



# Geotechnical Investigation

Proposed Two New Apartment Buildings  
1050 Tawadina Road, Ottawa, ON

Prepared For:

**WestUrban Developments Ltd.**  
111-2036 Island Hwy S  
Campbell River, BC, Canada  
V9W 0E8

November 03, 2022  
Englobe Ref No: 02203079.000

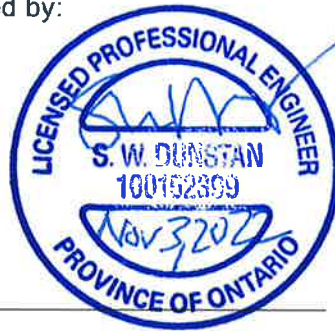
# WestUrban Developments Ltd.

Prepared by:

---

**Mohammed Al-Khazaali, Ph.D., P.Eng.**  
Project Manager - Geotechnical Engineer

Reviewed and Approved by:



---

**Shane Dunstan, P.Eng.**  
Team Lead  
Geotechnical and Materials - East

---

**Farbod Saadat, Ph.D. P.Eng.**  
Senior Technical Director  
Geotechnical

# Table of Contents

1	Introduction .....	1
2	Site Description and Project Understanding .....	2
3	Scope of Work .....	4
4	Field Investigation and Laboratory Testing .....	5
4.1	Geotechnical Drilling .....	5
4.2	Laboratory Testing .....	6
5	General Description of Subsurface Conditions .....	7
5.1	Fill .....	7
5.2	Bedrock/Auger Refusals .....	8
5.3	Groundwater .....	9
6	Discussion and Recommendations .....	11
6.1	Site Preparation .....	13
6.1.1	Subgrade Preparation .....	13
6.1.2	Interference with Existing Underground Utilities .....	14
6.1.3	Protection of Adjacent Structures .....	14
6.2	Excavations .....	14
6.2.1	Localized Shallow Sloped Excavations .....	14
6.2.2	Engineered Shoring .....	15
6.2.3	Bedrock Excavation .....	16
6.3	Temporary Construction Dewatering .....	16
6.4	Foundations .....	17
6.4.1	Footings on Rock .....	18
6.4.2	Lean Mix Concrete .....	18
6.5	Frost Protection .....	18
6.6	Seismic Site Classification .....	19
6.7	Lateral Earth Pressures .....	19
6.7.1	Static Conditions .....	19
6.7.2	Dynamic Conditions .....	20
6.8	Floor Slabs .....	21
6.9	Resistance of Foundation Uplift .....	22
6.10	Corrosion Potential of Soils .....	23
6.11	Waterproofing and Permanent Drainage .....	24
6.12	Backfill .....	24
6.12.1	Engineered Fill .....	24
6.12.2	Exterior Foundation Wall Backfill .....	25
6.13	Underground Utilities .....	26

6.13.1	Bedding and Cover.....	26
6.13.2	Trench Backfill.....	26
6.13.3	Clay Seals.....	27
6.13.4	Ottawa Interceptor Outfall Sewer.....	27
<b>7</b>	<b>Monitoring During Construction .....</b>	<b>28</b>
<b>8</b>	<b>Closure .....</b>	<b>30</b>

## Tables

Table 4-1:	Summary of New Borehole Depths.....	6
Table 5-1:	Summary of Particle Size Analysis Results of the Fill .....	8
Table 5-2:	Summary of Bedrock Observations .....	9
Table 5-3:	Summary of Monitoring Well Observations.....	10
Table 6-1:	Recommended Lateral Earth Pressure Coefficients for Static Conditions.....	19
Table 6-2:	Recommended Lateral Earth Pressure Coefficients under Dynamic Conditions .....	21
Table 6-3:	Corrosion Parameter Results .....	23
Table 6-4:	Additional Requirement for Concrete Subjected to Sulphate Attack.....	24

## Appendices

<b>Appendix A</b>	Limitations of Report
<b>Appendix B</b>	Figure 1: Site Location Map Figure 2: Borehole Location Plan
<b>Appendix C</b>	List of Symbols and Definitions Englobe Borehole Logs and Fence Diagram DST 2006 Monitoring Well Records Rock Core Photographs Sieve Gradation Analysis Results
<b>Appendix D</b>	Chemical Testing Results
<b>Appendix E</b>	2010 National Building Code Seismic Hazard Calculations
<b>Appendix F</b>	Schematic Design Presentation Received from Client



# 1 Introduction

Englobe Corp. (Englobe) is pleased to present the findings of our geotechnical investigation for the proposed two new apartment buildings (Project) at 1050 Tawadina Road in Ottawa, Ontario (Site).

Englobe Corp. was retained by WestUrban Developments Ltd. (Client) to carry out a geotechnical investigation consisting of four (4) boreholes within the footprint of the proposed Project. A signed authorization to proceed with this investigation was provided by Mr. Cameron Salisbury of WestUrban Developments Ltd. on April 7, 2022 followed by purchase order number PO#157-1-052 on April 22, 2022.

This report is prepared for the sole use of the Client. The use of the report, or any reliance on it by any third party, is the responsibility of such third party. This report is subject to the limitations shown in Appendix A. It is understood that the Project will be performed in accordance with all applicable codes and standards present within its jurisdiction.

This geotechnical investigation has been undertaken in conjunction with a Phase I ESA by Englobe. The results of the Phase I are provided under separate cover.



## 2 Site Description and Project Understanding

The Site is located in an area of the former Rockcliffe Canadian Forces Base designated for residential development in Ottawa, ON. It is located at the municipal address of 1050 Tawadina Road in Ottawa, ON. The location of the Site is shown on the Site Location Map, Figure 1 in Appendix B. It is located approximately 0.5 km south of Sir George-Etienne Cartier Parkway and 1.25 km east of Aviation Parkway. The Site is bounded by future Tawadina Road from the north, Michael Stoqua Street from the east and Bareille Snow Street. At the south side, the Site is bounded by vacant land subject to future development. To the east and southeast of the Site, newly constructed residential dwellings were observed.

The Site is currently vacant land covered with shrubs and bushes. Debris of previous structures included concrete, rebar, brick, and boulders were observed to cover most of the southeast part of the Site.

Englobe's understanding of the proposed Project is based on the "Design Update Package" prepared by FAAS dated September 16, 2022 and received from the Client on September 22, 2022.

The Site covers an approximate area of 6874 m<sup>2</sup>. The proposed development will consist of two new triangular buildings with one underground parking level for each building. The buildings will be separated by an easement.

Based on available information from previous geotechnical studies within the area and according to GeoOttawa database, Ottawa Interceptor Outfall Sewer pipe crosses beneath the Site in the East - West direction within the existing easement. The Ottawa Interceptor Outfall Sewer pipe is a 2.4 m diameter concrete pipe constructed within the bedrock using a tunnelling construction technique at an approximate

elevation of 36.25 to 35.25 masl. The elevation of the centreline of the pipe is approximately 52 m lower than the existing ground surface (~El. 88.6 masl).

Englobe understands that this geotechnical investigation is required to assist the Client with their initial structural designs. At the time of preparation of this report, Englobe has not been provided with any structural drawings of the proposed development or proposed grading plans of the Site. It is understood that the Project is currently in the pre-design stage. Therefore, it is important to emphasize that the general recommendations in this report should be considered as preliminary in nature at this stage. Englobe should be retained during detailed design to review the proposed foundation drawings and grading plans once they become available to ensure conformance with the general recommendations provided within this report.

The following assumptions about the proposed Project were made by Englobe during the preparation of this preliminary geotechnical investigation:

- The two buildings and the underground parking will be founded on shallow foundations supported on bedrock at an approximate elevation of 85.0 m above sea level (masl);
- The proposed structure will be designed under Part 4 of the Ontario Building Code (OBC 2012) and will therefore require a Site Classification for seismic Site response according to Table 4.1.8.4.-A.
- There will be no existing or proposed retaining walls or slopes exceeding 1 m in height. Therefore a slope stability assessment has not been conducted as part of this report.
- No significant global grade raises (i.e. > 0.5 m) are envisioned.



## 3 Scope of Work

Englobe's scope of the work for this assignment was outlined in our proposal (Ref No: P2203079.000 dated April 5, 2022) and was agreed to by the Client on April 7, 2021 by means of a signed services acceptance followed by a purchase order number PO#157-1-052 on April 22, 2022.

Our mandate consisted of the following activities in general:

- Retain a private utility subcontractor to provide public and private underground utility clearances at the proposed borehole locations;
- Retain a geotechnical drilling subcontractor to drill four (4) boreholes including the installation of one monitoring well.
- Supervise the fieldwork and log the subsoil and groundwater at the borehole locations based on the recovered samples;
- Perform geotechnical laboratory testing including selected index testing, and standard corrosion packages on selected soil samples; and
- Preparation of this geotechnical investigation report summarizing the findings of the field and laboratory testing and providing geotechnical parameters and recommendations to assist designers.





## 4 Field Investigation and Laboratory Testing

### 4.1 Geotechnical Drilling

Background geotechnical information in the general area was reviewed from an earlier geotechnical investigation report for subdivision approval at former CFB Rockcliffe development by DST dated September 2015. Englobe visited the Site at the outset of the fieldwork to evaluate the Site conditions, accessibility and mark the proposed borehole locations. Utility clearance was carried out by Underground Service Locators (USL-1) on behalf of Englobe and all utility clearance documents were obtained before the commencement of drilling work.

The fieldwork was conducted on May 5, 2022 and consisted of drilling four boreholes that were advanced to a maximum approximate depth 5.7 m below the ground surface (mbgs). The boreholes were drilled using a CME-850 track-mounted drilling rig, outfitted with hollow stem augers. The equipment used for drilling was owned and operated by CCC Geotechnical & Environmental Drilling Ltd. of Ottawa, Ontario.

Standard Penetration Testing (SPT) with a full-weight 107 kg hammer was performed at 0.75 m depth intervals. Disturbed soil samples were collected using a 51 mm diameter SPT split spoon sampler in addition to auger samples. The subsoils at the borehole location were logged by Englobe based on the samples that were recovered. Soil samples were labelled and submitted to Englobe's geotechnical laboratory for further visual examination and laboratory testing.

The bedrock was cored and sampled to approximately 3.0 m in BH22-2 and 22-3. Rock cores were obtained by diamond drilling and wireline tooling. Rock cores were retrieved in double-walled NQ coring methods.

A 51 mm diameter monitoring well was installed in borehole BH21-04. The well was protected in an above-ground protective casing. Details and location information of the well are provided in Section 5.3.

A summary of the new boreholes is shown in Table 4-1. The borehole locations are shown on the Borehole Location Plan attached as Figure 2 in Appendix B.

**Table 4-1: Summary of New Borehole Depths**

Borehole No.	Surface Elev. (masl)	Drilling Depth (mbgs)	Drilling Termination Criteria	Remarks
BH22-1	88.77	2.4	Auger refusal	--
BH22-2	89.66	5.0	~ 3.0 m confirmatory rock core	--
BH22-3	88.84	5.7	~ 3.0 m confirmatory rock core	--
MW22-4	88.61	2.1	Auger refusal	Monitoring well in the overburden

The boreholes were backfilled upon completion of drilling with bentonite and drill cuttings as applicable and restored to the existing ground level. In BH22-2 and 22-3, the bedrock cores were sealed with holeplug.

The subsurface stratigraphy encountered at the borehole locations was recorded by the Englobe representative based on the samples that were recovered and submitted to Englobe’s laboratory for further visual examination and/or transported to external laboratories for testing. The boreholes were surveyed with a GPS unit to record their locations and elevations.

## 4.2 Laboratory Testing

Geotechnical laboratory testing was conducted on representative soil samples, and consisted of sieve analysis, and moisture contents. The results of sieve analyses and moisture content are shown on the borehole log records in Appendix C.

Parcel Laboratories Ltd., in Ottawa, Ontario carried out chemical tests on representative soil samples to determine the susceptibility to corrosion to ductile iron pipes and concrete attack parameters. The chemical parameters consisted of pH, chloride, sulphate, sulphide, resistivity, and redox potential). Laboratory test results are included in Appendix C.



## 5 General Description of Subsurface Conditions

In general, the soil stratigraphy within the borehole locations consisted of fill underlain by limestone bedrock.

Details of the subsurface conditions encountered in the boreholes are presented graphically on the borehole logs in Appendix C. The soil at the test locations were classified based on the results of the grain size analysis tests. General descriptions of the subsurface conditions found at the test locations are provided in the following subsections.

It is important to note that the soil descriptions presented below and in the Borehole Logs represent the soils encountered at the borehole locations only. They may vary between and beyond borehole locations, especially in previously excavated and/or filled areas.

### 5.1 Fill

FILL soils were encountered in all borehole locations. The depth of the FILL ranged from approximately 1.8 m in BH22-2 to 2.4 mbgs in borehole BH22-3. This corresponds to approximate elevations ranging from 87.8 to 86.5 masl, respectively.

The FILL soils were generally described as a sandy soil with varying silt and gravel content. Thin clayey silt FILL layers with minor portions of sand and gravel were observed at the surface in BH22-2 and at the bottom of BH22-1. Organic materials (roots) were observed at the surface.

The FILL in general was brown in colour and was observed to damp to moist with moisture content values ranged from 4.2% to 17.9%, on average 10.9%.

Four samples from the FILL soils underwent grain-size analysis testing. The test results are summarized in Table 5-1 and presented in Appendix C.

**Table 5-1: Summary of Particle Size Analysis Results of the Fill**

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				USCS Soil Classification*
		Gravel	Sand	Silt	Clay	
BH22-1 / SS-2	1.1 (87.7)	38	42	21		Silty Sand and Gravel
BH22-2 / SS-3(A&B)	1.7 (88.0)	8	56	36		Silty Sand
BH22-3 / SS-2	1.1 (87.7)	12	50	38		Silty Sand
BH22-3 / SS-3B	1.7 (87.1)	27	60	13		Gravelly Sand

\* USCS: Unified Soil Classification System

The recorded SPT 'N' values for the range from 3 to 49 blows/300 mm, indicating the FILL has inconsistency compactness ranging from loose to dense.

## 5.2 Bedrock/Auger Refusals

Auger refusal was encountered in all boreholes. The bedrock was cored and sampled down to approximately 3.0 m in the bedrock using diamond core (NQ size) between El. 87.8 and 84.6 masl in BH22-2 and between El. 86.4 and 83.2 masl in BH22-3. The bedrock was observed to be strong, grey, limestone.

During the core drilling, measurements including Total Core Recovery (TCR) and Rock Quality Designation (RQD) were carried out for the rock quality classification. TCR is defined as the sum of all recovered rock core pieces from a core run expressed as a percent of the total length of the core run. The RQD is defined as percentage of the sum of the core pieces over 100 mm divided by the total length of core run. The TCR and RQD for the rock cores are presented in the borehole log records in Appendix C.

Based on the retrieved rock cores, the bedrock is observed to be moderately weathered near the bedrock surface to sound rock at deeper levels. The bedrock contained moderately spaced flat to vertical joint discontinuities.

The RQD-value of the first rock core (RC5) in BH22-3 was 42% indicating weathered rock. The RQD-value increases with depth and ranged between 61 to 100% indicating the bedrock is sound bedrock below an approximate El. 85.0 masl in BH22-3 and 87.8 masl in BH22-02.

Auger refusal without confirmatory rock coring was encountered inferred bedrock/boulders in BH22-1 and MW22-4 at 2.4 m (El. 86.4 masl) and 2.1 m (El 86.5 masl) depths, respectively. Designers and Contractors are cautioned that these may represent refusal on a cobble and/or boulder as posed to the bedrock surface.

Table 5-2 summarizes observations with respect to bedrock coring and auger refusal on inferred bedrock/boulders. Rock core photos are provided in Appendix C.

**Table 5-2: Summary of Bedrock Observations**

Borehole No.	Auger Refusal Elev. (masl)	Weathered Bedrock Elev. (masl)	Sound Bedrock Elev. (masl)	Bottom of Rock Core Elev. (masl)	Remarks
BH22-1	86.4	--	--	--	SPT sampler and Auger refusal on inferred bedrock/boulders
BH22-2	87.80	--	87.80	84.60	~ 3.0 m Bedrock coring
BH22-3	86.40	86.40	85.00	83.20	~ 3.0 m Bedrock coring
MW22-4	86.5	--	--	--	SPT sampler and Auger refusal on inferred bedrock/boulders

## 5.3 Groundwater

Water was not observed in any of open boreholes during and upon completion of drilling on May 5, 2022. The water level was measured in the monitoring well in MW22-4 on June 03, 2022 and the was observed to be dry. Based on previous investigations by Englobe, formerly DST, dated August 2006 for the overall Wateridge area, the groundwater level within the general proximity of the Site, based records of monitoring wells installed approximately at 75.0 to 150.0 m distance from the Site, is expected to vary between approximate depths of 0.8 and 2.5 mbgs, which corresponds to approximate elevations near 87.4 and 80.4 masl.

Water levels are expected to fluctuate seasonally and in response to precipitation and snowmelt events.

Monitoring well details and water level observations are shown on the borehole log records provided in Appendix C.

It is important to emphasize that a hydrogeological investigation in support of PTTW, EASR application or dewatering volume estimate was not requested at the time of this geotechnical investigation.

**Table 5-3: Summary of Monitoring Well Observations**

Monitoring Well No.	Location of Screen (masl)	Water Level Observation		
		Date	Depth (mbgs)	Elevation (masl)
MW22-4	88.0 to 86.5 screen is located within the overburden)	June 3, 2022	Dry	--
BHMW 7	88.9 to 81.1 screen is located within the overburden)	August 24, 2006	1.8	87.1
BHMW 8	82.9 to 74.3 screen is located within the overburden)	August 24, 2006	2.5	80.4
BHMW10 OB	81.8 to 78.4 screen is located within the overburden)	August 24, 2006	2.5	80.3
BHMW10 BR	70.2 to 66.8 screen is located within the overburden)	August 24, 2006	5.0	77.8
BHMW11	85.4 to 82.1 screen is located within the overburden)	August 24, 2006	0.8	87.4



## 6 Discussion and Recommendations

Based on the results of geotechnical field and laboratory investigation performed, the following discussion is provided to assist the Client and their Designers with the development of foundation general arrangements and geotechnical design for the proposed Project in general. The recommendations provided within this report are based on our understanding of the proposed Project which is summarized above in Section 2 and are general in nature. If any of these understandings changes, Englobe should be contacted to assess the implications of those changes on the recommendations provided herein.

Based on the soil conditions encountered in the boreholes, and assuming that they are representative of the soil conditions across the Site, the most important geotechnical considerations for the design of the foundations for the proposed Project are expected to be the following:

- **Pre-Design Geotechnical Investigation:** It is understood that this Project is currently in the pre-design stage. Therefore, it is important to emphasize that this report should be considered as preliminary in nature. Englobe requests to be retained to review the contemplated foundation and earthworks designs once they become available and provide comments to ensure conformance with the general recommendations provided within this report.
- **Ottawa Interceptor Outfall:** Ottawa Interceptor Outfall Sewer pipe crosses beneath the Site in the East - West direction within the existing easement. The Ottawa Interceptor Outfall Sewer pipe is a 2.4 m diameter concrete pipe constructed within the bedrock using a tunnelling construction

technique at an approximate elevation of 36.2 to 35.2 masl. The centreline elevation of the pipe is approximately 52 m lower than the existing ground surface (~El. 88.6 masl). The proposed building will be supported on spread or strip footing system founded on the bedrock at an approximate El. 85.0 masl. Assuming absence of any major limestone bedrock faults and/or solution cavities and rubble zones under the footprint of the proposed buildings, a minimum of 40 m unweathered competent bedrock cover is expected to prevent stressing the existing interceptor outfall sewer pipe.

- **Bearing Capacity on Sound Bedrock:** Foundation will be founded on sound bedrock at an approximate Elevation of 85.0 masl. Any loose or unstable rock pieces should be removed from the footing influence. Lean mixed concrete should be used for levelling the sound bedrock. If lean mixed concrete is used below any footings it must extend a minimum of 0.3 m beyond the edge of the footing and then downward at a 1H:1V. Recommended design bearing pressures on lean mix concrete would be the same as those for the bedrock, provided that the underlying subgrade has been approved by the Geotechnical Engineer.
- **Preliminary Seismic Site Classification:** In accordance with the OBC-2012, structures designed under Part Four of the Code must be designed to resist a minimum earthquake force. Based upon the results of the drilling program, we recommend that this structure be designed to “Site Class C”, with respect to Table 4.1.8.4.A of the OBC-2012, and subject to the limitations of the code.
- **Temporary Construction Dewatering:** Excavation for the structure will penetrate through the fill into the bedrock. Groundwater and surface runoff water may infiltrate and accumulate at the bottom of the excavations due to seasonal changes and extreme weather events. It is expected that dewatering will be required during the construction stage for this building location to keep the excavation reasonably dry. Dewatering may be achievable with traditional sump and pump dewatering method. Application for Permit to Take Water from the Ministry of Environment is not required based on the observed level of water in the monitoring well.
- **Permanent Drainage and Waterproofing:** The excavations for the underground parking will extend below the existing bedrock surface resulting in water pooling at the proposed floor slab level. Therefore, permanent under-floor drainage and waterproofing are required. Exterior perimeter drains are not recommended for this Site. Full water proofing membranes such as a WR Meadows Mel-ROL PRECON, or an equivalent type product for walls and under-slab will be required. Water stops should be installed at cold joints in the foundation walls and floor-wall joints. We also recommend that considerations should be given to the design of building basement as a fully waterproof ‘bath-tub’ design (without external perimeter drains) to avoid potential adverse impacts due to moisture movements in the immediate areas surrounding the proposed building footprint.



## 6.1 Site Preparation

Considering the proposed development will have one level of underground parking, all existing Fill and weathered rock are expected to be removed completely within the footprint of the proposed buildings, down to competent bedrock capable of supporting the structural loads of the proposed development. The existing Fill materials are heterogenous (i.e. contain demolition debris) in nature and not suitable for backfilling or Site grading.

The Site surrounding the excavation should be graded in the early stages of construction to provide positive control of surface water and directing it away from the excavation and subgrades. Appropriate provisions should be made for collection and disposal of storm water and runoff including an adequate pumping system.

### 6.1.1 Subgrade Preparation

The excavations for the foundations of the proposed two structures and floor slabs are generally expected to extend down to sound bedrock. Based on the recent boreholes the sound bedrock is expected to be encountered at approximate depths between 1.9 to 3.8 mbgs, corresponding to approximate elevations near El. 87.8 to 85.0 masl. It is our understanding that the final level of the finished ground floor will be approximately at the street level (~El. 90.2 masl). The footings are expected to be founded at an approximate elevation of El. 85.0 masl. Therefore, moderate bedrock excavation will be required to achieve the desired elevations which is expected to generate manageable amount of excavated rock materials.

Subgrade preparation for footings founded on rock will involve the removal of all soils and weathered bedrock to expose a sound limestone bedrock. Any pieces of rock that can be manipulated by conventional excavation equipment should be removed, and as directed by the Geotechnical Engineer. Final subgrade surfaces should be brushed and/or air blown clean, and dry. The exposed bedrock surface should be examined and approved by the Geotechnical Engineer to confirm the competency to support the design bearing pressures.

Confirmation of bedrock quality during construction will require the Contractor to perform probing of the bedrock using 50 mm diameter drill holes drilled to a depth of 1.5 m within the footings. These holes will need to be reviewed by the Geotechnical Engineer to confirm that no significant mud seams or voids exist at the footing location. If mud seams are found, localized areas of the footings may need to be lowered below the mud seam, or footing sizes increased to lower design bearing pressures accordingly. The locations of these probe holes should be selected under the direction of the Geotechnical Engineer during construction. Contractors should plan for one probe per pad footing and a minimum of 1 probe every 6 m in strip footings.

## 6.1.2 Interference with Existing Underground Utilities

Designers should review the proposed excavation locations and compare them to the location of any existing underground utilities in their vicinity and address the potential impacts of the proposed development on all existing underground utilities in advance of construction. Existing utilities that are excavated or exposed as part of construction will need to be supported and rerouted around the building.

