OC Transpo Bus Garage

Site Servicing Report

OC Transpo, City of Ottawa

Project number: 60716350

March 2026

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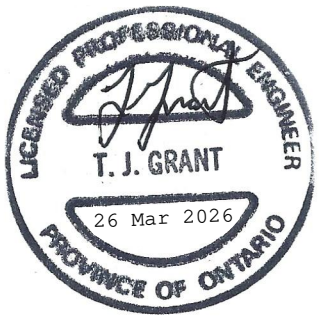
Project Team

Prepared by

Bita Pihani, EIT
Water Resources

Prepared by

Todd Grant, P.Eng.
Senior Civil Engineer



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01	November 26, 2025	Update based on ECA application submitted for City's review
02	January 26, 2026	Updated Drawing sets
03	March 24, 2026	Address City Comments

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Prepared for:

OC Transpo, City of Ottawa

Prepared by:

AECOM Canada ULC
302 – 1150 Morrison Drive
Ottawa, ON K2H 8S9
Canada

T: 613.820.8282
F: 613.702.8784
aecom.com

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1 Introduction

OC Transpo has retained AECOM Canada ULC (AECOM) to complete the grading, site servicing plans, stormwater design and report in support of the development of a proposed OC Transpo electrical (E-bus) storage, charging and maintenance garage within the existing areas of 1500 St. Laurent Boulevard. The garage and project are referred to as the Zero Emissions Bus (ZEB) Garage.

The OC Transpo site at 1500 St. Laurent Boulevard is located on the northwest corner of the intersection of Belfast Road and St Laurent Boulevard. The ZEB Garage is proposed to be situated on the northwest portion of the site. Access to the ZEB Garage site would be via the Belfast Road entrances. **Figure 1-1** indicates the location of the OC Transpo site and the proposed ZEB Garage location. Throughout this report, the proposed ZEB Garage will be referred to as the subject site. The southwest corner and main entrance of the site are located at 450271.33 Easting; 5029003.34 Northing and 450547.32 Easting; 5028933.28 Northing, respectively, based on UTM NAD83 Zone 18 geo-reference system..

This report is prepared to support the City of Ottawa Site Plan Application process as well as an amendment to an existing Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approval (ECA) for the site storm sewer and stormwater management design.

1.1 Background

The 1500 St-Laurent Boulevard site is operated by OC Transpo and owned by the City of Ottawa. The site consists of three properties that are operated as one single facility. The total site area is 13.59 hectares (ha) and generally consists of parking lots, garages and administrative buildings that services the City's OC Transpo operations. The ZEB Garage includes a building where a new line of electrical busses will be stored and charged. Due to the development of the garage, there are proposed modifications and tie-in of the new facility to the surrounding site.

There have been numerous upgrades and expansions implemented in the subject site over the past decades. In 2002 an ECA by the MECP (MOEE at the time) was requested prior the site undergoing construction of additional sewer network to support the expansion of bus surface storage facility. As part of the application, City of Ottawa provided the following criteria:

- A maximum allowable flow release rate based on 0.5 runoff coefficient;
- Use of runoff coefficients of 0.2 and 0.9 previous and impervious surfaces, respectively;
- 100-year storm event should be restricted to peak flow of 5 year storm event with runoff coefficient of 0.5; and
- Flows in excess of the allowable release rate for storm events up to the 100-year should be detained on-site.

The MECP also requested the installation of an online oil/grit (OGS) interceptor on the proposed stormwater sewer for containing any potential spills on the site from both fueling and sediment. The OGS was designed for 60% total suspended solids removal. The 2002 MECP ECA application was submitted with the understanding that an overall site Stormwater Management Plan would be prepared at later data. In 2006 OC Transpo retained J.L Richards & Associates Limited (JLR) for the site development supporting the parking lot expansion and an amended ECA in was submitted and approved.

In 2017 another ECA amendment was issued for redevelopment of a bus access lane located in south of the subject site. As part of initial works on the ZEB site, a Site Plan Application (SPA) was submitted to the City in 2022. The package was reviewed by the City and comments were provided but never addressed. One item from the 2022 SPA was the current ECA for the site will be amended as part of the ZEB design. Since 1500 St. Laurent Boulevard is zoned as industrial and used for that purpose, the ECA application would need to indicate that the site is for industrial use and a direct submission to the MECP for review and approval would be required. As an industrial site, the City's

Transfer of Review agreement with the MECP does not apply (i.e., the City cannot review and approve the ECA application on behalf on the MECP).

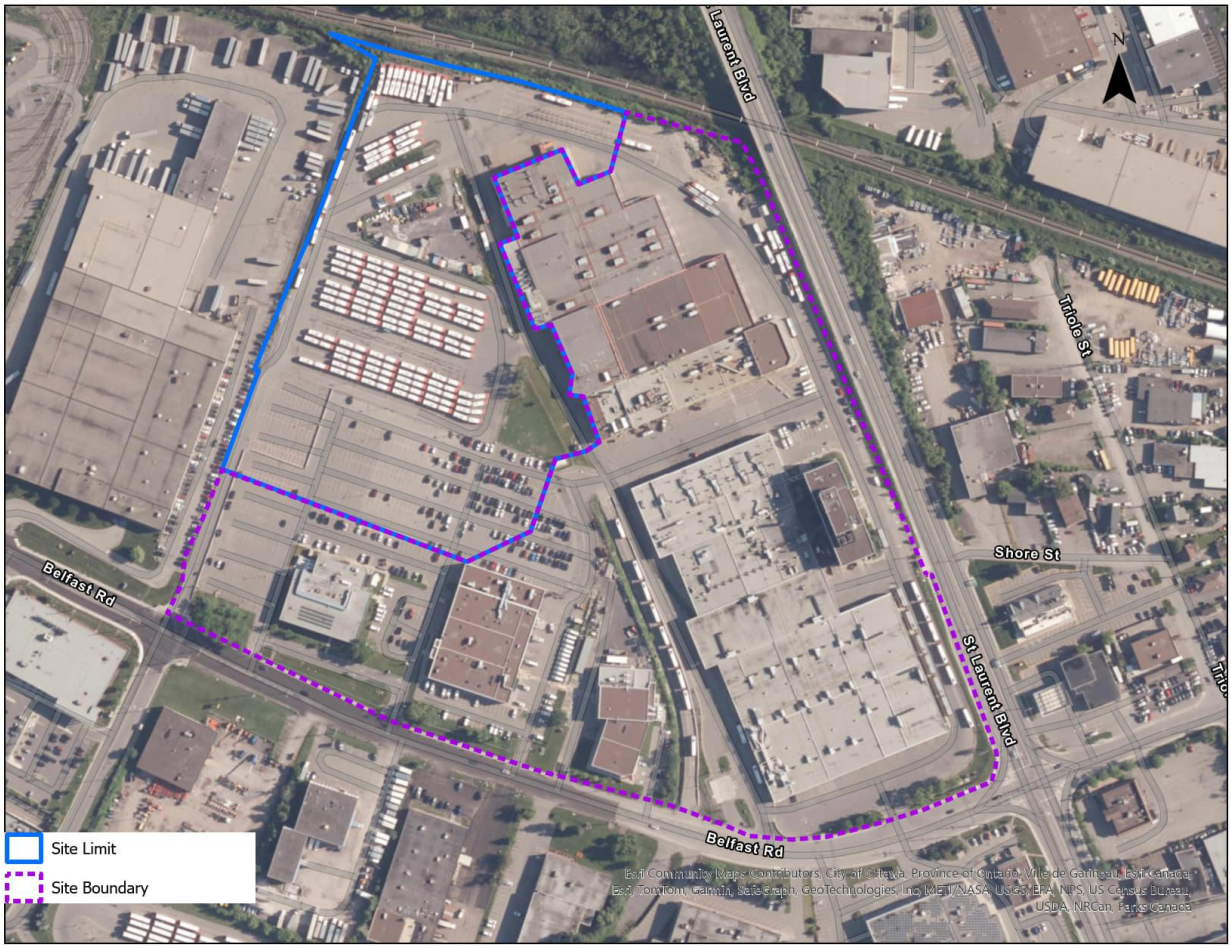


Figure 1-1. Subject Site Location and Boundary

1.2 Reference Documents

The following background documents have been referenced in the preparation of this report:

- Site Servicing Brief OC Transpo E-bus Parking Garage 1500 St. Laurent Boulevard, J.L Richards (2022);
- Geotechnical Investigation Proposed OC Transpo Electrical Bus Garage 1500 St-Laurent Boulevard Draft, exp (December 2, 2022);
- OC Transpo E-bus Maintenance Feasibility Report, J.L Richards (November 4, 2021);
- Amended Environmental Compliance Approval Number 8368-AGMS3S, Issue Date: February 3, 2017
- Stormwater Site Management Plan OC Transpo, J.L Richards and Associates Limited (July 2006);
- Site Servicing Brief OC Transpo E-bus Parking Garage 1500 St. Laurent Boulevard, J.L Richards (2006);
- Amended Environmental Compliance Approval Number 5605-6VZS8W, Issue Date: December 5, 2006
- Certificate of Approval Number 6643-5DUSP2, Issue Date: September 24, 2002

- Ontario LiDAR DTM Ottawa-Gatineau 2019 – 20 Package H
- Government of Canada Vertical Datum Transformation Stations

1.3 Consultation, Permits and Required Approvals

The following sections have been identified in JLR (2022) that would required approvals for the project.

City of Ottawa

The Site Plan Application (SPA) is supported by the submission of this Site Servicing Report. This report will be submitted for review by the City and it is the responsibility of the design team to address comments provided and revise the report as appropriate.

Ministry of the Environment, Conservation and Parks (MECP)

A pre-consultation was undertaken with the MECP Ottawa District Office in 2022 to support the 2022 SPA and the correspondence is provided in **Appendix B**. As part of that pre-consultation and subsequent consultation with the City of Ottawa, it was determined that the City due to the industrial zoning and use of the site, the City cannot undertake a Transfer of Review of the ECA application on behalf of the MECP. The ECA application to support the ZEB Garage and on-site changes would be an amendment to the existing ECA No. 8368-AGMS3S for the site. The ECA is presented in **Appendix C.**

Another pre-consultation was undertaken with the MECP Ottawa District Office and the City of Ottawa on March 4, 2025 due to the time lapse from the 2022 consultation and to present the updated ZEB Garage and site plan design. The communications related to the pre-consultation are presented in **Appendix D** and the following are the main outcomes from that meeting:

- MECP agreed that the Environmental Compliance Approval (EAC) application does not fall under the City of Ottawa's recently issued Combined Linear Infrastructure (CLI) EAC. Therefore, the ECA application will be submitted to using the standard application form.
- MECP indicated that the ECA application for the ZEB Garage site works should be submitted as an amendment to the latest ECA issued for the site in 2017.
- MECP agreed that the ECA amendment application could be submitted and reviewed by the City of Ottawa as part of their Transfer of Review agreement. Therefore, the ECA amendment application would be submitted to the City and ultimately their review and sign-off on the application then submitted to the MECP would result in the MECP providing administrative approval.

The ECA amendment will be undertaken as part of AECOM's scope of work.

Rideau Valley Conservation Authority (RVCA)

A pre-consultation with Rideau Valley Conservation Authority (RVCA) was undertaken as part of the 2022 SPA report and the correspondence is provided in **Appendix A**.

In lieu of another pre-consultation with RVCA due to the time lapse from the 2022 consultation, it has been agreed during the March 4, 2025 pre-consultation with MECP Ottawa District Office and City of Ottawa that RVCA's review of the updated ZEB Garage and site plan design as part of the revised Site Plan Application submission and associated comments will be accepted as the pre-consultation supporting the MECP ECA application. The communications from the March 4, 2025 pre-consultation meeting are presented in **Appendix D**.

The outcome of the 2022 pre-consultation with RVCA as part of the 2022 SPA submission are applied as part of the civil site and stormwater management design supporting the updated ZEB Garage and site plan.

2 Geotechnical Consideration

A geotechnical investigation was undertaken for the subject site and documented in the report entitled Geotechnical Investigation Proposed OC Transpo Electrical Bus Garage 1500 St. Laurent Boulevard Ottawa, Ontario (EXP Services Inc., November 2024).

The recommendations from that report were incorporated into the design of the subject site. A copy of the report is included in **Appendix E.**

3 Water Servicing

3.1 Background

Water Servicing Based on information provided by OC Transpo including the *Site Servicing Brief OC Transpo E-bus Parking Garage 1500 St. Laurent Boulevard, Ottawa, ON* (JL Richards, April 2022), the existing site consists of 150 mm and 200 mm diameter private watermain piping which loops around and services the existing North and South Garages. This system is fed from a 305 mm diameter watermain within Belfast Road. In addition, there is a 150mm service stub which is connected to a 406mm diameter main within St. Laurent Boulevard.

3.2 Design Criteria

The design criteria applied to the water servicing design followed the Ottawa Water Distribution Guidelines and associated Technical Bulletins. A summary of the applicable criteria is presented below:

- Average Heavy Industrial Flow = 55,000 L/ha/d
- Industrial Maximum Daily Demand = 1.5 x average day L/gross ha/d
- Industrial Maximum Hour Demand = 1.8 x maximum day L/gross ha/d
- Minimum Watermain Size = 150 mm diameter
- Minimum Depth of Cover = 2.4 m from top of watermain to finished grade
- During normal operating conditions desired operating pressure is within the range of 350 kPa and 480 kPa
- During normal operating conditions pressure must not drop below 275 kPa
- During normal operating conditions pressure shall not exceed 552 kPa
- During fire flow operating pressure must not drop below 140 kPa

The anticipated water demand and required minimum and maximum water pressures are based on the Ottawa Water Distribution Guidelines. Boundary conditions for the total 1500 St. Laurent Boulevard site, including the subject site, were reviewed by others, and it has been determined that a new 254 mm diameter service line fed from the 305 mm diameter watermain in Belfast Road is required to support the demand of the entire 1500 St. Laurent Boulevard site, including the proposed new ZEB Garage.

The consumption rate was estimated based on the Ottawa Water Distribution Guidelines for Heavy Industrial, using 55,000 L/ha/d. The area of the subject site is 1.80 ha, giving an average daily flow rate of 99,000 L/day or 68.75 L/min. Applying the peak factors noted above, the Maximum Day and Maximum Hour demand are calculated as 103.12.1 L/min (1.72 L/s) and 185.62 L/min (3.1 L/s), respectively.

3.3 Proposed Servicing

The new bus garage will be serviced from the existing watermain loop on the site by connecting to the existing 200 mm diameter watermain adjacent to the North Garage. A new fire hydrant will be added within 45 m of the Siamese connection, to be located at the mechanical room on north side of the new building.

In addition, a new fire hydrant will be located to the south of the new garage and will be fed by a new 200 mm diameter pipe connecting to a proposed 254 mm diameter watermain that will tie into to the City's 305 mm diameter watermain in Belfast Road. The proposed 254 mm diameter feed from Belfast Road will be constructed under a separate contract and has been determined by others to be required to provide the domestic and fire water flows for the total 1500 St. Laurent Boulevard site, including the ZEB Garage.

3.4 Fire Flow Requirements

The FUS method was used to estimate the required fire flow for the subject site, determined to be 183 L/s. A summary of the calculation is provided in **Table 3-1**.

Table 3-1. FUS Fire Flow Calculations (Per City of Ottawa ISTB-2018-02) for OC Transpo ZEB Garage

Step	Parameter	Value		Note
A	Type of Construction	Non-combustible		
	Coefficient (C)	0.8		Table G1 - ISTB-2018-02
B	Ground Floor Area	6331.5	m^2	
C	Height in storeys	1	storeys	
	Total Floor Area	6331.5	m^2	
D	Fire Flow Formula	F=220CVA		
	Fire Flow	14004	L/min	
	Rounded Fire Flow	14000		Rounded to nearest 1000 L/min
E	Occupancy Class	Free Burning		Municipal storage building - combustible occupancy class
	Occupancy Charge	15%		
	Occupancy Increase or Decrease	2100		
	Fire Flow	16100	L/min	
F	Sprinkler Protection	Automatic Fully Supervised		
	Sprinkler Credit	-50%		
	Decrease for Sprinkler	-8050	L/min	
G	***North Side Exposure***			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	0	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	0	m-storeys	
	Separation Distance	> 45	m	
	North Side Exposure Charge	0%		Table G5 - ISTB-2018-02
	East Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	86	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	86	m-storeys	
	Separation Distance	15.3	m	
	East Side Exposure Charge	14%		Table G5 - ISTB-2018-02
	South Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	0	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	0	m-storeys	
	Separation Distance	>45	m	
	South Side Exposure Charge	0%		Table G5 - ISTB-2018-02
	West Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	80	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	80	m-storeys	
	Separation Distance	40	m	
	West Side Exposure Charge	5%		Table G5 - ISTB-2018-02
	Total Exposure Charge	19%		
	Increase for Exposures	3059	L/min	
H	Fire Flow	11109	L/min	E + F + G
	Rounded Fire Flow	11000	L/min	Rounded to nearest 1000 L/min
City Cap	**Required Fire Flow (RFF)**	**11000**	**L/min**	City Cap Does Not Apply
		183	**L/sec**	

3.5 Summary and Conclusions

The total of maximum day and fire flow demands for the new garage is calculated to be 184.72 L/s (1.72 L/s domestic + 183 L/s fire).

4 Sanitary Servicing

4.1 Background

The existing site is serviced by a 200 mm sanitary pipe which conveys flows from the existing North and South Garages, and the Main building, to the existing 375mm diameter sanitary sewer within Belfast Road via a small pumping station. It has been determined that this pumping station is at capacity, and therefore the new ZEB Garage will connect directly by gravity to the 375mm diameter sanitary sewer in Belfast Road.

4.2 Design Criteria

The following summarizes the parameters, as per the Ottawa Sewer Design Guidelines (2012 OSDG), used to design the sanitary sewer system for the subject site:

- Heavy Industrial = 55,000 L/ha/day
- Infiltration and Inflow Allowance = 0.33 L/s/ha
- Average Daily Demand = 55,000 L/ha/d
- Peaking Factor (from Appendix 4-B of 2012 OSDG) = 6.5
- Sanitary sewers sized using Manning's Equation
- Minimum Sanitary Sewer Lateral = 135 mm diameter
- Minimum Manning's n = 0.013
- Minimum Depth of Cover = 2.5 m from crown of sewer to grade
- Minimum Full Flowing Velocity = 0.6 m/s
- Maximum Full Flowing Velocity = 3.0 m/s

4.3 Proposed Sanitary Servicing and Calculations

The anticipated peak flow from the proposed subject site is provided below and supporting calculations are provided in **Appendix G**:

The sanitary flow rate was estimated based on the 2012 OSDG for Heavy Industrial, using 55,000 L/ha/d. The area of the subject site (building and surrounding area) is 1.8 ha, giving an average daily flow rate of 99,990 L/day or 68.75 L/min (1.15 L/s).

Applying the Infiltration and Inflow Allowance of 0.33 L/ha/s gives 0.60 L/s for as total of 1.75 L/s.

Applying the peak factor of 6.5 noted above, the peak sanitary flow is calculated as 11.4 L/s.

The proposed sanitary servicing of the subject site is presented in Drawing Sheets C010. The sanitary service is a 200 mm diameter pipe.

4.4 Summary and Conclusions

From the above, calculations provided in **Appendix G** and Drawing Sheet C010, the sanitary sewer design for the subject site meets the City of Ottawa requirements.

5 Storm Servicing and Stormwater Management

5.1 Design Criteria and Design Approach

5.1.1 Design Criteria

At a minimum, the following guidelines will be referred to as part of the detailed stormwater management (SWM) design:

- Ottawa Sewer Design Guidelines (OSDG, 2012) and all associated Technical Bulletins
- Stormwater Management Planning and Design Guidelines (Ontario Ministry of Environment, 2003)

The primary intent of the SWM design is to service the area impacted by the ZEB Garage which is expected to extend beyond the footprint of the actual building structure to include up to the tie-in of the impacted area footprint to the existing grading and use of the remainder of 1500 St. Laurent Boulevard. In addition, a substation is also proposed for the northwest corner of the site. This substation is designed by Envari and their consultant and located in the far northwest corner of the site, north of the ZEB Garage.

In the context of SWM design, the ZEB Garage and substation refers to all areas in the northwest corner of 1500 St. Laurent Boulevard impacted by the integration of these features into the site. The main objectives and criteria of the SWM design to support the ZEB Garage and substation would be but is not limited to:

- Maintain the current drainage patterns, inlets (CBs and DIs) and conveyance (surface and subsurface) as much as possible.
- Attempt to have no negative drainage impacts to other portions of the 1500 St. Laurent Boulevard site.
- Use the same outlet from the site without any modifications to the outlet headwall and first upstream storm sewer as it ties into the recipient watercourse.
- Maintain current restricted flow rates from the site (180 + 175 + 40 L/s restricted flow rate during the 100-year by introducing storage within the impacted areas around the ZEB Garage and substation.
- Introduce water quality control measures to provide 80% total suspended solids (TSS) removal prior to flow discharging from the site.
- At a minimum, size any new storm sewers to convey the 5-year flow (2012 OSDG and MECP requirement).
- Design on-site storage for the volume generated between the 5-to-100-year storm peak flows (OSDG requirement).
- Design surface storage to a maximum of 0.3 m depth (2012 OSDG requirement).
- Contain the 100-year storm runoff on-site (2012 OSDG requirement).
- Design an emergency spill route to service the ZEB Garage and substation.

5.1.2 Design Approach

Based on the design criteria above and in consideration of the proposed changes to 1500 St. Laurent Boulevard with the construction of the ZEB Garage and substation, there following were used as part of the site stormwater design approach:

- The ZEB Garage will require buses to move into and out of the building plus through the site to access the existing North and South Garages by traveling designated routes through the 1500 St. Laurent Boulevard site. For any areas impacted by the ZEB Garage and substation, it was decided to store up to the 100-year storm event underground to avoid surface ponding and associated grading within driving lanes.
- The evaluation of the 1500 St. Laurent Boulevard site is undertaken using stormwater management modeling which is discussed in further detail in **Sections 5.2.3 and 5.3**. The following storm events were used to simulate site conditions (existing and proposed):
  - 5- and 100-year 3 hour Chicago storm event per the 2012 OSDG;
  - 100-year 3 hour Chicago storm + 20% to represent a stress test event on the system for climate change.
- The outlet conditions of the storm sewer discharging off-site for existing and proposed conditions are the following:
  - Free flow outlet to the ditch during the 5-year storm event;
  - Fixed water levels set to the obvert of the outlet pipe (67.53 m) during the 100-year and 100-year + 20% storm events.

5.2 Existing Storm Infrastructure

5.2.1 Overall Site Storm System

The overall 1500 St. Laurent Boulevard site is 13.59 ha and consists of several individual storm sewer systems servicing different portions of the site. Overall, the site drains to one of two outlets. The majority of the site ultimately drains to the South Cyrville Drain located north of the site (approximately 11.48 ha) with the remainder of the site draining to the Rideau River via the storm sewer in Belfast Road (approximately 2.11 ha). The outlets from the storm catchments areas for the site are indicated in **Figure 5-1**. The site plans from the 2006 Site Servicing report also included a figure indicating the catchment outlets and it is provided in **Appendix H**.

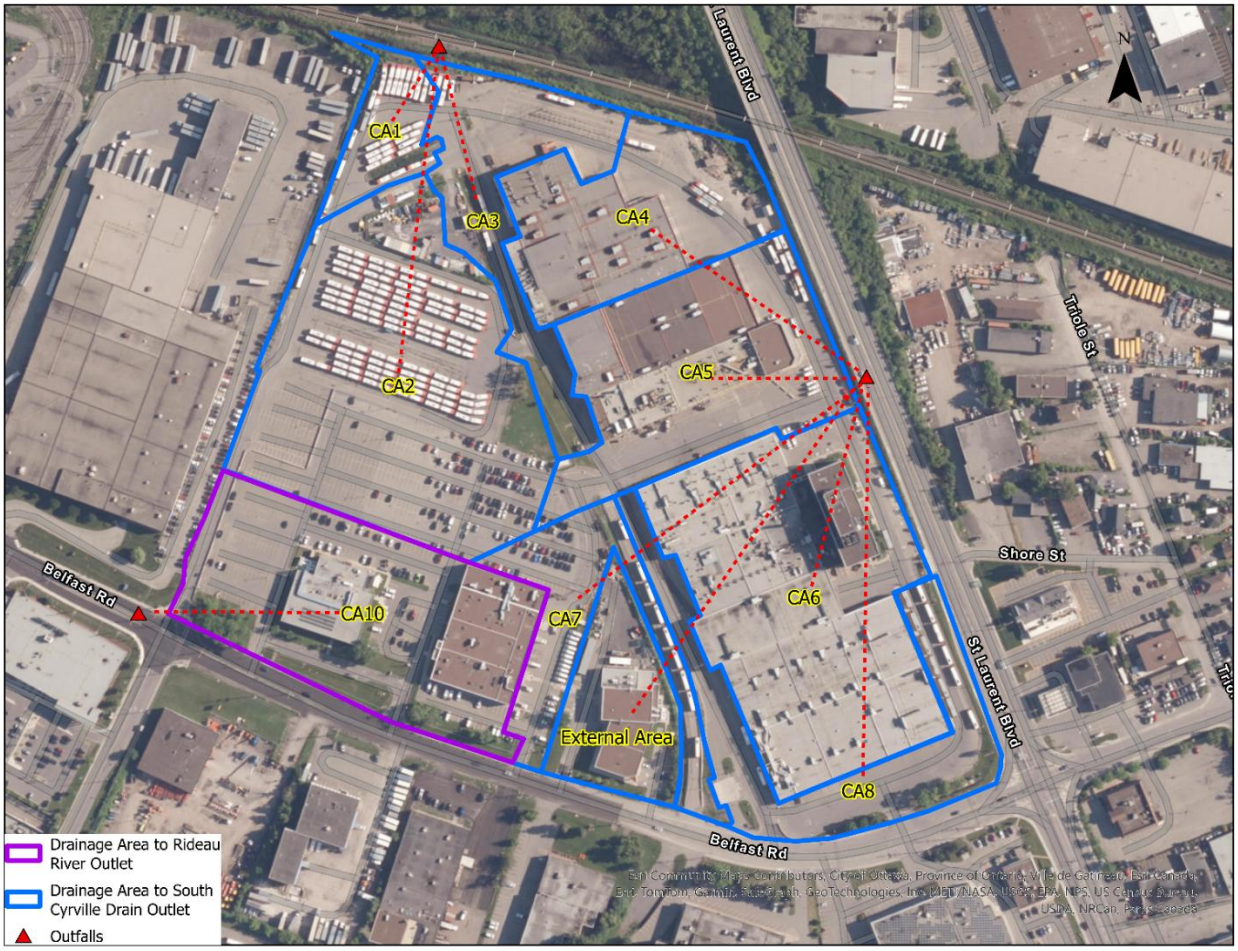


Figure 5-1. 1500 St. Laurent Boulevard Storm Catchment Areas Outlets

Runoff from catchments CA1, CA2, CA3 and CA4 on the northwest side of site are conveyed via an interconnected storm sewer system to a 600 mm storm sewer and outlets to the ditch adjacent to the railway track which connects to the South Cyrville Drain. Runoff from CA5 and CA6 on the central east part of the site, containing the North and South Garages are conveyed by local storm sewer network draining to a 750 mm storm sewer into St Laurent Boulevard that goes north and discharges into the South Cyrville Drain at the railway crossing. Runoff from catchments CA7 and CA8 on the south and southeast side of the site is conveyed into a storm sewer in Belfast Road that connects into the St. Laurent Boulevard storm sewer and conveys north to the South Cyrville Drain at the railway crossing. **Figure 5-2** provides layout of the existing site catchment areas that are the subject of this site service brief.



Figure 5-2. 1500 St Laurent Boulevard Catchment Areas – Northwest Corner and Subject of Site Service Brief

5.2.2 Northwest Corner of 1500 St. Laurent Boulevard

The northwest corner of the 1500 St. Laurent Boulevard site is the proposed location of the ZEB Garage. This consists of overall catchment areas CA1, CA2 and CA3 (see **Figure 5-2**). This portion of the site was the subject of a site servicing plan from 2006 which formed the basis of an amended ECA 5605-6VZS8W (Issued December 5, 2006, see **Appendix B**). The purpose of the site servicing design of the northwest area in 2006 was the installation of the fueling station (Jurassic Fueling Station) and an extension of the bus parking area in the northwest portion of the site.

The 2006 design was an upgrade to the original 2002 design within the northwest corner of the site related to parking lot upgrades and the basis of ECA 66643-5DUSP2 (Issued September 24, 2002, see **Appendix B**). The 2002 design included a number of storm and stormwater management design conditions which were carried into the 2006 design.

As part of the ECA application in 2002, there were a number of water quantity restrictions requested by the City related to control of on-site stormwater and the conditions are listed below:

- Maximum allowable flow should be based on runoff coefficient of 0.5;
- Runoff C factors 0.2 and 0.9 should be used for previous and impervious surfaces respectively;
- For 100-year storm event, total discharge from site should be restricted by 5-year storm event peak flow rate using the allowable discharge rate determined based on C value of 0.5;

- On-site detained up to 100-year storm event is required for storm discharge in excess of the allowable flow determined.

In addition to the outlet restrictions for the northwest portion of the site, the MECP requested that an oil/grit interceptor be provided to contain any potential spills from the site.

Currently the northwest area of the site consists of the following storm infrastructure:

- Storm sewer network with pipe sizes ranging from 300 mm to 600 mm diameter directed to an outlet headwall into the ditch along the railway corridor.
- Catchbasins (CBs) and one Ditch Inlet (DI) where surface flow is directed, captured and conveyed to the storm network.
- Oil Grit Separator (OGS, Stormceptor Model STC 2000) located in-line and flow from all the storm sewers from the northwest corner pass through it prior to discharging to the ditch in the railway corridor. The OGS can intercept 2,945 liters of oil and hydrocarbons in addition of providing 6,150 litres of sediment capacity.
- Three inlet control devices (ICDs):
  - ICD #1 controls the flows to 180 L/s from catchment CA2;
  - ICD #2 controls the flows to 175 L/s from catchment CA3; and
  - ICD #3 controls the flows to 40 L/s from catchment CA1 and a small portion of CA2.
- On-site surface storage.

Figure 5-1 presents the overall catchment areas from 1500 St. Laurent Boulevard to their various outlets. The catchment areas specific to the northwest corner of the site and subject of this site servicing brief are presented in **Figure 5-2**. The catchments and existing storm sewer layout including ICD locations as designed in 2006 for the northwest corner of the site is presented in **Figure 5-3**. The full site plan and storm sewer layout of the northwest corner from 2006 is provided in **Appendix H**. The characteristics of these 2006 delineated catchments are summarized in **Table 5-1**.

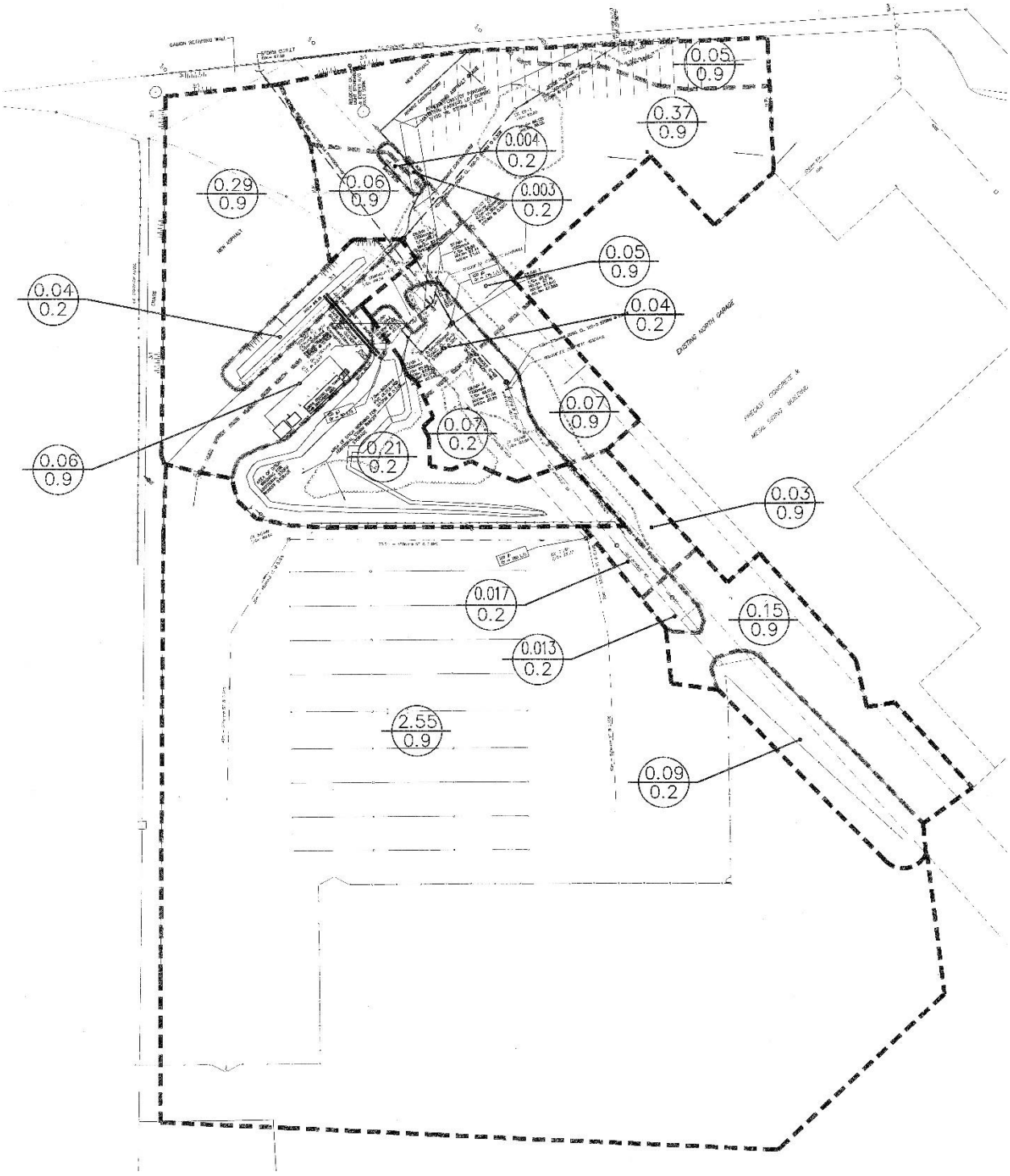


Figure 5-3. Site Plan and Storm Sewer Layout from 2006

Table 5-1. 2002-2006 Existing Conditions Catchment Areas - Northwest Corner 1500 St. Laurent Boulevard Site

Overall Catchment Area ID (Figure 5-2 & Figure 5-3)	Recipient MH or CB	Total Area (ha)	Area (ha) at Runoff Coefficient		Weighted Runoff Coefficient
			0.2	0.9	
CA2	CB4	1.38		1.38	0.9
CA2	CB3	0.26		0.26	0.9
CA2	CB2	0.6		0.6	0.9
CA2	CB1	0.31		0.31	0.9
CA3	Ex. STM/MH	0.26	0.1	0.16	0.63
CA3	Ex. CB/MH	0.05	0.02	0.03	0.62
CA3	CB/MH3	0.14	0.07	0.07	0.55
CA3	Ex. CB-1	0.05		0.05	0.9
CA3	Ex. CB-2	0.37		0.37	0.9
CA3	CB/MH1	0.05		0.05	0.9
CA3	CB/MH2	0.09	0.04	0.05	0.59
CA3	ST/MH1	0.09	0.04	0.05	0.59
CA1 and CA2	Ex. DICB	0.6	0.25	0.35	0.61
Total Catchment Area (ha)		**4.25**			

5.2.3 Existing Conditions PCSWMM Model

Though there are ICDs controlling outflow from the northwest site to a total of 395 L/s (180 + 40 + 175 = 395 L/s), an existing conditions PCSWMM model was created to understand how hydraulics of the existing storm sewer functions and to determine the approximate size of the ICDs. The modeling of the existing conditions will also inform the proposed stormwater design.

The PCSWMM model was developed using the existing drainage area plans from 2002 and 2006 as general guidance (see **Figure 5-3** and **Appendix H**). The existing storm sewer network was input based on information from 2002, 2006 and survey undertaken for this project in 2024. The existing conditions impervious values were based on aerial photography from GeoOttawa for 2020 to capture the current land use of the site. It was found that some of the areas indicated with a runoff coefficient of 0.2 in 2006 are now impervious surfaces.

Existing on-site storage was added to the model where currently available on-site. The available on-site storage determined using Provincially Sourced Digital Terrain Model (DTM) which was collected with LiDAR from Ontario GeoHub. The approximate maximum surface area that could pond by a catchbasin or inlet was determined along with the depth of ponding (subtraction of maximum ponding depth and top of CB or CBMM). This information was input into PCSWMM as a surcharge depth (depth of ponding) and ponding area. Due to the assumption in PCSWMM that the ponding area is uniform throughout the surcharge depth, like a cylinder, to account for the actual inverted conical shape of the surface storage, the only 1/3 of the ponding area was input into the model.

The existing condition catchment area plan and storm sewer layout as represented in PCSWMM is presented in **Figure 5-4**. Input parameters for the PCSWMM model is presented in **Table 5-2**.

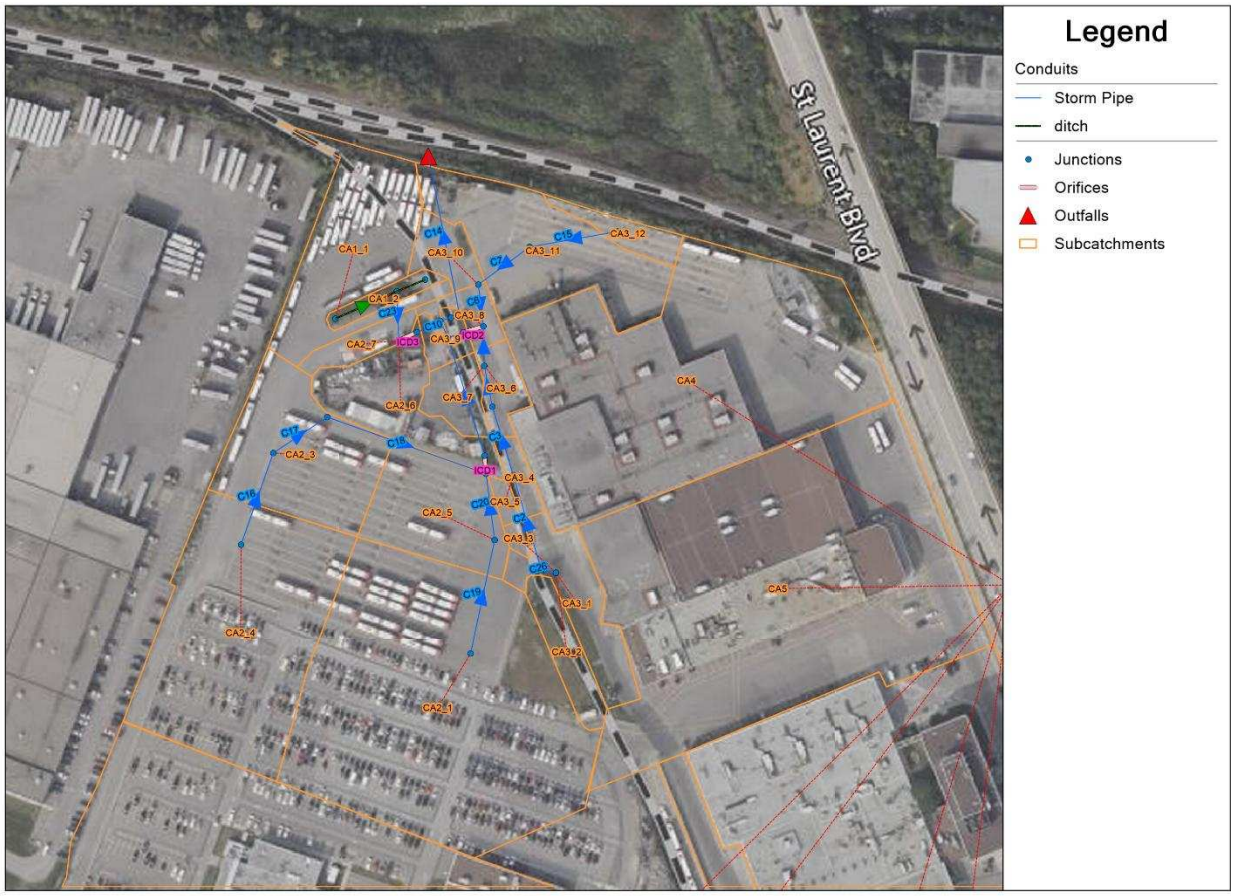


Figure 5-4. Existing Conditions Catchment Area and Storm Sewer for the Northwest Corner as Represented in PCSWMM

Table 5-2. Existing Conditions Catchment Parameters for PCSWMM Simulation

Catchment ID (Figure 5-4)	Recipient MH or CB	Area (ha)	Impervious (%)	On-site Storage Depth (m)	On-Site Storage Max. Surface Area (m^2) *
CA1	J4	0.37	100	-	-
CA2_1	CB4	1.29	100	0.3	389.39
CA2_3	CB1	0.35	100	0.3	442.68
CA2_4	CB2	0.75	100	0.3	404.65
CA2_5	CB3	0.25	100	0.2	429.9
CA3_1	ExCB	0.17	100	0.1	13.3
CA3_2	ExCB	0.09	25		
CA3_3	ExCB	0.01	100		
CA3_11	NE-CB2	0.39	100	0.2	545.0
CA3_4	ExCBMH1	0.04	100	-	-
CA3_6	CBMH3	0.06	100	0.13	36.1
CA3_7	CBMH3	0.07	95		
CA3_5	ExCBMH1	0.02	100	-	-
CA2_7	DICB1	0.06	100	1	11.6
CA2_6	DICB1	0.21	100		
CA3_8	CBMH2	0.05	100	-	-
CA3_9	CBMH2	0.04	50	-	-
CA3_10	CBMH1	0.07	100	0.25	43.2
CA1_2	J3	0.04	25	-	-
CA3_12	NE-CB1	0.06	100	0.05	86.9
Total Catchment Area (ha)		**4.38**	**97%**		

* For surface storage, only 1/3 of the ponding area was input into the PCSWMM model.

Further details related to the input and development of the existing conditions PCSWMM model, including catchment area parameters and assumptions related to storm sewers including inverts and losses, is provided in **Appendix I**.

Based on the existing conditions design, there are three ICDs throughout the northwest storm system that limit discharge from the area. Available plans only indicated that an ICD was installed and its a restricted flowrate, but no details were available regarding the specific sizes of the existing ICDs. From the 100-year existing conditions PCSWMM model, the estimated ICD sizes were determined to meet the assigned restricted rate from the 2006 design. Therefore, the estimated ICD sizes from the PCSWMM model simulation are 0.261 m diameter for ICD#1 (180 L/s), 0.425 m diameter for ICD#2 (175 L/s) and 0.15 m diameter for ICD#3 (40 L/s).

The hydraulic grade line (HGL) results for the existing conditions PCSWMM model are provided in **Table 5-3** and related back to the top of grate or rim elevation of the structure. Since there are no building weeping tiles are connected to the existing storm sewer, the HGL can reach the surface. Profiles of the three key storm sewer laterals are presented in **Figure 5-5, Figure 5-6 and Figure 5-7**.

Table 5-3. Existing Conditions Simulation Hydraulic Grade Line Results for All Storm Events

CB/MH ID	Rim Elev. (m)	Hydraulic Grade Line (m)			Difference (m)*		
		5-Year	100-Year	100-Year + 20%	5-Year	100-Year	100-Year + 20%
DICB1	68.00	68.90	69.07	69.18	*-0.90*	*-1.07*	*-1.18*
CB1	69.40	69.86	70.04	70.14	*-0.46*	*-0.64*	*-0.74*
CB2	69.40	69.96	70.44	70.72	*-0.56*	*-1.04*	*-1.32*
CB4	69.40	69.91	70.46	70.77	*-0.51*	*-1.06*	*-1.37*
CBMH1	68.75	68.86	68.99	69.06	*-0.11*	*-0.24*	*-0.31*
CB3	69.50	69.79	70.05	70.19	*-0.29*	*-0.55*	*-0.69*
NE-CB2	68.80	68.93	69.15	69.27	*-0.13*	*-0.35*	*-0.47*
CBMH3	68.64	68.80	68.82	68.84	*-0.16*	*-0.18*	*-0.20*
DICB1-DUM	68.00	68.56	68.62	68.64	*-0.56*	*-0.62*	*-0.64*
ExCB	68.79	69.06	69.23	69.33	*-0.27*	*-0.44*	*-0.54*
NE-CB1	68.85	68.93	69.16	69.27	*-0.08*	*-0.31*	*-0.42*
CBMH2	68.97	68.79	68.82	68.84	0.17	0.15	0.13
CBMH2-DUM	68.80	68.64	68.68	68.71	0.16	0.12	0.09
ExCBMH1	68.94	68.82	68.83	68.83	0.12	0.11	0.11
ExMH1	68.80	68.80	68.80	68.80	*0.00*	*0.00*	*0.00*
ExMH2	69.02	69.00	69.02	69.02	0.02	*0.00*	*0.00*
J2	68.75	68.85	68.85	68.85	*-0.10*	*-0.10*	*-0.10*
J3	68.80	68.85	68.86	68.86	*-0.05*	*-0.06*	*-0.06*
J4	68.80	68.86	68.87	68.87	*-0.06*	*-0.07*	*-0.07*
MH1	70.05	68.61	68.66	68.68	1.44	1.39	1.37
MH10	69.68	69.68	69.68	69.68	*0.00*	*0.00*	*0.00*
MH10-DUM	69.68	68.76	68.70	68.72	0.92	0.98	0.96
MH11	69.40	68.55	68.60	68.62	0.85	0.80	0.78
MH2	69.50	68.33	68.39	68.41	1.17	1.11	1.09
MH9	69.80	69.80	69.80	69.80	*0.00*	*0.00*	*0.00*
OGS-STC2000	69.58	68.45	68.50	68.52	1.13	1.08	1.06

* Difference is Rim minus HGL (Rim – HGL).

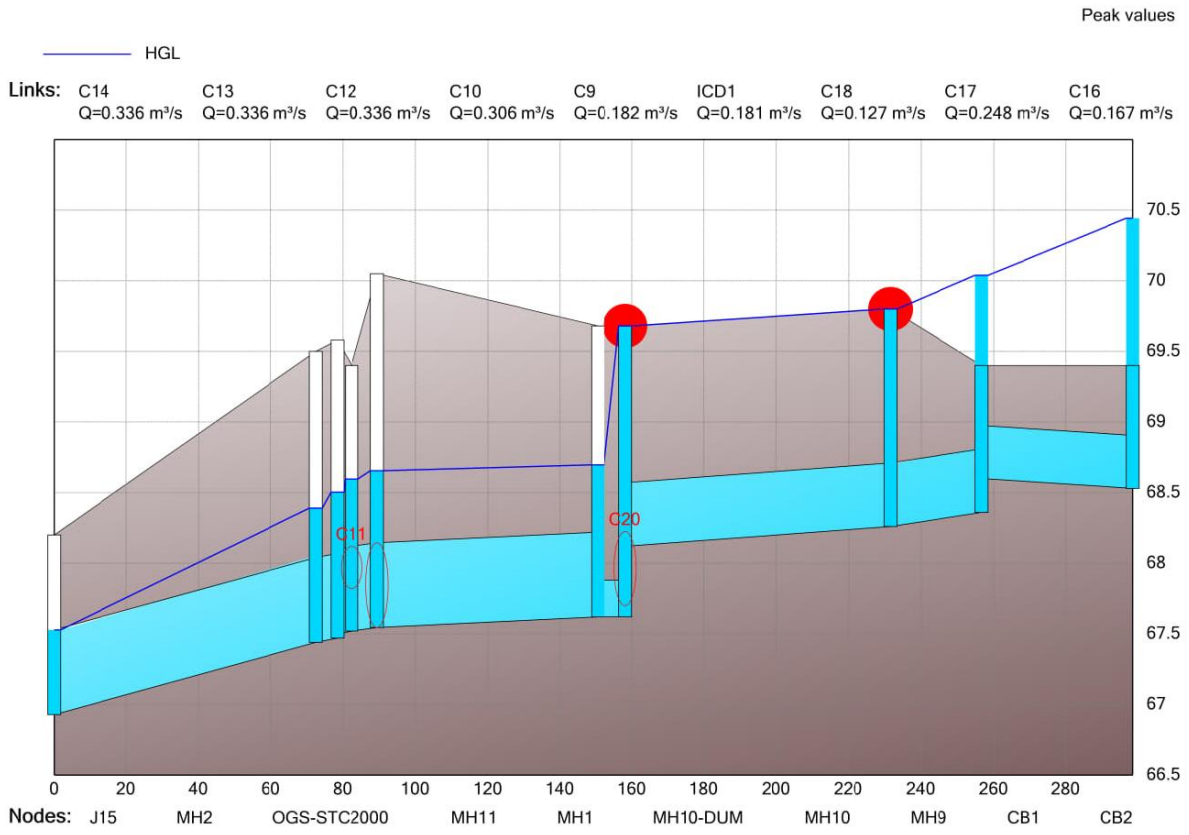


Figure 5-5. Existing Hydraulic Grade Line Profile for the Bus Parking Lot Storm Sewer for the 100-Year Storm Event

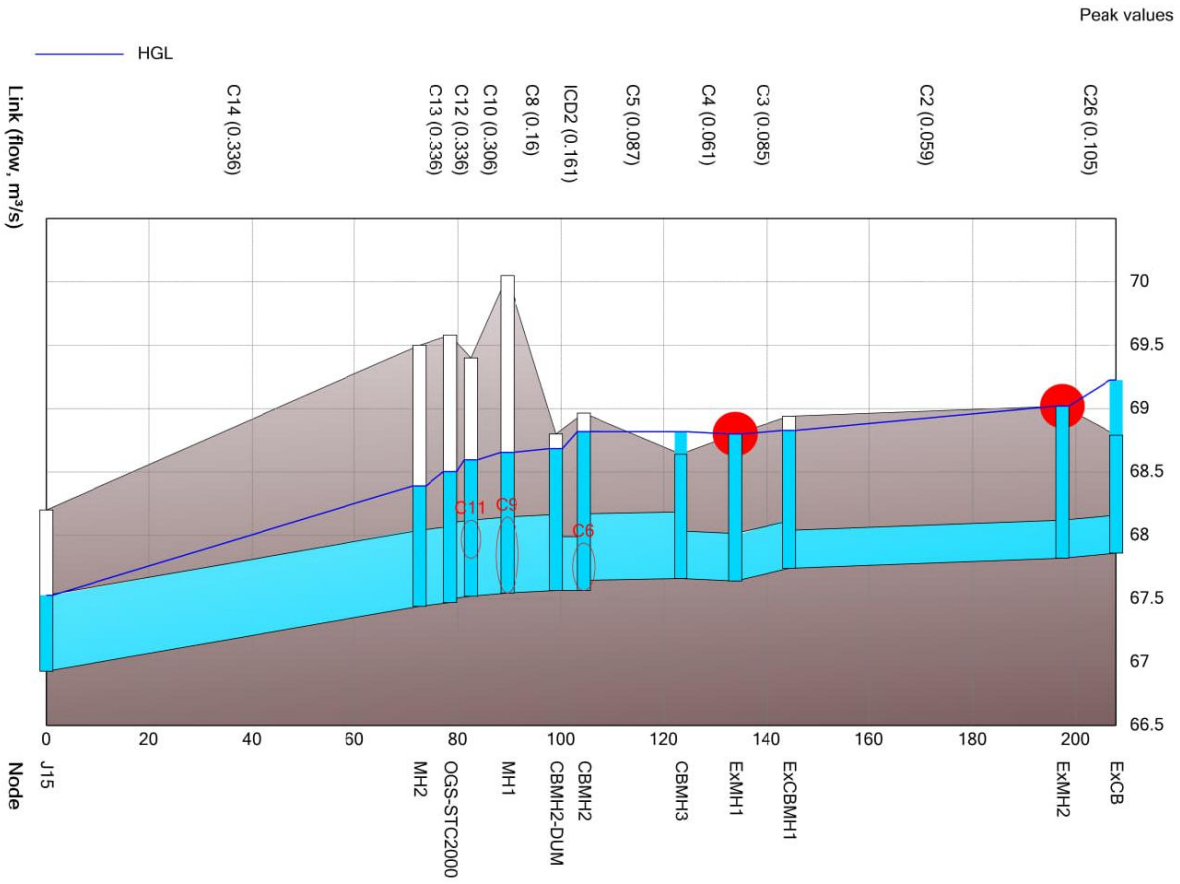


Figure 5-6. Existing Hydraulic Grade Line Profile for the Sewer Parallel to the North Garage for the 100-Year Storm Event

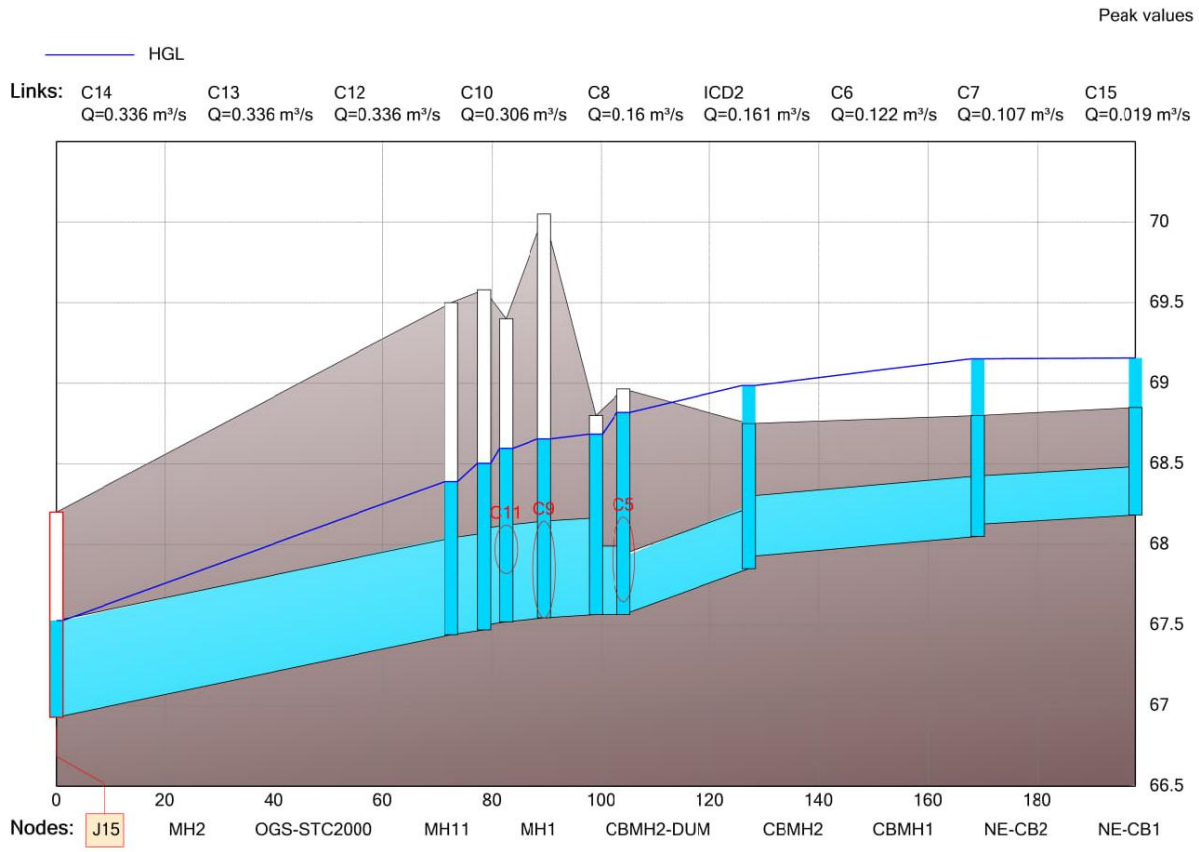


Figure 5-7. Existing Hydraulic Grade Line Profile for the Sewer North of the North Garage for the 100-Year Storm Event

From the existing conditions simulation of the storm sewer system for the northwest corner of 1500 St. Laurent Boulevard, it can be seen that:

- During the 5 -year event, there are some portions of the system which do not have capacity to convey the contributing area. As a result, surface storage is activated where it is available, the system surcharges in some locations and water spills to the surface at several manholes. Based on site topography, any spill would either sheet flow directly to a local surface storage or convey north to the next local surface storage.
- During the 100-year event, similar results to the 5-year event are observed with available surface storage being used, surcharging of the storm sewer system and some locations where water spills to the surface at several manholes.
- The stress test event (100-year + 20% storm event), the system performs in a similar manner as the 5-year and 100-year with the HGL slightly higher than the 100-year, more surface storage utilized and water spilling to the surface.

Though it was not simulated, based on existing topography of the site, it is possible that some excess surface flow from the northwest portion of the site may spill to the north and east off-site when surface storage is exceeded as an emergency spill route. The 2006 design did not include any indication of any spill or emergency spill locations in the northwest corner of the site.

It should also be noted that the above results present a simulation of the existing site as it is viewed currently. There are areas of the site which have been modified with surface features removed or altered.

Overall, from the existing conditions analysis, there are areas of the northwest corner storm system which will continue to surcharge and use surface storage during the 5-year event and possibly surcharge to the surface in less frequent events (100-year and stress test) since those areas are not proposed to be altered due to the ZEB Garage and remain as-is.

5.3 Proposed Storm Servicing and Stormwater Management

Using existing conditions model for the northwest corner of 1500 St. Laurent Boulevard as a base, the proposed site changes to accommodate the ZEB Garage were applied. This involves the following land use changes:

- Bus parking area replaced with the ZEB Garage
- Northwest corner serving as the bus graveyard is replaced with a substation, designed by Envari and their subconsultant, but draining into the storm sewer system.

The updated drainage area plan for the northwest corner of the site is presented in **Figure 5-8**.

The majority of the existing storm sewer system currently servicing the northwest site is proposed to remain as-is with the exception of areas where land use changes require modifications. These include around the ZEB Garage location as well as local modifications to accommodate the substation. The proposed storm sewer system is indicated in **Figure 5-8** with the proposed system indicated in green, changed existing storm sewer (i.e., change in rim elevation, pipe connection angles, break in existing pipe with new MH, etc.) in orange, and the existing system in blue. The proposed storm sewer presented in this report should be reviewed in conjunction with the Civil Drawing sheet C006 provided in **Appendix J**. Further details regarding the design and revisions to the storm sewer system are presented in the sections below.

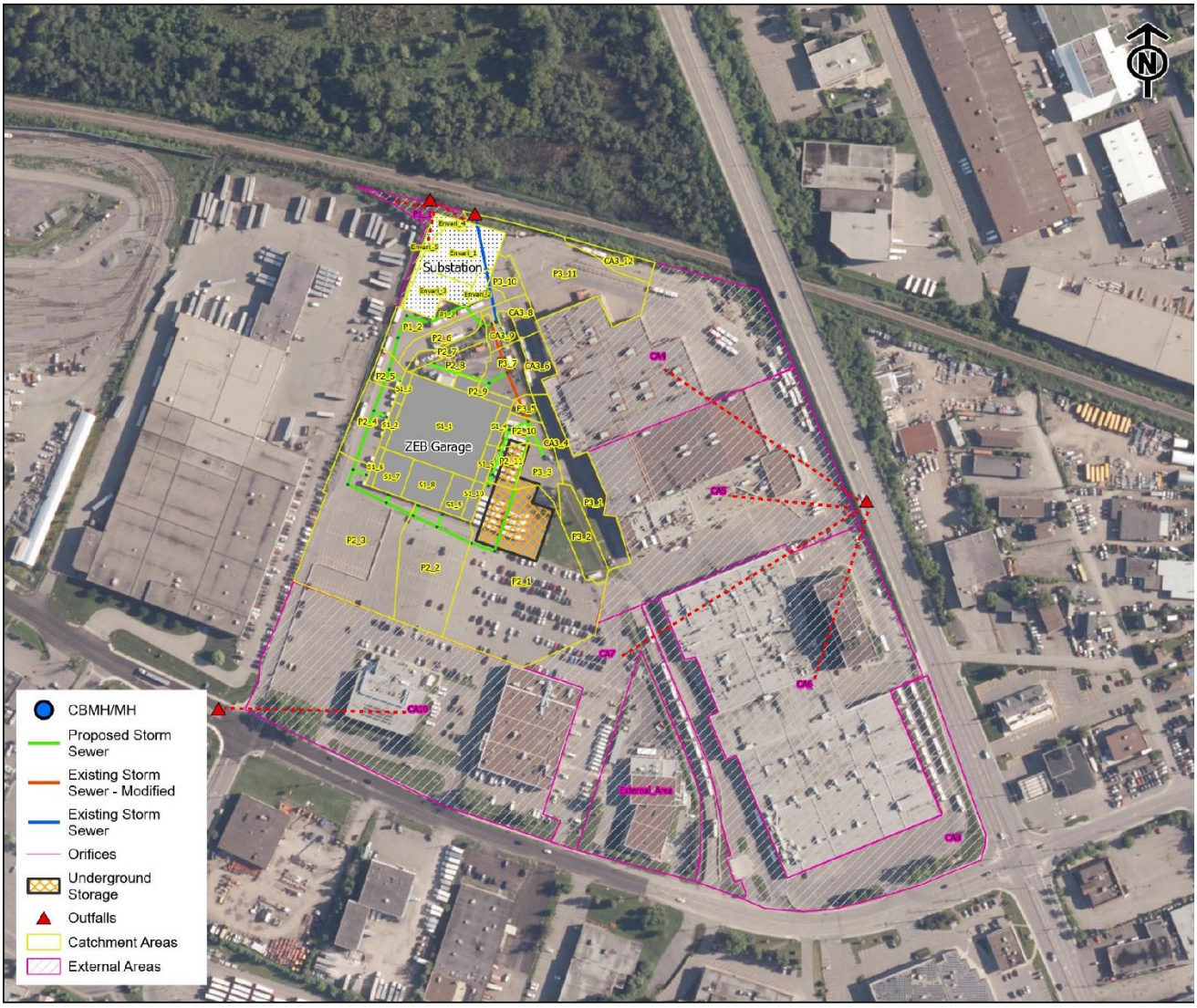


Figure 5-8. Proposed Conditions Catchment Area and Storm Sewer for the Northwest Corner as Represented in PCSWMM

5.3.1 Proposed Catchment Areas

The total catchment area to the northwest outlet increased slightly under proposed conditions compared to existing conditions. The total proposed conditions catchment area is 4.42 ha compared to 4.38 ha under existing conditions (increase in area of 0.04 ha). This increase is in part due to the confirmation of drainage boundaries based on existing grading at the far northwest corner of the site adjacent to the rail line. Due to the slightly increase catchment area, changes in land use and storm sewer locations, the overall catchment areas were subdivided into smaller areas. The revised drainage areas to the storm sewer system are presented in **Figure 5-8** and catchment areas and parameters are presented in **Table 5-4**.

For the areas contributing to the existing storm sewer north and parallel to the North Garage, the drainage areas remain generally the same except for those areas that bound the adjustments in the site grading due to the ZEB Garage and substation. These are areas CA3_4, CA3_6, CA3_8, CA3_9 and CA3_12 indicated in **Figure 5-8** and **Table 5-4**. These areas maintain the same catchment name as under existing conditions.

Table 5-4. Proposed Conditions Catchment Parameters for Rational Method and PCSWMM Simulation

Catchment ID (Figure 5-8)	Recipient MH or CB	Area (ha)	Impervious (%)	On-site Storage Depth (m)	On-Site Storage Max. Surface Area (m^2) *
CA3_12	NE-CB1	0.06	100	0.05	86.9
CA3_4	ExCBMH1	0.04	100	-	-
CA3_8	CBMH2	0.05	100	-	-
CA3_9	CBMH2	0.04	75	-	-
Envari_1	P3_10	0.15	100	-	-
Envari_2	NewCBMH4	0.02	100	-	-
Envari_3	NewCBMH3	0.09	100	-	-
Envari_4†	**OF1**	**0.01**	**100**	-	-
Envari_5†	**OF1**	**0.02**	**100**	-	-
P1_1†	**OF1**	**0.07**	**25**	**-**	**-**
P1_2	NewCBMH2	0.11	100	1.43**-	2306.6**-
P2_1	NewCBMH10	0.87	94	-	-
P2_10	MH12	0.05	100	-	-
P2_11	NewCBMH12	0.05	100	-	-
P2_2	NewCBMH11	0.32	100		
P2_3	NewCBMH9	0.51	100	-	-
P2_4	NewCBMH8	0.12	100		
P2_5	NewCBMH7	0.04	100		
P2_6	DICB1	0.06	100	-	-
P2_7	DICB1	0.05	100		
P2_8	DICB1	0.08	100		
P2_9	NewMH17	0.03	100	-	-
S1_1***	J14	0.33	100	-	-
S1_2***	J2	0.02	100	-	-
S1_3***	J1	0.01	100	-	-
S1_4***	J13	0.02	100	-	-
S1_5***	J12	0.02	100	-	-
S1_6***	J3	0.01	100	-	-
S1_7***	J4	0.06	100	-	-
S1_8***	J5	0.07	100	-	-
S1_9***	J6	0.04	100	-	-
S1_11***	J7	0.02	100	-	-
P3_1	ExCB	0.15	100	0.1	13.2
P3_2	ExCB	0.10	25		
P3_10	CBMH1	0.05	100	0.25	43.2
P3_11	NE-CB2	0.38	100	0.2	545.0
P3_3	NewCBMH12	0.08	94	-	-
P3_5	MH12	0.02	100	-	-
P3_7	CBMH3	0.09	95	0.13	36.1
CA3_6	CBMH3	0.06	100		
Total Catchment Area (ha)		**4.42**	**95%**		

* For surface storage, only 1/3 of the ponding area was input into the PCSWMM model.

** Underground storage depth and area are based on a stage-area curve provided by the supplier based on the footprint and design. Further details, including the stage-area curve are discussed in **Section 5.3.6 and Appendix K**. The storage provided is the total storage available based on the design.

† Area northwest of substation and released uncontrolled from the site to the rail line. Further details are provided in **Section 5.3.5**

***Roof drainage areas

Under proposed conditions, the addition of the ZEB Garage and substation to site result in a slight decrease in imperviousness compared to existing conditions (97% under existing conditions and 95% under proposed conditions). Most of the current site is hard surface some grassed areas scattered throughout the site. The ZEB Garage and substation are proposed to be constructed in areas that are currently hard surface and minimize removal

of grassed areas. There are no new grassed areas proposed to be added to the site with the addition of the ZEB Garage and substation. The decrease in impervious area between existing to proposed conditions is due to the existing conditions design not having accounted for the grassed areas on-site in their assignment of impervious (or runoff coefficient). For example, under existing conditions CA2_1 (see **Figure 5-4 and Table 5-2**) was assigned a runoff coefficient of 0.9 or 100% impervious value, but the area covers most of the triangle of grass located in the middle of the site. Whereas under proposed conditions the area covering the approximate same catchment, P2_1 (**Figure 5-8 and Table 5-4**) was assigned 94% to account for the triangle of grass area within the catchment.

The far northwest corner of the site, northwest of the substation, is currently graded to convey flow to the rail line (Catchment Area P1_1, **Table 5-4**). Under existing conditions, the drainage area in this corner of the site was accounted for in the catchment areas serviced by the existing storm sewer system. Upon review of the existing grading and integration of this area into the proposed grading, particularly for the substation, this area contributes runoff to the north to the rail line. This catchment under existing conditions consists of a vegetated ditch adjacent to the west property limits. This ditch is to remain under proposed conditions and convey the ditch area itself plus some subdrain flow from pads within the substation site. Catchment area P1_1 is assumed to release uncontrolled flow from the site (as shown in **Figure 5-8**) and further details are provided in **Section 5.3.5**. There are uncontrolled flow contribution from the substation areas (Catchment Areas Envari_4 and Envari_5) that are impervious surfaces draining to this ditch as well, as shown in **Figure 5-8**. The substation have been designed Envari and their subconsultant, and the information on the storm drainage plan is provided in **Appendix N**.

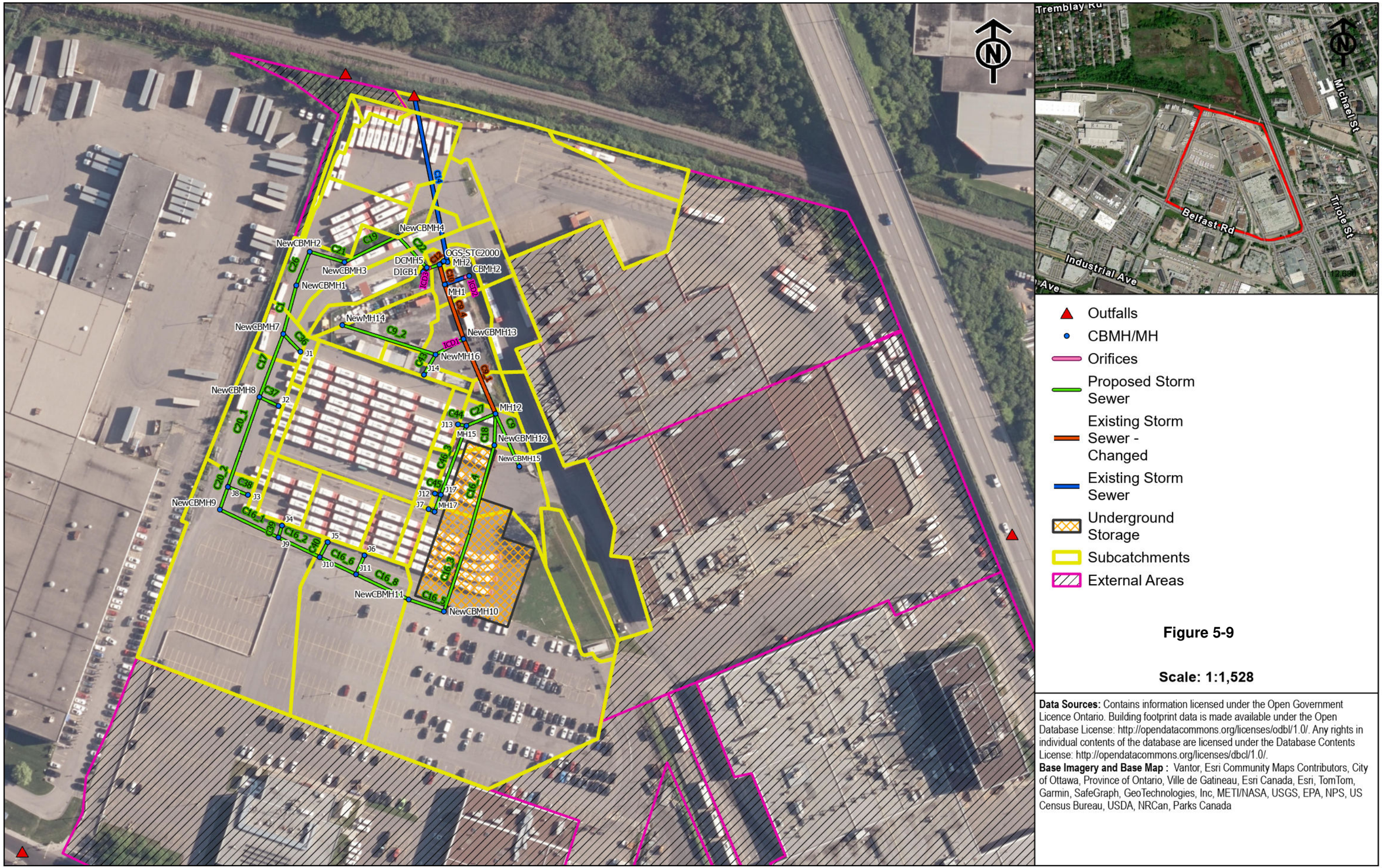
5.3.2 Proposed Storm Sewer System

The proposed storm sewer system to service the land use changes in the northwest corner is presented in **Figure 5-9**. The plan of the storm system is presented in Drawing Sheet C005 in **Appendix J**.

