGN	IT
DRAWN	AS
DATE	JANUARY 2025
FILE NO	OTT-24014796-A0

GEOTECHNICAL INVESTIGATION
BASELINE ROAD AT CENTREPOINTE DRIVE, OTTAWA, ONTARIO
PROPOSED RESIDENTIAL DEVELOPMENT LOT B, 85 GEMINI, OTTAWA, ONTARIO
SITE LOCATION PLAN

SCALE 1:10,000

SKETCH NO FIG 1

Filename: E:\OTT\OTT-24014796-A0\60 Execution\65 Drawings\OTT-24014796-A0_Geo_Centrepointe-at-Baseline_01.dwg
Last Saved: Jan 17, 2025 3:12 PM Last Plotted: Jan 17, 2025 3:13 PM Plotted by: SeverA

LOT B – 85 GEMINI WAY – PROPOSED SIX STOREY WOOD FRAME BUILDING

BH24-1 (GS = 86.47m) [AR = 74.2m]

BH24-2 (GS = 86.32m) [AR = 73.5m]

BH24-3 (GS = 86.36m) [BR = 73.2m]

BH 1-17 (GS = 86.31m) [CR = 75.01m]

BH 2-17 (GS = 86.48m) [CR = 73.88m]

BH 1

BH 2

BH 3-17 (GS = 6.66m) [CR = 73.96m]

BH 3

Aerial Photo Source: *geoOttawa*, 2022

LEGEND

- PROPERTY LINE
- PROPOSED NEW BUILDING APPROX. FOOTPRINT
- BH24-1 — BOREHOLE NO. & LOCATION (*EXP*, 2024)
- BH 1-17 — BOREHOLE NO. & APPROX. LOCATION (*PATERSON GROUP*, 2017)
- BH 1 — BOREHOLE NO. & APPROX. LOCATION (*SNC LAVALIN*, 2016)

(GS = *86.47m*) GROUND SURFACE ELEVATION (m)
[*BR* = *73.2m*] BEDROCK ELEVATION (m)
[*AR* = *74.2m*] AUGER REFUSAL ELEVATION (m)
[*CR* = *73.96m*] DCPT CONE REFUSAL ELEVATION (m)

NOTES:

1. THE BOUNDARIES, SOIL AND BEDROCK TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND BEDROCK CORES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. TOPSOIL AND ASPHALT QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION AT THE BOREHOLE LOCATIONS.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN OF SURVEY INFORMATION PRODUCED BY: *ANNIS O'SULLIVAN, VOLLEBEKK LTD.*, BLOCK 39 AND PART OF BLOCKS 22, 23 AND PART OF BLOCK 41, REGISTERED PLAN 4M–623 AND PART OF LOT 35 CONCESSION (RIDEAU FRONT), DATED: JULY 11, 2024.

ORIGINAL SHEET SIZE = 17" X 11"

0 5m 10m 30m

HORIZONTAL 1:750

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100-2650 Queensview Drive
Ottawa, ON K2B 8H6
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DESIGN	IT
DRAWN	AS
DATE	JANUARY 2025
FILE NO	OTT–24014796–A0

GEOTECHNICAL INVESTIGATION
BASELINE ROAD AT CENTREPOINTE DRIVE, OTTAWA, ONTARIO

PROPOSED RESIDENTIAL DEVELOPMENT LOT B , 85 GEMINI, OTTAWA, ONTARIO
BOREHOLE LOCATION PLAN

SCALE 1:750
SKETCH NO FIG 2

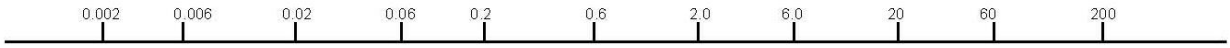
Filename: E:\OTT\OTT-24014796-A0\60 Execution\65 Drawings\OTT-24014796-A0_Geo_Centrepointe-at-Baseline_01.dwg
Last Saved: Jan 17, 2025 3:12 PM Last Plotted: Jan 17, 2025 3:14 PM Plotted by: SeverA

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH24-01

Project No: OTT-24014796-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Development

Location: 85 Gemini Way (Lot B), Ottawa, ON

Figure No. 3

Page. 1 of 1

Date Drilled: 'December 12, 2024

Drill Type: CME 75 Truck-Mounted Drill Rig

Datum: Geodetic

Logged by: A.N. Checked by: I.T.