## 6.1.3 Protection of Adjacent Structures

Designers and Contractors should review the geometry, depth, and sloping requirements of all planned excavations. Currently, there are no structures adjacent to Site location, except the existing roadways and the residential units to the East of the Site on Michael Stoqua St. Proposed excavation dimensions should be compared to adjacent load bearing structures should they exist to ensure they are not undermined. Undermining is avoided by ensuring that no excavations penetrate below an imaginary line drawn outward and downwards 10H:7V below the toe or founding level of any load bearing structures. If the limit of not undermining adjacent structures cannot be satisfied, then an Engineered Shoring system and/or underpinning program will need to be considered.

## 6.2 Excavations

Based on Englobe's current understanding of the Project, we anticipate that the excavations will extend to an approximate elevation of El. 85.0 masl. Therefore, the proposed excavation will range from approximately 1.9 to 3.8 mbgs. Excavations will extend through the soils and into the limestone bedrock. Based on the excavation depth required, it is anticipated that excavations for the building will need to be performed with Engineered Shoring to avoid undermining the adjacent roadways.

### 6.2.1 Localized Shallow Sloped Excavations

The comments in this subsection are intended for small localized shallow excavations performed in soil. The following subsection is intended to discuss Engineered Shoring for the deeper building excavation.

All excavations must be undertaken in accordance with the requirements of the Occupational Health and Safety Act of Ontario (OHSA), Regulations for Construction O.Reg. 213/91, amended. The comments within this subsection are intended to be in addition to, and not a replacement of the OHSA requirements.

Above the measured groundwater level, the soils are considered to be "Type 3 Soil" and as per OHSA, the excavation side slopes must be sloped from its bottom cut back at 1H:1V. Below the groundwater level, the soils are considered to be "Type 4 Soil" and as per OHSA, the excavation side slopes must be sloped from its bottom cut back at 3H:1V

Excavation through the soil below the groundwater level are anticipated to be more problematic. The sand to gravelly sand fill is anticipated to flow or run into the excavation. Therefore, as there are likely space restrictions, it is recommended the excavations be undertaken within the confines of an Engineered Shoring designed and installed in accordance with OHSA. The shoring will need to support the excavation sidewalls and act as a barrier against groundwater flow into the excavation. However, the removal of water within the shored excavation will still be required. Recommendations for appropriate dewatering measures beyond conventional sump pump techniques such as a positive dewatering system (e.g., well points or other specialized methods) to effectively lower the static groundwater level shall be provided by a specialized dewatering contractor.

For excavations into bedrock, the upper weathered rock zone will require back sloping depending on the degree of weathering. The bedrock quality and Site-specific requirements need to be assessed during construction by the Geotechnical Engineer. For planning purposes, a weathered bedrock is recommended to be treated as a "Type 2 Soil". Sound rock would generally be self-supporting, however, as a precautionary measure, it should be back-sloped at 10V:1H. All rock excavations should be scaled, to remove loose rock fragments to ensure safe working conditions. All rock faces should be reviewed by a Geotechnical Engineer to look for loose pieces and wedge failures. Rock bolting for worker safety may be necessary depending on the layout and field condition at that time.

The stability of the excavation side slopes will be highly dependent on the Contractor's methodology. No surface surcharges should be placed closer to the edge of the excavation than a distance equal to twice the depth of the excavation, unless an excavation support system has been designed to accommodate such a surcharge.

## 6.2.2 Engineered Shoring

Engineered Shoring systems through soil often include (but are not limited to): soldier piles and lagging, interlocking sheet piles, secant and/or tangent walls, permanent diaphragm walls, etc. The appropriate method should be selected by the Project Designers and Contractors considering the space restrictions, estimated costs, and availability of materials. Engineered Shoring systems must be designed by an experienced Professional Geotechnical Engineer taking into consideration the following Site-specific aspects:

- Lateral earth pressures;
- Hydraulic pressures of the groundwater;
- Loads from any adjacent structures, or infrastructure being retained;
- Seismic loadings;
- Freeze-thaw action on the face of the excavations;
- Expansion and contraction of shoring elements;

- Pre-stressing loads or post tensioning loads on tie backs;
- Possible surcharge loads throughout construction (i.e., trucks, equipment, stockpiles, etc.);
- Vibrations induced by construction processes; and
- Compatibility with the design of proposed waterproofing and drainage systems for the sub-surface levels.

Soldier piles and sheet piling, if used would require predrilling to provide sufficient embedment to achieve toe fixity. It is expected that the Engineered Shoring systems would need to be provided with tie-back rock anchors to ensure their lateral stability. It is recommended that the Client retain Contractors and Designers who have significant experience with deep excavations performed under similar soil conditions. Shop drawings should be submitted to the Designers and reviewed by the Geotechnical Engineer well in advance of mobilization.

The preliminary lateral earth pressure parameters to assist Designers and Contractors with shoring designs through soil are discussed in Section 6.7 below.

### 6.2.3 Bedrock Excavation

For excavations into bedrock, upper weathered rock zone will require back sloping depending on the degree of weathering. The Site-specific bedrock quality and associated requirements need to be assessed during construction by the Geotechnical Engineer. For planning purposes, a weathered bedrock is recommended to be treated as a “Type 2 Soil”. Sound rock would generally be self-supporting, however, as a precautionary measure, it should be back-sloped at 10V:1H. All rock excavations should be scaled, to remove loose rock fragments to ensure safe working conditions. All rock faces should be reviewed by a Geotechnical Engineer to look for loose pieces and wedge failures.

Bedrock excavation will require pneumatic or hydraulic breakers such as hoe-rams or heavyrock excavation equipment capable of breaking and ripping sound limestone bedrock. Alternatively, controlled blasting techniques may need to be used, subject to the laws and blasting restrictions that are in effect for the area. Designers are referred to the OPSS.MUNI 120 and the City of Ottawa Special Provision F-1201 specifications for the use of explosives. In general, these documents require a blasting plan to be prepared by a Blasting Engineer. They also require conducting pre-blast surveys on nearby buildings, utilities, structures, water wells, and facilities likely to be affected by the blast. Vibration monitoring during the blasting in nearby structures or infrastructure is required.

## 6.3 Temporary Construction Dewatering

As discussed in Section 5.3, one monitoring well (MW22-4) was installed at the Site. The water level was recorded in MW22-4 on June 03, 2022 and was observed to be dry. Based on previous investigations by

Englobe, formerly DST, dated August 2006 for the overall Wateridge area, the groundwater level within the general proximity of the Site, based records of monitoring wells installed approximately at 75.0 to 150.0 m distance from the Site, is expected to vary between approximate depths of 0.8 and 2.5 mbgs, which corresponds to approximate elevations near 87.4 and 80.4 masl. Given that excavations are expected to extend through the sandy fill into the bedrock to an approximate elevation El. 85.0 masl, groundwater and surface water seepage are expected in the excavations and will need to be adequately controlled.

Water quantities will depend on seasonal conditions, depths of excavations, presence and lateral extents of fractured rock zones, and the duration that excavations are left open. Groundwater will travel easily through the fill material and weathered rock surface. Existing utility trenches which join or intersect the excavations may act as a drain and supply off-Site water into the excavations. These should be plugged at the outset of construction in an attempt to mitigate this possibility.

Effective groundwater control prior to and during construction and possibly permanently in this case are expected to be required. Recommendations for appropriate dewatering measures beyond conventional sump pump techniques such as a positive dewatering system (e.g., well points or other specialized methods) to effectively lower the static groundwater level shall be provided by a specialized dewatering contractor. A Permit to Take Water (PTTW) from the Ontario Ministry of Environment will be required if the quantity of water to be pumped from the Site exceeds 50,000 L/day. Based on observation made during the site investigation and observed water level in the MW22-04 and other available information to date, it is expected that PTTW is not required.

It should be realized that dewatering can cause ground settlement that extends laterally beyond the immediate area of dewatering. It is recommended that the contractor assess the likely impact on nearby existing structures, underground services, roadways, groundwater wells and use methods which will control the dewatering impact. A pre-construction survey documenting the conditions of nearby settlement-sensitive facilities/infrastructure be completed prior to start of construction.

## 6.4 Foundations

It is important to note that at the time of this geotechnical investigation, the Project is still considered in the design stages, and Englobe has not been provided with the proposed foundation details. Based on the field investigation Englobe is anticipating that the foundations will be founded on sound limestone bedrock, below the weathered zone. All foundation subgrades must be approved by the Geotechnical Engineer.

Englobe understands that the currently proposed design is based on footings founded at an approximate elevation of El. 85.0 masl. Based on the results of the boreholes, Englobe recommends that the proposed footings for this structure shall be founded entirely on sound bedrock to avoid differential behaviour.

## 6.4.1 Footings on Rock

For conventional pad and strip footings founded on sound limestone bedrock, a factored bearing resistance of 1 MPa under Ultimate Limit States (ULS) conditions is recommended on sound bedrock, according to CFEM (2006). This includes for a geotechnical resistance factor of  $\Phi = 0.5$ .

There is no corresponding design bearing pressure recommended under Serviceability Limit State (SLS) conditions for bedrock as settlement under the ULS condition is expected to be minimal. Designers should keep footing dimensions to a minimum of 1.0 m for pad footings, and 0.5 m for strip footings regardless of the bearing pressure being used.

Subgrade preparation for footings founded on rock will involve the removal of all soils and weathered rock to expose sound bedrock. Any pieces of rock that can be manipulated by conventional excavation equipment should be removed, as directed by the Geotechnical Engineer. Final subgrade surfaces should be brushed and/or air blown clean, and dry. The exposed surface should be examined by the Geotechnical Engineer to assess its competency.

Confirmation of bedrock quality during construction will require probing of the bedrock at footing locations using 50 mm diameter holes drilled to a depth of 1.5 m within the footprint of footings. These holes will need to be reviewed by the Geotechnical Engineer to confirm that no significant mud seams or voids exist. If mud seams are found, localized areas of the footings may need to be lowered below the mud seam, or footing sizes increased to lower design bearing pressures accordingly. The locations of these probe holes should be provided under the direction of the Geotechnical Engineer during construction.

## 6.4.2 Lean Mix Concrete

If the grade is required to be raised between the approved sound bedrock subgrade and the design footing elevation, then it is recommended to use a lean mix concrete, as opposed to with granular fill soils. If lean mixed concrete is used below any footings it must extend a minimum of 0.3 m beyond the edge of the footing and then downward at a 1H:1V. Recommended design bearing pressures on lean mix concrete would be the same as those for the bedrock, provided that the underlying subgrade has been approved by the Geotechnical Engineer.

## 6.5 Frost Protection

All footings for heated structures must be provided with a minimum of 1.5 m of earth cover, and 1.8 m of earth cover for unheated or isolated structures in the Ottawa area. Otherwise, an equivalent insulation detail as well as insulated concrete forms would be required in order to provide adequate protection against frost action during and following foundation construction. Where soil cover cannot be provided, an

insulation detail should be designed or approved by a Geotechnical Engineer. Contractors must be aware that this detail may be such that the insulation may need to be placed below the footing and then the footing poured on top, and therefore pre-approval is recommended to ensure excavations and backfill are properly planned.

Should construction take place during winter, surfaces that support foundations or Engineered Fill must be protected by Contractors against freezing for the entire duration of construction or until adequate soil cover is in place. Backfill soils should not be placed in a frozen condition or placed on frozen subgrades.

## 6.6 Seismic Site Classification

In accordance with the OBC-2012, structures designed under Part Four of the Code must be designed to resist a minimum earthquake force. Based upon the results of the drilling program, we recommend that this structure be designed to “Site Class C”, with respect to Table 4.1.8.4.A of the OBC-2012, and subject to the limitations of the code.

## 6.7 Lateral Earth Pressures

The following preliminary lateral earth pressure parameters are provided to assist Contractors and Designers with the design of both permanent basement walls and temporary Engineered Shoring systems, if used. Designers will need to review if hydrostatic pressures are to be included in the earth pressure calculations based on the permanent drainage designs. If a fully waterproof ‘bath-tub’ design without perimeter drainage is being used, then hydrostatic pressures will need to be included in the design.

### 6.7.1 Static Conditions

The following Rankine earth pressure coefficients are being provided to assist Designers.

**Table 6-1: Recommended Lateral Earth Pressure Coefficients for Static Conditions**

Soil	Bulk Density ' $\gamma$ ' (kN/m <sup>3</sup> ) *	Angle of Internal Friction, $\phi$ ' (degrees)	Undrained Shear Strength, $S_u$ (kPa)	Rankin Earth Pressure Coefficients**		
				$K_a$	$K_o$	$K_p$
Existing Uncontrolled Cohesionless FILL Loose to compact	20	28	0	0.36	0.53	2.77
New Compacted Granular Backfill OPSS “Granular B, Type I”	22	30	0	0.33	0.50	3.00

\* Only the bulk unit weight is being presented, Designers will need to assess whether bulk, saturated, and/or submerged unit weights should be used based on their design conditions.

\*\*Assumes level/flat backfill surface. If Engineered Shoring is used, then Designers should refer to CFEM-2006 for design assistance and a Geotechnical Engineer should be retained to perform shoring design review.

For yielding retaining walls, the active earth pressure coefficients,  $K_a$ , is recommended to be used. For non-yielding permanent walls, such as basement walls, the at-rest,  $K_o$ , is recommended to be used for design. The resultant of the applicable static or at-rest force is assumed to act at  $1/3H$  above the base of the wall where  $H$  is the Height of the wall.

## 6.7.2 Dynamic Conditions

Below grade walls subjected to lateral forces due to seismic forces can be designed using the pseudo-static approach using the Mononobe-Okabe equations, shown in Section 24.9 of the Canadian Foundation Engineering Manual 2006 (CFEM-2006). In these formulas, there are both geotechnical and geometric components.

The total active thrust under seismic loading ( $P_{ae}$ ) is recommended to be expressed as follows:

$$P_{ae} = \frac{1}{2} \gamma H^2 (1 - k_v) K_{ae}$$

where:

$H$  = Height of the wall,

$K_{ae}$  = horizontal component of active earth pressure coefficient including effects of earthquake loading,

$k_v$  = Vertical component of the earthquake acceleration typically a range of  $2/3 \times k_h$  to  $1/3 \times k_h$  is considered but a value closer to  $2/3 \times k_h$  is recommended

$k_h$  = Horizontal component of the earthquake acceleration, typically Peak Ground Acceleration (PGA) or a factor thereof is used.

The Site Class-adjusted NBCC-2015 PGA for the Site is 0.322 at Site Class C and the probability of exceedance per annum is 0.000404. This value was determined using the NBCC-2010 Seismic Hazard Calculation document and can be found attached in Appendix E.

For passive earthquake pressure ( $P_{pe}$ ) the following equation can be used:

$$P_{pe} = \frac{1}{2} \gamma H^2 (1 - k_v) K_{pe}$$

where:

$K_{pe}$  = horizontal component of passive earth pressure coefficient including effects of earthquake loading

The resultant active and passive earth pressures in the above equations include both the active pressures under static ( $P_a$ ) and the passive earth pressure under static ( $P_p$ ), respectively, as well as the increased force due to seismic forces. The active and passive forces under static conditions are assumed to act at a



point of (0.3 x H) above the base and the seismic force is assumed to act near (0.6 x H) above the base, where H is the height of the wall. Therefore, the point of application for P<sub>ae</sub> and P<sub>pe</sub> may be calculated from the following equations:

$$h_a = [(0.33H.P_a) + (0.6H.P_e)]/P_{ae}$$

$$h_p = [(0.33H.P_p) + (0.6H.P_e)]/P_{pe}$$

The following soil parameters are presented to assist Designers in designing retaining walls for this Site under seismic conditions using the pseudo-static approach.

**Table 6-2: Recommended Lateral Earth Pressure Coefficients under Dynamic Conditions**

Soil	Bulk Density 'γ' (kN/m <sup>3</sup> ) *	Angle of Internal Friction, φ' (degrees)	Undrained Shear Strength, S <sub>u</sub> (kPa)	Mononobe Okabe Earth Pressure Coefficients**	
				K <sub>ae</sub>	K <sub>pe</sub>
Existing Uncontrolled Cohesionless FILL Loose to compact	20	28	0	0.78	1.29
New Compacted Granular Backfill OPSS "Granular B, Type II"	22	30	0	0.71	1.31

\* Only the bulk unit weight is being presented, Designers will need to assess whether bulk, saturated, and/or submerged unit weights should be used based on their design conditions.

\*\*Assumes level/flat backfill surface. If Engineered Shoring is used, then Designers should refer to CFEM-2006 for design assistance and the Geotechnical Engineer should be retained to perform shoring design review.

## 6.8 Floor Slabs

Based on the design traffic condition in the proposed underground parking lot, designers will need to decide what type of floor will be necessary in the parking garage. Typical options would be a flexible asphalt pavement, a rigid free-floating slab on grade, or alternatively a structural slab.

Englobe was not provided with any design criteria for floor slab loadings and traffic loadings for the floor slab of the underground parking garage, therefore we have assumed that floor slabs are lightly loaded with no heavy racking or process machinery that require specific support.

A typical floor slab loading for a lightly loaded slab on grade would be a maximum value of 24 kPa. If larger slab loadings are envisioned, then Englobe should be retained to perform additional consulting in regard to design of the floor slab. For design purposes and based upon a properly prepared native subgrade surface covered with 200 mm of Ontario Provincial Standard Specification (OPSS) 1010 "Granular A", a typical preliminary modulus of subgrade reaction appropriate for the slab design would be approximately 30 MPa/m on Engineered Fill and compacted to 100% of its Standard Proctor Maximum Dry density (SPMDD). Alternative values would require additional analysis and testing.

A capillary moisture barrier consisting of a layer of either 19 mm clear stone or an OPSS 1010 “Granular A” at least 200 mm thick should underlie the slab. This layer should be compacted to 100% of its SPMDD and placed on approved subgrade surfaces.

If floor coverings are to be used, vapour barriers are also recommended to be incorporated beneath the slab. Floor toppings may be impacted by curing and moisture conditions of the concrete. Floor finish manufacturer’s specifications and requirements should be consulted, and procedures outlined in the specifications should be followed.

Subgrade preparation below floor slabs will involve the removal of all soils and weathered bedrock to expose an intact limestone bedrock. Any pieces of rock that can be easily manipulated by conventional excavation equipment should be removed, as directed by the Geotechnical Engineer. Final subgrade surfaces should be brushed and/or air blown clean, and dry. The exposed bedrock surface should be examined and approved by the Geotechnical Engineer.

Any new fill used to raise the grade between the approved bedrock subgrade and the floor slab should be considered as Engineered Fill and should be placed in strict conformance with the requirements in Section 6.12.1.

## 6.9 Resistance of Foundation Uplift

Resistance to foundation uplift or overturning forces can be provided by considering the dead weight of the structures and backfill soils, increasing the dead weight of the structure using additional concrete elements, or with the use of additional rock anchors.

In the case that grouted rock anchors are considered, rock anchors may be designed based on a frictional stress between grout and intact bedrock. Based upon typical published values and conservative approach, Englobe recommends that a conservative allowable working stress value of 400 kPa be used to calculate the length of the required bond zone. The bond zone must be entirely within sound bedrock.

Designing in accordance with the Limit States Design (LSD) method, Designers may take the approach that working stress value is approximately equivalent to the SLS value. The ULS and SLS must be based upon both performance and structural criteria. However, based upon typical published values, the unfactored ULS values may be approximately 1,400 kPa to more than 2,100 kPa. As per CFEM-2006, a geotechnical resistance factor of  $\Phi=0.3$  should be applied to the empirical unfactored ULS values. Higher stress values may be available; however, performance load testing in the field will be required to prove the capacities. If performance testing is carried out at the outset of the Project, then a resistance factor of  $\Phi=0.4$  could be applied.

In order to mobilize the shear stress in the rock, the load at the top of the anchor must be properly transferred through the upper bedrock to the bond zone to prevent progressive grout fail and ensure

proper performance. Therefore, a “free length” is required through the foundation element, the weathered rock zone, and down to the bond zone.

The mass of rock mobilized by a rock anchor may be assumed to be based upon a 60-degree cone drawn upward from a point located at the lower one-third point of the bond zone and spaced such that the theoretical cones do not overlap. Designers should review the spacing of anchors and take into account of any overlapping cones (i.e. avoid doubling-up on rock mass calculations for overlapping cones). The bulk unit weight of bedrock may be assumed to be approximately 26 kN/m<sup>3</sup>. The corresponding buoyant unit weight would be approximately 16 kN/m<sup>3</sup>. It is recommended that Designers consider the water level to be near the surface, and therefore, use submerged unit weights for the rock mass calculations.

## 6.10 Corrosion Potential of Soils

Analytical testing was carried out on two soil sample collected from the boreholes (BH22-02 and BH22-03) to determine corrosion potential of the subsurface soils. The selected soil samples were tested for pH, resistivity, chlorides, sulphides, sulphates and redox potential. The test results are summarized in the following table and presented in Appendix D.

**Table 6-3: Corrosion Parameter Results**

Parameter	Tested Value	
	BH22-02, SS2	MW21-02, SS3A/SS4
pH	6.97	7.33 (SS4)
Chloroide (%)	0.0007	0.0011 (SS4)
Sulphate (%)	0.0291	0.0048 (SS4)
Resistivity (Ohm-cm)	2200	4600 (SS4)
Sulphide (%)	< 0.04	< 0.04 (SS3A+SS4)
Redox Potential (mV)	375*	370 (SS3A+SS4)

\*Sample holding time was exceeded prior to analysis

The American Water Works Association (AWWA) publication ‘Polyethylene Encasement for Ductile-Iron Pipe Systems’ ANSI/AWWA C105/A21.5-10 dated October 1, 2010 assigns points based on the results of the above tests. A soil that has a total point score of 10 or more is considered to be potentially corrosive to ductile iron pipe. Based on the results obtained for the sample submitted, the Site soils, are not considered to be moderately corrosive to ductile iron pipe.

The analytical results of the soil samples were compared with applicable Canadian Standards Association (CSA) A23.1-04 and are given in Table 6-4 below.

**Table 6-4: Additional Requirement for Concrete Subjected to Sulphate Attack**

Class of Exposure	Degree of Exposure	Water Soluble Sulphate in Soil Sample (%)	Cementing Material to be Used
S-1	Very Severe	> 2.0	HS or HSb
S-2	Severe	0.20 - 2.0	HS or HSb
S-3	Moderate	0.10 - 0.20	MS, MSb, LH, HS, or HSb

The chemical sulphate content analyses for selected soil samples tested indicate a sulphate concentration of maximum of a 0.0291% in soil, as shown in Table 6-3. indicating a “moderate” risk for sulphate attack on concrete material.

## 6.11 Waterproofing and Permanent Drainage

Under floor drainage is recommended for this structure based on groundwater level which is above the basement floor slab. The building basement can be designed as a fully waterproof ‘bath-tub’ design (without external perimeter drains to avoid potential adverse impacts due to moisture movements in the immediate areas around the proposed building footprint.

Full water proofing membranes such as a WR Meadows Mel-ROL PRECON or equivalent type product for walls and under-slab will be required. These types of membranes adhere to the concrete and provide a waterproof seal between the membrane and poured concrete. Their installation would require that excavations be planned large enough for safe worker accesses on the exterior of the foundation wall to allow installation. Water stops should be installed at cold joints in the foundation walls and floor-wall joint.

Under floor drainage systems should be placed at a minimum 4.5 m spacing between drains, running in one direction, and set at a minimum of 0.45 m below the underside of floor slabs.

## 6.12 Backfill

All new fill soils that underlie floor slabs, footings, in building interiors, or other structural applications are considered as Engineered Fill and must be treated as follows:

### 6.12.1 Engineered Fill

All new fill soils that underlie floor slabs, footing, or other structural applications is considered as Engineered Fill. For this Project, Engineered Fill may be required to raise the grade between the approved intact bedrock subgrade and floor slabs. Engineered Fill must meet the strict requirements as shown below:

- The proposed material must be tested for grain size and Proctor and reviewed and approved by the Geotechnical Engineer before being considered as Engineered Fill. Typically, a crushed well-graded material such as an OPSS 1010 “Granular A” or “Granular B Type II” type material is suitable. However, other suitable granular materials may be proposed and considered depending on the Site-specific conditions;
- Prior to placing any Engineered Fill, all unsuitable fill materials must be removed, and the subgrade approved by the Engineer. Any deficient areas should be repaired prior to placement;
- Engineered Fill should be placed in maximum loose lifts of 300 mm and adequately compacted to achieve 100% of its SPMDD. Engineered Fill must have full-time compaction testing by geotechnical personnel; and
- At a minimum, the Engineered Fill beneath foundations should extend laterally a distance of 0.3 m beyond the edge of the footings and then be sloped downward and outward at 1H:1V slope. Designers and contractors are cautioned that the resultant excavation can be quite large if a significant thickness of Engineered Fill is required.