The modifications to the storm sewer on the site was based on a combination of rational method and hydraulic model simulation. The hydraulic model simulation was due to the application of on-site controls and storage to meet stormwater management requirements including a set restricted outflow rate from this section of the site along with accommodation of underground storage. This is discussed in further detail in the sections below.

A rational method calculation of the storm sewer system servicing the northwest corner was created following the MECP and 2012 OSDG. The spreadsheet and drainage area plan (Drawing Sheet C008) are presented in **Appendix J.**

A summary of the existing and proposed storm sewer system to service the land use changes in the northwest corner of the site is presented in **Table 5-5**.



- Outfalls
- CBMH/MH
- Orifices
- Proposed Storm Sewer
- Existing Storm Sewer - Changed
- Existing Storm Sewer
- Underground Storage
- Subcatchments
- External Areas

Figure 5-9

Scale: 1:1,528

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Base Imagery and Base Map : Vantor, Esri Community Maps Contributors, City of Ottawa, Province of Ontario, Ville de Gatineau, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

Table 5-5. Proposed Storm Sewer System to Service Northwest Corner and Land Use Changes

Upstream MH or CB	Downstream MH or CB	Pipe Length (m)	Inlet Invert (m)	Outlet Invert (m)	Pipe Diameter (m)
Existing Storm Sewer to Remain					
CBMH1	CBMH2	23.0	67.85	67.57	0.375
CBMH2-DUM	MH1	9.5	67.57	67.55	0.600
CBMH3	CBMH2	19.0	67.66	67.65	0.525
ExCB	ExMH2	10.6	67.86	67.82	0.300
ExCBMH1	ExMH1	10.5	67.74	67.64	0.375
ExMH1	CBMH3	12.6	67.64	67.66	0.375
ExMH2	ExCBMH1	53.0	67.82	67.74	0.300
MH1	MH11	8.9	67.54	67.52	0.600
MH11	OGS-STC2000	3.3*	67.52	67.47	0.600
MH12†	NewCBMH13	35.2	67.62	67.57	0.600
MH2	OUTLET	72.5	67.44	66.93	0.600
NE-CB1	NE-CB2	29.0	68.18	68.13	0.300
NE-CB2	CBMH1	42.0	68.05	67.93	0.375
OGS-STC2000	MH2	3.3*	67.50	67.44	0.600

Upstream MH or CB	Downstream MH or CB	Pipe Length (m)	Inlet Invert (m)	Outlet Invert (m)	Pipe Diameter (m)
Proposed Storm Sewer					
NewCBMH1	NewCBMH7	23.5	68.75	68.67	0.450**
NewCBMH1	NewCBMH2	16.0	67.94	67.92	0.600**
NewCBMH10	Storage	4.7	67.84	67.72	0.675**
NewCBMH11	NewCBMH10	16.9	67.90	67.88	0.675**
NewCBMH12	MH12	15.2	67.72	67.70	0.600
NewCBMH15	MH12	35.3	67.75	67.62	0.600
NewCBMH2	NewCBMH3	15.8	67.84	67.82	0.675**
NewCBMH3	NewCBMH4	26.7	67.77	67.73	0.675**
NewCBMH4	DCMH5	16.9	67.68	67.66	0.675**
NewCBMH7	NewCBMH8	29.5	68.26	68.22	0.675**
DICB1	DCMH5	10.7	67.90	67.87	0.300
DCMH5-DUM	MH11	3.1	67.61	67.57	0.600
NewCBMH8	J8^	42.7	68.19	68.13	0.675**
J8^	NewCBMH9	9.5	68.12	68.11	0.675**
NewCBMH9	J9^	28.3	68.06	68.02	0.675**
J9^	J10^	20.0	68.02	67.99	0.675**
J10^	J11^	17.5	67.99	67.97	0.675**
J11^	NewCBMH11	25.5	67.97	67.93	0.675**
NewMH14	NewMH16	49.0	68.00	67.90	0.450
NewMH16	NewCBMH13	3.0	67.90	67.87	0.450
DUM-NewCBMH13	MH1	25.6	67.57	67.55	0.600
Storage	NewCBMH12	2.5	67.72	67.72	0.600
J14^	NewMH16	19.8	68.10	67.90	0.300
J1^	NewCBMH7	10.8	68.74	68.64	0.300
J2^	NewCBMH8	9.2	68.66	68.57	0.300
J3^	J8^	10.0	68.13	68.12	0.300
J4^	J9^	5.4	68.60	68.55	0.150
J5^	J10^	7.4	68.59	68.52	0.150
J6^	J11^	9.1	68.58	68.49	0.150
J7^	MH17	2.9	68.30	68.27	0.150
MH17	J17^	7.7	68.12	68.11	0.300
J12^	J17^	2.6	68.29	68.26	0.150
J17^	MH15	31.4	68.11	68.07	0.300
J13^	MH15	3.7	68.26	68.22	0.150
MH15	MH12	11.9	68.02	68.00	0.300

* Existing MH with changes to pipe lengths due to change in angel/placement or new pipe connections to the existing system

** Pipe sizes increased to provide storage as “super-pipes”.

† MH12 is MH10 under existing conditions (see **Table 5-3**). Due to naming conventions with the design of the proposed pipe system integrated into MH10, which is to remain, it was renamed to MH12.

^Connections from roof to proposed storm sewer

5.3.3 Surface Storage

Due to controlled outflow from the site under existing and for proposed conditions, on-site storage is required.

As noted in **Section 5.2.3**, under existing conditions, there are several locations within the northwest area of the site that use on-site surface storage. Those areas which are proposed to remain as-is, the surface storage already within those areas will remain.

There is an existing DICB1 located south of the substation across the driveway near the existing Jurassic Gas Station. This DICB is proposed to remain, but due to the grading adjustments around the ZEB Garage and substation, the top of grate has been raised and the storage available around the DICB has been adjusted.

To accommodate the proposed land use changes in the northwest corner, surface storage is not proposed. The ZEB Garage will limit and confine bus driving lanes within area and limit surface storage. Therefore, underground storage is proposed to service all of the proposed land use changes. It should be noted that there may be some localized surface storage as water is entering the minor system through CBs or CBMHs, but it is proposed that underground storage will have sufficient capacity to accommodate infrequent storm events.

The proposed site grading plan (Drawing Sheet C004) for the northwest corner is provided in **Appendix J**.

5.3.4 Roof Storage

Roof storage has been proposed for the ZEB Garage building. Storage is designed across various roof sections to manage roof runoff up to a specific volume. Once this volume is exceeded, overflow is directed through scuppers as part of the drainage system.

In the PCSWMM model, the roof area is divided into 10 separate subcatchments, each connected to a corresponding storm sewer outlet. However, while roof storage is part of the actual design, in the PCSWMM model no roof storage is assumed. This conservative assumption was made to assess the system's capacity and ensure that the proposed storm sewer network can adequately handle peak roof runoff during storm events, even without the benefit of roof storage attenuation.

5.3.5 Inlet Restriction

As noted in **Section 5.2.3**, the existing northwest area of the site has controlled outflow through three ICDs locations. The proposed northwest site outflow is to remain to the total outflow target of 395 L/s.

It is proposed to replace all three ICDs to assist in re-balance the outflow from the storm sewer and use the proposed storage available as efficiently as possible. The proposed ICD locations are presented in **Figure 5-9.**

The proposed ICDs were sized to restrict the outflow during the 100-year storm event and using PCSWMM. The sizing of the ICDs is based on accounting for the uncontrolled outflow from the catchment to the far northwest corner of the site (northwest of the substation). The uncontrolled flow from catchment P1_1, Envari_4 and Envari_5 (northwest corner of the site, see **Table 5-4**) is 30 L/s (0.03 m^3/s) for the 100-year storm event. Therefore, the controlled discharge from the site is 365 L/s which is divided between three ICDs.

The ICDs are assumed to be installed on the outlet pipe of the manhole they are assigned. Custom circular ICDs are proposed with the inverts matching the pipe invert. The custom ICDs are proposed to be stainless steel plates bolted to the inside of the manhole. The following summarizes the proposed ICD locations, sizes and 100-year outflow.

Table 5-6. Proposed ICDs for Proposed Conditions Site Outflow Control

ICD ID	MH or CB	ICD Diameter (m)	Invert Elevation (m)	Orifice Discharge Coefficient	100-Year Discharge (m^3/s)
ICD1	NewCBMH13	0.075	67.57	0.65	0.012
ICD2	CBMH2	0.394	67.57	0.65	0.244
ICD3	DCMH5	0.225	67.61	0.65	0.106
U/C*	Catchment P1_1	-	-	-	0.010
U/C*	Catchment Enavri_4	-	-	-	0.010
U/C*	Catchment Envari_5	-	-	-	0.010
				Total Site Outflow	**0.392**

* U/C is uncontrolled discharge from the site during the 100-year storm event.

Drawing Sheet C009 in **Appendix J** provides typical details for all the ICD plates proposed for the northwest site.

5.3.6 Underground Storage

Underground storage is proposed to service all the land use changes in the northwest area of the site. Underground storage is proposed to be a combination of larger sized pipes (i.e., “super pipes”) and plastic pipe-arch storage. The location of the proposed underground storage is indicated in **Figure 5-9.**

The sizing and amount of underground storage required to service the site was determined using PCSWMM and simulating the 100-year. The objective was to contain the hydraulic grade line of the new storm system below the ground surface. Therefore, the storm sewer system was allowed to surcharge, but not surface pond or flood within the proposed modified areas. For storm sewer sections remaining as-is, the system was allowed to surface pond as it does under existing conditions.

The sizing of the underground storage to service the land use changes in the northwest portion of the site was achieved by modifying the three ICD sizes and outflow rates and optimizing the storm sewer sizing for the “super pipes” and keeping the underground storage tanks a reasonable footprint within the available area in the site.

Storage in Oversized Pipes

Underground storage proposed in oversized pipes is located throughout the areas proposed to be modified by the ZEB Garage. The oversized pipes for storage are proposed due to space constraints in certain areas of the site including along the southern edge of the substation and around the ZEB Garage. Space constraints include consideration for minimal disturbance of active bus movement throughout the site during construction and minimize MH or CB infrastructure within the bus driving lanes. Further consideration was given to the substation design including size and location so pipes or underground storage in proximity to large transformers and generators. Around the ZEB Garage, storm sewer pipes were also increased in size to provide additional storage within the system to assist with the larger underground storage and assist in balancing outflow from the site. The increased size of pipes are located both upstream and downstream of the underground storage unit.

The proposed storm sewers reported in **Section 5.3.2** and **Table 5-5** indicates which storm sewers were oversized for storage.

Underground Storage Structure

Due to the existing infrastructure (sewers, buildings and parking) within 1500 St. Laurent Boulevard and the location of the ZEB Garage within the greater site plus confining the site modifications to the northwest corner of the site, there is limited space within the northwest corner site limits to accommodate underground storage. As noted, underground storage is being accommodated as part of the proposed storm sewer system using oversized pipes.

A larger underground storage unit is being proposed on the southeast of the new ZEB Garage just outside the entry bay and within an area that is currently asphalt and grass. The area will ultimately be restored with the same surface treatment. The area proposed for the larger underground storage has a surface slope from west to east which also provides a challenge to include sufficient storage and cover.

The large underground storage containment is proposed to be StormTech Infrastructure or approved equivalent storage. The grading plan for the site, required storage and surface treatment (i.e., pavement requirements) were provided to ADS for a layout. The underground storage is proposed to be the arched plastic units surrounded by porous granular material (assumed 40% porosity). Infiltration from these units into the surrounding soils is not recommended based on the industrial stie use, therefore, an impermeable barrier is proposed around the unit.

The design is a StormTech MC-3500 with a surface area footprint of 2629 m^2 with a 1.43 m height resulting in an available volume of 2759 m^3 for storage. The design and layout of the StormTech underground storage is presented in **Appendix K.**

Based on the Geotechnical investigation report (provided in **Appendix G**), groundwater levels vary within the site from between 1.5 m to 2.1 m below existing ground level. The proposed grade in the area of the new building including the area of the underground storage has been raised by as much as 400mm to promote positive drainage away from the building and throughout the site. This raise in grade is also expected to eliminate the effect of ground water pressure on the storage system, whose bottom is designed to sit 2.1 m below finished grade.

5.3.7 Proposed Conditions PCSWMM Model

The information from the previous sections were input into a PCSMWM model to simulate the proposed conditions with the ZEB Garage and substation in place. The catchment areas for PCSWMM are presented in **Section 5.3.1 and Table 5-4**.

Further details related to the input and development of the proposed conditions PCSWMM model which are not presented in previous sections, is provided in **Appendix L**.

The hydraulic grade line (HGL) results for the proposed conditions PCSWMM model are provided in **Table 5-7** and related back to the top of grate or rim elevation of the structure. There is only a small portion of the existing storm sewer remaining with the proposed site modifications. For comparison, the existing HGL for those remaining storm sewers is compared with the proposed conditions results in **Table 5-8**.

Profiles of the four key storm sewer laterals are presented in **Figure 5-10** to **Figure 5-12**.

Table 5-7. Proposed Conditions Simulation Hydraulic Grade Line Results for All Storm Events

CB/MH ID	Rim Elev. (m)	Hydraulic Grade Line (m)			Difference (m)**		
		5-Year	100-Year	100-Year + 20%	5-Year	100-Year	100-Year + 20%
Existing Storm Sewer to Remain							
CBMH1	68.75	68.87	69.10	69.22	*-0.12*	*-0.35*	*-0.47*
CBMH2	68.97	68.77	68.83	68.86	0.20	0.14	0.11
CBMH2-DUM	68.80	68.41	68.49	68.53	0.39	0.31	0.27
CBMH3	68.64	68.78	68.82	68.86	*-0.14*	*-0.18*	*-0.22*
DCMH5	69.35	68.87	69.28	69.35	0.48	0.07	*0.00*
DCMH5-DUM	69.35	68.33	68.42	68.46	1.02	0.93	0.89
DICB1	69.58*	68.94	69.47	69.63	0.64	0.11	*-0.05*
ExCB	68.79	69.00	69.18	69.27	*-0.21*	*-0.39*	*-0.48*
ExCBMH1	68.94	68.94	68.83	68.83	*0.00*	0.11	0.11
ExMH1	68.80	68.80	68.80	68.80	*0.00*	*0.00*	*0.00*
ExMH2	69.02	69.02	69.02	69.02	*0.00*	*0.00*	*0.00*
MH1	70.04	68.35	68.44	68.47	1.69	1.60	1.57
MH11	69.40	68.32	68.41	68.44	1.08	0.99	0.96
MH12†	69.78	68.17	68.55	68.78	1.61	1.23	1.00
MH2	69.50	68.16	68.23	68.27	1.34	1.27	1.23
NE-CB1	68.85	68.92	69.22	69.36	*-0.07*	*-0.37*	*-0.51*
NE-CB2	68.80	68.92	69.21	69.35	*-0.12*	*-0.41*	*-0.55*
OGS-STC2000	69.45*	68.24	68.32	68.35	1.21	1.13	1.10
Proposed Storm Sewer							
NewCBMH1	70.41	68.88	69.27	70.41	1.53	1.14	0.00
NewCBMH10	70.05	68.24	68.57	68.79	1.81	1.48	1.26
NewCBMH11	70.24	68.40	68.88	69.42	1.84	1.36	0.82
NewCBMH12	69.76	68.17	68.55	68.79	1.59	1.21	0.97
NewCBMH15	69.54	68.17	68.55	68.79	1.37	0.99	0.75
NewCBMH2	69.90	68.88	69.28	69.90	1.02	0.62	0.00
NewCBMH3	69.63	68.88	69.28	69.63	0.75	0.35	0.00
NewCBMH4	69.40	68.87	69.28	69.40	0.53	0.12	0.00
NewCBMH7	70.64	68.55	69.55	70.64	2.09	1.09	0.00
NewCBMH8	69.82	68.55	69.39	69.82	1.27	0.43	0.00
NewCBMH9	69.85	68.54	69.29	69.74	1.31	0.56	0.11
NewCBMH13	70.16	68.17	68.55	68.78	1.99	1.61	1.38
DUM-NewCBMH13	70.16	68.35	68.44	68.47	1.81	1.72	1.69
NewMH14	70.26	68.20	68.55	68.79	2.06	1.71	1.47
NewMH16	70.18	68.20	68.55	68.78	1.98	1.63	1.40
MH17	70.34	68.23	68.55	68.78	2.11	1.79	1.56
J17	70.32	68.23	68.55	68.78	2.09	1.77	1.54
MH15	70.23	68.19	68.55	68.79	2.04	1.68	1.44
J14	70.04	68.61	69.26	69.81	1.43	0.78	0.23
J1	69.90	68.78	69.74	69.90	1.12	0.16	0.00
J2	69.84	68.70	69.42	69.84	1.14	0.42	0.00

CB/MH ID	Rim Elev. (m)	Hydraulic Grade Line (m)			Difference (m)**		
		5-Year	100-Year	100-Year + 20%	5-Year	100-Year	100-Year + 20%
J3	69.85	68.57	69.38	69.85	1.28	0.47	0.00
J8	69.85	68.54	69.31	69.85	1.31	0.54	0.00
J4	69.98	68.77	69.38	69.91	1.21	0.60	0.07
J9	69.98	68.49	69.13	69.54	1.49	0.85	0.44
J5	70.06	68.84	69.57	70.06	1.22	0.49	0.00
J10	70.06	68.46	69.03	69.51	1.60	1.03	0.55
J6	70.13	68.69	69.11	69.70	1.44	1.02	0.43
J11	70.13	68.44	68.93	69.38	1.69	1.20	0.75
J7	70.34	68.37	68.55	68.78	1.97	1.79	1.56
J12	70.32	68.36	68.55	68.78	1.96	1.77	1.54
J13	70.22	68.33	68.55	68.79	1.89	1.67	1.43
Storage	70.05	68.17	68.55	68.79	1.88	1.50	1.26

* Existing MH Rim elevation was adjusted due to regrading of the site.

** Difference is Rim minus HGL (Rim – HGL).

† MH12 is MH10 under existing conditions (see **Table 5-3**). Due to naming conventions with the design of the proposed pipe system integrated into MH10, which is to remain, it was renamed to MH12.

Table 5-8. Comparison of Existing and Proposed HGL for Storm Sewers to Remain for the 100-Year Storm Event

CB/MH ID	Rim Elev. (m)		Existing Minus Proposed Rim Elev. (m)	100-Year Hydraulic Grade Line (m)		Difference (m)**	
	Existing*	Proposed		Existing	Proposed	Rim – Proposed	Existing - Proposed
CBMH1	68.75	68.75	0.00	68.99	69.10	-0.35	*-0.11*
CBMH2	68.97	68.97	0.00	68.82	68.83	0.14	*-0.01*
CBMH2-DUM	68.80	68.80	0.00	68.68	68.49	0.31	0.19
CBMH3	68.64	68.64	0.00	68.82	68.82	-0.18	0.00
DICB1	68.00	69.58	-1.58	69.07	69.47	0.11	*-0.40*
ExCB	68.79	68.79	0.00	69.23	69.18	-0.39	0.05
ExCBMH1	68.94	68.94	0.00	68.83	68.83	0.11	0.00
ExMH1	68.80	68.80	0.00	68.80	68.80	0.00	0.00
ExMH2	69.02	69.02	0.00	69.02	69.02	0.00	0.00
MH1	70.05	70.04	0.01	68.66	68.44	1.60	0.22
MH11	69.40	69.40	0.00	68.60	68.41	0.99	0.19
MH12†	69.68	69.78	-0.10	69.68	68.55	1.23	1.13
MH2	69.50	69.50	0.00	68.39	68.23	1.27	0.16
NE-CB1	68.85	68.85	0.00	69.16	69.22	-0.37	*-0.06*
NE-CB2	68.80	68.80	0.00	69.15	69.21	-0.41	*-0.06*
OGS-STC2000	69.58	69.45	0.13	68.50	68.32	1.13	0.18

* Existing Rim Elev. is from **Table 5-3.**

** Difference is Rim minus Proposed HGL (Rim – Proposed HGL) or Existing HGL minus Proposed HGL.

† MH12 is MH10 under existing conditions (see **Table 5-3**). Due to naming conventions with the design of the proposed pipe system integrated into MH10, which is to remain, it was renamed to MH12.

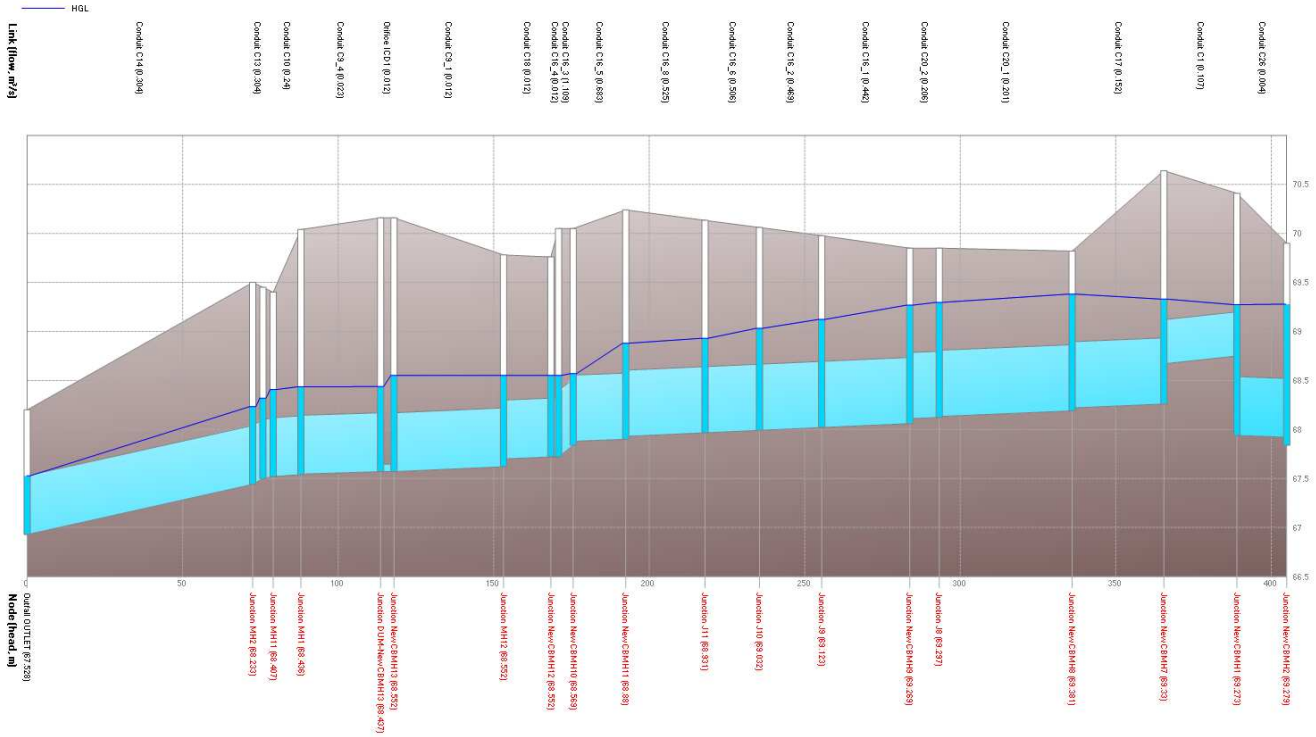


Figure 5-10. Proposed Conditions Hydraulic Grade Line Profile for the Storm Sewer around the ZEB Garage for the 100-Year Storm Event

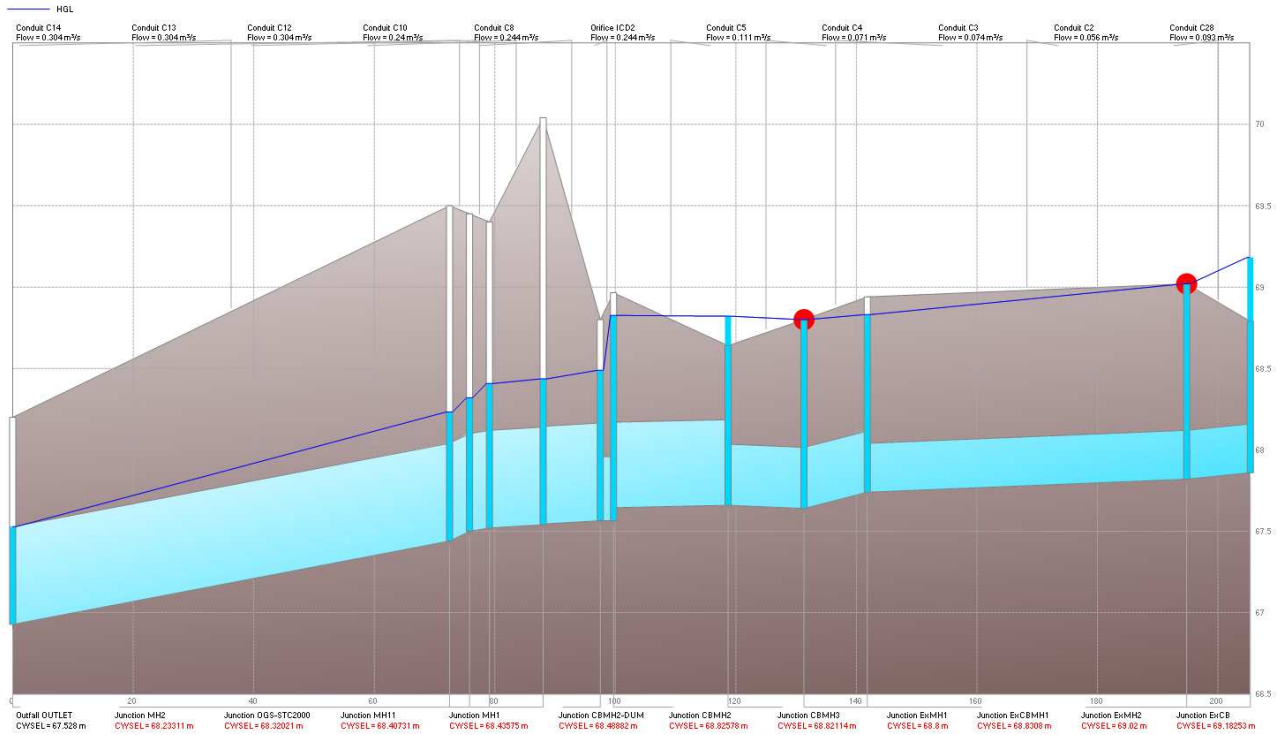


Figure 5-11. Proposed Conditions Hydraulic Grade Line Profile for the Sewer Parallel to the North Garage for the 100-Year Storm Event

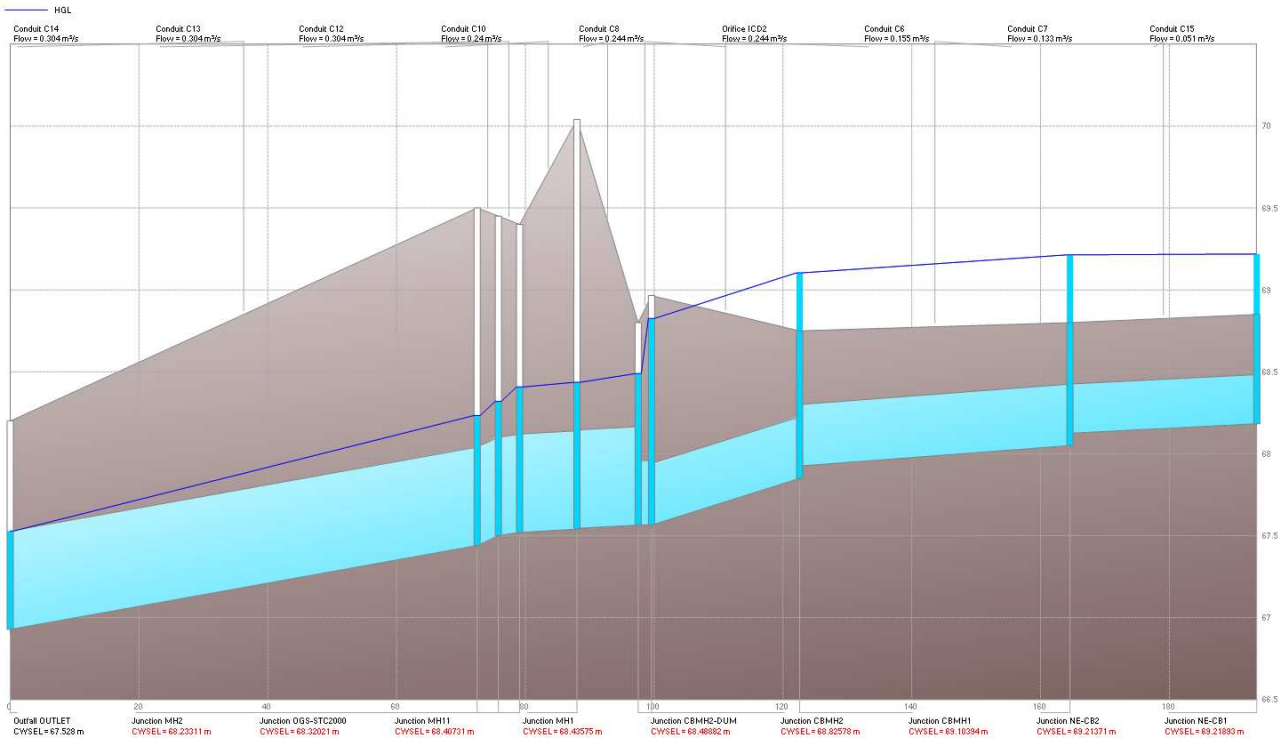


Figure 5-12. Proposed Conditions Hydraulic Grade Line Profile for the Sewer North of the North Garage for the 100-Year Storm Event

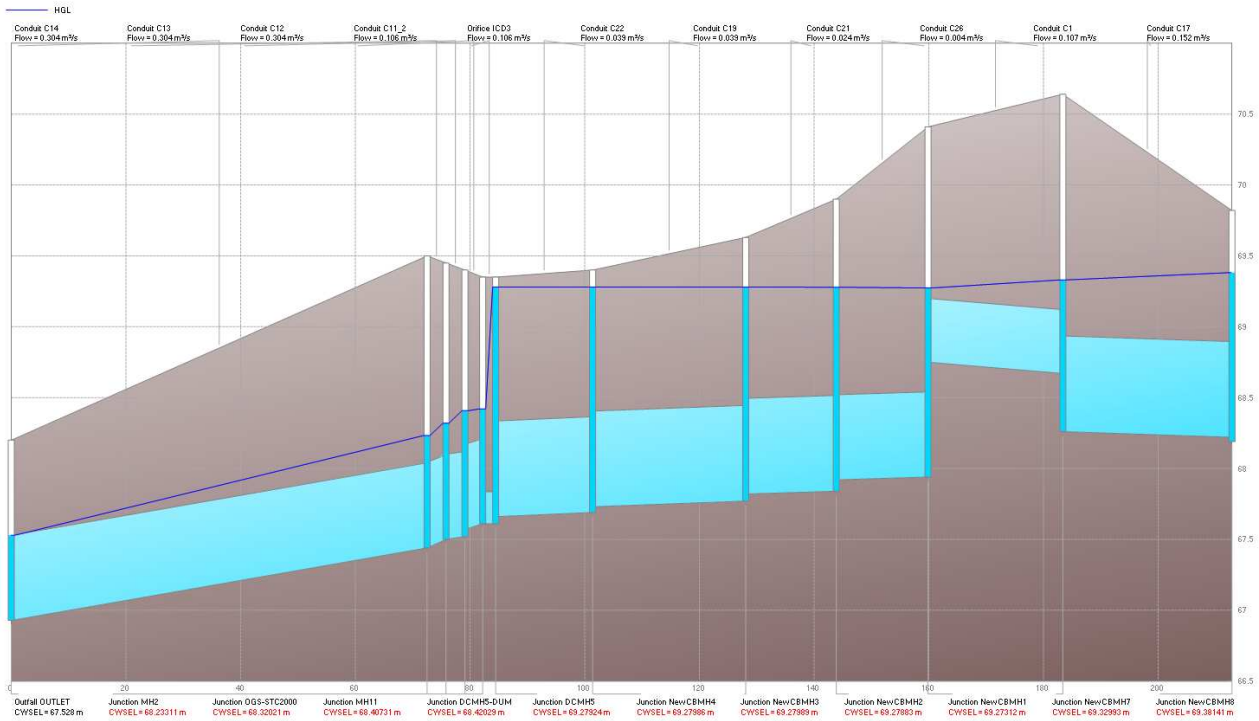


Figure 5-13. Proposed Conditions Hydraulic Grade Line Profile for the Sewer South of the Substation for the 100-Year Storm Event

From the proposed conditions simulation of the storm sewer system for the northwest corner of 1500 St. Laurent Boulevard, it can be seen that:

Existing Storm System to Remain

- During the 5-year event, the existing storm system to remain parallel to the North Garage and north of the North Garage does not have capacity to convey the contributing area and therefor continue to use the existing surface ponding available at those CBs or CBMHs. There are two existing MHs (ExMH1 and ExMH2, see **Table 5-7**) where the system surcharges and water spills to the surface.
- During the 100-year event, similar results to the 5-year event are observed for the existing storm sewer to remain with available surface storage being used, surcharging of the storm sewer system continues to occur at ExMH1 and ExMH2, but no additional locations are identified where water spills to the surface.
- The stress test event (100-year + 20% storm event), the existing storm system the system performs in a similar manner as the 5-year and 100-year with the HGL slightly higher than the 100-year, more surface storage utilized and water spilling to the surface one additional MH (DCMH5, see **Table 5-7**).

Proposed Storm Sewer

- During the 5-year and 100-year storm events, the proposed storm sewer system HGL remains below the rim and is fully stored underground with additional capacity.
- During the stress test event (100-year + 20% storm event), the proposed storm sewer reaches capacity and spills to the surface. This occurs primarily in the storm sewer proposed along the west side of the ZEB Garage and south of the substation. An emergency overland flow route is indicated on the grading plan provided in **Appendix J**.

Comparison of Impact of Proposed System on Existing Storm System to Remain

A comparison of the resulting differences in HGL during the 100-year event within the existing storm sewer with the implementation of the proposed storm system changes was undertaken and presented in **Table 5-8**. Based on the differences in HGL between existing and proposed conditions, it was found that the HGL was maintained or lower for most of the existing CBs and MHs. There were four CBs or MHs where the HGL increased under proposed conditions:

- CBMH1: This is a CBMH which has existing surface storage. The HGL has increased by 0.11 m, resulting in incremental use of surface storage at this location. This elevation increase from the existing condition is attributed to grading changes at substation (designed by Envari and their subconsultants), where additional flow is directed toward the existing northeast storm sewer segment under the proposed condition.

  Based on the survey data and digital elevation model (DEM), once CBMH1 reaches its full capacity, available existing surface storage may allow water to pond. In proposed condition, under the 100-year, the water depth exceeds the ponding of 0.24 m under the existing condition**,** surcharge from CBMH1 is expected to occur, flowing eastward and exiting through the ditch adjacent to the railway. An analysis of the spot elevations and contour mapping indicates a low point near the north garage building, at an elevation of 69.087 m. Additionally, contour elevations show, the edge of the north garage building towards the west is at elevation of 69.1 m as shown in **Figure 5-14**. Under a 100-year storm event, the projected HGL at CBMH1 is anticipated to reach 69.1 m, implying that water may potentially pond adjacent to the north garage building with an approximate depth of 1 cm. **Figure 5-14** shows the inundated area and flooding extended once HGL of 69.1 m is reached. It is important to note that the north garage building would only be at risk if the water fails to drain into the eastern ditch, which serves as the primary outflow route for the major flow at an elevation of 68.84 m. The HGL profiles for existing and post condition in **Figure 5-7** and **Figure 5-12**, respectively, shows the surcharging for CBMH 1.



Figure 5-14: Inundated Extent under existing and post condition for CBMH1 (*figure was generated by delineating contour lines provided by the surveyor, not through PCSWMM 2D modeling)*

- NE-CB1: This is a CB which has existing surface storage. The HGL increased by 0.06 m which results in more surface storage being used at this location. This is due to grading changes at substation, where additional flow is directed toward the existing northeast storm sewer segment under the proposed condition. Under a 100-year

storm event, the water may potentially pond adjacent to the north garage building. It is important to note that the north garage building would only be at risk if the water fails to drain into the eastern ditch, which serves as the primary outflow route for the major flow. The location of NE-CB1 is shown in **Figure 5-14**. The HGL profiles for existing and post condition in **Figure 5-7** and **Figure 5-12**, respectively, shows the surcharging for NE-CB1.

- NE-CB2: This is a CB which has existing surface storage. The HGL increased by 0.06 m which results in more surface storage being used at this location. This is due to grading changes at substation, where additional flow is directed toward the existing northeast storm sewer segment under the proposed condition. Under a 100-year storm event, the water may potentially pond adjacent to the north garage building. It is important to note that the north garage building would only be at risk if the water fails to drain into the eastern ditch, which serves as the primary outflow route for the major flow. The location of NE-CB1 is shown in **Figure 5-14**. The location of NE-CB 2 is shown in **Figure 5-14**. The HGL profiles for existing and post condition in **Figure 5-7** and **Figure 5-12**, respectively, shows the surcharging for NE-CB2.

- CBMH2: The HGL increased by 0.01 m, but the HGL remains below the Rim elevation. Therefore, the proposed changes to the site storm system does result in new surface spilling.

- DICB1: This DI is located south of the substation adjacent to the Jurassic Gas Station. Due to grading changes to accommodate the ZEB Garage and substation, the top of grate or rim elevation was increased. Due to the change in grading and adjustments in the drainage area contributions to this DI, the HGL has increased but remains below the rim elevation.

Overall, the proposed storm system changes to accommodate the ZEB Garage and substation provides on-site storage to accommodate the site changes while generally maintaining existing conditions for most of the storm sewer system to remain as-is. However, the portion of the existing storm sewer system in the northeast area will require increased use of surface storage under post-development conditions compared to the existing condition. Consequently, this change may increase the risk of ponding or localized flooding adjacent to the north garage building during larger storm events.

5.3.7.1 Surface Storage Volume Usage – Existing vs Post

As requested by the City the surface storage volumes assigned to the existing sewer system that will remain in place (east side system), as existing condition, have been quantified in this section under existing and proposed condition. The comparison of surface volume utilized under both existing and proposed conditions for the 5-year and 100-year storm events are presented in **Table 5-9**. The intended of this section is to quantity and demonstrate the surface storage volume used in areas where the hydraulic grade line (HGL) at the CB-NE1, CB-NE2 and CBMH1 increases under the proposed condition compared to the existing condition.

As presented in **Table 5-9**, the three locations where surface storage has been assigned and where the HGL increases under the proposed condition during the 100-year storm event are presented. For these three locations, the available surface storage volume based on the assumed ponding depth and surface area in PCSWMM is quantified. The calculated volume used during each storm event (existing and proposed conditions) is based the HGL results from the PCSWMM model at the corresponding CB/CBMH structures.

As shown in the table, under the 100-year storm event proposed condition, all three CB/CBMH locations exceed the available surface storage volume. Additionally, for CBMH1 under the proposed condition, the volume used exceeds the available volume and is greater than under the existing 100-year storm event. As a result, inundation of this area has been documented in **Section 5.3.7** of the report.

For NE-CB1 and NE-CB2, under the existing 100-year condition, the volume used already exceeds the available volume, indicating that spill conditions would occur. Under the proposed condition, a similar behavior is observed, with a slight increase in volume used due to the higher HGL. When NE-CB1 and NE-CB2, exceed their available storage volume, the spill will occur by flowing eastward and exiting through the ditch adjacent to the railway. It is important to note that, similar to CBMH 1 spill extent (explained earlier in **Section 5.3.7**), the north garage building would be at risk of fooding if the water fails to drain into the eastern ditch, which serves as the primary outflow route for the major flow at an elevation of 68.84

In **Appendix J**, Site Servicing Plan drawings, Sheet C005, presents the existing surface storage areas at each three structures of CBMH1, NE-CB1 and NE-CB2 incorporated into the PCSWMM model. The existing on-site surface storages were determined using the Provincially 2019 DTM which was collected with LiDAR from Ontario GeoHub. The LiDAR resolution is 0.5 m by 0.5 m. For each catchbasin or inlet, the approximate maximum ponding surface area was estimated along with the maximum ponding depth (calculated as the difference between the maximum ponding elevation and the top elevation of the CB or CBMH). The approach on how these were inputted in PCSWMM were explained earlier on in **Section 5.2.3** of this report.

In addition, to the CB/CBMH structures, the volume available in the underground storage tank and the volume used under the 5-year and 100-year storm events are presented in **Table 5-10** as per City's request. The values for the under-ground storage tank surface area and volume available shown in **Table 5-10** are based on the stage-area curve provided by the supplier based on the footprint and design. Further details, including the stage-area curve are discussed in **Section 5.3.6** and **Appendix K** of the report.

Provincial DTM LiDAR Vertical Datum Conversion

The Ontario provincial DTM (2019) is referenced to the CGVD2013 vertical datum, while the OC Transpo site is referenced to CGVD28. To ensure consistency with the project vertical datum, the LiDAR data (originally in CGVD2013) was adjusted by +0.307 m. This adjustment was derived from vertical datum transformation values provided by the Government of Canada. Transformation Station ID 6530100 was used to determine the separation between CGVD28 and CGVD2013.

Table 5-9: Surface Storage Volume Existing vs Proposed – 5- and 100-year storm event

CB/MH ID	Rim Elevation (m)	Hydraulic Grade Line (m)				On-Site Depth (m)	Surface Area Assumed in PCSWMM	Volume Available (m^3)	5-Year				100-year			
		5-Year - Existing	5-Year - Proposed	100-year -Existing	100-year-Proposed				Storage Depth - Existing	Volume Used - Existing	Storage Depth- Proposed	Volume Used - Post	Storage Depth - Existing	Volume Used - Existing	Storage Depth- Proposed	Volume Used - Post
CBMH1	68.75	68.86	68.87	68.99	69.10	0.25	14.40	3.6	0.11	1.58	0.12	1.73	0.24	3.46	0.35	5.04
NE-CB1	68.85	68.94	68.92	69.16	69.22	0.05	29.00	1.45	0.09	2.61	0.07	2.03	0.31	8.99	0.37	10.73
NE-CB2	68.80	68.93	68.92	69.15	69.21	0.20	181.70	36.34	0.13	23.62	0.12	21.80	0.35	63.60	0.41	74.50

Table 5-10: Underground storage tank volume usage - 5- and 100-year storm event

ID	Rim Elevation (m)	Hydraulic Grade Line (m)				On-Site Depth (m)	Surface Area (m2)	Volume Available (m^3)	5-Year				100-year			
		5-Year - Existing	5-Year - Proposed	100-year - Existing	100-year-Proposed				Storage Depth - Existing	Volume Used - Existing	Storage Depth- Proposed	Volume Used - Post	Storage Depth - Existing	Volume Used - Existing	Storage Depth- Proposed	Volume Used - Post
Proposed Storm Sewer																
Storage	70.05	N/A	68.17	N/A	68.55	1.43	2306.60	2460.73	N/A	N/A	0.45	1030.00	N/A	N/A	0.83	1810.00

5.3.8 Water Quality Treatment

Water quality control is provided for the northwest corner of the site via a Stormceptor Model STC2000. The Stormceptor was installed under the 2006 site design and ECA. The Stormceptor is located immediately upstream of the last manhole leaving the site and indicated in **Figure 5-9** and therefore provides total solids sediment (TSS) removal for the total northwest area of the site. As part of the 2006 design, it was indicated that the Stormceptor was only required to provide 60% TSS removal for the area at the runoff coefficients at that time.

It is still required to provide water treatment for the northwest corner of the site. The RVCA has indicated that Enhanced Level of Protection per the 2003 MECP Stormwater Manual is required. In other words, 80% TSS removal from the stormwater runoff is required.

Based on the current TSS removal requirements and the impervious area slightly higher than the design from 2006, the current Stormceptor servicing the northwest site is likely undersized and requires replacement as part of the proposed site modifications. Based on the proposed contributing area and runoff coefficient, the current unit would only be able to provide 68% TSS removal which is less than the required 80% TSS removal.

There are several types of oil grit separators (OGS), of which Stormceptor is one brand. It is proposed that the replacement OGS will remain as a hydrodynamic separator without membrane carbon filters. Due to the space where the current Stormceptor is located, an OGS with a similar footprint (surface and underground) is proposed. Therefore, it is proposed to replace the current Stormceptor Model STC2000 with another Stormceptor unit.

The information presented below and in **Table 5-11** was provided to the supplier for the sizing of the proposed Stormceptor.

- Catchment Area to Unit: 4.31 ha
- Site Impervious: 100%
- Equivalent Runoff Coefficient: 0.9
- Unit Type: Hydrodynamic unit without hydrocarbon capture
- Inlet Invert: 67.50 m
- Outlet Invert: 67.44 m
- Top of Grate Elevation: 69.45 m
- TSS Removal Required: 80% TSS

Table 5-11. Design Information for Stormceptor Sizing

Storm Event	Peak Flow (m^3/s)
100-Year	0.304

The Stormceptor sized for the proposed site modifications per the above provided information is a Stormceptor Model EFO10. The unit provides 80% TSS removal for 90% of the runoff volume captured.

The features of the Stormceptor EFO10 are summarized in **Table 5-12** and the supporting design calculations and standard technical drawings for the Stormceptor Model EFO10 are provided in **Appendix M.**

Table 5-12. Summary of Stormceptor EFO10 Features

Features	Capabilities
Maximum Treatment Flow Rate	65.0 L/s
Maintenance Sediment Volume	3,560 L
Maximum Sediment Capacity	17,790 L
Maximum Hydrocarbon Storage Capacity	1,670 L
Total Storage Volume	23,700 L

Based on the Geotechnical investigation report (provided in **Appendix G**), the groundwater levels are high within the site and the OGS unit design should consider the uplift loads caused by the buoyance forces. Hence, as recommended by Stormceptor, a base extension of 200 mm all around and 300 mm thick should be added to ensure the OGS unit remains stable and resist uplift or displacement caused by buoyant forces resulting from high groundwater levels. The buoyancy calculation provided by Storcemptor for the OGS unit is provided in **Appendix M**.

5.4 Summary and Conclusion

The storm system servicing the northwest corner of 1500 St. Laurent Boulevard discharges to the north into a ditch along the rail line. The existing storm system outflow is controlled via three ICDs on-site with storage accommodated through surface ponding throughout the area. The ZEB Garage and substation proposed within the western half of this area of 1500 St. Laurent Boulevard is proposed to be serviced by a new storm system which includes underground storage to the 100-year storm event. Portions of the existing storm sewer are to remain as-is which are located parallel and north of the North Garage.

Discharge from the site remains controlled to the existing conditions flows with the relocation and replacement of ICDs within the storm system. Proposed storage is provided by oversized pipes and underground storage chamber consisting of arched plastic units surrounding by clear stone. Water quality for the site is provided through an oil grit separator (OGS) unit sized to provide 80% Total Suspended Solids removal. The OGS replaces an existing, undersized unit that currently services the site.

The analysis of the proposed storm system in comparison to the existing system evaluation, under the 100-year storm event, indicates that the proposed works introduce some changes to the existing storm infrastructure that will remain. These changes result in elevated HGLs; however, HGLs remain below the for most of the catchbasin and manhole rims.

One notable concern is the existing storm sewer segment in the northeast portion of the site, which will depend on increased surface storage under post-development grading conditions. The revised site grading for the proposed substation conveys additional runoff toward this area, beyond what occurs under existing conditions. Therefore, this may increase the risk of ponding or localized flooding adjacent to the north garage building during major rainfall events.

6 Sediment and Erosion Control

Sediment and erosion control measures are presented on Drawing Sheet C006 presented in **Appendix J**. Due to the existing conditions of the site and expected impact on the remainder of the site, the following mitigation measures are proposed during the construction phase of the subject site servicing:

- Sediment control mud mat (minimum 450 mm depth) at the construction access point from the existing parking lot to the south with entry access via Belfast Road; and,

- Sediment traps with filter cloth to be installed on all existing ditch inlets (DI), catchbasins (CBs) and CBMH within the vicinity of the site.

To facilitate construction, access will be via Belfast Road.

The sediment and erosion control plan presented will be used as a base for the contractor who is responsible for prepare their own plan by an engineer licenced to practice in Ontario. The contractor will be responsible for installation, maintenance and monitoring of the measures during construction. The contractor will be responsible to adjust and repair any sediment and erosion control measures as required.

7 Approval and Permit Requirements

The following is a list of the approval and permits required to develop the subject site:

- Ontario Ministry of Environment, Conservation and Parks – Environmental Compliance Approval (ECA) under the Ontario Water Resources Act for water service, sanitary and storm sewer pipes and stormwater management measures. This ECA will be an amendment to an existing ECA for the site as discussed in **Section 1.3**;
- Rideau Valley Conservation Authority – Review of site servicing to provide agreement to the site development in support of the ECA application submission;
- City of Ottawa – Approvals for the development application, municipal sign-off on the ECA application and all other applicable permits required for connection of services and site development.

Appendix A 2022 Pre-Consultation with Rideau Valley Conservation Authority

Marie-France Duthilleul

From: Jamie Batchelor <jamie.batchelor@rvca.ca>
Sent: April 14, 2022 2:04 PM
To: Lee Jablonski
Cc: Terry Davidson; Glen McDonald
Subject: RE: RE: OC Transpo E-Bus Facility JLR 31489-004

Follow Up Flag: Follow up
Flag Status: Flagged

[CAUTION] This email originated from outside JLR. Do not click links or open attachments unless you recognize the sender and know the content is safe. If in doubt, please forward suspicious emails to Helpdesk.

Good Afternoon Lee,

I have had a chance to look into your inquiry. The Conservation Authority agrees with your assessment that the rood top drainage would be considered enhances as rooftop drainage is traditionally considered clean for the purposes of water quality for receiving watercourses. Provided the overall storage is not lost, the RVCA would not require any additional onsite measures. Because the stormwater would be directed to municipal services, we would defer the technical review to the City.

Jamie Batchelor, MCIP, RPP
Planner, ext. 1191
Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority
3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 **F** 613-692-0831 | www.rvca.ca

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From: Jamie Batchelor
Sent: Tuesday, April 12, 2022 4:08 PM
To: ljablonski@jlrichards.ca
Subject: RE: OC Transpo E-Bus Facility JLR 31489-004

Good Afternoon Lee,

I am writing to let you know that I have received your email and will respond Thursday.

Jamie Batchelor, MCIP, RPP
Planner, ext. 1191
Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority

3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 **F** 613-692-0831 | www.rvca.ca

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Appendix B 2022 Pre-Consultation with MECP Ottawa Office

J.L. Richards
ENGINEERS · ARCHITECTS · PLANNERS

J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

OC Transpo
1500 Saint-Laurent

Pre-Consultation Meeting with MECP
Minutes of Meeting No. 1

Attendance:	Name	Company	Email
	Charlie Primeau (CP)	MECP	charlie.primeau@ontario.ca
	Scott Dupont (SD)	City of Ottawa	Scott.Dupont@ottawa.ca
	Sami Qadan (SQ)	City of Ottawa	Sami.Qadan@ottawa.ca
	Lee Jablonski (LJ)	J.L. Richards & Associates Limited	ljablonski@jlrichards.ca
	Marie-France Duthilleul (MD)	J.L. Richards & Associates Limited	mduthilleul@jlrichards.ca

The meeting commenced at 9:00 a.m. on Wednesday, April 6, 2022 **via TEAMS**.

The following summary of the discussions of this meeting has been prepared to record decisions reached and actions required for the project. Please advise the undersigned of any errors or omissions within the next three business days.

ITEM		**ACTION BY**	**DUE BY**
1.1	L. Jablonski provided a brief introduction to the site and the proposed redevelopment, replacing a portion of the existing asphalt parking lot with a new E-bus storage building.	INFO	
1.2	L. Jablonski stated that the proposed project was split into two parts. The first part concept design, to include support documents for city site plan application and ECA amendment is being led by JLR, currently under contract with the City. The second part is the detailed design to be done by another consulting firm as part of a design-build Team.	INFO	
1.3	L. Jablonski anticipated an end-of-month deadline to submit the site plan application.	INFO	
1.4	C. Primeau stated that the existing approved Feb. 3, 2017 (No. 8368-AGMS3S) ECA would need to be amended. He also mentioned that since 2017 the Ministry is now attempting to consolidate approval conditions. New conditions may or may not be applied to the current ECA amendment request. The MECP reviewer assigned to the application will confirm the additional conditions, if required, to be added to the amendment. A draft ECA template with an outline of various conditions is to be forwarded.	CP	
1.5	S. Dupont stated that the expected completion date for the building is 2025.	INFO	
1.6	C. Primeau mentioned as part of the ECA amendment that a copy of SWM Facility monitoring records (spill control, etc.) would need to be provided by the City as part of the submission package.	CITY	
1.7	C. Primeau stated that the permitting system has been streamlined, and the timeline once a submission package is received is approximately six to eight months. However, the submission can be delayed if the documents are deemed incomplete. Given that this is a city project, the process could be fast-tracked. JLR can review this request with Charles Warnock at the City of Ottawa to determine if the application can be approved	JLR	

J.L. Richards
ENGINEERS · ARCHITECTS · PLANNERS

J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

OC Transpo
1500 Saint-Laurent

Pre-Consultation Meeting with MECP
Minutes of Meeting No. 1

ITEM		ACTION BY	DUE BY
	under the Transfer of Review (TOR) program. CP noted that such TOR approvals are not unprecedented. CP also noted that Charles Warnock may call CP directly to discuss among themselves.		
1.8	C. Primeau noted that during construction, the Ministry assigns an Environmental Officer (Angelo Capello) to be onsite. They help address unexpected design-related environmental concerns that may occur during construction and provide direct input on design solutions, so as not to delay works. This approach is currently being done on the LRT project. In the case where ECA approval has not been received for a project and construction is imminent, the Environmental Officer can help expedite approvals within the Ministry.	INFO	
	Meeting adjourned at 09:45 a.m.		
	Next meeting TBD.		

Prepared by: Issued on: April 8, 2022



Marie-France Duthilleul, P.Eng.
Senior Civil Engineer

Distribution: All attendees
Andrew Duncan, JLR
Tim Chadder, JLR
Shahira Jalal, JLR

Appendix C Environmental Compliance Approvals Previously Issued for 1500 St. Laurent Boulevard

Ministry of the Environment / Ministère de l'Environnement

Ontario

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 6643-5DUSP2

City of Ottawa
1500 St. Laurent Boulevard
Ottawa, Ontario
K1G 0Z8

Site Location: 1500 St. Laurent Boulevard
City of Ottawa, Ontario

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

A stormwater management system to be constructed at the northwest corner of St. Laurent Boulevard and Belfast Road, for the OC Transpo regional bus service, as follows:

Stormwater management system collecting up to 100-year storm event runoff from the development of a 1.25 ha parcel of land, consisting of detention storage in the parking lot of 304 cubic metres to a depth of 0.3 metres, with the 1:5 year storms discharging via a manhole, complete with a 295 mm diameter orifice, restricting flows to 240 Litres per second, and with detention of storms up to the 1:100 year event, in a swale/dry pond, with storage of 276 cubic metres to a depth of 0.8 metres, with an inlet control device with a 145 millimetre diameter orifice restricting flows to 42.8 Litres per second, and one (1) manhole oil/grit separator, having a sediment capacity of 6150 litres, an oil capacity of 2,945 litres, a total holding capacity of 10,925 litres and a maximum treated flow rate of 30 litres per second, with eventual discharge to the surface ditch adjacent to the site and to Cyrville Drain, complete with all sewers, catchbasins and manholes,

all in accordance with the application dated August 13, 2002, signed by David McDougall (Fleet Safety Engineer), City of Ottawa, and final plans and specifications prepared by J.L. Richards and Associates Limited.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

(i) "Act" means the *Ontario Water Resources Act;*

(ii) "Certificate" means this entire Certificate of Approval document, issued in accordance with Section

53 of the *Ontario Water Resources Act;*

(iii) "Director" means any Ministry employee appointed by the Minister pursuant to Section 5 of the *Ontario Water Resources Act;*

(iv) "District Manager" means the District Manager of the Ottawa District Office of the Ministry of the Environment's Eastern Region;

(v) "Ministry" means Ministry of Environment;

(vi) "Owner" means the City of Ottawa;

(vii) "Environmental Appeal Board" means the Environmental Review Tribunal established pursuant to the *Environmental Review Tribunal Act*; and

(viii) "Works" means the sewage works described in the Owner's application, this Certificate and in the supporting documentation referred to herein, to the extent approved by this Certificate.

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Certificate, the application for approval of the Works and the submitted supporting documents and plans and specifications as listed in this Certificate.

2. Where there is a conflict between a provision of any submitted document referred to in this Certificate and the Conditions of this Certificate, the Conditions in this Certificate shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

3. The Owner shall design, construct and operate the manhole oil/grit separator(s) with the objective that no visible oil sheens occur in the effluent discharged from the manhole oil/grit separator(s).

4. The Owner shall carry out and maintain an annual inspection and maintenance program on the operation of the manhole oil/grit separator(s) in accordance with the manufacturer's recommendation.

5. After a two (2) year period, the District Manager of the MOE District Office may alter the frequency of inspection of the manhole oil/grit separator(s) if he/she is requested to do so by the Owner and considers it acceptable upon review of information submitted in support of the request.

The Owner shall ensure that sediment and oily materials are removed from the above noted stormwater management system at such a frequency as to prevent the excessive buildup and potential overflow of

sediment and/or oily material into a receiving watercourse.

The reasons for the imposition of these terms and conditions are as follows:

1. Conditions No. 1 and 2 are imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. These conditions are also included to emphasize the precedence of Conditions in the Certificate and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Conditions No. 3, 4 and 5 are imposed to ensure that the manhole oil/grit separator(s) are operated and maintained without any adverse impact on the environment.

3. Condition No. 6 is included as regular removal of sediment and oily materials from this approved stormwater management system are required to mitigate the impact of sediment and/or oily material on a downstream receiving watercourse. It is also required to ensure that adequate storage is maintained in the stormwater management facilities at all times as required by the design.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

:e Secretary*
Environmental Review Tribunal
2300 Yonge St., 12th Floor
P. O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of Environment and Energy
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 20th day of September, 2002

THIS CERTIFICATE WAS MAILED
ON Sept 24, 2002
W. [illegible]
(Signed)

A. Ahmed

Aziz Ahmed, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

AA/

c: District Manager, MOE Ottawa
Lee Jablonski, P.Eng., J.L. Richards and Associates Limited

Ontario

Ministry of the Environment | Ministère de l'Environnement

AMENDED CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 5605-6VZS8W
Issue Date: December 5, 2006

City of Ottawa
1500 St. Laurent Boulevard
Ottawa, Ontario
K1G 0Z8

Site Location: 1500 St. Laurent Boulevard
City of Ottawa

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

A stormwater management system comprising of two (2) existing facilities constructed to serve the 1500 St. Laurent Boulevard site (a 13.59 ha industrial area located at the northwest corner of St. Laurent Boulevard and Belfast Road), which accommodates service buildings, parking lots and an administrative building for the OC Transpo regional bus service, as follows:

- a stormwater management facility serving the northwest area of the site (sub-areas 4A, 4C and 4D) comprising of parking lot storage of 355 cubic metres to a maximum depth of 0.3 metres, with runoff during minor storms discharged to onsite storm sewers system equipped with flow control orifices to restrict flows to 355 Litres per second, and detention of runoff during major storm provided in a swale/dry pond, with storage of 475 cubic metres to a depth of 1.0 metre, with a flow control orifice restricting flows to 40.0 Litres per second, together with one (1) manhole oil/grit separator, having a sediment capacity of 6,150 litres, an oil capacity of 2,945 litres, a total holding capacity of 10,925 litres and a maximum treated flow rate of 30 litres per second, with discharge via a 600 mm diameter storm sewer from the area to an existing open ditch (located along the Canadian Pacific easement) which empties into a 750 mm storm sewer, (which also receives uncontrolled storm discharges from sub-areas 3A, 3B and 4B), then to Cyrville Drain, eventually to Green's Creek.

- a stormwater management facility serving the southeastern area of the site (sub-area 1A) comprising of onsite storm sewer system discharging to an existing 6 m x 2.1 m x 3 m high dual chamber cast-in-place oil/grit separator, located at the northwest corner of the intersection of St. Laurent Boulevard and Belfast Road, discharging into the existing municipal storm sewer system (which also receives uncontrolled storm discharges from sub-area 1B),

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned *Works* ,

RECEIVED
DEC 12 2006
J. L. Richards & Associates Limited
OTTAWA OFFICE

all in accordance with the following submitted supporting documents:

1. Application for Approval of Municipal and Private Sewage Works dated August 8, 2006 submitted by Jean Lachance, P. Eng., City of Ottawa.

2. Report entitled 'Stormwater Site Management Plan, OC Transpo, City of Ottawa, 1500 St. Laurent Site' dated July 2006 prepared by J.L. Richards & Associates Limited, Consulting Engineers.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

"*Certificate* " means this entire certificate of approval document, issued in accordance with Section 53 of the Ontario Water Resources Act, and includes any schedules;

"*Director* " means any *Ministry* employee appointed by the Minister pursuant to section 5 of the Ontario Water Resources Act;

"*District Manager* " means the District Manager of the Ottawa District Office of the *Ministry* ;

"*Ministry* " means the Ontario Ministry of the Environment;

"*Owner* " means City of Ottawa and includes its successors and assignees;

"*Works* " means the sewage works described in the *Owner* 's application, this *Certificate* and in the supporting documentation referred to herein, to the extent approved by this *Certificate* .

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) Except as otherwise provided by these Conditions, the *Owner* shall design, build, install, operate and maintain the *Works* in accordance with the description given in this *Certificate* , the application for approval of the works and the submitted supporting documents and plans and specifications as listed in this *Certificate* .

(2) Where there is a conflict between a provision of any submitted document referred to in this *Certificate* and the Conditions of this *Certificate* , the Conditions in this *Certificate* shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

(3) Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

2. EXPIRY OF APPROVAL

The approval issued by this *Certificate* will cease to apply to those parts of the *Works* which have not been constructed within five (5) years of the date of this *Certificate* .

3. CHANGE OF OWNER

The *Owner* shall notify the *District Manager* and the *Director* , in writing, of any of the following changes within thirty (30) days of the change occurring:

(a) change of *Owner* ;

(b) change of address of the *Owner* ;

(c) change of partners where the *Owner* is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the *District Manager* ; and

(d) change of name of the corporation where the *Owner* is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the *District Manager* .

4. OPERATION AND MAINTENANCE.

(1) The *Owner* shall ensure that the design minimum liquid retention volume(s) is maintained at all times.

(2) The *Owner* shall inspect the *Works* at least once a year and, if necessary, clean and maintain the *Works* to prevent the excessive buildup of sediments, oil/grit and/or vegetation.

(a) The Owner shall design, construct and operate the manhole oil/grit separator(s) with the objective that no visible oil sheens occur in the effluent discharged from the manhole oil/grit separator(s).

(b) The Owner shall carry out and maintain an annual inspection and maintenance program on the operation of the manhole oil/grit separator(s) in accordance with the manufacturer's recommendation.

(c) The District Manager may alter the frequency of inspection of the manhole oil/grit separator(s) if he/she is requested to do so by the Owner and considers it acceptable upon review of information submitted in support of the request.

(3) The *Owner* shall maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken, and shall keep the logbook for inspection by the *Ministry* . The logbook shall include the following:

(a) the name of the *Works* ; and

(b) the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed.

5. RECORD KEEPING

The *Owner* shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the operation and maintenance activities required by this *Certificate* .

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the *Works* are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the *Certificate* and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the *Works* are constructed, the *Works* will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment..

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved works and to ensure that subsequent owners of the works are made aware of the certificate and continue to operate the works in compliance with it.

4. Condition 4 is included to require that the *Works* be properly operated and maintained such that the environment is protected.

5. Condition 5 is included to require that all records are retained for a sufficient time period to adequately evaluate the long-term operation and maintenance of the *Works* .

This Certificate of Approval revokes and replaces Certificate(s) of Approval No. 6643-5DUSP2 issued on September 20, 2002.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;

5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
2300 Yonge St., Suite 1700
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 5th day of December, 2006

Dec. 7, 2006
DC

Mohamed Dhalla, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

HV/

c: District Manager, MOE Ottawa District Office
Derrick Upton, P. Eng., J.L. Richards & Associates Limited ✓

Content Copy Of Original

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 8368-AGMS3S
Issue Date: February 3, 2017

City of Ottawa
1500 St. Laurent Boulevard
Ottawa, Ontario
K1G 0Z8

Site Location: 1500 St. Laurent Boulevard
City of Ottawa,
K1G 0Z8

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

an amendment to the stormwater management Works which accommodates service buildings, parking lots and an administrative building for the OC Transpo regional bus service, located at the northwest corner of St. Laurent Boulevard and Belfast Road, within the Ottawa River watershed, in the City of Ottawa, for the collection, treatment and disposal of stormwater run-off from the property, for the reconstruction of the bus storage/access road including stormwater management facilities to service approximately 1.03 hectares of the overall 13.59 hectares site area, providing Enhanced Level water quality control and erosion protection and attenuating post-development peak flows for all storm events up to and including the 100-year storm event to the pre-development peak flows for the 5-year storm event, consisting of the following:

Proposed Works:

infiltration trench (catchment area - 1.03 hectares) : - an approximately 185 m long by 0.5 m wide infiltration trench located along the west side of the bus storage/access road, receiving inflows from employee parking and rooftop from adjacent property located at 925 Belfast Road (ECA#3627-ADUGRU issued September 28, 2016) as well as bus storage/access road at 1500 St.Laurent, consisting of a 0.8 m deep layer of 19 mm diameter clear stone wrapped with non-woven geotextile fabric, having a total infiltration storage volume of approximately 46 m 3 , to store a portion of run-off from the 2-year storm event, providing stormwater infiltration with a design infiltration rate of approximately 60 mm/hr;

grassed swale: -one (1) grassed swale with a length of 185 m, a bottom width of 0.5 m, average depth of 0.85 m, side slopes of 2:1, and slope of 0.18%, located along the west side of the bus storage/access road, on the west side of the light industrial site, having a storage volume of approximately 375 m 3 , to convey up to the 100-year storm event from a small portion of the overall site area (bus storage/access road) and parking lot and adjacent building located at 925 Belfast Road, discharging to the ditch inlet, identified below;

ditch inlet: one (1) swale ditch inlet to be constructed on the north side of Belfast Road, receiving inflows from run-off of grassed swale, identified above, complete with a 235 mm diameter orifice plate to control the discharge to a flow rate of 0.103 m 3 /s, discharging to the storm sewer, identified below;

storm sewer: 300 mm diameter storm sewer to be constructed on the west side of the industrial site, discharging to an existing 375 storm sewer on Belfast Road;

Previous Works under amended Approval 5605-6VZS8W, issued December 5, 2006:

a stormwater management facility serving the northwest area of the site (sub-areas 4A, 4C and 4D) comprising of parking lot storage of 355 cubic metres to a maximum depth of 0.3 metres, with runoff during minor storms discharged to onsite storm sewers system equipped with flow control orifices to restrict flows to 355 Litres per second, and detention of runoff during major storm provided in a swale/dry pond, with storage of 475 cubic metres to a depth of 1.0 metre, with a flow control orifice restricting flows to 40.0 Litres per second, together with one (1) manhole oil/grit separator, having a sediment capacity of 6,150 litres, an oil capacity of 2,945 litres, a total holding capacity of 10,925 litres and a maximum treated flow rate of 30 litres per second, with discharge via a 600 mm diameter storm sewer from the area to an existing open ditch (located along the Canadian Pacific easement) which empties into a 750 mm storm sewer, (which also receives uncontrolled storm discharges from sub-areas 3A, 3B and 4B), then to Cyrville Drain, eventually to Green's Creek.

a stormwater management facility serving the southeastern area of the site (sub-area 1A) comprising of onsite storm sewer system discharging to an existing 6 m x 2.1 m x 3 m high dual chamber cast-in-place oil/grit separator, located at the northwest corner of the intersection of St. Laurent Boulevard and Belfast Road, discharging into the existing municipal storm sewer system (which also receives uncontrolled storm discharges from sub-area 1B),

Previous Works under Approval 6643-5DUSP2, issued September 20, 2002:

stormwater management system collecting up to 100-year storm event runoff from the development of a 1.25 ha parcel of land, consisting of detention storage in the parking lot of 304 cubic metres to a depth of 0.3 metres, with the 1:5 year storms discharging via a manhole, complete with a 295 mm diameter orifice, restricting flows to 240 Litres per second, and with detention of storms up to the 1:100 year event, in a swale/dry pond, with storage of 276 cubic metres to a depth of 0.8 metres, with an inlet control device with a 145 millimetre diameter orifice restricting flows to 42.8 Litres per second, and one (1) manhole oil/grit separator, having a sediment capacity of 6150 litres, an oil capacity of 2,945 litres, a total holding capacity of 10,925 litres and a maximum treated flow rate of 30 litres per second, with eventual discharge to the surface ditch adjacent to the site and to Cyrville Drain, complete with all sewers, catchbasins and manholes,

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted supporting documents listed in Schedule"A" forming part of this Approval.

For the purpose of this environmental compliance approval, the following definitions apply:

"Approval" means this entire document including the application and any supporting documents listed in any schedules in this Approval;

"Director" means a person appointed by the Minister pursuant to section 5 of the Environmental Protection Act for the purposes of Part II.1 of the Environmental Protection Act;

"Equivalent" means a substituted product that meets the required quality and performance standards of a named product;

"Ministry" means the ministry of the government of Ontario responsible for the Environmental Protection Act and the Ontario Water Resources Act and includes all officials, employees or other persons acting on its behalf;

"Owner" means the City of Ottawa and includes their successors and assignees;

"Previous Works" means those portions of the sewage Works previously approved under an Approval;

"Significant Drinking Water Threat Policies" has the same meaning as in the Clean Water Act , 2006;

"Source Protection Plan" means a drinking water source protection plan prepared under the Clean Water Act , 2006;

"Works" means the sewage works described in the Owner's application(s) and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the Conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

(2) Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

(3) Where there is a conflict between a provision of any submitted document referred to in this Approval and the Conditions of this Approval, the Conditions in this Approval shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

(4) Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(5) The Conditions of this Approval are severable. If any Condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such Condition to other circumstances and the remainder of this Approval shall not be affected thereby.

(6) The issuance of, and compliance with the Conditions of this Approval does not:

(a) relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement, including, but not limited to, the obligation to obtain approval from the local conservation authority necessary to construct or operate the sewage Works; or

(b) limit in any way the authority of the Ministry to require certain steps be taken to require the Owner to furnish any further information related to compliance with this Approval.

2. EXPIRY OF APPROVAL

(1) This Approval will cease to apply to those parts of the new Works which have not been constructed within **five (5) years** of the date of this Approval.