Split Spoon Sample | Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Shear Strength by Vane Test (S)

Combustible Vapour Reading | Natural Moisture Content | Atterberg Limits | Undrained Triaxial at % Strain at Failure | Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~ 25mm thick	86.47	0			AS1	
		FILL 725mm thick of Granular material underlain by sand and gravel fill with some topsoil inclusions, grey to brown moist to wet (Compact)	86.4					
			85.0	1	19		SS2	
		SILTY CLAY Brown, wet, (stiff to very stiff)		2	10; 192 kPa		SS3	
				3	9; 156 kPa		SS4	
					6; 144 kPa		SS5	
				4	1		SS6	
			82.17		86 kPa			
		SILTY CLAY Silty sand seams or pockets shells, dark grey, wet, (firm to stiff)	81.9		Hammer Weight; s=6.0		SS7	
				5	43 kPa			
				6	Hammer Weight		SS8	
				7	62 kPa; s=13.0			
					Hammer Weight		SS9	
				8	86 kPa; s=6.0			
				9	Hammer Weight		SS10	
				10	86 kPa; s=5.2			
		GLACIAL TILL Silty sand sith gravel and trace clay, rock fragments, moist, (dense)	76.1					
				11	48		SS11	
		Auger grinding below 10.8m on possible cobbles and boulders.		12	50 for 50mm		SS12	
			74.2					
		Auger Refusal at 12.3 m Depth						

LOG OF BOREHOLE BASELINE AT CENTERPOINT.GPJ TROW OTTAWA.GDT 1/17/25

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24014796-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.3	12.3

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH24-02

Project No: OTT-24014796-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Development

Location: 85 Gemini Way (Lot B), Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'December 12, 2024

Drill Type: CME 75 Truck-Mounted Drill Rig

Datum: Geodetic

Logged by: A.N. Checked by: I.T.

Split Spoon Sample | Auger Sample | SPT (N) Value | Dynamic Cone Test | Shelby Tube | Shear Strength by Vane Test (S)

Combustible Vapour Reading | Natural Moisture Content | Atterberg Limits | Undrained Triaxial at % Strain at Failure | Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~ 38mm thick	86.32	0			AS1	
		FILL 700mm thick of Granular material underlain by silty sand with some clay fill, grey to brown, moist to wet (loose)	86.3					
			85.1	1	7		SS2	
		SILTY CLAY Silty sand seams, brown, wet, (very stiff to firm)		2	11; 180 kPa		SS3	
					7; 108 kPa		SS4	
				3	2; 48 kPa		SS5	
			82.5					
		SILTY CLAY Silty sand seams grey to dark grey, wet, (firm to stiff)		4	1		SS6	
				5	Hammer Weight		SS7	
					43 kPa; s=8.0			
				6	1 for 600mm		SS8	
			79.14	7	67 kPa; s=7.0			
					1 for 600mm		SS9	
				8	62 kPa; s=6.5			
				9	Hammer Weight		SS10	
			76.5					
		GLACIAL TILL Silty sand sith gravel and trace clay, rock fragments, moist, (dense)		10				
		Auger grinding below 10.8m on possible cobbles and boulders.		11	10 for 25mm		SS11	
				12	74		SS12	
			73.5					
		Auger Refusal at 12.8 m Depth						

LOG OF BOREHOLE BASELINE AT CENTERPOINT.GPJ TROW OTTAWA.GDT 1/17/25

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24014796-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.3	12.7
22 days	7.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH24-03

Project No: OTT-24014796-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Development

Location: 85 Gemini Way (Lot B), Ottawa, ON

Figure No. 5

Page. 1 of 2

Date Drilled: 'December 19, 2024

Drill Type: CME 75 Truck-Mounted Drill Rig

Datum: Geodetic

Logged by: A.N. Checked by: I.T.