### **6.12.2 Exterior Foundation Wall Backfill**

The backfill placed against exterior foundations should be a free draining granular material meeting the grading requirements of an OPSS 1010 “Granular B, Type I” or equivalent granular material. Exterior foundation backfill should be placed and compacted as outlined below:

- Backfill should not be placed in a frozen condition, or place on a frozen subgrade;
- Backfill should be placed and compacted in maximum loose lift thickness compatible with the selected construction equipment, but not thicker than 0.3 m;
- In landscaped areas the upper 0.3 m of backfill below landscape details should be a low permeable soil to reduce surface water infiltration;
- Backfill should be placed uniformly on both sides of the foundation walls to avoid build-up of unbalanced lateral pressures, or alternatively wait until basement wall are tied together with the floor above before backfilling the exterior foundation wall;
- For backfill that would underlie paved areas, sidewalks or exterior slabs-on-grade, each lift should be uniformly compacted to achieve 98% of its SPMDD;
- For backfill on the building exterior that would underlie landscaped areas, each lift should be uniformly compacted to at least 95% of its SPMDD;

- Exterior grades should be sloped away from the foundation wall, and roof drainage downspouts should be placed so that water flows away from the foundation wall;
- Entrance slabs should be founded on frost walls or alternatively have insulation details developed to prevent frost heaving at the building entrances; and
- In areas where the building backfill underlies a pavement, sidewalk, or other hard landscaping, the excavation should have a frost taper incorporated to prevent differential heaving around the building.

## 6.13 Underground Utilities

The recommendations within this section are intended to be a supplement to, and not a replacement of the most recent local municipal requirements.

### 6.13.1 Bedding and Cover

The following are recommendations for service trench bedding and cover materials:

- Bedding for buried utilities should consist of an OPSS 1010 "Granular A" material and placed in accordance with municipal requirements, assuming the subgrade soils are not allowed to become disturbed;
- The use of clear stone is not recommended for use as pipe bedding. The voids in the stone may result in a low gradient water flow and infiltration of fines from the surrounding soils and cover materials, causing settlement and loss of support to pipes and structures;
- The cover material should be a service sand material or an OPSS 1010 "Granular A". The dimensions should comply with pertinent specification section;
- The bedding, springline, and cover should be compacted to at least 98% of its SPMDD; and
- Compaction equipment should be used in such a way that the utility pipes are not damaged during construction.

### 6.13.2 Trench Backfill

Backfill above the cover for buried utilities should be in accordance with the following recommendations:

- For service trenches underlying pavement areas, the backfill should be placed and compacted in uniform lift thickness compatible with the selected compaction equipment and not thicker than 300 mm. Each lift should be compacted to a minimum of 98% of its SPMDD;

- The backfill placed in the upper 0.3 m below the pavement subgrade elevation should be compacted to a minimum of 100% of its SPMDD;
- Excavation backfill should attempt to match texture of the existing adjacent soils. If imported materials are used, side slopes with frost tapers are recommended. Frost tapers should be a back-slope of 10H:1V through the frost zone, (i.e., 1.8 m from finished grade);
- During backfilling, care should be taken to ensure the backfill proceeds in equal stages simultaneously on both sides of the pipe; and
- No frozen material should be used as backfill; neither should the trench base be allowed to freeze.

The quality and workmanship in the construction is as important as the compaction standards themselves. It is imperative that the guidelines for the compaction be followed for the full depth of the trench to achieve satisfactory performance.

### 6.13.3 Clay Seals

Clay seals should be incorporated into the design of the any utility trenches. If clay seals are not used, then there is the potential for the trench to act as a drain and into the proposed building. The location of the clay seals should be at a frequency prescribed by the Civil Engineer, and at the property lines. Ontario Provincial Standard Specifications (OPSS) 1205 and Drawings (OPSD) 802.095 are referred to both the Designers and Contractor for guidance on clay seals. Acceptable imported clay material may be used for the construction of the clay seals.

### 6.13.4 Ottawa Interceptor Outfall Sewer

Englobe, Formerly DST, performed a geotechnical investigation for subdivision approval at the former CFB Rockliffe, Ottawa, Ontario dated September 2015. This- study included preliminary evaluation of the influence of new subdivision developments on the existing sewer line considering the depth of the Ottawa Interceptor Outfall sewer pipe and assuming over 40 m thick competent rock cover, the anticipated rock RQD values, typical rock mass rating (RMR) determination, and existing/limited unconfined Compressive Strength (UCS) test results. Under these assumptions, the study concluded that the effect of the increase of the stress on the top of the bedrock due to grade raise and development can be considered negligible. The study suggested that the minimum bedrock crown to be maintain is 30 m or more between any intrusive work into the bedrock and the top of the sewer.

The study recommended that construction activities that will induce vibrations such as blasting will require vibration monitoring plan prepared by a professional engineer to ensure the integrity of the sewer is maintained during the construction activities. In addition, a pre-construction survey of the outfall sewer should be undertaken prior to the start of construction activities.



# 7 Monitoring During Construction

Englobe requests to be retained once the plans and specifications are finalized to review the documents and ensure the recommendations in this report are adequately addressed.

The recommendations presented in this report are based on the assumption that an adequate level of construction monitoring by qualified geotechnical personnel during construction will be provided. Based on our understanding of the scope of the Project, an adequate level of construction monitoring is as follows:

- Review and approval of all footing subgrades by geotechnical personnel prior to placement of lean concrete mud slabs;
- Confirmation of bedrock quality during construction using 1.5 m probe holes within the footings. These holes will need to be reviewed by the Geotechnical Engineer to confirm that no significant mud seams or voids exist;
- Review and approval of subgrades below the floor slab, prior to placement of lean concrete mud slabs;
- Laboratory testing and pre-approval of fill soils that are proposed to be used on Site;
- Full time compaction testing of Engineered Fill and part time compaction testing of exterior foundation wall backfill;
- Periodic testing of concrete;



- Vibration and settlement monitoring of adjacent Structures;
- Visual review of waterproofing membranes.

An important purpose of providing an adequate level of monitoring is to check that recommendations, based on data obtained at the discrete borehole locations, are relevant to other areas of the Site.



## 8 Closure

A description of limitations which are inherent in carrying out Site investigation studies is given in Appendix A and forms an integral part of this report.

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



# Appendix A

## Limitations of Report



## **LIMITATIONS OF REPORT GEOTECHNICAL STUDIES**

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that Englobe Consulting Engineers Inc. be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the boreholes.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid. Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others and Englobe Corp. cannot warranty their accuracy. Similarly, Englobe cannot warranty the accuracy of information supplied by the Client.

# Appendix B

- Figure 1: Site Location Map
- Figure 2: Borehole Location Plan





OTTAWA RIVER

AVIATION & SPACE MUSEUM

SIR GEORGE ETIENNE PKWY

Site Location

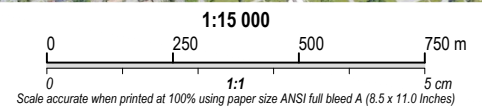
HEMLOCK ROAD

BLAIR RD

AVIATION PKWY

MONTREAL RD


Source:  
Google Earth 2022



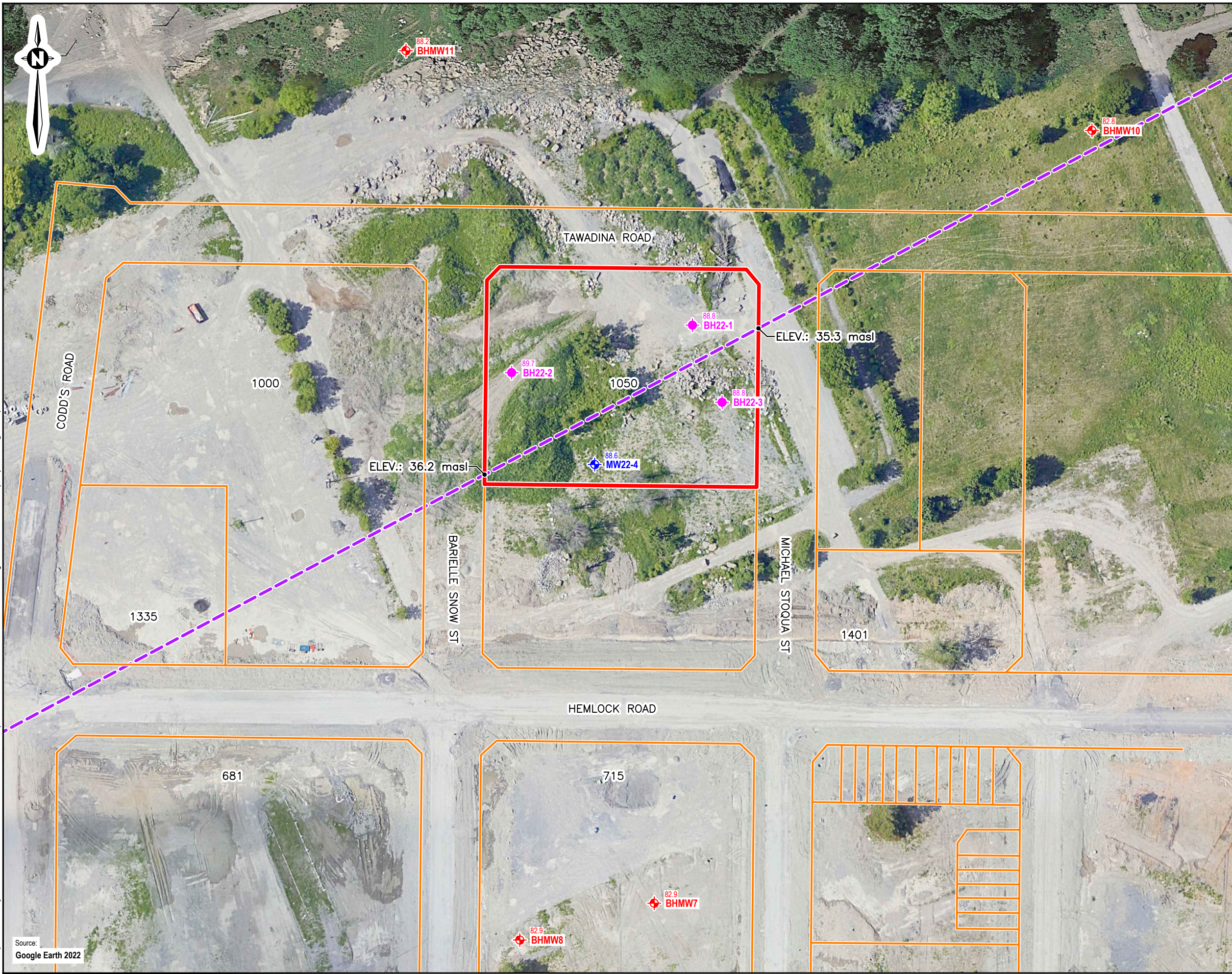
**Note**

1. This drawing shall be read in conjunction with the associated technical report.

A	2022/07/08	Preliminary	
Revision	Date	Issue	Approval

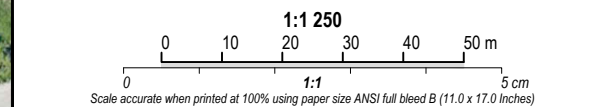
Client <b>WestUrban Developments Ltd.</b>		Site <b>1050 Tawadina Road, Ottawa, ON</b>	
	Report Title <b>Geotechnical Investigation</b>	Designed By <b>MA</b>	Date <b>July 2022</b>
	Drawing Title <b>Site Location Map</b>	Drawn By <b>JM</b>	Project No. <b>02203079.000</b>
		Approved By	Figure No. <b>1</b>
		Scale <b>As shown</b>	

Drawing: 1 Site Location.dwg Folder: D:\Joven OneDrive\OneDrive - Englobe Corp\Work\02203079 Tawadina Rd\Geotechnical Investigation\DWGs Friday, July 08, 2022 @ 13:33 by Joven Mendoza



**Note**  
 1. This drawing shall be read in conjunction with the associated technical report.

- Legend**
- Approximate Site Boundary
  - Parcel / Future Development
  - - - 2400 Ø mm Ottawa Interceptor Outfall Sewer Pipe
  - ◆ 88.8 Borehole Location and Ground Elevation
  - ◆ 88.6 Monitoring Well Location and Ground Elevation
  - ◆ 82.8 Monitoring Well Location (DST, 2006)



<b>A</b>	<b>2022/07/08</b>	<b>Preliminary</b>	
<b>Revision</b>	<b>Date</b>	<b>Issue</b>	<b>Approval</b>

Client: **WestUrban Developments Ltd.**

Site: **1050 Tawadina Road, Ottawa, ON**

Report Title: **Geotechnical Investigation**

Drawing Title: **Site Plan**

Designed By	<b>MA</b>	Scale	<b>As shown</b>
Drawn By	<b>JM</b>	Date	<b>July 2022</b>
Approved By		Project No.	<b>02203079.000</b>

Figure No. **2**

Drawing: 2 Site Plan.dwg  
 Folder: D:\Joven OneDrive\OneDrive - Englobe Corp\Work\02203079 Tawadina Rd\Geotechnical Investigation\DWGs  
 Friday, July 08, 2022 @ 13:33 by Joven Mendoza

Source:  
 Google Earth 2022

# Appendix C

- List of Symbols and Definitions
- Englobe Borehole Logs and Fence Diagram
- DST 2006 Monitoring Well Records
- Rock Core Photographs
- Sieve Gradation Analysis Results





## LIST OF SYMBOLS AND DEFINITIONS FOR GEOTECHNICAL SAMPLING AND COMMON LITHOLOGIES

The following is a reference sheet for commonly used symbols and definitions within this report and in any figures or appendices, including borehole logs and test results. Symbols and definitions conform to the standard proposed by the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) wherever possible. Discrepancies may exist when comparing to third-party results using the Unified Soil Classification System (USCS).

### PART A – SOILS

#### Standard Penetration Test (SPT) 'N'

The number of blows required to drive a 50-mm (2 in) split barrel sampler 300 mm (12 in). The standard hammer has a mass of 63.5 kg (140 lbs) and is dropped vertically from a height of 760 mm (30 in). Additional information can be found in ASTM D1586-11 and in §4.5.2 of the CFEM 4<sup>th</sup> Ed.

For penetration less than 300 mm, 'N' is recorded with the penetration that was achieved.

#### Non-Cohesive Soils

The relative density of non-cohesive soils relates empirically to SPT 'N' as follows:

Relative Density	'N'
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	> 50

#### Cohesive Soils

The consistency and undrained shear strength of cohesive soils relates empirically to SPT 'N' as follows:

Consistency	Undrained Shear Strength (kPa)	'N'
Very Soft	< 12	0 – 2
Soft	12 – 25	2 – 4
Firm	25 – 50	4 – 8
Stiff	50 – 100	8 – 15
Very Stiff	100 – 200	15 – 30
Hard	> 200	> 30

### PART B – ROCK

The following parameters are used to describe core recovery and to infer the quality of a rockmass.

#### Total Core Recovery, TCR (%)

The total length of solid drill core recovered, regardless of the quality or length of the pieces, taken as a percentage of the length of the core run.

#### Solid Core Recovery, SCR (%)

The total length of solid, full-diameter drill core recovered, taken as a percentage of the length of the core run.

#### Rock Quality Designation, RQD (%)

The sum of the lengths of solid drill core greater than 100 mm long, taken as a percentage of the length of the core run. RQD is commonly used to infer the quality of the rockmass, as follows:

Rockmass Quality	RQD (%)
Very Poor	< 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	> 90

#### Weathering

The terminology used to describe the degree of weathering for recovered rock core is defined as follows, as suggested by the *Geological Society of London*:

**Completely weathered:** All rock material is decomposed and/or disintegrated to soil. The original mass structure is largely intact.

**Highly weathered:** More than half the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a discontinuous framework or as core stone.

**Moderately weathered:** Less than half the rock material is decomposed and/or disintegrates to soil. Fresh or discolored rock is present either as a continuous framework or as core stone.

**Slightly weathered:** Discoloration indicates weathering of rock material and discontinuity of surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than its fresh condition.

**Fresh:** No visible signs of weathering.

### PART C – SAMPLING SYMBOLS

Symbol	Description
SS	Split spoon sample
TW	Thin-walled (Shelby Tube) sample
PH	Sampler advanced by hydraulic pressure
WH	Sampler advanced by static weight
SC	Soil core

### PART D – IN-SITU AND LAB TESTING

#### SOIL NAMING CONVENTIONS

Particle sizes are described as follows:

Particle Size Descriptor	Size (mm)	
Boulder	> 300	
Cobble	75 – 300	
Gravel	Coarse	19 – 75
	Fine	4.75 – 19
Sand	Coarse	2.0 – 4.75
	Medium	0.425 – 2.0
	Fine	0.075 – 0.425
Silt	0.002 – 0.075	
Clay	< 0.002	

The principle constituent of a soil is written in uppercase. The minor constituents of a soil are written according to the following convention:

Descriptive Term	Proportion of Soil (%)
Trace	1 – 10
Some	10 – 20
(ey) or (y)	20 – 35
And	35 – 50

**Ex.:** A soil comprising 65% Silt, 21% Sand and 14% Clay would be described as a: Sandy SILT, Some Clay

# LOG OF BOREHOLE BH22-1

DST REF. No.: 02203079.000

CLIENT: WestUrban Developments Ltd.

PROJECT: Two 6-Storey Apartment Buildings-1050 Tawadina Rd, Ottawa

LOCATION: 1050 Tawadian Rd, Ottawa

SURFACE ELEV.: 88.77 metres

\*Elevations are not geodetic, for reference within this report only.

Drilling Data

METHOD: Hollow Stem Auger

START DATE: 05/04/2022

COMPLETION DATE: 5/4/2022

COORDINATES: 5033601.535 m N, 450646.901 m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	Su (kPa)		SPT (N) <small>Blows/0.3m</small>	PP* DCPT ◆	CHVC 1 (ppm)	CHVC 2 (ppm)	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL	
			W <sub>p</sub>	W	W <sub>i</sub>					VANE ✕	PP*						
88						FILL: SILTY SAND, traces of clay and gravel, brown, moist, compact to loose  FILL: SANDY SILT, traces of clay and gravel, brown, moist, loose  FILL: CLAY SILT, some sand and traces of gravel, brown, damp  End of Borehole at ~2.36 m (~Elev. 86.41 m) on Auger refusal on inferred bedrock/boulders. - Dry borehole on completion of drilling.	SS1	11 70%									38 42 (21)  - Auger and SPT spoon refusal on inferred bedrock/boulders. Drilled a second hole 3.5 m to the north of the first hole. - Auger and SPT spoon refusal on inferred bedrock/boulders.
1.0							SS2	3 58%									
87							SS3	20 73%									
2.0							SS4	58 100%									
86																	
3.0																	
85																	
4.0																	
84																	
5.0																	
83																	
6.0																	
82																	
7.0																	
81																	
8.0																	
9.0																	
79																	

BOREHOLE (THUNDER BAY) GINT LOGS.GPJ DATA TEMPLATE.GDT 6/7/22



Englobe Corp  
 2713 LANCASTER ROAD  
 OTTAWA, ON, K1B 5R6  
 PH: 1-877-300-4800  
 FX: 1-888-979-6772  
 Web: www.englobecorp.com

### SAMPLE TYPE LEGEND

<table border="0"> <tr> <td></td> <td>Auger Sample</td> </tr> <tr> <td></td> <td>Split Spoon Sample</td> </tr> <tr> <td></td> <td>Bulk Sample</td> </tr> </table>		Auger Sample		Split Spoon Sample		Bulk Sample	<table border="0"> <tr> <td></td> <td>Rock Core</td> </tr> <tr> <td></td> <td>Core Sample</td> </tr> <tr> <td></td> <td>Shelby Tube</td> </tr> </table>		Rock Core		Core Sample		Shelby Tube
	Auger Sample												
	Split Spoon Sample												
	Bulk Sample												
	Rock Core												
	Core Sample												
	Shelby Tube												

### WELL LEGEND

	Bentonite
	Sand
	Screen

✕<sup>3</sup> Numbers refers to Sensitivity  
 PP: Pocket Penetrometer  
 CHVC: Combustible Headspace Vapor Concentration  
 NFP: No Further Penetration

# LOG OF BOREHOLE BH22-2

DST REF. No.: 02203079.000  
 CLIENT: WestUrban Developments Ltd.  
 PROJECT: Two 6-Storey Apartment Buildings-1050 Tawadina Rd, Ottawa  
 LOCATION: 1050 Tawadian Rd, Ottawa  
 SURFACE ELEV.: 89.66 metres

Drilling Data  
 METHOD: Hollow Stem Auger  
 START DATE: 05/04/2022  
 COMPLETION DATE: 5/4/2022  
 COORDINATES: 5033585.527 m N, 450586.063 m E

*\*Elevations are not geodetic, for reference within this report only.*

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	TV VALUE / RECOVERY %	Su (kPa)				CHVC 1 (ppm)	CHVC 2 (ppm)	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
			W <sub>p</sub>	W	W <sub>i</sub>						VANE	PP*	SPT (N)	DCPT			
			20	40	60	80				40	80	120	160				
89							FILL: CLAYEY SILT, some sand, traces gravel, presence of organic (roots), brown, moist, loose.	SS1	7								
1.0							FILL: SILTY SAND, traces of gravel, brown, damp, compact	SS2	15								
88								SS3	35								
2.0							LIMESTONE moderately weathered, Fair quality	RC4	100%							8 56 (36) RQD = 73%	
87								RC5	100%							RQD = 61%	
86								RC6	93%							Vertical fracture in the rock core. RQD = 66%	
85																	
5.0							End of Borehole at ~5.02 m (~Elev. 84.64 m) in bedrock. - Dry borehole on completion of drilling.										
84																	
83																	
82																	
81																	
80																	

BOREHOLE (THUNDER BAY) GINT LOGS.GPJ DATA TEMPLATE.GDT 6/7/22



Englobe Corp  
 2713 LANCASTER ROAD  
 OTTAWA, ON, K1B 5R6  
 PH: 1-877-300-4800  
 FX: 1-888-979-6772  
 Web: www.englobecorp.com

### SAMPLE TYPE LEGEND

	Auger Sample		Rock Core
	Split Spoon Sample		Core Sample
	Bulk Sample		Shelby Tube

### WELL LEGEND

	Bentonite
	Sand
	Screen

<sup>3</sup> Numbers refers to Sensitivity  
 PP: Pocket Penetrometer  
 CHVC: Combustible Headspace Vapor Concentration  
 NFP: No Further Penetration

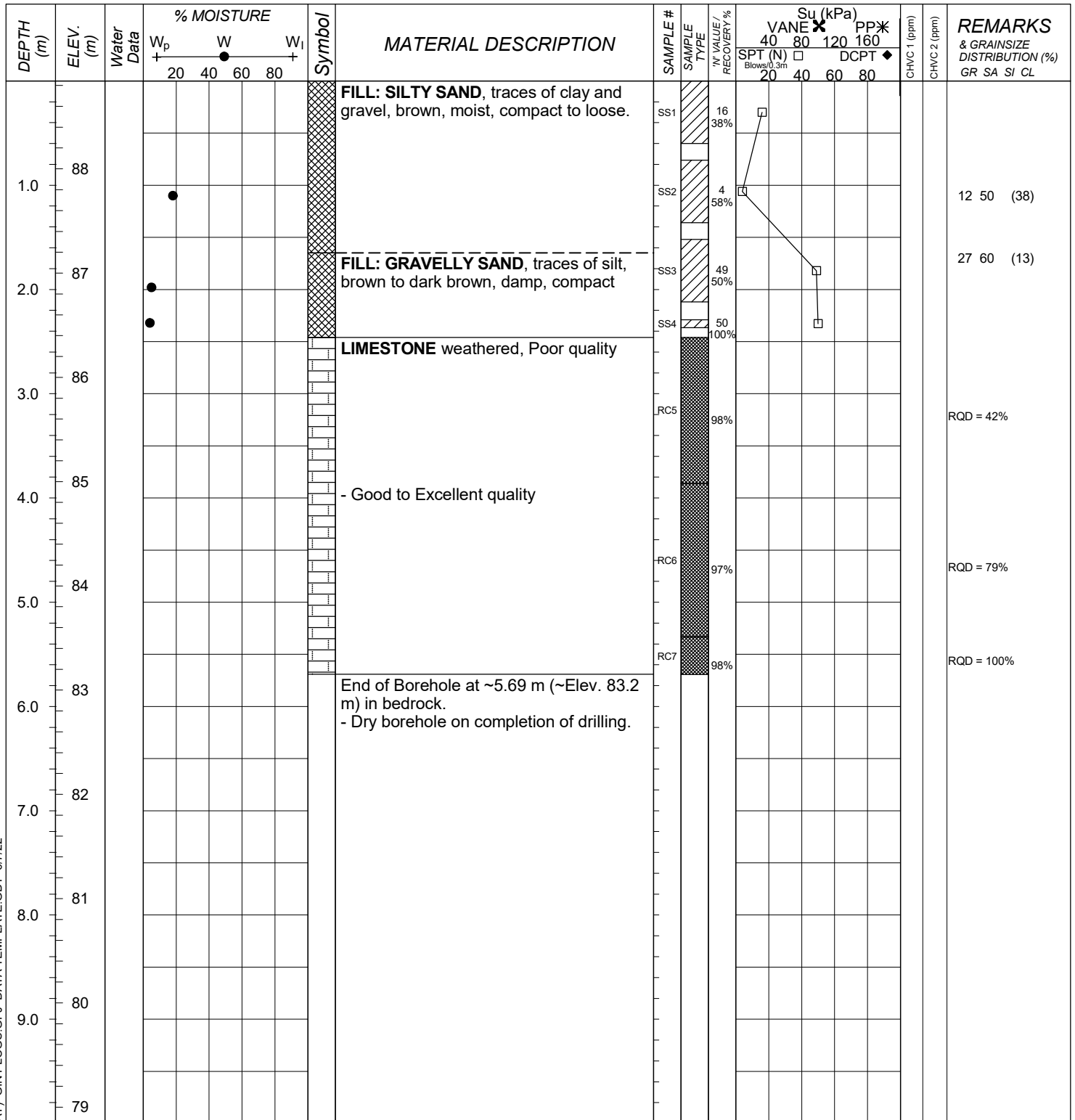
**ENCLOSURE 2**

# LOG OF BOREHOLE BH22-3

DST REF. No.: 02203079.000  
 CLIENT: WestUrban Developments Ltd.  
 PROJECT: Two 6-Storey Apartment Buildings-1050 Tawadina Rd, Ottawa  
 LOCATION: 1050 Tawadian Rd, Ottawa  
 SURFACE ELEV.: 88.84 metres

Drilling Data  
 METHOD: Hollow Stem Auger  
 START DATE: 05/04/2022  
 COMPLETION DATE: 5/4/2022  
 COORDINATES: 5033576.327 m N, 450656.556 m E

\*Elevations are not geodetic, for reference within this report only.