3. CHANGE OF OWNER

(1) The Owner shall notify the Director, in writing, of any of the following changes within **thirty (30) days** of the change occurring:

(a) change of Owner;

(b) change of address of the Owner;

(c) change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act , R.S.O. 1990, c. B17 shall be included in the notification to the Director;

(d) change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act , R.S.O. 1990, c. C39 shall be included in the notification to the Director.

4. OPERATION AND MAINTENANCE

(1) The Owner shall inspect the Works at least **once a year** and, if necessary, clean and maintain the Works to prevent the excessive build-up of sediments and/or vegetation.

(2) The Owner shall maintain a record the results of these inspections and any cleaning and maintenance operations undertaken. The record shall include the following:

(a) the name of the Works; and

(b) the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed.

5. MONITORING AND REPORTING

(1) The Owner shall carry out a monitoring program for the inspection and maintenance of the Works as outlined in this Approval, and shall make the information available to the Ministry, upon request.

6. SPILL CONTINGENCY AND POLLUTION PREVENTION PLAN

(1) Upon commencement of operation of the Works, the Owner shall implement a Spill Contingency and Pollution Prevention Plan that outlines procedures as to how to mitigate the impacts of a spill within the area serviced by the Works and/or prevent pollution incidents. The said plan shall include as a minimum, but not limited to:

(a) the name, job title and location (address) of the Owner, person in charge, management or control of the 1500 St. Laurent Boulevard site at 1500 St. Laurent Boulevard;

(b) the name, job title and 24-hour telephone number of the person(s) responsible for activating

the Spill Contingency and Pollution Prevention Plan;

(c) a site plan drawn to scale showing the facility, nearby buildings, streets, catchbasins & manholes, drainage patterns (including direction(s) of flow in storm sewers) and any features which need to be taken into account in terms of potential impacts on access and response (including physical obstructions and location of response and clean-up equipment);

(d) steps to be taken to report, contain, clean up and dispose of contaminants following a spill;

(e) a listing of telephone numbers for: local clean-up companies who may be called upon to assist in responding to spills; local emergency responders including health institution(s); and MOECC Spills Action Centre 1-800-268-6060;

(f) Materials Safety Data Sheets (MSDS) for each and every hazardous material which may be transported or stored within the area serviced by the Works;

(g) the means (internal corporate procedures) by which the Spill Contingency and Pollution Prevention Plan is activated;

(h) a description of the spill response and pollution prevention training provided to employees assigned to work in the area serviced by the Works, the date(s) on which the training was provided and to whom;

(i) an inventory of response and clean-up equipment available to implement the Spill Contingency and Pollution Prevention Plan, location and date of maintenance/replacement if warranted, including testing and calibration of the equipment; and

(j) the date on which the Spill Contingency and Pollution Prevention Plan was prepared and subsequently, amended.

(2) The Spill Contingency and Pollution Prevention Plan shall be kept in a conspicuous place near the reception area on site.

(3) The Spill Contingency and Pollution Prevention Plan will be amended from time to time as needed by changes in the operation of the facility or to reflect updates in the Municipal By-Laws, or improved Best Management Practices by the Owner.

7. TEMPORARY EROSION AND SEDIMENT CONTROL

(1) The Owner shall install and maintain temporary sediment and erosion control measures during construction and conduct inspections once every **two (2) weeks** and after each significant storm event (a significant storm event is defined as a minimum of 25 mm of rain in any 24 hours period). The inspections and maintenance of the temporary sediment and erosion control measures shall continue until they are no longer required and at which time they shall be removed and all disturbed areas reinstated properly .

(2) The Owner shall maintain records of inspections and maintenance which shall be made available for inspection by the Ministry, upon request. The record shall include the name of the inspector, date of inspection, and the remedial measures, if any, undertaken to maintain the temporary sediment and erosion control measures.

8. SOURCE WATER PROTECTION

(1) The Owner shall ensure, if applicable, that the design, construction and operation of the Works conforms to any Significant Drinking Water Threat Policies in any Source Protection Plan that applies to the location of the Works.

9. RECORD KEEPING

The Owner shall retain for a minimum of **five (5) years** from the date of their creation, all records and information related to or resulting from the operation and maintenance activities required by this Approval

Schedule "A"

1. Application for Approval of Municipal and Private Sewage Works dated August 8, 2006 submitted by Jean Lachance, P. Eng., City of Ottawa.

2. Report entitled 'Stormwater Site Management Plan, OC Transpo, City of Ottawa, 1500 St. Laurent Site' dated July 2006 prepared by J.L. Richards & Associates Limited, Consulting Engineers.

3. Application for Environmental Compliance Approval , dated July 4, 2016, received on July 22, 2016, submitted by Morrison Hershfield Limited;

4. SWM Technical Memo to the Ministry of Environment and Climate Change , dated June 20, 2016, prepared by Morrison Hershfield Limited;

5. Set of Engineering Drawings (7 drawings) for OC Transpo- 1500 St-Laurent Access Road Reconstruction, dated June 9, 2016, prepared by Morrison Hershfield Limited;

6. E-mail from Sarah Mitchelson of Morrison Hershfield Limited to the Ministry, dated January 17, 2017;

7. E-mail from Sarah Mitchelson of Morrison Hershfield Limited to the Ministry, dated January 27, 2017; and

8. E-mail from Sarah Mitchelson of Morrison Hershfield Limited to the Ministry, dated February 1, 2017.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. This Condition is also included to emphasize the precedence of Conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved Works and to ensure that any subsequent Owner of the Works is made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to require that the Works be properly operated and maintained such that the

environment is protected.

5. Condition 5 is included to enable the Owner to evaluate and demonstrate the performance of the Works on a continual basis, so that the Works are properly operated and maintained at a level which is consistent with the design objectives specified in the Approval and that the Works do not cause any impairment of the receiving watercourse.

6. Condition 6 is included to ensure that the Ministry is immediately informed of the occurrence of an emergency or otherwise abnormal situation so that appropriate steps are taken to address the immediate concerns regarding the protection of public health and minimizing environmental damage and to be able to devise an overall abatement strategy to prevent long term degradation and the re-occurrence of the situation.

7. Condition 7 is included as installation, regular inspection and maintenance of the temporary sediment and erosion control measures is required to mitigate the impact on the downstream receiving watercourse during construction, until they are no longer required.

8. Condition 8 is included to ensure that the Works conform to the policies of the local Source Water Protection Plan.

9. Condition 9 is included to require that all records are retained for a sufficient time period to adequately evaluate the long-term operation and maintenance of the Works.

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 5605-6VZS8W issued on December 5, 2006.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;
6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of Part II.1 of the Environmental Protection Act
Ministry of the Environment and Climate Change
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 3rd day of February, 2017

Gregory Zimmer, P.Eng.
Director
appointed for the purposes of Part II.1 of the *Environmental Protection Act*

TN/
c: DWMD Supervisor, MOECC Ottawa office
Sarah Mitchelson, Morrison Hershfield Limited

Appendix D 2025 MECP Pre-Consultation Communications

Brown, Rikke

From: Grant, Todd
Sent: March 27, 2025 8:44 AM
To: Brown, Rikke
Subject: FW: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter
Attachments: 20241106 Email - Transfer of Review - OCTranspo New Garage.pdf; SPA- pre application 20250304.pptx

As discussed.

Todd Grant, P.Eng.
Project Manager, Water
D +1-613-371-4905
M +1-613-371-4905
todd.grant@aecom.com

AECOM Canada ULC
302-1150 Morrison Drive
Ottawa, Ontario K2H 8S9, Canada
T +1-613-820-8282
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

From: Craig, Ian <Ian.Craig@ottawa.ca>
Sent: March 4, 2025 4:27 PM
To: Diamond, Emily (MECP) <emily.diamond@ontario.ca>; Cote, Joff (MECP) <joff.cote@ontario.ca>; Hart,Tracy <Tracy.Hart@ontario.ca>
Cc: Alex Leung <aleung@provencherroy.ca>; Fleith, Ross <ross.fleith@aecom.com>; Amor, Jonathan <jonathan.amor@ottawa.ca>; Dupont, Scott <Scott.Dupont@ottawa.ca>; Faris, Robert W <Robert.Faris@ottawa.ca>; Dehghani, Narges <Narges.Dehghani@aecom.com>; Sadeghi, Amin <Amin.Sadeghi@aecom.com>; Grant, Todd <Todd.Grant@aecom.com>
Subject: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter

This Message Is From an External Sender

This message came from outside your organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Report Suspicious

Emily & Joff :

Thank you for meeting with us this afternoon at your office.
Here is copy of the SPA pre-consult presentation description of the project , and the email from Aziz S. Ahmed regarding the ToR.

AECOM / GRC will submit their ECA application by end of month or before for the new design of the Zero Emission Bus (ZEB) Garage to amend the current ECA.
They will provide the necessary supporting documents as required for review.

Thank you both again for your help with this.

Regards,

Infrastructure Services Department
City of Ottawa, 6thFlr.W, 100 Constellation Cres, Ottawa, ON K2G 6J8
Ian Craig, Sr. Project Manager, Facilities Design & Construction
c: 613-762-5596

'

This e-mail originates from the City of Ottawa e-mail system. Any distribution, use or copying of this e-mail or the information it contains by other than the intended recipient(s) is unauthorized. Thank you.

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.

'

Classified as City of Ottawa - Internal / Ville d'Ottawa - classé interne

From: Warnock, Charles <Charles.Warnock@ottawa.ca>
Sent: November 06, 2024 11:55 AM
To: Mask, Darren <darren.mask@ottawa.ca>
Subject: OC Transpo Parking Garage
Hi Darren, would this be your project?
If it is not yours, would you know who's project it is?
If it is yours, you can use this email to proceed under the Transfer of Review process.
Let me know if you have any questions on the ECA process.
Thanks.
Charles

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From: Ahmed, Aziz (MECP) <Aziz.Ahmed@ontario.ca>
Sent: October 29, 2024 10:28 AM
To: Warnock, Charles <Charles.Warnock@ottawa.ca>
Cc: Mitchell, Bryan (MECP) <Bryan.Mitchell2@ontario.ca>; Hart,Tracy <Tracy.Hart@ontario.ca>
Subject: OC Transpo Parking Garage
Charles,
We are processing this application for amendment to an existing ECA attached for the OC Transpo Garage, and would like the City to process
this under their Transfer of Review agreement. You may then withdraw you application 1000181180 and receive a refund of your fees.
Best,
Aziz

1000181180	CITY OF OTTAWA	1500 St. Laurent Boulevard - OC Transpo E-Bus Parking Garage	1500 ST. LAURENT Boulevard (BLVD) OTTAWA	Technical Amendment to Existing ECA	Technical Review In Progress	7682	Active

Aziz S. Ahmed, P.Eng.
Manager, Licensing and Approvals
Environmental Assessment and Permissions Branch
Ministry of the Environment and Climate Change
40 St. Clair Avenue W., 2nd Floor
Toronto, Ontario
M4V 1M2
aziz.ahmed@ontario.ca
ph. (416) 314-4625
fax. (416) 212-7576
Toll Free: 1-888-999-1305

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New Zero Emission Bus Garage

OC Transpo

Ian Craig, Jonathan Amor,
Alex Leung, Ross Fleith,
Narges Dehghani, Todd Grant

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Agenda

1. Introductions
2. Project Background
3. Traffic Flow
4. Architecture
5. Civil Design
6. ECA Clarifications



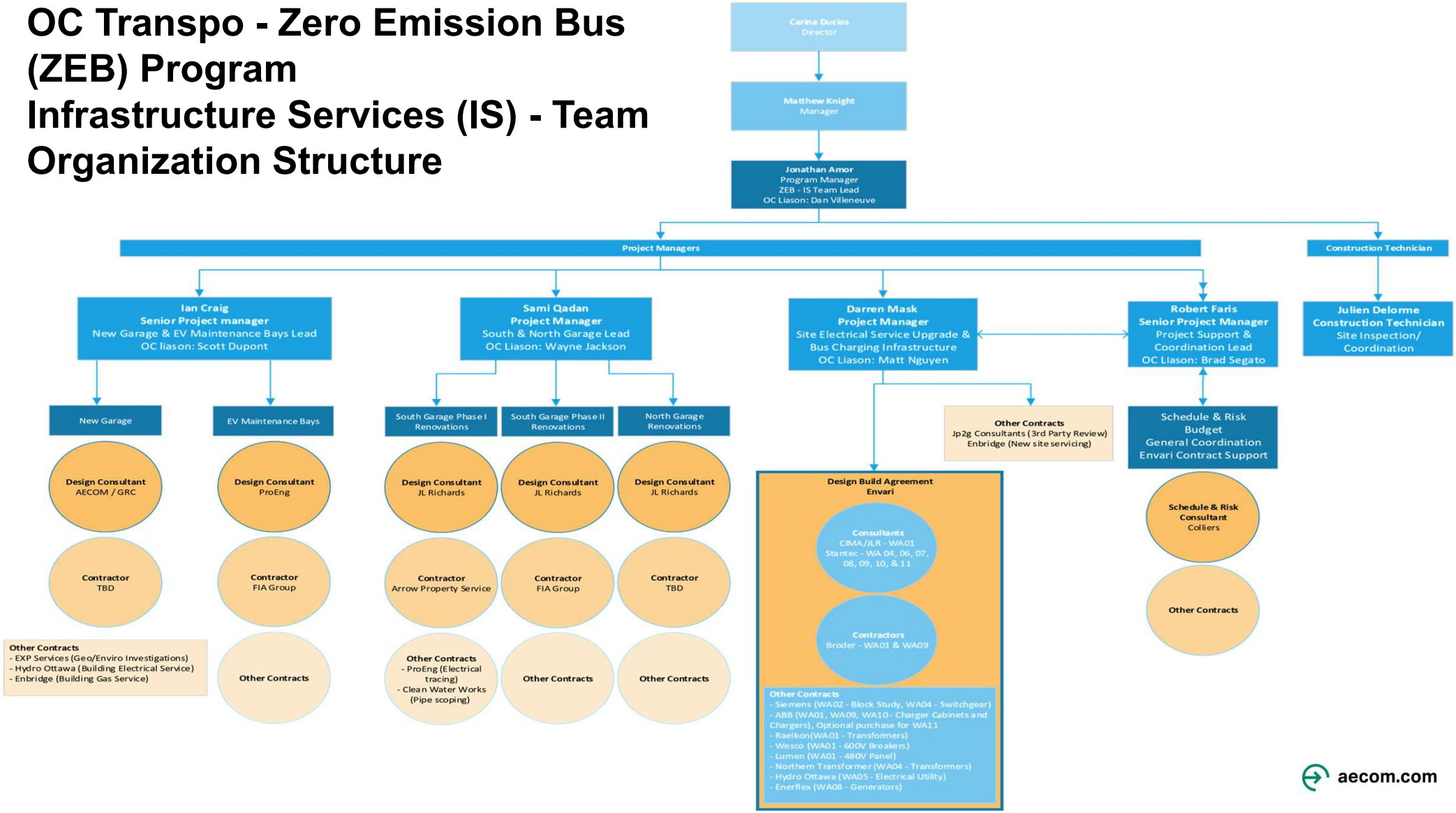
1

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Introductions

Ian Craig, Jonathan Amor,
Alex Leung, Ross Fleith,
Narges Dehghani, Todd Grant

OC Transpo - Zero Emission Bus (ZEB) Program
Infrastructure Services (IS) - Team Organization Structure



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Project Background

Project Background

- AECOM in Collaboration with GRC Architects were Hired by the City of Ottawa for the design of the new Zero Emission Bus (ZEB) garages which is a vital infrastructure in enhancing quality and sustainability of transit in the City of Ottawa.
- The purpose of the facility is to store and charge the ZEB buses at the end of each shift, making them ready for the next.
- The project was previously presented to the City in a much larger format. Although a bus maintenance bay and countdown were required at first, these sections of the project were later excluded from the program.
- The overall program has two major components that are designed by AECOM/GRC Architects and Envari. These major parts are the Bus Garage and the electrical generation equipment. AECOM?GRC Architects and Envari are fully co-ordinating their efforts for this project through meetings attended by OC transpo and the City of Ottawa.
- The project will be designed to house eighty 40 foot equivalent buses and will obtain LEED Certification.

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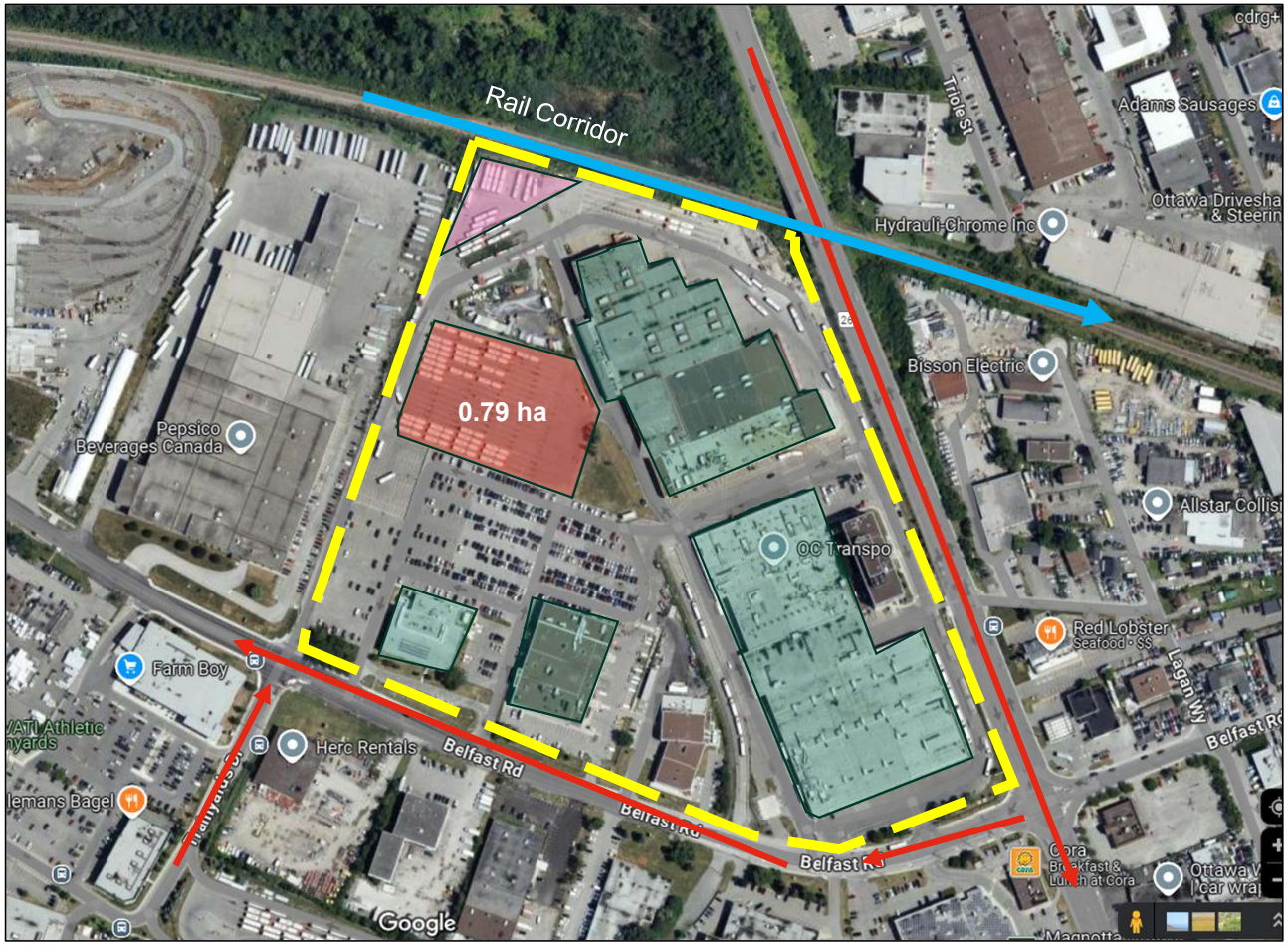
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Traffic Flow

Traffic Flow

- The City of Ottawa (City) owns and operates three (3) adjacent properties in the northwestern quadrant of the St. Laurent Boulevard and Belfast Road intersection; the entire site functions as a single facility with an address of 1500 St-Laurent Boulevard.
- The site has an area of ±13.59 ha and consists of parking lots, maintenance and administrative buildings that service the City's OC Transpo operations.
- Part of the site's parking lot (0.78 ha) will be redeveloped with a proposed building (garage) to house the new line of electrical buses (E-bus).



Traffic Flow- Current



Traffic Flow- Future



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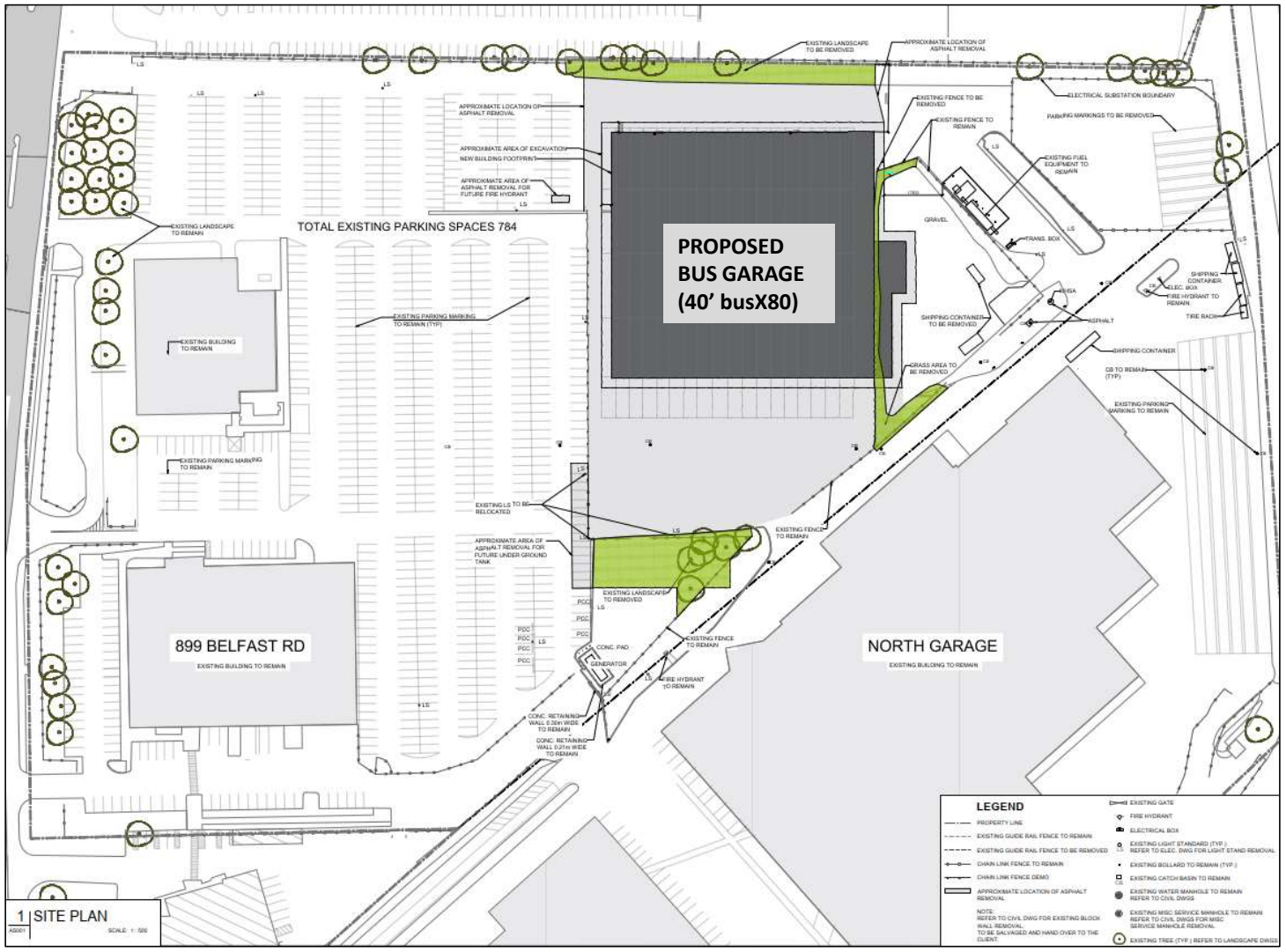
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5

Architecture

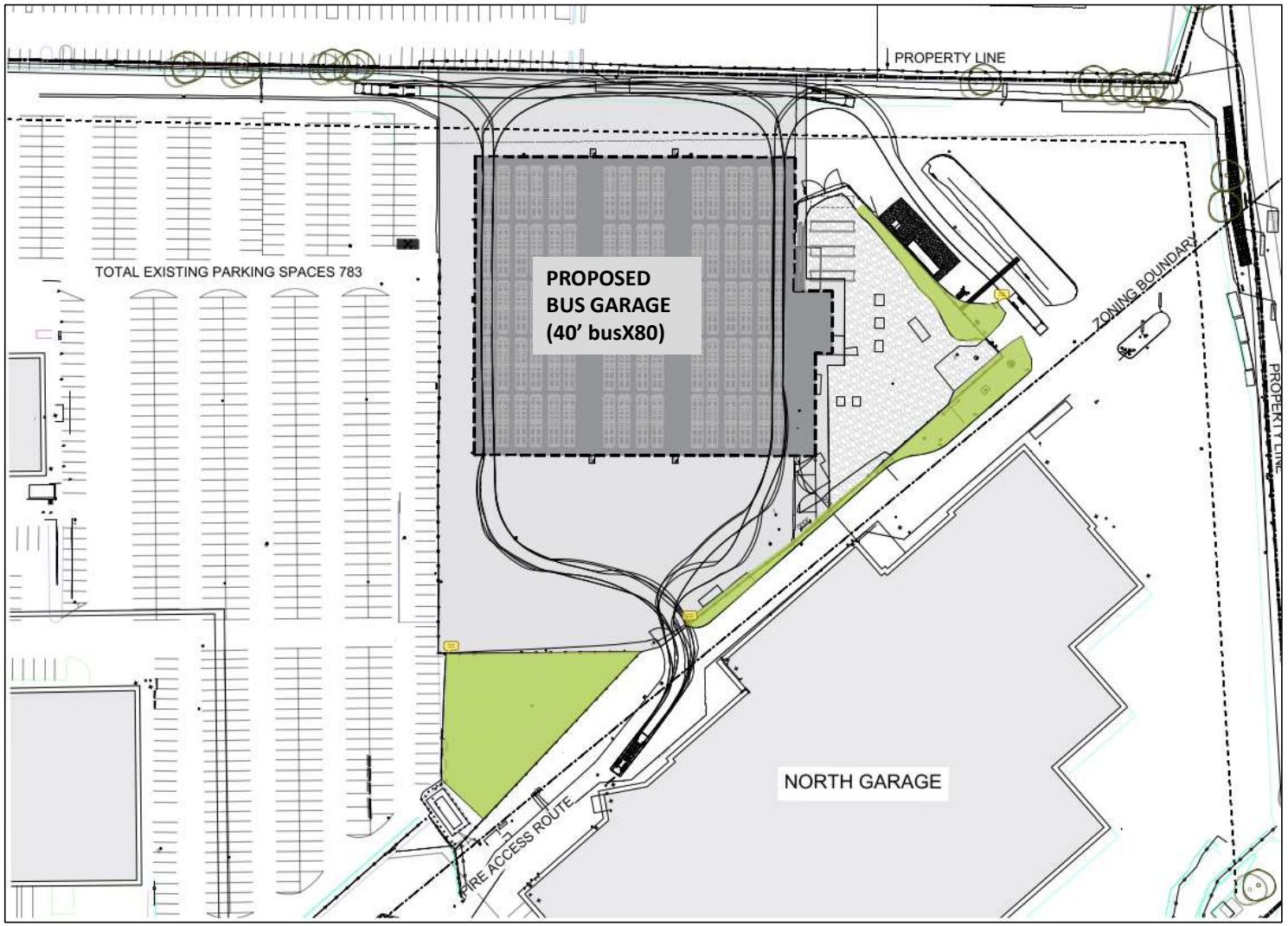
Architecture

- **Building GFA 6355 Sq.m**
- **Building Program:**
  - **Bus Garage**

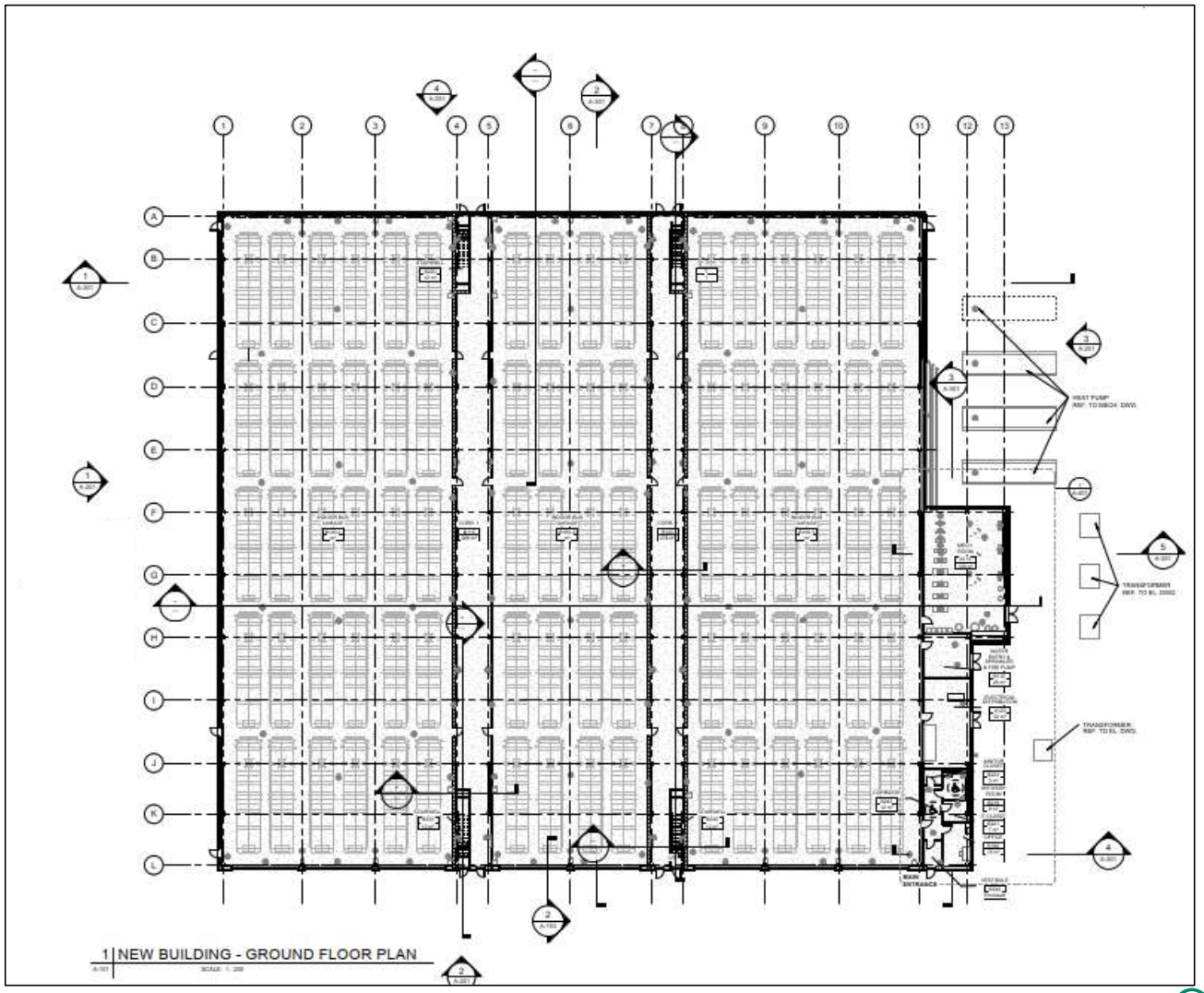


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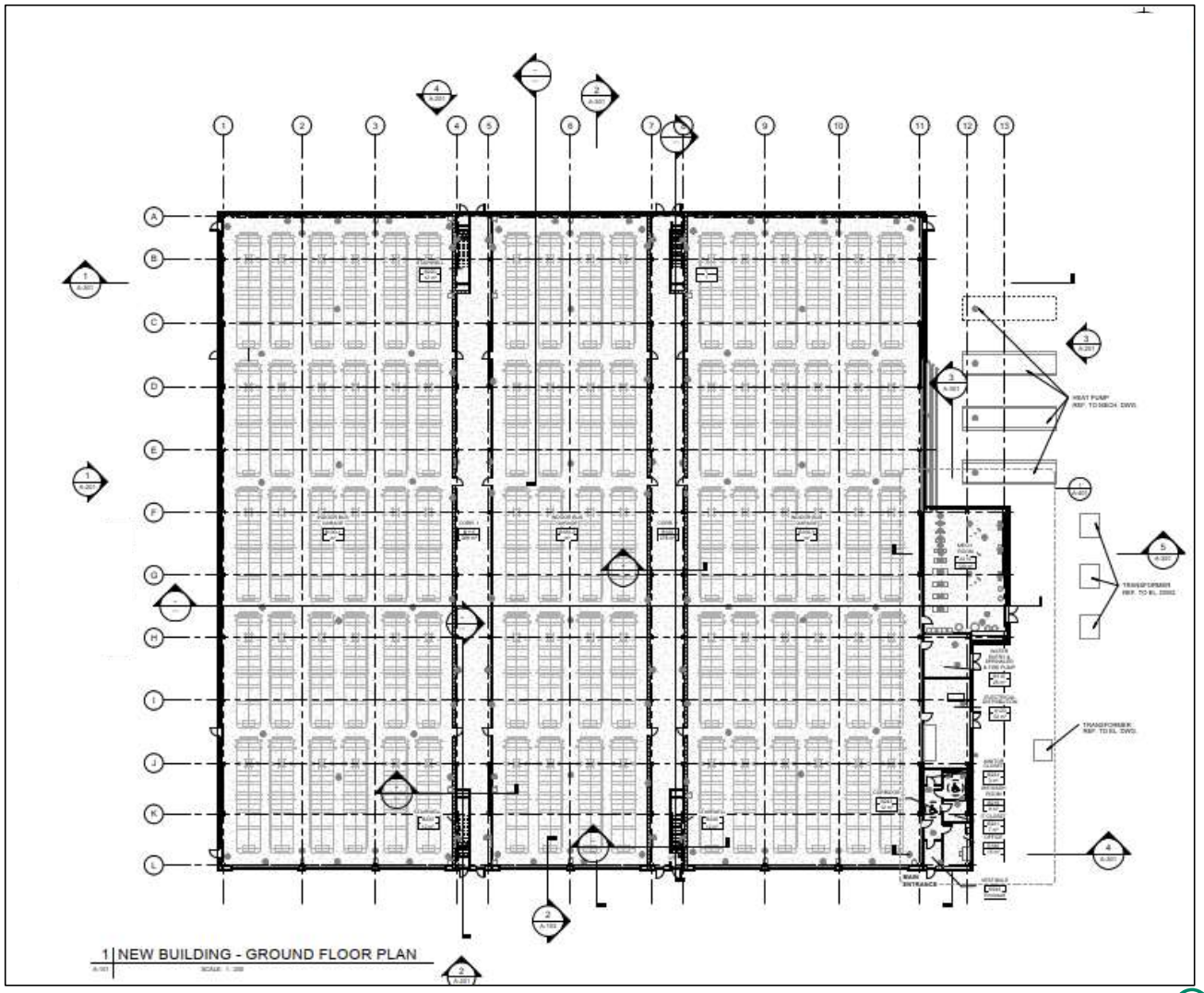
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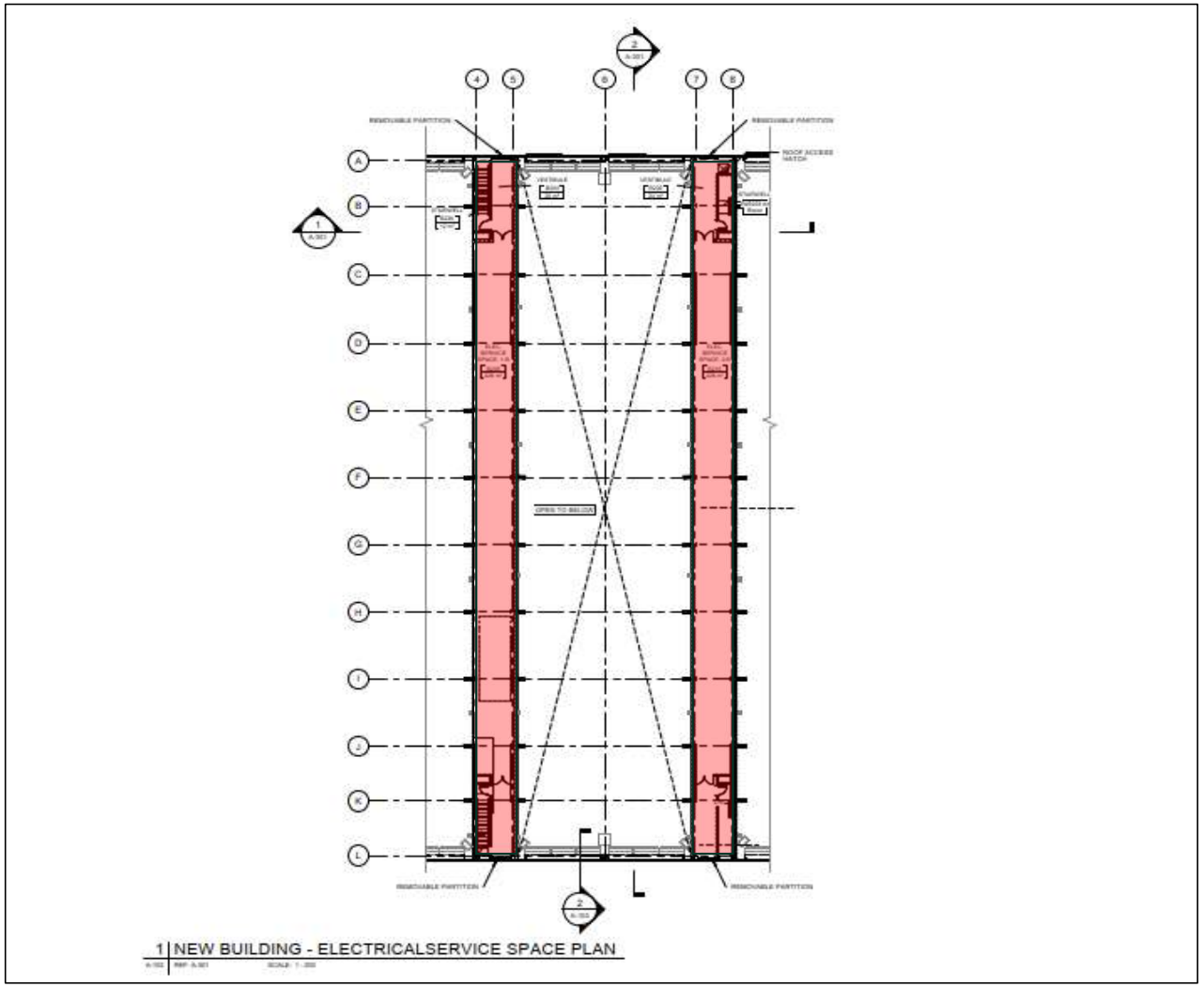
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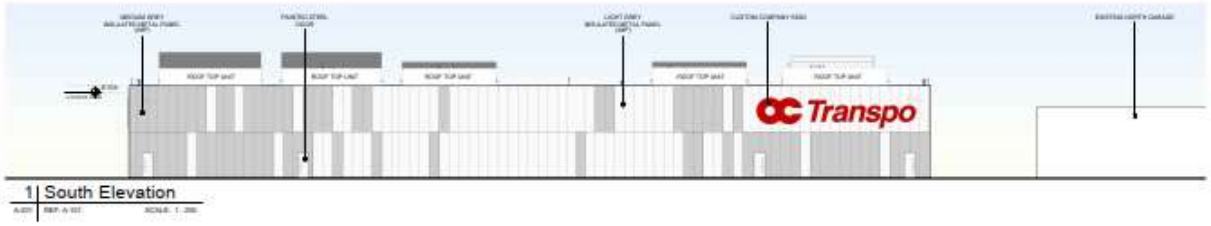
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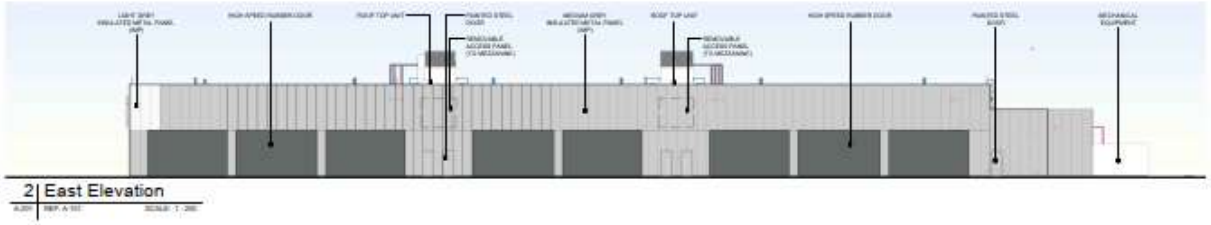
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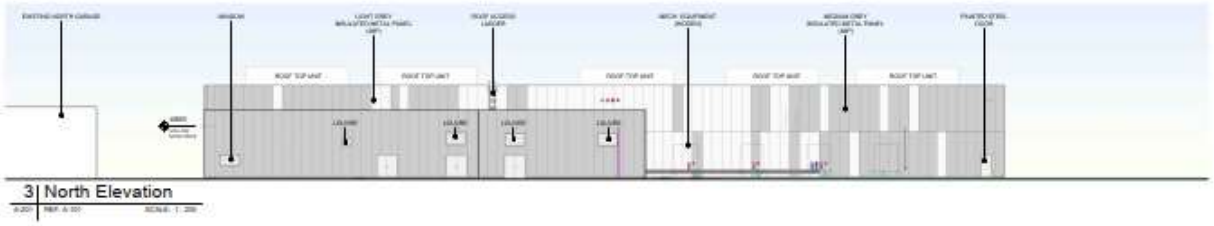
Architecture



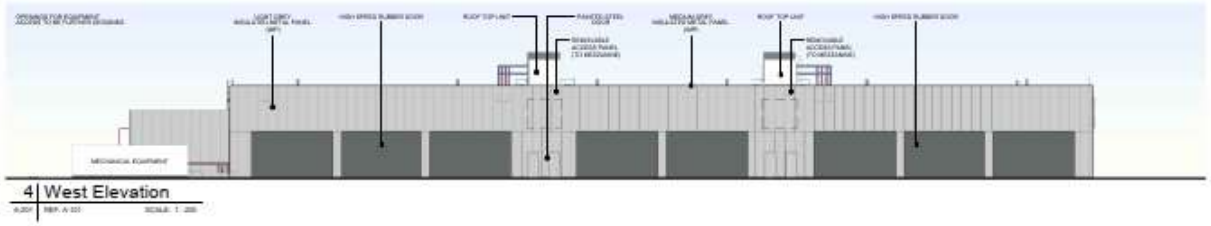
1 | South Elevation



2 | East Elevation



3 | North Elevation



4 | West Elevation

Architecture



VIEW OF THE BUILDING APPROACHING SOUTH-EAST CORNER



VIEW OF THE BUILDING APPROACHING SOUTH-WEST CORNER

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Civil Design

Overview of SWM

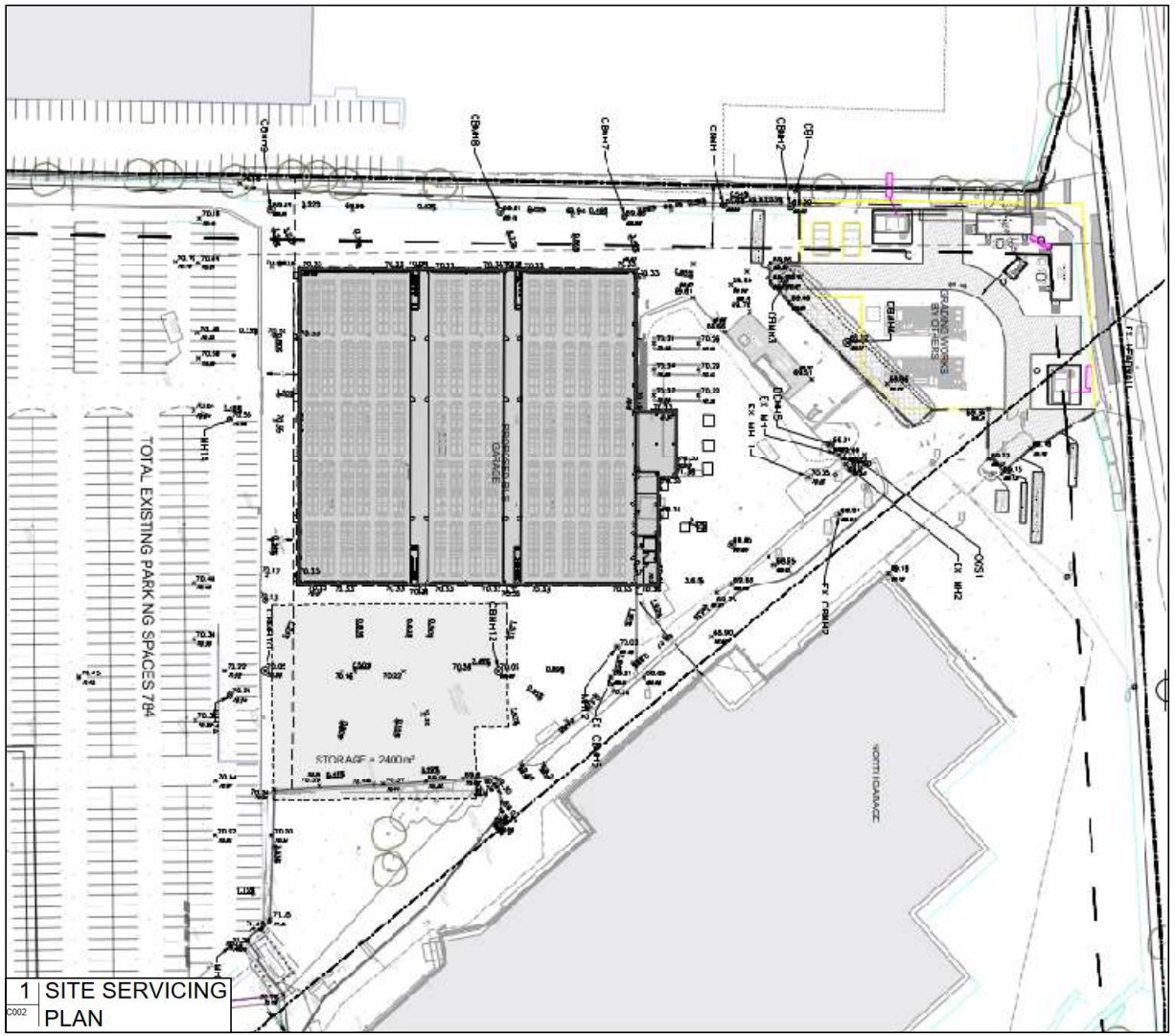
- Existing storm sewer and surface water management for site, outflow controlled by ICDs, water quality treated by OGS. Discharge into the South Cyrville Drain to the northeast of the site along the rail corridor. Site outflow limited to 398 l/s using three ICDs in the storm sewer to limit outflow.
- Proposed building and substation development. Similar concept in SWM:
  - Adjusting storm system around the substation (oversized pipes for storage with an ICD as it enters existing storm system).
  - Around garage building, pipes around building to an underground storage tank southeast of the building. ICD to restrict outflow from system as it enters existing storm system.
  - North and west of North Garage existing system to remain (no modifications to grading or storm sewer system). Change in ICD servicing the system, but outflow similar as pervious design (do not know what size of ICD was installed, only outflow known).
  - No changes to existing outlet to north.
- Water Quantity
  - Large size pipes (600 mm dia or 675 mm dia)
  - Underground storage (proposed ADS plastic with clear stone) and impermeable liner (no infiltration) due to zoning and type of site.
  - Size of underground storage footprint approximately 2200 m2 for a volume of 2400 m3.

Overview of SWM

- Water Quality
  - Replacement of existing OGS on-site (too small for drainage area to provide Enhanced Level of Protection (80% TSS removal). Enhanced level of protection was based on RVCA pre-consult in 2022 with previous consultant on file.
  - Recommended OGS is Stormceptor EFO10.

- Summary of Pre-consultation from 2022
  - City requested that ECA application be submitted as an amendment on the last ECA issued for the site in 2017.
  - City requested that the ECA application note that the land use is industrial (zoned industrial).
  - Due to City of Ottawa's Transfer of Review rules, the ECA application would be a direct submission.
  - RVCA consultation indicated that Enhanced Level of Protection should be provided for water quality. No other permits were required.

Civil Design



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ECA Clarifications

Questions

1. City was issued their CLI ECA for storm in late December 2024. Based on our knowledge of the CLI ECA and this site, we do not believe that this site falls under the CLI ECA and will be a direct submission to the MECP. Could you confirm if our understanding is correct?
2. For direct submission of the ECA, we will attach the required/recommended documents listed at the end of the application. Are there any other specific documents, beyond that list, we should also submit?
3. At the local MECP office who is the main contact we should be cc-ing on any applications or other MECP submission requests?
4. For RVCA, are there any changes related to water quality requirements from the 2022 pre-consultation?
5. For RVCA, are there any permits required to be obtained for the site per the latest proposed design? As noted, we are not proposing any changes to the storm outlet location, headwall or pipes into the outlet.
6. Overall – Are there any high level observations, concerns or comments that anyone has on the proposed SWM design for the OC Transpo site?

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Thank you.

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Brown, Rikke

From: Craig, Ian <Ian.Craig@ottawa.ca>
Sent: March 17, 2025 2:56 PM
To: aleung; Fleith, Ross; Sadeghi, Amin; Grant, Todd; Brown, Rikke
Cc: Amor, Jonathan; Faris, Robert W; Dupont, Scott
Subject: FW: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter

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FYI - please refer to email below regarding ECA appilication.

Regards,

Infrastructure Services Department
City of Ottawa, 6thFlr.W, 100 Constellation Cres, Ottawa, ON K2G 6J8
Ian Craig, Sr. Project Manager, Facilities Design & Construction
c: 613-762-5596



Be safe & protect yourself

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From: Cote, Joff (MECP) <Joff.Cote@ontario.ca>
Sent: Monday, March 17, 2025 11:48 AM
To: Craig, Ian <Ian.Craig@ottawa.ca>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Cc: Cote, Joff (MECP) <Joff.Cote@ontario.ca>
Subject: RE: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter

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Hi Ian,

I just confirmed with my supervisor that the entire ToR process: the application review, approval, and issuance of the actual ECA is all handled by the City (Planning Authority) and its Engineer(s).

Thanks,

Joffre Côté
A/Environmental Compliance Officer, Ottawa District Office
Agent de la conformité environnementale (par interim), Bureau du District d'Ottawa
Drinking Water and Environmental Compliance Division
Ministry of the Environment, Conservation and Parks, Government of Ontario
Ministère de l'Environnement, de la Protection de la nature et des Parcs, Gouvernement de l'Ontario
Tel: 613-410-9217
joff.cote@ontario.ca
2430 Don Reid Drive, Unit 103
Ottawa, ON, K1H 1E1

Ontario

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From: Craig, Ian <Ian.Craig@ottawa.ca>
Sent: Friday, March 7, 2025 7:27 AM
To: Cote, Joff (MECP) <Joff.Cote@ontario.ca>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter

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Thank you very much, this wonderful news, so what is the submission requirement?
Could you describe what form we do need to submit or do we just complete the site plan application with City's Planning .

Regards,
Ian Craig

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From: Cote, Joff (MECP) <Joff.Cote@ontario.ca>
Sent: Friday, March 7, 2025 7:21 AM
To: Craig, Ian <Ian.Craig@ottawa.ca>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>; Hart,Tracy <Tracy.Hart@ontario.ca>
Cc: Alex Leung <aleung@provencherroy.ca>; Fleith, Ross <Ross.fleith@aecom.com>; Amor, Jonathan <jonathan.amor@ottawa.ca>; Dupont, Scott <Scott.Dupont@ottawa.ca>; Faris, Robert W <Robert.Faris@ottawa.ca>; Dehghani, Narges <narges.dehghani@aecom.com>; Sadeghi, Amin <amin.sadeghi@aecom.com>; Grant, Todd <Todd.Grant@aecom.com>; Cote, Joff (MECP) <Joff.Cote@ontario.ca>; Lalonde, Patrick <patrick.lalonde@ontario.ca>
Subject: RE: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter

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Good morning Ian et al.,

After confirming with our Ministry's Environmental Permissions Branch, given that this proposal only requires an amendment to a pre-existing Industrial Sewage/Stormwater ECA and that the proposed changes are considered relatively low risk, the Ministry is allowing this particular file to proceed under the Transfer of Review program.

Please let me know if you have any other questions.

Thanks,

Joffre Côté
A/Environmental Compliance Officer, Ottawa District Office
Agent de la conformité environnementale (par interim), Bureau du District d'Ottawa
Drinking Water and Environmental Compliance Division
Ministry of the Environment, Conservation and Parks, Government of Ontario
Ministère de l'Environnement, de la Protection de la nature et des Parcs, Gouvernement de l'Ontario
Tel: 613-410-9217
joff.cote@ontario.ca
2430 Don Reid Drive, Unit 103
Ottawa, ON, K1H 1E1

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From: Craig, Ian <Ian.Craig@ottawa.ca>
Sent: Tuesday, March 4, 2025 4:27 PM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>; Cote, Joff (MECP) <Joff.Cote@ontario.ca>; Hart, Tracy (MECP) <Tracy.Hart@ontario.ca>
Cc: Alex Leung <aleung@provencherroy.ca>; Fleith, Ross <Ross.fleith@aecom.com>; Amor, Jonathan <jonathan.amor@ottawa.ca>; Dupont, Scott <Scott.Dupont@ottawa.ca>; Faris, Robert W <Robert.Faris@ottawa.ca>; Dehghani, Narges <narges.dehghani@aecom.com>; Sadeghi, Amin <amin.sadeghi@aecom.com>; Grant, Todd <Todd.Grant@aecom.com>
Subject: ZEB New Garage - 1500 St Laurent - previous ECA - ToR letter

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Emily & Joff :

Thank you for meeting with us this afternoon at your office.

Here is copy of the SPA pre-consult presentation description of the project , and the email from Aziz S. Ahmed regarding the ToR.

AECOM / GRC will submit their ECA application by end of month or before for the new design of the Zero Emission Bus (ZEB) Garage to amend the current ECA.
They will provide the necessary supporting documents as required for review.

Thank you both again for your help with this.

Regards,

Infrastructure Services Department
City of Ottawa, 6thFlr.W, 100 Constellation Cres, Ottawa, ON K2G 6J8
Ian Craig, Sr. Project Manager, Facilities Design & Construction
c: 613-762-5596

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'

Appendix E Geotechnical Report

Geotechnical Investigation
Proposed OC Transpo Electrical Bus Garage
1500 St. Laurent Boulevard
Ottawa, Ontario

Client:
Ian Craig
Project Manager
Infrastructure and Water Services Department
City of Ottawa
100 Constellation Drive (6th Floor)
Ottawa, Ontario K2G 6J8

Type of Document:
FINAL REPORT

Project Number:
OTT-22007382-A0

Prepared By:
EXP Services Inc.
100-2650 Queensview Drive
Ottawa, Ontario K2B 8H6
Canada

Date Submitted:
November 26, 2024

100-2650 Queensview Drive | Ottawa, Ontario K2B 8H6 | Canada
t: +1.613.688.1899 | f: +1.613.225.7337 | exp.com

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Legal Notification

List of Distribution

Executive Summary

Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed electrical bus garage to be located at the OC Transpo facility at 1500 St. Laurent Boulevard, Ottawa, Ontario (Figure 1). The geotechnical investigation was undertaken in two (2) phases with the original investigation conducted in 2022 and the additional investigation conducted in 2024. Terms and conditions of the two (2) phases of this assignment were outlined in EXP's two (2) proposals dated June 21,2022 and March 11,2024 and are under EXP's standing offer agreements (SOAs) with the City of Ottawa SOA 30820-02500-S01 Category 5A and 5B (2022) and SOA 24423 24423-92500-S01 Category 5A and 5B (2024). Authorization to proceed with this work was provided by City of Ottawa Purchase Order Numbers: 0045102541 dated October 4,2022 and 0045108222 dated April 25,2024.

The geotechnical investigation for the proposed electrical bus garage was undertaken in conjunction with the geotechnical investigation for the proposed hydro substation to be located at the OC Transpo facility. The proposed garage will be located in the northwest portion of the facility and the proposed hydro substation will be located north of the proposed garage. The boreholes completed for the geotechnical investigation for the proposed OC Transpo electrical bus garage include Borehole Nos. 22-01 to 22-09, 22-16, 22-17, 24-01 to 24-07, 24-09 and 24-12. The boreholes completed for the hydro substation include Borehole Nos. 22-10 to 22-15, 24-10 and 24-11. This geotechnical report discusses the results for the proposed electrical bus garage. The results of the geotechnical investigation for the proposed hydro substation are provided in a separate geotechnical report.

EXP completed a Phase One Environmental Site Assessment (ESA) of the site for the proposed development and the results of the ESA are provided in a separate report dated May 15,2023 (EXP Project Number: OTT-22007382-A0). EXP also completed a Phase Two of the site for the proposed development and the results are presented in a separate report dated December 8, 2022 (EXP Project No. OTT-22007382-A0) . As part of the current assignment, EXP updated the Phase Two ESA of the site for the proposed development and the results are provided in a separate report.

Proposed Development

The proposed electrical bus garage will be located in the northwest portion of the OC Transpo facility at 1500 St. Laurent Boulevard in Ottawa. Currently, the site is occupied by an outdoor paved parking lot for buses. Based on available design information including the schematic architectural drawing, Sheet No. AS101, dated March 28,2024 (Project No. 60716350), the proposed building will have an approximate footprint of 8800 square metres and will be a single-storey industrial type slab-on-grade building with no basement. The design elevation of the floor slab will be at Elevation 69.90 m. Factored axial loads for perimeter columns will be approximately 1000 kN and approximately 1600 kN for central columns. Some of the columns at braced bays may have net uplift loads of approximately 200 kN. The proposed garage building will be serviced by new municipal services. The exterior ground surface around the building will have concrete aprons, paved access roads and parking lots and landscaped areas. A retaining wall will be located east of the new garage building.

Fieldwork Program

The fieldwork for this geotechnical investigation was undertaken in two (2) phases and consists of a total of twenty (20) boreholes. The first phase was undertaken on September 19,20 and November 17,2022 and consists of eleven (11) boreholes (Borehole Nos. 22-01 to 22-09, 22-16 and 22-17) advanced to auger refusal and termination depths ranging from 2.4 m to 8.7 m below existing grade. The second phase was undertaken from May 3 to 10,2024 and consists of nine (9) boreholes (Borehole Nos. 24—01 to 24-07, 24-09 and 24-12) advanced to casing refusal and termination depths of 5.2 m to 8.8 m below existing grade. Borehole No. 24-08 was not drilled due to conflict with existing underground services.

A seismic shear wave velocity soundings survey consisting of one (1) survey line was conducted at the site on May 15,2024 by Geophysics GPR International Inc. (GPR).

Subsurface Conditions

The borehole information indicates the subsurface conditions at the site for the proposed garage building and retaining wall consist of fill, buried topsoil and organic layers that extend to depths of 1.1 m to 3.0 m (Elevation 68.8 m to Elevation 67.0 m) underlain by loose to very dense shaley glacial till followed by shale bedrock contacted at 2.8 m to 4.6 m depths (Elevation 66.9 m to Elevation 65.2 m). The groundwater level ranges from 0.9 m to 2.2 m depths (Elevation 69.0 m to Elevation 67.9 m).

Geotechnical Engineering Comments and Recommendations

The seismic shear wave velocity soundings survey report dated May 31,2024 and prepared by GPR is shown in Appendix A. The GPR report indicates the seismic shear wave velocities (Vs) of the subsurface soils are greater than 200 m/s. Therefore, based on the results of the seismic shear wave velocity soundings survey and the results of the additional boreholes drilled as part of the additional geotechnical investigation, the subsurface soils are considered not to be liquefiable during a seismic event.

For the underside of footings and grade beams founded 3.0 m or less from the bedrock surface, the site class for seismic response may be taken as **Class A**. If the underside of footings and grade beams are greater than 3.0 m from the bedrock surface, the site class for seismic response is **Class C**.

A review of the available design information and borehole data indicates that the proposed garage building may be supported by strip and spread footings designed to bear on an engineered fill pad constructed on top of the native shaley glacial till. Alternatively, the proposed garage building may be supported by caissons socketed into the sound shale bedrock. Piles designed in end bearing and driven to practical refusal into the shale bedrock are not considered practical due to the shallow depth of the bedrock. For the two (2) foundation options, the ground floor of the proposed garage building may be designed as a slab-on-grade founded on an engineered fill pad constructed on the shaley glacial till. The proposed retaining wall may be supported by a strip footing founded on the engineered fill pad that is constructed on top of the native shaley glacial till. The existing fill and buried topsoil/organic soil are not suitable to support foundations and the ground floor slab-on-grade of the proposed garage building and to support the foundations of the proposed retaining wall.

The excavation for the construction of the engineered fill pad to support the footings and the floor slab-on-grade of the proposed garage building and retaining wall is anticipated to extend below the groundwater level into the shaley glacial till that contains loose zones. The loose zones of the shaley glacial till below the groundwater level are susceptible to instability of the base of the excavation in the form of piping or heave. To minimize 'base-heave' type failure of the excavation base, it is necessary to lower the groundwater table at the site to below the final excavation level prior to the start of the excavation. This may be achieved by installing deep sumps, pumping with high-capacity pumps and pumping on a continuous basis (such as twenty-four (24) hours a day, seven (7) days a week). The groundwater level should be lowered and maintained to at least 1.0 m below the bottom of the excavation until the placement and compaction of the engineered fill pad has been completed to the design subgrade level. Standpipes should also be installed to monitor the groundwater level during initial groundwater lowering and during construction. A specialized dewatering contractor should be consulted to determine the most appropriate dewatering method for the site conditions to allow for the construction of the engineered fill pad to be undertaken in relatively dry conditions.

The ground floor of the proposed garage building may be designed and constructed as a slab-on-grade placed on a 200 mm thick 19 mm sized clear stone bed placed on a minimum 300 mm thick engineered fill pad set on the approved shaley glacial till. The clear stone will minimize the capillary rise of moisture from the sub-soil to the floor slab. Alternatively, the clear stone layer may be replaced with a 200 mm thick bed of OPSS Granular A overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking.

The proposed garage building will require perimeter and underfloor drainage systems.

All excavations must be undertaken in accordance with the Occupational Health and Safety Act (OHSA), Ontario Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils on site are considered to be Type 3 and as such must be cut back at 1H:1V from the bottom of the excavation. Within zones of seepage, the excavation side slopes are expected to slough and eventually stabilize at 2H:1V to 3H:1V from the bottom of the excavation. For excavations above the groundwater level or properly dewatered (refer to paragraph below), the installation of the municipal underground services may be undertaken within the confines of a prefabricated support system (trench box) designed and installed in accordance with OHSA.

If side slopes cannot be achieved due to space restrictions on site such as the proximity of open cut excavations to the property limits, existing infrastructure or to foundations of adjacent existing building(s), the new building construction would have to be undertaken within the confines of an engineered support system (shoring system).

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building and retaining wall and in the underground service trenches will need to be imported and should preferably conform to the material specifications indicated in the attached geotechnical report.

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

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed electrical bus garage to be located at the OC Transpo facility at 1500 St. Laurent Boulevard, Ottawa, Ontario (Figure 1). The geotechnical investigation was undertaken in two (2) phases with the original investigation conducted in 2022 and the additional investigation conducted in 2024. Terms and conditions of the two (2) phases of this assignment were outlined in EXP's two (2) proposals dated June 21,2022 and March 11,2024 and are under EXP's standing offer agreements (SOAs) with the City of Ottawa SOA 30820-02500-S01 Category 5A and 5B (2022) and SOA 24423 24423-92500-S01 Category 5A and 5B (2024). Authorization to proceed with this work was provided by City of Ottawa Purchase Order Numbers: 0045102541 dated October 4,2022 and 0045108222 dated April 25,2024.

The geotechnical investigation for the proposed electrical bus garage was undertaken in conjunction with the geotechnical investigation for the proposed hydro substation to be located at the OC Transpo facility. The proposed garage will be located in the northwest portion of the facility and the proposed hydro substation will be located north of the proposed garage. The boreholes completed for the geotechnical investigation for the proposed OC Transpo electrical bus garage include Borehole Nos. 22-01 to 22-09, 22-16, 22-17, 24-01 to 24-07, 24-09 and 24-12. The boreholes completed for the hydro substation include Borehole Nos. 22-10 to 22-15, 24-10 and 24-11. This geotechnical report discusses the results for the proposed electrical bus garage. The results of the geotechnical investigation for the proposed hydro substation are provided in a separate geotechnical report.

EXP completed a Phase One Environmental Site Assessment (ESA) of the site for the proposed development and the results of the ESA are provided in a separate report dated May 15,2023 (EXP Project Number: OTT-22007382-A0). EXP also completed a Phase Two of the site for the proposed development and the results are presented in a separate report dated December 8, 2022 (EXP Project No. OTT-22007382-A0). As part of the current assignment, EXP updated the Phase Two ESA of the site for the proposed development and the results are provided in a separate report.

The proposed electrical bus garage will be located in the northwest portion of the OC Transpo facility at 1500 St. Laurent Boulevard in Ottawa. Currently, the site is occupied by an outdoor paved parking lot for buses. Based on available design information including the schematic architectural drawing, Sheet No. AS101, dated March 28,2024 (Project No. 60716350), the proposed building will have an approximate footprint of 8800 square metres and will be a single-storey industrial type slab-on-grade building with no basement. The design elevation of the floor slab will be at Elevation 69.90 m. Factored axial loads for perimeter columns will be approximately 1000 kN and approximately 1600 kN for central columns. Some of the columns at braced bays may have net uplift loads of approximately 200 kN. The proposed garage building will be serviced by new municipal services. The exterior ground surface around the building will be occupied by concrete aprons, paved access roads and parking lots and landscaped areas. A retaining wall will be located east of the new garage building.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at twenty (20) boreholes located on the site,

b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code
(as amended January 1,2022) and assess the potential for liquefaction of the subsurface soils during a seismic event,

c) Comment on grade-raise restrictions and provide site grading requirements,

d) Make recommendations regarding the most suitable type of foundations, founding depth and bearing pressure at serviceability limit state (SLS) and factored geotechnical resistance at ultimate limit state (ULS) of the founding strata and comment on the anticipated total and differential settlements of the recommended foundation type,

e) Provide comment regarding slab-on-grade construction and the requirement for perimeter and underfloor drainage systems,

f) Comment on excavation conditions and de-watering requirements during construction,

g) Provide pipe bedding requirements for underground services,

h) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes,

i) Recommend pavement structure thicknesses for concrete aprons and paved access roads and parking lots,

j) Comment on the corrosion potential of subsurface soils buried concrete and steel structures/members; and

k) Provide comment on tree planting restrictions.

The comments and recommendations given in this report are based on the assumption that the above-described design concepts will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations, or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description

The site of the proposed garage will be located at the OC Transpo facility at 1500 St. Laurent Boulevard in the northwest portion of the facility, west of the existing north garage building. The site of the retaining wall will be located east of the proposed garage. The site is currently occupied by an outdoor paved parking lot for buses. The overall site is relatively flat with borehole ground surface elevations ranging from Elevation 70.36 m to Elevation 69.28 m.

3. Site Geology

3.1 Surficial Geology Map

The surficial geology map (Map 1506A – Surficial Geology, Ontario-Quebec, Geological Survey of Canada, printed by the Surveys and Mapping Branch, 1982) indicates that beneath any fill, the site is underlain by glacial till.

3.2 Bedrock Geology Map

The bedrock geology map (Map 1508A – Generalized Bedrock Geology, Ottawa-Hull, Ontario and Quebec, Geological Survey of Canada, printed by the Surveys and Mapping Branch, 1979) indicates the site is underlain by shale bedrock of the Billings formation.

4. Procedure

4.1 Boreholes

4.1.1 Fieldwork

The fieldwork for this geotechnical investigation was undertaken in two (2) phases and consists of a total of twenty (20) boreholes. The first phase was undertaken on September 19,20 and November 17,2022 and consists of eleven (11) boreholes (Borehole Nos. 22-01 to 22-09, 22-16 and 22-17) advanced to auger refusal and termination depths ranging from 2.4 m to 8.7 m below existing grade. The second phase was undertaken from May 3 to 10,2024 and consists of nine (9) boreholes (Borehole Nos. 24-01 to 24-07, 24-09 and 24-12) advanced to casing refusal and termination depths of 5.2 m to 8.8 m below existing grade. Borehole No. 24-08 was not drilled due to conflict with existing underground services. The borehole fieldwork was supervised on a full-time basis by EXP.

It is noted that Borehole Nos. 22-10 to 22-15, 24-10 and 24-11 were undertaken for the proposed hydro substation to be located north of the proposed garage building and are included in a separate geotechnical engineering report. The locations of the proposed garage building and hydro substation are shown in Figure 2.

The locations and geodetic elevations of the boreholes for the proposed garage and retaining wall were established on site by EXP and are shown on the borehole location plan, Figure 3.

The boreholes were drilled using a CME-55 and CME-75 truck-mounted drill rigs equipped with continuous flight hollow-stem auger equipment and rock coring capabilities. Below the augered depth of 1.5 m, the 2024 boreholes (Borehole Nos. 24-01 to 24-07, 24-09 and 24-12) were advanced to casing refusal depths using casing and wash-boring technique and maintaining a head (column) of water in the casing. Grab (GS) and auger (AS) samples were taken in the upper level of the boreholes. Standard penetration tests (SPTs) were performed in all the boreholes on a continuous basis to 0.75 m depth interval and the soil samples (SS) retrieved by the split-spoon sampler. The bedrock was cored in selected boreholes using the N-size core barrel and conventional rock coring techniques. A field record of wash water return, colour of wash water and any sudden drops of the core barrel were kept during rock coring operations.

The subsurface soil conditions in each borehole were logged and each soil sample placed in labelled plastic bags. Similarly, the rock cores were visually examined, placed in core boxes, identified, and logged.

Monitoring wells ranging in diameter from nineteen (19 mm) to thirty-two (32 mm) to fifty (50 mm) were installed in selected boreholes for long-term monitoring of the groundwater level and for groundwater sampling as part of the Phase Two ESA. The monitoring wells were installed in accordance with EXP standard practice, and the installation configuration is documented on the respective borehole log. The boreholes were backfilled upon completion of drilling and installation of the monitoring wells.

4.1.2 Laboratory Testing Program

On completion of the borehole fieldwork, the soil samples and rock cores were transported to the EXP laboratory in Ottawa where they were examined by a geotechnical engineer and borehole logs prepared. The main constituents of the soils are classified in accordance with the Unified Soil Classification System (USCS) using the soil group name and symbol and by the modified Burmister soil classification method for the classification of the minor constituents of the soil using adjectives and modifiers such as trace and some (2006 Fourth Edition of the Canadian Foundation Engineering Manual (CFEM)).

The rock cores were visually examined by the geotechnical engineer and logged in accordance with Section 3.2 of the 2006 Canadian Foundation Engineering Manual (CFEM) Fourth Edition. Photographs were taken of the bedrock cores.