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits —○— | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL 50 mm of topsoil Over Sand and gravel fill, organic, brown, moist, (compact)	86.36	0			AS1	
		SILTY CLAY Brown, wet, (very stiff)	85.2	1	15		SS2	
				2	12; 152 kPa		SS3	
				3	5; 160 kPa; 2; 120 kPa		SS4; SS5	
				4	120 kPa			
		SILTY CLAY Silty sand, dark grey, wet, (firm to stiff)	81.8	5	Hammer Weight		SS6	
				6	67 kPa s=3.5; Hammer Weight		SS7	
				7	86 kPa s=9.0			
				8	Hammer Weight		SS8	
				9	82 kPa s=5.7			
				10	Hammer Weight		SS9	
		GLACIAL TILL Silty sand sith gravel and trace clay, rock fragments, moist, (loose to dense)	75.8	11	7		SS10	
		Bouldery Till TO Weathered Bedrock	73.9	12	25 and 50 for 100mm		SS11	
		SHALEY LIMESTONE BEDROCK Grey, (Good Quality)	73.2	13			RUN1	
				14				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24014796-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	12.5 - 13.9	68	0
2	13.9 - 14.7	88	79
3	14.7 - 15.8	100	78

Log of Borehole BH24-03

Project No: OTT-24014796-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Development

Figure No. 5

Page. 2 of 2

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		SHALEY LIMESTONE BEDROCK Grey, (Good Quality) *(continued)*	72.36	14	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60	RUN2	
				15			RUN3	
			70.6					
		Borehole Terminated at 15.8 m Depth						

LOG OF BOREHOLE BASELINE AT CENTERPOINT.GPJ TROW OTTAWA.GDT 1/17/25

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24014796-A0

WATER LEVEL RECORDS

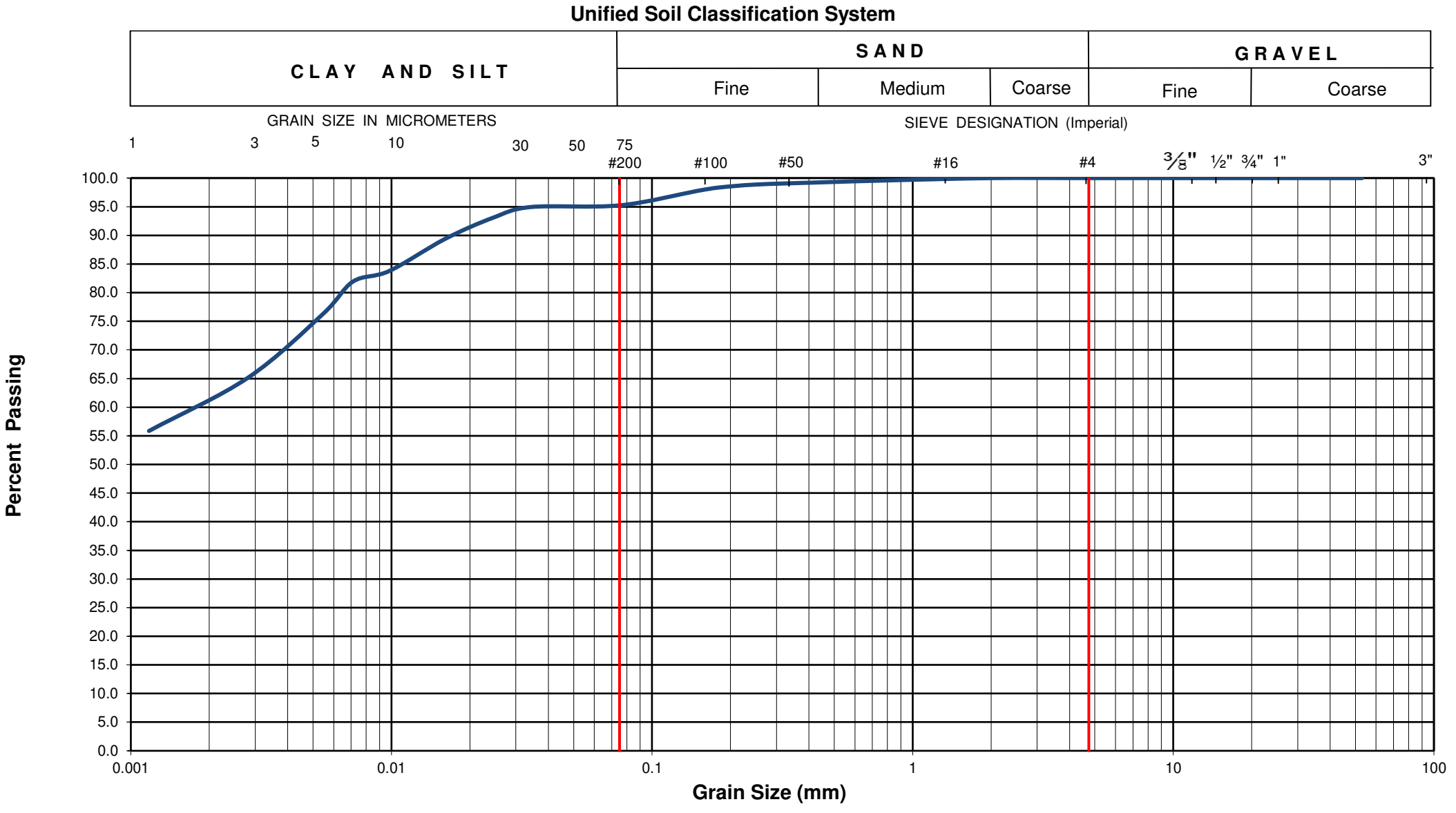
Date	Water Level (m)	Hole Open To (m)
Completion	4.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	12.5 - 13.9	68	0
2	13.9 - 14.7	88	79
3	14.7 - 15.8	100	78