BOREHOLE (THUNDER BAY) GINT LOGS.GPJ DATA TEMPLATE.GDT 6/7/22



Englobe Corp  
 2713 LANCASTER ROAD  
 OTTAWA, ON, K1B 5R6  
 PH: 1-877-300-4800  
 FX: 1-888-979-6772  
 Web: www.englobecorp.com

### SAMPLE TYPE LEGEND

- |                    |             |
|--------------------|-------------|
| Auger Sample       | Rock Core   |
| Split Spoon Sample | Core Sample |
| Bulk Sample        | Shelby Tube |

### WELL LEGEND

- |           |
|-----------|
| Bentonite |
| Sand      |
| Screen    |

<sup>3</sup> Numbers refers to Sensitivity  
 PP: Pocket Penetrometer  
 CHVC: Combustible Headspace Vapor Concentration  
 NFP: No Further Penetration

# LOG OF BOREHOLE MW22-4

DST REF. No.: 02203079.000  
 CLIENT: WestUrban Developments Ltd.  
 PROJECT: Two 6-Storey Apartment Buildings-1050 Tawadina Rd, Ottawa  
 LOCATION: 1050 Tawadian Rd, Ottawa  
 SURFACE ELEV.: 88.61 metres

Drilling Data  
 METHOD: Hollow Stem Auger  
 START DATE: 05/04/2022  
 COMPLETION DATE: 5/4/2022  
 COORDINATES: 5033555.743 m N, 450613.958 m E

*\*Elevations are not geodetic, for reference within this report only.*

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	Su (kPa)		SPT (N) Blows/0.3m	PP*	CHVC 1 (ppm)	CHVC 2 (ppm)	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
			W <sub>p</sub>	W	W <sub>i</sub>					VANE	DCPT					
			20	40	60	80			40	80	120	160				
88							<b>FILL: SAND</b> , some silt and gravel, traces of clay, presence of concrete debris, brown, damp, compact.	SS1	14	63%						
1.0							<b>FILL: SAND and GRAVEL</b> , presence of concrete debris, light grey, dry, compact.	SS2	27	42%						
87							<b>FILL: GRAVELLY SAND</b> , some silt, brown, damp, loose.	SS3	8	25%						
2.0							End of Borehole at ~2.13 m (~Elev. 86.48 m) on Auger refusal on inferred bedrock/boulders. - Dry borehole on completion of drilling. - <b>Dry well</b> on June 3, 2022.									- Auger and SPT spoon refusal on inferred bedrock/boulders.
86																
3.0																
85																
4.0																
84																
5.0																
83																
6.0																
82																
7.0																
81																
8.0																
80																
9.0																
79																

BOREHOLE (THUNDER BAY) GINT LOGS.GPJ DATA TEMPLATE.GDT 6/7/22



Englobe Corp  
 2713 LANCASTER ROAD  
 OTTAWA, ON, K1B 5R6  
 PH: 1-877-300-4800  
 FX: 1-888-979-6772  
 Web: www.englobecorp.com

### SAMPLE TYPE LEGEND

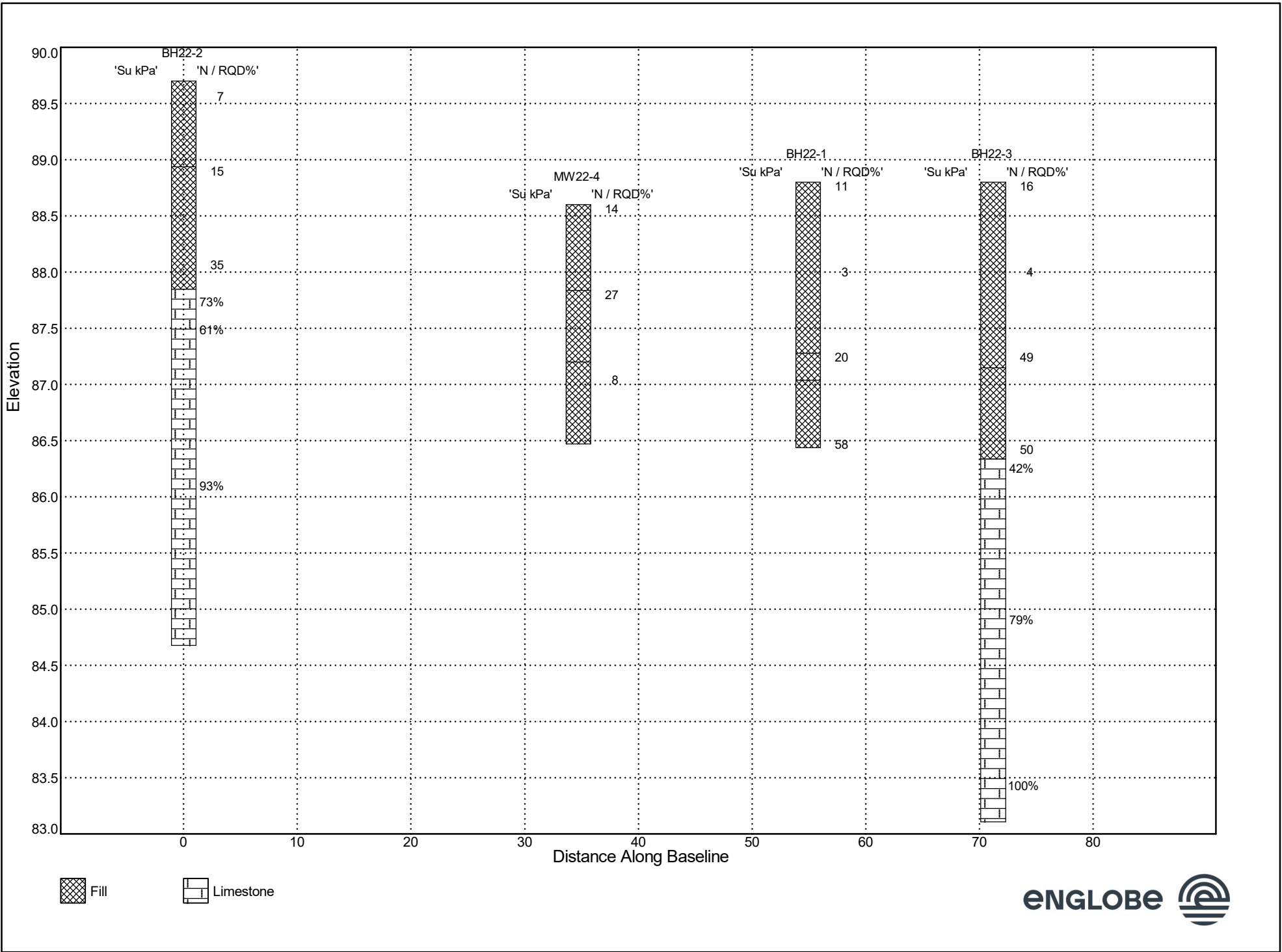
	Auger Sample		Rock Core
	Split Spoon Sample		Core Sample
	Bulk Sample		Shelby Tube

### WELL LEGEND

	Bentonite
	Sand
	Screen

<sup>3</sup> Numbers refers to Sensitivity  
 PP: Pocket Penetrometer  
 CHVC: Combustible Headspace Vapor Concentration  
 NFP: No Further Penetration

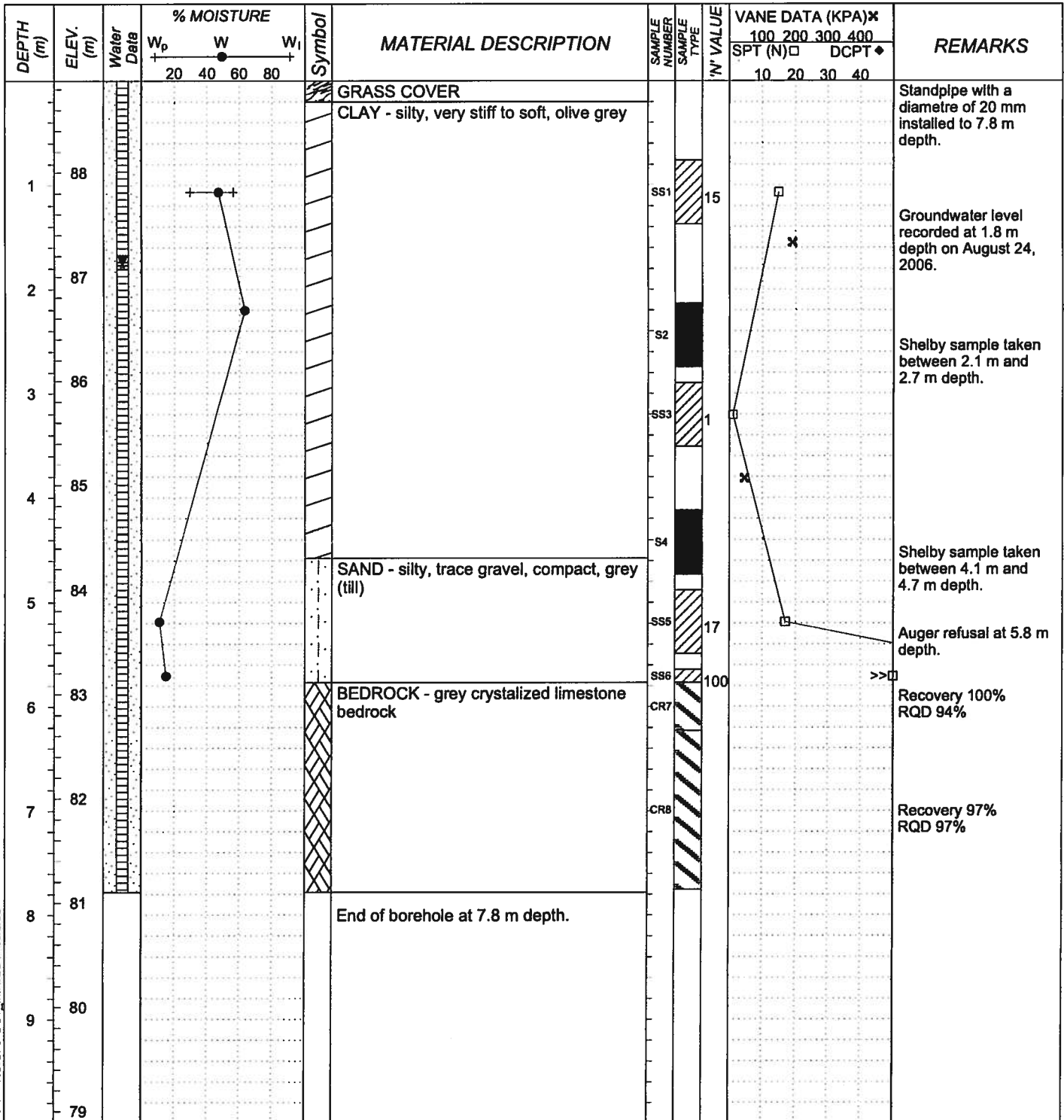
**ENCLOSURE 4**



# LOG OF BOREHOLE BH7

DST REF. No.: OG06562  
 CLIENT: Canada Lands Company  
 PROJECT: Preliminary Geotechnical Investigation  
 LOCATION: CFB Rockcliffe, Ottawa, Ontario  
 SURFACE ELEV.: 88.88 m (Geodetic)

Drilling Data  
 METHOD: CME 75 Drill Rig  
 DIAMETER: 200 mm  
 DATE: August 14 2006



BOREHOLE (STANDARD) OG06562 GPJ\_DST\_MIN.GDT 10/3/06



DST Consulting Engineers Inc.  
 2150 Thurston Drive, Suite 203  
 Ottawa, Ontario, K1G 5T9  
 PH: (613)748-1415  
 FX: (613)748-1356  
 Email: ottawa@dstgroup.com  
 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

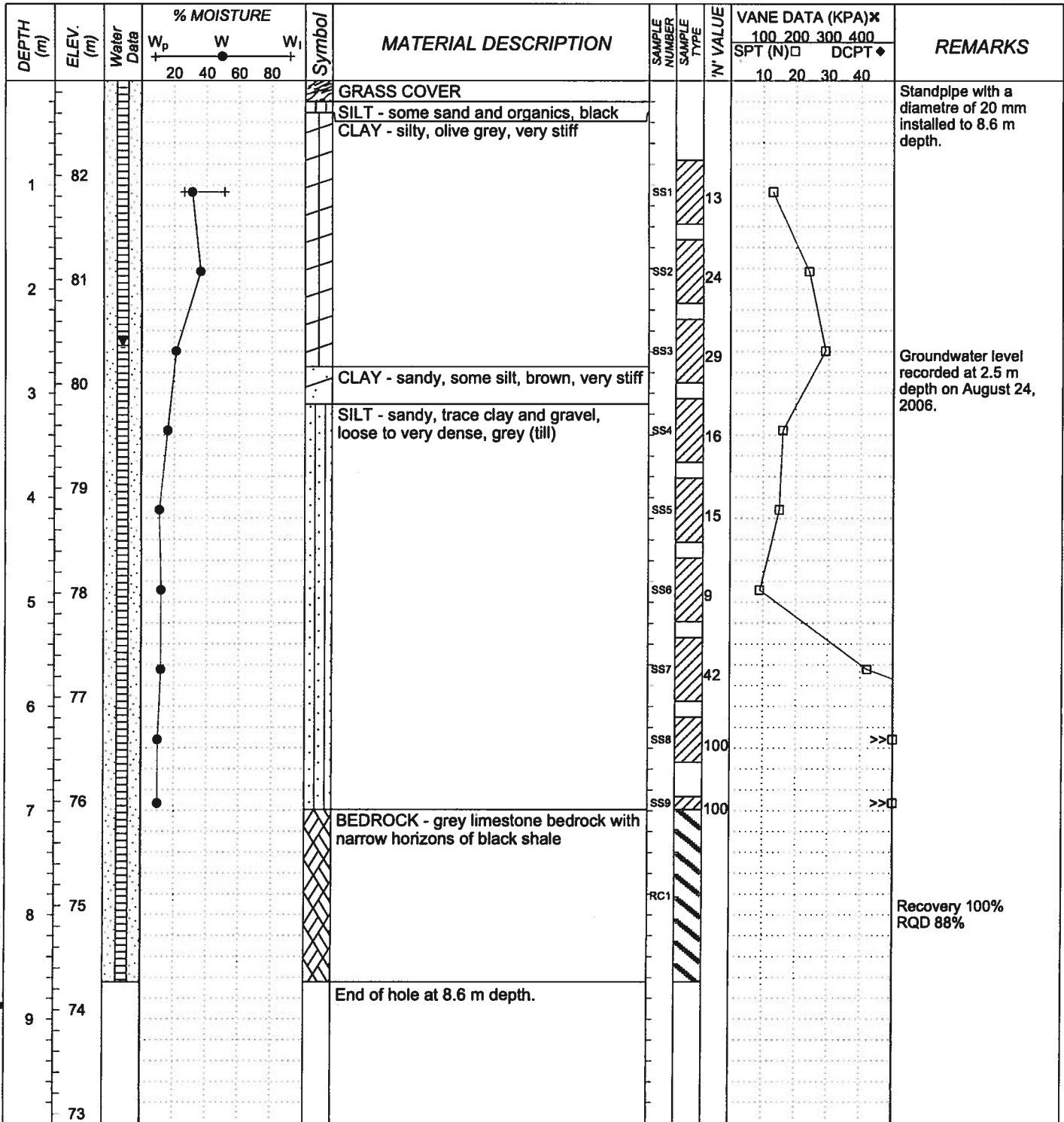
- Auger Sample
- Rock Core
- Ponar Sample
- Split Spoon Sample
- Side Sampler
- Grab Sample
- Thin Wall Tube

**APPENDIX D**

# LOG OF BOREHOLE BH8

DST REF. No.: **OG06562**  
 CLIENT: **Canada Lands Company**  
 PROJECT: **Preliminary Geotechnical Investigation**  
 LOCATION: **CFB Rockcliffe, Ottawa, Ontario**  
 SURFACE ELEV.: **82.91 m (Geodetic)**

Drilling Data  
**METHOD: CME 75 Drill Rig**  
**DIAMETER: 200 mm**  
**DATE: August 11 2006**



BOREHOLE (STANDARD) OG06562.GPJ DST\_MIN.GDT 10/3/06



DST Consulting Engineers Inc.  
 2150 Thurston Drive, Suite 203  
 Ottawa, Ontario, K1G 5T9  
 PH: (613)748-1415  
 FX: (613)748-1356  
 Email: [ottawa@dstgroup.com](mailto:ottawa@dstgroup.com)  
 Web: [www.dstgroup.com](http://www.dstgroup.com)

### SAMPLE TYPE LEGEND

- |                    |              |              |
|--------------------|--------------|--------------|
| Auger Sample       | Rock Core    | Ponar Sample |
| Split Spoon Sample | Side Sampler | Grab Sample  |
| Thin Wall Tube     |              |              |

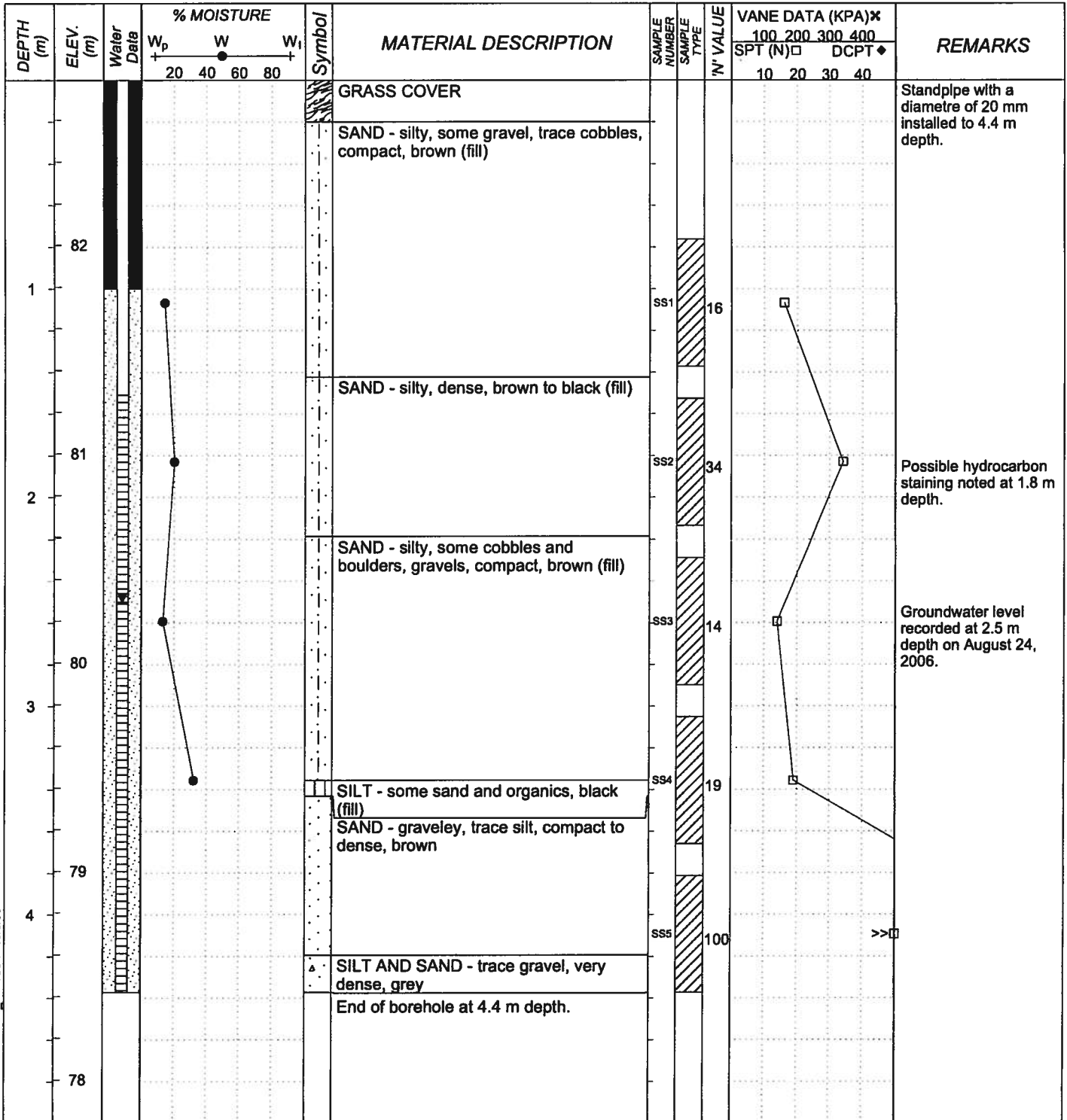
**APPENDIX D**



# LOG OF BOREHOLE / MONITORING WELL BHMW10 OB

DST REF. No.: OG06562  
 CLIENT: Canada Lands Company  
 PROJECT: Preliminary Geotechnical Investigation  
 LOCATION: CFB Rockcliffe, Ottawa, Ontario  
 SURFACE ELEV.: 82.79 m (Geodetic)

Drilling Data  
 METHOD: CME 75 Drill Rig  
 DIAMETER: 200 mm  
 DATE: August 10 2006



BOREHOLE (STANDARD) OG06562.GPJ DST\_MIN.GDT 10/3/06



DST Consulting Engineers Inc.  
 2150 Thurston Drive, Suite 203  
 Ottawa, Ontario, K1G 5T9  
 PH: (613)748-1415  
 FX: (613)748-1356  
 Email: ottawa@dstgroup.com  
 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