The laboratory testing program for the soil samples and rock core sections is summarized in Table I.

Table I: Summary of Laboratory Testing Program	
Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	116
Grain Size Analysis	14
Atterberg Limit Determination	6
Corrosion Analysis (pH, sulphate, chloride and resistivity)	11
Bedrock Core Sections	
Unit Weight Determination	21
Unconfined Compressive Strength Test	21
Corrosion Analysis (pH, sulphate, chloride and resistivity)	3

4.2 Seismic Shear Wave Velocity Soundings Survey

A seismic shear wave velocity soundings survey consisting of one (1) survey line was conducted at the site on May 15,2024 by Geophysics GPR International Inc. (GPR). The purpose of the seismic shear wave survey was to determine the seismic shear wave velocity of the site and based on the shear wave velocity provide the site classification for seismic response and to assist in determining if the subsurface soils are liquefiable during a seismic event. The survey line is located within the footprint of the proposed garage building. The location of the survey line is shown on the Borehole Location Plan, Figure 3. The seismic shear wave survey was undertaken using the multi-channel analysis of surface waves (MASW), spatial auto correlation (SPAC) and seismic refraction methods. The seismic shear wave velocity soundings survey report dated May 31,2024 and prepared by GPR is shown in Appendix A.

5. Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface conditions encountered in the boreholes is given on the attached Borehole Logs, Figures 4 to 23.

The borehole logs and related information depict subsurface conditions only at the specific locations and at the times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

Boreholes were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions. Reference should be made to the EXP Phase One and Two Environmental Site Assessments (ESAs) for potential environmental concerns with respect to the subsurface conditions at the site.

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

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

5.1 Topsoil

Borehole No. 24-12 is located in a landscaped area and a 75 mm thick surficial topsoil layer was encountered in the borehole.

5.2 Pavement Structure

With the exception of Borehole No. 22-17, the remaining boreholes are located in a paved area where the pavement structure consists of 65 mm to 180 mm thick asphaltic concrete underlain by 300 mm to 620 mm thick (locally 1100 mm thick in Borehole No. 22-16) granular fill (base). The granular fill (base) consists of gravel, sand and silt of varying percentages. Based on the standard penetration test (SPT) N-values of 22 to 61 the granular fill (base) is in a compact to very dense state. Moisture contents of the granular fill (base) range from 1 percent to 3 percent.

Borehole No. 22-17 is located in a gravel surface area where the granular fill (base) extends to an 0.8 m depth (Elevation 69.2 m). The granular fill (base) consists of a sand and gravel that is in a dense state, based on the SPT N-value of 30. The moisture content of the granular fill (base) is 5 percent.

Results from the grain-size analysis conducted on one (1) sample of the granular fill (base) are summarized in Table II. The grain-size distribution curve is shown in Figure 24.

Table II: Summary of Results from Grain-Size Analysis – Granular Fill (Base)

Borehole No. (BH): Sample No. (SS)	Depth (m)	Grain-Size Analysis (%)				Soil Classification
		Gravel	Sand	Silt	Clay	
BH 24-02 – AS1	0.1-0.6	54	33	13	0	Gravel (GM) – Sandy, Some Silt

Based on a review of the results of the grain-size analysis, the granular fill (base) may be classified as a gravel (GM) that is sandy with some silt.

5.3 Buried Topsoil Layer

A 50 mm thick buried topsoil layer was contacted beneath the pavement structure at a 1.2 m depth (Elevation 68.4 m) in Borehole No. 22-16.

5.4 Fill

Fill was contacted beneath the pavement structure, surficial topsoil layer and buried topsoil layer in all boreholes except Borehole Nos. 22-02, 22-03, 22-05 and 22-08. The fill extends to depths of 1.1 m to 3.0 m below existing grade (Elevation 68.8 m to Elevation 67.0 m). The fill consists of gravel, sand silt and clay of varying percentages. In some boreholes, the fill also contains asphalt and wood fragments, organics (rootlets), blast-shattered rock type fragments and possible cobbles and boulders. Based on the SPT N-values of 4 to 35, the fill is in a loose to dense state. The moisture content of the fill is 5 percent to 15 percent.

Results from the grain-size analysis and Atterberg limit determination conducted on four (4) samples of the fill are summarized in Table III. The grain-size distribution curves are shown in Figures 25 to 28.

Table III: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination – Fill Samples

Borehole No. (BH): Sample No. (SS)	Depth (m)	Grain-Size Analysis (%) and Atterberg Limits (%)								
		Gravel	Sand	Silt	Clay	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification
BH/MW 22-01: SS3	1.5-2.1	17	42	28	13	10	-	-	-	Silty Sand (SM) – Some Gravel and Clay
BH 22-06: SS2	0.8-1.4	16	46	25	13	8	18	13	5	Clayey Sand (SC) – Low Plasticity, Some Gravel, Silty
BH 24-03: SS3	1.5-2.1	21	43	25	11	8	17	9	8	Clayey Sand (SC) – Low Plasticity, Gravelly, Silty
BH/MW 24-07: SS2	0.8-1.4	8	47	32	13	10	25	13	12	Clayey Sand (SC) – Low Plasticity, Silty, Trace Gravel

Based on a review of the results of the grain-size analysis and Atterberg limits, the fill may be classified as a silty sand (SM) with some gravel and clay to a clayey sand (SC) of low plasticity, that is gravelly to trace gravel and silty.

5.5 Buried Organic Soil

An approximate 900 mm thick buried organic soil was encountered below the fill in Borehole No. 24-09 at a 1.4 m depth (Elevation 67.9 m) and extends to a 2.3 m depth (Elevation 67.0 m). The organic soil consists of a mixture of silty sand and organic soil (with rootlets). Based on the SPT N-value of 7, the organic soil is in a loose state. The moisture content of the organic soil is 12 percent.

5.6 Shaley Glacial Till

The pavement structure, fill and buried organic soil (Borehole No. 24-09) in all of the boreholes are underlain by shaley glacial till contacted at 0.5 m to 3.0 m depths (Elevation 69.8 m to Elevation 67.0 m). The shaley glacial till extends to depths of 2.7 m to 4.6 m (Elevation 67.5 m to Elevation 65.4 m). The shaley glacial till contains varying percentages of gravel, sand, silt and clay. The shaley glacial till also contains shale fragments and possible cobbles and boulders. Based on the SPT N-values of 5 to 115, the shaley glacial till is in a loose to very dense state. In some boreholes, the SPT N-value is high for low sampler penetration, such as 50 for 125 mm of sampler penetration. This

may be a result of the sampler making contact with a possible cobble, boulder or concentrated zone or seams of shale fragments within the shaley glacial till. The natural moisture content of the shaley glacial till ranges from 3 percent to 14 percent.

The results from the grain-size analysis and Atterberg limit determination conducted on nine (9) samples of the shaley glacial till are summarized in Table IV. The grain-size distribution curve is shown in Figures 29 to 37.

Table IV: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination – Glacial Till Samples

Borehole No. (BH): Sample No. (SS)	Depth (m)	Grain-Size Analysis (%) and Atterberg Limits (%)								
		Gravel	Sand	Silt	Clay	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification
BH/MW 22-02-2: SS4	2.3-2.9	27	38	23	12	8	-	-	-	Silty Sand (SM) – Gravelly, Some Clay
BH/MW 22-02: SS6	3.8-4.2	16	52	26	6	6	-	-	-	Silty Sand (SM) – Some Gravel, Trace Clay
BH/MW 22-03: SS4	2.3-2.9	31	48	15	6	4	-	-	-	Silty Sand (SM) – Gravelly, Trace Clay
BH 22-04: SS4	2.3-2.9	14	44	30	12	10	-	-	-	Silty Sand (SM) – Some Gravel and Clay
BH 22-05: SS6	3.8-4.2	15	50	30	5	8	-	-	-	Silty Sand (SM) – Some Gravel, Trace Clay
BH/MW 22-08: SS4	2.3-2.9	15	46	26	13	6	-	-	-	Silty Sand (SM) – Some Gravel and Clay
BH/MW 24-05: SS4	2.3-2.9	17	47	26	10		16	8	8	Clayey Sand (SC) – Low Plasticity, some gravel, silty
BH 24-06: SS3	1.5-2.1	15	47	28	10	9	19	10	9	Clayey Sand (SC) – Low Plasticity, Some Gravel, Silty
BH 24-12: SS5	3.0-3.6	26	39	25	10	10	19	11	8	Clayey Sand (SC) – Low Plasticity, Gravelly, Silty

Based on a review of the test results of the grain-size analysis and Atterberg limits, the glacial till may be classified as a silty sand (SM) that is gravelly to some gravel with trace to some clay to a clayey sand (SC) of low plasticity that is gravelly to some gravel, with trace to some clay. The shaley glacial till contains shale fragments and may contain possible cobbles and boulders.

5.7 Sand

Locally, in Borehole No. 22-04, the shaley glacial till is underlain by a sand contacted at a 3.8 m depth (Elevation 66.1 m).

5.8 Inferred and Actual Bedrock

Auger and casing refusal was met on inferred cobbles, boulders or bedrock in Borehole Nos. 22-01, 22-03 to 22-06, 22-08, 22-16, 22-17 and 24-12 at 2.4 to 5.2 m depths (Elevation 67.4 m to Elevation 65.6 m). Bedrock was contacted in the remaining boreholes at 2.8 m to 4.6 m (Elevation 66.9 m to Elevation 65.2 m). It was necessary to core through cobbles and boulders within the glacial till in order to reach the bedrock in Borehole Nos. 24-01, 24-07 and in 24-09. A summary of the auger refusal and bedrock depths (elevations) are shown in Table V.

Table V: Summary of Inferred and Actual Bedrock Depths (Elevations)			
Borehole (BH)/Monitoring Well (MW) No.	Ground Surface Elevation (m)	Auger Depth (Elevation) on Inferred Bedrock (m)	Bedrock Depth (Elevation) (m)
BH/MW 22-01	70.09	4.0 (66.1)	-
BH/MW 22-02	70.01	-	4.2 (65.8)
BH/MW 22-03	69.72	3.6 (66.1)	-
BH 22-04	69.87	4.1 (65.8)	-
BH 22-05	70.25	4.2 (66.1)	-
BH 22-06	69.80	2.4 (67.4)	-
BH 22-07	69.72	-	4.1 (65.6)
BH/MW 22-08	70.32	4.4 (65.9)	-
BH 22-09	69.69	-	2.8 (66.9)
BH/MW 22-16	69.60	3.7 (65.9)	-
BH 22-17	69.99	4.4 (65.6)	-
BH/MW 24-01	70.15	-	3.4 (66.8)
BH 24-02	70.28	-	4.5 (65.8) – weathered bedrock 4.8 (65.5) – intact bedrock
BH 24-03	70.19	-	4.6 (65.6)
BH 24-04	69.83	-	4.0 (65.8)
BH/MW 24-05	69.80	-	3.7 (66.1)
BH 24-06	70.26	-	4.3 (66.0)
BH/MW 24-07	70.36	-	4.5 (65.9)
BH 24-09	69.28	-	4.1 (65.2)
BH 24-12	70.78	5.2 (65.6)	-

The bedrock is black shale of the Billings formation. A review of the borehole logs indicates that in Borehole No. 24-02, a 300 mm thick weathered zone of the bedrock was contacted at a 4.5 m depth (Elevation 65.8 m). The total core recovery ranges from 77 percent to 100 percent. The rock quality designation (RQD) ranges from 37 percent to 100 percent indicating the quality of the bedrock is poor to excellent. Photographs of the bedrock cores are shown in Appendix B.

A summary of the unit weight and unconfined compressive strength of the bedrock are shown in Table VI.

Table VI: Summary of Unit Weight and Unconfined Compressive Strength – Bedrock Cores			
Borehole (BH)/Monitoring Well (MW)No.: Run No.	Depth (m)	Unit Weight (kN/m³)	Unconfined Compressive Strength (MPa)
BH/MW 22-02: Run 1Run3	4.8-4.9	25.9	28.8
BH/MW 22-02: Run 3	8.5-8.7	25.9	40.3
BH 22-07: Run 1	4.9-5.0	25.8	38.3
BH 22-07: Run 3	7.5-7.6	26.0	40.0
BH 22-09: Run 3	6.1-6.2	25.9	39.6
BH/MW 24-01: Run 1	3.7-3.9	26.5	36.6
BH/MW 24-01: Run 3	6.8-6.9	26.7	44.4
BH 24-02: Run 1	5.2-5.3	26.4	41.8
BH 24-02: Run 3	8.2-8.3	26.9	39.7
BH 24-03: Run 3	5.5-5.8	25.9	66.6
BH 24-03: Run 4	7.4-7.5	26.1	40.2
BH 24-04: Run 1	4.6-4.8	25.9	33.2
BH 24-04: Run 2	6.6-7.0	25.8	35.6
BH 24-05: Run 2	4.6-4.7	26.8	45.9
BH 24-05: Run 3	6.8-6.9	26.6	43.0
BH 24-06: Run 2	5.6-5.8	26.6	36.5
BH 24-06: Run 3	8.3-8.5	26.3	31.0
BH/MW 24-07: Run 2	4.7-4.9	26.2	49.2
BH/MW 24-07: Run 3	6.4-6.6	26.9	38.5
BH 24-09: Run 2	4.1-4.2	26.6	44.5
BH 24-09: Run 3	6.5-6.7	26.6	41.3

A review of the test results in Table VI indicates the strength of the rock may be classified as medium strong (R3) in accordance with the Canadian Foundation Engineering Manual (CFEM), Fourth Edition, 2006. Locally, Run 3 (5.5 m to 5.8 m) in Borehole No. 24-03 is classified as strong (R4).

5.9 Groundwater Level Measurements

A summary of the groundwater level measurements taken in the boreholes equipped with monitoring wells on May 29 and 30,2024 and November 14 and 24,2022 is shown in Table VII.

Table VII: Summary of Groundwater Level Measurements			
Borehole (BH)/Monitoring Well (MW) No.	Ground Surface Elevation (m)	Date of Measurement (Elapsed Time in Years/Days from Date of Installation)	Groundwater Depth Below Ground Surface (Elevation), (m
BH/MW 22-01	70.09	May 29,2024 (~1.5 years))	1.7 (68.4)
		November 14,2022 (55 days)	2.2 (67.9)
BH/MW 22-02	70.01	May 29,2024 (~1.5 years)	1.1 (68.9)
		November 14,2022 (56 days)	1.7 (68.3)
BH/MW 22-03	69.72	May 29,2024 (~1.5 years)	0.9 (68.8)
		November 14,2022 (56 days)	1.4 (686.3)
BH/MW 22-08	70.32	May 29, 2024 (~1.5 years)	2.0 (68.3)
BH/MW 22-16	69.60	May 30,2024 (~1.5 years)	1.1 (68.5)
		November 24,2022 (7 days)	1.4 (68.2)
BH/MW 24-01	70.15	May 30,2024 (104 days)	1.2 (69.0)
BH/MW 24-05	69.80	May 30, 2024 (20 days)	1.5 (68.3)
BH/MW 24-07	70.36	May 30,2024 (23 days)	2.1 (68.3)

Based on a review of the measurements, the groundwater level ranges from 0.9 m to 2.2 m (Elevation 69.0 m to Elevation
67.9 m).

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

6. Site Classification for Seismic Site Response and Liquefaction Potential of Soils

6.1 Liquefaction Potential of Soils

The seismic shear wave velocity soundings survey report dated May 31,2024 and prepared by GPR is shown in Appendix A. The GPR report indicates the seismic shear wave velocities (Vs) of the subsurface soils are greater than 200 m/s. Therefore, based on the results of the seismic shear wave velocity soundings survey and the results of the additional boreholes drilled as part of the additional geotechnical investigation, the subsurface soils are considered not to be liquefiable during a seismic event.

6.2 Site Classification for Seismic Site Response

For the underside of footings and grade beams founded 3.0 m or less from the bedrock surface, the site class for seismic response may be taken as **Class A**. If the underside of footings and grade beams are greater than 3.0 m from the bedrock surface, the site class for seismic response is **Class C**.

7. Grade Raise Restrictions

The borehole information indicates that compressible clays do not exist at the site. Therefore, from a geotechnical perspective, there is no restriction to raising the grades at the site.

8. Site Grading

The borehole information indicates the subsurface conditions at the site for the proposed garage building and retaining wall consist of fill, surficial and buried topsoil and organic layers that extend to depths of 1.1 m to 3.0 m (Elevation 68.8 m to Elevation 67.0 m) underlain by loose to very dense shaley glacial till followed by shale bedrock contacted at 2.8 m to 4.6 m depths (Elevation 66.9 m to Elevation 65.2 m). The groundwater level ranges from 0.9 m to 2.2 m depths (Elevation 69.0 m to Elevation 67.9 m).

Site grading within the **proposed garage building and retaining wall footprints** should consist of the excavation and removal of the existing fill, buried topsoil/organic layers and organic stained soils down to the shaley glacial till. Underground service locate information indicates that municipal services such as storm sewers and associated catchbasins and manholes exist within the footprint of the proposed garage building. The existing underground services will need to be relocated to the outside the proposed garage building and retaining wall footprints. The existing fill inside and outside the service trenches will also need to be excavated and removed down to the shaley glacial till. Within existing service trenches, the fill may be deeper than indicated on the borehole logs.

For engineered fill pad areas that will support the foundations and slab-on-grade of the proposed garage building and foundation for the proposed retaining wall, the native shaley glacial till subgrade should be examined by a geotechnician. Any loose/soft areas identified during the subgrade examination should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 100 percent standard Proctor maximum dry density (SPMDD). Once the subgrade has been approved, the grades may be raised to the design underside footing and/or floor slab elevation by an engineered fill pad constructed in accordance with Section 9.1.1 of this report.

The excavation for the construction of the engineered fill pad is anticipated to extend below the groundwater level into the shaley glacial till which contains loose zones. The loose zones of the shaley glacial till below the groundwater level are susceptible to instability of the base of the excavation in the form of piping or heave. To minimize 'base-heave' type failure of the excavation base, it is necessary to lower the groundwater table at the site to below the final excavation level prior to the start of the excavation. This may be achieved by installing deep sumps, pumping with high-capacity pumps and pumping on a continuous basis (such as twenty-four (24) hours a day, seven (7) days a week). The groundwater level should be lowered and maintained to at least 1.0 m below the bottom of the excavation until the placement and compaction of the engineered fill pad has been completed to the design subgrade level. Standpipes should also be installed to monitor the groundwater level during initial groundwater lowering and during construction. A specialized dewatering contractor should be consulted to determine the most appropriate dewatering method for the site conditions to allow for the construction of the engineered fill pad to be undertaken in relatively dry conditions.

Site grading outside the proposed garage building and retaining wall in areas within the **proposed concrete apron, parking lots and access road areas** should consist of the removal of existing pavement structure, surficial topsoil and organic stained soils. The subgrade should be proofrolled in the presence of a geotechnician. Any loose/soft areas identified during the proofrolling process should be excavated, removed, and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II or OPSS Select Subgrade Material (SSM) compacted to 95 percent standard Proctor maximum dry density (SPMDD). Once the subgrade has been approved, the grades may be raised to the design subgrade level of the pavement structure by approved on site material and/or OPSS Select Subgrade Material (SSM) compacted to 95 percent SPMDD.

In place density tests should be performed on each lift of placed material to ensure that it has been compacted to the project specifications.

9. Foundation Considerations

The borehole information indicates the subsurface conditions at the site for the proposed garage building and retaining wall consist of fill, buried topsoil and organic layers that extend to depths of 1.1 m to 3.0 m (Elevation 68.8 m to Elevation 67.0 m) underlain by loose to very dense shaley glacial till followed by shale bedrock contacted at 2.8 m to 4.6 m depths (Elevation 66.9 m to Elevation 65.2 m). The groundwater level ranges from 0.9 m to 2.2 m depths (Elevation 69.0 m to Elevation 67.9 m).

9.1 Proposed Garage Building

Based on available design information including the schematic architectural drawing, Sheet No. AS101, dated March 28,2024 (Project No. 60716350), the proposed building will have an approximate footprint of 8800 square metres and will be a single-storey industrial type slab-on-grade building with no basement. The design elevation of the floor slab will be at Elevation 69.90 m. Factored axial loads for perimeter columns will be approximately 1000 kN and approximately 1600 kN for central columns. Some of the columns at braced bays may have net uplift loads of approximately 200 kN. A retaining wall will be located east of the new garage building.

The site for the proposed garage building is relatively flat with borehole ground surface elevations ranging from Elevation 70.36 m to Elevation 69.28 m. A design floor slab elevation of Elevation 69.90 m will result in fill areas of up to approximately 0.6 m and cut areas to approximately 0.5 m within the garage building footprint.

A review of the available design information and borehole data indicates that the proposed building may be supported by strip and spread footings designed to bear on an engineered fill pad constructed on top of the native shaley glacial till. Alternatively, the proposed garage building may be supported by caissons socketed into the sound shale bedrock. Piles designed in end bearing and driven to practical refusal into the shale bedrock is not considered practical due to the shallow depth of the bedrock. For the two (2) foundation options, the ground floor of the proposed garage building may be designed as a slab-on-grade founded on an engineered fill pad constructed on the shaley glacial till. The existing fill and buried topsoil/organic soil are not suitable to support foundations and the ground floor slab-on-grade of the proposed garage building and to support the foundations of the proposed retaining wall.

As previously discussed, the excavation for the construction of the engineered fill pad is anticipated to extend below the groundwater level into the shaley glacial till that contains loose zones. The loose zones of the shaley glacial till below the groundwater level are susceptible to instability of the base of the excavation in the form of piping or heave. To minimize ‘base-heave’ type failure of the excavation base, it is necessary to lower the groundwater table at the site to below the final excavation level prior to the start of the excavation. This may be achieved by installing deep sumps, pumping with high-capacity pumps and pumping on a continuous basis (such as twenty-four (24) hours a day, seven (7) days a week). The groundwater level should be lowered and maintained to at least 1.0 m below the bottom of the excavation until the placement and compaction of the engineered fill pad has been completed to the design subgrade level. Standpipes should also be installed to monitor the groundwater level during initial groundwater lowering and during construction. A specialized dewatering contractor should be consulted to determine the most appropriate dewatering method for the site conditions to allow for the construction of the engineered fill pad to be undertaken in relatively dry conditions.

The two (2) foundation options of footings and caissons are discussed in the following sections of this report.

9.1.1 Footings

The proposed garage building may be supported by strip and spread footings founded on a minimum 300 mm thick engineered fill pad set on the shaley glacial till and constructed in accordance with the procedure below. It is anticipated that the footing will be founded to a maximum depth of 1.5 m below the finished floor. Footings founded to a maximum 1.5 m depth below finished floor on the properly constructed engineered fill pad may be designed for a bearing pressure at serviceability limit state (SLS) of 200 kPa and factored geotechnical resistance at ultimate

limit state (ULS) of 300 kPa. The factored geotechnical resistance at ULS value includes a geotechnical resistance factor of 0.50.

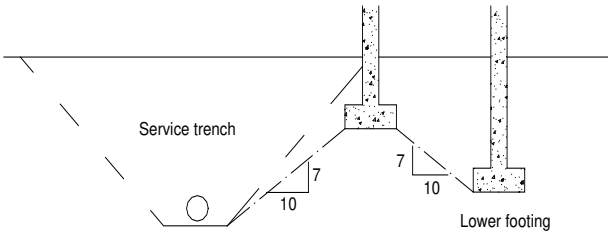
The total and differential settlements of footings designed in accordance with the recommendations of this report and with careful attention to construction detail are expected to be less than 25 mm and 19 mm respectively.

The preparation of the site for engineered fill pad construction requires all fill, surficial and buried topsoil/organic soil be excavated and removed down to the shaley glacial till. The excavation should extend a sufficient distance beyond the limits of the footprint of the proposed building to accommodate a 1.0 m wide bench of engineered fill around the perimeter of the building, which is thereafter sloped at an inclination of 1H:1V down to the approved shaley glacial till. The exposed shaley glacial till subgrade should be proofrolled and examined by a geotechnical engineer. Any loose/soft areas identified during proofrolling operations should be excavated and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II compacted to 100 percent standard Proctor maximum dry density (SPMDD).

Following approval of the subgrade for the engineered fill pad, the excavation may be backfilled with the engineered fill consisting of free draining Ontario Provincial Standard Specification (OPSS) Granular B Type II material placed in 300 mm thick lifts and each lift compacted to 100 percent of the SPMDD under the footings and floor slab area. The engineered fill should be placed under the full-time supervision of a geotechnician working under the direction of a geotechnical engineer. In-place density tests should be undertaken on each lift of the engineered fill to ensure that it is properly compacted prior to placement of the subsequent lift.

Reference is made to previous comments dealing with dewatering of the excavation for the construction of the engineered fill pad.

Footings founded in soils at different elevations should be located such that the higher footings are set below a line drawn up at 10 horizontal to 7 vertical (10H:7V) from the near edge of the lower footing, as shown below. This concept should also be applied to service excavation, etc. to ensure that undermining is not a problem.



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All footing beds should be examined by a geotechnical engineer to ensure that the founding soil is capable of supporting the bearing pressure at SLS and that the footing beds have been properly prepared.

It should be noted that the exposed shaley glacial till subgrade surface is susceptible to disturbance due to movement of workers and construction traffic and the prevailing weather conditions during construction. To prevent disturbance to the soil subgrade, the approved shaley glacial till subgrade should be covered with a layer of engineered fill within the same day of approval.

A minimum of 1.5 m of earth cover should be provided to the exterior foundations founded on soil of heated structures to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity and to 2.4 m if snow will be removed from the vicinity of the structure. When earth cover is less than the minimum required, an equivalent thermal combination of earth cover and rigid insulation board or rigid insulation board alone should be provided. EXP can provide developmental comments in this regard, if required.

9.1.1.1 Resistance to Uplift Forces

9.1.1.1.1 Weight of Footing

Footings may resist uplift forces by the submerged or effective weight of the footing. Alternatively, rock anchors may be used to resist uplift forces.

9.1.1.1.2 Rock Anchors

Post-tensioned rock anchors installed in the bedrock may be required as part of the footing design to resist uplift forces.

Pre-stressed anchors may fail in one or more of the following manners:

a) Failure of the grout/tendon bond,

b) Failure of the steel tendon or top anchorage,

c) Failure of the rock/grout bond; or

d) Pull-out failure of the cone-shaped rock mass.

Failure modes a) and b) require review by the structural engineer. Geotechnical related failure modes c) and d) for vertical grouted anchors are discussed below:

Failure of the rock/grout bond:

- The factored ultimate limit state (ULS) bond stress between the sound shale bedrock and the grout may be taken as 600 kPa and includes a resistance factor of 0.3. The unconfined compressive strength of the grout is assumed to be 35 MPa.
- Weathered zones such as in the upper 300 mm of the shale bedrock in Borehole No. 24-02 should not be included in the bond length. The depth and presence of the weathered and highly fractured zones of the bedrock may vary at locations away from the boreholes. For design purposes, the sound bedrock may be assumed to commence at 1.0 m below the bedrock surface.
- The minimum bonded length should be 3.0 m.

Pull-out failure of the cone-shaped rock mass:

- The pull-out failure of the embedment cone-shaped rock mass is defined by a 60 or 90-degree cone in the bedrock with the apex located at the midpoint of the bonded length of the anchor. For the shale bedrock, the apex angle of the rock failure cone should be taken as 60 degrees.
- The unbonded length may be taken as equal to the height of the theoretical rock cone minus half of the bonded length.
- The factored uplift resistance of the anchor should be determined by the submerged weight of the cone-shaped rock mass around the anchor. The submerged weight of the rock cone mass should not be less than the ultimate capacity of the anchor. The submerged unit weight of the shale bedrock equal to 16.5 kN/m^3 should be used in the calculations.
- Where the embedment rock cones for a group of anchors overlap with each other, the combined embedment cones for the group of anchors should be used to determine the anchor group resistance to the rock mass pull-out failure.

The installation method of the rock anchors should take into consideration the presence of cobbles and boulders and shale fragments within the soils.

Corrosion Protection of the Anchors:

- Corrosion protection of the anchors should be in accordance with the Ontario Provincial Standard Specification (OPSS) 942.

Testing of Rock Anchors:

Pre-production or design performance tests of permanent rock anchors should be in accordance with the Ontario Provincial Standard Specification (OPSS) 942. Pre-production performance tests should be conducted on selected rock anchors. Proof load tests should be conducted on all anchors and should be in accordance with OPSS 942.

9.1.2 Drilled Shafts (Caissons)

The proposed building may be supported by drilled shafts (caissons) socketed into the sound shale bedrock below the any weathered zones of the bedrock. Based on the borehole information, shale bedrock was contacted at 2.8 m to 4.6 m depths (Elevation 66.9 m to Elevation 65.2 m). For design purposes, the sound bedrock may be assumed to commence at 1.0 m below the bedrock surface.

The axial geotechnical resistance is based on the caisson designed to carry the load based on sidewall (shaft) resistance between the concrete and the sound shale bedrock for the socketed length of the caisson in the sound bedrock and neglecting end bearing capacity. The caissons may be designed for a factored sidewall resistance at ULS of 800 kPa and includes a geotechnical resistance factor of 0.4. Compressive strength of concrete should be 35 MPa. The socket length into the sound bedrock should be at least 3 times the diameter of the caisson and the caissons should be spaced at a minimum of three (3) caisson diameters (centre-to-centre). Uplift forces may be resisted by the submerged weight of the caisson or by rock anchors.

The sidewall resistance of the bedrock at SLS required to produce 25 mm of settlement will be much larger than the recommended value for factored sidewall resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design.

The installation of the caissons should take into consideration the presence of cobbles and boulders and shale fragments within the soils. Installation of the caissons will require the use of at least one liner to minimize soil loss. The liner should be driven to the shale bedrock. It may be necessary to loosen the overburden material by augering through to the shale bedrock. The liner may then be advanced through the soil slurry to the bedrock. It is noted that the caissons will likely require dewatering operations since the groundwater level at the site is high above the bedrock surface. If the caissons cannot be dewatered, concrete may have to be placed by 'tremie' technique. During the withdrawal of the liner, a positive head of concrete would have to be maintained in the liner with respect to the exterior hydrostatic pressure.

It is imperative that the sidewalls of the portion of the caisson socketed into the sound bedrock be cleaned of any soil smearing, to ensure the concrete is in contact with clean bedrock.

All caissons must be inspected by a geotechnician under the supervision of a geotechnical engineer to confirm the factored geotechnical resistance value at ULS of the founding rock and to ensure that the caissons have been prepared satisfactorily and properly cleaned.

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

9.2 Retaining Wall

It is our understanding that a retaining wall will be constructed in the vicinity of Borehole No. 24-12. Details regarding the design of the retaining wall were not available at the time of this geotechnical investigation. The borehole information indicates the subsurface conditions consist of fill to a 3.0 m depth (Elevation 67.9 m) underlain by loose

to compact shaley glacial till. The existing fill is not considered suitable to support the foundation for the retaining wall. Therefore, consideration may be given to supporting the retaining wall by a strip footing founded at a 2.4 m depth below existing grade, for frost protection, on an engineered fill pad constructed on the shaley glacial till and designed for a bearing pressure at SLS of 100 kPa and factored geotechnical resistance at ULS of 150 kPa. If higher SLS and factored ULS values are required, the strip footing for the retaining wall may be founded higher up to a maximum depth of 1.5 m below existing grade and designed for an SLS value of 200 kPa and factored ULS value of 300 kPa. For the footing founded at a 1.5 m depth below existing grade, the footing will need to be protected from frost action by a combination of soil cover and rigid insulation board. EXP can provide additional comments regarding frost protection for the footing, if required. Reference is made to section 9.1.1 of this report for the procedure to construct the engineered fill pad.

Reference is made to previous comments dealing with dewatering of the excavation for the construction of the engineered fill pad.

9.2.1 Sliding Resistance

The factored coefficient of friction at ULS between the concrete of the footing and engineered fill is estimated at 0.46 and includes a geotechnical resistance factor of 0.8.

9.3 Additional Comment for Foundations

The recommended bearing pressure at SLS and factored geotechnical resistances at ULS have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes, when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

10. Floor Slab and Drainage Requirements

10.1 Floor Slab and Drainage Requirements

The ground floor of the proposed garage building may be designed and constructed as a slab-on-grade placed on a 200 mm thick well-packed 19 mm sized clear stone bed placed on a minimum 300 mm thick engineered fill pad set on the approved shaley glacial till. The engineered fill pad should be constructed in accordance with section 9.1.1. of this report. The clear stone will minimize the capillary rise of moisture from the sub-soil to the floor slab. Alternatively, the clear stone layer may be replaced with a 200 mm thick bed of OPSS Granular A compacted to 100 percent SPMDD overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking.

Reference is made to previous comments dealing with dewatering of the excavation for the construction of the engineered fill pad.

The proposed garage building will require perimeter and underfloor drainage systems.

The perimeter drainage system may consist of 100 mm diameter perforated pipe set on the footings and surrounded with
150 mm thick 19 mm sized clear stone that is fully wrapped or covered with an approved porous geotextile membrane, such as Terrafix 270R or equivalent. The underfloor drainage system may consist of 100 mm diameter perforated pipe or equivalent placed in parallel rows at 5 m to 6 m centres and at least 300 mm below the underside of the floor slab. The drains should be set on a 100 mm thick bed of 19 mm sized clear stone and covered on top and sides with 100 mm thick clear stone that is fully wrapped or covered with an approved porous geotextile membrane, such as Terrafix 270R or equivalent.

The perimeter and underfloor drainage systems should be connected to separate sumps equipped with backup (redundant) pumps and generators in case of mechanical failure and/or power outage, so that at least one system would be operational should the other fail.

The floor slab should be set at a minimum of 150 mm higher than the final exterior grade surrounding the garage building.

The final exterior grade surrounding the garage building should be sloped away from the building to prevent ponding of surface water close to the exterior walls of the building.

10.2 Vertical Modulus of Subgrade Reaction

For the slab-on-grade founded on the granular material consisting of 200 mm thick well-packed clear stone or OPSS Granular A layer over a minimum 300 mm thick engineered fill pad (OPSS Granular B Type II) compacted to 100 percent SPMDD, the vertical modulus of subgrade reaction is estimated to be 50 MPa/m.

11. Lateral Earth Pressure Against Retaining Wall

11.1 Lateral Earth Pressure against Retaining Wall

The retaining wall will be subjected to lateral static as well as lateral seismic (dynamic) earth forces during a seismic event. The seismic lateral earth pressure coefficients given below have been derived based on the peak horizontal ground acceleration (PGA) of 0.32g for the site determined from the 2020 National Building Code of Canada Seismic Hazard Tool.

The retaining wall should be backfilled with free draining material, such as Ontario Provincial Standard Specification (OPSS) Granular B Type II compacted to 95 percent SPMDD and equipped with a permanent drainage system to prevent the buildup of hydrostatic pressure behind the wall. The expressions below assume the walls are backfilled with free-draining material and equipped with a drainage system.

Seismic loading will result in an increase in the active lateral earth pressure on the wall. The total active pressure distribution can be separated into a static component and a seismic (dynamic) component and may be determined as follows (Mononobe and Matsuo, 1929):

$$\sigma_{AE}(z) = K_A\gamma z + (K_{AE} - K_A)\gamma(H - z) + q$$

Where $\sigma_{AE}(z)$ = the total combined active earth pressure (static and seismic) at depth z, (kPa).

z = depth below the top of the retaining wall at back of wall (m)

K_A = static lateral active earth pressure coefficient

K_{AE} = seismic lateral active earth pressure coefficient

γ = unit weight of the backfill soil (kN/m^3)

H = total height of the wall (m)

q = surcharge such as traffic and compaction pressure, where applicable (kPa)

For the total active earth pressure, the seismic (dynamic) pressure distribution is an inverted triangle with maximum pressure at the top of the wall and a minimum at the bottom of the wall. Therefore, the resultant of the static and seismic (dynamic) pressures on the retaining wall is assumed to be applied at depths ranging between 0.67z from the top of the backfill behind the wall and 0.67 (H-z) from the bottom of the wall, respectively.

The total passive pressure in front of the wall can similarly be separated into static and seismic (dynamic) components as follows:

$$\sigma_{PE}(z) = K_p\gamma z + (K_{PE} - K_p)\gamma(z) + q$$

Where $\sigma_{PE}(z)$= the total combined passive earth pressure (dynamic and static) a depth z, (kPa)

z = depth below the ground surface in front of the wall (m)

K_p = static lateral passive earth pressure coefficient

K_{PE} = seismic lateral passive earth pressure coefficient

γ = unit weight of the backfill soil (kN/m^3)

q = surcharge such as traffic and compaction pressure, where applicable (kPa)

The seismic passive pressure acts in the opposite direction to the static passive pressure thereby reducing the available passive pressure. The resultant force of the static and dynamic components of the passive pressure acts at 0.67z from the top of final grade in front of the retaining wall.

The lateral earth pressure parameters are summarized in Table VIII.

Table VIII: Lateral Earth Pressure Parameters	
Soil Type:	OPSS Granular B Type II
Unit Weight of Soil (γ); kN/m^3	22
Angle of Internal Friction (ϕ'); degrees	30 ^{o}
Coefficient of Static Active Lateral Earth Pressure Coefficient, K_A	0.33
Coefficient of Static Passive Lateral Earth Pressure Coefficient, K_P	3.00
Coefficient of Seismic Active Lateral Earth Pressure, K_{AE}	0.44
Coefficient of Seismic Passive Lateral Earth Pressure, K_{PE}	2.70

For the calculation of the active and passive seismic lateral earth pressure coefficients, the seismic coefficient in the horizontal direction, k_h, was taken as 0.5 times the PGA value of 0.32g. The calculated active and passive seismic lateral earth pressure coefficients assume the seismic coefficient in the vertical direction, k_v, is zero. If vertical acceleration is taken into consideration, the computed active and passive seismic lateral earth pressure coefficient values would be somewhat different.

The K_{AE} and K_{PE} value calculations assume the front and back faces of the wall are vertical, there is no friction between the wall and the backfill soil (in front of and behind the wall) and the ground surface of the backfill (in front of and behind the wall) is level or flat and the ground surface of the backfill behind the wall is at the same level as the top of the retaining wall

11.2 Factor of Safety Against Global Instability

For retaining walls greater than 1.0 m in height, a global stability analysis will be required to determine the factor of safety against global instability, as per the City of Ottawa document titled, *Slope Stability Guidelines for Development Applications in the City of Ottawa (2012).*

12. Excavation and De-Watering Requirements

12.1 Excess Soil Management

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

Reference is also made to the updated Phase Two ESA completed by EXP as part of this assignment.

12.2 Excavation

Excavations for the construction of the proposed garage building and retaining wall and installation of the underground services are anticipated to extend to depths ranging from approximately 3.0 m to 4.0 m below existing grade and are expected to be within the fill and shaley glacial till for the proposed building and retaining wall and may possibly extend to shallow depths below the surface of the shale bedrock for site servicing. Excavations will extend below the groundwater level.

12.2.1 Soil Excavation

The excavations within the soils may be undertaken by conventional heavy equipment capable of removing possible debris, cobbles and boulders within the fill and cobbles and boulders within the shaley glacial till.

Open cut excavations within the soils above the groundwater level are anticipated to be relatively straight forward.

All excavations must be undertaken in accordance with the Occupational Health and Safety Act (OHSA), Ontario Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils on site are considered to be Type 3 and as such must be cut back at 1H:1V from the bottom of the excavation. Within zones of seepage, the excavation side slopes are expected to slough and eventually stabilize at 2H:1V to 3H:1V from the bottom of the excavation. For excavations above the groundwater level or properly dewatered (refer to paragraph below), the installation of the municipal underground services may be undertaken within the confines of a prefabricated support system (trench box) designed and installed in accordance with OHSA.

The open cut excavations for this project are anticipated to extend below the groundwater level into the shaley glacial till which contains loose zones. The loose zones of the shaley glacial till below the groundwater level are susceptible to instability of the base of the excavation in the form of piping or heave. To minimize ‘base-heave’ type failure of the excavation base, it is necessary to lower the groundwater table at the site to below the final excavation level prior to the start of the excavation. This may be achieved by installing deep sumps, pumping with high-capacity pumps and pumping on a continuous basis (such as twenty-four (24) hours a day, seven (7) days a week). The groundwater level should be lowered and maintained to at least 1.0 m below the bottom of the excavation until the placement and compaction of the engineered fill pad has been completed to the design subgrade level. Standpipes should also be installed to monitor the groundwater level during initial groundwater lowering and during construction. A specialized dewatering contractor should be consulted to determine the most appropriate dewatering method for the site conditions to allow for the construction to be undertaken in relatively dry conditions.

If side slopes cannot be achieved due to space restrictions on site such as the proximity of open cut excavations to the property limits, existing infrastructure or to foundations of adjacent existing building(s), the new building construction would have to be undertaken within the confines of an engineered support system (shoring system).

The need for a shoring system, the most appropriate type of shoring system and the design and installation of the shoring system should be determined by the contractors bidding on this project. The design of the shoring system should be undertaken by a professional engineer experienced in shoring design and the installation of the shoring system should be undertaken by a contractor experienced in the installation of shoring systems. The shoring system should be designed and installed in accordance with latest edition of Ontario Regulation 213/91 under the OHSA and the 2006 Fourth Edition of the Canadian Foundation Engineering Manual (CFEM). The shoring system should be monitored on a periodic basis for lateral and vertical movements.

12.2.2 Bedrock Excavation

It is anticipated that excavations may extend to shallow depths below the bedrock surface. The side walls of the excavation that extend into the weathered zone of the bedrock should be cut back at 1H:1V from the bottom of this zone. Excavation of the competent sound bedrock is anticipated to be at a minimum. If excavations extend into the competent sound bedrock, excavation side slopes may be cut back with near vertical sides subject to examination by a geotechnical engineer.

The upper level of the bedrock may be excavated using a hoe ram for removal of very small quantities of the bedrock; however, this process is expected to be slow. The excavation of the sound shale bedrock will likely require line drilling and blasting method. Should blasting not be permitted, the excavation of the bedrock would have to be undertaken by line drilling and excavation. Specialized contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

The vibration limits for blasting should be monitored and in accordance with City of Ottawa Special Provisions (SP No. 1201).

12.2.3 Additional Comments

It is recommended that a pre-construction condition survey of adjacent building(s) and infrastructure located within the zone of influence of construction be undertaken prior to any earth (soil) and rock excavation work as well as vibration monitoring during excavation, blasting and construction operations. Prior to the commencement of blasting, a detailed blast methodology should be submitted by the Contractor.

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

12.3 De-Watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible remove groundwater entering into excavation by pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated and will require high-capacity pumps to keep the excavation dry (may need to operate 24 hours a day, seven (7) days a week).

As discussed above, to minimize base type failure of excavations that extend below the groundwater level and into the shaley glacial till, it is recommended that the groundwater level should be lowered by at least 1.0 m below the bottom of the excavation prior to the start of excavation. This may be achieved by installing deep sumps and pumping with high-capacity pumps. A specialized dewatering contractor should be consulted to determine the most appropriate dewatering method for the site conditions to allow for the construction to be undertaken in relatively dry conditions.

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

hydrogeological assessment and would take at least 90 days for the MECP to process once the application is submitted.

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

12.4 Short and Long-Term Effects of Dewatering on Existing Structures

Based on a review of the subsurface conditions at the site, short-term dewatering of the site during construction and long-term lowering of the groundwater by perimeter and underfloor drainage systems are not anticipated to negatively impact adjacent foundations and infrastructure.

13. Pipe Bedding Requirements

It is anticipated that the subgrade for the proposed underground services will consist of existing fill and shaley glacial till.

The pipe bedding including material specifications, thickness of cover material and compaction requirements should conform to City of Ottawa specifications, drawings and special provisions. The bedding and cover material should be compacted to a minimum of 95 percent standard Proctor maximum dry density (SPMDD).

The bedding thickness may be increased in areas where the subgrade is subject to disturbance. If this is the case, trench base stabilization techniques, such as the removal of loose material, placement of sub-bedding, consisting of OPSS Granular B Type II completely wrapped in a non-woven geotextile, may be used.

To minimize the potential for bending stresses within the pipe, a transition zone treatment should be provided in areas where the pipe subgrade changes from soil to bedrock and vice versa. In areas where the surface of the bedrock slopes at a steeper gradient than 3H:1V, the bedrock should be excavated and additional bedding material placed to create a 3H:1V transition zone.

For paved surfaces that will be located over service trenches, it is recommended that the trench backfill material within the 1.8 m frost zone, should match the existing material exposed along the trench walls to minimize differential frost heaving of the subgrade. The trench backfill should be placed in 300 mm thick lifts and each lift should be compacted to 95 percent SPMDD. Alternatively, frost tapers may be used.

The underground services should be installed in short open trench sections that are excavated and backfilled the same day.

14. Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The materials to be excavated from the site will comprise of topsoil, buried organic soil, fill and shaley glacial till and possibly shale bedrock. From a geotechnical perspective, the excavated topsoil, buried organic soil, fill and shale bedrock are not considered suitable for reuse as backfill material in the interior or exterior of the garage building and retaining wall and should be discarded. These soils (free of debris) may be used for general grading purposes in landscaped areas. Portions of the excavated granular fill (base) and shaley glacial till (free of cobbles and boulders) above the groundwater level may be re-used as fill in locations away from the proposed building and retaining wall as backfill in service trenches and subgrade fill in paved and landscaped areas, subject to further geotechnical examination and testing during construction. These soils are subject to moisture absorption due to precipitation and must be protected at all times from the elements. Subject to additional examination and testing during construction, portions of the shaley glacial till (free of cobbles and boulders) below the groundwater level, may be re-used as fill in locations away from the proposed building and retaining wall as backfill in service trenches and subgrade fill in paved and landscaped areas, but will likely require air-drying to reduce the moisture content to compact the materials to the specified degree of compaction. Air-drying may be problematic (difficult) since it is weather dependent, may take time and that the soils are subject to moisture absorption from precipitation and must be protected at all times from the elements.

Therefore, it is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building, retaining wall and in the underground service trenches will need to be imported and should preferably conform to the following specifications:

- Engineered fill under footings and the floor slab for the proposed garage building and backfill against the retaining wall – OPSS Granular B Type II placed in 300 mm thick lifts and each lift compacted to 100 percent SPMDD under footings and floor slab and 95 percent SPMDD for the backfill against the retaining wall.
- Backfill material for footing trenches and against foundation walls located outside the proposed garage building – OPSS Granular B Type II placed in 300 mm thick lifts and each lift compacted to 95 percent SPMDD,
- Trench backfill and subgrade fill should consist of OPSS Granular B Type I or OPSS Select Subgrade Material (SSM) placed in 300 mm thick lifts and each lift compacted to 95 percent SPMDD; and
- Landscaped areas - Clean fill that is free of organics and deleterious material, cobbles and boulders and is placed in 300 mm thick lifts with each lift compacted to 92 percent of the SPMDD.

15. Pavement Structures for Concrete Aprons, Access Roads and Parking Lots

Subgrade for the proposed concrete aprons and paved parking lots and access roads are anticipated to comprise of existing fill, OPSS Granular B Type II material or select subgrade material (SSM) used to raise the grades to the design subgrade level.

15.1 Rigid Pavement Structure - Concrete Apron

Rigid pavement structure thicknesses for the new concrete aprons were computed and are shown on Table IX. The pavement structure is based upon an estimate of the subgrade soil properties determined from visual examination, textural classification of the soil samples and functional design life of 15 to 18 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table IX: Rigid Pavement Structure – Concrete Aprons		
Pavement Layer	Compaction Requirements	Computed Pavement Structure – Light Duty Traffic (Cars) and Heavy Duty Traffic (Buses, Emergency Vehicles and Trucks)
Reinforced Concrete	-	200 mm
OPSS 1010 Granular A Base (crushed limestone)	100% SPMDD	150 mm
OPSS 1010 Granular B Sub-base, Type II	100% SPMDD	600 mm
Note: SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698-12e2.		

The concrete for the rigid pavement structure should be designed by a structural engineer. The concrete should be reinforced and equipped with expansion and control joints. The concrete should also have a compressive strength of 32 MPa and air content ranging from 5 percent to 8 percent.

Additional comments on the construction of the new concrete aprons are as follows:

1. As part of the subgrade preparation, the proposed concrete apron area should be stripped of the existing pavement structure and fill and any other unsuitable material. Portions of the existing fill may remain as part of the subgrade, subject to further examination during construction.
2. The subgrade should be properly shaped, crowned, proofrolled and the exposed subgrade examined by a geotechnical technician. Any soft or spongy subgrade areas detected should be excavated and replaced with OPSS Granular B Type II material compacted to 95 percent SPMDD.
3. Fill required to raise the grades to the design subgrade elevation should consist of to OPSS Granular B Type II compacted to 95 percent SPMDD.
4. The need for adequate drainage of surface and subsurface water for the concrete aprons cannot be over emphasized. The drainage system should comprise of sub-drains as well as a trench drain at the low point of the concrete aprons that will direct water away from the aprons to a suitable outlet.

5. The granular materials used for pavement structure should conform to OPSS 1010 for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.

15.2 Flexible Pavement Structures – Access Roads and Parking Lots

Pavement structure thicknesses required for the new paved access roads and parking lots set on the anticipated approved subgrade materials were computed and are shown in Table X. The pavement structures assume a functional design life of 15 to 18 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table X: Flexible Pavement Structures – Parking Lots and Access Roads			
Pavement Layer	Compaction Requirements	Computed Pavement Structure	
		Light Duty Traffic (Cars Only)	Heavy Duty Traffic (Buses, Emergency Vehicles and Trucks)
Asphaltic Concrete	92 percent-97 percent MRD	65 mm HL3/SP12.5 mm/ Cat. B (PG 58-34)	60 mm HL3/SP12.5 Cat. D (PG 64-34) 90 mm HL8/SP 19 Cat. D (PG 64-34)
OPSS 1010 Granular A Base	100% percent SPMDD	150 mm	150 mm
OPSS 1010 Granular B Type II Sub-base	100% percent SPMDD	450 mm	600 mm

Notes:

1. *SPMDD denotes standard Proctor maximum dry density, ASTM, D-698-12e2.*
2. *MRD denotes Maximum Relative Density, ASTM D2041.*
3. *The upper 300 mm of the subgrade fill must be compacted to 98 percent SPMDD.*
4. *The approved subgrade should be covered with a woven geotextile prior to placement of granular sub-base of the pavement structure.*

The foregoing design assumes that construction is carried out during dry periods and that the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather and heaving or rolling of the subgrade is experienced, additional thickness of granular material may be required in addition to the woven geotextile indicated in Table X.

Additional comments for the construction of the access roads and parking lots are as follows:

1. As part of the subgrade preparation, the proposed parking areas and the internal access roads should be stripped of existing pavement structure, surficial topsoil and any other unsuitable material. The subgrade should be properly shaped, crowned, then proofrolled with a heavy vibratory roller in the full-time presence by a geotechnician. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with suitable approved material or approval OPSS Granular B Type II placed in 300 mm lift and each lift compacted to 95 percent SPMDD (ASTM D698-12e2).
2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. The need for adequate drainage cannot be over-emphasized. Subdrains should be installed on both sides of the access road(s). Subdrains must be installed in the proposed parking area and on both sides of the roadways at low points and should be continuous between catchbasins to intercept excess surface and subsurface moisture and to prevent subgrade softening. This will ensure no water collects in the granular course, which could result in pavement failure during the spring thaw.
3. To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular B Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of any water that may accumulate in the granular fill.

4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, temporary construction roadways, etc., may be required, especially if construction is carried out during unfavorable weather.
5. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.
6. Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level. if this is the case, it is recommended that additional 150 mm of granular sub-base Granular B Type II should be provided in these areas in addition to the use of a geotextile at the subgrade level.
7. The granular materials used for pavement construction should conform to OPSS 1010 for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD (ASTM D698). The asphaltic concrete and its placement should meet OPSS requirements. It should be compacted to 92 to 97 percent of the maximum relative density in accordance with ASTM D2041.

The asphaltic concrete used, and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted from 92 percent to 97 percent of the MRD (ASTM D2041). Asphalt placement should be in accordance with OPSS 310 and OPSS 313.

15.3 Additional Comments

Prior to construction, it is recommended that EXP be retained to review the final pavement structure design and drainage plans for the rigid (concrete aprons) and flexible pavement structures (paved areas) to ensure they are consistent with the recommendations of this report.

16. Corrosion Potential

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on eleven (11) soil samples and three (3) sections of the bedrock cores. A summary of the results is shown in Table XI. The laboratory certificate of analysis is shown in Appendix C.

Table XI: Corrosion Test Results on Soil Samples and Rock Core Sections

Borehole – Sample/Run No.	Depth (m)	Soil/Bedrock Type	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
Soil Samples						
BH/MW 22-01: SS2	0.8-1.4	Fill	7.84	0.0281	0.0933	362
BH/MW 22-03: SS3	1.5-2.1	Shaley Glacial Till	7.65	0.0819	0.1320	207
BH 22-05: SS5	3.0-3.6	Shaley Glacial Till	7.54	0.0515	0.0422	599
BH 22-07: SS5	3.0-3.6	Shaley Glacial Till	7.55	0.0863	0.1140	265
BH 22-09: SS3	1.5-2.1	Shaley Glacial Till	7.84	0.0116	0.0518	621
BH 24-02: SS6	3.8-4.4	Shaley Glacial Till	6.83	0.0353	0.1250	400
BH 24-04: SS4	2.3-2.9	Shaley Glacial Till	8.38	0.0639	0.2570	167
BH/MW 24-05: SS3	1.5-2.1	Shaley Glacial Till	8.62	0.0829	0.2350	240
BH/MW 24-07: SS6	3.8-4.2	Shaley Glacial Till	8.52	0.0527	0.0905	645
BH 24-09: SS4	2.3-2.9	Shaley Glacial Till	7.80	0.0419	0.0810	415
BH 24-12: SS6	3.8-4.4	Shaley Glacial Till	7.30	0.0429	0.0642	800
Bedrock Core Sections						
BH/MW 24-01: Run 1	3.4-3.5	Shale Bedrock	9.89	0.0055	0.0104	1960
BH/MW 24-05: Run 2	4.2-4.3	Shale Bedrock	9.95	0.0047	0.0102	2670
BH/MW 24-07: Run 1	4.2-4.3	Shale Bedrock	9.29	0.0033	0.0087	3370

The test results indicate the soils and shale bedrock have a negligible sulphate attack on subsurface concrete. The concrete should be designed in accordance with CSA A.23.1-19.

The results from the resistivity tests indicate that the fill and shaley glacial till are very corrosive to moderately corrosive and the shale bedrock is corrosive to mildly corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be taken to protect the buried bare steel from corrosion.

17. Tree Planting Restrictions

Since sensitive marine clays are not present at the site, there are no restrictions to tree planting with respect to the City of Ottawa 2005 Clay Soils Policy and 2017 Tree Planting in Sensitive Marine Clay Soils Guidelines.

18. General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for the design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report is not intended to reflect on environmental aspects of the soils and groundwater. Reference should be made to the EXP Phase One and Two Environmental Site Assessments (ESAs) for the environmental aspects of the soils and groundwater.

We trust that the information contained in this report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

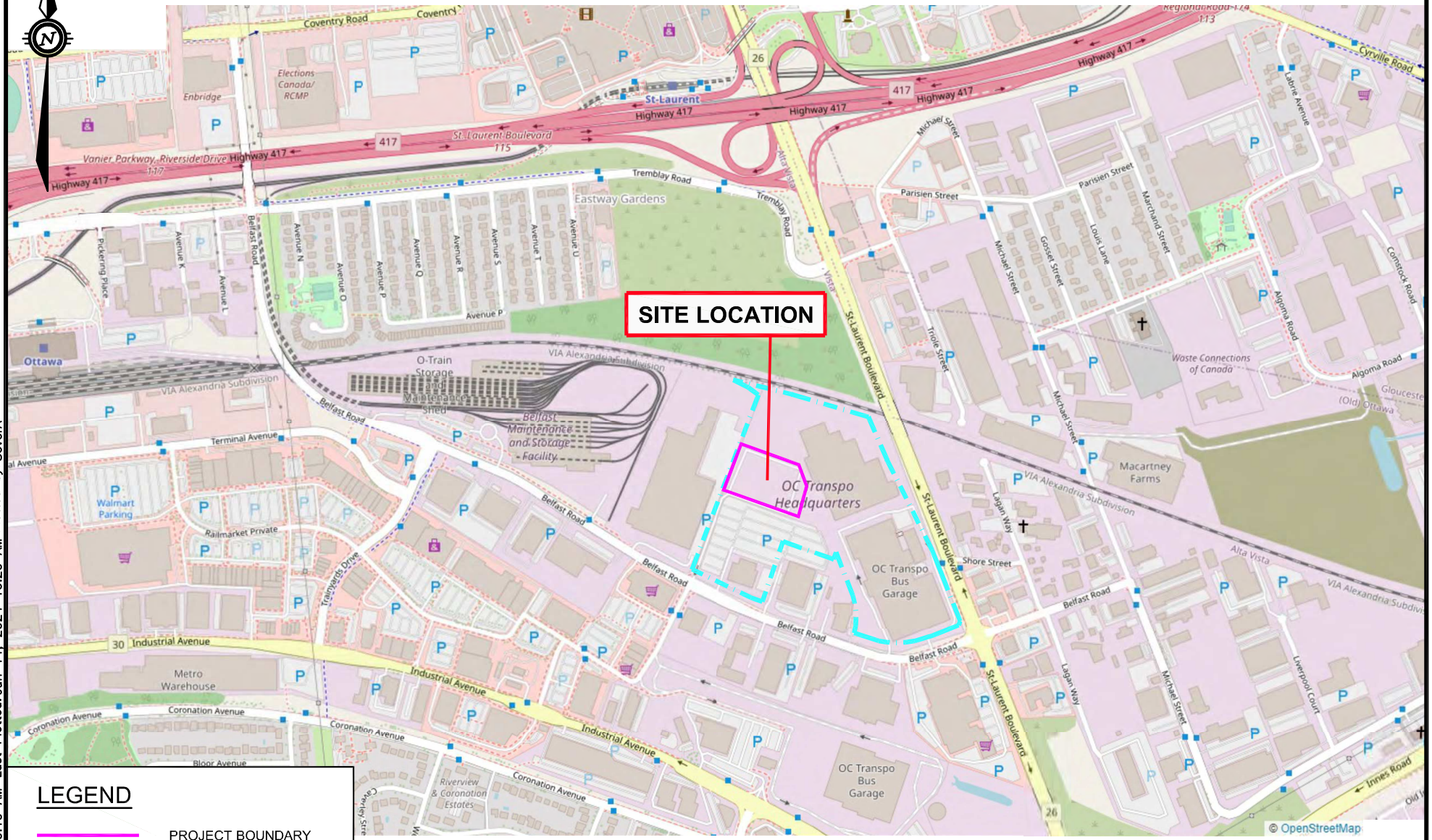
Sincerely,



Susan M. Potyondy, P.Eng.
Senior Geotechnical Engineer
Earth & Environment

Ismail M. Taki, M.Eng., P.Eng.
Senior Manager, Eastern Region
Earth & Environment

Figures



SOURCE MAP: *Open Street Map* (2024)

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
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DESIGN	SP/IT
DRAWN	AS
DATE	JUNE 2024
FILE NO	OTT-22007382-A0

GEOTECHNICAL INVESTIGATION
(PROPOSED OC TRANSPO ELECTRICAL BUS GARAGE BUILDING) 1500 ST. LAURENT BLVD. OTTAWA, ON

SITE LOCATION PLAN

SCALE 1:10,000
SKETCH NO
FIG 1

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LEGEND

PROPERTY LINE

ELECTRICAL BUS GARAGE BUILDING AREA

HYDRO SUB–STATION AREA

ORIGINAL SHEET SIZE = 17" X 11"

0 10m 20m 50m

HORIZONTAL 1:1250

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GEOTECHNICAL INVESTIGATION
(PROPOSED OC TRANSPO ELECTRICAL BUS GARAGE BUILDING) 1500 ST. LAURENT BLVD. OTTAWA, ON

LOCATIONS OF PROPOSED STRUCTURES

SCALE 1:1,250

SKETCH NO FIG 2

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PROPOSED OC TRANSPO HYDRO SUBSTATION AREA

PROPOSED OC TRANSPO ELECTRICAL BUS GARAGE BUILDING

EXISTING NORTH GARAGE BUILDING

TOTAL PROPOSED PARKING SPACES 656

BH24-09
GS = 69.28m
BR = 4.1m (65.2m)

BH/MW22-16
GS = 69.60m
AR = 3.7m (65.9m)

BH22-17
GS = 69.99m
AR = 4.4m (65.6m)

BH22-09
GS = 69.69m
BR = 2.8m (66.9m)

BH/MW24-07
GS = 70.36m
BR = 4.5m (65.9m)

BH/MW22-08
GS = 70.32m
AR = 4.4m (65.9m)

BH24-08
GS = 69.89m
Not Drilled

BH22-06
GS = 69.80m
AR = 2.4m (67.4m)

BH24-06
GS = 70.26m
BR = 4.3m (66.0m)

BH22-07
GS = 69.72m
BR = 4.1m (65.6m)

BH24-04
GS = 69.83m
BR = 4.0m (65.8m)

BH22-05
GS = 70.25m
AR = 4.2m (66.1m)

SL-1

BH/MW22-03
GS = 69.72m
AR = 3.6m (66.1m)

BH24-03
GS = 70.19m
BR = 4.6m (65.6m)

BH/MW24-05
GS = 69.80m
BR = 3.7m (66.1m)

BH22-04
GS = 69.87m
AR = 4.1m (65.8m)

BH/MW24-01
GS = 70.15m
BR = 3.4m (66.8m)

BH/MW22-02
GS = 70.01m
BR = 4.2m (65.8m)

BH24-12
GS = 70.78m
CR = 5.2m (65.6m)

BH/MW22-01
GS = 70.09m
AR = 4.0m (66.1m)

BH24-02
GS = 70.28m
BR = 4.5m (65.8m)

AERIAL PHOTOGRAPH SOURCE: *geoOttawa* (*maps.ottawa.ca/geoottawa*)

LEGEND

PROPERTY LINE

BH/MW22-01 — *EXP* BOREHOLE/MONITORING WELL NO. & LOCATION (COMPLETED IN 2022)

BH22-04 — *EXP* BOREHOLE NO. & LOCATION (COMPLETED IN 2022)

BH/MW24-01 — *EXP* BOREHOLE/MONITORING WELL NO. & LOCATION (COMPLETED IN 2024)

BH24-02 — *EXP* BOREHOLE NO. & LOCATION (COMPLETED IN 2024)

GS = 70.15m — GROUND SURFACE ELEVATION (m)

AR = 4.6m (65.7m) — AUGER REFUSAL DEPTH (ELEVATION) ON INFERRED BEDROCK (m)

CR = 5.2m (65.6m) — CASING REFUSAL DEPTH (ELEVATION) ON INFERRED BEDROCK (m)

BR = 3.4m (66.8m) — BEDROCK DEPTH (ELEVATION) (m)

SL-1 — APPROXIMATE LOCATION OF SEISMIC LINE FROM GEOPHYSICS *GPR INTERNATIONAL INC.* (*GPR*) REPORT DATED MAY 31, 2024. FOR THE PROPOSED OC TRANSPO ELECTRICAL BUS GARAGE BUILDING.