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-24014796-A0**	**Project Name :**	**Prelimninary Geotechnical Investigation - Proposed Residential Development**						
Client :	**Centurion Appelt (1 Centrepoint) LP.**	**Project Location :**	**85 Gemini Way (Lot B), Ottawa, ON**						
Date Sampled :	**December 12, 2024**	**Borehole No:**	**BH24-1**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3-2.9**
Sample Description :		**% Silt and Clay**	**95**	**% Sand**	**5**	**% Gravel**	**0**	**Figure :**	**6**
Sample Description :		**Clay of High Plasticity (CH)**							

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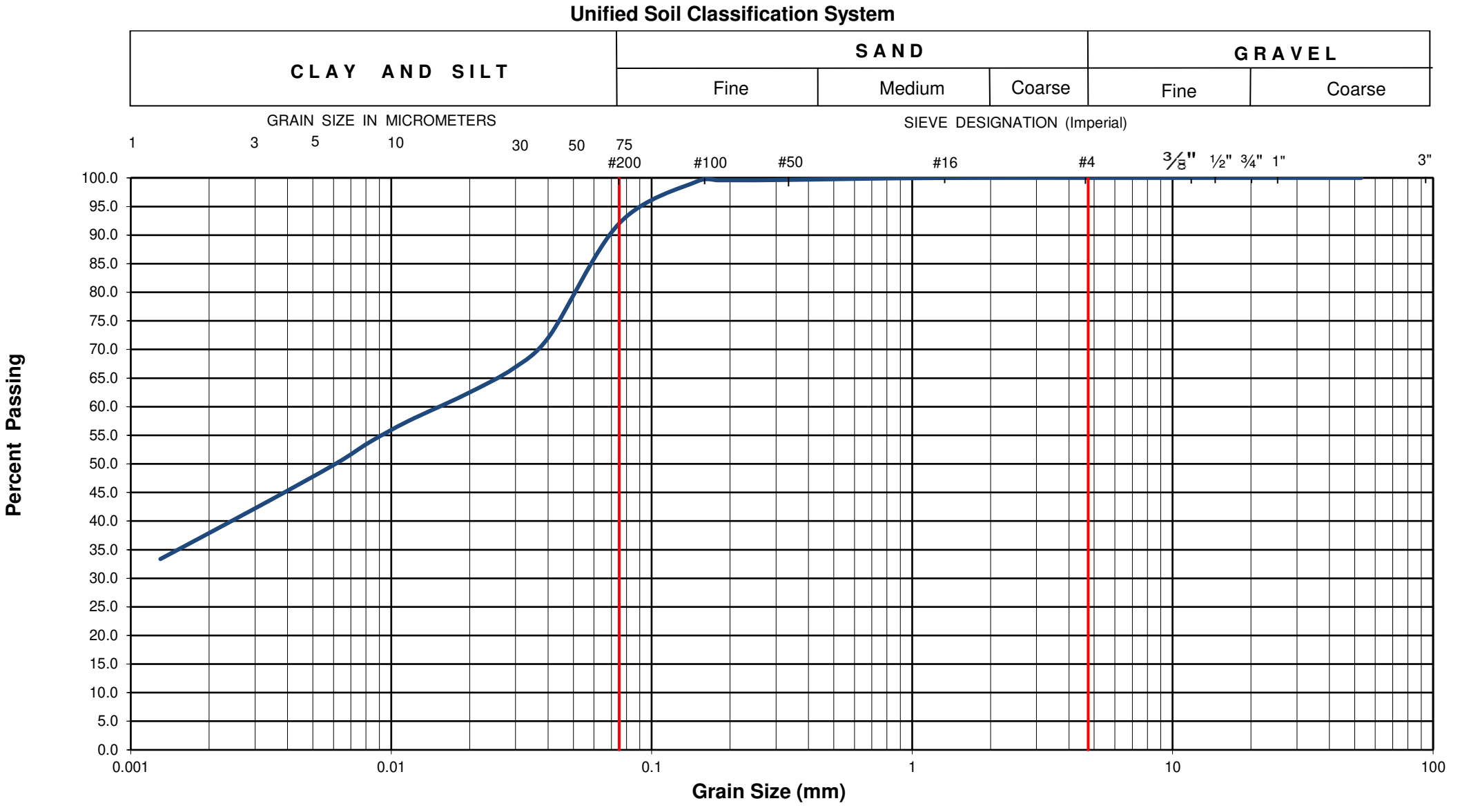
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-24014796-A0**	**Project Name :**	**Preliminary Geotechnical Investigation - Proposed Residential Development**						
Client :	**Centurion Appelt (1 Centrepoint) LP.**	**Project Location :**	**85 Gemini Way (Lot B), Ottawa, ON**						
Date Sampled :	**December 19, 2024**	**Borehole No:**	**BH24-3**		**Sample No.:**	**SS6**		**Depth (m) :**	**4.6-5.2**
Sample Description :		**% Silt and Clay**	**92**	**% Sand**	**8**	**% Gravel**	**0**	**Figure :**	**7**
Sample Description :		**Clay Low to medium Plasticity (CL)**							