- |                    |              |              |
|--------------------|--------------|--------------|
| Auger Sample       | Rock Core    | Ponar Sample |
| Split Spoon Sample | Side Sampler | Grab Sample  |
| Thin Wall Tube     |              |              |

**APPENDIX D**

# LOG OF BOREHOLE / MONITORING WELL BHMW10 BR

DST REF. No.: OG06562  
 CLIENT: Canada Lands Company  
 PROJECT: Preliminary Geotechnical Investigation  
 LOCATION: CFB Rockcliffe, Ottawa, Ontario  
 SURFACE ELEV.: 82.79 m (Geodetic)

Drilling Data  
 METHOD: CME 75 Drill Rig  
 DIAMETER: 200 mm  
 DATE: August 10 2006

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	N' VALUE	VANE DATA (KPA)*				REMARKS
			W <sub>p</sub>	W	W <sub>i</sub>						100 200 300 400		SPT (N) □	DCPT ◆	
			20	40	60	80					10	20	30	40	
1	82														Auger advanced to 5.2 m depth.
2	81														Standpipe with a diameter of 20 mm installed to 16.0 m depth. Groundwater level recorded at 5.1 m depth on August 24, 2006.
3	80														Recovery 100% RQD 0%
4	79														Recovery 50% RQD 0%
5	78						CR1 CR2 CR3	CR1 CR2 CR3							Recovery 100% RQD 71%
6	77														Recovery 83% RQD 65%
7	76														Recovery 92% RQD 67%
8	75														Recovery 100% RQD 50%
9	74														Recovery 100% RQD 94%
10	73														Recovery 100% RQD 90%
11	72														Recovery 97% RQD 93%
12	71														Recovery 97% RQD 73%
13	70														Recovery 100% RQD 94%
14	69														End of borehole at 16.0 m depth.
15	68														
16	67														
17	66														Fault gouge noted at 13.7 m depth.
18	65														
19	64														Cut core axis at 90 degrees between 15.9 m to 16.0 m depth.
	63														

BOREHOLE (STANDARD) OG06562.GPJ DST\_MIN.GDT 10/3/06



DST Consulting Engineers Inc.  
 2150 Thurston Drive, Suite 203  
 Ottawa, Ontario, K1G 5T9  
 PH: (613)748-1415  
 FX: (613)748-1356  
 Email: ottawa@dstgroup.com  
 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

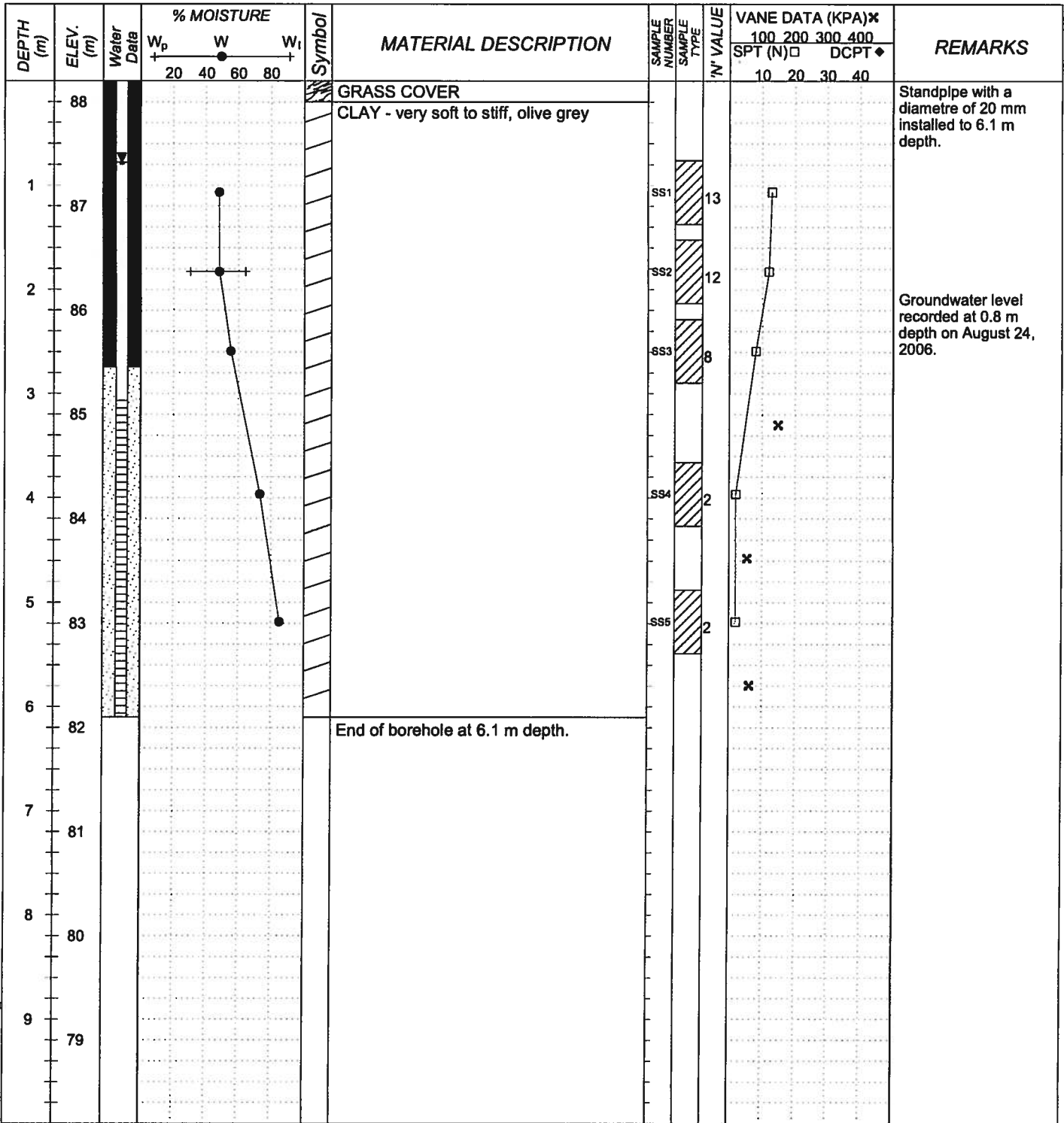
- |                    |              |              |
|--------------------|--------------|--------------|
| Auger Sample       | Rock Core    | Ponar Sample |
| Split Spoon Sample | Side Sampler | Grab Sample  |
| Thin Wall Tube     |              |              |

**APPENDIX D**

# LOG OF BOREHOLE / MONITORING WELL BHMW11

DST REF. No.: OG06562  
 CLIENT: Canada Lands Company  
 PROJECT: Preliminary Geotechnical Investigation  
 LOCATION: CFB Rockcliffe, Ottawa, Ontario  
 SURFACE ELEV.: 88.20 m (Geodetic)

Drilling Data  
 METHOD: CME 75 Drill Rig  
 DIAMETER: 200 mm  
 DATE: August 14 2006



BOREHOLE (STANDARD) OG06562.GPJ DST\_MIN.GDT 10/3/06



DST Consulting Engineers Inc.  
 2150 Thurston Drive, Suite 203  
 Ottawa, Ontario, K1G 5T9  
 PH: (613)748-1415  
 FX: (613)748-1356  
 Email: ottawa@dstgroup.com  
 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

- |                    |              |              |
|--------------------|--------------|--------------|
| Auger Sample       | Rock Core    | Ponar Sample |
| Split Spoon Sample | Side Sampler | Grab Sample  |
| Thin Wall Tube     |              |              |

**APPENDIX D**



**Rock Core Photographs**  
**1050 Tawadina Road, Ottawa, ON**

**Project No.: 02203079.000**

**RC 4 – 87.8 to 87.7 masl**  
**(RQD = 73%)**

**RC 5 – 87.7 to 86.1 masl**  
**(RQD = 61%)**

**RC 6 – 86.1 to 84.6 masl**  
**(RQD = 66%)**



**Rock Core No.: RC4 to RC6**

**Borehole: BH22-02**

**Date: May 2022**

**RC 5 – 86.4 to 85.0 masl**  
**(RQD = 42%)**

**RC 6 – 85.0 to 83.5 masl**  
**(RQD = 79%)**

**RC 7 – 83.5 to 83.2 masl**  
**(RQD = 100%)**



**Rock Core No.: RC5 to RC7**

**Borehole: BH22-03**

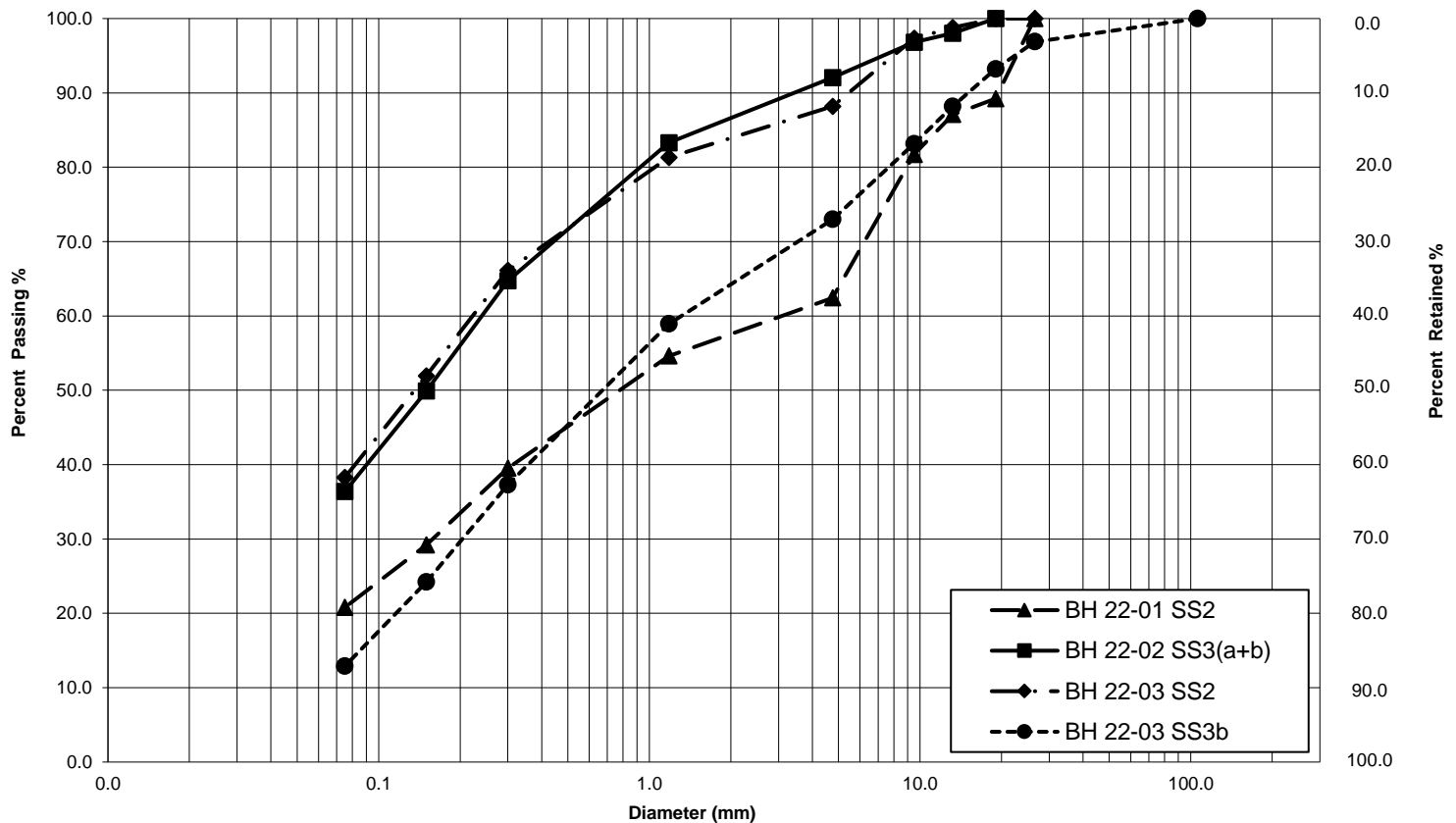
**Date: May 2022**



Englobe Corp.  
 2713 Lancaster Road, Unit 101  
 Ottawa, ON  
 K1B 5R6  
 T: 1.877.300.4800  
 Fax: 613 748 1356  
[www.englobecorp.com](http://www.englobecorp.com)  
[ottawalab@englobecorp.com](mailto:ottawalab@englobecorp.com)

### GRAIN SIZE ANALYSIS

<b>Englobe Ref. No.:</b> 2203079.000	<b>Date Sampled:</b> 5-May-22
<b>Project:</b> Preliminary Geotechnical Investigation	<b>Sampled By:</b> AA
<b>Client:</b> Westurban Devolpment Ltd.	<b>Material Source:</b> Geotechnical Investigation
<b>Project Location:</b> 1050 Tawadina Rd, Ottawa,ON	<b>Sampling Location:</b> 1050 Tawadina Rd, Ottawa,ON
<b>Sample #:</b> See table below	<b>Material Description:</b> Sand/Sand and Gravel



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

SUMMARY				
Sample #	Depth (m)	Gravel (%)	Sand (%)	Clay and Silt (%)
BH 22-01 SS2	1.1	38	42	21
BH 22-02 SS3(a+b)	1.7	8	56	36
BH 22-03 SS2	1.1	12	50	38
BH 22-03 SS3b	1.7	27	60	13

# Appendix D

## - Chemical Testing Results



**ENGLOBE**

## Certificate of Analysis

**Englobe Corp. (Ottawa)**

2713 Lancaster Road, Unit 101  
Ottawa, ON K1B 5R6  
Attn: Alexandre Aramouni

Client PO:  
Project: 02203079  
Custody: 137091

Report Date: 16-May-2022  
Order Date: 10-May-2022

**Order #: 2220226**

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2220226-01	02203079 BH22-02 SS2
2220226-02	02203079 BH22-03 SS4

Approved By:



Dale Robertson, BSc  
Laboratory Director

Certificate of Analysis

Report Date: 16-May-2022

Client: Englobe Corp. (Ottawa)

Order Date: 10-May-2022

Client PO:

Project Description: 02203079

### Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	12-May-22	12-May-22
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	11-May-22	11-May-22
Resistivity	EPA 120.1 - probe, water extraction	16-May-22	16-May-22
Solids, %	Gravimetric, calculation	11-May-22	11-May-22



Certificate of Analysis

Report Date: 16-May-2022

Client: Englobe Corp. (Ottawa)

Order Date: 10-May-2022

Client PO:

Project Description: 02203079

<b>Client ID:</b>	02203079 BH22-02 SS2	02203079 BH22-03 SS4	-	-
<b>Sample Date:</b>	04-May-22 13:00	04-May-22 14:00	-	-
<b>Sample ID:</b>	2220226-01	2220226-02	-	-
<b>MDL/Units</b>	Soil	Soil	-	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	86.8	92.4	-	-
----------	--------------	------	------	---	---

**General Inorganics**

pH	0.05 pH Units	6.97	7.33	-	-
Resistivity	0.10 Ohm.m	22.0	46.0	-	-

**Anions**

Chloride	5 ug/g dry	7	11	-	-
Sulphate	5 ug/g dry	291	48	-	-

Certificate of Analysis

Report Date: 16-May-2022

Client: Englobe Corp. (Ottawa)

Order Date: 10-May-2022

Client PO:

Project Description: 02203079

**Method Quality Control: Blank**

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
<b>General Inorganics</b>									
Resistivity	ND	0.10	Ohm.m						

Certificate of Analysis

Report Date: 16-May-2022

Client: Englobe Corp. (Ottawa)

Order Date: 10-May-2022

Client PO:

Project Description: 02203079

**Method Quality Control: Duplicate**

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	ND	5	ug/g	ND			NC	20	
Sulphate	ND	5	ug/g	ND			NC	20	
<b>General Inorganics</b>									
pH	6.90	0.05	pH Units	6.97			1.0	2.3	
Resistivity	13.8	0.10	Ohm.m	13.6			2.0	20	
<b>Physical Characteristics</b>									
% Solids	71.3	0.1	% by Wt.	69.5			2.5	25	

Certificate of Analysis

Report Date: 16-May-2022

Client: Englobe Corp. (Ottawa)

Order Date: 10-May-2022

Client PO:

Project Description: 02203079

**Method Quality Control: Spike**

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	110	5	ug/g	ND	110	82-118			
Sulphate	105	5	ug/g	ND	105	80-120			

Certificate of Analysis

Report Date: 16-May-2022

Client: Englobe Corp. (Ottawa)

Order Date: 10-May-2022

Client PO:

Project Description: 02203079

**Qualifier Notes:**

*Login Qualifiers :*

Sample - One or more parameter received past hold time - Redox.

*Applies to samples: 02203079 BH22-02 SS2*

**Sample Data Revisions**

None

**Work Order Revisions / Comments:**

None

**Other Report Notes:**

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.



vd.  
JB  
com

Parcel Order Number (Lab Use Only) <i>2220226</i>	Chain Of Custody (Lab Use Only) No 137091
---	---

Client Name: <i>Englobe Corp.</i>	Project Ref: <i>02203079</i>	Page <u>1</u> of <u>1</u>
Contact Name: <i>Alexandre Aramoni</i>	Quote #:	Turnaround Time <input type="checkbox"/> 1 day <input type="checkbox"/> 3 day <input type="checkbox"/> 2 day <input checked="" type="checkbox"/> Regular
Address: <i>2713 Lancaster Rd, Unit 101 Hoffawa, NJ</i>	PO #:	
Telephone: <i>613-697-7450</i>	E-mail: <i>alexandre.aramoni@englobecorp.com</i>	
Date Required: _____		

<input type="checkbox"/> REG 153/04 <input type="checkbox"/> REG 406/19	Other Regulation	Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)	Required Analysis																
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/Fine	<input type="checkbox"/> REG 558 <input type="checkbox"/> PWQO	Matrix	Air Volume	# of Containers	Sample Taken		PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	PH	CrVI	B (HWS)	Redox Potential	Sulphide	Chloride	Sulphate	Resistivity	
<input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse	<input type="checkbox"/> CCME <input type="checkbox"/> MISA				Date	Time													
<input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other	<input type="checkbox"/> SU - Sani <input type="checkbox"/> SU - Storm																		
<input type="checkbox"/> Table _____	Mun: _____																		
For RSC: <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Other: _____																		
Sample ID/Location Name																			
1	<i>02203079 BH 22-02 SS2</i>	<i>S</i>		<i>1</i>	<i>2022-05-04</i>	<i>13:00</i>					<i>X</i>			<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>
2	<i>02203079 BH 22-03 SS4</i>	<i>S</i>		<i>1</i>	<i>2022-05-04</i>	<i>14:00</i>					<i>X</i>			<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

Comments:		Method of Delivery:	
Relinquished By (Sign): <i>Alexandre Aramoni</i>	Received By Driver/Depot:	Received at Lab: <i>[Signature]</i>	Verified By: <i>[Signature]</i>
Relinquished By (Print): <i>[Signature]</i>	Date/Time:	Date/Time: <i>May 10/22 8:23a</i>	Date/Time: <i>May 10, 22 16:24</i>
Date/Time: <i>2022-05-10 18:25</i>	Temperature: °C	Temperature: <i>18.8</i> °C	pH Verified: <input type="checkbox"/> By:

## Subcontracted Analysis

**Englobe Corp. (Ottawa)**

2713 Lancaster Road, Unit 101  
Ottawa, ON K1B 5R6

Attn: Alexandre Aramouni

Paracel Report No. **2220226**

Client Project(s): **02203079**

Client PO:

Reference: **Standing Offer**

CoC Number: **137091**

Order Date: 10-May-22

Report Date: 24-May-22

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
2220226-01	02203079 BH22-02 SS2	Redox potential, soil Sulphide, solid
2220226-03	02203079 BH22-03 SS4+SS3a	Redox potential, soil Sulphide, solid



**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.  
Lakefield - Ontario - K0L 2H0  
Phone: 705-652-2000 FAX: 705-652-6365

20-May-2022

**Paracel Laboratories**

Attn : Dale Robertson

300-2319 St.Laurent Blvd.  
Ottawa, ON  
K1G 4K6, Canada

Phone: 613-731-9577  
Fax:613-731-9064

**Date Rec. :** 17 May 2022  
**LR Report:** CA15259-MAY22  
**Reference:** Project#: 2220226

**Copy:** #1

# CERTIFICATE OF ANALYSIS

## Final Report

Sample ID	Sample Date & Time	Sulphide (Na2CO3) %
1: Analysis Start Date		20-May-22
2: Analysis Start Time		07:57
3: Analysis Completed Date		20-May-22
4: Analysis Completed Time		09:49
5: QC - Blank		< 0.04
6: QC - STD % Recovery		107%
7: QC - DUP % RPD		7%
8: RL		0.02
9: 02203079 BH22-02 SS2	04-May-22	< 0.04
10: 02203079 BH22-03 SS4+SS3a	13-May-22	< 0.04

RL - SGS Reporting Limit

Kimberley Didsbury  
Project Specialist,  
Environment, Health & Safety





## CERTIFICATE OF ANALYSIS

Client: Dale Robertson  
Company: Paracel Laboratories Ltd. - Ottawa  
Address: 300-2319 St. Laurent Blvd.  
Ottawa, ON, K1G 4J8  
Phone/Fax: (613) 731-9577 / (613) 731-9064  
Email: drobertson@paracellabs.com

Work Order Number: 462882  
PO #:   
Regulation: None  
Project #: 2220226  
DWS #:   
Sampled By:

Date Order Received: 5/17/2022  
Arrival Temperature: 15 °C

Analysis Started: 5/24/2022  
Analysis Completed: 5/24/2022

### WORK ORDER SUMMARY

ANALYSES WERE PERFORMED ON THE FOLLOWING SAMPLES. THE RESULTS RELATE ONLY TO THE ITEMS TESTED.

Sample Description	Lab ID	Matrix	Type	Comments	Date Collected	Time Collected
02203079 BH22-02 SS2	1754141	Soil	None		5/4/2022	1:00 PM
02203079 BH22-03 SS4+SS3a	1754142	Soil	None		5/13/2022	

### METHODS AND INSTRUMENTATION

THE FOLLOWING METHODS WERE USED FOR YOUR SAMPLE(S):

Method	Lab	Description	Reference
RedOx - Soil (T06)	Mississauga	Determination of RedOx Potential of Soil	Modified from APHA-2580B

### REPORT COMMENTS

Non Testmark containers received 05/17/2022 - K.G  
Proceed regardless of hold time as requested by client -K.G  
Lot# 2220226-01D & 2220226-03A- K.G



**TESTMARK Laboratories Ltd.**

*Committed to Quality and Service*

## CERTIFICATE OF ANALYSIS

Paracel Laboratories Ltd. - Ottawa

Work Order Number: 462882

This report has been approved by:

Marc Creighton  
Laboratory Director



## CERTIFICATE OF ANALYSIS

Parcel Laboratories Ltd. - Ottawa

Work Order Number: 462882

### WORK ORDER RESULTS

Sample Description	02203079 BH22 - 02 SS2		02203079 BH22 - 03 SS4+SS3a		
Sample Date	5/4/2022 1:00 PM		5/13/2022 12:00 AM		
Lab ID	1754141		1754142		
General Chemistry	Result	MDL	Result	MDL	Units
RedOx (vs. S.H.E.)	375	N/A	370	N/A	mV

### LEGEND

Dates: Dates are formatted as mm/dd/year throughout this report.

MDL: Method detection limit or minimum reporting limit.

Quality Control: All associated Quality Control data is available on request.

Field Data: Reports containing Field Parameters represent data that has been collected and provided by the client. Testmark is not responsible for the validity of this data which may be used in subsequent calculations.

Sample Condition Deviations: A noted sample condition deviation may affect the validity of the result. Results apply to the sample(s) as received.

Reproduction of Report: Report shall not be reproduced, except in full, without the approval of Testmark Laboratories Ltd.

ICPMS Dustfall Insoluble: The ICPMS Dustfall Insoluble Portion method analyzes only the particulate matter from the Dustfall Sampler which is retained on the analysis filter during the Dustfall method.