ORIGINAL SHEET SIZE = 17" X 11"

0 10m 20m 40m

HORIZONTAL 1:1000

GENERAL NOTES:

1. THE BOUNDARIES AND SOIL AND ROCK TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLE THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK CORES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. TOPSOIL AND ASPHALT QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION AT THE BOREHOLE LOCATIONS.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN PRODUCED BY: *AECOM CANADA ARCHITECTS LTD. / GRC ARCHITECTS INC.*, PROJECT: OTC ZEB–NEW GARAGE, CITY PROJECT NO.: 60706271, SHEET NO.: AS001

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DESIGN	SP/IT
DRAWN	AS
DATE	JUNE 2024
FILE NO	OTT–22007382–A0

GEOTECHNICAL INVESTIGATION
(PROPOSED OC TRANSPO ELECTRICAL BUS GARAGE BUILDING) 1500 ST. LAURENT BLVD. OTTAWA, ON

BOREHOLE LOCATION PLAN

SCALE 1:1,000

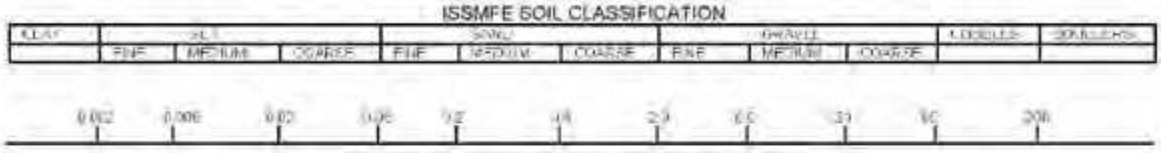
SKETCH NO FIG 3

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Notes On Sample Descriptions

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

ISSMFE SOIL CLASSIFICATION



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES



UNIFIED SOIL CLASSIFICATION

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

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

Log of Borehole MW22-01

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'Sept 20, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~150 mm thick	70.09	0			GS1	
		GRANULAR FILL (BASE) ~600mm thick	69.9					
		Sand and gravel, light brown, damp, (dense)	69.3		39		SS1	
		FILL Silty sand some gravel, and clay, brown to black, moist, no odours, no stains,(loose)		1	8		SS2	
			68.39		9		SS3	
		SHALEY GLACIAL TILL	67.8	2				
		Silty sand, some gravel, and clay, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet , no odours, no stains, (compact)			11		SS4	
				3	19		SS5	
					50/ 135 mm		SS6	
			66.1	4				

Auger Refusal at 4.0 m Depth

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 50 mm monitoring well installed upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	
'November 14, 2022	2.2	
'May 29, 2024	1.7	

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole MW22-02

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'Sept 19, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
			70.01	0
		ASPHALT ~175 mm thick	69.8	
		GRANULAR FILL(BASE)~400mm thick Sand and gravel, light brown, damp, (dense)	69.4	
		SHALEY GLACIAL TILL Silty sand, gravelly, trace to some clay, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet , no odours, no stains, (compact to dense)	68.91	1
				2
				3
			65.8	4
		SHALE BEDROCK Dark grey to black		5
				6
				7
			61.3	8
		Borehole Terminated at 8.7 m Depth		

Standard Penetration Test N Value: 20 40 60 80; Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

49; 17; 10; 11; 11, 40, 50 / 75 mm; 20, 50 / 125 mm

SAMPLES	Natural Unit Wt. kN/m³
GS1	
SS1	
SS2	
SS3	
SS4	
SS5	
SS6	
	Run 1
	Run 2
	Run 3

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 19 mm standpipe installed upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
		3.4
'November 14, 2022	1.7	
'May 29, 2024	1.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4.2 - 5.7	98	60
2	5.7 - 7.2	99	99
3	7.2 - 8.7	98	98

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole MW22-03

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 6

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Date Drilled: 'Sept 19, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~175 mm thick	69.72	0			GS1	
		GRANULAR FILL (BASE) ~500mm thick Sand and gravel, light brown, damp, (dense)	69.5		36		SS1	
			69.0					
		SHALEY GLACIAL TILL Silty sand, gravelly, trace clay, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (loose to dense)	68.82	1	9		SS2	
				2	10		SS3	
					48		SS4	
				3	50 / 135 mm		SS5	
			66.1					
		Auger Refusal at 3.6 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 50 mm monitoring well installed upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	no cave
'November 14, 2022	1.4	
'May 29, 2024	0.9	

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH22-04

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'Sept 20, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~150 mm thick	69.87	0			GS1	
		GRANULAR FILL (BASE) ~600mm thick Silty sand, some gravel and clay, dark to black, moist, no odours, no stains, (dense)	69.7		39	×	SS1	
			68.8	1	10	×	SS2	
		SHALEY GLACIAL TILL Silty sand, some gravel and clay, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet, no odours, no stains, (loose to compact)		2	7	×	SS3	
					8	×	SS4	
				3	20	×	SS5	
			66.1		12, 14, 14 for 50mm	×	SS6	
		SAND Sand, black, wet, no odours, no stains, (compact)	65.8	4				
		Auger Refusal at 4.1 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	2.1	3.0

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH22-05

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 8

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Date Drilled: 'Sept 19, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~150 mm thick	70.25	0			GS1	
		GRANULAR FILL (BASE) ~300mm thick	70.1					
		Sand and gravel, brown, damp (dense)	69.8		50	×	SS1	
		SHALEY GLACIAL TILL		1	22	×	SS2	
		Silty sand, some gravel, trace clay, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet , no odours, no stains, (compact to very dense)			11	×	SS3	
				2	17	×	SS4	
				3	14	×	SS5	
				4	53	×	SS6	
		Auger Refusal at 4.2 m Depth	66.1					

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	2.7

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH22-06

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 9

Page. 1 of 1

Date Drilled: 'Sept 19, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		ASPHALT ~175 mm thick	69.8	0
		GRANULAR FILL (BASE) ~300mm thick	69.6	
		Sand and gravel, brown, damp	69.3	
		FILL Clayey sand, some gravel, silty, dark brown to black, damp, no odours, no stains, (compact to dense)		1
			68.4	
		SHALEY GLACIAL TILL Clayey sand, some gravel, silty, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet , no odours, no stains, (compact to dense)		2
			67.4	
		Auger Refusal at 2.4 m Depth		

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

SPT values: 36 (0.5 m), 19 (1.2 m), 10 (2.0 m), 50 / 125 mm (2.3 m)

SAMPLES	Natural Unit Wt. kN/m³
GS1	
SS1	
SS2	
SS3	
SS4	

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	no cave

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH22-07

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 10

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Date Drilled: 'Sept 20, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~150 mm thick	69.72	0			GS1	
		GRANULAR FILL (BASE) ~500mm thick	69.6					
		Sand and gravel, light brown, damp, (dense)	69.1		41	×	SS1	
		FILL		1	13	×	SS2	
		Silty sand with gravel, some clay, dark brown to black, moist , no odours, no stains, (compact)	68.6					
		SHALEY GLACIAL TILL		2	11	×	SS3	
		Clayey sand, some gravel, and clay, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet , no odours, no stains, (compact)			12	×	SS4	
				3	21	×	SS5	
					15, then 50 / 150 mm	×	SS6	
			65.6	4				
		SHALE BEDROCK						
		Dark grey to black		5			Run 1	
				6				
							Run 2	
				7				
							Run 3	
				8				
			61.2					
		Borehole Terminated at 8.5 m Depth						

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
		3.5

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4.1 - 5.6	85	55
2	5.6 - 7.1	99	86
3	7.1 - 8.5	98	77

Log of Borehole MW22-08

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 11

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Date Drilled: 'Sept 20, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			70.32	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		ASPHALT ~175 mm thick	70.1				GS1	
		GRANULAR FILL (BASE) ~500mm thick Sand and gravel, light brown, damp, (very dense)	69.6		61	×	SS1	
		SHALEY GLACIAL TILL Silty sand, some gravel, and clay, possible cobbles and boulders, dark brown to dark grey to black, damp to wet , no odours, no stains, (loose to dense)		1	38	×	SS2	
					15	×	SS3	
			68.32	2				
					7	×	SS4	
				3	8	×	SS5	
					49	×	SS6	
			65.9	4				
		Auger Refusal at 4.4 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 50 mm monitoring well installed upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	no cave
'May 29, 2024	2.0	

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH22-09

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 12

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Date Drilled: 'Sept 20, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~150 mm thick	69.69	0				
		GRANULAR FILL (BASE) ~600mm thick	69.5					
		Sand and gravel, light brown, damp, (dense)	68.9		32	0	GS1	
		FILL				0	SS1	
		Silty sand, some gravel, trace clay, rootlets, dark brown, moist to wet , no odours, no stains, (compact)	68.2	1	17	0	SS2	
		SHALEY GLACIAL TILL			55	0	SS3	
		Clayey sand, some gravel, clay, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, damp to wet , no odours, no stains, (compact to very dense)	66.9	2	19	0	SS4	
		SHALE BEDROCK						
		Dark grey		3			RUN1	
				4				
				5			RUN2	
				6				
							RUN3	
			62.6	7				
		Borehole Terminated at 7.1 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	dry	2.4

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.8 - 4.1	98	68
2	4.1 - 5.7	99	82
3	5.7 - 7.1	100	79

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (NEW BUS GARAGE).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole MW22-16

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 13

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Date Drilled: 'Nov. 17, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT ~180 mm thick	69.6	0				
		GRANULAR FILL (BASE) ~1100mm thick Silty sand and gravel, light brown, damp, no odours, no stains, (compact to dense)	69.4		35	15	SS1	
		TOPSOIL~50mm thick	68.4 68.5	1	22	0	SS2	
		FILL Silty sand, trace clay, with topsoil, inclusions(black with rootlets), greenish grey, moist, no odours, no stains, (loose)	68.4	2	9	0	SS3	
		SHALEY GLACIAL TILL Silty sand, some gravel, shale fragments, possible cobbles and boulders, dark brown to grey to black, moist, no odours, no stains, (compact to dense)	67.3		20	0	SS4	
			65.9	3	46	0	SS5	
		Auger Refusal at 3.7 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 50 mm monitoring well installed upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
'November 24, 2022	1.4	
'May 30, 2024	1.1	

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (HYDRO SUBSTATION).GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH22-17

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd., Ottawa, Ontario

Figure No. 14

Page. 1 of 1

Date Drilled: 'Nov. 17, 2022

Drill Type: CME-55 Truck Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL~790mm thick Sand and gravel, light brown, moist, no odours, no stains, (dense)	69.99	0	30	10	SS1	
			69.2					
		FILL Silty sand, some gravel, trace clay, dark brown to black, moist to wet, no odours, no stains, (loose to compact)		1	10	10	SS2	
				2	4	10	SS3	
					5	0	SS4	
			67.0	3				
		SHALEY GLACIAL TILL Silty sand, gravel, some shale fragments, possible cobbles and boulders, dark brown to grey to black, moist, no odours, no stains, (compact)			11	0	SS5	
				4	12	10	SS6	
			65.6					
		Auger Refusal at 4.4 m Depth						

LOG OF BOREHOLE OTT-22007382 - 1500 SAINT LAURENT BH LOGS (HYDRO SUBSTATION).GPJ TROW OTTAWA.GDT 06/12/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole MW24-01

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 15

Page. 1 of 1

Date Drilled: 'May 10, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~125 mm thick	70.15	0				
		GRANULAR FILL(BASE)~560 mm thick Silty sand and gravel, brown, moist, no odours, no stains	70.0					
		FILL Silty sand, blast shattered rock type fragments, brown to dark grey, moist, no odours, no stains, (compact)	69.5	1	25		AS1 SS2	
		SHALEY GLACIAL TILL Silty sand, some gravel, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist to wet, no odours, no stains, (compact)	68.95	2	17		SS3	
		COBBLES AND BOULDERS	68.7		13,14, then 50 for 50mm		SS4	
		SHALE BEDROCK Dark grey	67.5	3			RUN0	
			66.8	4			RUN1	
				5			RUN2	
				6			RUN3	
			63.1	7				

Borehole Terminated at 7.1 m Depth

Note:

1) SS2 & SS3 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 32 mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
'May 30, 2024	1.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.4 - 4.1	100	67
2	4.1 - 5.5	100	85
3	5.5 - 7.1	100	100

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH24-02

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 16

Page. 1 of 1

Date Drilled: 'May 8, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~65 mm thick	70.28	0				
		GRANULAR FILL(BASE)~620 mm thick Gravel, sandy, some silt, brown, moist, no odours, no stains	70.2				AS1	
			69.6					
		FILL Silty sand, blast shattered rock type fragments, brown to dark grey, moist, no odours, no stains, (compact)	68.8	1	22		SS2	
		SHALEY GLACIAL TILL Silty sand, some gravel, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (compact to very dense)		2	15		SS3	
					23		SS4	
				3	68		SS5	
				4	115		SS6	
			65.8					
		WEATHERD SHALE BEDROCK Dark grey	65.5	5			RUN1	
		SHALE BEDROCK Dark grey		6			RUN2	
				7				
				8			RUN3	
			61.5					
		Borehole Terminated at 8.8 m Depth						

Note:

1) SS2 & SS6 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4.6 - 5.7	97	72
2	5.7 - 7.3	90	83
3	7.3 - 8.8	100	67

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH24-03

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 17

Page. 1 of 1

Date Drilled: 'May 3, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			70.19	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		ASPHALT~140mm thick	70.0					AS1
		GRANULAR FILL(BASE)~545 mm thick Silty sand and gravel, brown, moist, no odours, no stains	69.5					
		FILL Clayey sand, low plasticity, gravelly, silty, blast shattered rock type fragments, brown to dark grey, moist, no odours, no stains, (compact)		1	24			SS2
				2	24			SS3
		SHALEY GLACIAL TILL Silty sand, some gravel, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (compact to very dense)	68.2					
				3	14			SS4
					82			SS5
				4	43, then 50 for 25mm			SS6
		Cobbles and boulders from 4.0 m to 4.6 m depths.						RUN1
		SHALE BEDROCK Dark grey	65.6	5				RUN2
				6				RUN3
				7				
				8				RUN4
			61.6					

Borehole Terminated at 8.6 m Depth

Note:

1) SS2,SS5 & SS7 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4 - 4.2	0	0
2	4.2 - 5.6	100	37
3	5.6 - 7.1	100	88
4	7.1 - 8.6	100	100

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH24-04

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 18

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Date Drilled: 'May 3, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~130mm thick	69.83	0			AS1	
		GRANULAR FILL(BASE)~555 mm thick	69.7					
		Sand and gravel, brown, moist, no odour, no stains	69.1					
		FILL Silty sand, some gravel, blast shattered rock type fragments, brown to dark grey, moist, no odours, no stains, (loose to compact)		1	26		SS2	
				2	8		SS3	
			67.6					
		SHALEY GLACIAL TILL Silty sand, some gravel, clayey, possible cobbles and boulders, dark brown to dark grey to black, moist, no odour, no stains, (compact to dense)		3	11		SS4	
					24		SS5	
				4	46, then 50 for 25mm		SS6	
			65.8					
		SHALE BEDROCK Dark grey		5			RUN1	
				6			RUN2	
			62.7	7				

Borehole Terminated at 7.1 m Depth

Note:

1) SS2 & SS5 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4 - 5.5	100	75
2	5.5 - 7.1	100	77

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole MW24-05

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 19

Page. 1 of 1

Date Drilled: 'May 8, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~140 mm thick	69.8	0			AS1	
		GRANULAR FILL(BASE)~545 mm thick	69.7					
		Sand and gravel, brown, moist, no odour, no stains	69.1					
		FILL Silty sand, black organic pockets, brown, moist, no odours, no stains, (compact)		1	15		SS2	
			68.3					
		SHALEY GLACIAL TILL	68.1	2	12		SS3	
		Clayey sand, low plasticity, some gravel, silty, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (compact)		3	11		SS4	
					22		SS5	
			66.1	4			RUN1	
		SHALE BEDROCK Dark grey		5			RUN2	
				6			RUN3	
			62.7	7				

Borehole Terminated at 7.1 m Depth

Note:

1) SS2 & SS4 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
'May 30, 2024	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.7 - 4.2	95	84
2	4.2 - 5.7	88	80
3	5.7 - 7.1	100	94

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH24-06

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 20

Page. 1 of 1

Date Drilled: 'May 7, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASHPHALT~180 mm thick	70.26	0			AS1	
		GRANULAR FILL(BASE)~505 mm thick Silty sand and gravel, brown, moist, no odours, no stains	70.1					
		FILL Silty sand, gravel, brown to dark grey, moist, no odour, no stain, (compact)	69.6	1	26		SS2	
		SHALEY GLACIAL TILL Clayey sand, low plasticity, some gravel, silty, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (compact to very dense)	68.8	2	10		SS3	
				3	17		SS4	
					30		SS5	
				4	97		SS6	
		SHALE BEDROCK Dark grey	66.0	5			RUN1	
				6				
				7			RUN2	
				8			RUN3	
			61.5					

Borehole Terminated at 8.8 m Depth

Note:

1) SS2 & SS4 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4.3 - 5.3	84	41
2	5.3 - 7.3	100	97
3	7.3 - 8.8	100	91

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole MW24-07

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 21

Page. 1 of 1

Date Drilled: 'May 7, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALT~180 mm thick	70.36	0			AS1	
		GRANULAR FILL(BASE)~520 mm thick Sand and gravel, brown, moist, no odours, no stains	70.2					
			69.7					
		FILL Clayey sand, low plasticity, trace gravel, silty, blast shattered rock type fragments, brown, moist, no odours, no stains, (loose to compact)		1	7		SS2	
				2	18		SS3	
▽			68.26					
			67.8	3	29		SS4	
		SHALEY GLACIAL TILL Silty sand, some gravel, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (compact to very dense)			29		SS5	
				4	54		SS6	
			65.9				RUN1	
		SHALE BEDROCK Dark grey		5			RUN2	
				6			RUN3	
				7				
				8			RUN 4	
			61.7					
		Borehole Terminated at 8.7m Depth						
		Note: 1) SS3 & SS5 samples submitted for environmental laboratory analyses.						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
'May 30, 2024	2.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	4.2 - 4.5	77	0
2	4.5 - 5.7	100	57
3	5.7 - 7.2	95	95
4	7.2 - 8.7	100	92

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 6/13/24

Log of Borehole BH24-09

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 22

Page. 1 of 1

Date Drilled: 'May 9, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

Geodetic Elevation m	Depth	SOIL DESCRIPTION	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
69.28	0	**ASPHALT**~180 mm thick				
69.1		**GRANULAR FILL(BASE)**~520 mm thick				
		Silty sand and gravel, brown, moist, no odours, no stains				
68.6		**FILL**				
	1	Silty sand, blast shattered rock type fragments, possible cobbles and boulders, grey, moist, no odour, no stains, (dense)	35	×	AS1 / SS2	
67.9		**ORGANIC SOIL**				
	2	Mixture of silty sand and organic soil with rootlets, brown to black, wet, no odours, no stains, (loose)	7	×	SS3	
67.0		**SHALEY GLACIAL TILL**				
	3	Silty sand, some gravel, shale fragments, possible cobbles and boulders, dark brown to dark grey to black, moist, no odours, no stains, (dense)	41	×	SS4	
			31	×	SS5	
	4		50 for 50mm		SS6 / RUN1	
65.2		**SHALE BEDROCK**				
	5	Dark grey			RUN2	
	6					
					RUN3	
62.2	7	**Borehole Terminated at 7.1 m Depth**				

Note:

1) SS3 & SS5 samples submitted for environmental laboratory analyses

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.9 - 4.1	100	0
2	4.1 - 5.7	100	75
3	5.7 - 7.1	100	67

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

Log of Borehole BH24-12

Project No: OTT-22007382-A0

Project: Proposed OC Transpo Electrical Bus Garage

Location: 1500 St. Laurent Blvd, Ottawa, Ontario

Figure No. 23

Page. 1 of 1

Date Drilled: 'May 10, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: S.P

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL~75 mm thick	70.78	0				
		FILL	70.7					
		Silty sand, some gravel, blast shattered rock type fragments, rootlets, asphalt fragments,possible cobbles and boulders, brown, moist, no odour, no stain, (loose to compact)			20	×	AS1	
				1	8	×	SS2	
				2	22	×	SS3	
					18	×	SS4	
		SHALY GLACIAL TILL	67.8	3				
		Clayey sand, low plasticity, gravelly, silty, shale fragments, possible cobbles and boulders, moist, no odours, no stains, (loose to compact)			5	×	SS5	
				4	5	×	SS6	
					24		SS7	
			65.6	5				
		Casing Refusal at 5.2 m Depth						

Note:

1) SS3 & SS7 samples submitted for environmental laboratory analyses.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22007382-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

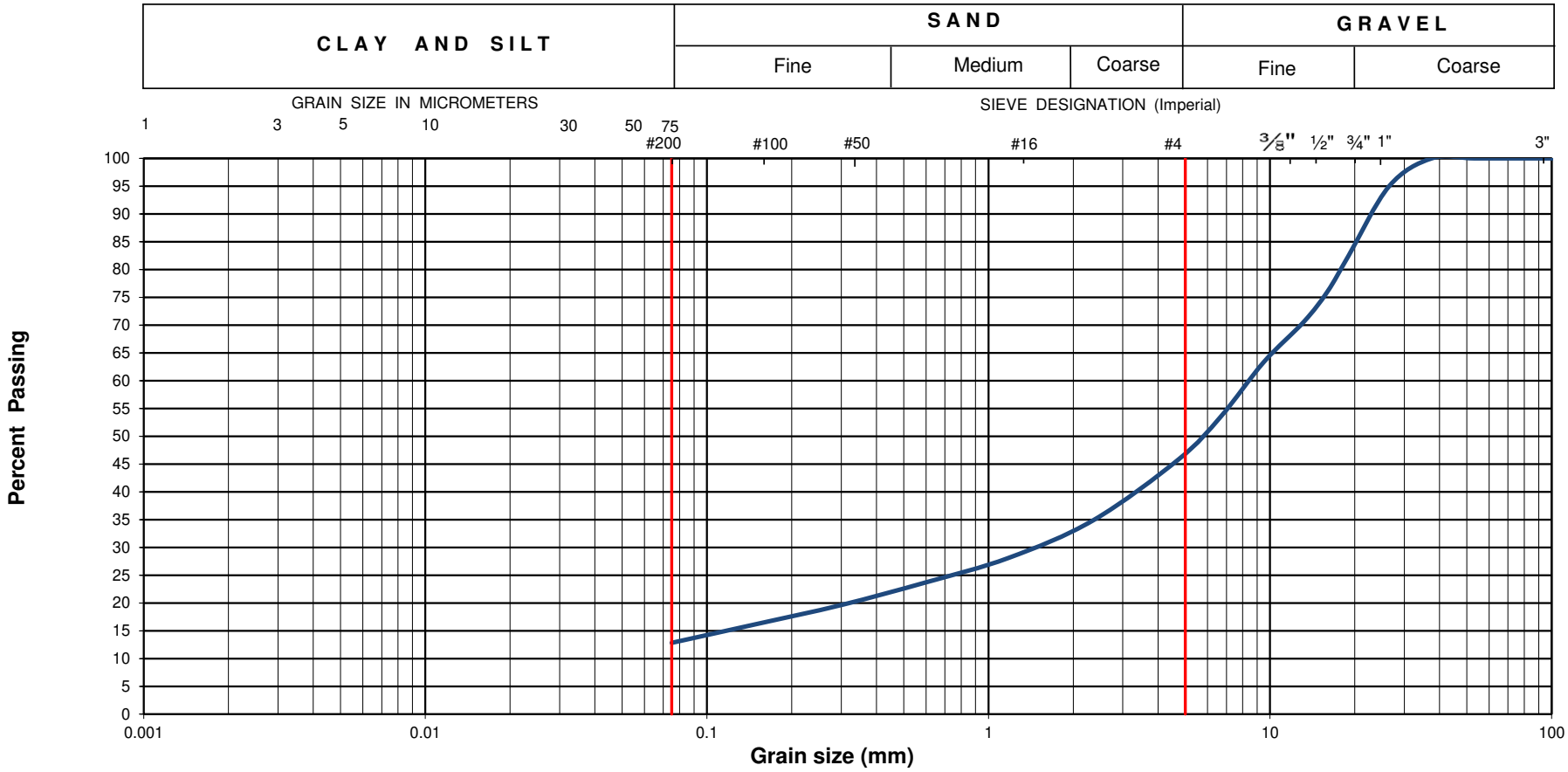
CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS-NEW BUS GARAGE.GPJ TROW OTTAWA.GDT 06/12/24

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Grain-Size Distribution Curve
Method of Test For Sieve Analysis of Aggregate
ASTM C-136

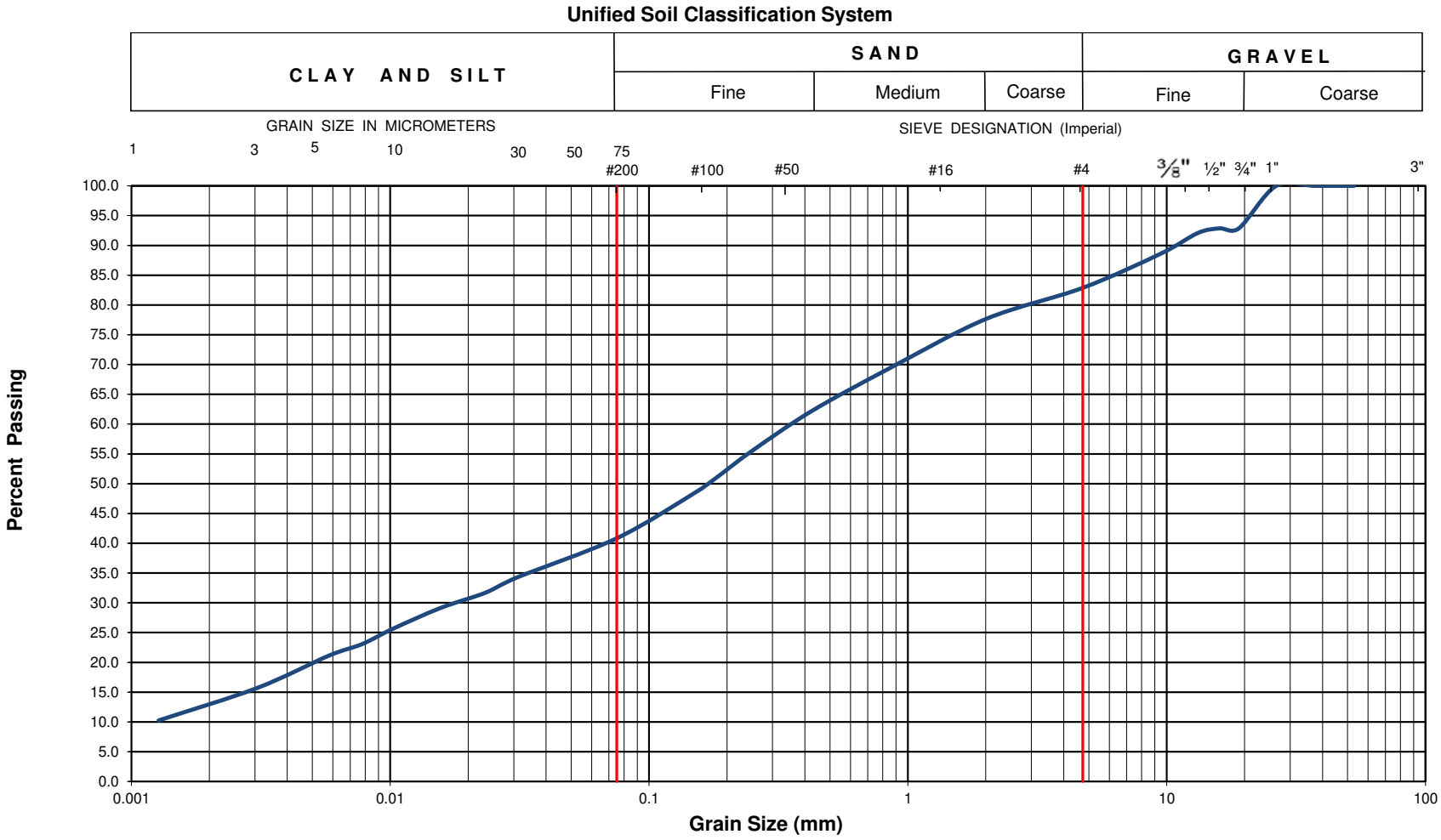
Unified Soil Classification System



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**May 7, 2024**	**Borehole No:**	**BH24-02**	**Sample:**	**AS1**	**Depth (m) :**	**0.1-0.6**		
Sample Composition :		**Gravel (%)**	**54**	**Sand (%)**	**33**	**Silt & Clay (%)**	**13**	**Figure :**	**24**
Sample Description :	**GRANULAR FILL (BASE): Gravel (GM) - Sandy, Some Silt**								

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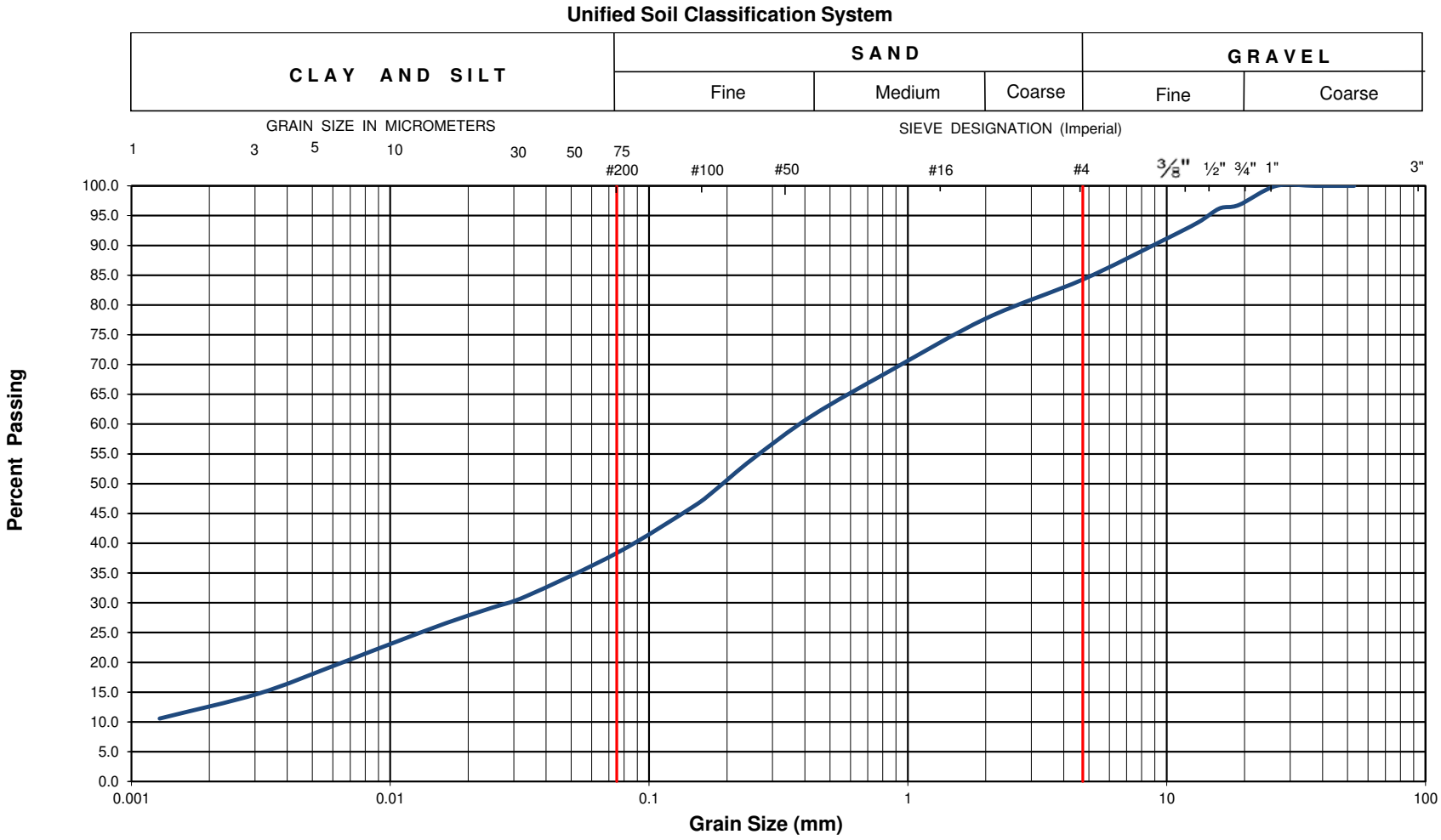
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 20, 2022**	**Borehole No:**	**22-01**	**Sample No.:**	**SS3**	**Depth (m) :**	**1.5-2.1**		
Sample Description :		**% Silt and Clay**	**41**	**% Sand**	**42**	**% Gravel**	**17**	**Figure :**	**25**
Sample Description :		**FILL: Silty Sand (SM) - Some Gravel and Clay**							

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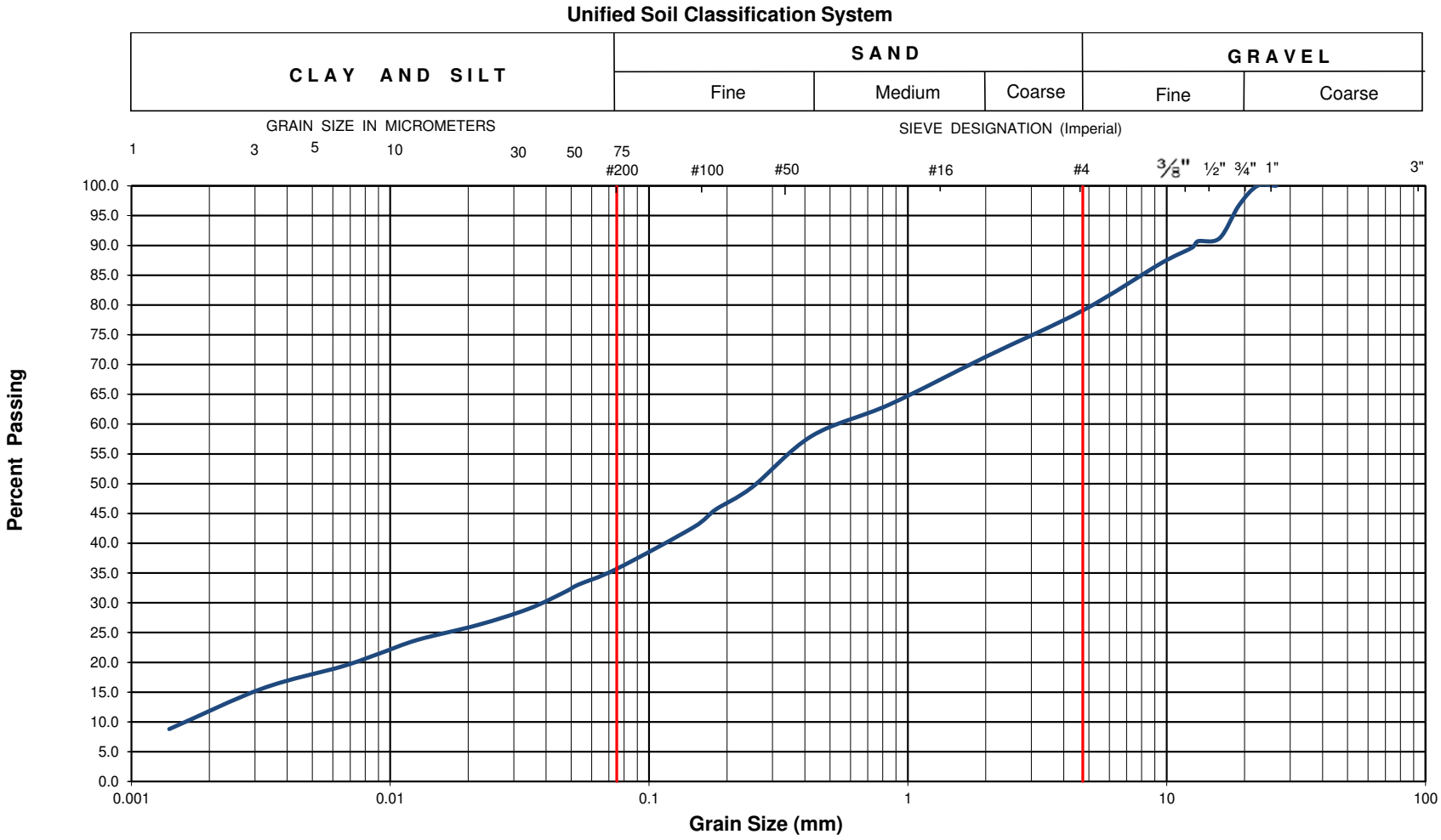
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 19, 2022**	**Borehole No:**	**22-06**	**Sample No.:**	**SS2**	**Depth (m) :**	**0.8-1.4**		
Sample Description :		**% Silt and Clay**	**38**	**% Sand**	**46**	**% Gravel**	**16**	**Figure :**	**26**
Sample Description :	**FILL: Clayey Sand (SC) - Low Plasticity, Some Gravel, Silty**								

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

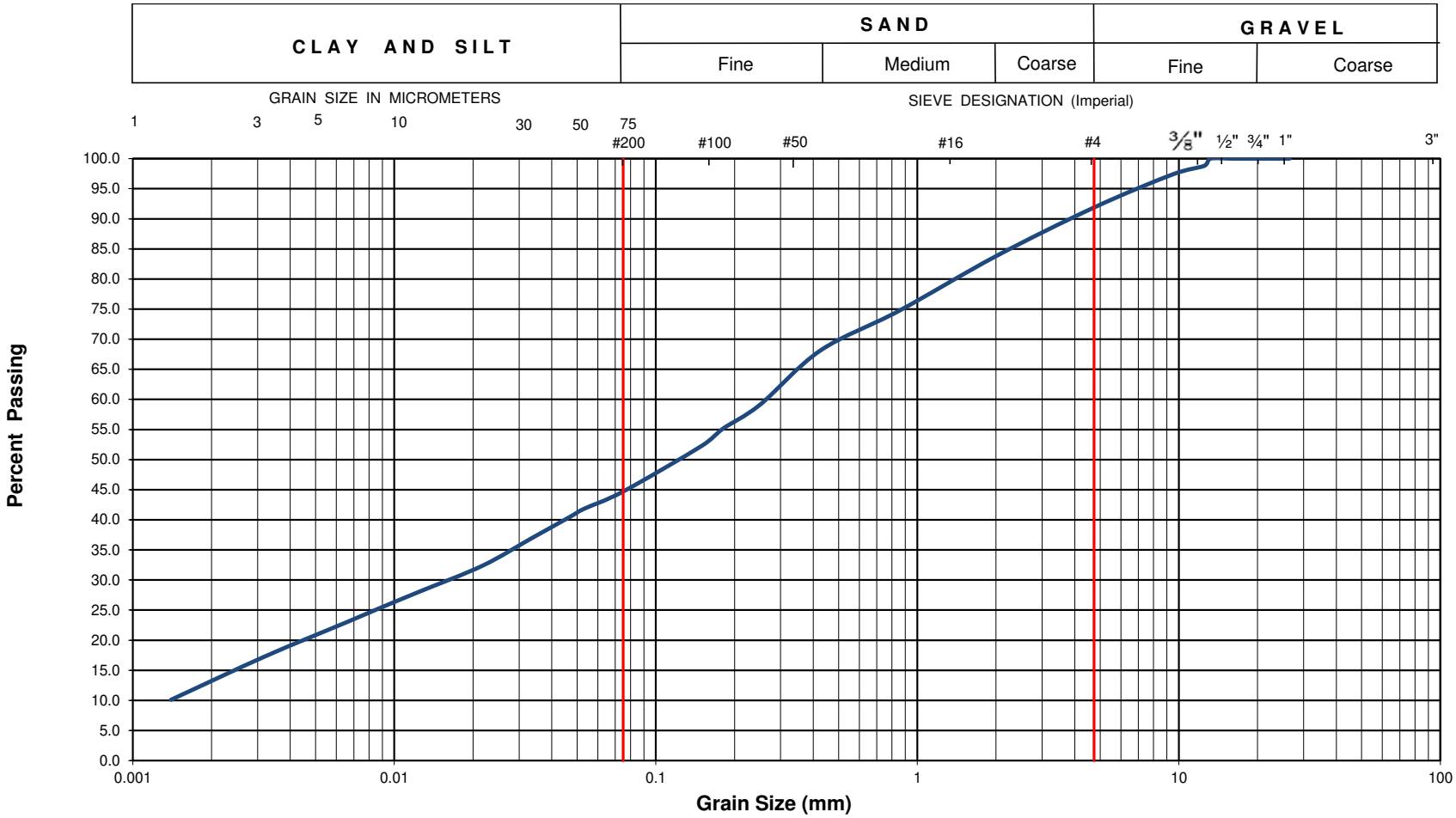


EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**May 3, 2024**	**Borehole No:**	**24-03**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5-2.1**
Sample Description :		**% Silt and Clay**	**36**	**% Sand**	**43**	**% Gravel**	**21**	**Figure :**	**27**
Sample Description :		**FILL: Clayey Sand (SC) - Low Plasticity, Gravelly, Silty**							

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

Unified Soil Classification System

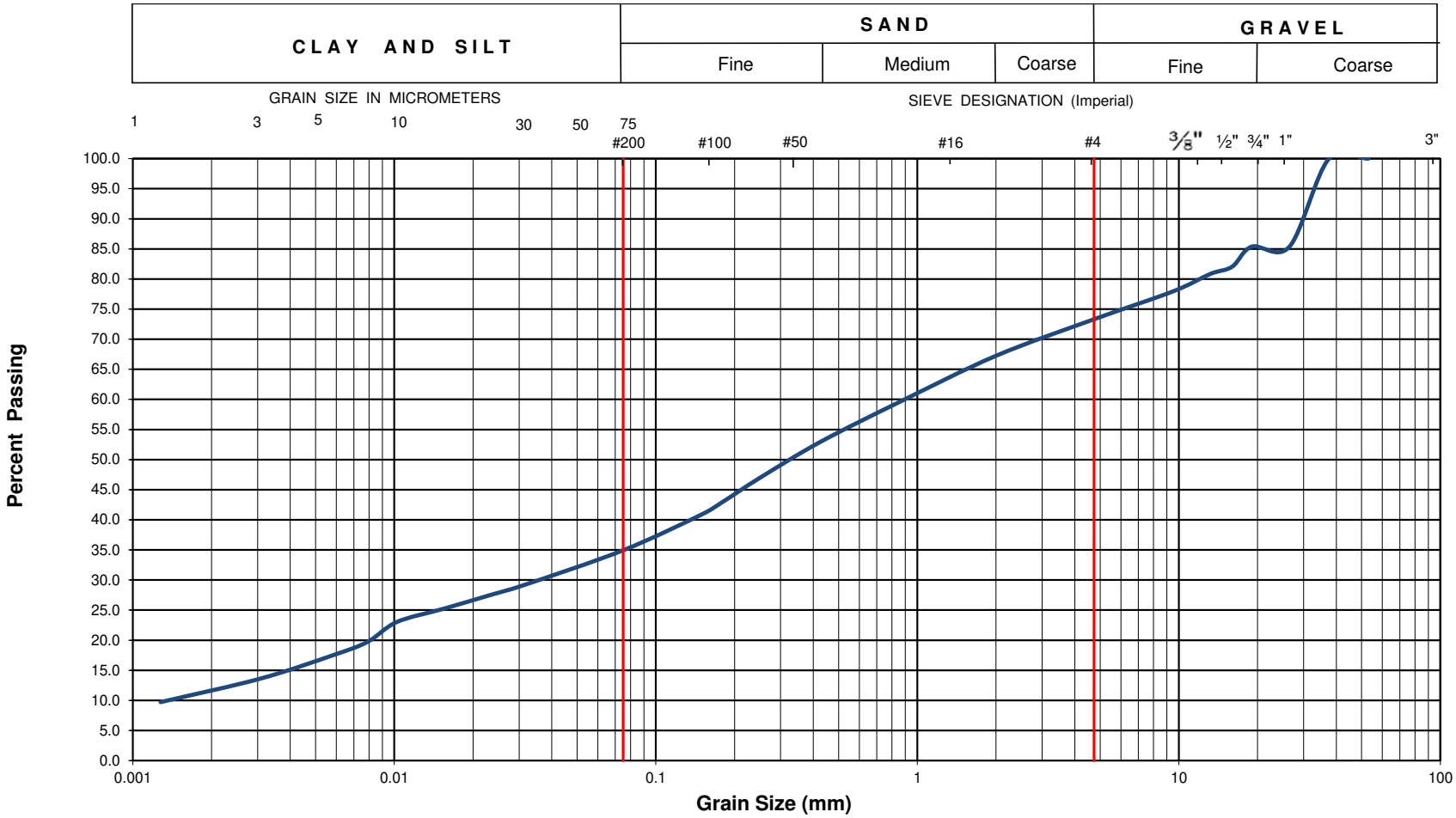


EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**May 7, 2024**	**Borehole No:**	**24-07**	**Sample No.:**	**SS2**	**Depth (m) :**	**0.8 - 1.4**		
Sample Description :		**% Silt and Clay**	**45**	**% Sand**	**47**	**% Gravel**	**8**	**Figure :**	**28**
Sample Description :	**FILL: Clayey Sand (SC) - Low Plasticity, Silty, Trace Gravel**								

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

Unified Soil Classification System

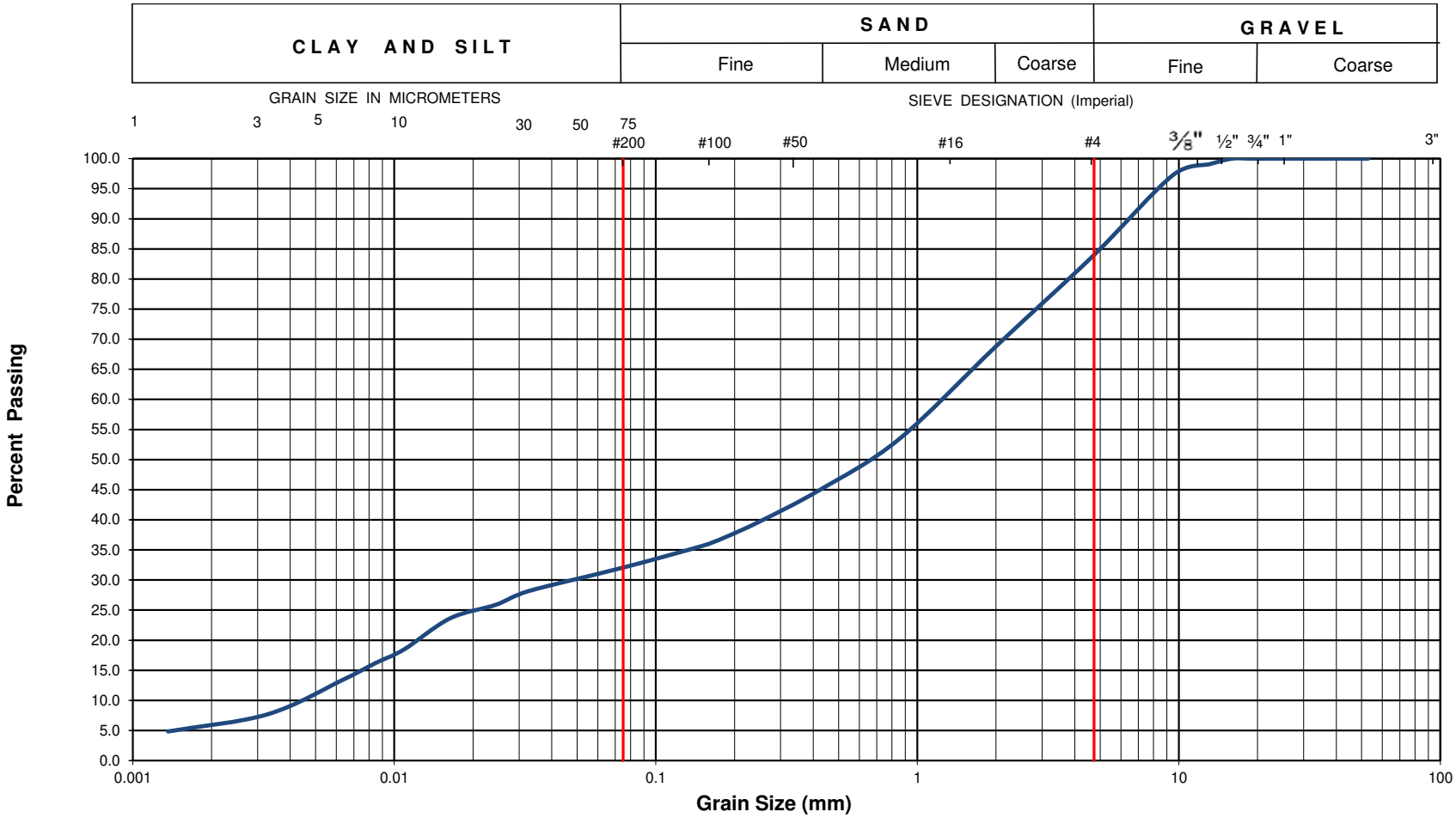


EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 19, 2022**	**Borehole No:**	**22-02**	**Sample No.:**	**SS4**	**Depth (m) :**	**2.3-2.9**		
Sample Description :		**% Silt and Clay**	**35**	**% Sand**	**38**	**% Gravel**	**27**	**Figure :**	**29**
Sample Description :	**GLACIAL TILL: Silty Sand (SM) - Gravelly, Some Clay**								

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

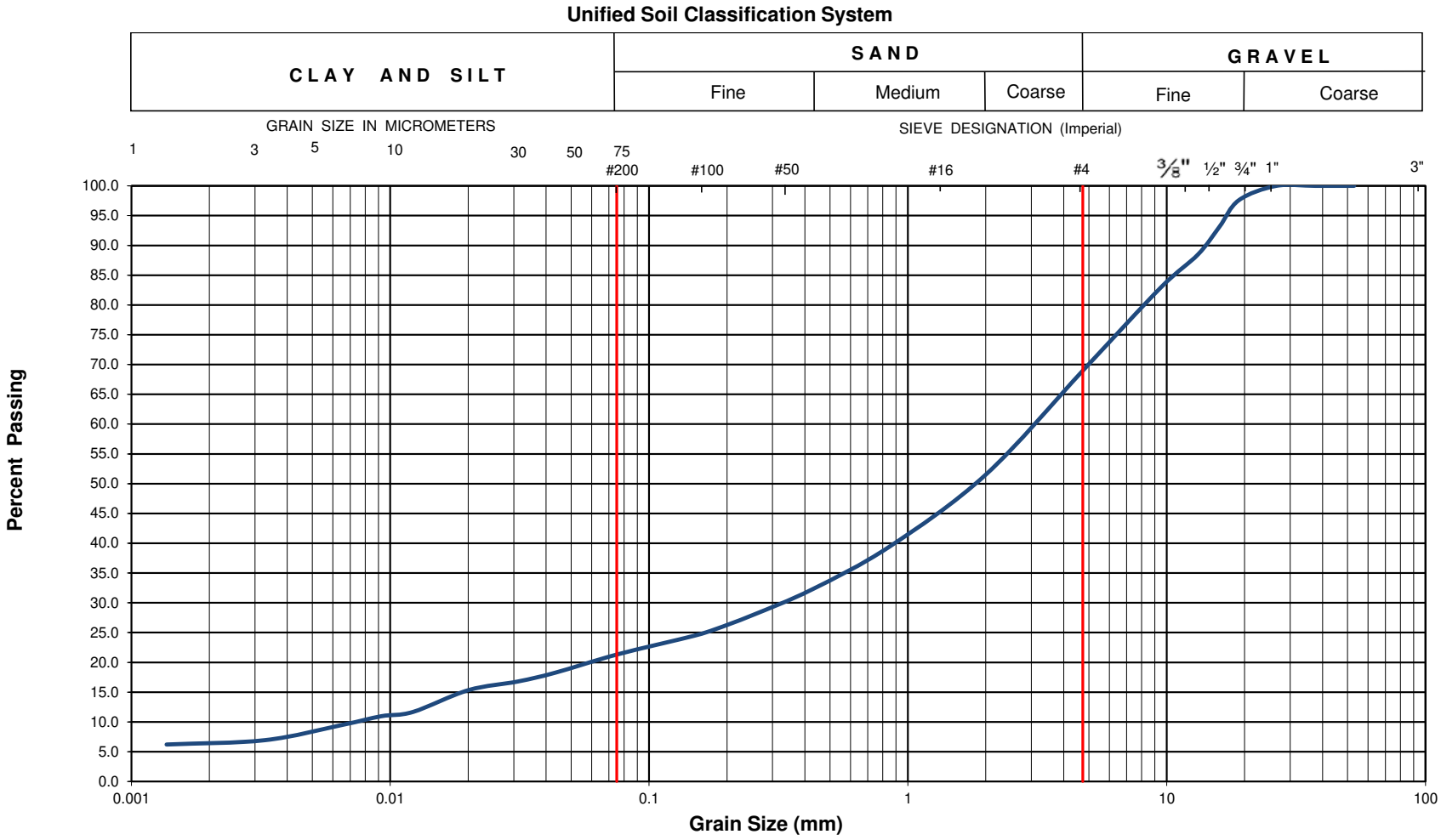
Unified Soil Classification System



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 19, 2022**	**Borehole No:**	**22-02**		**Sample No.:**	**SS6**		**Depth (m) :**	**3.8-4.2**
Sample Description :		**% Silt and Clay**	**32**	**% Sand**	**52**	**% Gravel**	**16**	**Figure :**	**30**
Sample Description :	**GLACIAL TILL: Silty Sand (SM) - Some Gravel, Trace Clay**								

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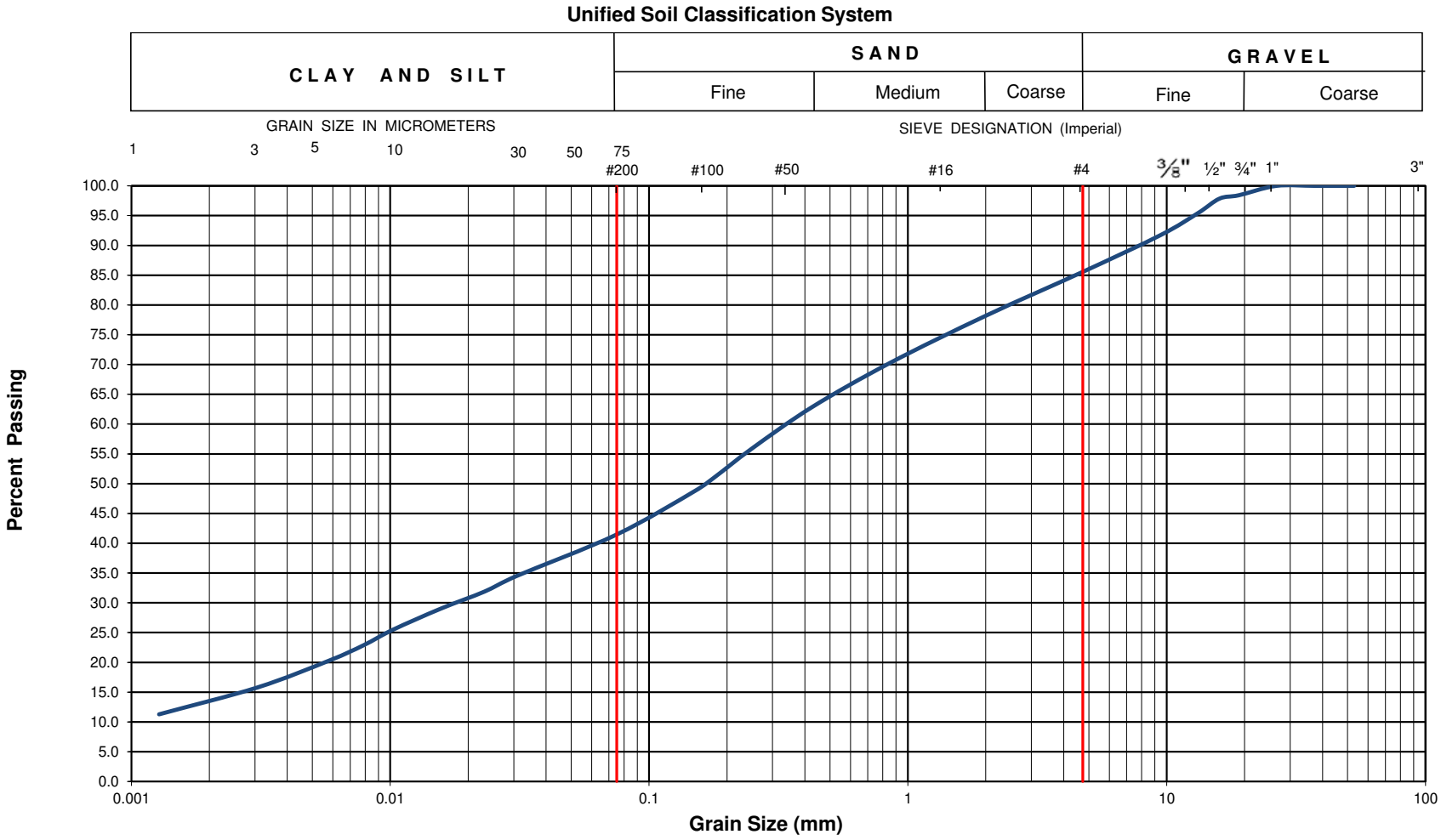
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 19, 2022**	**Borehole No:**	**22-03**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3-2.9**
Sample Description :		**% Silt and Clay**	**21**	**% Sand**	**48**	**% Gravel**	**31**	**Figure :**	**31**
Sample Description :		**GLACIAL TILL: Silty Sand (SM) - Gravelly, Trace Clay**							

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

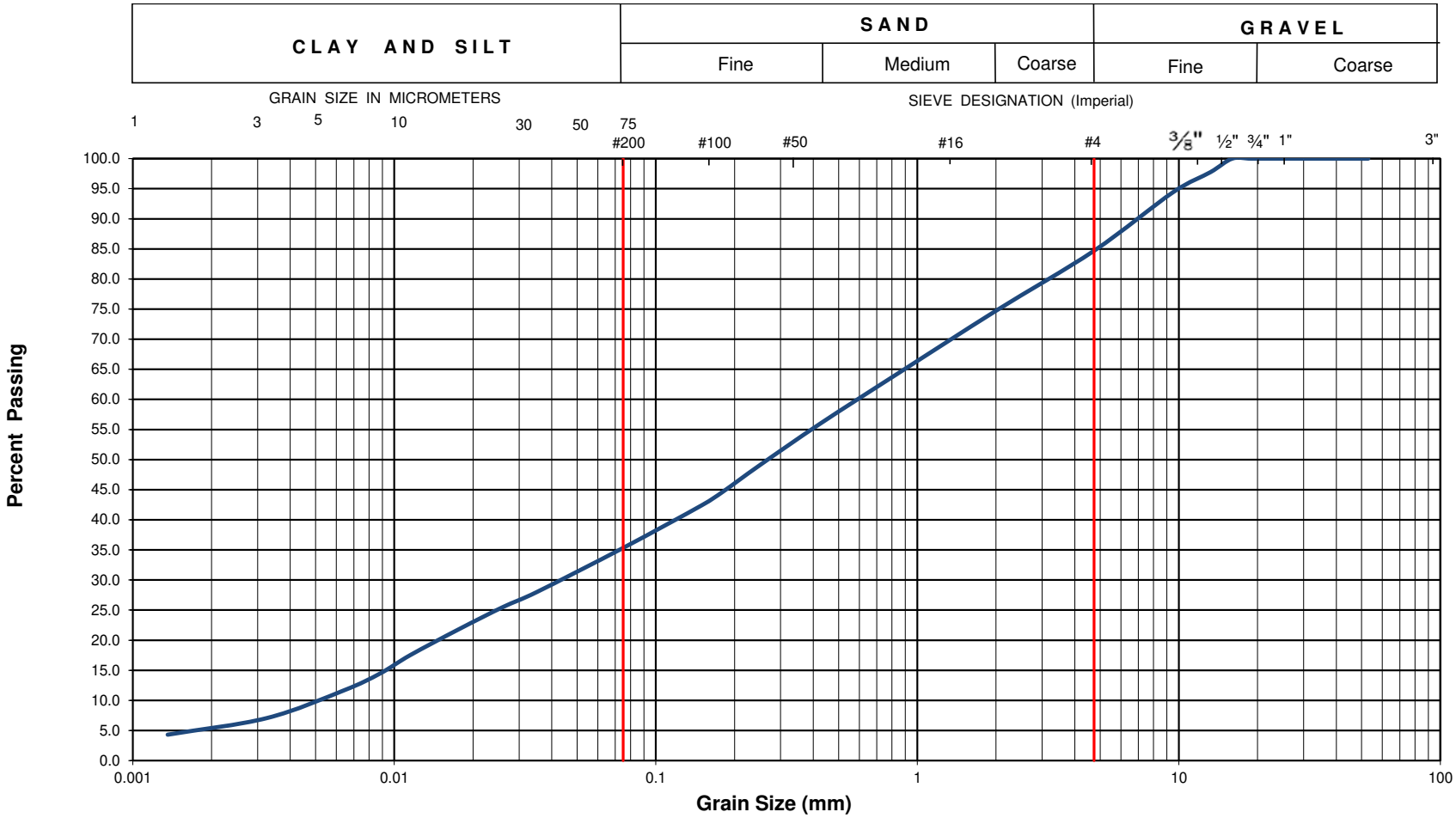


EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 20, 2022**	**Borehole No:**	**22-04**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3-2.9**
Sample Description :		**% Silt and Clay**	**42**	**% Sand**	**44**	**% Gravel**	**14**	**Figure :**	**32**
Sample Description :	**GLACIAL TILL: Silty Sand (SM) - Some Gravel and Clay**								

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

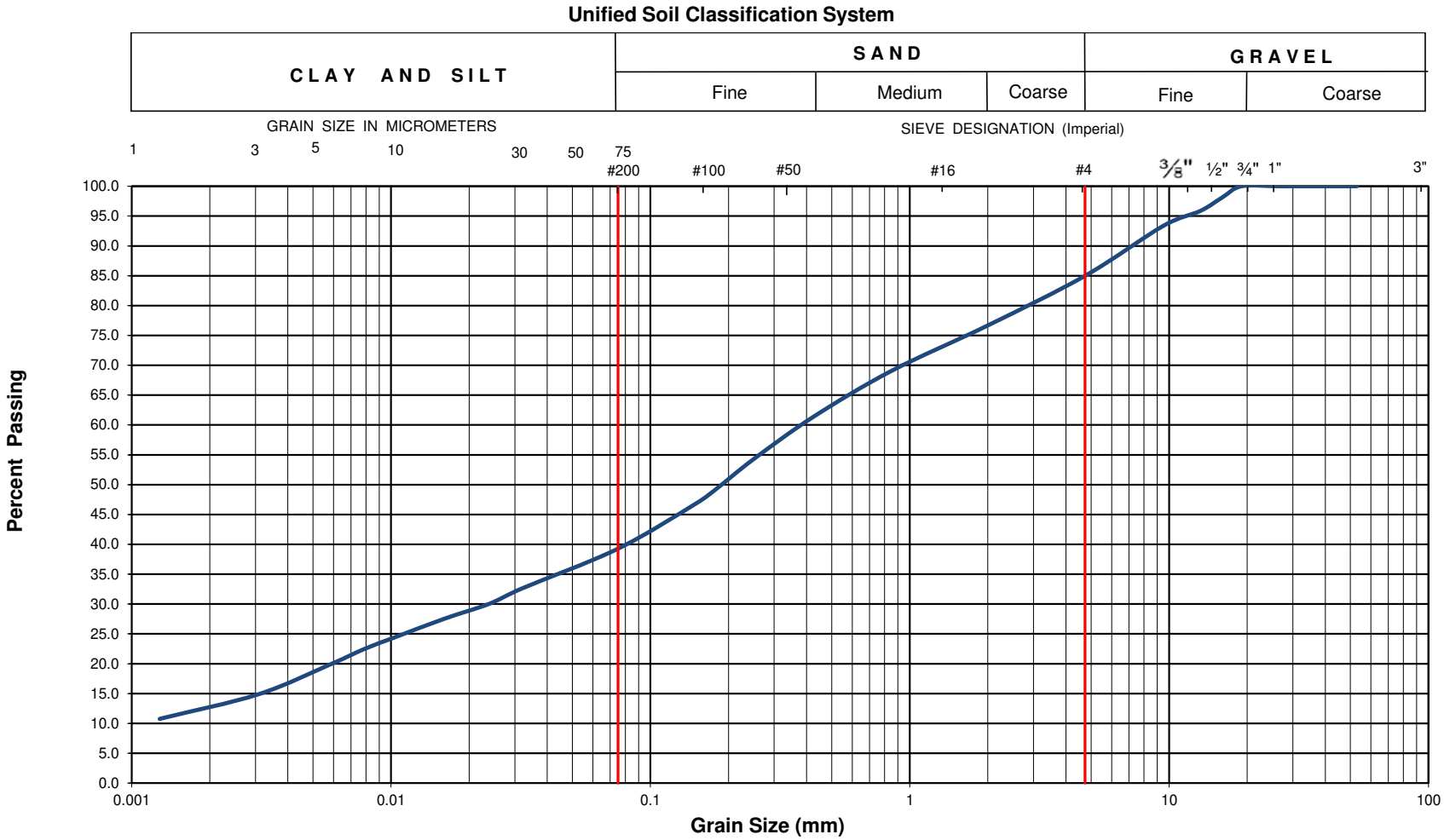
Unified Soil Classification System



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 19, 2022**	**Borehole No:**	**22-05**	**Sample No.:**	**SS6**	**Depth (m) :**	**3.8-4.2**		
Sample Description :		**% Silt and Clay**	**35**	**% Sand**	**50**	**% Gravel**	**15**	**Figure :**	**33**
Sample Description :	**GLACIAL TILL: Silty Sand (SM) - Some Gravel, Trace Clay**								

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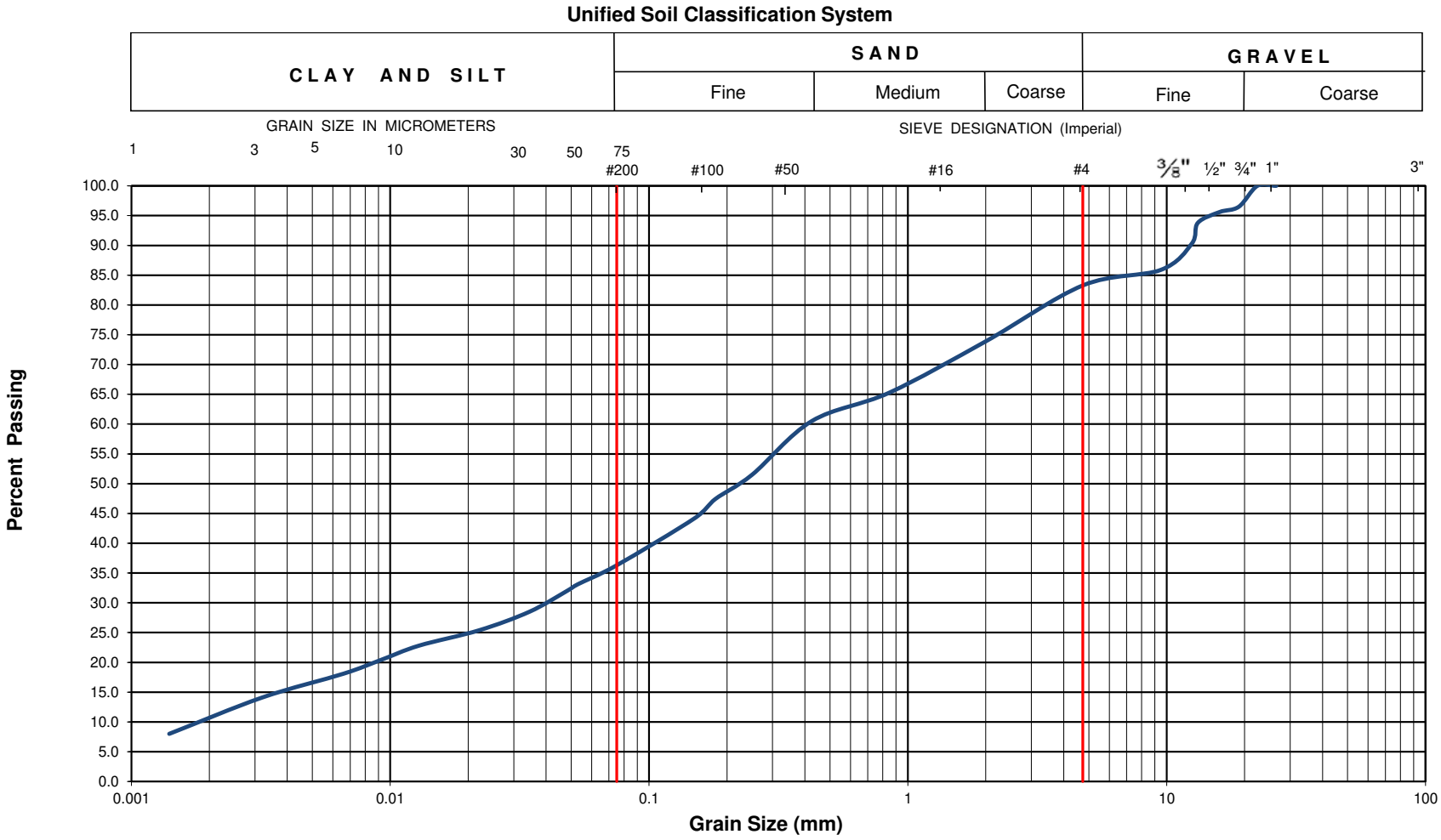
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**September 20, 2022**	**Borehole No:**	**22-08**	**Sample No.:**	**SS4**	**Depth (m) :**	**2.3-2.9**		
Sample Description :		**% Silt and Clay**	**39**	**% Sand**	**46**	**% Gravel**	**15**	**Figure :**	**34**
Sample Description :	**GLACIAL TILL: Silty Sand (SM) - Some Gravel and Clay**								

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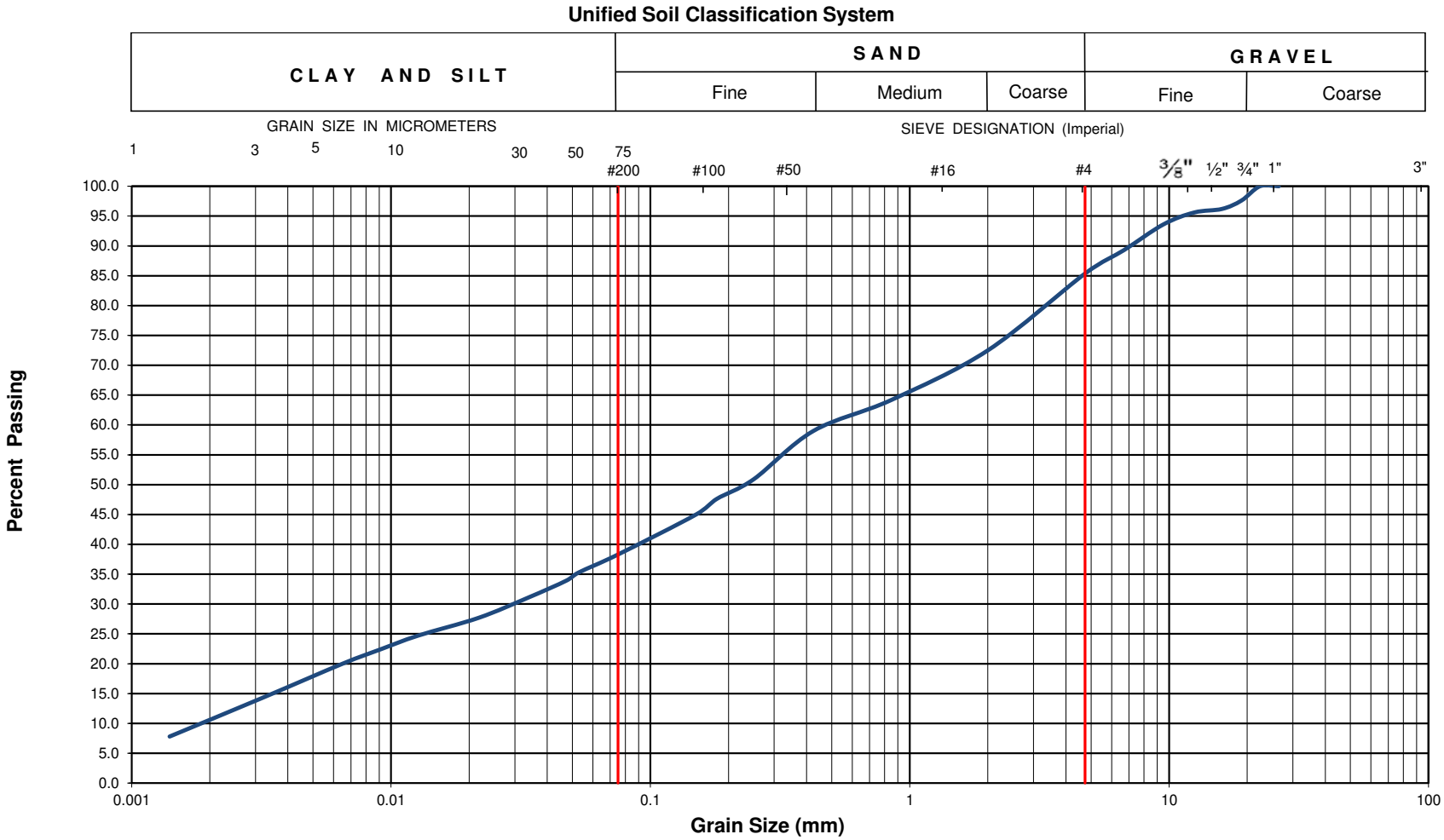
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**May 8, 2024**	**Borehole No:**	**24-05**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3 - 2.9**
Sample Description :		**% Silt and Clay**	**36**	**% Sand**	**47**	**% Gravel**	**17**	**Figure :**	**35**
Sample Description :	**GLACIAL TILL: Clayey Sand (SC) - Low Plasticity, Some Gravel, Silty**								

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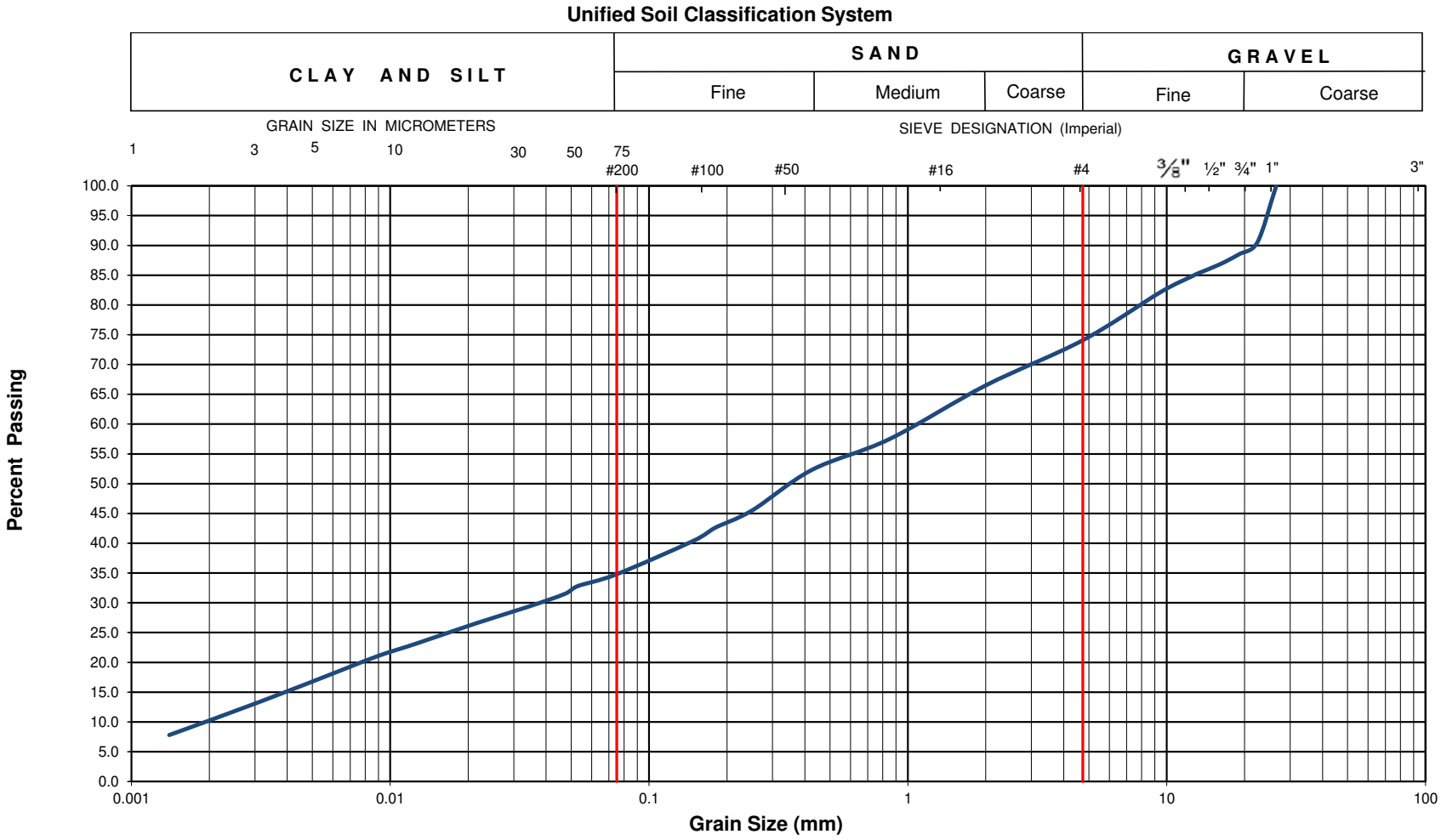
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**May 7, 2024**	**Borehole No:**	**24-06**	**Sample No.:**	**SS3**	**Depth (m) :**	**1.5-2.1**		
Sample Description :		**% Silt and Clay**	**38**	**% Sand**	**47**	**% Gravel**	**15**	**Figure :**	**36**
Sample Description :	**Glacial Till: Clayey Sand (SC) - Low Plasticity, Some Gravel, Silty**								

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Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
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EXP Project No.:	**OTT-22007382-A0**	**Project Name :**	**Proposed OC Transpo Electrical Bus Garage**						
Client :	**City of Ottawa**	**Project Location :**	**1500 St. Laurent Blvd., Ottawa, ON**						
Date Sampled :	**May 8, 2024**	**Borehole No:**	**24-12**	**Sample No.:**	**SS5**	**Depth (m) :**	**3.0-3.6**		
Sample Description :		**% Silt and Clay**	**35**	**% Sand**	**39**	**% Gravel**	**26**	**Figure :**	**37**
Sample Description :	**GLACIAL TILL: Clayey Sand (SC) - Low Plasticity. Gravelly, Silty**								

Appendix A – Seismic Shear Wave Velocity Soundings Survey Report by GPR

GEOPHYSICS GPR INTERNATIONAL INC.

May 31st, 2024

Transmitted by email : ismail.taki@exp.com
Our ref : GPR24-05486-b

Mr. Ismail Taki, M.Eng., P.Eng.
Senior Manager, Earth & Environment, Eastern Region
exp Services inc.
100 - 2650 Queensview Drive
Ottawa ON K2B 8H6

Subject: **Shear Wave Velocity Soundings for the Site Classes Determination**
1500 St. Laurent Boulevard, Ottawa (ON)

[Project: OTT-22007382-B0]

Dear Mr. Taki,

Geophysics GPR International inc. has been mandated by **exp** Services inc. to carry out seismic surveys at the OC Transpo Bus Garage Parking, located at 1500 St. Laurent Boulevard, in Ottawa (ON). The geophysical investigation used the Multi-channel Analysis of Surface Waves (MASW), the Spatial AutoCorrelation (SPAC), and the seismic refraction method. From the subsequent results, the seismic shear wave velocity values were calculated for the soils and the rock, to determine two Site Classes.