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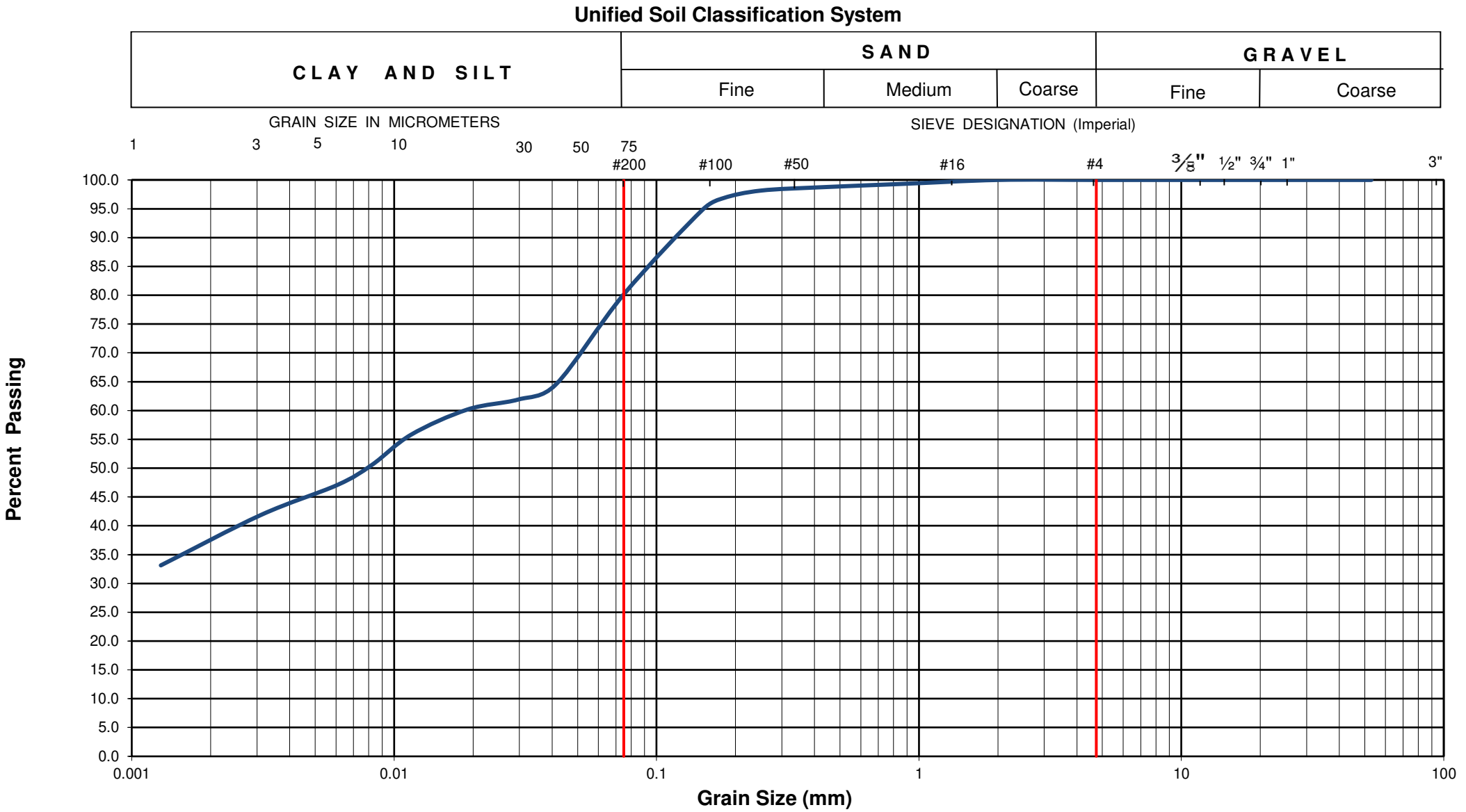
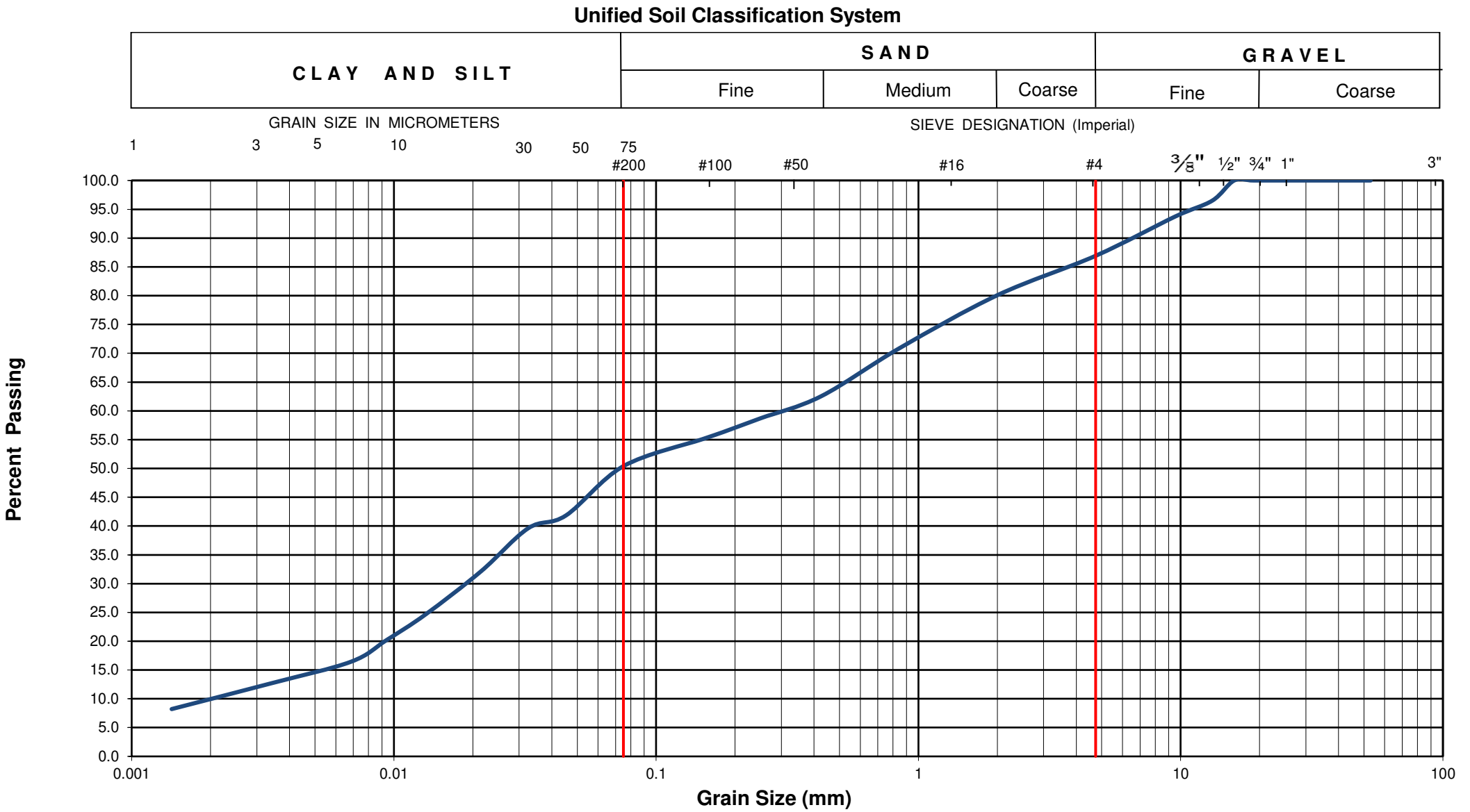
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-24014796-A0**	**Project Name :**	**Preliminary Geotechnical Investigation - Proposed Residential Development**						
Client :	**Centurion Appelt (1 Centrepoint) LP.**	**Project Location :**	**85 Gemini Way (Lot B), Ottawa, ON**						
Date Sampled :	**December 12, 2024**	**Borehole No:**	**BH24-1**	**Sample No.:**	**SS9**	**Depth (m) :**	**7.6-8.3**		
Sample Description :		**% Silt and Clay**	**80**	**% Sand**	**20**	**% Gravel**	**0**	**Figure :**	**8**
Sample Description :	**Clay low to medium Plasticity (CL)**								