# Appendix E

## - 2010 National Building Code Seismic Hazard Calculations



**eNGLOBE**

# 2010 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836  
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.454N 75.631W

User File Reference: 1050 Tawadina Rd, Ottawa

2022-06-02 15:52 UT

Requested by: Englobe Corp

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.2)	0.634	0.386	0.249	0.090
Sa (0.5)	0.309	0.187	0.123	0.043
Sa (1.0)	0.138	0.088	0.056	0.017
Sa (2.0)	0.046	0.028	0.018	0.006
PGA (g)	0.322	0.201	0.123	0.039

**Notes:** Spectral ( $S_a(T)$ , where  $T$  is the period in seconds) and peak ground acceleration (PGA) values are given in units of  $g$  ( $9.81 \text{ m/s}^2$ ). Peak ground velocity is given in  $\text{m/s}$ . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity  $450 \text{ m/s}$ ). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

---

## References

**National Building Code of Canada 2015 NRCC no. 56190;** Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

**Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)**  
**Commentary J:** Design for Seismic Effects

**Geological Survey of Canada Open File 7893** Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites [www.EarthquakesCanada.ca](http://www.EarthquakesCanada.ca) and [www.nationalcodes.ca](http://www.nationalcodes.ca) for more information



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Appendix F

## - Schematic Design Presentation Received from Client



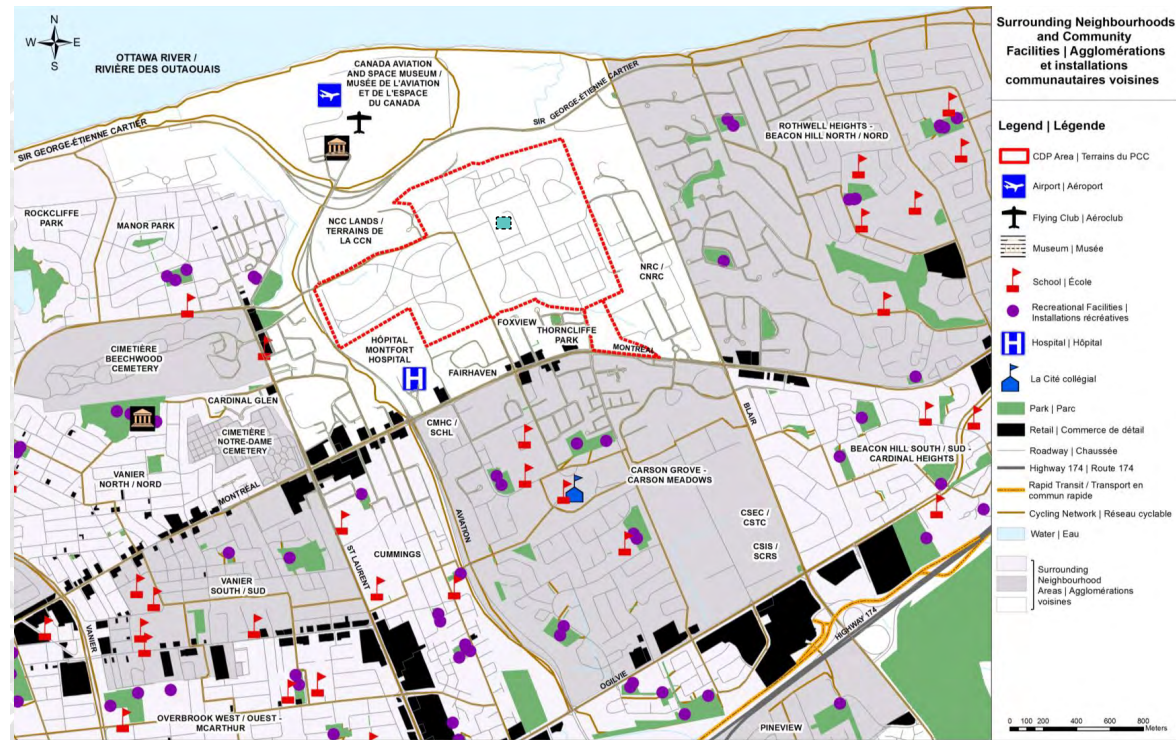
**ENGLOBE**

# WESTURBAN WATERIDGE

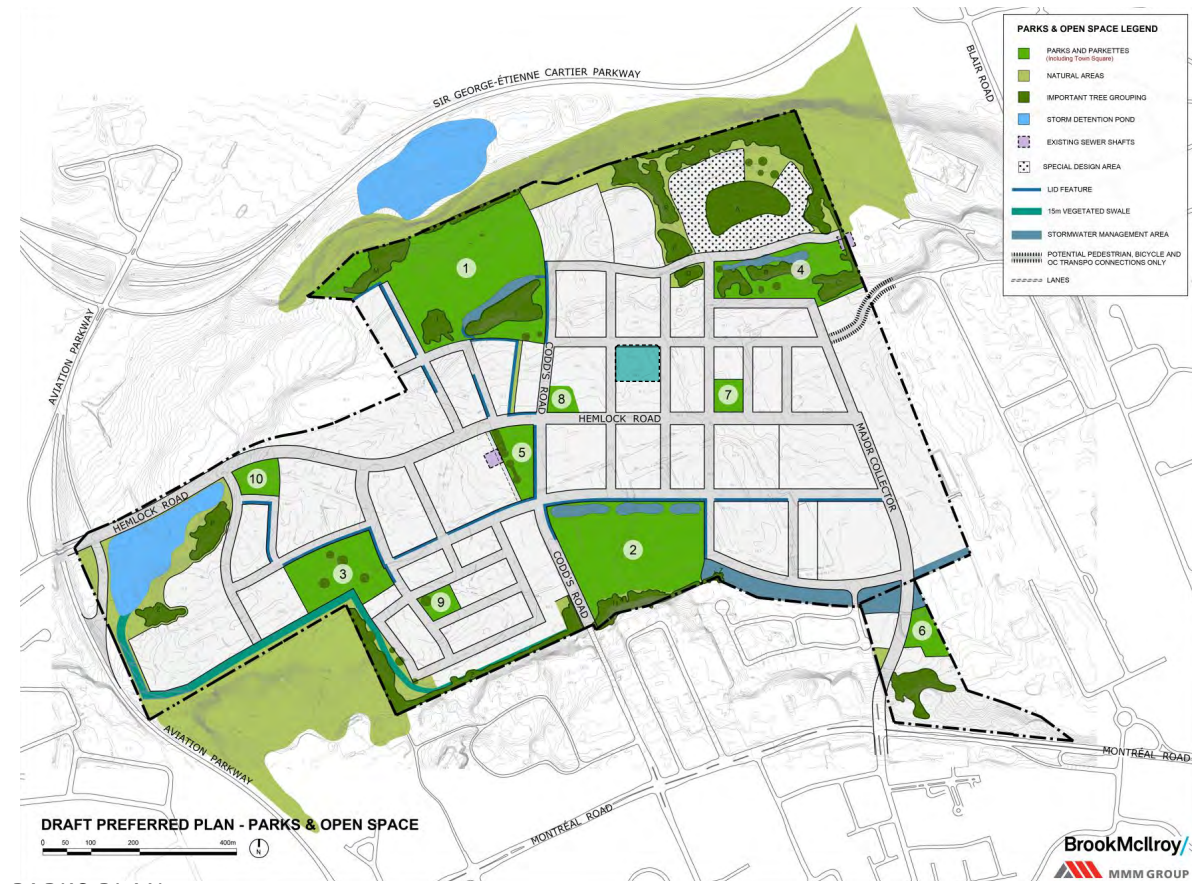
DESIGN UPDATE PACKAGE

2022.09.16

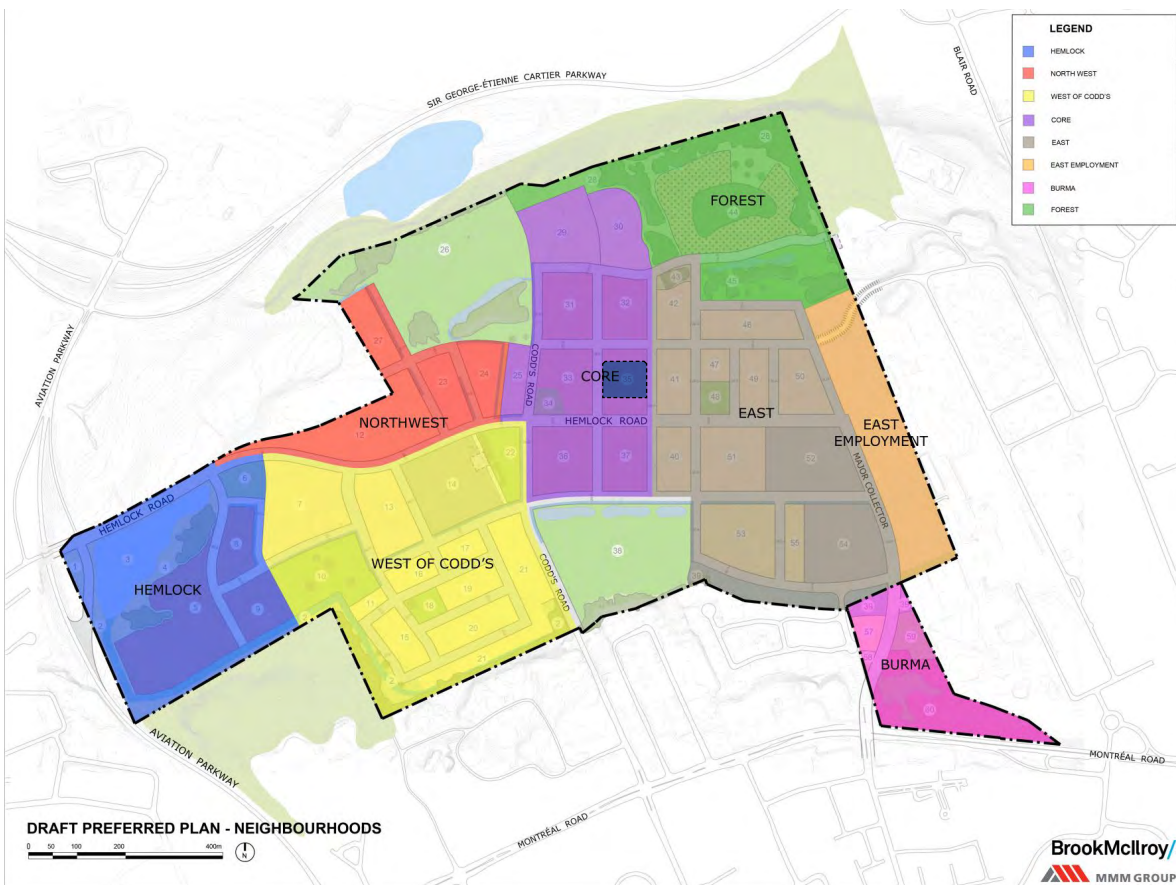
FAAS



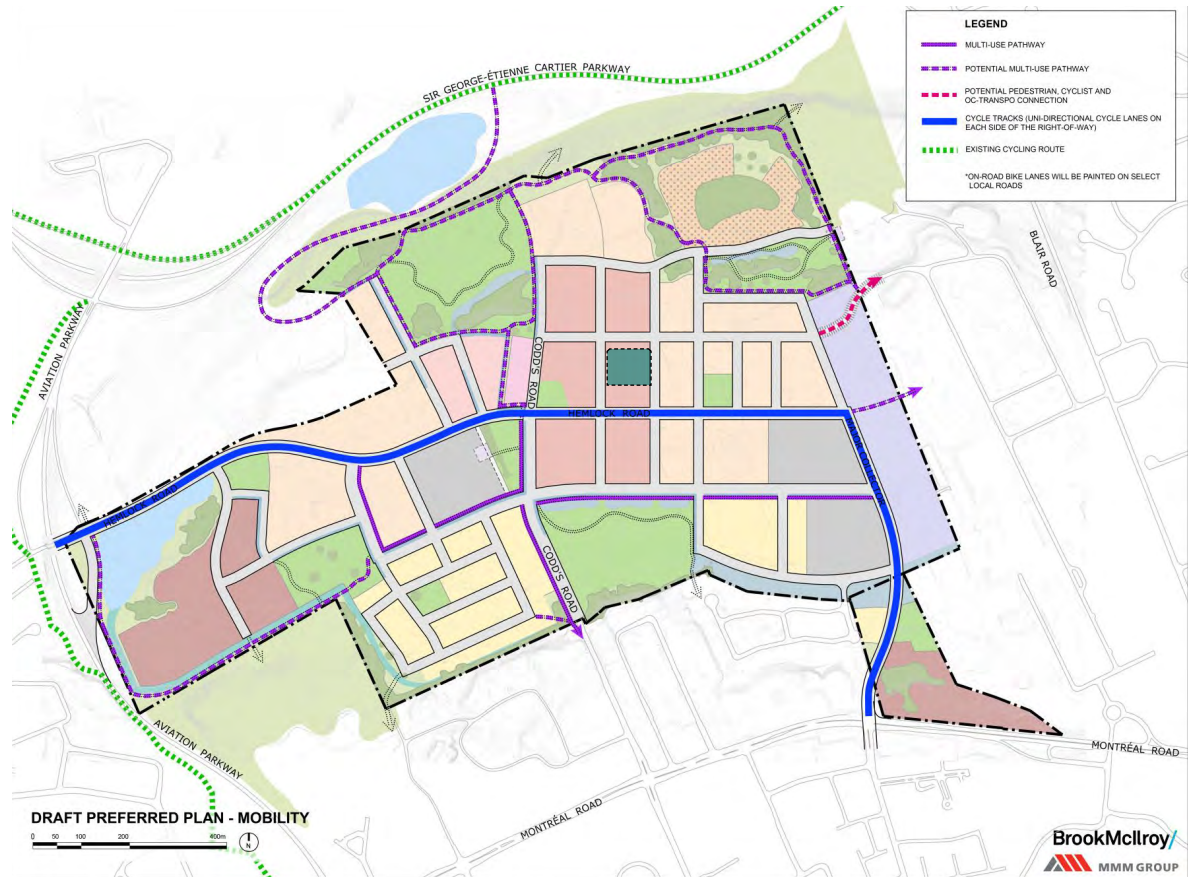
CONTEXT PLAN



PARKS PLAN



NEIGHBOURHOODS PLAN



MOBILITY PLAN

SITE DIAGRAMS

2022.09.16

WATERIDGE

FAAS



**LANDUSE BYLAW REVIEW- WATERRIDGE**  
CURRENT ZONE: GM 31 H(30)

**CONTEXT**

WEST	BARIELLE-SNOW STREET
SOUTH	GM 31 H(30) (FUTURE DEVELOPMENT BY OTHERS)
NORTH	TAWADINA ROAD
EAST	MICHAEL STOQUA STREET

**HEIGHT**

Minimum 2 storeys  
Maximum 30m\*  
\*at least half of the total land area of each of these blocks will have a maximum building height of 20M (as per Wateridge Village Guide)

**SETBACK**

AS PER BYLAW TABLE 188H

	MIN
SIDEYARD (TAWADINA ROAD)	5.0M
CORNER/FRONT (MICHAEL STOQUA STREET)	5.0M
CORNER/FRONT (BARIELLE-SNOW STREET)	5.0M
INTERIOR SIDEYARD (GM 31 H(30))	3.0M

\*\*WHERE THE BUILDING CONTAINS MORE THAN FOUR STOREYS BUT LESS THAN 13 STOREYS, AT AND ABOVE THE FOURTH STOREY A BUILDING MUST BE SETBACK A MINIMUM OF AN ADDITIONAL 2 METRES MORE THAN THE PROVIDED SETBACK FROM THE FRONT AND CORNER SIDE LOT LINES; AS PER GM31(31)(C)

NOTE: SETBACKS BASED ON THROUGH CORNER LOT

**SEPARATION DISTANCE BETWEEN BUILDING PORTIONS**

AS PER GM31(31)(F)

HEIGHT	DISTANCE
0-4 STOREYS	3M
4-9 STOREYS	23M
9+ STOREYS	30M

**MAXIMUM FLOOR PLATE AREA**

750SM FOR STOREYS OVER 20M HEIGHT

**SITE AREA**

AREA [SM]	AREA [SF]	AREA [HEC]
7,188	77,371	0.72

**FLOOR SPACE INDEX: NO MAXIMUM**

AS PER BYLAW TABLE 188H

**DENSITY**

AS PER ROCKCLIFFE COMMUNITY PLAN

MIN. DENSITY	143 UNITS/HA
MIN UNITS	99

**AMENITY SPACE**

AS PER TABLE 137  
MIN TOTAL: 6.0M<sup>2</sup>/UNIT  
MIN 50% OF TOTAL AMENITY AS COMMUNAL  
AT LEAST 1 AGGREGATED AREA MIN 54 M<sup>2</sup>

**VEHICLE PARKING**

AS PER BYLAW TABLE 101 AND 102

	REQUIREMENT	@253 UNITS
RESIDENT - DWELLING	0.5/UNIT	126
VISITOR - DWELLING	0.1/UNIT	25
MIN PARKING STALL	2.6M X 5.2M	
	2.4M X 4.6M	
MIN COMPACT STALL	(2.6M WIDTH IF ABUT)	
MAX COMPACT STALLS	40%	50
MIN MOTORBIKE STALL	1.3M X 3.0M	
MAX MOTORBIKE STALLS	5%	12
MIN TYPICAL STALLS	55%	69

6.7M AISLE WIDTH FOR 2 SIDED 90° PARKING

**SHARED PARKING PROVISIONS**

AS PER BYLAW SECTION 105

ONLY WHERE MORE THAN ONE OF THE USES ARE LOCATED ON THE SAME LOT

**TANDEM PARKING PROVISIONS**

AS PER BYLAW SECTION 105

IN THE CASE OF AN APARTMENT BUILDING, MID - HIGH RISE AND LOW RISE AND STACKED DWELLING, WHERE A DWELLING UNIT HAS A DRIVEWAY ACCESSING ITS OWN REQUIRED PARKING SPACE, ADDITIONAL REQUIRED PARKING MAY BE LOCATED IN TANDEM IN THE DRIVEWAY.

**BICYCLE PARKING**

AS PER BYLAW 111

RESIDENT - DWELLING	0.5/ UNIT
MIN BIKE STALL HORIZONTAL	0.6M X1.8M
MIN BIKE STALL VERTICAL	0.5M X1.5M
MAX VERTICAL STALLS	50%

**LANDSCAPING**

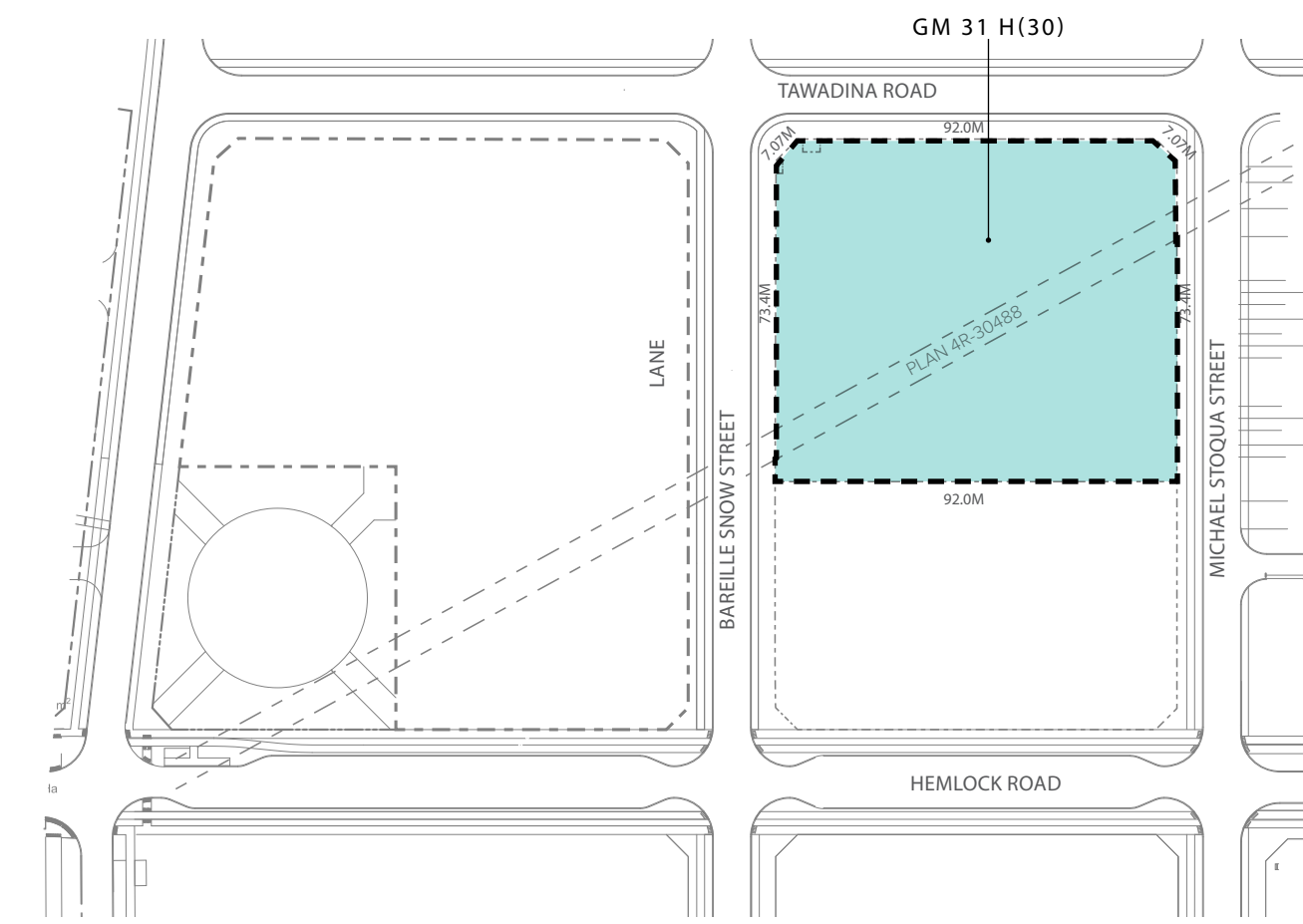
AS PER BYLAW TABLE 187 (H)