The surveys were conducted on May 15th, 2024, by Mrs. Karyne Faguy, B.Sc. geophysics and Mr. Charles Trottier, M.Sc. physics. Figure 1 shows the regional location of the site and Figure 2 illustrates the locations of the seismic spreads. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the testing methods, and the results presented in table and graph.

MASW Principle

The *Multi-channel Analysis of Surface Waves* (MASW) and the *SPatial AutoCorrelation* (SPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface wave. The MASW is considered an "active" method, as the seismic signal is induced at known location and time in the geophones' spread axis. Conversely, the SPAC is considered a "passive" method, using the low frequency "signals" produced far away. The method can also be used with "active" seismic source records. The SPAC method generally allows deeper V_S soundings. Its dispersion curve can then be merged with the one of higher frequency from the MASW to calculate a more complete inversion. The dispersion properties are expressed as a change of velocities with respect to frequencies. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. The inversion of the Rayleigh wave dispersion curve yields a shear wave (V_S) velocity depth profile (sounding).

Figure 3 schematically outlines the basic operating procedure for the MASW method. Figure 4 illustrates an example of one of the MASW/SPAC records, a corresponding spectrogram analysis and resulting 1D V_S model.

INTERPRETATION

The main processing sequence involved data inspection and edition when required; spectral analysis (from MASW and SPAC); picking the fundamental mode; and 1D inversion of the MASW and SPAC shot records using the SeisImagerSW™ software. The data inversions used a nonlinear least squares algorithm.

In theory, all the shot records for a given seismic spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation, local surface seismic velocities variations, and/or dipping of overburden layers or rock. In general, the precision of the calculated seismic shear wave velocities (V_S) is around 15% or better.

More detailed descriptions of these methods are presented in *Shear Wave Velocity Measurement Guidelines for Canadian Seismic Site Characterization in Soil and Rock*, Hunter, J.A., Crow, H.L., et al., Geological Surveys of Canada, General Information Product 110, 2015.

SURVEY DESIGN

The seismic spreads were laid out west of the building (Figure 2). The seismic line SL-1 was located South, and SL-2 was located North. For SL-1, the geophone spacing was 3.0 metres for the main spread, using 24 geophones, and it was 2.5 metres for SL-2. Two shorter seismic spreads, with geophone spacing of 0.5 and 1.0 metre, were dedicated to the near surface materials. The seismic records were produced with a seismograph Terraloc MK6 (from ABEM Instrument), and the geophones were 4.5 Hz.

The seismic records counted 4096 data, sampled at 1000 µs for the MASW surveys, and at 50 µs for the seismic refraction. The records included a pre-trigged portion of 10 ms. An 8 kg sledgehammer was used as the energy source, with impacts being recorded off both ends of the seismic spreads. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

The shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length.

RESULTS

The MASW calculated V_S results are illustrated at Figure 5.

The $\overline{V}_{S30}$ value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (30 metres) by the sum of the time spent in each velocity layer from the surface down to 30 metres, as:

$$\bar{V}_{S30} = \frac{\sum_{i=1}^{N} H_i}{\sum_{i=1}^{N} {}^{H_i}/_{V_i}} \quad | \quad \sum_{i=1}^{N} H_i = 30\ \text{m}$$

(N: number of layers; H_i : thickness of layer "*i*" ; V_i : V_S of layer "*i*")

Thus, the $\overline{V}_{S30}$ value represents the seismic shear wave velocity of an equivalent homogeneous single layer response, between the surface and 30 metres deep.

The calculated $\overline{V}_{S30}$ values of the actual sites are 1171.6 m/s (Table 1) for the South part and 1094.1 m/s (Table 3) for the North part, both corresponding to the Site Class "B". However, the Site Classes A and B are not to be used if there is 3 metres or more of soils between the rock and the bottom of the foundation. In the case there would be 2.6 metres or less of soils at the South location (table 2), and 1.7 metres or less of soils at the North one (Table 4), the $\overline{V}_{S30}$* values would be greater than 1500 m/s, corresponding to the Site Class "A".

CONCLUSION

Geophysical surveys were carried out to identify two Site Classes at the OC Transpo Bus Garage Parking, located at 1500 St. Laurent Boulevard, in Ottawa (ON). The seismic surveys used the MASW and the SPAC analysis, and the seismic refraction to calculate the $\overline{V}_{S30}$ values. Their calculations are presented at Table 1 and Table 3.

The $\overline{V}_{S30}$ values of the actual sites are 1172 and 1094 m/s, for the South and the North parts respectively. Both values are corresponding to the Site Class "B" ($760 < \overline{V}_{S30} \leq 1500$ m/s), as determined through the MASW and SPAC methods, Table 4.1.8.4.-A of the NBC (2015), and the Building Code, O. Reg. 332/12. It must be noted that the Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated materials between the rock surface and the bottom of spread footing or mat foundation.

In the case there would be 2.6 metres or less of soils at the South location, and 1.7 metres or less of soils at the North one, the $\overline{V}_{S30}$* values would be greater than 1500 m/s, corresponding to the Site Class "A".

It must also be noted that other geotechnical information gleaned on site; including the presence of liquefiable soils, very soft clays, high moisture content etc. (cf. Table 4.1.8.4.-A of the NBC 2015) can supersede the Site classification provided in this report based on the $\overline{V}_{S30}$ value.

The V_S values calculated are representative of the in situ materials and are not corrected for the total and effective stresses.

Hoping the whole to your satisfaction, we remain yours truly,

Jean-Luc Arsenault, M.A.Sc., P.Eng.
Senior Project Manager

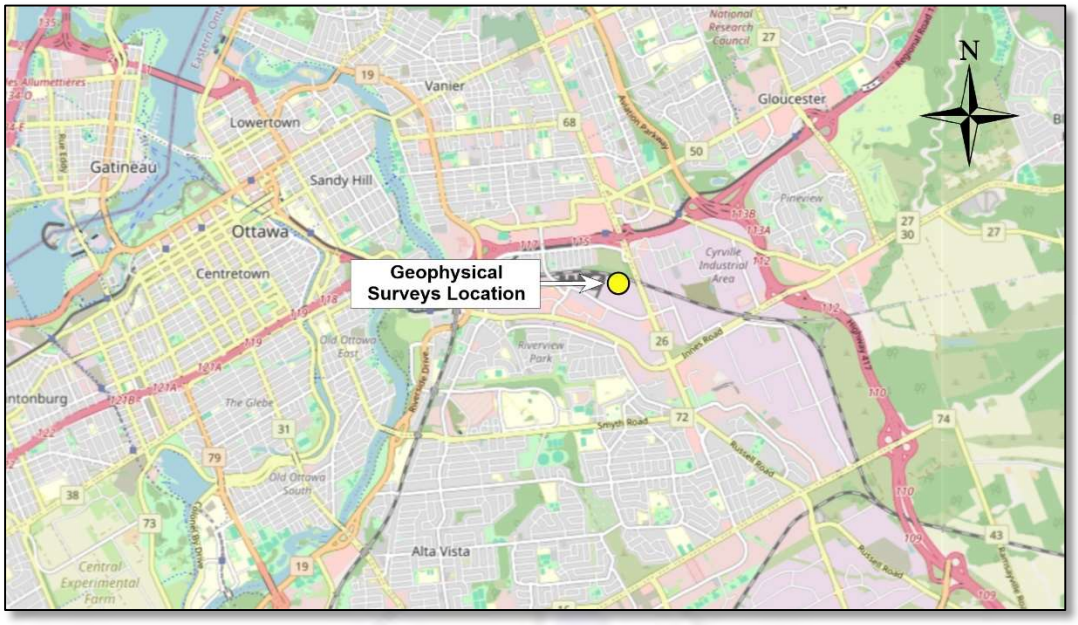


Figure 1: Regional location of the Site
(Source : OpenStreetMap©)

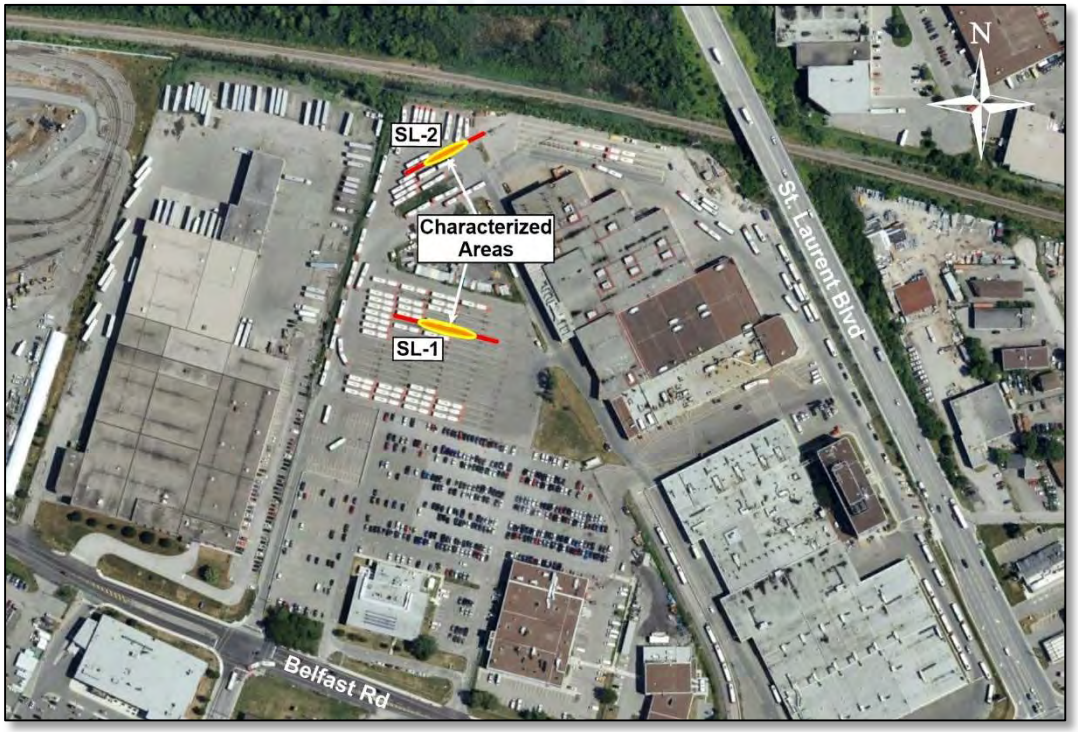


Figure 2: Location of the seismic spreads
(source: *Google Earth™*)

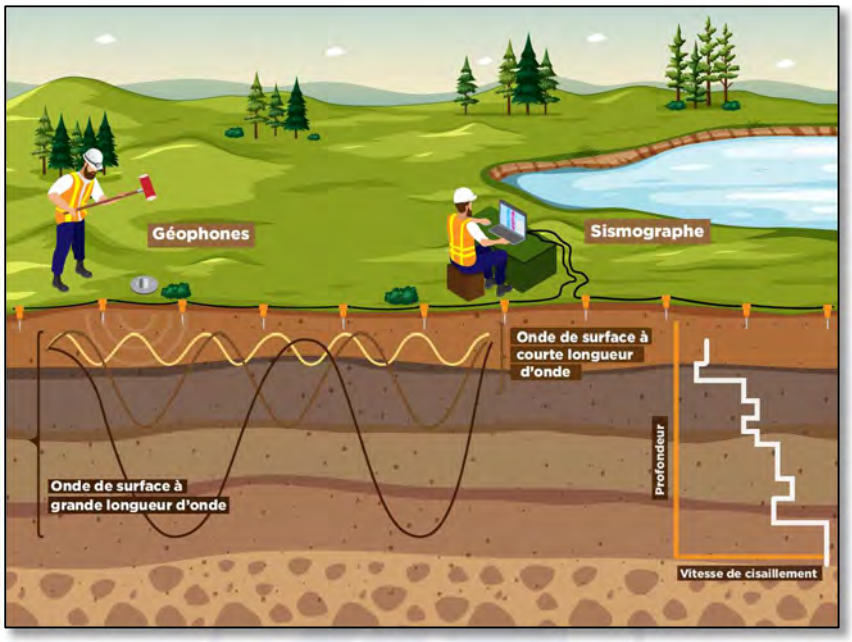


Figure 3: MASW Operating Principle

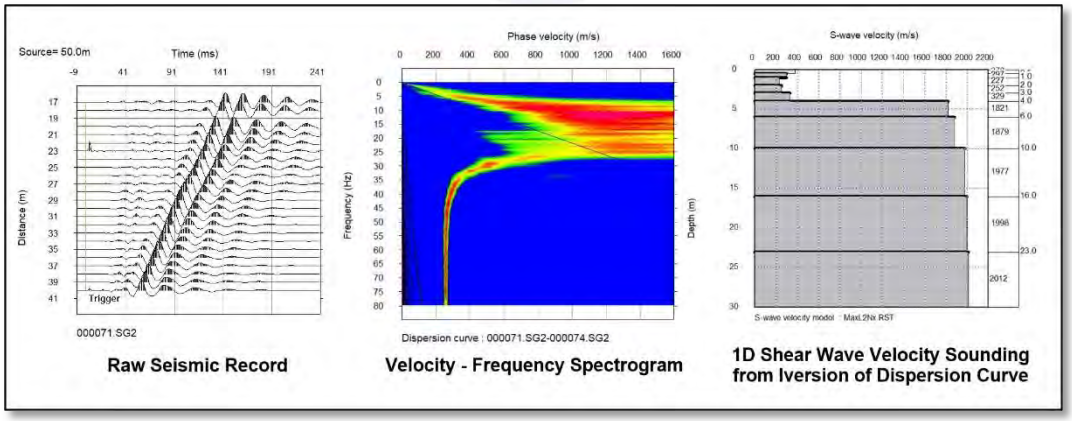


Figure 4: Example of a MASW/SPAC record, Phase Velocity - Frequency curve of the Rayleigh wave and resulting 1D Shear Wave Velocity Model

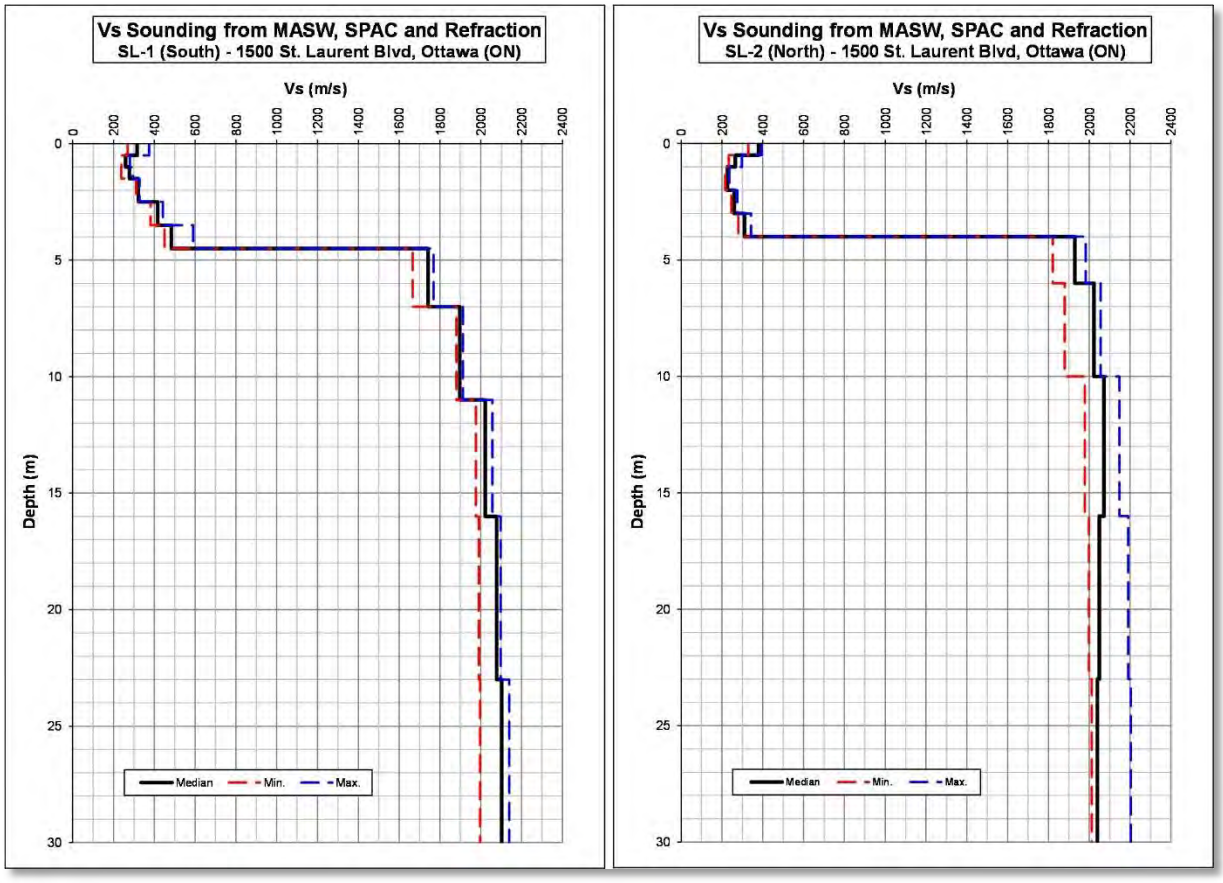


Figure 5: MASW Shear-Wave Velocity Soundings

TABLE 1

SL-1 (South) - $\bar{V}_{S30}$ Calculation for the Site Class (actual site)

Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	269.5	315.9	374.8	**Grade Level (May 15th, 2024)**				
0.5	238.4	259.4	280.3	0.50	0.50	0.001583	0.001583	315.9
1.0	238.3	278.0	294.0	0.50	1.00	0.001928	0.003510	284.9
1.5	310.3	321.3	327.0	0.50	1.50	0.001798	0.005309	282.6
2.5	382.1	416.5	441.8	1.00	2.50	0.003113	0.008421	296.9
3.5	450.2	483.3	590.3	1.00	3.50	0.002401	0.010822	323.4
4.5	1665.9	1741.6	1768.9	1.00	4.50	0.002069	0.012891	349.1
7.0	1880.4	1897.0	1912.0	2.50	7.00	0.001435	0.014326	488.6
11.0	1975.7	2021.6	2056.7	4.00	11.00	0.002109	0.016435	669.3
16.0	1990.7	2077.9	2097.2	5.00	16.00	0.002473	0.018908	846.2
23.0	1996.5	2102.5	2139.3	7.00	23.00	0.003369	0.022277	1032.5
30				7.00	30.00	0.003329	0.025606	1171.6

V_{S30} (m/s)	**1171.6**
Class	**B (1)**

(1) The Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated material between the rock surface and the bottom of the spread footing or the mat foundation.

TABLE 2

SL-1 (South) - $\bar{V}_{S30}$ * Calculation for the Limit of the Site Class A

Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	269.5	315.9	374.8	**Limit for the Site Class A (2.6 metres of soils)**				
0.5	238.4	259.4	280.3					
1.0	238.3	278.0	294.0					
1.5	310.3	321.3	327.0					
1.9	310.3	321.3	327.0					
2.5	382.1	416.5	441.8	0.60	0.60	0.001868	0.001868	321.3
3.5	450.2	483.3	590.3	1.00	1.60	0.002401	0.004268	374.8
4.5	1665.9	1741.6	1768.9	1.00	2.60	0.002069	0.006337	410.3
7.0	1880.4	1897.0	1912.0	2.50	5.10	0.001435	0.007773	656.1
11.0	1975.7	2021.6	2056.7	4.00	9.10	0.002109	0.009881	920.9
16.0	1990.7	2077.9	2097.2	5.00	14.10	0.002473	0.012355	1141.3
23.0	1996.5	2102.5	2139.3	7.00	21.10	0.003369	0.015723	1341.9
31.9				8.90	30.00	0.004233	0.019957	1503.3

V_{S30} *	**1503.3**
Class	**A**

TABLE 1

SL-2 (North) - $\bar{V}_{S30}$ Calculation for the Site Class (actual site)

Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	329.5	378.5	394.5	**Grade Level (May 15th, 2024)**				
0.5	233.7	265.4	297.4	0.50	0.50	0.001321	0.001321	378.5
1.0	215.3	227.3	236.3	0.50	1.00	0.001884	0.003205	312.0
2.0	246.4	260.6	275.0	1.00	2.00	0.004399	0.007604	263.0
3.0	280.3	310.3	342.5	1.00	3.00	0.003838	0.011442	262.2
4.0	1821.3	1929.8	1982.3	1.00	4.00	0.003222	0.014664	272.8
6.0	1879.0	2023.1	2055.8	2.00	6.00	0.001036	0.015700	382.2
10.0	1977.9	2072.0	2147.5	4.00	10.00	0.001977	0.017677	565.7
16.0	1998.4	2049.1	2190.9	6.00	16.00	0.002896	0.020573	777.7
23.0	2012.4	2039.9	2203.7	7.00	23.00	0.003416	0.023989	958.8
30				7.00	30.00	0.003432	0.027421	1094.1

V_{S30} (m/s)	**1094.1**
Class	**B (1)**

(1) The Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated material between the rock surface and the bottom of the spread footing or the mat foundation.

TABLE 2

SL-2 (North) - $\bar{V}_{S30}$ * Calculation for the Limit of the Site Class A

Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	329.5	378.5	394.5	**Limit for the Site Class A (1.7 metres of soils)**				
0.5	233.7	265.4	297.4					
1.0	215.3	227.3	236.3					
2.0	246.4	260.6	275.0					
2.3	246.4	260.6	275.0					
3.0	280.3	310.3	342.5	0.70	0.70	0.002686	0.002686	260.6
4.0	1821.3	1929.8	1982.3	1.00	1.70	0.003222	0.005909	287.7
6.0	1879.0	2023.1	2055.8	2.00	3.70	0.001036	0.006945	532.8
10.0	1977.9	2072.0	2147.5	4.00	7.70	0.001977	0.008922	863.0
16.0	1998.4	2049.1	2190.9	6.00	13.70	0.002896	0.011818	1159.2
23.0	2012.4	2039.9	2203.7	7.00	20.70	0.003416	0.015234	1358.8
32.3				9.30	30.00	0.004559	0.019793	1515.7

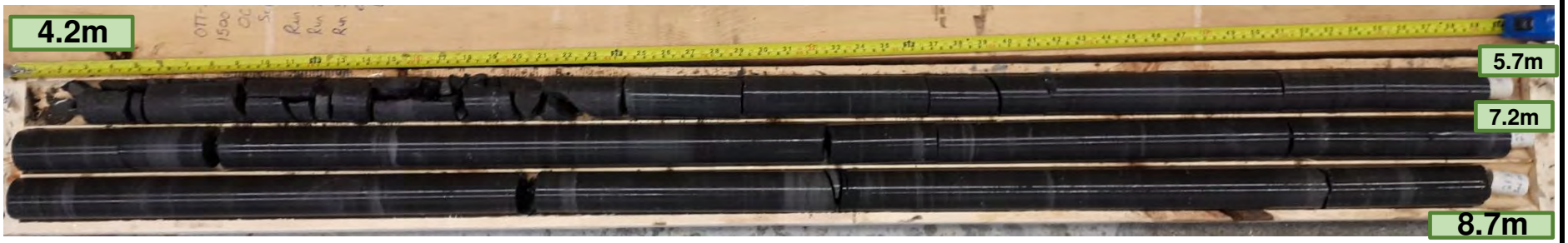
V_{S30} *	**1515.7**
Class	**A**

Appendix B – Bedrock Core Photographs

DRY BEDROCK CORES



WET BEDROCK CORES



EXP Services Inc. www.exp.com
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

borehole no.		project	project no.
BH/MW 22-02	Run 1: 4.2m - 5.7m Run 2: 5.7m - 7.2m Run 3: 7.2m - 8.7m	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	OTT-22007382-A0
date cored Sep 21, 2022		Rock Core Photographs	FIG. B-1

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Ottawa, ON K2B 8H6, Canada

borehole no. **BH 22-07**	Run 1: 4.1m - 5.6m Run 2: 5.6m - 7.1m Run 3: 7.1m - 8.5m	project	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	project no. OTT-22007382-A0
date cored Sep 21, 2022			Rock Core Photographs	FIG. B-2

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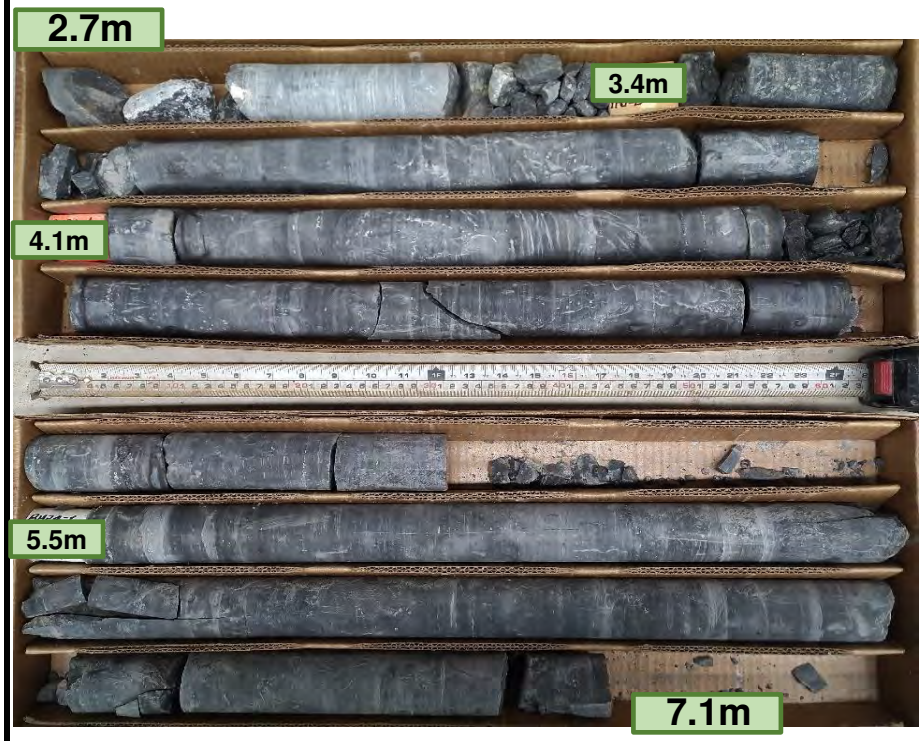
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Ottawa, ON K2B 8H6, Canada

borehole no.		project		project no.
BH 22-09	Run 1: 2.8m - 4.1m Run 2: 4.1m - 5.7m Run 3: 5.7m - 7.1m		Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	OTT-22007382-A0
date cored				
Sep 21, 2022			Rock Core Photographs	FIG. B-3

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borehole no. **BH/MW 24-01**	Run 0: 2.7m - 3.4m Run 1: 3.4m - 4.1m Run 2: 4.1m - 5.5m Run 3: 5.5m - 7.1m end of borehole	project	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	project no. OTT-22007382-A0
date cored May 10, 2024			Rock Core Photographs	FIG. B-4

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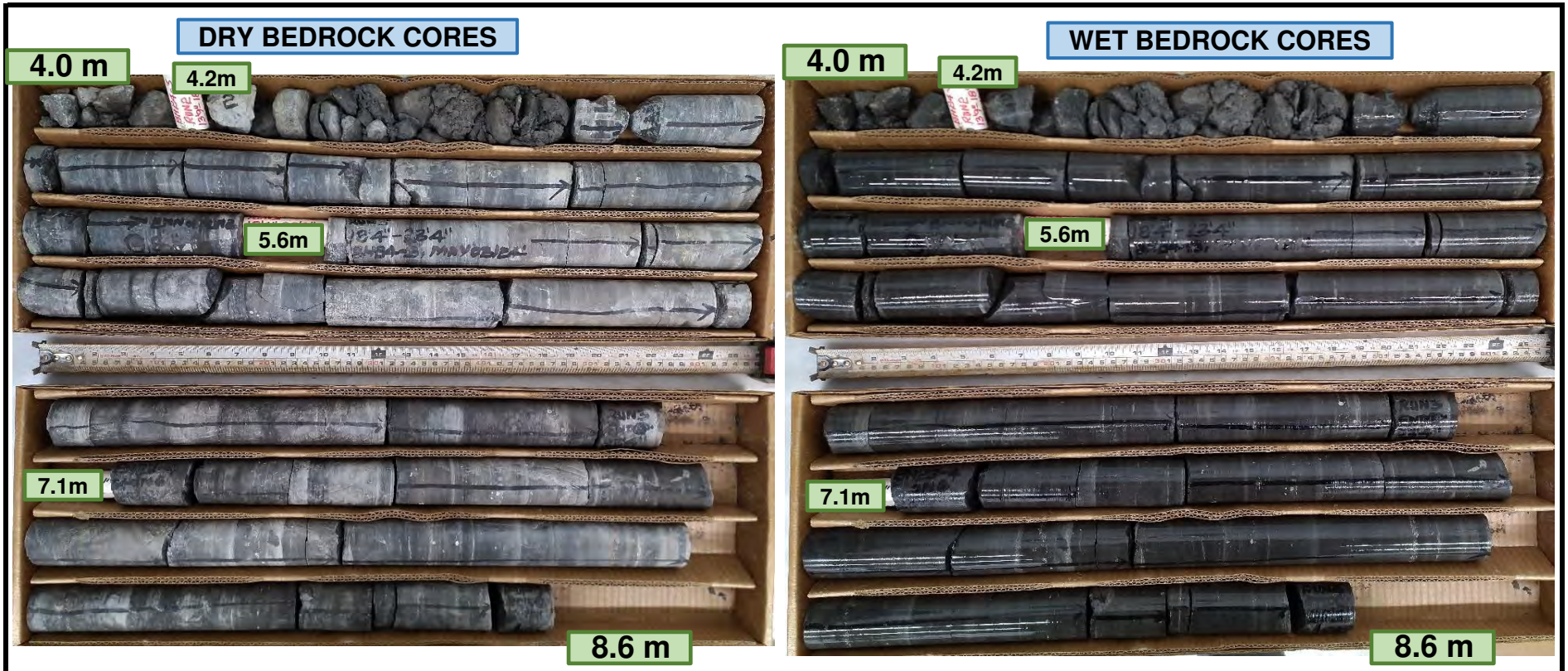


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borehole no. **BH24-02**	Run 1: 4.6m - 5.7m Run 2: 5.7m - 7.3m Run 3: 7.3m - 8.8m end of borehole	project	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	project no. OTT-22007382-A0
date cored May 08, 2024			Rock Core Photographs	FIG. B-5



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borehole no. **BH 24-03**	Run 1: 4.0m - 4.2m Run 2: 4.2m - 5.6m Run 3: 5.6m - 7.1m Run 4: 7.1m - 8.6m end of borehole	project	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	project no. OTT-22007382-A0
date cored May 03, 2024			Rock Core Photographs	FIG. B-6

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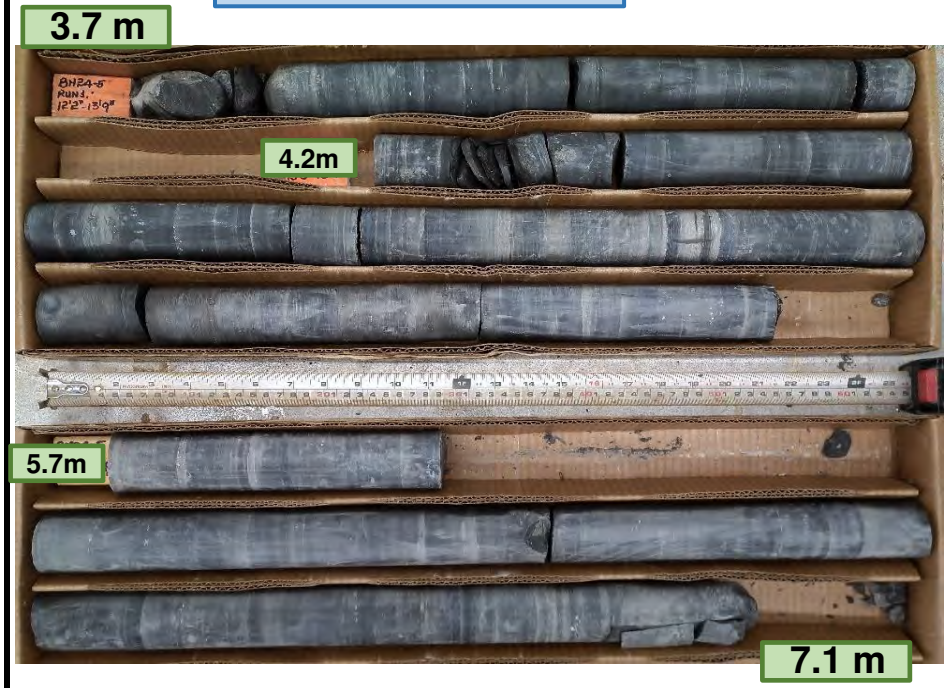
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borehole no. **BH24-04**	Run 1: 4.0m - 5.5m Run 2: 5.5m - 7.1m end of borehole	project	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	project no. OTT-22007382-A0
date cored May 03, 2024			Rock Core Photographs	FIG. B-7

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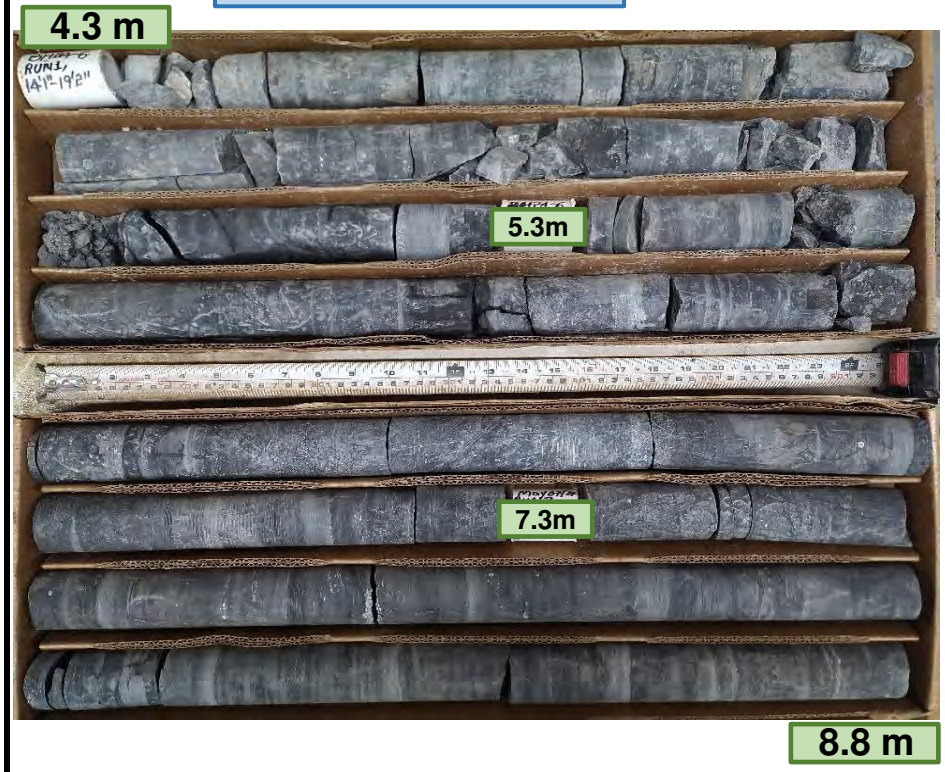
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Ottawa, ON K2B 8H6, Canada

borehole no.		project	project no.
BH/MW 24-05	Run 1: 3.7m - 4.2m Run 2: 4.2m - 5.7m Run 3: 5.7m - 7.1m end of borehole	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	OTT-22007382-A0
date cored May 08, 2024		Rock Core Photographs	FIG. B-8

DRY BEDROCK CORES



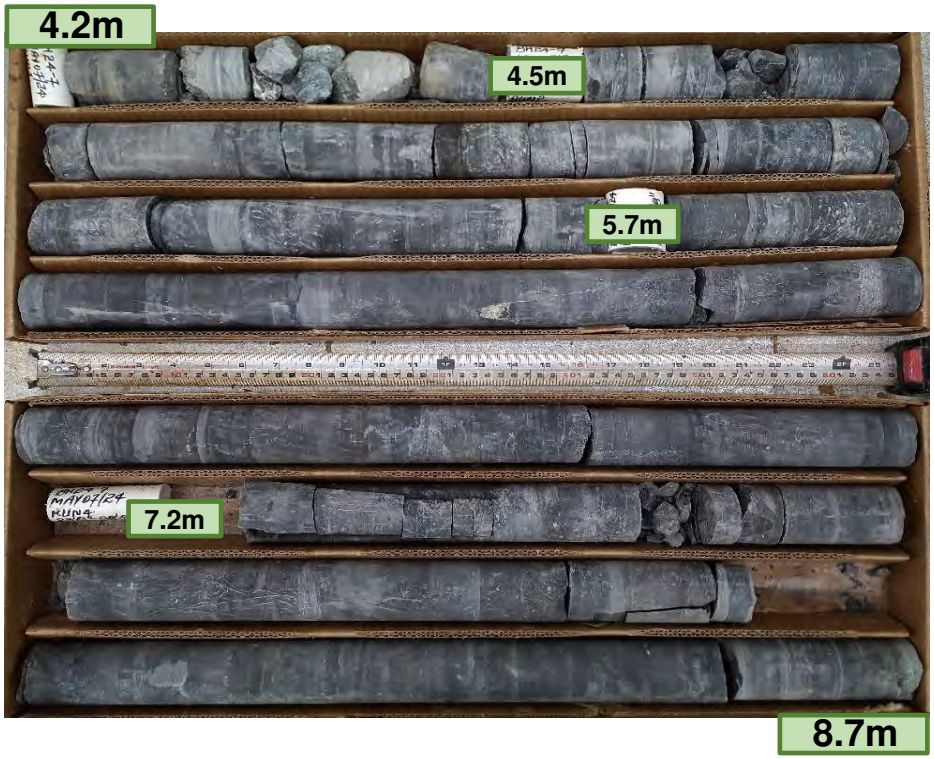
WET BEDROCK CORES



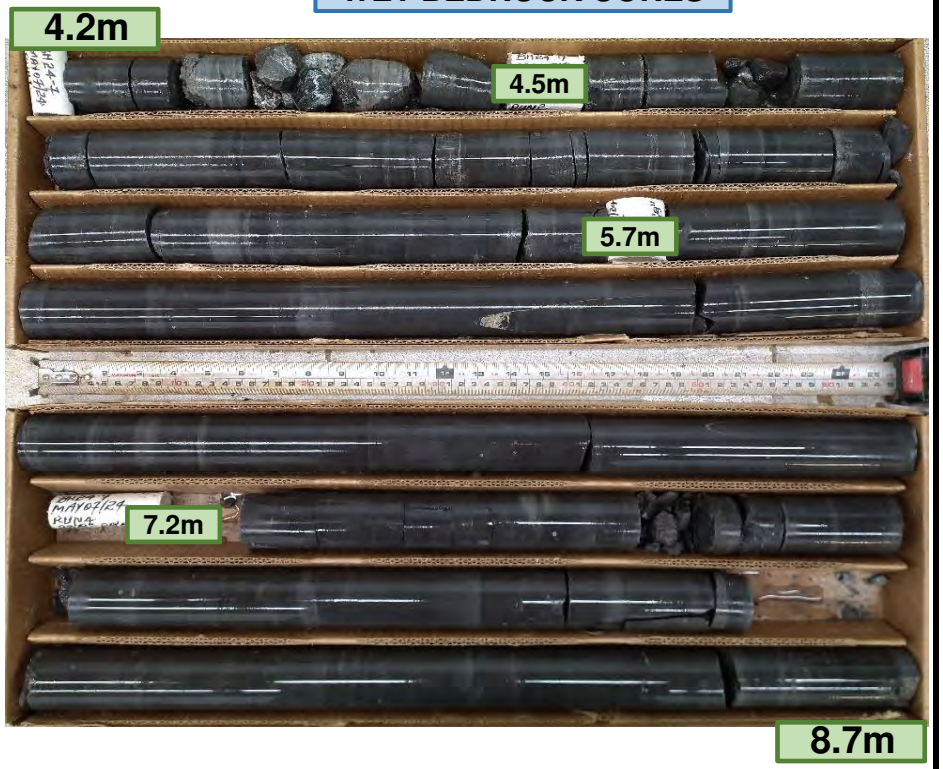
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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

borehole no.		project	project no.
BH 24-06	Run 1: 4.3m - 5.3m Run 2: 5.3m - 7.3m Run 3: 7.3m - 8.8m end of borehole	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	OTT-22007382-A0
date cored May 07, 2024		Rock Core Photographs	FIG. B-9

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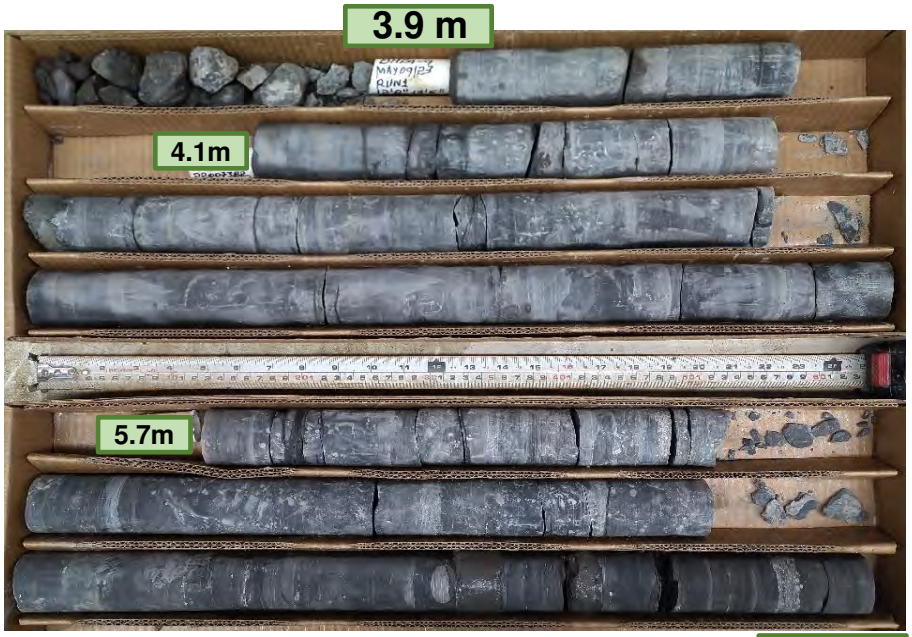
WET BEDROCK CORES



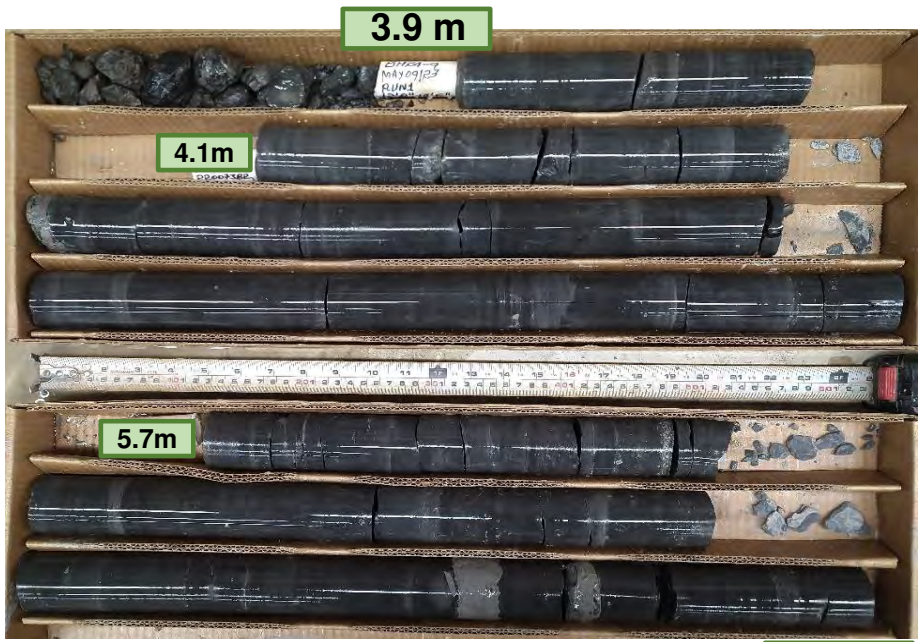
EXP Services Inc. www.exp.com
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

borehole no. **BH/MW 24-07**	Run 1: 4.2m - 4.5m Run 2: 4.5m - 5.7m Run 3: 5.7m - 7.2m Run 4: 7.2m - 8.7m end of borehole	project	Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	project no. OTT-22007382-A0
date cored May 07, 2024			Rock Core Photographs	FIG. B-10

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borehole no.		project		project no.
BH24-09	Run 1: 3.9m - 4.1m Run 2: 4.1m - 5.7m Run 3: 5.7m - 7.1m end of borehole		Proposed OC Transpo Electrical Bus Garage - 1500 St. Laurent Blvd., Ottawa, ON	OTT-22007382-A0
date cored May 09, 2024			Rock Core Photographs	FIG. B-11

Appendix C – Laboratory Certificate of Analysis Report by AGAT

AGAT Laboratories

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

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

ATTENTION TO: SURINDER AGGARWAL

PROJECT: OTT-22007382-AO

AGAT WORK ORDER: 22Z962626

SOIL ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician

DATE REPORTED: Nov 03, 2022

PAGES (INCLUDING COVER): 6

VERSION*: 1

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

*Notes

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- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
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- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
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- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.

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Western Enviro-Agricultural Laboratory Association (WEALA)
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AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 22Z962626

PROJECT: OTT-22007382-AO

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:

SAMPLED BY:

Anion Scan in Soil

DATE RECEIVED: 2022-10-27

DATE REPORTED: 2022-11-03

				BH 1 SS 2 2.				BH 5 SS 5		BH 7 SS 5
SAMPLE DESCRIPTION:				5'-4.5'		BH 3 SS 3 5'-7'		10'-12'		10'-12'
SAMPLE TYPE:				Soil		Soil		Soil		Soil
DATE SAMPLED:				2022-10-20		2022-10-19		2022-10-19		2022-10-20
Parameter	Unit	G / S	RDL	4467358	RDL	4467360	RDL	4467361	RDL	4467362
Chloride (10:1)	mg/kg		40	933	100	1320	20	422	40	1140
Sulphate (10:1)	mg/kg		40	281	100	819	20	515	40	863
10:1 (DI water Extr.)			N/A	Y	N/A	Y	N/A	Y	N/A	Y

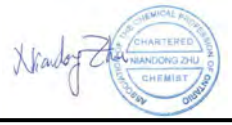
						BH 11 SS 4 7.		BH 13 SS 4 7.		BH 13 SS 6
SAMPLE DESCRIPTION:				BH 9 SS 3 5'-7'		5'-9.5'		5'-9.5'		12.5'-14.5'
SAMPLE TYPE:				Soil		Soil		Soil		Soil
DATE SAMPLED:				2022-10-20		2022-10-21		2022-10-22		2022-10-22
Parameter	Unit	G / S	RDL	4467363	RDL	4467364	RDL	4467365	RDL	4467366
Chloride (10:1)	mg/kg		20	518	40	1660	20	237	40	1630
Sulphate (10:1)	mg/kg		20	116	40	111	20	576	40	67
10:1 (DI water Extr.)			N/A	Y	N/A	Y	N/A	Y	N/A	Y

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

4467358-4467366 Results are based on a dry weight.
Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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Certificate of Analysis

AGAT WORK ORDER: 22Z962626

PROJECT: OTT-22007382-AO

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Resistivity, pH (Soil)

DATE RECEIVED: 2022-10-27

DATE REPORTED: 2022-11-03

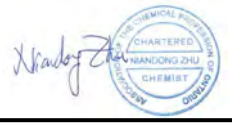
				BH 1 SS 2 2.		BH 5 SS 5	BH 7 SS 5	
SAMPLE DESCRIPTION:				5'-4.5'	BH 3 SS 3 5'-7'	10'-12'	10'-12'	BH 9 SS 3 5'-7'
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2022-10-20	2022-10-19	2022-10-19	2022-10-20	2022-10-20
Parameter	Unit	G / S	RDL	4467358	4467360	4467361	4467362	4467363
Resistivity (2:1) (Calculated)	ohm.cm		1	362	207	599	265	621
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.84	7.65	7.54	7.55	7.84

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

4467358-4467366 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract obtained from 2:1 leaching procedure (2 parts extraction fluid:1 part wet soil).

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Results relate only to the items tested. Results apply to samples as received.

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

Quality Assurance

CLIENT NAME: EXP SERVICES INC
PROJECT: OTT-22007382-AO
SAMPLING SITE:

AGAT WORK ORDER: 22Z962626
ATTENTION TO: SURINDER AGGARWAL
SAMPLED BY:

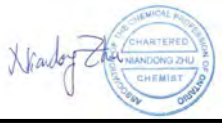
Soil Analysis

RPT Date: Nov 03, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Resistivity, pH (Soil)															
pH, 2:1 CaCl2 Extraction	4467360	4467360	7.65	7.55	1.3%	NA	101%	80%	120%						
Anion Scan in Soil															
Chloride (10:1)	4474463		10	10	NA	< 10	97%	80%	120%	95%	90%	110%	96%	80%	120%
Sulphate (10:1)	4474463		15	15	NA	< 10	94%	80%	120%	93%	90%	110%	96%	80%	120%

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

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

Certified By:



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Results relate only to the items tested. Results apply to samples as received.

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

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 22Z962626

PROJECT: OTT-22007382-AO

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (10:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (10:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
10:1 (DI water Extr.)		McKeague 4.12	N/A
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	EC METER
pH, 2:1 CaCl2 Extraction	INOR-93-6075	modified from EPA 9045D, MCKEAGUE 3.11 E3137	PC TITRATE

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905 712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

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

Laboratory Use Only

Work Order #: 22796276276

Cooler Quantity: N/A - bag - no ice packs

Arrival Temperatures: 21.1 | 21.2 | 21.2

LT 3.3 | 3.8 | 3.2

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: Bagged ice

Report Information:

Company: EXP

Contact: Surinder Aggarwal

Address: 7650 Queensview Dr Suite 100
Ottawa ON K2B 8HC

Phone: 613-686-1899 Fax:

Reports to be sent to:

1. Email: Surinder.Aggarwal@exp.com

2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Excess Soils R406
Table ____ *Indicate One*

☐ Regulation 558

☐ CCME

☐ Sewer Use
☐ Sanitary ☐ Storm
____ *Region*

☐ Prov. Water Quality Objectives (PWQO)

☐ Other
____ *Indicate One*

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

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

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

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

OR Date Required (Rush Surcharges May Apply):

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

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

Project Information:

Project: OTT-22007382-A0

Site Location: 1500 St. Laurent Blvd, Ottawa

Sampled By: EXP

AGAT Quote #: PO:

Please note: If quotation number is not provided, client will be billed full price for analysis

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:

Contact:

Address:

Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification		Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	O. Reg 153: Analyze F4G if required ☐ Yes ☐ No	O. Reg 153: PAHs	O. Reg 153: PCBs	O. Reg 153: VOC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach ☐ Metals ☐ VOCs ☐ SVOCs	O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	pH	Sulphides	Chlorides	Electro Resistivity				Potentially Hazardous or High Concentration (Y/N)
BH 1	SS2	7.5'-9.5'	Sept 20/22	AM PM	1														✓	✓	✓	✓				
BH 3	SS3	5'-7'	Sept 19	AM PM	1																					
BH 5	SS5	10'-12'	Sept 19	AM PM	1																					
BH 7	SS5	10'-12'	Sept 20	AM PM	1																					
BH 9	SS3	5'-7'	Sept 20	AM PM	1																					
BH 11	SS4	7.5'-9.5'	Sept 21	AM PM	1																					
BH 13	SS4	7.5'-9.5'	Sept 22	AM PM	1																					
BH 13	SS6	12.5'-14.5'	Sept 22	AM PM	1														✓	✓	✓	✓				
				AM PM																						
				AM PM																						
				AM PM																						

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Ryan D'Gueiros	Oct 26/22	6:00PM	C. Chan-Tin	OCT 27 2022	0830
C. Chan-Tin to Ryan	OCT 27 2022	16h00	Sana A. Abayed	28 Oct	9:58am
	Date	Time	Samples Received By (Print Name and Sign)	Date	Time

Page ____ of ____

N°: T 133519

AGAT Laboratories

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

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

ATTENTION TO: **Matthew Zammit**

PROJECT: **OTT-22007382**

AGAT WORK ORDER: **24Z154646**

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

DATE REPORTED: **Jun 03, 2024**

PAGES (INCLUDING COVER): **6**

VERSION*: **1**

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

*Notes

Disclaimer:

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

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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5835 COOPERS AVENUE
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CANADA L4Z 1Y2
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Certificate of Analysis

AGAT WORK ORDER: 24Z154646

PROJECT: OTT-22007382

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Matthew Zammit

SAMPLING SITE:1500 St Laurent, Ottawa, ON

SAMPLED BY:EXP

(Soil) Inorganic Chemistry

DATE RECEIVED: 2024-05-27 **DATE REPORTED: 2024-06-03**

				BH24-2 SS6	BH24-4 SS4	BH24-5 SS3	BH24-7 SS6	BH24-12 SS6	BH24-9 SS4	BH24-11 SS5	BH24-1 Run1
		SAMPLE DESCRIPTION:		12.5'-14.5'	7.5'-9.5'	5'-7'	12.5'-14.5'	12.5'-14.5'	7.5'-9.5'	10'-12'	11'2-11'6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2024-05-08	2024-05-03	2024-05-08	2024-05-07	2024-05-10	2024-05-09	2024-05-09	2024-05-10
Parameter	**Unit**	**G / S**	**RDL**	**5888898**	**5888900**	**5888901**	**5888902**	**5888903**	**5888904**	**5888905**	**5888906**
Chloride (2:1)	µg/g		2	1250	2570	2350	905	642	810	1370	104
Sulphate (2:1)	µg/g		2	353	639	829	527	429	419	422	55
pH (2:1)	pH Units		NA	6.83	8.38	8.62	8.52	7.30	7.80	7.63	9.89
Resistivity (2:1) (Calculated)	ohm.cm		1	400	167	240	645	800	415	337	1960

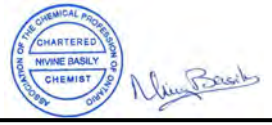
				BH24-5 Run2	BH24-7 Run1	BH24-10 Run2	BH24-11 Run1
		SAMPLE DESCRIPTION:		3'8-14'3	13'10-14'2	18'4-18'8	15'1-15'7
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		2024-05-07	2024-05-07	2024-05-09	2024-05-09
Parameter	**Unit**	**G / S**	**RDL**	**5888907**	**5888908**	**5888909**	**5888910**
Chloride (2:1)	µg/g		2	102	87	81	16
Sulphate (2:1)	µg/g		2	47	33	29	20
pH (2:1)	pH Units		NA	9.95	9.29	9.84	9.23
Resistivity (2:1) (Calculated)	ohm.cm		1	2670	3370	4220	6060

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

5888898-5888910 pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

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

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z154646

PROJECT: OTT-22007382

ATTENTION TO: Matthew Zammit

SAMPLING SITE:1500 St Laurent, Ottawa, ON

SAMPLED BY:EXP

Soil Analysis

RPT Date: Jun 03, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(Soil) Inorganic Chemistry															
Chloride (2:1)	5888898	5888898	1250	1260	0.4%	< 2	96%	70%	130%	96%	80%	120%	NA	70%	130%
Sulphate (2:1)	5888898	5888898	353	348	1.5%	< 2	95%	70%	130%	104%	80%	120%	99%	70%	130%
pH (2:1)	5888898	5888898	6.83	6.83	0.0%	NA	97%	80%	120%						

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

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

(Soil) Inorganic Chemistry															
Chloride (2:1)	5888906	5888906	104	102	1.9%	< 2	97%	70%	130%	95%	80%	120%	90%	70%	130%
Sulphate (2:1)	5888906	5888906	55	56	1.8%	< 2	96%	70%	130%	100%	80%	120%	96%	70%	130%
pH (2:1)	5888906	5888906	9.89	9.73	1.6%	NA	101%	80%	120%						

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

Certified By:



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Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

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

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z154646

PROJECT: OTT-22007382

ATTENTION TO: Matthew Zammit

SAMPLING SITE:1500 St Laurent, Ottawa, ON

SAMPLED BY:EXP

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION

Results relate only to the items tested. Results apply to samples as received.

PS 1/2

AGAT Laboratories

Have feedback? Scan here for a quick survey!

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

Chain of Custody Record

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

Report Information:

Company: EXP
Contact: Matthew Zammit
Address: 2650 Queensview dr Suite 100
Ottawa Ontario K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Matthew.Zammit@exp.com
2. Email: Ryan.digiuseppe@exp.com

Project Information:

Project: OTT-22007382
Site Location: 1500 St Laurent, Ottawa, ON
Sampled By: EXP
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

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

Regulatory Requirements:

(Please check all applicable boxes)

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

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

☐ Regulation 558
☐ CCME

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

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

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

Legal Sample ☐

Sample Matrix Legend

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

Laboratory Use Only

Work Order #: 24715464 6

Cooler Quantity: n/a - bag - no ice packs.
Arrival Temperatures: 21.0 | 20.9 | 20.7
Depot Temperatures: 4.0 | 4.4 | 4.1
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: M155 sent to BV

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

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

OR Date Required (Rush Surcharges May Apply):

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

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	VOC	PAHs	PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Corrosivity: ☐ Moisture ☐ Sulphide	pH	Sulphate-S	Chloride	Electro Resistivity			Potentially Hazardous or High Concentration (Y/N)
1. BH 24-2 SS6 12.5'-14.5'	May 8	AM PM	1															✓						
2. BH 24-4 SS4 7.5'-9.5'	May 7	AM PM	1															✓						
3. BH 24-5 SS3 5'-7'	May 6	AM PM	1															✓						
4. BH 24-7 SS6 12.5'-14.5'	May 7	AM PM	1															/						
5. BH 24-12 SS6 12.5'-14.5'	May 10	AM PM	1															/						
6. BH 24-9 SS4 7.5'-9.5'	May 9	AM PM	1															/						
7. BH 24-11 SS5 10'-12'	May 9	AM PM	1															/						
8. BH 24-1 Run 1 11'2-11'6		AM PM																/						
9. BH 24-5 Run 2 13'8-14'3		AM PM																/						
10. BH 24-7 Run 1 13'10-14'2		AM PM																/						
11. BH 24-10 Run 2 18'4-18'8		AM PM																/						

	Date	Time		Date	Time
Samples Relinquished By (Print Name and Sign):			Samples Received By (Print Name and Sign):	05/27/24	08h15
Samples Relinquished By (Print Name and Sign):	05/27/24	15h00	Samples Received By (Print Name and Sign):	May 28	5:45pm
Samples Relinquished By (Print Name and Sign):			Samples Received By (Print Name and Sign):		

Page _____ of _____

N°:

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

Any and all products and/or services provided by AGAT Labs are pursuant to the terms and conditions as set forth at www.agatlabs.com/termsandconditions unless otherwise agreed in a current written contractual document.

Pg 2/2

AGAT Laboratories

Have feedback? Scan here for a quick survey!

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

Chain of Custody Record

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

Laboratory Use Only
Work Order #: 24715416046
Cooler Quantity: N/A - bag - no ice packs
Arrival Temperatures: 21.0 | 20.9 | 20.7
~~Depot~~ Temperatures: 4.0 | 4.1 | 4.1
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: BI

Report Information:
Company: ExP
Contact:
Address:
Phone: Fax:
Reports to be sent to:
1. Email:
2. Email:

Regulatory Requirements:
(Please check all applicable boxes)

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

☐ Regulation 406
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
☐ Regulation 558
☐ CCME

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

Turnaround Time (TAT) Required:
Regular TAT ☐ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*
For 'Same Day' analysis, please contact your AGAT CSR

Project Information:
Project: OTT-72007362
Site Location:
Sampled By:
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

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

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

Legal Sample ☐

Invoice Information:
Bill To Same: Yes ☐ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	VOC	PAHs	PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs TCLP:	Corrosivity: ☐ Moisture ☐ Sulphide						Potentially Hazardous or High Concentration (Y/N)
1. BH 24-11 Run 1		AM PM			15'1 - 15'7													pH ✓	Sulphides ✓	Chlorides ✓	Electro Resistivity ✓			
2.		AM PM																						
3.		AM PM																						
4.		AM PM																						
5.		AM PM																						
6.		AM PM																						
7.		AM PM																						
8.		AM PM																						
9.		AM PM																						
10.		AM PM																						
11.		AM PM																						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
			C. Griffiths	05/27/24	08h15
C to Pino	05/27/24	13h00		May 28	8:45

Page _____ of _____
N°:

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

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Report Distributed To:

Ian Craig, City of Ottawa; Ian.Craig@ottawa.ca

Jonathan Amor, City of Ottawa; jonathan.amor@ottawa.ca

Robert W. Faris, City of Ottawa; Robert.Faris@ottawa.ca

Scott Dupont, City of Ottawa; Scott.Dupont@ottawa.ca

Appendix F Supporting Information and Calculations for Water Servicing Design

FUS Fire Flow Calculations (Per City of Ottawa ISTB-2018-02)
OC Transpo Electrical Bus Storage Facility (Industrial Building) REV1

Step	Parameter	Value		Note
A	Type of Construction	Non-combustible		
	Coefficient (C)	0.8		Table G1 - ISTB-2018-02
B	Ground Floor Area	6331.5	m^2	
C	Height in storeys	1	storeys	
	Total Floor Area	6331.5	m^2	
D	Fire Flow Formula	F=220C√A		
	Fire Flow	14004	L/min	
	Rounded Fire Flow	14000		Rounded to nearest 1000 L/min
E	Occupancy Class	Free Burning		Municipal storage building - combustible occupancy class
	Occupancy Charge	15%		
	Occupancy Increase or Decrease	2100		
	Fire Flow	16100	L/min	
F	Sprinkler Protection	Automatic Fully Supervised		
	Sprinkler Credit	-50%		
	Decrease for Sprinkler	-8050	L/min	
G	North Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	0	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	0	m-storeys	
	Separation Distance	> 45	m	
	North Side Exposure Charge	0%		Table G5 - ISTB-2018-02
	East Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	86	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	86	m-storeys	
	Separation Distance	15.3	m	
	East Side Exposure Charge	14%		Table G5 - ISTB-2018-02
	South Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	0	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	0	m-storeys	
	Separation Distance	>45	m	
	South Side Exposure Charge	0%		Table G5 - ISTB-2018-02
	West Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	80	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	80	m-storeys	
	Separation Distance	40	m	
	West Side Exposure Charge	5%		Table G5 - ISTB-2018-02
	Total Exposure Charge	19%		
	Increase for Exposures	3059	L/min	
H	Fire Flow	11109	L/min	E + F + G
	Rounded Fire Flow	11000	L/min	Rounded to nearest 1000 L/min
City Cap	Required Fire Flow (RFF)	11000	L/min	City Cap Does Not Apply
		183	L/sec	

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

MEMO

Date: March 2, 2026

To: Jonathan Amor

From: Alexandra Marchese, P.Eng. – J.L. Richards and Associates
Annie Williams, P.Eng. – J.L. Richards and Associates

CC: Andrew Duncan, P.Eng. – J.L. Richards and Associates

Subject: City of Ottawa – 1500 St. Laurent Blvd – OCT South Garage Upgrades – Phase 2

Rev 2: North Garage Water Servicing Memo Updates

JLR No.: 31489-023

Purpose of Undertaking

The Climate Change Master Plan recently approved by the City of Ottawa (January 2020) provided a framework on how to mitigate and adapt to climate change in the next 30 years. This Master Plan identified Greenhouse Gas (GHG) emission reduction as one of the goals and identified priority targets for the next five (5) years. One of the primary actions identified in the Master Plan is the transition to a zero-emissions fleet of vehicles which includes transit buses.

To achieve this ambitious goal over the next five (5) years, the north and south garages sited at 1500 St Laurent Blvd will need to be upgraded to accommodate pantograph chargers for E-Buses. Similarly, the chargers will also be implemented for the proposed garage which is under design by AECOM. The three (3) buildings will also need to incorporate a sprinkler system sized to achieve regulatory fire protection.

As a result of the proposed pantograph chargers and EV-Buses that are highly flammable, the existing garages (north and south) and proposed garage will require an increase in fire flow availabilities. As a result, a need was identified to evaluate the adequacy of the existing on-site distribution system to determine whether it can deliver sufficient flow at the existing garages and new buildings to meet this increase in fire flow requirements. If the on-site watermains are found not to be capable in meeting the increased in fire flow availabilities, watermain servicing upgrades were to be developed and evaluated as part of this Memorandum.

Summary of Updates

This memo serves as a revision to the servicing strategies outlined in the original document prepared by J.L. Richards and Associates, titled *"City of Ottawa – 1500 St. Laurent Blvd – OCT South Garage Upgrades – Phase 2"*, dated June 2024.

Since the issuance of that memo, the proposed watermain servicing strategy for the proposed garage has been revised as follows:

- A new 254 mm diameter watermain is proposed to extend from the existing 254 mm watermain at 899 Belfast Road. This new watermain will provide two (2) separate connections: one (1) to a proposed fire hydrant south of the proposed garage, and one (1) to the existing 200 mm diameter watermain loop that services the north and south garages.

- A 200 mm diameter water service is proposed to extend from the existing 200 mm loop (near the existing north garage) to directly service the proposed garage.

The updated hydraulic network analysis reflecting these changes is presented in this memo. The revised watermain servicing option described above can be found in the engineering drawings prepared by EXP for the City of Ottawa, titled *"New Watermain Loop and Water Service – OC Transpo Campus, 1500 St. Laurent Boulevard, Ottawa, Ontario, Contract No. CF000471.09 – Issued for Tender,"* dated August 13, 2025, as well as in the drawings prepared by AECOM, titled *"OTC ZEB – New Garage,"* dated April 15, 2025.

In addition to revisions to the proposed servicing, the water demand estimates have been revised and reduced due to the removal of the bus wash from the design. The updated demand values are as follows:

- Total Average Day Demand: 5,100 L/day (0.06 L/s)
- Total Peak Hour Demand: 950,040 L/day (11.00 L/s)

Furthermore, the flow and pressure requirements for the proposed garage sprinkler system have been revised from 101 L/s at 46 psi to 117 L/s at 50 psi. It is noted that for the existing north and south garages, the sprinkler flow of 101 L/s at 46 psi is to be maintained.

This memo is updated herein (February 2026) to accommodate new domestic and fire demands provided by AECOM and the City of Ottawa for the proposed garage.

Background

To evaluate the on-site fire flow capabilities, a hydraulic water model was developed and used as a modelling tool to assess conformance of the distribution system in achieving regulatory requirements. The hydraulic model was developed using water servicing information depicted on Drawings provided by the City of Ottawa and subsequently confirmed via a comparison with the information displayed on "geoOttawa".

The hydraulic model is now updated to incorporate the proposed servicing strategies indicated in the separate engineering drawings prepared by EXP and AECOM respectively.

Based on the review of the background information, the existing north and south garages at 1500 St Laurent Blvd are currently being serviced by an on-site 200 mm diameter watermain loop. This privately owned 200 mm diameter looped system receives its water supply from the Municipal system from two (2) service connections:

- a 152 mm diameter lateral crossing the St Laurent Blvd right-of-way.
- a 200 mm diameter watermain lateral along Belfast Road, immediately west of St Laurent Blvd.

In addition to the 200 mm diameter loop, there is a 254 mm diameter watermain which extends from 899 Belfast Road and is immediately west of the 200mm diameter noted above.

The above-noted service laterals are connected to the St Laurent Blvd 400 mm diameter feedermain and to the Belfast Road 300 mm diameter feedermain, respectively. It should also be noted that other buildings adjacent to 1500 St Laurent Blvd property also have their own service lateral which are all fed by the Belfast Road 300 mm diameter feedermain, including buildings sited at 925 Belfast Road (150 mm diameter lateral), 899 Belfast Road (254 mm diameter lateral) and 875 Belfast Road (150 mm diameter lateral).

Water Servicing Design Criteria

A Hydraulic Network Analysis (HNA) was carried out to evaluate the performance of the existing on-site watermains to confirm whether it meets regulatory requirements and to subsequently identify system upgrades, if any, are required to demonstrate that it can achieve the pressure constraints described in the City of Ottawa Design Guidelines for Water Distribution (January 2025) section 4.2.2. The Design Guidelines require that all new development additions to the private

and public water distribution network be designed such that the minimum and maximum residual pressures, as well as flow rates, comply with the following design criteria:

- In general conformance with the MOE Design Guidelines for Drinking-Water Systems the desired range of system pressures should be approximately 350 to 480 kPa (50 to 70 psi) and not less than 275 kPa (40 psi) during normal operating conditions.
- Where fire flow has been provided; during periods of maximum day and fire flow demand the residual pressure at any point in the distribution system shall not be less than 140 kPa (20 psi.)
- In accordance with the Ontario Code & Guide for Plumbing, the maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi.)
- The maximum pressure at any point in the distribution system in unoccupied areas shall not exceed 689 kPa (100 psi.)
- Feedermains, which have been provided primarily for the purpose of redundancy, shall meet, at a minimum, the basic day plus fire flow demand.

Buildings Under Review

The fire flow availability from the on-site distribution system was estimated via a water model for both existing garages (north and south) as well as for the proposed garage designed by others. The north and south garages are currently serviced by the on-site 200 mm diameter watermain loop. There is a proposed 254 mm diameter watermain extension to increase water supply on the 200 mm diameter watermain loop, as identified by AECOM and EXP.

Water Demands

Proposed Garage

The average day and peak hour water demands for the proposed garage are provided in the table below.

Since the submission of the original memo, AECOM has revised the projected demand for the proposed garage to 1.15 L/s for average day demand, 1.72 L/s for maximum day demand, and 3.10 L/s for peak hour demand. It is now understood that the proposed garage will not require bus-washing operations.

Existing Garages

Domestic water demands consisting of those of the proposed garage as described above and those associated with the existing garages (north and south) were estimated using water metered data provided by OC Transpo. The data was processed and lumped together given that the supply originates from the on-site 200 mm diameter loop.

The flow metering data for the existing north and south garages showed a combined average day demand of 1.09 L/s and a maximum day demand of 1.63 L/s. Since the available data did not provide support for determining a peak-hour demand, a peak flow rate of 11.00 L/s was assumed for each existing garage, inclusive of bus-washing operations. This assumption aligns with AECOM's previous estimate for the proposed garage.

The overall domestic demands as described above have been summarized in Table 1 below while Appendix A includes the detailed water demand calculations.

Table 1: Total Water Demand

	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)
Proposed Garage	1.15	1.72	3.10
Existing Garages (North and South)	1.09	1.63	22.00
Total	2.24	3.35	2.51

Watermain Sizing and Roughness

The water model, which was developed using the WaterCAD® platform, requires roughness coefficients to enable the software to estimate headlosses along the distribution system.

Given that the existing systems consist of non-PVC watermains, a separate simulation confirmed that the impact of the age/roughness of ductile and cast-iron pipes was found to be negligible as the fire flow and pressure results in the water model did not differ significantly compared to the results with typical pipe roughness coefficient as shown in Table 2. Consequently, the roughness coefficients used in the water model were set by using Section 4.2.12 of the Design Guidelines and summarized in Table 2 (below) while the internal pipe diameters were modelled based on Section 4.3.5 of the Design Guidelines and are summarized in Table 3 (below).