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-24014796-A0**	**Project Name :**	**Preliminary Geotechnical Investigation - Proposed Residential Development**						
Client :	**Centurion Appelt (1 Centrepoint) LP.**	**Project Location :**	**85 Gemini Way (Lot B), Ottawa, ON**						
Date Sampled :	**December 12, 2024**	**Borehole No:**	**BH24-1**	**Sample No.:**	**SS11**	**Depth (m) :**	**10.7-11.3**		
Sample Description :		**% Silt and Clay**	**50**	**% Sand**	**37**	**% Gravel**	**13**	**Figure :**	**9**
Sample Description :		**Sand-Silt Mixture (SM)**							

Run 1 - 12.5 to 13.9 m

Run 2 and Run 3 - 13.9 m to 15.8 m

Borehole No:	Core Runs/Depth	project	Project N0:
BH 24-3	Run 1 : 12.5 m - 13.9 m Run 2: 13.9 m - 14.7 m Run 3 : 14.7 m - 15.8 m	Preliminary Geotechnical Investigation - Proposed Residential Development. 85 Gemini Way (Lot B), Ottawa, ON	OTT-24014796-A0
Date Cored Dec 20, 2024		Rock Core Photographs	FIG 10

Appendix A: Laboratory Certificate of Analysis Report

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: **EXP SERVICES INC**
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899