MIN. WIDTH OF LANDSCAPED AREA ABUTTING A STREET	3.0M
WIDTH OF LANDSCAPE BUFFER NOT ABUTTING A STREET	1.5M

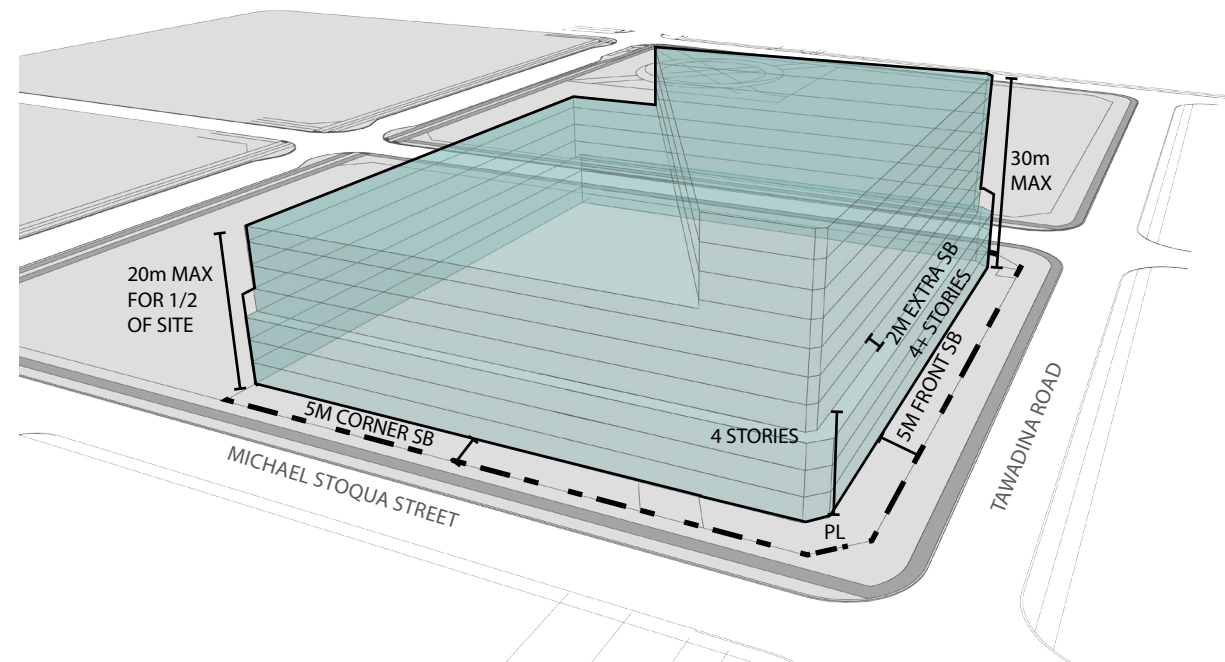
**EASEMENTS**

AS PER SURVEYS

OCI755037	ABOVE GROUND ELECTRIC
OCI771382	BELOW GROUND SEWER



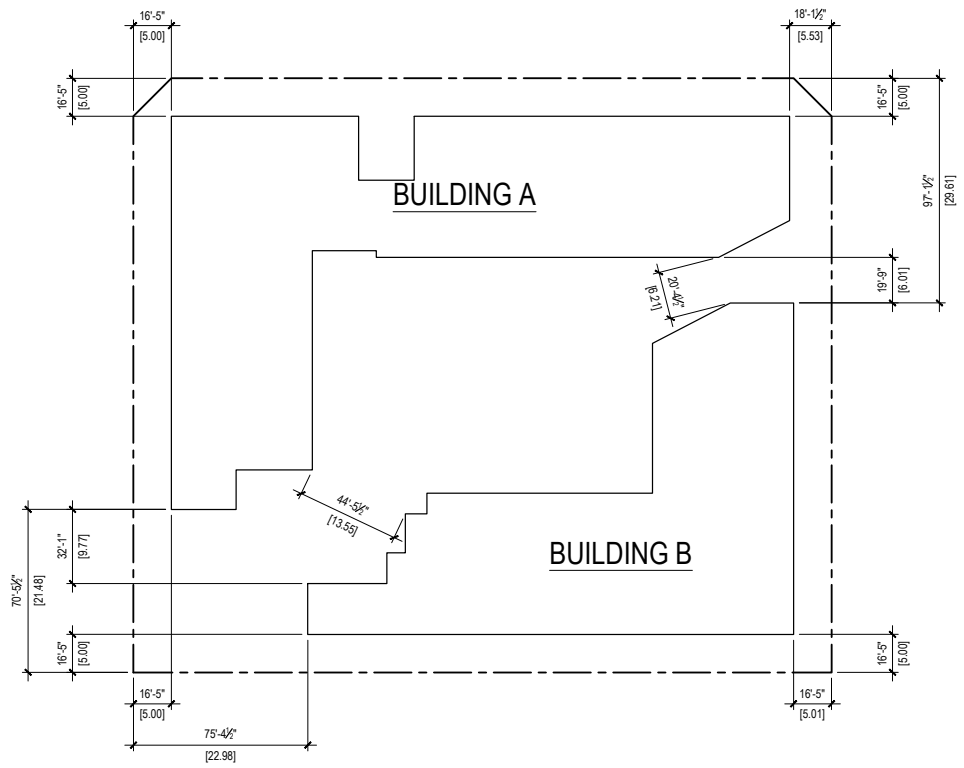
**SITE PLAN**  
SCALE: NTS



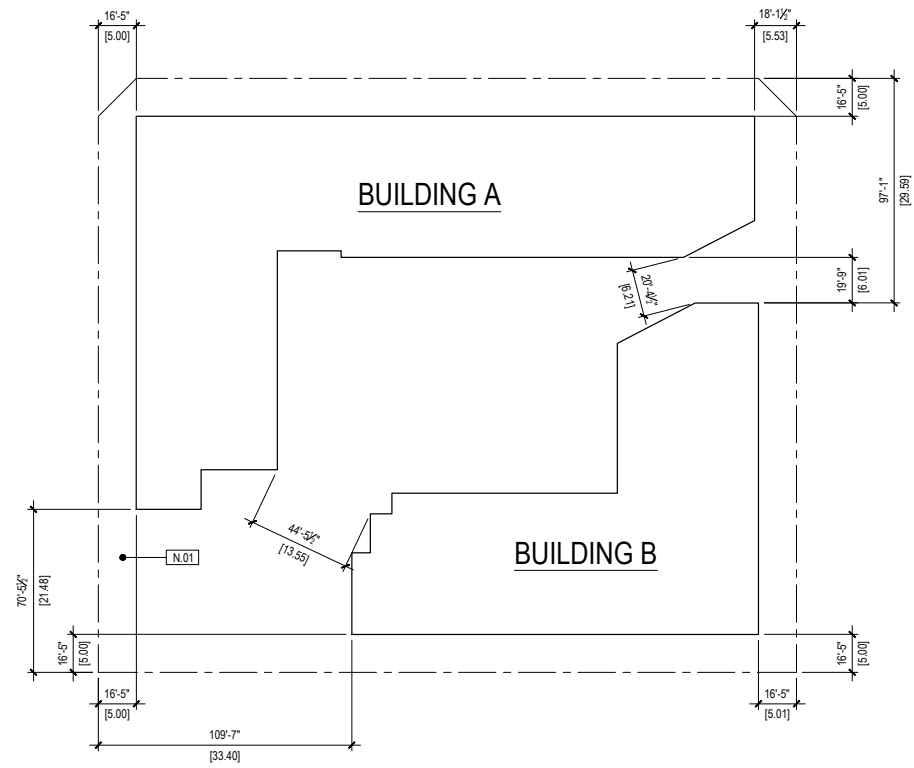
**BYLAW ENVELOPE**

LAND USE  
BYLAW REVIEW  
2022.09.16  
WATERIDGE

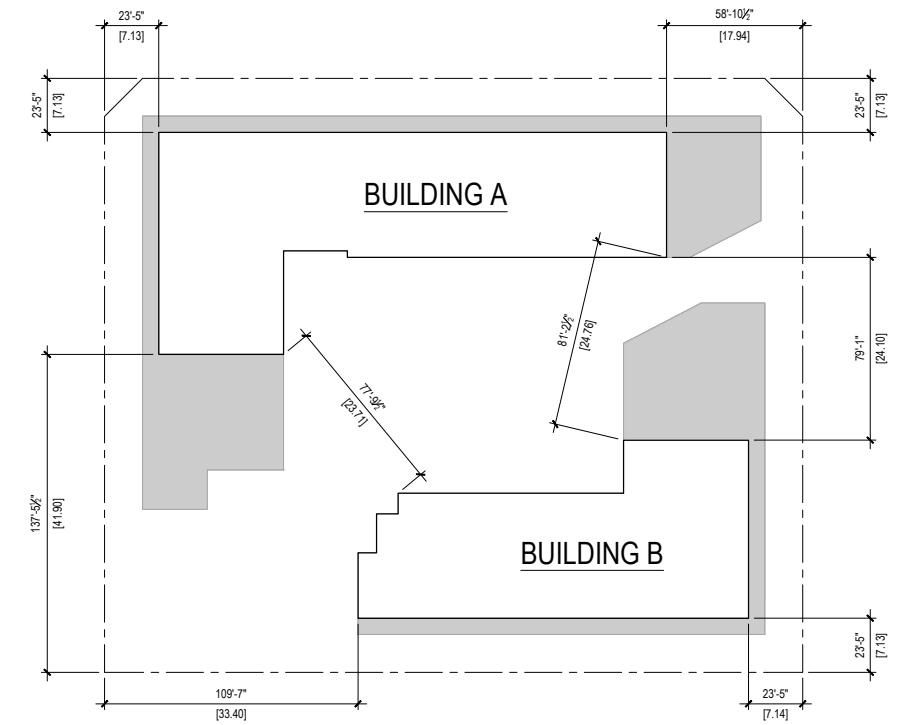




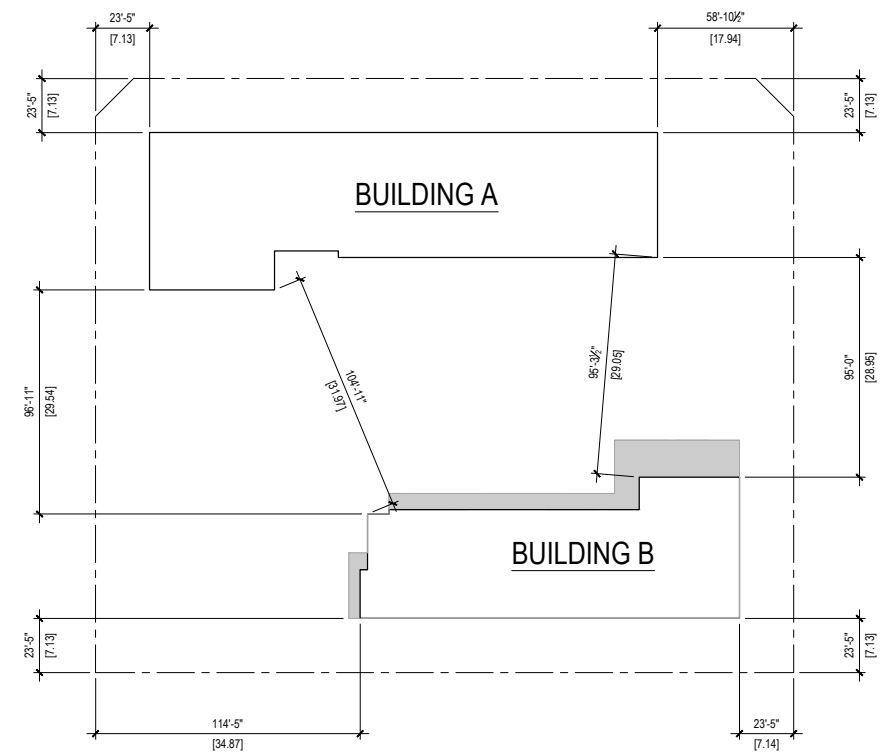
1 LEVEL 01 PLAN  
DP.010 NTS



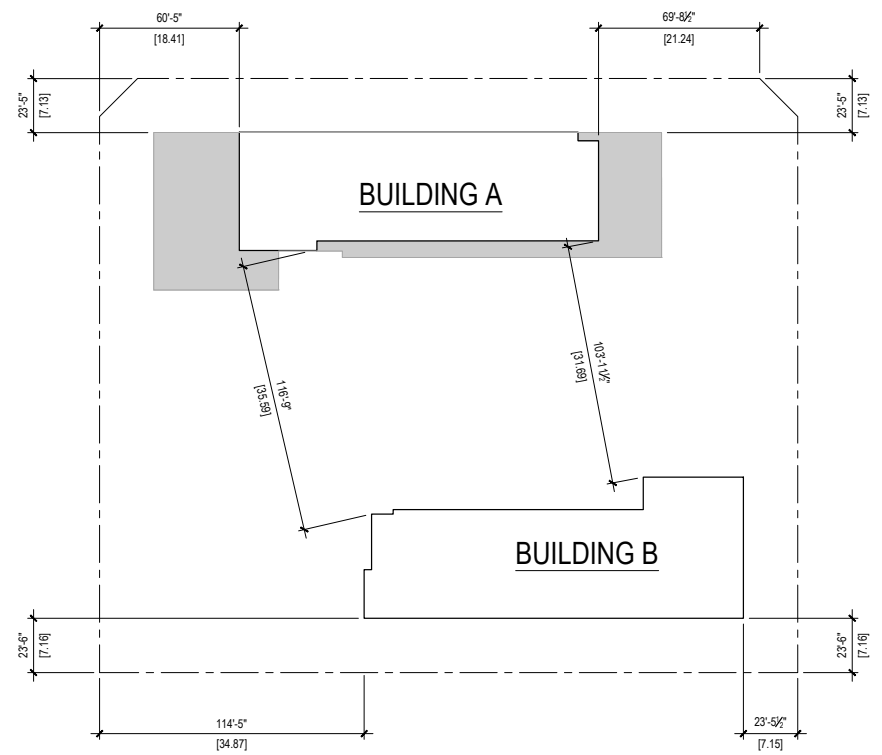
2 LEVEL 02 + 03 PLAN  
DP.010 NTS



3 LEVEL 04 + 05 PLAN  
DP.010 NTS



4 LEVEL 06 PLAN  
DP.010 NTS

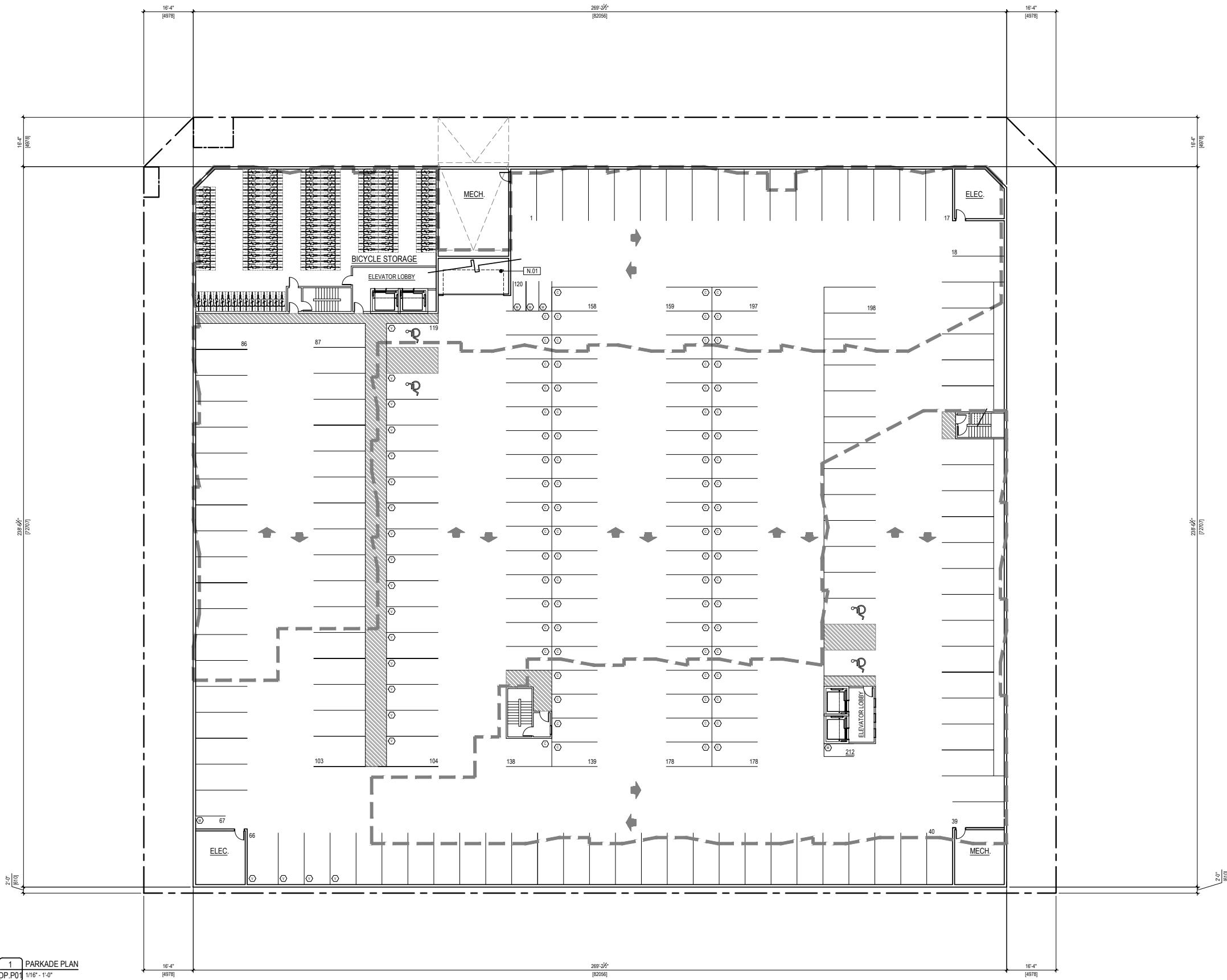


5 LEVEL 07 + 08 + 09 PLAN  
DP.010 NTS

SETBACK  
DIAGRAM  
BYLAW REVIEW  
2022.09.16

WATERIDGE

FAAS



PARKADE STALLS	PARKADE
STANDARD	102
SURFACE	5
COMPACT	77
VISITOR	25
BARRIER FREE	4
MOTORCYCLE	3
<b>TOTAL</b>	<b>216</b>

- A COMPACT STALL
- B MOTORBIKE STALL
- C VISITOR STALL

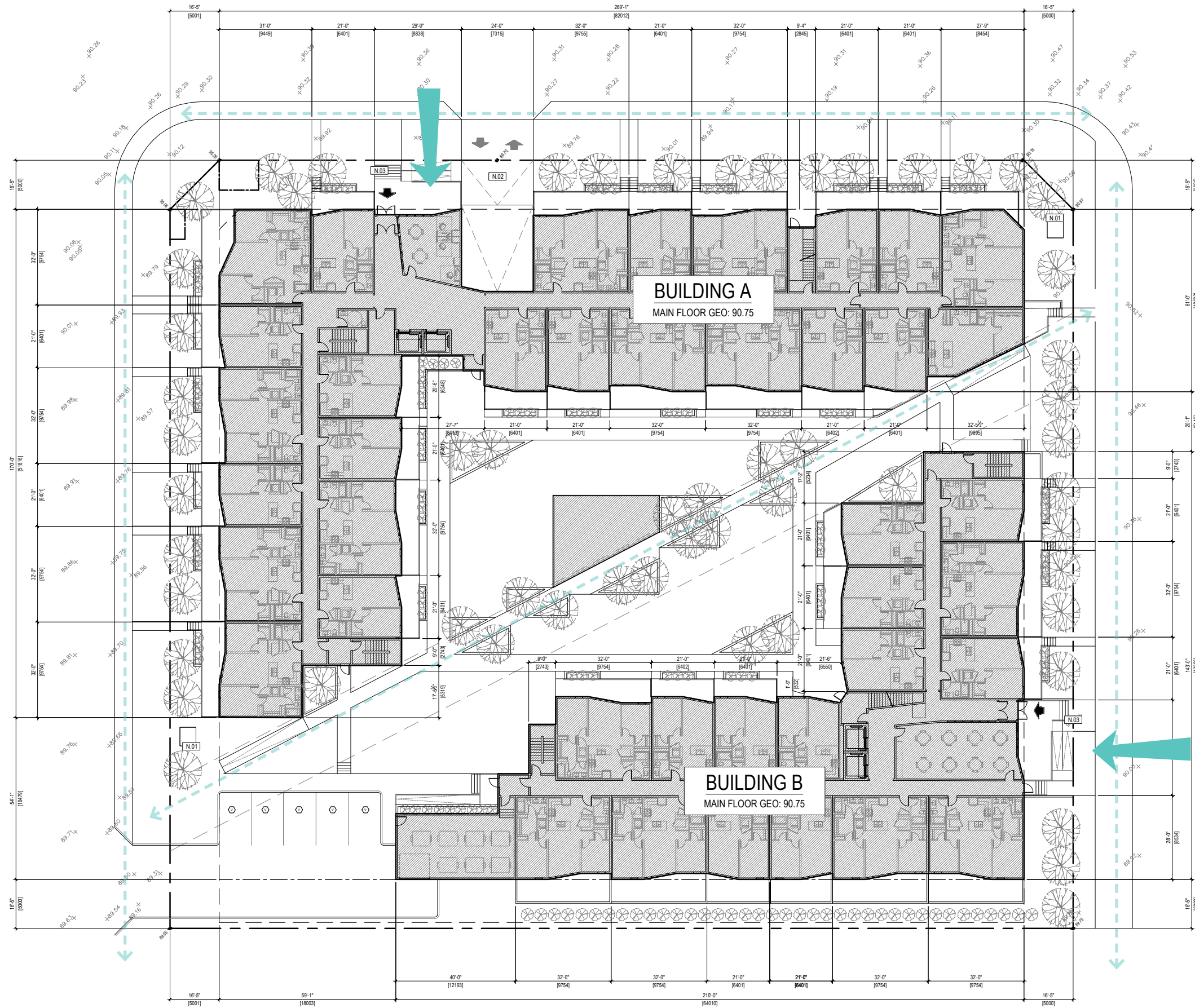
N  
 1 PARKADE PLAN  
 DP.P01 1/16" = 1'-0"

PARKADE PLAN

2022.09.16

WATERIDGE

FAAS



**PROJECT STATISTICS**  
**WESTURBAN - WATERIDGE**

SITE AREAS	sf	sm
SITE AREA	77,274	7,179
<b>TOTAL</b>	<b>77,274</b>	<b>7,179</b>
<b>FAR</b>	<b>2.6</b>	

BICYCLE STALLS	BIKE STALLS
HORIZONTAL	139
<b>TOTAL</b>	<b>139</b>

UNIT COUNT	BUILDING A	BUILDING B	
FLOOR 1	24	16	
FLOOR 2	26	17	
FLOOR 3	26	17	
FLOOR 4	16	12	
FLOOR 5	14	12	
FLOOR 6	14	9	
FLOOR 7	8	9	
FLOOR 8	8	9	
FLOOR 9	8	9	
<b>TOTAL</b>	<b>144</b>	<b>110</b>	<b>254</b>

BUILDING AREAS	BUILDING A		BUILDING B	
	NET	GROSS	NET	GROSS
FLOOR 1	16,865	19,395	10,990	12,639
FLOOR 2	18,330	21,080	11,855	13,633
FLOOR 3	18,310	21,057	11,855	13,633
FLOOR 4	10,840	12,466	7,755	8,918
FLOOR 5	9,800	11,270	7,755	8,918
FLOOR 6	9,800	11,270	6,170	7,096
FLOOR 7	5,560	6,394	6,170	7,096
FLOOR 8	5,560	6,394	6,170	7,096
FLOOR 9	5,560	6,394	6,170	7,096
<b>TOTAL</b>	<b>100,625</b>	<b>115,719</b>	<b>74,890</b>	<b>86,124</b>

note: GROSS AREAS = NET + 15%

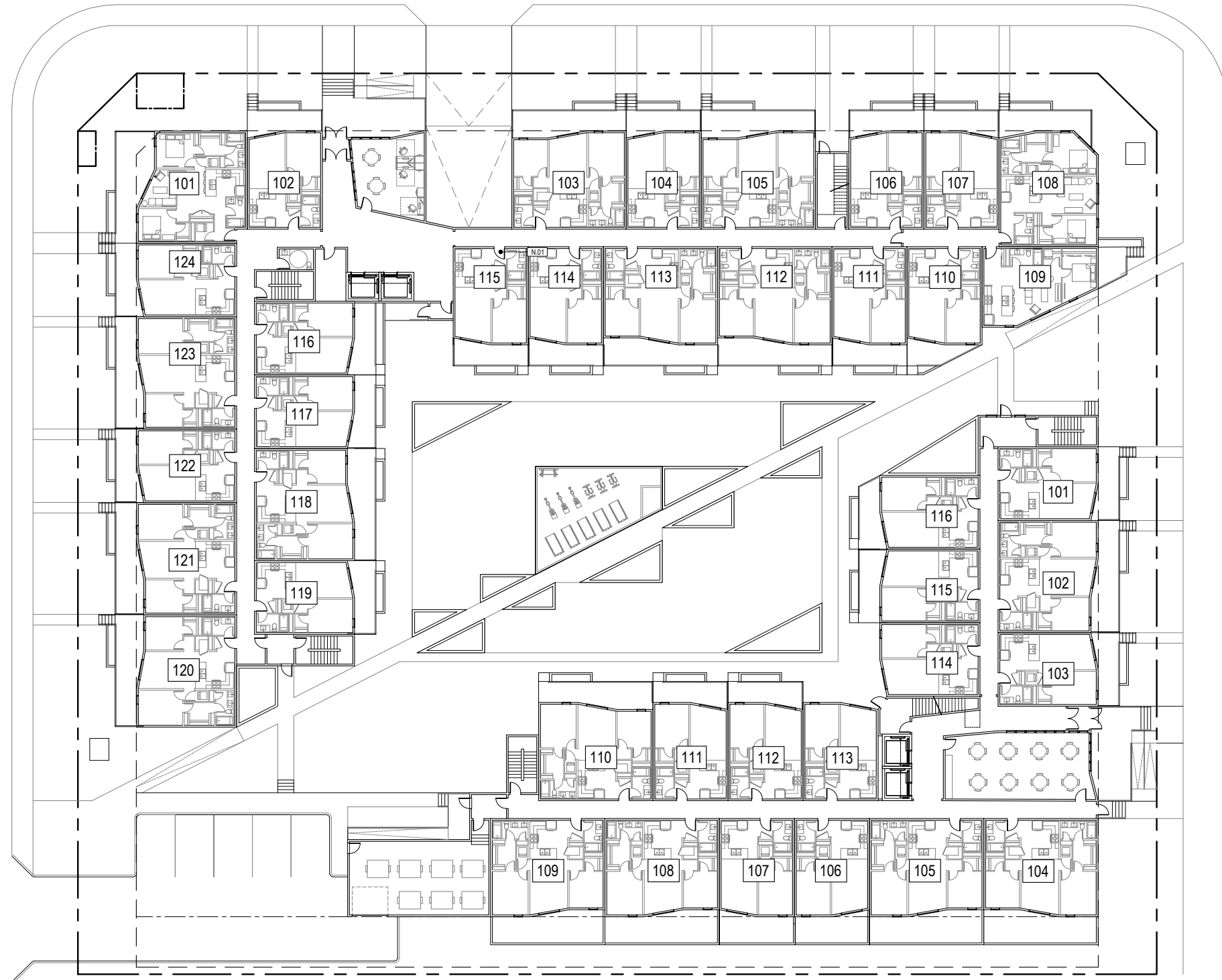
← MAIN ENTRY  
 ↔ SITE CIRCULATION

SITE PLAN

2022.09.16


WATERIDGE

FAAS



FLOOR 01 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
101	2B-b	900
102	1B-b	580
103	2B-b	865
104	1B-b	580
105	2B-b	865
106	1B-b	580
107	1B-b	580
108	2B-b	885
109	1B-b	620
110	1B-b	580
111	1B-b	580
112	2B-b	865
113	2B-b	865
114	1B-b	580
115	1B-b	580
116	1B-b	580
117	1B-b	580
118	2B-b	865
119	1B-b	580
120	2B-b	865
121	2B-b	865
122	1B-b	580
123	2B-b	865
124	1B-b	580
<b>24</b>		<b>16865</b>