Table 2: Watermain Roughness Coefficients

Watermain Diameter (mm)	C-Factor
150	100
200 to 250	110
300 to 600	120

Table 3: PVC Watermain Internal Diameters

Nominal Diameter (mm)	Inside Diameter (mm)
150	155
200	204
300	297
400	393

Fire Flow Requirements and Pressure Requirements

The required fire flow protection was calculated in accordance with the City of Ottawa Design Guidelines (2025) and the FUS (2020) method.

The proposed garage and both existing garages will be equipped with pantograph chargers for the E-Buses. Each of these buildings will be equipped by an automated, fully supervised sprinkler system designed in accordance with the Ontario Building Code (OBC).

For the proposed garage, the location of the siamese connection and mechanical room, as well as water demands, including sprinkler flows, were reviewed with the project's mechanical engineer. The sprinkler requirements determined by the mechanical engineer are as follows:

- Proposed Garage Sprinkler = 117 L/s at a minimum pressure of 344 kPa (50 psi)
- North Garage and South Garage = 101 L/s at a minimum pressure of 317 kPa (46 psi)

The required fire flow for the proposed garage was provided by AECOM per the FUS (email dated February 18, 2026) and has been included in Appendix B. The required fire flows (RFF) for the existing garages (north and south) were calculated as per the FUS Guidelines based on building size, properties, and exposure to adjacent units as shown in Appendix C. The required fire flows for each building are as follows:

- Proposed Garage RFF = 183 L/s
- North Garage RFF = 250 L/s
- South Garage RFF = 267 L/s

Hydraulic Water Model and Boundary Conditions

The hydraulic water model was developed for the subject site using the WaterCAD® software platform. At the onset, the model included the existing private watermains with two (2) connections to the feedermains; one connection to the Belfast Road 300 mm diameter feedermain (noted as Connection 1, Table 4 below) and one connection to the St-Laurent Boulevard 400 mm diameter feedermain (noted as Connection 2, Table 4 below).

Given that the simulation of the watermain loop did not yield results that met the pressure constraint of 140 kPa (20 psi), a second supply from the Belfast Road 300 mm diameter feedermain was also added to the model noted as Connection 3, Table 4 below.

Thus, the water model, with two (2) sources of supply was used to simulate the existing conditions while the model was revised with three (3) sources of supply to investigate servicing upgrades to meet the pressure constraints noted in the above Water Servicing and Design Criteria section.

An updated boundary condition request (dated May 7, 2024) was made to the City of Ottawa to obtain the supply characteristics at each of the connection points. An email correspondence was subsequently received from the City on May 22, 2024 (Appendix B). The supply elevations are shown in Table 4 below.

Table 4: Summary of Boundary Conditions Provided by City

	Connection 1 - Belfast	Connection 2 – St. Laurent	Connection 3 - Belfast
Minimum HGL (m)	110.1	110.1	110.1
Maximum HGL (m)	118.3	118.2	118.4
Max Day + Fire Flow (233 L/s) (m)	108.0	110.8	107.4
Max Day + Fire Flow (250 L/s) (m)	107.2	110.5	106.6
Max Day + Fire Flow (267 L/s) (m)	106.4	110.1	105.7

Boundary Conditions for Connections 1 and 2 remain the same with and without Connection 3. It is important to note that the originally requested boundary condition of 233 L/s for the proposed garage has been revised to 183 L/s. Since the required fire flow has decreased since the initial boundary condition request, it was determined that maintaining the original boundary condition is acceptable as it provides a more conservative approach.

Description of Servicing Alternatives

Several simulations were carried out using the water model to evaluate whether fire protection at each of the three (3) buildings was met. This memorandum presents two servicing scenarios. Note that Scenario 2, initially recommended as a 200 mm watermain extension in the June 2024 JLR memo, has since been revised to a 254 mm diameter extension.

- **Scenario 1 – Existing Conditions:** The existing and proposed garages were evaluated under the existing conditions of the site. This included two (2) water supply connections. The first connection is located at St. Laurent Boulevard and the second connection is located at Belfast Road.

- **Scenario 2 – Third Supply with proposed 254 mm Watermain Extension:** The second scenario consists of a third supply connection at 899 Belfast Road. From this connection, a 254 mm diameter watermain is proposed to extend approximately 270 m northeast into the site where it will connect to the on-site watermain loop.

The proposed servicing and servicing upgrades described under Scenario 2 are as follows:

- A 200 mm diameter water service, identified by AECOM, will connect the proposed building to the existing on-site 200 mm diameter watermain loop.

- A new 254 mm diameter watermain is proposed to extend from the existing 254 mm watermain at 899 Belfast Road. This new watermain will provide supply to a proposed fire hydrant south of the proposed garage, and also to the existing on-site 200 mm diameter watermain loop.

Findings and Simulation Results

Scenario 1 – Existing Conditions (no upgrades)

Maximum Day Demand Plus Fire Flow

Manual fire flow simulations were modelled for each building under maximum day plus fire flow conditions. For these scenarios, the sprinkler flow is applied directly to the node that is servicing the building. The remaining required fire flow is distributed to the nearby hydrants in accordance with Appendix I of the Water Design Guidelines. The required sprinkler flow and remaining required fire flow for each garage are summarized in Table 5 below.

Table 5: Required Fire Flows and Sprinkler Flows

	Total Required Fire Flow (L/s)	Required Sprinkler Flow (L/s)	Remaining Required Fire Flow (L/s)
Proposed Garage	183	117	66
North Garage	250	101	149
South Garage	267	101	166

The proposed garage was simulated with 117 L/s on node J-29 and 66 L/s on hydrant H-7. The simulation results indicate that both the minimum pressure and flow requirements are satisfied, with the lowest system pressure measured at 165 kPa (24 psi) at J-29. However, the sprinkler requirement of a minimum pressure of 344 kPa (50 psi) at node J-29 is not achieved.

The north garage was simulated with 101 L/s on node J-12, 95 L/s on H-5 and 54 L/s on H-1. The simulation shows that system pressures in this scenario drop below the required minimum of 140 kPa (20 psi), with the lowest pressure recorded at H-5 being 129 kPa (19 psi). This also indicates that the minimum pressure of 317 kPa (46 psi) for the sprinkler is not met.

The south garage was simulated with 101 L/s on node J-28, 83 L/s on H-2, 40 L/s on H-6 and 43 L/s on H-3. The simulation results show that minimum pressures and flows can be met with the minimum pressure in the system at 217 kPa (31 psi) at J-28. However, the minimum pressure of 317 kPa (46 psi) at node J-28 for the sprinkler is not met.

It is therefore determined that an additional supply connection is required to support the development.

Scenario 2 – Proposed 254 mm Watermain Extension

Maximum Day plus Fire Flow Demand

To ensure that the proposed building has adequate fire protection, the 254mm watermain extension upgrade was modelled first under the automated fire flow simulator then under manual fire flow simulations in WaterCAD. For these scenarios, the sprinkler flow is applied directly to the node that is servicing the building. The remaining required fire flow is distributed to the nearby hydrants in accordance with Appendix I of the Water Design Guidelines. The required sprinkler flow and remaining required fire flow for each garage are summarized in Table 5 above.

Proposed Garage

Under the automatic fire flow simulation, the demand for the sprinkler was applied to J-29 and the remaining available fire flows were calculated on all hydrants in the system. The results of the automatic fire flow simulation show that there is

sufficient flow available and that all nodes exceed 140 kPa (20 psi) with the minimum pressure at 276 kPa (40 psi) observed at J-29.

Under the manual fire flow simulation, 117 L/s was applied to node J-29 and the remaining 66 L/s was applied to hydrant H-7. These results showed that minimum pressures in the system remain above 140 kPa (20 psi), with the minimum pressure in the system being 209 kPa (30 psi) at J-29. The residual pressure at the proposed garage (J-29) is therefore below the sprinkler requirement of 344 kPa (50 psi) for the proposed garage.

North Garage

Under the automatic fire flow simulation, the demand for the sprinkler was applied to node J-12 and the remaining available fire flows were calculated on all hydrants in the system. The results of the automatic fire flow simulation show that there is sufficient flow available and that all nodes exceed 140 kPa (20 psi), with the minimum pressure in the system being 323 kPa (46 psi) at J-12.

Under the manual fire flow simulation, 101 L/s was applied to node J-12, 95 L/s on H-5 and 54 L/s on H-6. These results showed that minimum pressures in the system remain above 140 kPa (20 psi), with the minimum pressure in the system being 173 kPa (25 psi) at H-5 and 181 kPa (26 psi) at J-12. The residual pressure at the north garage (J-12) is therefore below the sprinkler requirement of 317 kPa (46 psi) for the north garage.

South Garage

Under the automatic fire flow simulation, the demand for the sprinkler was applied to node J-28 and the remaining available fire flows were calculated on all hydrants in the system. The results of the automatic fire flow simulation show that there is sufficient flow available and that all nodes exceed 140 kPa (20 psi) with the minimum pressure in the system being 314 kPa (45 psi) observed at J-28.

Under the manual fire flow simulation, 101 L/s was applied to node J-28, 71 L/s on H-2 and 95 L/s on H-6. These results showed that minimum pressures in the system remain above 140 kPa (20 psi), with the minimum pressure in the system being 259 kPa (38 psi) at J-28. The residual pressure at the south garage (J-28) therefore does not meet the sprinkler requirement of 317 kPa (46 psi) for the south garage.

Peak Hour Demand

The peak hour demand of 3.10 L/s was applied on the representative junction in the model (J-29) of the proposed building. For the existing garages (north and south), the peak hour demand of 22.0 L/s was distributed across junctions throughout the site to reflect the various service laterals into the north and south buildings. Similarly, the demand of 0.32 L/s for the existing building that extends from the existing 254 mm diameter watermain on 899 Belfast Road was applied at Node J-58. Under the peak hour demands identified in Table 1, the simulation results show a minimum residual pressure of 377 kPa (55 psi) at node J-60 which exceeds the minimum pressure requirement of 276 kPa (40 psi) (refer to Appendix D for junction and pipe summary reports).

Maximum HGL

The maximum pressure (maximum HGL) scenario was simulated to determine the need, if any, for pressure reducing valves (PRVs) to ensure that the pressure in the water distribution system does not exceed the maximum pressure constraint of 552 kPa (80 psi) set by the OBC. The maximum simulated pressure in the system was found to be 483 kPa (70 psi) at several nodes in the model as shown in Appendix D. Therefore, the proposed building will not require the installation of a PRV as the simulated pressures throughout the site are below the maximum pressure constraint of 552 kPa (80 psi).

Pressure Constraints

The recommended 254 mm watermain extension upgrade satisfies the pressure constraints in Section 4.2.2 of the Design Guidelines. However, the upgrade does not meet the project specific constraints of 344 kPa (50 psi) for the sprinkler system

for the proposed garage. Furthermore, the upgrade does not meet the project specific constraint of 317 kPa (46 psi) for the sprinkler system for the existing south and north garages. It is understood that a fire pump will be included in the proposed and north garages to address these pressure constraints, and a sprinkler code consultant has determined that a fire pump is not required for the south garage.

Water Summary and Recommendations

The simulation of existing conditions confirmed that the on-site system could not provide adequate fire flow protection for the site. Therefore, a system upgrade involving the extension of a 254 mm watermain was required for the proposed, north, and south garages to meet required fire flow standards.

With this upgrade, the simulation results under the maximum day plus fire flow conditions showed that the distribution system and hydrants can supply the required fire flows previously described for all three (3) garages and meet the minimum pressure requirement of 140 kPa (20 psi). However, the results also show that the pressure requirements for the sprinkler systems cannot be met with the proposed upgrade. To address this, a fire pump is expected to be installed in the proposed and north garages. A sprinkler code consultant has confirmed that a fire pump is not required for the south garage.

The simulation results with the proposed upgrade under the peak hour condition showed that the system pressures will exceed the minimum pressure criterion of 276 kPa (40 psi).

The simulation results with the proposed upgrade under the maximum HGL do not exceed the maximum pressure constraint of 552 kPa (80 psi) and the buildings will not require the installation of PRVs.

Should you have any questions, please do not hesitate to contact the undersigned.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

Alexandra Marchese, P.Eng.
Civil Engineer

Reviewed by:



Annie Williams, P.Eng.
Manager, Ottawa Civil Department
Senior Civil Engineer

Appendix A

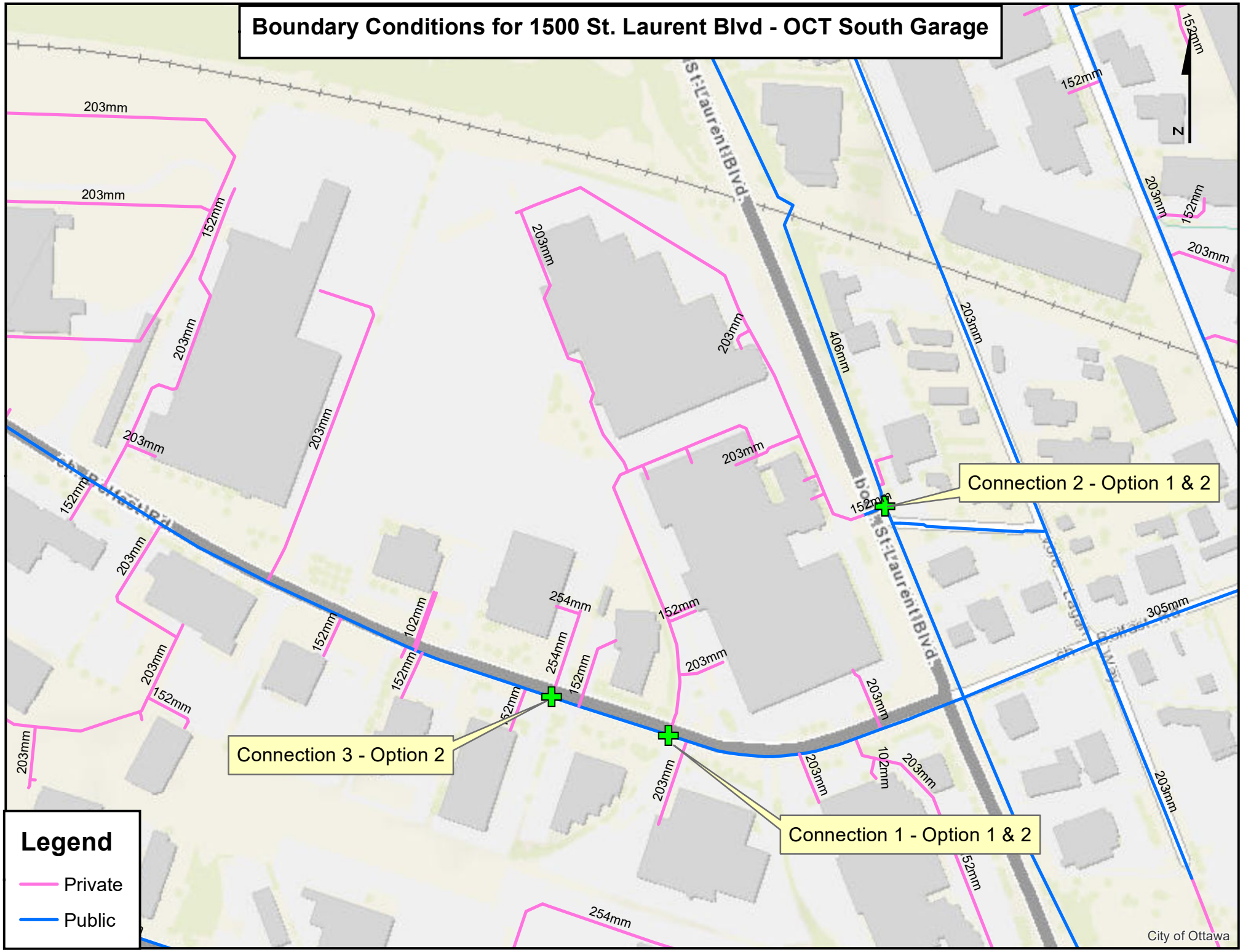
Water Demands

Water Demand Calculations		
(JLR 31489-021)		
OCT North & South Garage Upgrades Ph2 - 2 Existing Buildings		
Demand Breakdown	**No.**	**Unit**
Peak Hour Demand	**22.00**	**L/s**
Maximum Day Demand	**1.63**	**L/s**
Maximum Day Peaking Factor	1.50	
Average Day Demand	**1.09**	**L/s**
OCT Proposed Garage Ph2		
Demand Breakdown	**No.**	**Unit**
Peak Hour Demand	**3.10**	**L/s**
Peak Hour Peaking Factor	1.80	
Maximum Day Demand	**1.72**	**L/s**
Maximum Day Peaking Factor	1.50	
Average Day Demand	**1.15**	**L/s**
Total Demands for Storage Facility		
Average Day Demand	**2.24**	**L/s**
Maximum Day Demand	**3.35**	**L/s**
Peak Hour Demand	**25.10**	**L/s**

Peaking factors based on City of Ottawa Water Design Guidelines

Appendix B

Email Correspondence


Boundary Conditions for 1500 St. Laurent Blvd - OCT South Garage
St. Laurent Blvd
St. Laurent Blvd
St. Laurent Blvd
Connection 2 - Option 1 & 2
Connection 3 - Option 2
Connection 1 - Option 1 & 2
Legend
Private
Public
N
City of Ottawa
203mm
152mm
406mm
254mm
102mm
305mm

Tatyana Roumie

From: Andrew Duncan
Sent: June 3, 2024 9:40 AM
To: Annie Williams; Tatyana Roumie; Lee Jablonski
Subject: FW: 31489-021 - OCT South Garage Upgrades Ph2
Attachments: 1500 St. Laurent Blvd - OCT South Garage REVISED May 2024.pdf

Importance: High

Follow Up Flag: Follow up
Flag Status: Flagged

Hi,

Please review the information included below and attached and let me know if we have what we need to finish the site wide water supply investigation.

Andrew

Andrew Duncan, P.Eng.
Senior Associate
Senior Mechanical Engineer
Practice Lead, Environmental Infrastructure
Ottawa, ON
Work: 343-804-4383
Mobile: 613-889-4788

From: Qadan, Sami <Sami.Qadan@ottawa.ca>
Sent: Monday, June 3, 2024 9:37 AM
To: Andrew Duncan <aduncan@jlrichards.ca>
Cc: Amor, Jonathan <jonathan.amor@ottawa.ca>
Subject: FW: 31489-021 - OCT South Garage Upgrades Ph2
Importance: High

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Hi Andrew,

Apology that I forward this late. I was off last week and completely forget to forward it to you.

Let us know if you still have any concerns with the reply below.

Regards

Sami

From: Ahmad, Shohan <Shohan.Ahmad@ottawa.ca>
Sent: May 22, 2024 5:09 PM
To: Qadan, Sami <Sami.Qadan@ottawa.ca>
Cc: Amor, Jonathan <jonathan.amor@ottawa.ca>; Afzalan, Bahar <bahar.afzalan@ottawa.ca>
Subject: RE: 31489-021 - OCT South Garage Upgrades Ph2

Hi Sami,

We do not consider private infrastructure. BC are only provided from Public Infrastructure.

From following scenario's **Option 1** and **Option 2** are provided in the BC.

- Scenario #1: No upgrades. Requesting boundary conditions at Connections 1 and 3 (Connection 3 is located on the St. Laurent Blvd 406mm watermain on the other side of the 152mm stub.) **- Provided as Option 1**
- Scenario #2: Proposed 300 mm pipe upgrade crossing St. Laurent Blvd. Requesting boundary conditions at Connections 1 and 3
- Scenario #3: Proposed third connection to the site from Belfast Rd using existing 254mm water service. Requesting boundary conditions at Connections 1, 2, and 4
- Scenario #4: Proposed third connection to the site from Belfast Rd using existing 254mm water service + proposed 300 mm pipe upgrade crossing St. Laurent Blvd. Requesting boundary conditions at Connections 1, 3, and 4 **- Provided as Option 2 with no private pipe upgrade and addition.**
- Scenario #5: Proposed third connection to the site from Belfast Rd using existing 254mm water service. Requesting boundary conditions at Connections 1, 2, and 5
- Scenario #6: Proposed third connection to the site from Belfast Rd using existing 254mm water service + proposed 300 mm pipe upgrade crossing St. Laurent Blvd. Requesting boundary conditions at Connections 1, 3, and 5

******The following information may be passed on to the consultant, but do NOT forward this e-mail directly.******

The following are boundary conditions, HGL, for hydraulic analysis at OC Transpo at 1500 St. Laurent Blvd. (zone 1E) assumed to be connected via two connections to the 305mm on Belfast Road and 406mm on St. Laurent Street (option #1) **OR** two connections to the 305mm on Belfast Road and one connection to the 406mm on St. Laurent Street (option #2) (see attached PDF for location).

Option 1	305mm on Belfast Connection 1	406 mm on St-Laurent Connection 2
Minimum HGL (m)	110.1	110.1
Maximum HGL (m)	118.3	118.2

Max Day + FF (233 L/s) (m)	108.0	110.8
Max Day + FF (250 L/s) (m)	107.2	110.5
Max Day + FF (267 L/s) (m)	106.4	110.1

Option 2	305mm on Belfast Connection 1	406 mm on St-Laurent Connection 2	305mm on Belfast Connection 3
Minimum HGL (m)	110.1	110.1	110.1
Maximum HGL (m)	118.3	118.2	118.4
Max Day + FF (233 L/s)	108.0	110.8	107.4
Max Day + FF (250 L/s)	107.2	110.5	106.6
Max Day + FF (267 L/s)	106.4	110.1	105.7

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Shohan

Shohan Ahmad, P.Eng., M.E.Sc., Ph.D.
Senior Engineer, Water Resources
City of Ottawa - Infrastructure & Water Services
Shohan.ahmad@ottawa.ca

From: Qadan, Sami <Sami.Qadan@ottawa.ca>
Sent: 2024/05/22 3:29 PM
To: Ahmad, Shohan <Shohan.Ahmad@ottawa.ca>
Cc: Amor, Jonathan <jonathan.amor@ottawa.ca>
Subject: FW: 31489-021 - OCT South Garage Upgrades Ph2

Hi Shohan,

Could you please advise us on the status of the request sent below by the project consultant.

Please let us know if you have any concerns or questions about this request.

Kind regards

Sami Qadan
613 9132715

From: Tatyana Roumie <troumie@jlrichards.ca>
Sent: Tuesday, May 7, 2024 3:47 PM
To: Ahmad, Shohan <Shohan.Ahmad@ottawa.ca>
Cc: Andrew Duncan <aduncan@jlrichards.ca>; Lee Jablonski <ljablonski@jlrichards.ca>; Annie Williams <awilliams@jlrichards.ca>
Subject: RE: 31489-021 - OCT South Garage Upgrades Ph2

Hello Shohan,

As a follow up to our previous boundary condition request, we're now looking at options to achieve higher fire flows on our site.

We are requesting boundary conditions for four (4) of the configuration scenarios below (refer to the attached). We prefer boundary conditions for Scenarios #1, #2, #5 and #6. However, if this information at the end of the 254mm water service is not available, then we request boundary conditions for Scenarios #1, #2, #3 and #4. Please also send meter data for the existing building supplied by the 254mm water service if this is the case.

- Scenario #1: No upgrades. Requesting boundary conditions at Connections 1 and 3 (Connection 3 is located on the St. Laurent Blvd 406mm watermain on the other side of the 152mm stub.)

- Scenario #2: Proposed 300 mm pipe upgrade crossing St. Laurent Blvd. Requesting boundary conditions at Connections 1 and 3
- Scenario #3: Proposed third connection to the site from Belfast Rd using existing 254mm water service. Requesting boundary conditions at Connections 1, 2, and 4
- Scenario #4: Proposed third connection to the site from Belfast Rd using existing 254mm water service + proposed 300 mm pipe upgrade crossing St. Laurent Blvd. Requesting boundary conditions at Connections 1, 3, and 4
- Scenario #5: Proposed third connection to the site from Belfast Rd using existing 254mm water service. Requesting boundary conditions at Connections 1, 2, and 5
- Scenario #6: Proposed third connection to the site from Belfast Rd using existing 254mm water service + proposed 300 mm pipe upgrade crossing St. Laurent Blvd. Requesting boundary conditions at Connections 1, 3, and 5

We kindly request these boundary conditions for the same demands and fire flows provided previously.

Should you have any questions, please do not hesitate to contact me.

Thanks,
Tatyana

Tatyana Roumie, EIT, M.Eng.
Civil Engineering Intern
Ottawa, ON
Work: 343-804-9370

From: Ahmad, Shohan <Shohan.Ahmad@ottawa.ca>
Sent: Wednesday, April 17, 2024 1:44 PM
To: Tatyana Roumie <troumie@jlrichards.ca>
Cc: Andrew Duncan <aduncan@jlrichards.ca>; Lee Jablonski <ljablonski@jlrichards.ca>; Annie Williams <awilliams@jlrichards.ca>
Subject: RE: 31489-021 - OCT South Garage Upgrades Ph2

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Hi Tatyana, BC request received.

Shohan

Shohan Ahmad, P.Eng., M.E.Sc., Ph.D.
Senior Engineer, Water Resources
City of Ottawa - Infrastructure & Water Services

Shohan.ahmad@ottawa.ca

From: Tatyana Roumie <troumie@jlrichards.ca>
Sent: 2024/04/17 9:04 AM
To: Ahmad, Shohan <Shohan.Ahmad@ottawa.ca>
Cc: Andrew Duncan <aduncan@jlrichards.ca>; Lee Jablonski <ljablonski@jlrichards.ca>; Annie Williams <awilliams@jlrichards.ca>
Subject: 31489-021 - OCT South Garage Upgrades Ph2

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Hello Shohan,

We would like to obtain hydraulic boundary conditions for OC Transpo's industrial site located at 1500 Saint Laurent Boulevard.

The site consists of two existing buildings owned by OC Transpo and a third building is proposed to be constructed for the storage of electrical buses.

The site has an existing watermain loop which is connected to the City's system at St. Laurent Blvd. and Belfast Road. We are requesting the boundary conditions at these two existing watermain connections. (See attached)

The demands for the two existing buildings were calculated using the water usage data provided from OC Transpo. For the proposed building, the maximum day demand and peak hour demand were provided by AECOM and the average day demand was derived using the same peaking factor as the existing buildings. The total demands are shown in the table below:

	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)
Two Existing Buildings	1.09	1.63	36.00
Proposed Building	0.54	0.81	18.00
Total	**1.63**	**2.44**	**54.00**

Average Day = 1.63 L/s
Maximum Day = 2.44 L/s
Peak Hour = 54.00 L/s
Fire Flow 1 (OBC Sprinkler) = 101 L/s
Fire Flow 2 (FUS) = 233 L/s
Fire Flow 3 (FUS) = 250 L/s
Fire Flow 4 (FUS) = 267 L/s

The sprinkler system was calculated by AECOM to be 101 L/s (6,060 L/min). The FUS fire flow requirement for the proposed building was also calculated by AECOM to be 233 L/s (13,980 L/min).

The FUS fire flow requirement of 250 L/s (15,000 L/min) was calculated for the existing north garage building, as detailed in the attachment.

The FUS fire flow requirement of 267 L/s (16,020 L/min) was calculated for the existing south garage building, as detailed in the attachment.

We kindly request hydraulic boundary conditions for minimum and maximum pressures and under maximum day demand based on fire flows of 101 L/s, 233 L/s, 250 L/s, and 267 L/s.
If we could receive the requested boundary conditions at your earliest convenience it would be much appreciated.

Should you have any questions or require any further information, please do not hesitate to contact me.

Thank you,

Tatyana

Tatyana Roumie, EIT, M.Eng.
Civil Engineering Intern

1000-343 Preston Street
Ottawa, ON, K1S 1N4

Work: 343-804-9370
troumie@jlrichards.ca

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FUS Fire Flow Calculations (Per City of Ottawa ISTB-2018-02)
OC Transpo Electrical Bus Storage Facility (Industrial Building) REV1

Step	Parameter	Value		Note
A	Type of Construction	Non-combustible		
	Coefficient (C)	0.8		Table G1 - ISTB-2018-02
B	Ground Floor Area	6331.5	m^2	
C	Height in storeys	1	storeys	
	Total Floor Area	6331.5	m^2	
D	Fire Flow Formula	F=220CVA		
	Fire Flow	14004	L/min	
	Rounded Fire Flow	14000		Rounded to nearest 1000 L/min
E	Occupancy Class	Free Burning		Municipal storage building - combustible occupancy class
	Occupancy Charge	15%		
	Occupancy Increase or Decrease	2100		
	Fire Flow	16100	L/min	
F	Sprinkler Protection	Automatic Fully Supervised		
	Sprinkler Credit	-50%		
	Decrease for Sprinkler	-8050	L/min	
G	***North Side Exposure***			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	0	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	0	m-storeys	
	Separation Distance	> 45	m	
	North Side Exposure Charge	0%		Table G5 - ISTB-2018-02
	East Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	86	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	86	m-storeys	
	Separation Distance	15.3	m	
	East Side Exposure Charge	14%		Table G5 - ISTB-2018-02
	South Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	0	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	0	m-storeys	
	Separation Distance	>45	m	
	South Side Exposure Charge	0%		Table G5 - ISTB-2018-02
	West Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Non-combustible		
	Length of Exposed Wall:	80	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	80	m-storeys	
	Separation Distance	40	m	
	West Side Exposure Charge	5%		Table G5 - ISTB-2018-02
	Total Exposure Charge	19%		
	Increase for Exposures	3059	L/min	
H	Fire Flow	11109	L/min	E + F + G
	Rounded Fire Flow	11000	L/min	Rounded to nearest 1000 L/min
City Cap	**Required Fire Flow (RRF)**	**11000**	**L/min**	City Cap Does Not Apply
		183	**L/sec**	

OC Transpo Ottawa - Bus Garage
Prelim Water Demand
20 Feb 2024

1) Limitations

The following water requirements for this proposed ZEB Bus Garage at 1500 St. Laurent Boulevard are estimated on the basis of very preliminary design stage information. Process water requirements are not fully developed, and usage patterns are estimated but will be refined in the tertiary stages of design.

Fire water requirements including Sprinkler flows and pressures are also preliminary, and are not based on any hydraulic calculations.

FUS fire flow requirement are not included, as it is assumed that this will be part of the site-wide water service investigation, and feeds to hydrants to serve the proposed building, will not affect preliminary demands. This is to be confirmed.

2) Current Preliminary Design

Fire Sprinkler System will tentatively include zones with Extra high Hazard Group II classification, and this results in large nominal flows. Actual design flows may be slightly higher but can only be confirmed when hydraulic calculations are done by the installation contractor. Flow requires to be maintained for a minimum of a 2-hour fire-fighting period.

Tentatively, a fire pump has been allowed in the design but may be omitted later if available pressures are found to be adequate, over this 2-hour duration. This is based on an assumed pressure at water entry point of 50psi (345Kpa)

There are only a few washrooms in this building. Fixture usage has been based on congested use and domestic water flow calculated accordingly. Domestic water will also be used for Garage floor wash washdown and this results in much heavier demands.

Process water is mainly the make-up supply for the Bus Wash. Estimates are based on initial considerations of Wash Equipment supplier and with assumed frequency of Bus washing. This will be confirmed later at detailed design stage.

3) Preliminary Water Demand

a) Water

Peak Flow rates:

Domestic	3.5 L/s
Floor Wash	12 L/s
Bus Wash	2.5 L/s
Total	18 L/s

Maximum Day Demand :

Domestic	2,000L
Floor Wash	2,400 L
Bus Wash	66,000 L
Total	70,400 L

Fire

Sprinkler, Hose demand and assumed Hydraulic calculation adjustment: 1600gpm.	101 L/s

Appendix C

FUS Calculations

FUS Fire Flow Calculations

OCT South Garage Upgrades Ph2 - Industrial Building

(JLR 31489-021)

Step	Parameter	Value		Note
A	Type of Construction	Non-combustible		
	Coefficient (C)	0.8		
B	Ground Floor Area	24675	m^2	Inlcuded 4 storey office building here (same as total floor area)
C	Height in storeys	1	storeys	1 storey warehouse with 4 storey office accounted above
	Total Floor Area	24675	m^2	
D	Fire Flow Formula	$F=220C\sqrt{A}$		
	Fire Flow	27647	L/min	
	Rounded Fire Flow	28000	L/min	Flow rounded to nearest 1000 L/min.
E	Occupancy Class	Combustible		
	Occupancy Charge	2%		Weighted average of the 3 different occupancy classes within the building
	Occupancy Increase or Decrease	456.8510638		
	Fire Flow	28456.85106	L/min	No rounding applied.
F	Sprinkler Protection	Automatic Fully Supervised		
	Sprinkler Credit	-50%		
	Decrease for Sprinkler	-14228	L/min	
G	*North Side Exposure*			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	89.8	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	89.8	m-storeys	
	Separation Distance	33.36	m	
	North Side Exposure Charge	5%		
	East Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	0.0	m	
	Height of Exposed Wall:	0	storeys	
	Length-Height Factor	0.0	m-storeys	
	Separation Distance	50	m	All buildings are greater than 50 m away
	East Side Exposure Charge	0%		
	South Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	0.0	m	
	Height of Exposed Wall:	0	storeys	
	Length-Height Factor	0.0	m-storeys	
	Separation Distance	83.27	m	Mixed use commercial building further than 50 m
	South Side Exposure Charge	0%		
	West Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	0.0	m	
	Height of Exposed Wall:	0	storeys	
	Length-Height Factor	0.0	m-storeys	
	Separation Distance	70.71	m	Existing building further than 50 m away
	West Side Exposure Charge	0%		
	Total Exposure Charge	5%		The total exposure charge is below the maximum value of 75%.
	Increase for Exposures	1423	L/min	
H	Fire Flow	15651	L/min	
	Rounded Fire Flow	16000	L/min	Flow rounded to nearest 1000 L/min.
City Cap	**Required Fire Flow (RFF)**	**16000**	**L/min**	
		267	**L/s**	

Fire Underwriters Survey (FUS) Fire Flow Calculations

In accordance with City of Ottawa Technical Bulletin ISTB-2018-02 dated March 21, 2018

FUS Fire Flow Calculations

OCT South Garage Upgrades Ph2 - Industrial Building

(JLR 31489-021)

Step	Parameter	Value		Note
A	Type of Construction	Non-combustible		
	Coefficient (C)	0.8		
B	Ground Floor Area	16485	m^2	Inlcuded 4 storey office building here (same as total floor area)
C	Height in storeys	1	storeys	1 storey warehouse with 4 storey office accounted above
	Total Floor Area	16485	m^2	
D	Fire Flow Formula	$F=220C\sqrt{A}$		
	Fire Flow	22597	L/min	
	Rounded Fire Flow	23000	L/min	Flow rounded to nearest 1000 L/min.
E	Occupancy Class	Combustible		
	Occupancy Charge	2%		Weighted average of the 3 different occupancy classes within the building
	Occupancy Increase or Decrease	477.4772036		
	Fire Flow	23477.4772	L/min	No rounding applied.
F	Sprinkler Protection	Automatic Fully Supervised		
	Sprinkler Credit	-50%		
	Decrease for Sprinkler	-11739	L/min	
G	*North Side Exposure*			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	0.0	m	
	Height of Exposed Wall:	0	storeys	
	Length-Height Factor	0.0	m-storeys	
	Separation Distance	50	m	No building within 50 m away
	North Side Exposure Charge	0%		
	East Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	0.0	m	
	Height of Exposed Wall:	0	storeys	
	Length-Height Factor	0.0	m-storeys	
	Separation Distance	68	m	
	East Side Exposure Charge	0%		
	South Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	89.8	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	89.8	m-storeys	
	Separation Distance	36.36	m	
	South Side Exposure Charge	5%		
	West Side Exposure			
	Exposing Wall:	Non-combustible		
	Exposed Wall:	Wood Frame		
	Length of Exposed Wall:	73.1	m	
	Height of Exposed Wall:	1	storeys	
	Length-Height Factor	73.1	m-storeys	
	Separation Distance	29	m	
	West Side Exposure Charge	9%		
	Total Exposure Charge	14%		The total exposure charge is below the maximum value of 75%.
	Increase for Exposures	3287	L/min	
H	Fire Flow	15026	L/min	
	Rounded Fire Flow	15000	L/min	Flow rounded to nearest 1000 L/min.
City Cap	**Required Fire Flow (RFF)**	**15000**	**L/min**	
		250	**L/s**	

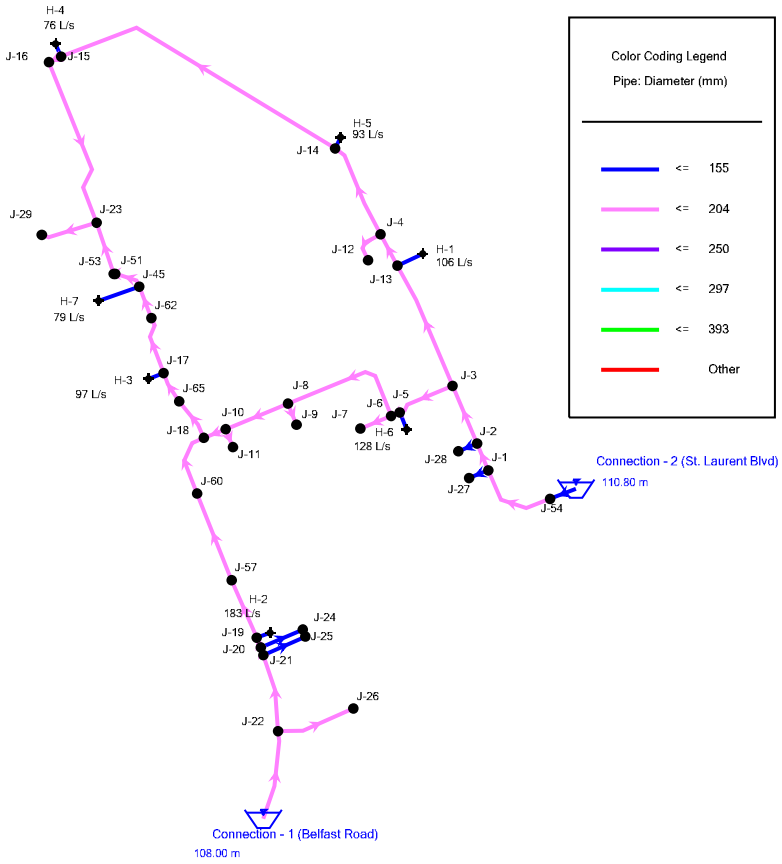
Fire Underwriters Survey (FUS) Fire Flow Calculations

In accordance with City of Ottawa Technical Bulletin ISTB-2018-02 dated March 21, 2018

Appendix D

WaterCAD Schematics

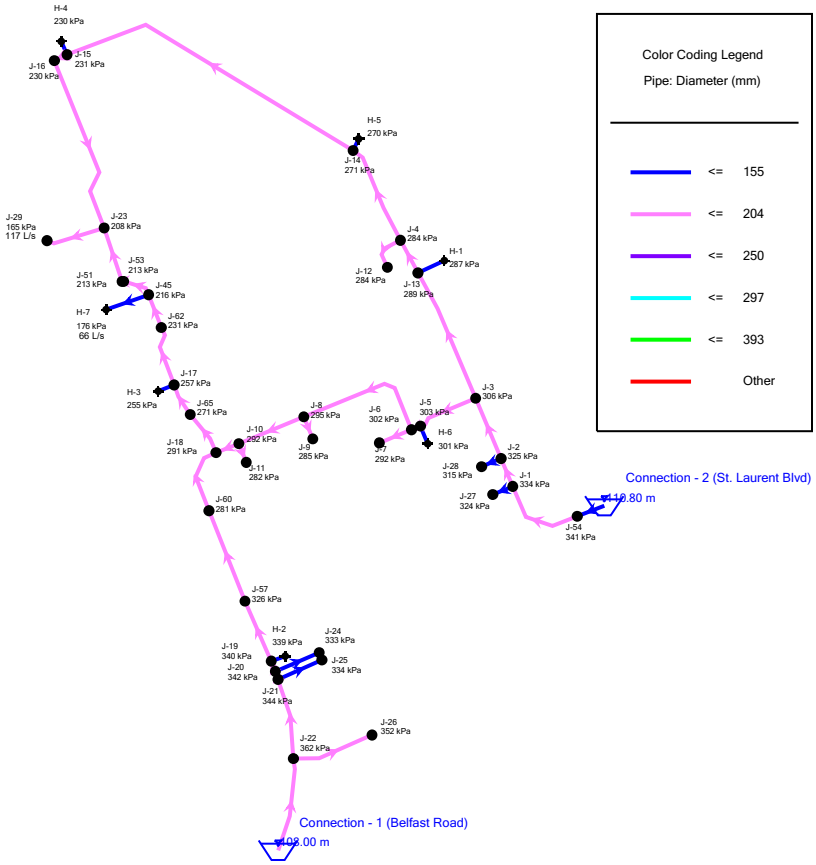
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 183 L/s)
Proposed Garage Sprinkler Demand = 117 L/s
Automatic Fire Flow



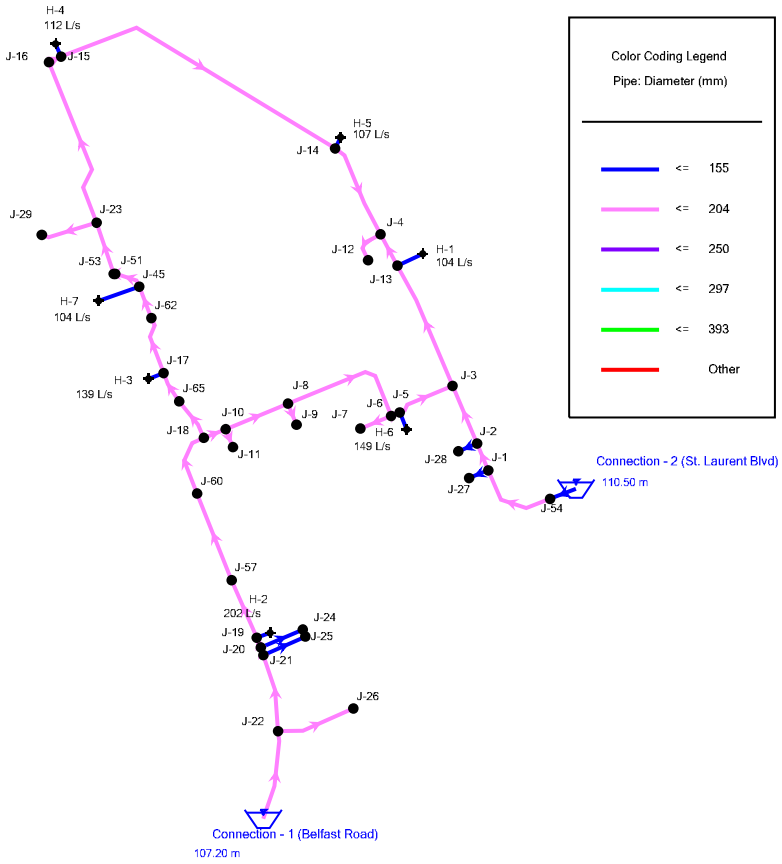
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 183 L/s)
Proposed Garage Sprinkler Demand = 117 L/s
Fire Flow Results Table

Label	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Zone Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Junction w/ Minimum Pressure (System)
H-1	106	106	True	140	140	149	J-29
H-2	183	183	True	140	140	154	J-29
H-3	97	97	True	140	140	178	J-29
H-4	76	76	True	140	140	170	J-29
H-5	93	93	True	140	140	169	J-29
H-6	128	128	True	140	140	175	J-29
H-7	79	79	True	140	141	140	J-29

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 183 L/s)
Proposed Garage Sprinkler Demand = 117 L/s
Manual Check



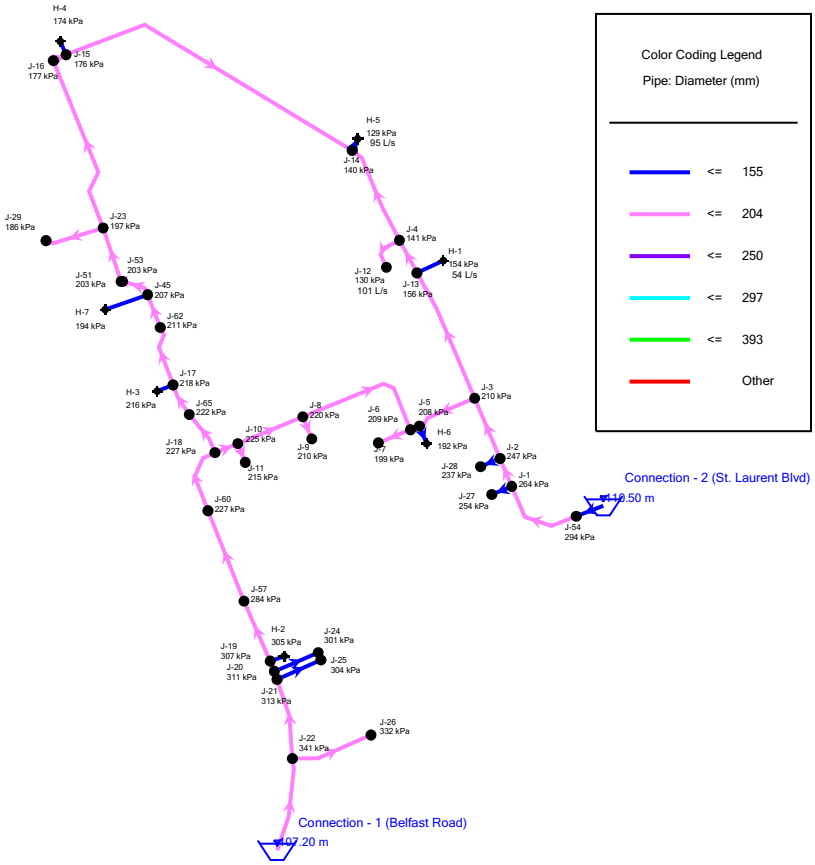
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 250 L/s)
North Garage Sprinkler Demand = 101 L/s
Automatic Fire Flow



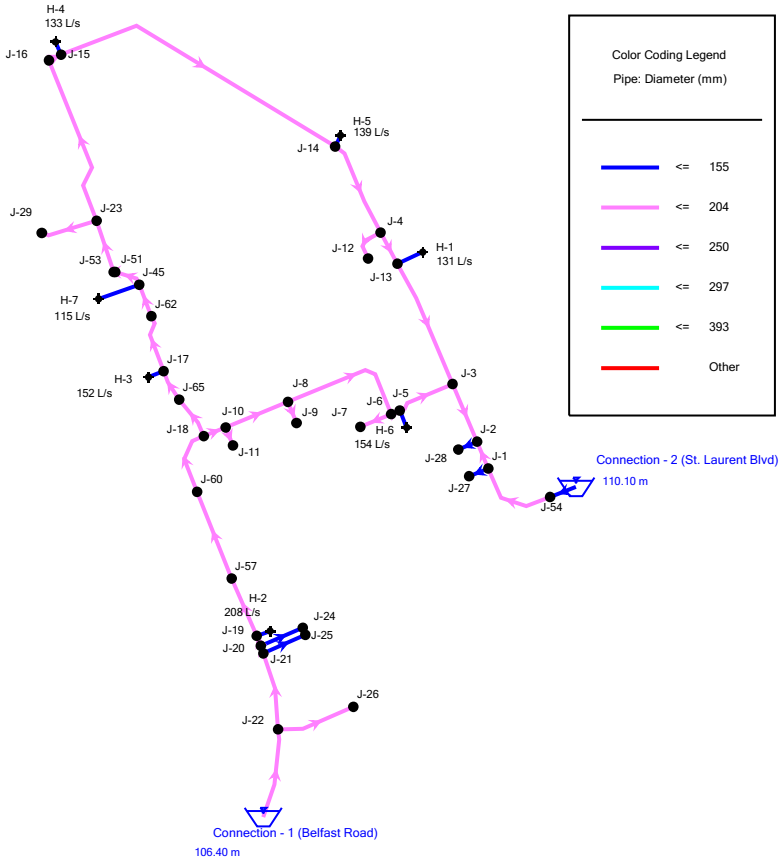
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 250 L/s)
North Garage Sprinkler Demand = 101 L/s
Fire Flow Results Table

Label	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Zone Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Junction w/ Minimum Pressure (System)
H-1	104	104	True	140	169	140	J-12
H-2	202	202	True	140	193	140	J-60
H-3	139	139	True	140	170	140	H-7
H-4	112	112	True	140	165	140	J-15
H-5	107	107	True	140	155	140	J-12
H-6	149	149	True	140	174	140	J-12
H-7	104	104	True	140	205	140	J-12

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 250 L/s)
North Garage Sprinkler Demand = 101 L/s
Manual Check



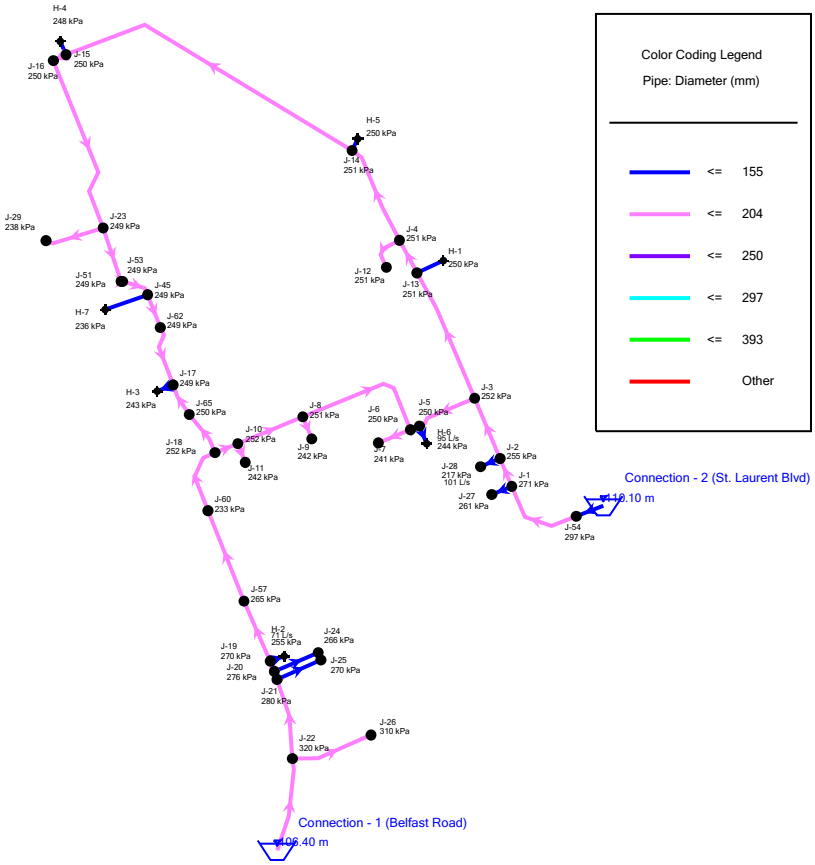
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 267 L/s)
South Garage Sprinkler Demand = 101 L/s
Automatic Fire Flow



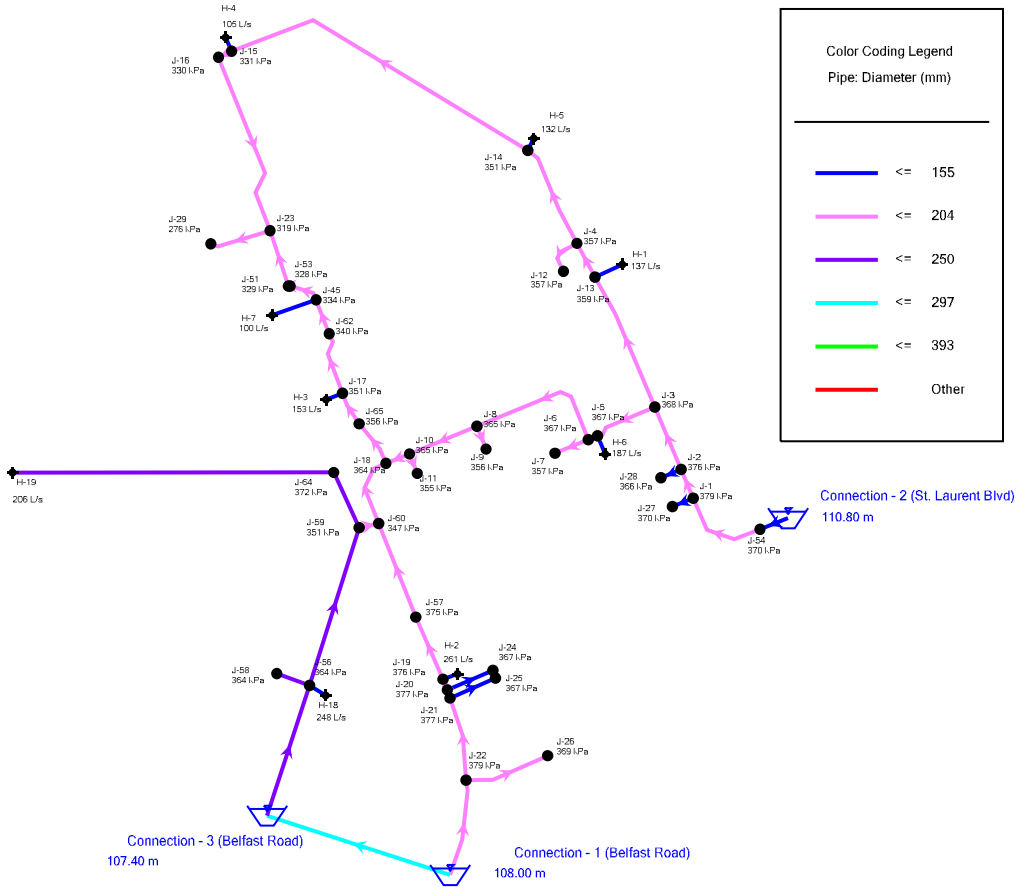
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 267 L/s)
South Garage Sprinkler Demand = 101 L/s
Fire Flow Results Table

Label	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Zone Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Junction w/ Minimum Pressure (System)
H-1	131	131	True	140	204	140	J-28
H-2	208	208	True	140	202	140	J-60
H-3	152	152	True	140	181	140	H-7
H-4	133	133	True	140	174	140	J-15
H-5	139	139	True	140	173	140	J-14
H-6	154	154	True	140	178	140	J-28
H-7	115	115	True	140	223	140	J-29

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 1 Existing Conditions
Max Day + Fire Flow (RFF = 267 L/s)
South Garage Sprinkler Demand = 101 L/s
Manual Check



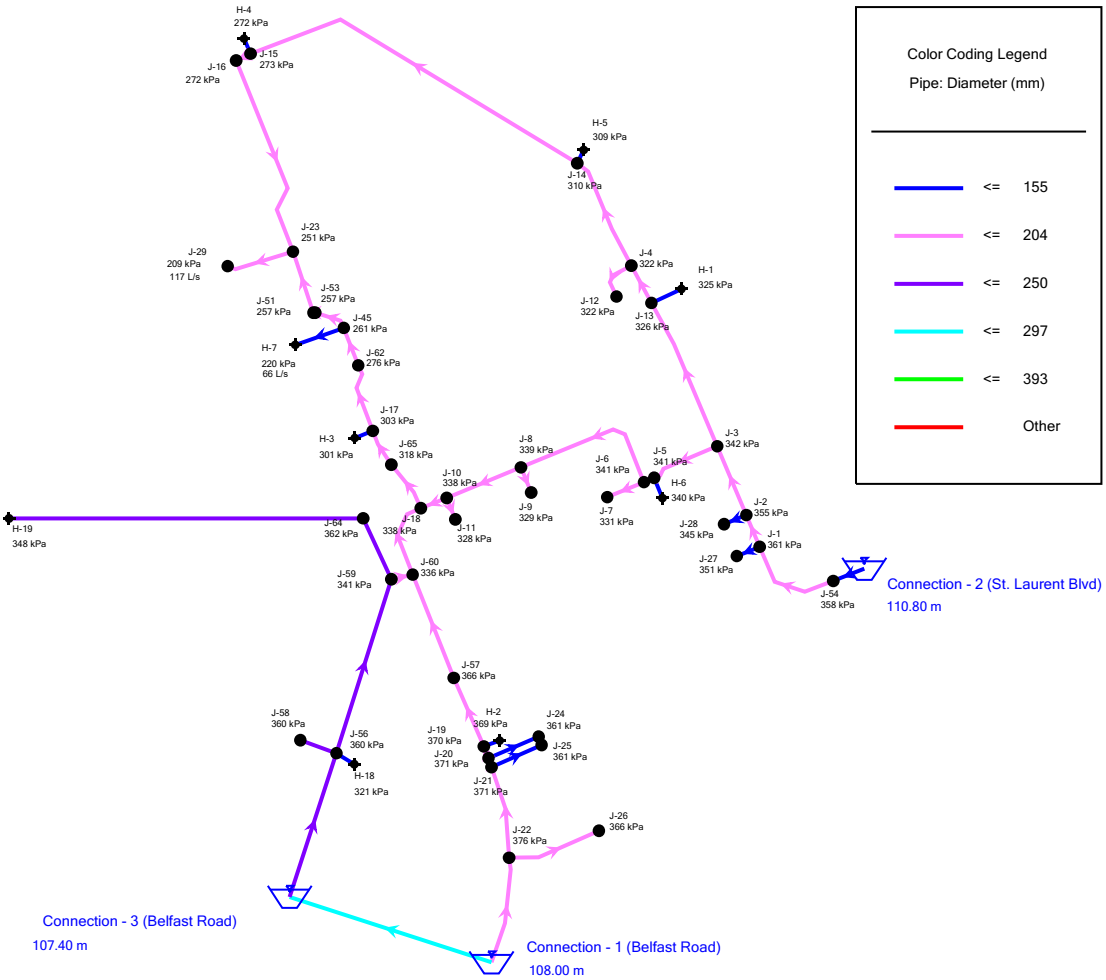
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Max Day + Fire Flow (RFF = 183 L/s)
Proposed Garage Sprinkler Demand = 117 L/s
Automatic Fire Flow



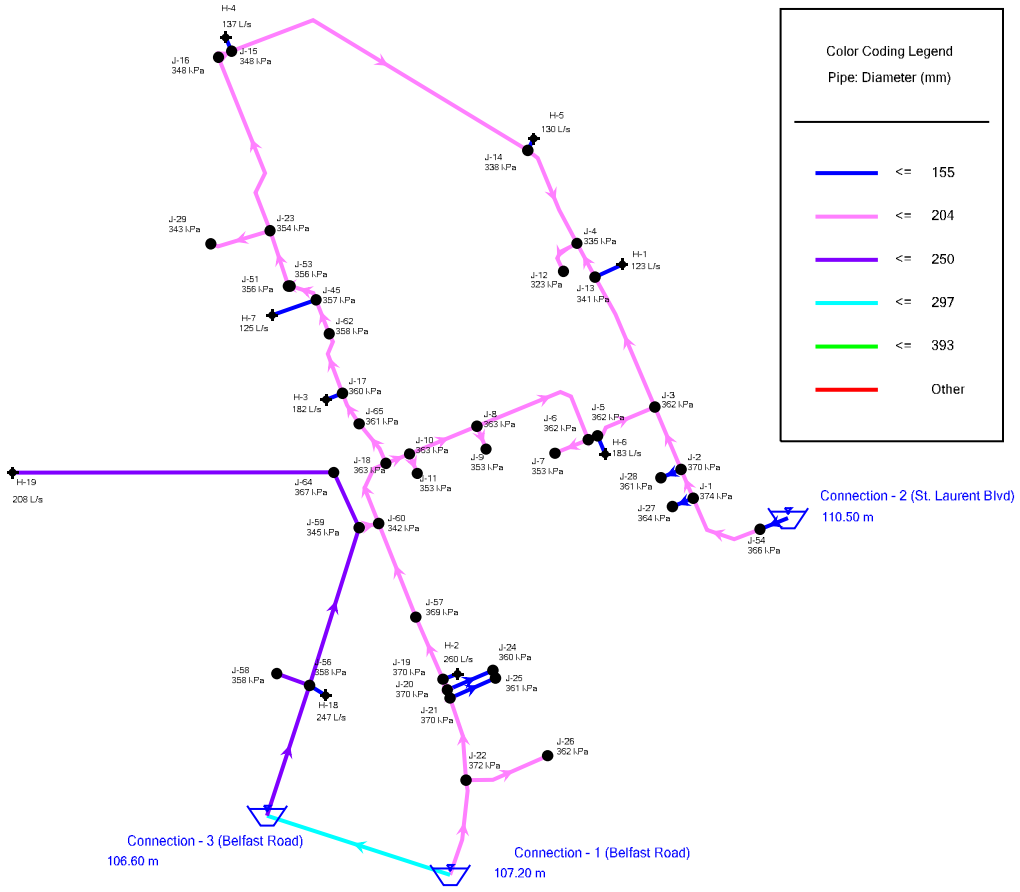
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Max Day + Fire Flow (RFF = 183 L/s)
Proposed Garage Sprinkler Demand = 117 L/s
Fire Flow Results Table

Label	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Zone Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Junction w/ Minimum Pressure (System)
H-1	137	137	True	140	167	140	J-29
H-2	261	261	True	140	226	140	J-29
H-3	153	153	True	140	140	146	J-29
H-4	105	105	True	140	140	158	J-29
H-5	132	132	True	140	140	150	J-29
H-6	187	187	True	140	173	140	J-29
H-7	100	100	True	140	163	140	J-29
H-18	248	248	True	140	236	140	J-29
H-19	206	206	True	140	223	140	J-29

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Max Day + Fire Flow (RFF = 183 L/s)
Proposed Garage Sprinkler Demand = 117 L/s
Manual Check



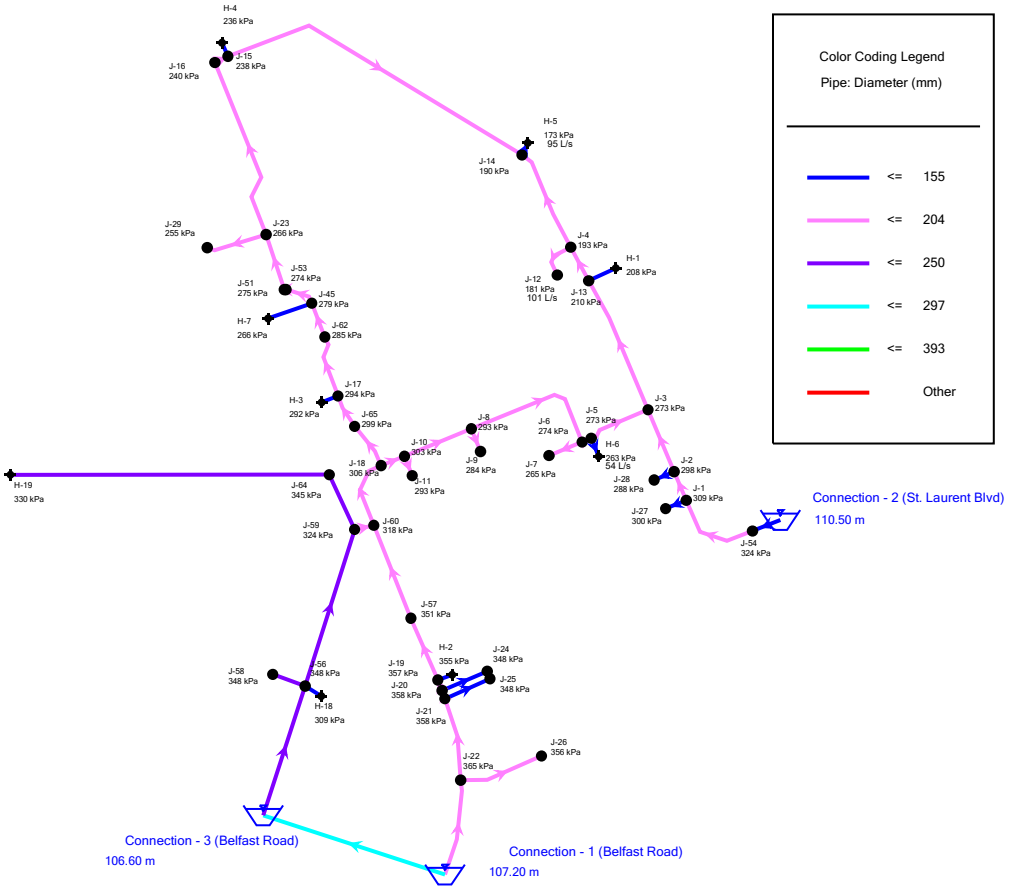
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Max Day + Fire Flow (RFF = 250 L/s)
North Garage Sprinkler Demand = 101 L/s
Automatic Fire Flow



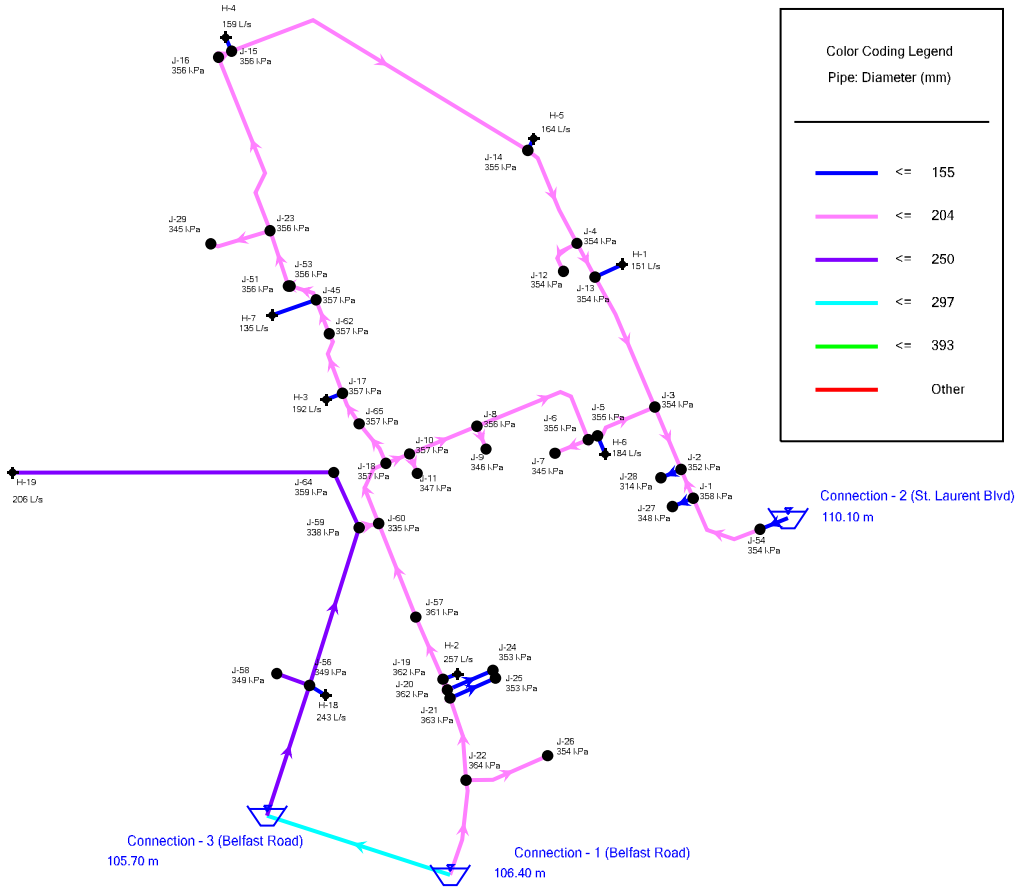
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Max Day + Fire Flow (RFF = 250 L/s)
North Garage Sprinkler Demand = 101 L/s
Fire Flow Results Table

Label	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Zone Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Junction w/ Minimum Pressure (System)
H-1	123	123	True	140	185	140	J-12
H-2	260	260	True	140	253	140	J-24
H-3	182	182	True	140	197	140	H-7
H-4	137	137	True	140	176	140	J-15
H-5	130	130	True	140	167	140	J-12
H-6	183	183	True	140	206	140	J-12
H-7	125	125	True	140	232	140	J-29
H-18	247	247	True	140	287	140	J-12
H-19	208	208	True	140	275	140	J-12

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Max Day + Fire Flow (RFF = 250 L/s)
North Garage Sprinkler Demand = 117 L/s
Manual Check



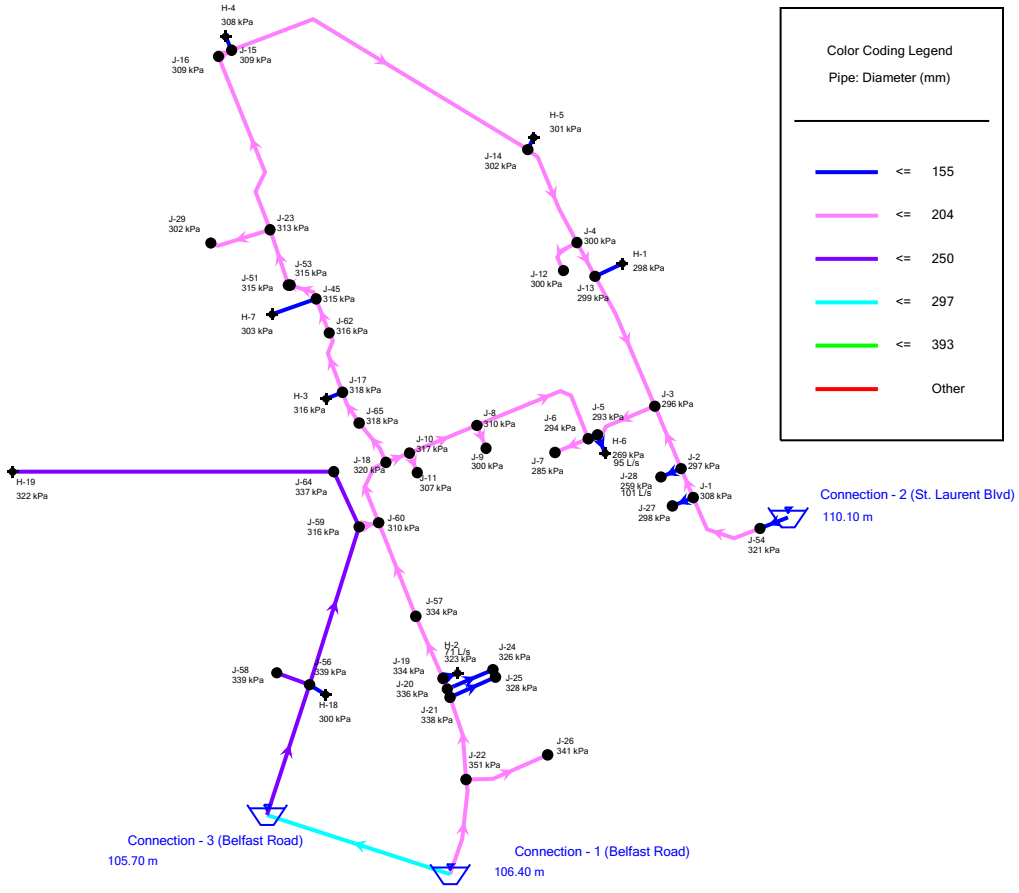
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Max Day + Fire Flow (RFF = 267 L/s)
South Garage Sprinkler Demand = 101 L/s
Automatic Fire Flow