ATTENTION TO: **Ismail M. Taki**

PROJECT: **OTT-24014795-A0**

AGAT WORK ORDER: **25Z236572**

SOIL ANALYSIS REVIEWED BY: **Nivine Basily, Inorganic Team Lead**

DATE REPORTED: **Jan 14, 2025**

PAGES (INCLUDING COVER): **5**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.*
- *This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

AGAT Laboratories

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CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 25Z236572

PROJECT: OTT-24014795-A0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:

SAMPLED BY:

(Soil) Inorganic Chemistry

DATE RECEIVED: 2025-01-06

DATE REPORTED: 2025-01-14

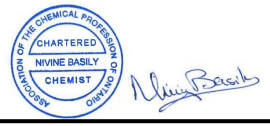
				BH24-2 SS7	BH24-2 SS11
		SAMPLE DESCRIPTION:		15'-17'	35'-37'
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2024-12-12	2024-12-12
Parameter	Unit	G / S	RDL	6446832	6446843
Chloride (2:1)	µg/g		2	532	838
Sulphate (2:1)	µg/g		2	123	209
pH (2:1)	pH Units		NA	7.63	8.14
Electrical Conductivity (2:1)	mS/cm		0.005	1.21	1.41

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6446832-6446843 pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories

5835 COOPERS AVENUE
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CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 25Z236572

PROJECT: OTT-24014795-A0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jan 14, 2025			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(Soil) Inorganic Chemistry															
Chloride (2:1)	6446832	6446832	532	550	3.3%	< 2	95%	70%	130%	98%	80%	120%	NA	70%	130%
Sulphate (2:1)	6446832	6446832	123	124	0.8%	< 2	100%	70%	130%	101%	80%	120%	97%	70%	130%
pH (2:1)	6446832	6446832	7.63	7.96	4.2%	NA	89%	80%	120%						
Electrical Conductivity (2:1)	6446832	6446832	1.21	1.11	8.6%	< 0.005	96%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 25Z236572

PROJECT: OTT-24014795-A0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE

AGAT Laboratories

Have feedback? Scan here for a quick survey!

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: EXP Services
Contact: Ismail Taki
Address: 2650 Queensview Drive, Suit 100
Ottawa, Ontario, K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Ismail.taki@exp.com
2. Email: ryan.digiuseppe@exp.com

Project Information:

Project: OTT-24014795-A0
Site Location: 1 Centrepointe Drive, Ottawa
Sampled By: EXP
AGAT Quote #: PO:
Please note: if quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Regulation 406
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture

☐ Regulation 558
☐ CCME

☐ Sewer Use ☐ Sanitary ☐ Storm
Region
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
Indicate One

Is this submission for a **Record of Site Condition (RSC)**? ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Legal Sample ☐

Sample Matrix Legend

GW	Ground Water	**SD**	Sediment
O	Oil	**SW**	Surface Water
P	Paint	**R**	Rock/Shale
S	Soil		

Laboratory Use Only

Work Order #: 25723657 2

Cooler Quantity: n/a - bag
Arrival Temperatures: 19.0 | 18.9 | 18.8
~~Depot~~ Temperatures: 4.5 | 4.3 | 1.2
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: L I

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CSR

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	BTEX, F1-F4 PHCs	VOC	PAHs	PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package pH, Metals, BTEX, F1-F4	EC, SAR	Regulation 406 SPLP Rainwater Leach mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Corrosivity ☐ Moisture ☐ Sulphide	pH	Sulphates	Chlorides	Electro Conductivity			Potentially Hazardous or High Concentration (Y/N)
1. BH24-2 SS7 15'-17'	Dec 12	AM PM	1															☑	☑	☑	☑			
2. BH24-2 SS11 35'-37'	Dec 12	AM PM	1															☑	☑	☑	☑			
3.		AM PM																						
4.		AM PM																						
5.		AM PM																						
6.		AM PM																						
7.		AM PM																						
8.		AM PM																						
9.		AM PM																						
10.		AM PM																						
11.		AM PM																						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
				01/06/25	16h40
Samples Relinquished By (Print Name and Sign): CA TO Driver	Date 01/07/25	Time 13h00	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page ____ of ____
N°:

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Legal Notification

This report was prepared by EXP Services for the account of Centurion Appelt (1 Centrepoint) LP.

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