FLOOR 01 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
101	1B-b	580
102	2B-b	865
103	1B-b	580
104	2B-b	865
105	2B-b	865
106	1B-b	580
107	1B-b	580
108	2B-b	865
109	2B-b	865
110	2B-b	865
111	1B-b	580
112	1B-b	580
113	1B-a	580
114	1B-a	580
115	1B-b	580
116	1B-b	580
<b>16</b>		<b>10990</b>

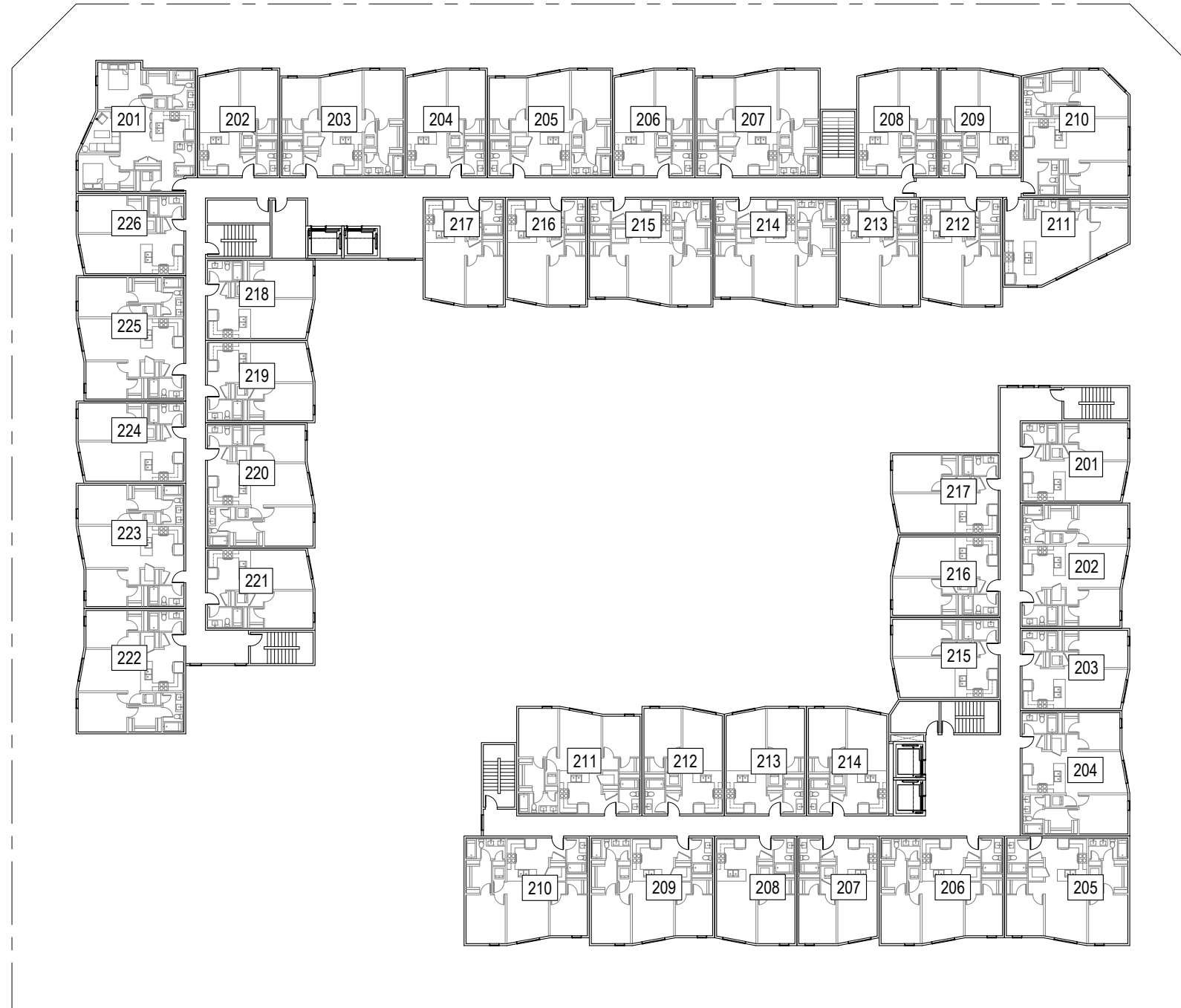

1 LEVEL 01 PLAN  
 DP.101 1/16" = 1'-0"

MAIN FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 02 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
201	2B-a	920
202	1B-a	580
203	2B-a	865
204	1B-a	580
205	2B-a	865
206	1B-a	580
207	2B-a	865
208	1B-a	580
209	1B-a	580
210	2B-a	865
211	1B-a	620
212	1B-b	580
213	1B-b	580
214	2B-b	865
215	2B-b	865
216	1B-b	580
217	1B-b	580
218	1B-a	580
219	1B-a	580
220	2B-a	865
221	1B-a	580
222	2B-a	865
223	2B-a	865
224	1B-a	580
225	2B-a	865
226	1B-a	580
<b>26</b>		<b>18330</b>

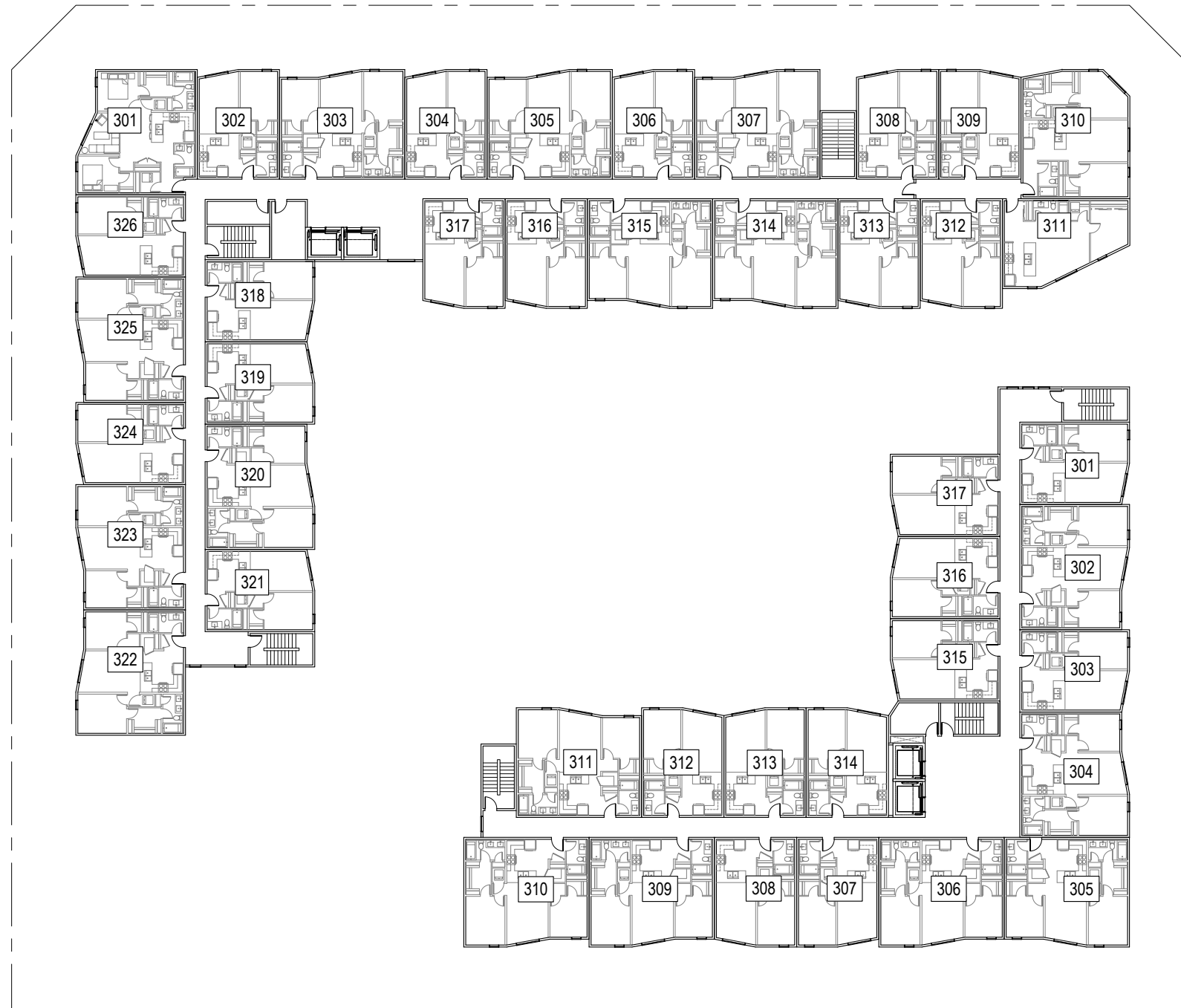
FLOOR 02 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
201	1B-a	580
202	2B-a	865
203	1B-a	580
204	2B-a	865
205	2B-a	865
206	2B-a	865
207	1B-a	580
208	1B-a	580
209	2B-a	865
210	2B-a	865
211	2B-b	865
212	1B-b	580
213	1B-b	580
214	2B-b	580
215	1B-a	580
216	1B-a	580
217	1B-a	580
<b>17</b>		<b>11855</b>

SECOND FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 03 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
301	2B-a	900
302	1B-a	580
303	2B-a	865
304	1B-a	580
305	2B-a	865
306	1B-a	580
307	2B-a	865
308	1B-a	580
309	1B-a	580
310	2B-a	885
311	1B-a	620
312	1B-b	580
313	1B-b	580
314	2B-b	865
315	2B-b	865
316	1B-b	580
317	1B-b	580
318	1B-a	580
319	1B-a	580
320	2B-a	865
321	1B-a	580
322	2B-a	865
323	2B-a	865
324	1B-a	580
325	2B-a	865
326	1B-a	580
<b>26</b>		<b>18310</b>

FLOOR 03 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
301	1B-a	580
302	2B-a	865
303	1B-a	580
304	2B-a	865
305	2B-a	865
306	2B-a	865
307	1B-a	580
308	1B-a	580
309	2B-a	865
310	2B-a	865
311	2B-b	865
312	1B-b	580
313	1B-b	580
314	2B-b	580
315	1B-a	580
316	1B-a	580
317	1B-a	580
<b>17</b>		<b>11855</b>

THIRD FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 04 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
401	2B-a	720
402	1B-a	530
403	1B-a	530
404	1B-a	590
405	2B-a	840
406	2B-a	800
407	1B-a	625
408	2B-b	865
409	2B-b	965
410	2B-b	965
411	1B-b	580
412	1B-b	580
413	1B-a	600
414	1B-a	590
415	1B-a	530
416	1B-a	530
<b>16</b>		<b>10840</b>

FLOOR 04 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
401	1B-a	590
402	1B-a	590
403	2B-a	840
404	2B-a	840
405	1B-a	590
406	1B-a	590
407	1B-a	530
408	2B-b	865
409	1B-b	580
410	1B-b	580
411	1B-b	580
412	1B-a	580
<b>12</b>		<b>7755</b>

FOURTH FLOOR

2022.09.16

WATERIDGE

FAAS





FLOOR 05 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
501	2B-a	840
502	1B-a	590
503	1B-a	530
504	1B-a	590
505	2B-a	840
506	2B-a	840
507	1B-a	625
508	2B-b	865
509	2B-b	865
510	2B-b	865
511	1B-b	580
512	2B-b	580
513	1B-b	600
514	1B-b	590
<b>14</b>		<b>9800</b>

FLOOR 05 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
501	1B-a	590
502	1B-a	590
503	2B-a	840
504	2B-a	840
505	1B-a	590
506	1B-a	590
507	1B-a	530
508	2B-b	865
509	1B-b	580
510	1B-b	580
511	1B-b	580
512	1B-a	580
<b>12</b>		<b>7755</b>

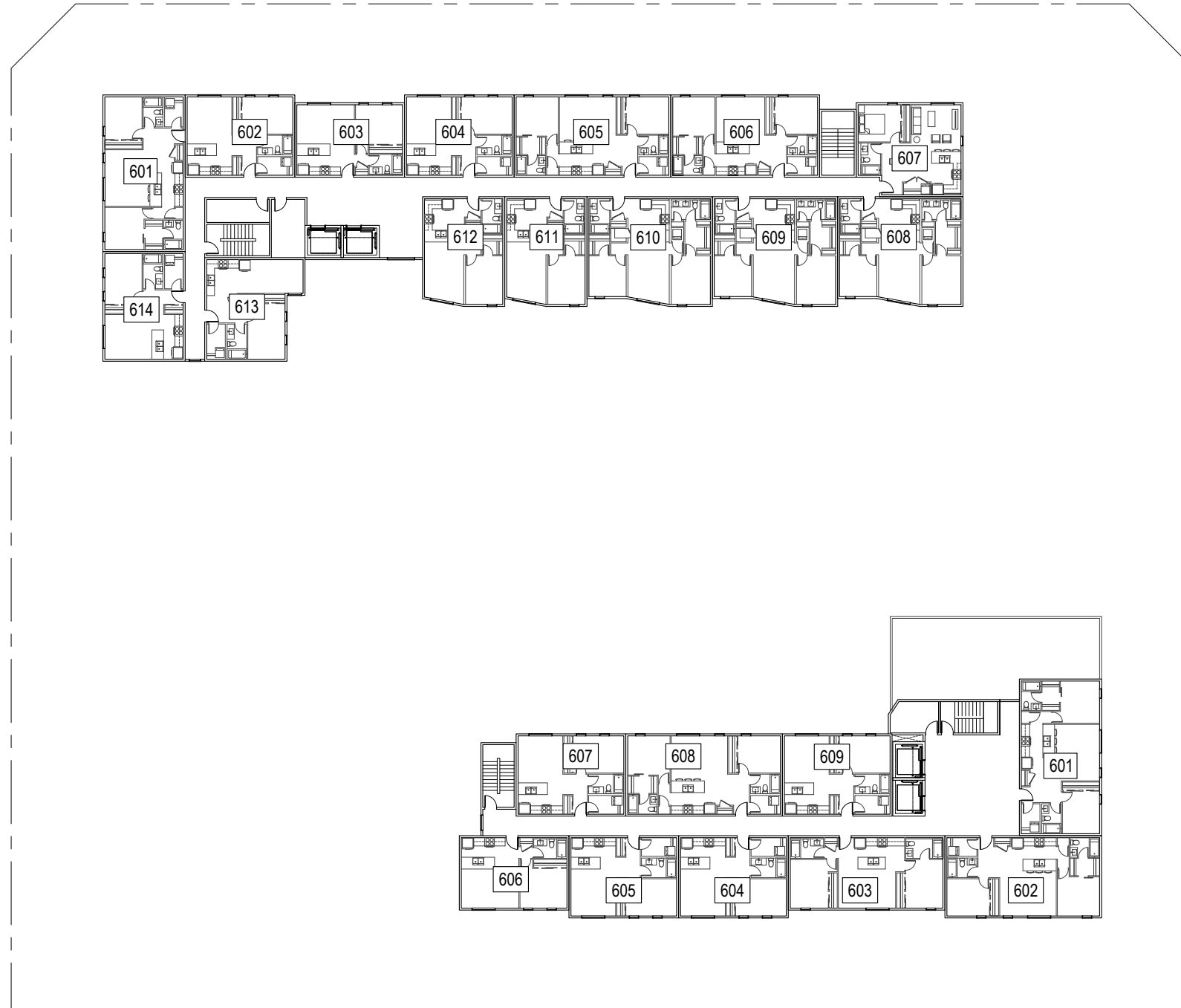
N  
 1 LEVEL 05 PLAN  
 DP.103 1/16" = 1'-0"

FIFTH FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 06 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
601	2B-a	840
602	1B-a	590
603	1B-a	530
604	1B-a	590
605	2B-a	840
606	2B-a	840
607	1B-a	625
608	2B-b	865
609	2B-b	865
610	2B-b	865
611	1B-b	580
612	2B-b	580
613	1B-b	600
614	1B-b	590
<b>14</b>		<b>9800</b>

FLOOR 06 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
601	2B-a	840
602	2B-a	840
603	2B-a	760
604	1B-a	590
605	1B-a	590
606	1B-a	530
607	1B-b	590
608	2B-b	840
609	1B-b	590
<b>9</b>		<b>6170</b>

SIXTH FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 07 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
701	2B-a	760
702	1B-a	590
703	2B-a	840
704	2B-a	800
705	2B-b	800
706	1B-b	590
707	1B-b	590
708	1B-b	590
<b>8</b>		<b>5560</b>

FLOOR 07 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
701	2B-a	840
702	2B-a	840
703	2B-a	760
704	1B-a	590
705	1B-a	590
706	1B-a	530
707	1B-b	590
708	2B-b	840
709	1B-b	590
<b>9</b>		<b>6170</b>

SEVENTH FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 08 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
801	2B-a	760
802	1B-a	590
803	2B-a	840
804	2B-a	800
805	2B-b	800
806	1B-b	590
807	1B-b	590
808	1B-b	590
<b>8</b>		<b>5560</b>

FLOOR 08 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
801	2B-a	840
802	2B-a	840
803	2B-a	760
804	1B-a	590
805	1B-a	590
806	1B-a	530
807	1B-b	590
808	2B-b	840
809	1B-b	590
<b>9</b>		<b>6170</b>

EIGHTH FLOOR

2022.09.16

WATERIDGE

FAAS



FLOOR 09 - BUILDING A		
Unit #	TYPE	AREA (ft <sup>2</sup> )
901	2B-a	760
902	1B-a	590
903	2B-a	840
904	2B-a	800
905	2B-b	800
906	1B-b	590
907	1B-b	590
908	1B-b	590
<b>8</b>		<b>5560</b>

FLOOR 09 - BUILDING B		
Unit #	TYPE	AREA (ft <sup>2</sup> )
901	2B-a	840
902	2B-a	840
903	2B-a	760
904	1B-a	590
905	1B-a	590
906	1B-a	530
907	1B-b	590
908	2B-b	840
909	1B-b	590
<b>9</b>		<b>6170</b>

NINTH FLOOR

2022.09.16

WATERIDGE

FAAS



WEST ELEVATION - BUILDING A



SOUTH ELEVATION - BUILDING A



EAST ELEVATION - BUILDING A



NORTH ELEVATION - BUILDING A

ELEVATIONS  
BUILDING A

2022.09.16

WATERIDGE

FAAS



WEST ELEVATION - BUILDING B



SOUTH ELEVATION - BUILDING B



EAST ELEVATION - BUILDING B



NORTH ELEVATION - BUILDING B

ELEVATIONS  
BUILDING B

2022.09.16

WATERIDGE

FAAS







---

FAAS



FAAS





---

FAAS



---

FAAS

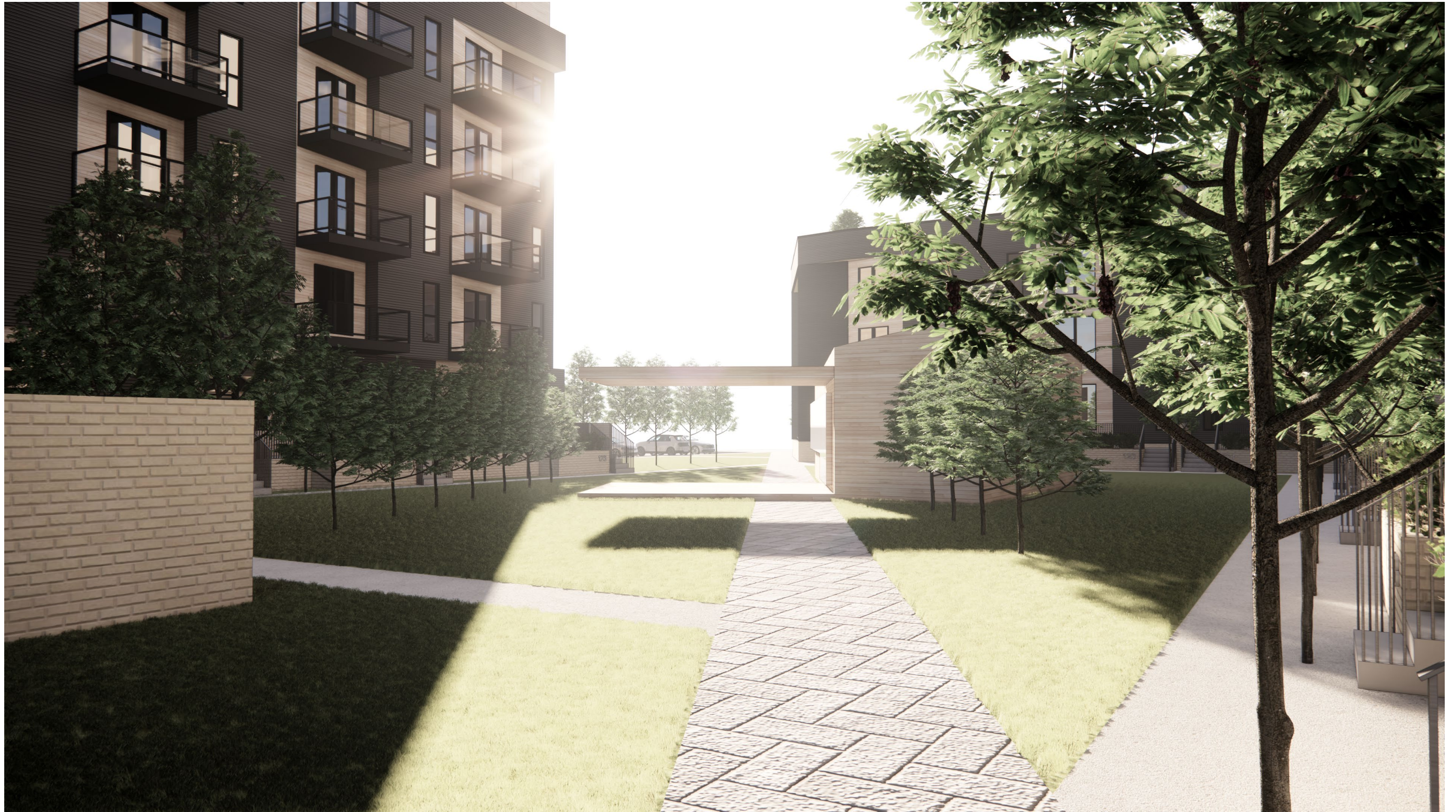


---

FAAS



FAAS



FAAS





F A A S





FAAS





FAAS