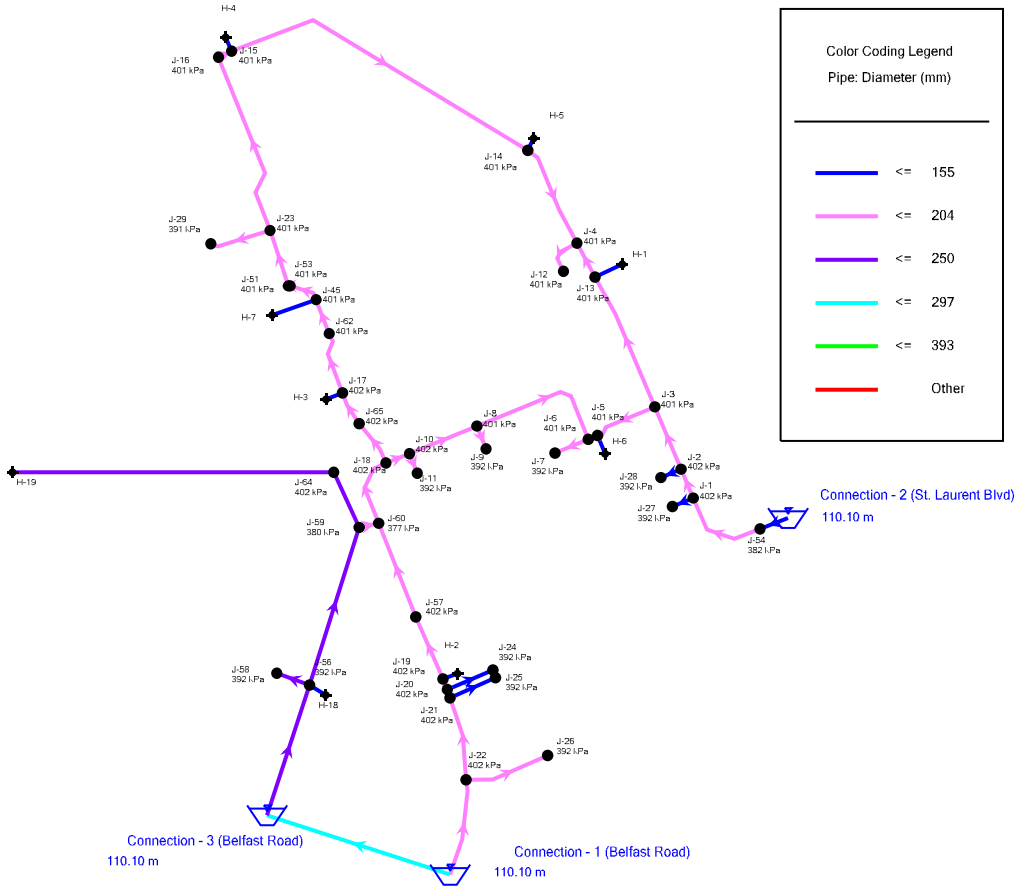
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Max Day + Fire Flow (RFF = 267 L/s)
South Garage Sprinkler Demand = 101 L/s
Fire Flow Results Table

Label	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Zone Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Junction w/ Minimum Pressure (System)
H-1	151	151	True	140	224	140	J-13
H-2	257	257	True	140	251	140	J-24
H-3	192	192	True	140	209	140	H-7
H-4	159	159	True	140	186	140	J-15
H-5	164	164	True	140	184	140	J-14
H-6	184	184	True	140	200	140	J-28
H-7	135	135	True	140	249	140	J-29
H-18	243	243	True	140	284	140	J-28
H-19	206	206	True	140	271	140	J-28

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Max Day + Fire Flow (RFF = 267 L/s)
South Garage Sprinkler Demand = 101 L/s
Manual Check



OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Peak Hour Demand



OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Peak Hour Demand
Junction Table

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-60	71.50	0.00	110.06	377
J-59	71.20	0.00	110.06	380
J-54	71.00	0.00	110.05	382
J-29	70.10	3.10	110.01	391
J-7	70.00	2.44	110.02	392
J-9	70.00	2.44	110.02	392
J-28	70.00	2.44	110.02	392
J-27	70.00	2.44	110.03	392
J-11	70.00	2.44	110.03	392
J-24	70.00	2.44	110.05	392
J-25	70.00	2.44	110.05	392
J-26	70.00	2.44	110.07	392
J-58	70.00	0.32	110.08	392
J-56	70.00	0.00	110.08	392
J-12	69.00	2.44	110.02	401
J-4	69.00	0.00	110.02	401
J-14	69.00	0.00	110.02	401
J-15	69.00	0.00	110.02	401
J-16	69.00	0.00	110.02	401
J-23	69.00	0.00	110.02	401
J-13	69.00	0.00	110.02	401
J-53	69.00	0.00	110.02	401
J-51	69.00	0.00	110.02	401
J-6	69.00	0.00	110.02	401
J-5	69.00	0.00	110.02	401
J-3	69.00	0.00	110.02	401
J-45	69.00	0.00	110.02	401
J-8	69.00	0.00	110.02	401
J-62	69.00	0.00	110.02	401
J-2	69.00	0.00	110.02	402
J-17	69.00	0.00	110.03	402
J-10	69.00	0.00	110.03	402
J-1	69.00	0.00	110.03	402
J-65	69.00	0.00	110.03	402
J-18	69.00	0.00	110.03	402
J-57	69.00	0.00	110.06	402
J-19	69.00	0.00	110.06	402
J-20	69.00	0.00	110.06	402
J-21	69.00	0.00	110.06	402
J-64	69.00	0.00	110.06	402
J-22	69.00	0.00	110.07	402

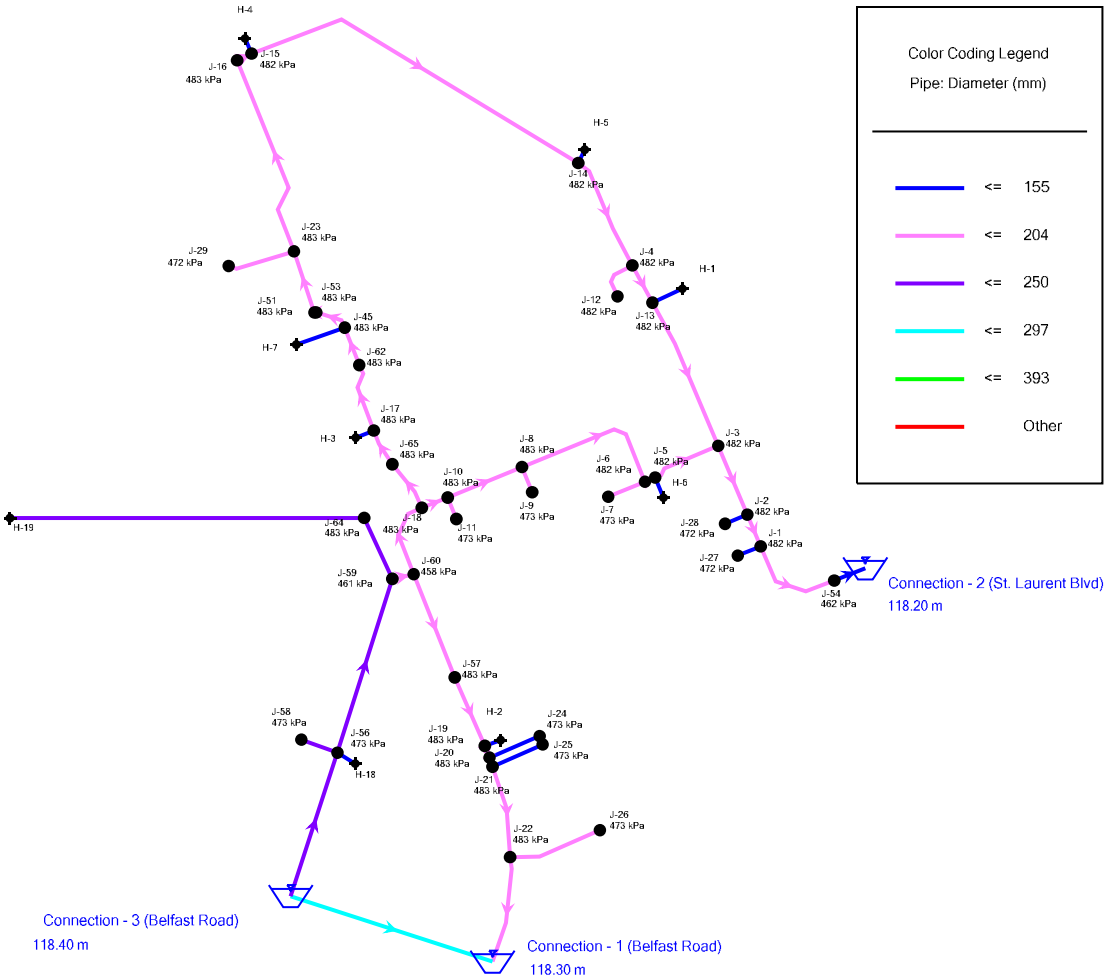
OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Peak Hour Demand
Pipe Table

Label	Length (Scaled) (m)	Diameter (mm)	Material	Hazen-Williams C	Hydraulic Grade (Start) (m)	Hydraulic Grade (Stop) (m)	Flow (L/s)	Velocity (m/s)
P-7	9.9	155	PVC	100.0	110.02	110.02	0.00	0.00
P-15	15.1	155	PVC	100.0	110.02	110.02	0.00	0.00
P-25	7.7	155	PVC	100.0	110.06	110.06	0.00	0.00
P-26	8.8	155	PVC	100.0	110.03	110.03	0.00	0.00
P-27	7.5	155	PVC	100.0	110.02	110.02	0.00	0.00
P-28	6.7	155	PVC	100.0	110.02	110.02	0.00	0.00
P-33	24.8	155	PVC	100.0	110.06	110.05	2.44	0.13
P-34	24.9	155	PVC	100.0	110.06	110.05	2.44	0.13
P-36	11.2	155	PVC	100.0	110.03	110.03	2.44	0.13
P-37	10.9	155	PVC	100.0	110.02	110.02	2.44	0.13
P-38	23.3	155	PVC	100.0	110.02	110.02	0.00	0.00
P-56	15.1	155	Cast Iron	100.0	110.05	110.10	-8.10	0.43
P-60	9.5	155	PVC	100.0	110.08	110.08	0.00	0.00
P-39	31.1	200	PVC	100.0	110.01	110.02	-3.10	0.10
P-2	15.7	204	PVC	110.0	110.03	110.02	5.66	0.17
P-3	33.9	204	PVC	110.0	110.02	110.02	3.22	0.10
P-4	32.9	204	PVC	110.0	110.02	110.02	1.03	0.03
P-5	5.0	204	PVC	110.0	110.02	110.02	1.03	0.03
P-6	18.0	204	PVC	110.0	110.02	110.02	2.44	0.07
P-8	74.3	204	PVC	110.0	110.02	110.02	-1.41	0.04
P-9	12.3	204	PVC	110.0	110.02	110.02	2.44	0.07
P-10	36.4	204	PVC	110.0	110.02	110.03	-3.85	0.12
P-11	10.5	204	PVC	110.0	110.03	110.03	2.44	0.07
P-12	20.1	204	PVC	110.0	110.02	110.02	2.44	0.07
P-13	71.6	204	PVC	110.0	110.02	110.02	2.19	0.07
P-14	19.2	204	PVC	110.0	110.02	110.02	2.19	0.07
P-16	53.3	204	PVC	110.0	110.02	110.02	-0.25	0.01
P-17	169.3	204	PVC	110.0	110.02	110.02	-0.25	0.01
P-18	7.2	204	PVC	110.0	110.02	110.02	-0.25	0.01
P-20	12.7	204	PVC	110.0	110.03	110.03	-6.29	0.19
P-21	5.7	204	PVC	110.0	110.06	110.06	-0.89	0.03
P-22	4.4	204	PVC	110.0	110.06	110.06	-3.33	0.10
P-23	42.2	204	PVC	110.0	110.06	110.07	-5.77	0.18
P-24	48.7	204	PVC	110.0	110.07	110.10	-8.21	0.25
P-30	93.8	204	PVC	110.0	110.02	110.02	-0.25	0.01
P-35	43.3	204	PVC	110.0	110.07	110.07	2.44	0.07
P-31(2)	15.7	204	PVC	110.0	110.02	110.02	-3.35	0.10
P-31(1) (1)	29.2	204	PVC	110.0	110.02	110.02	-3.35	0.10
P-31(1) (2)	0.8	204	PVC	110.0	110.02	110.02	-3.35	0.10
P-57	45.4	204	PVC	110.0	110.05	110.03	8.10	0.25

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 Proposed Conditions
Peak Hour Demand
Pipe Table

Label	Length (Scaled) (m)	Diameter (mm)	Material	Hazen-Williams C	Hydraulic Grade (Start) (m)	Hydraulic Grade (Stop) (m)	Flow (L/s)	Velocity (m/s)
P-29(2)	33.9	204	PVC	110.0	110.06	110.06	-0.89	0.03
P-29(1) (1)	36.4	204	PVC	110.0	110.03	110.06	-9.64	0.29
P-29(1) (2)	50.4	204	PVC	110.0	110.06	110.06	-0.89	0.03
P-32(1)	18.2	204	PVC	110.0	110.02	110.02	-3.35	0.10
P-32(2)	32.0	204	PVC	110.0	110.02	110.03	-3.35	0.10
P-19(1)	17.6	204	PVC	110.0	110.03	110.03	-3.35	0.10
P-19(2)	24.0	204	PVC	110.0	110.03	110.03	-3.35	0.10
P-69	9.9	204	PVC	110.0	110.06	110.06	8.74	0.27
P-59	68.5	250	PVC	110.0	110.10	110.08	9.06	0.18
P-62	17.4	250	PVC	110.0	110.08	110.08	0.32	0.01
P-63	82.8	250	PVC	110.0	110.08	110.06	8.74	0.18
P-67	30.4	250	PVC	110.0	110.06	110.06	0.00	0.00
P-70	160.7	250	PVC	110.0	110.06	110.06	0.00	0.00
P-58	96.3	297	Cast Iron	120.0	110.10	110.10	0.09	0.00

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Maximum HGL



OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Maximum HGL
Junction Table

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-60	71.50	0.00	118.33	458
J-59	71.20	0.00	118.34	461
J-54	71.00	0.00	118.24	462
J-29	70.10	0.00	118.31	472
J-27	70.00	0.00	118.26	472
J-28	70.00	0.00	118.27	472
J-7	70.00	0.00	118.29	473
J-9	70.00	0.00	118.31	473
J-26	70.00	0.00	118.31	473
J-11	70.00	0.00	118.31	473
J-25	70.00	0.00	118.32	473
J-24	70.00	0.00	118.32	473
J-56	70.00	0.00	118.37	473
J-58	70.00	0.00	118.37	473
J-1	69.00	0.00	118.26	482
J-2	69.00	0.00	118.27	482
J-3	69.00	0.00	118.28	482
J-13	69.00	0.00	118.29	482
J-4	69.00	0.00	118.29	482
J-12	69.00	0.00	118.29	482
J-5	69.00	0.00	118.29	482
J-6	69.00	0.00	118.29	482
J-14	69.00	0.00	118.29	482
J-15	69.00	0.00	118.30	482
J-16	69.00	0.00	118.30	483
J-8	69.00	0.00	118.31	483
J-23	69.00	0.00	118.31	483
J-22	69.00	0.00	118.31	483
J-53	69.00	0.00	118.31	483
J-51	69.00	0.00	118.31	483
J-45	69.00	0.00	118.31	483
J-62	69.00	0.00	118.31	483
J-10	69.00	0.00	118.31	483
J-17	69.00	0.00	118.31	483
J-65	69.00	0.00	118.31	483
J-18	69.00	0.00	118.32	483
J-21	69.00	0.00	118.32	483
J-20	69.00	0.00	118.32	483
J-19	69.00	0.00	118.32	483
J-57	69.00	0.00	118.32	483
J-64	69.00	0.00	118.34	483

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Maximum HGL
Pipe Table

Label	Length (Scaled) (m)	Diameter (mm)	Material	Hazen-Williams C	Hydraulic Grade (Start) (m)	Hydraulic Grade (Stop) (m)	Flow (L/s)	Velocity (m/s)
P-7	9.9	155	PVC	100.0	118.29	118.29	0.00	0.00
P-15	15.1	155	PVC	100.0	118.29	118.29	0.00	0.00
P-25	7.7	155	PVC	100.0	118.32	118.32	0.00	0.00
P-26	8.8	155	PVC	100.0	118.31	118.31	0.00	0.00
P-27	7.5	155	PVC	100.0	118.30	118.30	0.00	0.00
P-28	6.7	155	PVC	100.0	118.29	118.29	0.00	0.00
P-33	24.8	155	PVC	100.0	118.32	118.32	0.00	0.00
P-34	24.9	155	PVC	100.0	118.32	118.32	0.00	0.00
P-36	11.2	155	PVC	100.0	118.26	118.26	0.00	0.00
P-37	10.9	155	PVC	100.0	118.27	118.27	0.00	0.00
P-38	23.3	155	PVC	100.0	118.31	118.31	0.00	0.00
P-56	15.1	155	Cast Iron	100.0	118.24	118.20	7.34	0.39
P-60	9.5	155	PVC	100.0	118.37	118.37	0.00	0.00
P-39	31.1	200	PVC	100.0	118.31	118.31	0.00	0.00
P-2	15.7	204	PVC	110.0	118.26	118.27	-7.34	0.22
P-3	33.9	204	PVC	110.0	118.27	118.28	-7.34	0.22
P-4	32.9	204	PVC	110.0	118.28	118.29	-4.84	0.15
P-5	5.0	204	PVC	110.0	118.29	118.29	-4.84	0.15
P-6	18.0	204	PVC	110.0	118.29	118.29	0.00	0.00
P-8	74.3	204	PVC	110.0	118.29	118.31	-4.84	0.15
P-9	12.3	204	PVC	110.0	118.31	118.31	0.00	0.00
P-10	36.4	204	PVC	110.0	118.31	118.31	-4.84	0.15
P-11	10.5	204	PVC	110.0	118.31	118.31	0.00	0.00
P-12	20.1	204	PVC	110.0	118.29	118.29	0.00	0.00
P-13	71.6	204	PVC	110.0	118.28	118.29	-2.49	0.08
P-14	19.2	204	PVC	110.0	118.29	118.29	-2.49	0.08
P-16	53.3	204	PVC	110.0	118.29	118.29	-2.49	0.08
P-17	169.3	204	PVC	110.0	118.29	118.30	-2.49	0.08
P-18	7.2	204	PVC	110.0	118.30	118.30	-2.49	0.08
P-20	12.7	204	PVC	110.0	118.31	118.32	-4.84	0.15
P-21	5.7	204	PVC	110.0	118.32	118.32	4.35	0.13
P-22	4.4	204	PVC	110.0	118.32	118.32	4.35	0.13
P-23	42.2	204	PVC	110.0	118.32	118.31	4.35	0.13
P-24	48.7	204	PVC	110.0	118.31	118.30	4.35	0.13
P-30	93.8	204	PVC	110.0	118.30	118.31	-2.49	0.08
P-35	43.3	204	PVC	110.0	118.31	118.31	0.00	0.00
P-31(2)	15.7	204	PVC	110.0	118.31	118.31	-2.49	0.08
P-31(1) (1)	29.2	204	PVC	110.0	118.31	118.31	-2.49	0.08
P-31(1) (2)	0.8	204	PVC	110.0	118.31	118.31	-2.49	0.08
P-57	45.4	204	PVC	110.0	118.24	118.26	-7.34	0.22

OC Transpo - 1500 St. Laurent Boulevard
Boundary Condition - Scenario 2 - Proposed Conditions
Maximum HGL
Pipe Table

Label	Length (Scaled) (m)	Diameter (mm)	Material	Hazen-Williams C	Hydraulic Grade (Start) (m)	Hydraulic Grade (Stop) (m)	Flow (L/s)	Velocity (m/s)
P-29(2)	33.9	204	PVC	110.0	118.32	118.32	4.35	0.13
P-29(1) (1)	36.4	204	PVC	110.0	118.32	118.33	-7.34	0.22
P-29(1) (2)	50.4	204	PVC	110.0	118.33	118.32	4.35	0.13
P-32(1)	18.2	204	PVC	110.0	118.31	118.31	-2.49	0.08
P-32(2)	32.0	204	PVC	110.0	118.31	118.31	-2.49	0.08
P-19(1)	17.6	204	PVC	110.0	118.31	118.31	-2.49	0.08
P-19(2)	24.0	204	PVC	110.0	118.31	118.32	-2.49	0.08
P-69	9.9	204	PVC	110.0	118.34	118.33	11.69	0.36
P-59	68.5	250	PVC	110.0	118.40	118.37	11.69	0.24
P-62	17.4	250	PVC	110.0	118.37	118.37	0.00	0.00
P-63	82.8	250	PVC	110.0	118.37	118.34	11.69	0.24
P-67	30.4	250	PVC	110.0	118.34	118.34	0.00	0.00
P-70	160.7	250	PVC	110.0	118.34	118.34	0.00	0.00
P-58	96.3	297	Cast Iron	120.0	118.30	118.40	-33.60	0.48

Appendix G Supporting Information and Calculations for Sanitary Servicing Design

OCTranpo - ZEB Garage - 1500 St. Laurent Blvd., Ottawa ON

SANITARY SEWER DESIGN SHEET - PROPOSED CONDITIONS

PROJECT: 60716350
DATE: October, 2025

Exteranious Flow

I (l/s/ha) = 0.33
n = 0.013

Commercial
Q (l/s/ha) = 33600

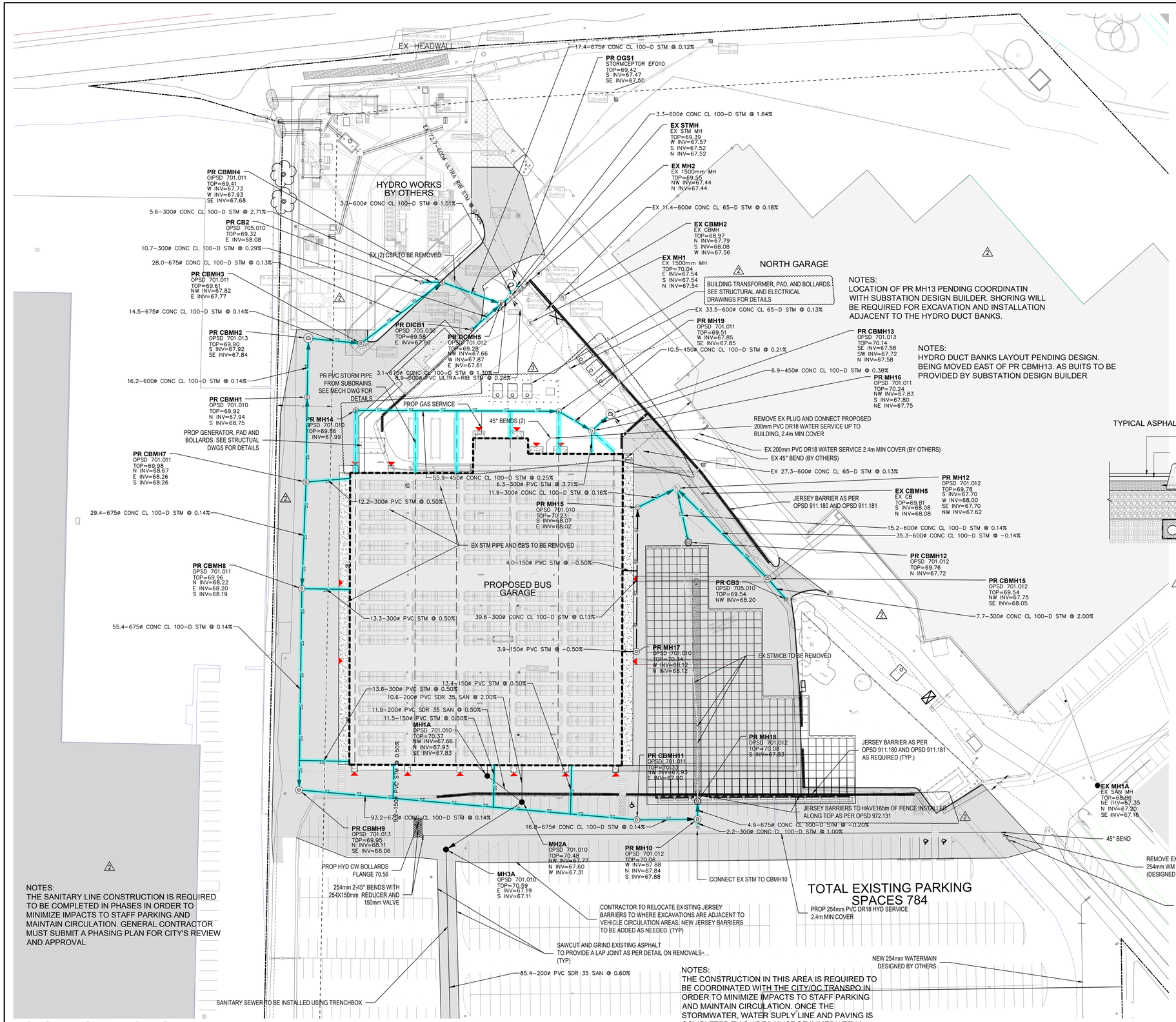
Industrial
Q (l/s/ha) = 55000

STREET	LOCATION		INDUSTRIAL		CUMULATIVE		PEAKING		PEAK	PEAK	PROPOSED SEWER						
	FROM MH	TO MH		AREA (ha)		AREA (ha)	FACTOR M	FLOW (l/s)	EXTR.FLOW (l/s)	DESIGN FLOW (l/s)	LENGTH (m)	SIZE (mm)	Type of Pipe	Grade (%)	CAPACITY (l/s)	FULL FLOW VEL.(m/s)	ACTUAL VEL.(m/s)
	Garage	MH1A	0	1.80	0	1.80	6.5	1.15	0.59	11.31	12.80	200	PVC	3.74	62.80	2.00	1.51
	MH1A	MH2A			0	1.80		0.00	0.00	11.31	11.90	200	PVC	0.50	22.96	0.73	0.73
	MH2A	MH3A			0	1.80		0.00	0.00	11.31	24.60	200	PVC	1.00	32.47	1.03	0.94
	MH3A	MH4A			0	1.80		0.00	0.00	11.31	85.40	200	PVC	0.80	29.04	0.92	0.87
	MH4A	Ex. Main			0	1.80		0.00	0.00	11.31	77.20	200	PVC	0.50	22.96	0.73	0.73

Input

Calculation

ARCH D 24" x 36"



NOTES:
THE SANITARY LINE CONSTRUCTION IS REQUIRED TO BE COMPLETED IN PHASES IN ORDER TO MINIMIZE IMPACTS TO STAFF PARKING AND MAINTAIN CIRCULATION. GENERAL CONTRACTOR MUST SUBMIT A PHASING PLAN FOR CITY'S REVIEW AND APPROVAL

NOTES:
LOCATION OF PR MH13 PENDING COORDINATIN WITH SUBSTATION DESIGN BUILDER. SHORING WILL BE REQUIRED FOR EXCAVATION AND INSTALLATION ADJACENT TO THE HYDRO DUCT BANKS.

NOTES:
HYDRO DUCT BANKS LAYOUT PENDING DESIGN. BEING MOVED EAST OF PR CBMH13. AS BUITS TO BE PROVIDED BY SUBSTATION DESIGN BUILDER

NOTES:
THE CONSTRUCTION IN THIS AREA IS REQUIRED TO BE COORDINATED WITH THE CITY/OC TRANSPO IN ORDER TO MINIMIZE IMPACTS TO STAFF PARKING AND MAINTAIN CIRCULATION. ONCE THE STORMWATER, WATER SUPLY LINE AND PAVING IS COMPLETED THIS AREA MUST BE IMMEDIATELY RETURNED TO THE STAFF PARKING AREA.

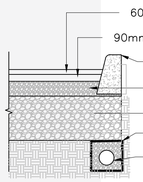
LEGEND

- EX STORM SEWER
- EX SANITARY SEWER
- EX WATERMAIN
- PROP STORM SEWER
- PROP SANITARY SEWER
- PROP WATERMAIN
- PROP ASPHALT AREA
- SEWER TO BE INSULATED AS PER OPSD 1109.030 (NOTE:CONC PIPE CLASS TO BE 100-D)
- PROP FLOOR SUBDRAIN

NOTES:
ORIFICE PLATES TO BE PLACED ON CBMH13, EX MH1 AND DCBMH5. SEE DRAWING C012 FOR ORIFICE PLATE LOCATION, SIZE AND INVERTS.

BUILDING SLAB TO HAVE SUBDAIN DRAINAGE SYSTEM. DRAINAGE SYSTEM TO CONNECT TO STORM SYSTEM. SEE MECHANICAL / STRUCTURAL DRAWINGS FOR DRAINAGE SYSTEM DETAILS.

TYPICAL ASPHALT SECTION



NOTES:
EXISTING UTILITIES, STORM AND SANITARY SYSTEMS TO BE LOCATED AND CONFIRMED IN FIELD PRIOR TO INSTALLATION OF SANITARY OUTLET. DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER.
ALL CROSSINGS OF UTILITIES, SEWERS, WATERMAINS AND STRUCTURES TO BE SUPPORTED AND PROTECTED WITHIN THE TRENCH.
WHERE SANITARY SEWERS, STORM SEWERS AND WATERMAINS TO BE INSTALLED WITHIN EXISTING PAVED AREAS TO BE INSTALLED WITH TRENCH BOX STORM SEWER AND SERVICES ARE TO BE INSULATED AS PER OPSD 1109.030 WHERE COVER IS LESS THAN 1.5m. SEWER CONNECTIONS TO THE BUILDING TO BE TERMINATED 1m FROM BUILDING AND CAPPED.

NOTES:
THE STORMWATER INFRASTRUCTURE CONSTRUCTION ON THE NORTH AND WEST SIDES OF THE NEW GARAGE MUST BE COMPLETED IN PHASES PRIOR TO NEW GARAGE FOUNDATION EXCAVATION IN ORDER TO MINIMIZE IMPACTS TO BUS AND CONSTRUCTION TRAFFIC CIRCULATION. CONTRACTOR MUST SUBMIT A PHASING PLAN FOR CITY'S REVIEW AND APPROVAL. BUS ACCESS TO FUELLING STATION AND BUS EXIT AT BELFAST TO BE MAINTAINED.

File Number D07-12-25-0095
Plan Number 19357

1 | C006 SITE SERVICING PLAN

SCALE: 1 : 500

Last Plotted:
Filename:

Ottawa
INFRASTRUCTURE SERVICES
DESIGN AND CONSTRUCTION

SERVICES D'INFRASTRUCTURE
DIRECTION DE CONCEPTION ET DE CONSTRUCTION

FOR / POUR
Client - Department
Infrastructure and Water Services Department
Design & Construction

CONSULTANT
AECOM

PRIME:
AECOM Canada Architects Ltd.
50 Sportsworld Crossing Road, Suite 290
Kitchener, Ontario, N2P 0A4

grc architects

SUBCONSULTANT:
GRC ARCHITECTS INC.
47 Clarence Street, Suite 401
Ottawa, Ontario, K1N 9K1

NOTE:
IT IS THE RESPONSIBILITY OF THE CONTRACTORS TO INFORM THEMSELVES OF THE EXACT LOCATION OF, AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES, SERVICES AND STRUCTURES WHETHER ABOVE GROUND OR BELOW GRADE BEFORE COMMENCING THE WORK. SUCH INFORMATION IS NOT NECESSARILY SHOWN ON THE DRAWING, AND WHERE SHOWN, THE ACCURACY CANNOT BE GUARANTEED.
WITH THE SOLE EXCEPTION OF THE BENCHMARK(S) SPECIFICALLY DESCRIBED FOR THIS PROJECT, NO ELEVATION INDICATED OR ASSUMED HEREON IS TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

NUMBER / NUMÉRO	MILESTONE/FAIT SAILLANT	DATE: (Y/M/D) / (AN/J)	INITIALS / INITIALES
4	ISSUED FOR SPA	2026/03/26	TG
3	REISSUED FOR TENDER	2026/03/26	TG
2	REISSUED FOR TENDER	2026/03/12	TG
1	ISSUED FOR TENDER	2025/12/15	TG

DESIGNED BY / CONCU PAR: TG/SS
CHECKED BY / VERIFIÉ PAR: TG
DRAWN BY / DESSINÉ PAR: SS
SCALE / ÉCHELLE: 1 : 500

DETAIL NUMBER 1 / A1.1 SHEET NUMBER — DRAWING TITLE

THIS DRAWING IS THE PROPERTY OF THE CITY OF OTTAWA AND ALL COPYRIGHT IS RESERVED. DIMENSIONS ON DRAWING ARE FOR ESTIMATING PURPOSES ONLY. IT IS THE RESPONSIBILITY OF EACH CONTRACTOR AND SUB-CONTRACTOR OR CONSULTANT TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON SITE. NOTIFY OWNER OF ANY ERRORS OR OMISSIONS PRIOR TO COMMENCING THE WORK. DO NOT SCALE THE DRAWINGS.

CE DESSIN CONSTITUE LA PROPRIÉTÉ DE LA VILLE D'OTTAWA ET TOUT DROIT D'AUTEUR EST RÉSERVÉ. LES DIMENSIONS UTILISÉES LE SONT À DES FINS D'ESTIMATION SEULEMENT. IL INCOMBE À CHAQUE ENTREPRENEUR, SOUS-CONTRACTANT OU CONSULTANT DE VÉRIFIER TOUTES LES DIMENSIONS ET LES CONDITIONS SUR LE CHANTIER. VEUILLEZ INFORMER LE PROPRIÉTAIRE DE TOUTE ERREUR OU OMISSION AVANT D'ENTAMER LES TRAVAUX. NE DRESSEZ PAS LES PLANS À L'ÉCHELLE.

ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER — T. J. GRANT — 26 Mar 2026 — PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

CONSULTANT / EXPERT-CONSEIL

PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

Enter address here,

OTTAWA, ONTARIO

DRAWING / DESSIN

SITE SERVICING PLAN

BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT: **OMF1**

SHEET NO. / FEUILLE No.: **C006**

CITY PROJECT NO. / NUMÉRO DE PROJET: **60716350**

CONS_PROJECT NO. / NUMÉRO DE PROJET:

Appendix H Site Stormwater Background Information and Previous Plans

STORMWATER SITE MANAGEMENT PLAN

OC TRANSPO
CITY OF OTTAWA
1500 ST. LAURENT BOULEVARD SITE

July, 2006

Prepared for:

OC TRANSPO
CITY OF OTTAWA
1500 St. Laurent Boulevard
Ottawa, Ontario
K1G 0Z8

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
Consulting Engineers, Architects & Planners
864 Lady Ellen Place
Ottawa, Ontario
K1Z 5M2

JLR 21301-01

LEGEND

SUB-AREA NO.
WEIGHTED RUNOFF COEFFICIENT
OUTLET DESCRIPTION
AREA (ha.)

2	0.90
2.58ha	750 STM

SUB-AREA NO.
ACTUAL WEIGHTED RUNOFF COEFFICIENT (DRAINAGE AREA CONTROLLED TO RUNOFF COEFFICIENT OF 0.50)
OUTLET DESCRIPTION
AREA (ha.)

4C	0.69*
0.43ha	CP DITCH

LANDSCAPED AREA (C=0.2)
DRAINAGE AREA BOUNDARY
DITCH/SWALE
STORM SEWER
CATCH BASIN
DITCH INLET CATCH BASIN
CULVERT

3	ISSUED FOR MOE APPROVAL	JULY 14/06
2	FOR REVIEW	MAR 12/03
1	FOR REVIEW	DEC 20/02
NO.	ISSUE	DATE

SCALE: 1:1000

J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2
Tel: (613) 728-3571 Fax: (613) 728-6012

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

CITY OF OTTAWA

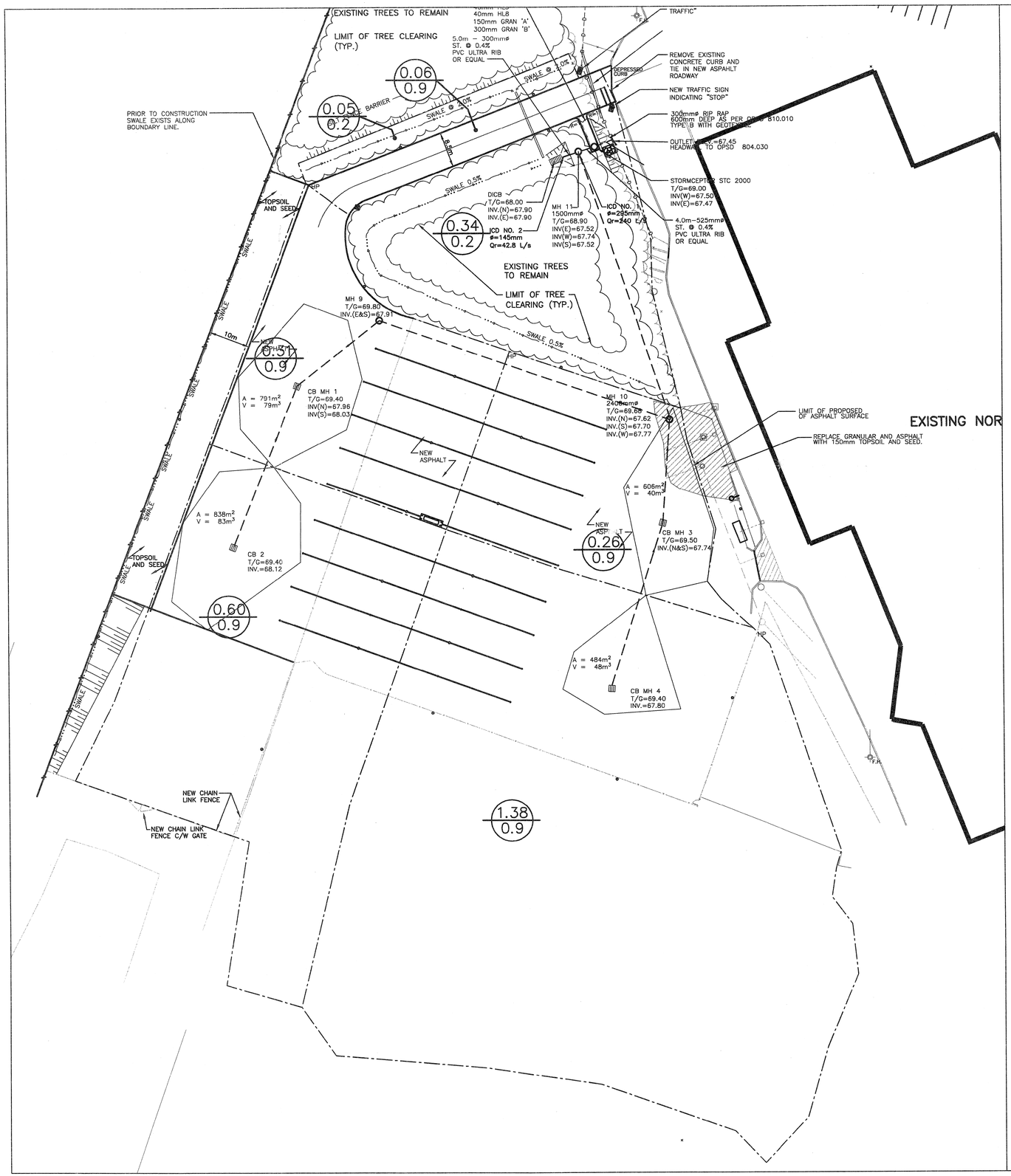
OC Transpo

1500 ST. LAURENT BLVD SITE

DRAWING:

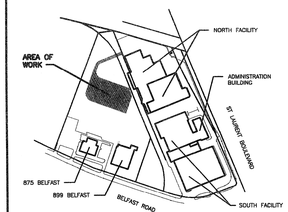
SITE STORM
DRAINAGE AREA PLAN

DESIGN: GF/DU	DRAWING NO.: SD1
DRAWN: MF/DU	
CHECKED: LJ	
CAD FILE: 21301-SD1	JLR JOB NO.: 21301-01
PLOTTED: JULY 2006	



LEGEND

- EXISTING CATCH BASIN
- PROPOSED CATCH BASIN
- STORM SEWER AND MANHOLE
- DRAINAGE BOUNDARY
- 0.26 / 0.9 — AREA, ha / RUN OFF COEFFICIENT



OC TRANSPO SITE
NOT TO SCALE

NO.	ISSUE	DATE
4	DITCH IDENTIFIED PER CITY COMMENTS	3/09/02
3	ISSUED FOR MOEE APPROVAL	20/08/02
2	ISSUED FOR CITY REVIEW	01/08/02
1	ISSUED FOR REVIEW	29/07/02

SCALE: 1:500

J.L.Richards & Associates Limited
Consulting Engineers, Architects & Planners
864 LADY ELLEN PLACE, OTTAWA, CANADA K1Z 5M2
Tel: (613) 728-3571 Fax: (613) 728-6012

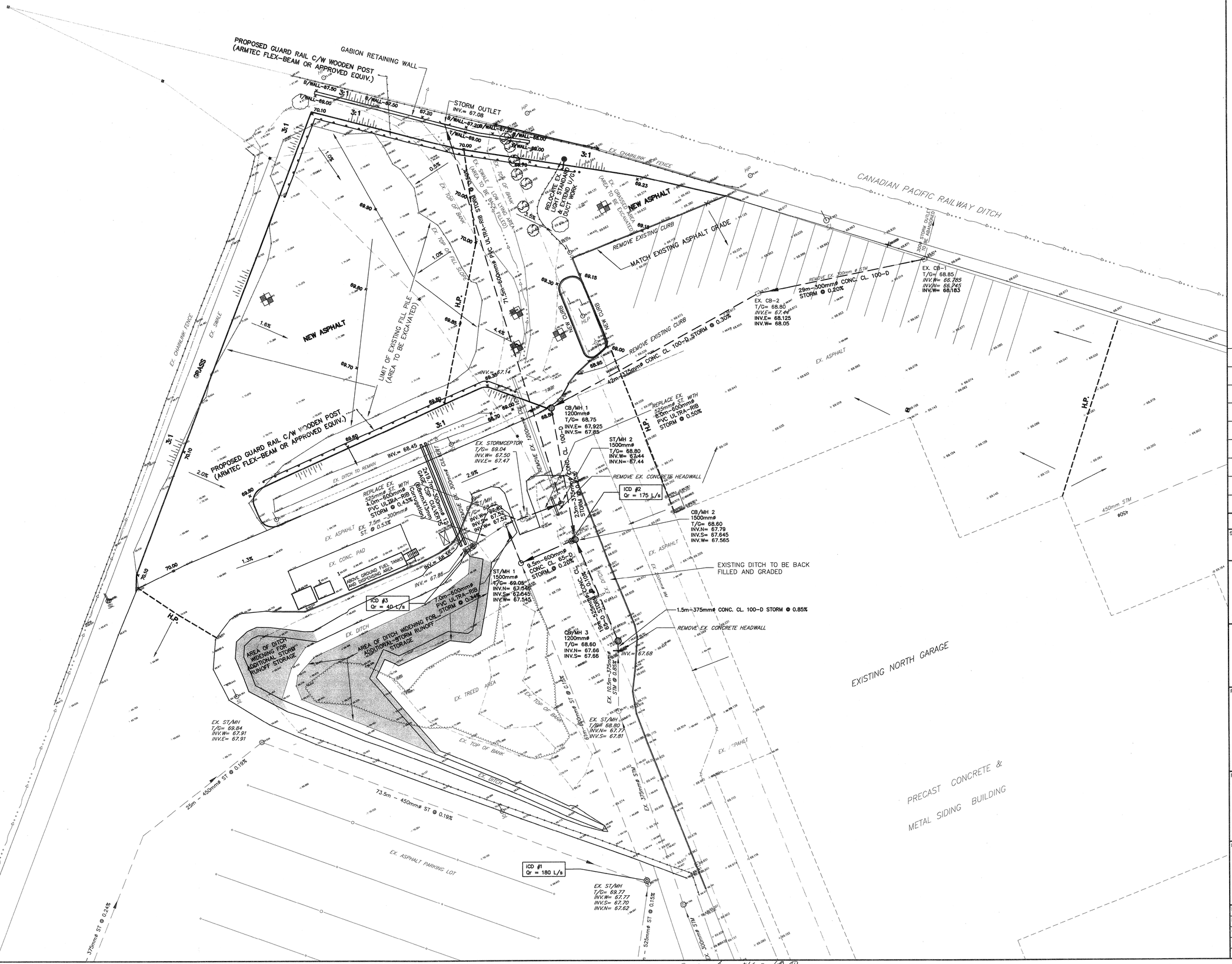
PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:
CITY OF OTTAWA
OC Transpo
1500 ST. LAURENT BLVD, OTTAWA

DRAWING:
BUS PARKING LOT UPGRADE
STORM DRAINAGE PLAN

DESIGN: LJ	DRAWING NO.: DR-1
DRAWN: JCW	
CHECKED: LJ	
CAD FILE:	JLR JOB NO: 17926-10
PLOTTED:	



LEGEND:

- PROPOSED STORM SEWER & MANHOLE
- PROPOSED CATCH BASIN / MANHOLE
- EXISTING WATERMAIN, VALVE & HYDRANT
- EXISTING STORM SEWER & MANHOLE
- EXISTING CATCH BASIN
- 69.05 EXISTING ELEVATION
- x 69.85 PROPOSED ELEVATION
- DIRECTION OF FLOW
- PROPOSED 3:1 BANKING
- H.P. HIGH POINT

NO.	ISSUE	DATE
2	FOR MOE APPROVAL	JULY 28/06
1	CITY REVIEW / COMMENTS	MAY 17/06

SCALE: 1:300

Ottawa

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS

J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

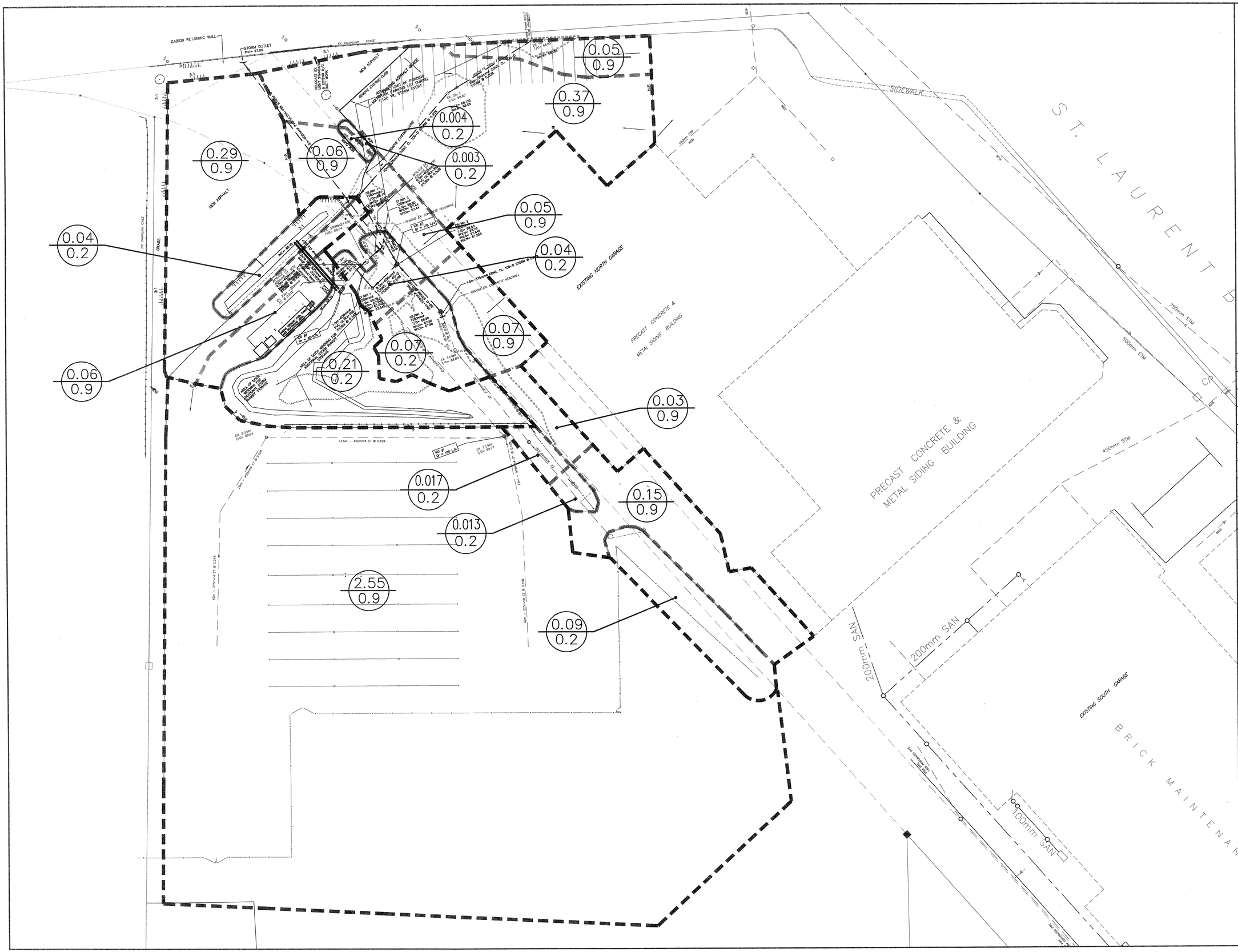
CITY OF OTTAWA
OC Transpo
PARKING LOT EXPANSION
1500 ST. LAURENT BLVD. , OTTAWA

DRAWING:

PRELIMINARY SITE SERVICE AND GRADING PLAN

DESIGN: DU	DRAWING NO.: S1
DRAWN: DU	
CHECKED: LJ	
CAD FILE: 21301 C S1	J.L.R. NO.: 21301
PLOTTED: MAY 2006	

CB MH 4 T/G = 68.80
INV = 67.80


LEGEND:
PROPOSED STORM SEWER & MANHOLE
PROPOSED CATCH BASIN / MANHOLE
EXISTING WATERMAIN, VALVE & HYDRANT
EXISTING STORM SEWER & MANHOLE
EXISTING CATCH BASIN
DIRECTION OF FLOW
PROPOSED 3:1 BANKING
H.P. HIGH POINT
DRAINAGE BOUNDARY
0.26 / 0.9 AREA, ha
RUN OFF COEFFICIENT
GABION RETAINING WALL
STORM OUTLET INV.= 67.05
EX. CHAINLINK FENCE
NEW ASPHALT
REMOVE EXISTING CURB
ADDITIONAL ASPHALT GRADE ADDITIONAL PARKING LOT DURING SATURDAY MKT. 100 YR. STORM EVENT
RELOCATE EX. LIGHT STANDARD & DUCT WORK
NEW CURB
EX. CB=1.50 T/G= 68.50
INV.E= 66.125
INV.W= 66.00
EX. CB=1.50 T/G= 68.50
INV.E= 66.00
INV.W= 65.875
EX. CB=1.50 T/G= 68.50
INV.E= 65.875
INV.W= 65.750
EX. CB=1.50 T/G= 68.50
INV.E= 65.750
INV.W= 65.625
EX. CB=1.50 T/G= 68.50
INV.E= 65.625
INV.W= 65.500
EX. CB=1.50 T/G= 68.50
INV.E=

Appendix I Existing Storm System Model Supporting Information

OC Transpo Zero Emissions Bus Garage
PN 60716350
Existing Conditions

Existing Conditions Parameters for PCSWMM Simulation - Catchments and On-Site Storage

Subcatchment ID	Recipient MH or CB	Area (ha)	Impervious %	On-Site Storage Depth (m)	On-Site Storage Maximum Surface Area (m2)*	On-Site Storage Maximum Surface Area (m2) Input into PCSWMM*	Width (m)	Flow Length (m)	Slope (%)
CA1	J4	0.37	100	-	-	-	61.2	60.0	0.50
CA2_1	CB4	1.29	100	0.3	389.39	129.8	106.3	121.0	0.50
CA2_3	CB1	0.35	100	0.3	442.68	147.6	44.1	80.0	0.50
CA2_4	CB2	0.75	100	0.3	404.65	134.9	64.9	115.0	0.50
CA2_5	CB3	0.25	100	0.2	429.9	143.3	43.2	57.0	0.50
CA3_1	ExCB	0.17	100	0.1	13.3	4.4	19.7	88.0	0.50
CA3_2	ExCB	0.09	25				12.7	72.0	0.50
CA3_3	ExCB	0.01	100				7.3	17.0	0.50
CA3_11	NE-CB2	0.39	100	0.2	545.0	181.7	38.7	100.0	0.50
CA3_4	ExCBMH1	0.04	100	-	-	-	10.6	36.0	0.50
CA3_6	CBMH3	0.06	100	0.13	36.1	12.0	18.9	33.0	0.50
CA3_7	CBMH3	0.07	95				23.3	31.0	0.50
CA3_5	ExCBMH1	0.02	100	-	-	-	8.3	20.0	0.50
CA2_7	DICB1	0.06	100	1	11.6	3.9	11.3	51.0	0.50
CA2_6	DICB1	0.21	100				46.5	45.0	0.50
CA3_8	CBMH2	0.05	100	-	-	-	19.9	26.0	0.50
CA3_9	CBMH2	0.04	50	-	-	-	18.1	23.0	0.50
CA3_10	CBMH1	0.07	100	0.25	43.2	14.4	17.2	40.0	0.50
CA1_2	J3	0.04	25	-	-	-	8.4	50.0	0.50
CA3_12	NE-CB1	0.06	100	0.05	86.9	29.0	9.5	60.0	0.50
Total Area (ha)	**4.38**	**97%**							

Applied to all Areas	
N Imperv	0.013
N Perv	0.25
Dstore Imperv (mm)	1.57
Dstore Perv (mm)	4.67
Horton's Parameters	
Max. Infilt. Rate (mm/hr)	76.2
Min. Infilt. Rate (mm/hr)	13.2
Decay Constant (1/hr)	4.14
Drying Time (days)	7

Existing Conditions Parameters for PCSWMM Simulation - Storm Sewers

Conduit ID	Inlet Node	Outlet Node	Length (m)	Inlet Elev. (m)	Outlet Elev. (m)	Pipe Diameter (m)	Roughness	Entry Loss Coeff.	Exit Loss Coeff.
C10	MH1	MH11	7.0	67.5	67.5	0.6	0.0	0.1	0.7
C11	DICB1-DUM	MH11	7.5	67.5	67.8	0.3	0.0	0.1	1.0
C12	MH11	OGS-STC2000	4.0	67.5	67.5	0.6	0.0	0.7	0.1
C13	OGS-STC2000	MH2	6.0	67.5	67.4	0.6	0.0	0.1	0.7
C14	MH2	J15	72.5	67.4	66.9	0.6	0.0	0.7	1.0
C15	NE-CB1	NE-CB2	29.0	68.2	68.1	0.3	0.0	0.1	0.2
C16	CB2	CB1	42.0	68.5	68.6	0.4	0.0	0.1	0.2
C17	CB1	MH9	25.0	68.4	68.3	0.5	0.0	0.2	0.2
C18	MH9	MH10	73.5	68.3	68.1	0.5	0.0	0.2	1.0
C19	CB4	CB3	42.0	68.2	68.1	0.5	0.0	0.1	0.2
C2	ExMH2	ExCBMH1	53.0	67.8	67.7	0.3	0.0	0.1	0.1
C20	CB3	MH10	25.0	68.1	67.7	0.5	0.0	0.2	0.2
C23	J2	DICB1	20.1	68.5	67.9	0.3	0.0	0.9	1.0
C24	J4	J2	28.9	68.5	68.5	0.4	0.0	0.0	0.0
C25	J3	J2	13.5	68.5	68.5	0.4	0.0	0.0	0.0
C26	ExCB	ExMH2	10.6	67.9	67.8	0.3	0.0	0.1	0.7
C3	ExCBMH1	ExMH1	10.5	67.7	67.6	0.4	0.0	0.1	0.1
C4	ExMH1	CBMH3	10.5	67.6	67.7	0.4	0.0	0.1	0.1
C5	CBMH3	CBMH2	19.0	67.7	67.6	0.5	0.0	0.7	0.1
C6	CBMH1	CBMH2	23.0	67.9	67.6	0.4	0.0	0.2	1.0
C7	NE-CB2	CBMH1	42.0	68.1	67.9	0.4	0.0	0.2	0.2
C8	CBMH2-DUM	MH1	9.5	67.6	67.5	0.6	0.0	0.7	1.0
C9	MH10-DUM	MH1	61.0	67.6	67.5	0.6	0.0	0.2	0.1

* C24 and C25 are ditches with trapezoid shape, 3H:1V side slopes, 2 m bottom width and 0.4 m depth

Existing Conditions Hydraulic Grade Line Results

CB/MH ID	Rim Elevation (m)	Hydraulic Grade Line (m)			Difference Rim Minus HGL (m)			On-Site Ponding Depth (m)
		5-Year	100-year	100-Year + 20%	5-Year	100-year	100-Year + 20%	
DICB1	68.00	68.90	69.07	69.18	-0.90	-1.07	-1.18	1.00
CB1	69.40	69.86	70.04	70.14	-0.46	-0.64	-0.74	0.30
CB2	69.40	69.96	70.44	70.72	-0.56	-1.04	-1.32	0.30
CB4	69.40	69.91	70.46	70.77	-0.51	-1.06	-1.37	0.30
CBMH1	68.75	68.86	68.99	69.06	-0.11	-0.24	-0.31	0.25
CB3	69.50	69.79	70.05	70.19	-0.29	-0.55	-0.69	0.20
NE-CB2	68.80	68.93	69.15	69.27	-0.13	-0.35	-0.47	0.20
CBMH3	68.64	68.80	68.82	68.84	-0.16	-0.18	-0.20	0.13
DICB1-DUM	68.00	68.56	68.62	68.64	-0.56	-0.62	-0.64	1.00
ExCB	68.79	69.06	69.23	69.33	-0.27	-0.44	-0.54	0.10
NE-CB1	68.85	68.93	69.16	69.27	-0.08	-0.31	-0.42	0.05
CBMH2	68.97	68.79	68.82	68.84	0.17	0.15	0.13	-
CBMH2-DUM	68.80	68.64	68.68	68.71	0.16	0.12	0.09	-
ExCBMH1	68.94	68.82	68.83	68.83	0.12	0.11	0.11	-
ExMH1	68.80	68.80	68.80	68.80	0.00	0.00	0.00	-
ExMH2	69.02	69.00	69.02	69.02	0.02	0.00	0.00	-
J2	68.75	68.85	68.85	68.85	-0.10	-0.10	-0.10	-
J3	68.80	68.85	68.86	68.86	-0.05	-0.06	-0.06	-
J4	68.80	68.86	68.87	68.87	-0.06	-0.07	-0.07	-
MH1	70.05	68.61	68.66	68.68	1.44	1.39	1.37	-
MH10	69.68	69.68	69.68	69.68	0.00	0.00	0.00	-
MH10-DUM	69.68	68.76	68.70	68.72	0.92	0.98	0.96	-
MH11	69.40	68.55	68.60	68.62	0.85	0.80	0.78	-
MH2	69.50	68.33	68.39	68.41	1.17	1.11	1.09	-
MH9	69.80	69.80	69.80	69.80	0.00	0.00	0.00	-
OGS-STC2000	69.58	68.45	68.50	68.52	1.13	1.08	1.06	-

Appendix J Rational Method and Site Plan Drawings

AECOM

OC Transpo Zero Emissions Bus Garage

STORM SEWER DESIGN SHEET
Version: 3.0
Project No.: 60716350
Date: Nov-25
Design: BP

City of Ottawa IDF Data			
Return Period	Parameters		
	A	B	C
2 Year	732.951	6.199	0.810
5 Year	998.071	6.053	0.814
10 Year	1174.184	6.014	0.816
25 Year	1402.884	6.018	0.819
50 Year	1569.580	6.014	0.820
100 Year	1735.688	6.014	0.820

Runoff C Adjustment Factors	
Ca 25 Year =	1.10
Ca 50 Year =	1.20
Ca 100 Year =	1.25

Mannings "n"	
CONC	0.013
CMP	0.024

LOCATION			CONTRIBUTING AREA														RAINFALL INTENSITY I_n (mm/hr)						FLOW Q_n (L/s)						SEWER DESIGN						
Segment	FROM	TO	AREA A(ha)	IMPERV RATIO	RUNOFF C < 10 Year	RUNOFF C 25 Year	RUNOFF C 50 Year	RUNOFF C 100 Year	AxC (ha) <10 Year	ACCUM. AxC (ha) <10 Year	AxC (ha) 25 Year	ACCUM. AxC (ha) 25 Year	AxC (ha) 50 Year	ACCUM. AxC (ha) 50 Year	AxC (ha) 100 Year	ACCUM. AxC (ha) 100 Year	I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	LENGTH (m)	SLOPE (%)	DIA. (mm)	FULL FLOW Capacity (L/s)	FULL FLOW Velocity (m/s)	FLOW TIME in pipe (min)	TIME OF CONC. (min)
Existing Sewer North and West of North Garage (No Modifications)																																		
100	NE-CB1	NE-CB2	0.06	0.90	0.90	0.99	1.08	1.13	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.07	104	141	166	197	219	243	15.2	20.8	24.4	31.8	38.7	44.6	29.0	0.2	300	43.2	0.61	0.79	5.00
101	NE-CB2	CBMH1	0.38	0.90	0.90	0.99	1.08	1.13	0.34	0.39	0.38	0.43	0.41	0.47	0.43	0.49	98	133	157	186	207	229	107.3	146.1	171.5	223.6	272.3	313.7	42.0	0.3	375	95.7	0.87	0.81	5.79
102	CBMH1	CBMH2	0.22	0.90	0.90	0.99	1.08	1.13	0.20	0.59	0.21	0.65	0.23	0.71	0.24	0.74	93	126	148	176	196	217	152.1	207.0	242.8	316.7	385.6	444.2	23.0	1.2	375	195.2	1.77	0.22	6.60
200	ExCB	ExMH2	0.26	0.58	0.58	0.63	0.69	0.72	0.39	0.39	0.16	0.16	0.18	0.18	0.18	0.18	104	141	166	197	219	243	112.2	152.9	179.6	88.7	108.0	124.4	10.6	0.4	300	59.5	0.84	0.21	5.00
201	ExMH2	ExCBMH1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.16	0.00	0.18	0.00	0.18	102	139	163	194	216	239	110.5	150.6	176.8	87.3	106.4	122.5	53.0	0.2	300	37.6	0.53	1.66	5.21
202	ExCBMH1	ExMH1	0.04	0.90	0.90	0.99	1.08	1.13	0.03	0.42	0.04	0.20	0.04	0.22	0.04	0.23	91	124	146	173	193	213	107.7	146.5	171.9	96.1	117.0	134.7	10.5	1.0	375	171.1	1.55	0.11	6.87
203	ExMH1	CBMH3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.20	0.00	0.22	0.00	0.23	91	123	145	172	192	212	106.9	145.4	170.6	95.4	116.1	133.8	12.6	0.0	375	0.2	0.00	0.00	6.98
204	CBMH3	CBMH2	0.15	0.88	0.88	0.97	1.06	1.10	0.14	0.56	0.15	0.35	0.16	0.38	0.17	0.40	91	123	145	172	192	212	141.0	191.7	225.0	166.2	202.4	233.1	19.0	0.1	525	120.8	0.56	0.57	6.98
New Sewer South of Substation and north of ZEB Garage																																		
400	NewCBMH1	NewCBMH2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	104	141	166	197	219	243	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.1	600	200.1	0.71	0.38	5.00
401	NewCBMH2	NewCBMH3	0.12	0.90	0.90	0.99	1.08	1.13	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.13	101	137	161	191	214	236	30.2	41.2	48.3	63.1	76.8	88.5	15.8	0.1	675	162.0	0.45	0.58	5.38
402	NewCBMH3	NewCBMH4	0.09	0.90	0.90	0.99	1.08	1.13	0.08	0.19	0.09	0.21	0.10	0.23	0.10	0.24	97	132	155	184	205	227	50.8	69.1	81.1	105.8	128.8	148.4	26.7	0.1	675	176.2	0.49	0.90	5.96
403	NewCBMH4	DCMH5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.21	0.00	0.23	0.00	0.24	91	124	146	173	193	214	47.9	65.1	76.4	99.7	121.4	139.8	16.9	0.1	675	156.6	0.44	0.64	6.86
300	DICB1	DCMH5	0.19	0.90	0.90	0.99	1.08	1.13	0.17	0.17	0.19	0.19	0.21	0.21	0.22	0.22	104	141	166	197	219	243	50.1	68.3	80.2	104.6	127.4	146.7	10.7	0.3	300	51.2	0.72	0.25	5.00
500	DCMH5	MH11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.40	0.00	0.44	0.00	0.45	88	120	140	166	186	205	88.6	120.4	141.3	184.2	224.3	258.3	3.1	1.3	600	697.5	2.47	0.02	7.51
New Sewer Southwest, South and Southeast of ZEB Garage																																		
600	NewCBMH1	NewCBMH7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	104	141	166	197	219	243	0.0	0.0	0.0	0.0	0.0	0.0	23.5	0.3	450	166.3	1.05	0.37	5.00
601	NewCBMH7	NewCBMH8	0.05	0.90	0.90	0.99	1.08	1.13	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	101	137	161	191	214	236	13.1	17.8	20.9	27.3	33.2	38.3	29.5	0.1	675	309.5	0.86	0.57	5.37
602	NewCBMH8	NewCBMH9	0.15	0.90	0.90	0.99	1.08	1.13	0.13	0.18	0.15	0.20	0.16	0.21	0.17	0.22	97	132	155	184	205	227	48.2	65.7	77.1	100.5	122.4	141.0	55.2	0.1	675	320.0	0.89	1.03	5.94
603	NewCBMH9	NewCBMH11	0.68	0.90	0.90	0.99	1.08	1.13	0.62	0.79	0.68	0.87	0.74	0.95	0.77	0.99	91	124	145	172	192	212	200.5	272.7	320.0	417.2	508.0	585.2	93.2	0.1	675	313.9	0.88	1.77	6.97
604	NewCBMH11	NewCBMH10	0.32	0.90	0.90	0.99	1.08	1.13	0.29	1.09	0.32	1.20	0.35	1.30	0.36	1.36	82	111	131	155	173	191	247.5	336.0	394.0	513.6	625.3	720.3	16.9	0.1	675	289.2	0.81	0.35	8.74
605	NewCBMH10	Storage	0.87	0.86	0.86	0.95	1.03	1.08	0.75	1.84	0.83	2.02	0.90	2.20	0.94	2.30	80	109	128	152	169	187	410.7	557.5	653.7	851.9	1037.2	1194.8	4.7	2.6	675	1343.2	3.75	0.02	9.09
606	Storage	NewCBMH12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	2.02	0.00	2.20	0.00	2.30	80	109	128	152	169	187	410.2	556.8	652.9	851.0	1036.0	1193.4	2.5	0.0	600	19.4	0.07	0.61	9.11
607	NewCBMH12	MH12	0.05	0.90	0.90	0.99	1.08	1.13	0.05	1.89	0.05	2.07	0.06	2.26	0.06	2.36	78	106	124	147	164	181	408.0	553.6	649.0	845.8	1029.7	1186.1	15.2	0.1	600	222.7	0.79	0.32	9.72
700	NewCBMH15	MH12	0.08	0.86	0.86	0.95	1.04	1.08	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	104	141	166	197	219	243	19.4	26.4	31.0	40.5	49.3	56.8	35.3	0.1	600	231.1	0.82	0.72	5.00
800	MH17	MH15	0.02	0.90	0.90	0.99	1.08	1.13	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	104	141	166	197	219	243	5.2	7.0	8.2	10.8	13.1	15.1	39.1	0.1	300	34.6	0.49	1.33	5.00
801	MH15	MH12	0.04	0.90	0.90	0.99	1.08	1.13	0.04	0.05	0.04	0.06	0.04	0.07	0.05	0.07	95	129	151	179	200	221	14.2	19.4	22.7	29.6	36.1	41.6	11.9	0.2	300	39.6	0.56	0.35	6.33
900	MH12	NewCBMH13	0.08	0.90	0.90	0.99	1.08	1.13	0.07	2.08	0.08	2.28	0.08	2.49	0.09	2.60	77	104	122	144	161	178	442.0	599.7	702.9	916.0	1115.1	1284.5	35.2	0.1	600	231.3	0.82	0.72	10.04
1000	NewMH14	NewMH16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	104	141	166	197	219	243	0.0	0.0	0.0	0.0	0.0	0.0	49.0	0.2	450	128.8	0.81	1.01	5.00
1001	NewMH16	NewCBMH13	0.36	0.90	0.90	0.99	1.08	1.13	0.33	0.33	0.36	0.36	0.39	0.39	0.41	0.41	97	131	154	183	204	226	87.8	119.5	140.3	182.9	222.7	256.6	3.0	1.0	450	285.1	1.79	0.03	6.01
1100	NewCBMH13	MH1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	2.64	0.00	2.88	0.00	3.00	74	100	118	139	155	172	494.1	669.9	785.2	1023.0	1245.4	1434.6	25.6	0.1	600	191.9	0.68	0.63	10.76
Existing Storm Sewer to Outlet																																		
1200	CBMH2	MH1	0.09	0.82	0.82	0.91	0.99	1.03	0.08	1.23	0.08	1.08	0.09	1.18	0.10	1.23	88	119	140	166	185	205	298.5	405.8	476.0	497.9	606.2	698.3	9.5	0.2	600	281.7	1.00	0.16	7.55
1300	MH1	MH11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.63	0.00	3.72	0.00	4.06	0.00	4.23	72	97	114	135	151	167	724.3	981.7	1150.5	1398.7	1702.6	1961.2	8.9	0.3	600	325.2	1.15	0.13	11.39
1400	MH11	OGS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.99	0.00	4.12	0.00	4.50	0.00	4.69	71	97	113	134	150	166	792.0	1073.4	1257.8	1539.2	1873.6	2158.2	3.3	1.5	600	755.8	2.67	0.02	11.52
1401	OGS	MH2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.99	0.00	4.12	0.00	4.50	0.00	4.69	71	97	113	134	150	166	791.3	1072.3	1256.6	1537.7	1871.8	2156.1	3.3	1.8	600	827.9	2.93	0.02	11.54
1402	MH2	OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.99	0.00	4.12	0.00	4.50	0.00	4.69	71	97	113	134	150	165	790.6	1071.4	1255.5	1536.3	1870.1	2154.2	72.5	0.7	600	516.0	1.82	0.66	11.56

Total Drainage Area (ha) 4.31

ARCH D 24" x 36"

SYMBOLS

	EXISTING	PROPOSED	REMOVALS
			CONC. ASPH.
Edge of Road & Type 1 : 500			
Concrete Curb Type 1 : 1000			
Concrete Curb Type 1 : 500		DETAIL NUMBER	
Ditches and Creeks etc. over 0.6m wide			
Ditch			
Storm Sewer & Manhole	EX MH1 ST EX MH1A	MH1 ST MH1A	EX MH1 ST EX MH1A
San. Sewer & Manhole			
Water Main & Valve Chamber	WV EX. WATERMAIN	WV 250 WM	WV EX. WATERMAIN
Gas Main & Valve	G	G	
Culvert			
Culvert with Headwalls			
Bell Telephone Conduit & Manhole	MH B	MH B	
Hydro Conduit & Manhole	MH H	MH H	
Hydro Street Lighting Conduit			
Single Catch Basin or Ditch Inlet	CB DI		CB DI
Double Catch Basin	DCB		DCB
Hydrant & Valve Box	VB FH	VB	VB FH
Bell Utility Pole & Anchor	B	(BY OTHERS) B	B
Hydro Utility Pole & Anchor	H	(BY OTHERS) H	H
Street Light	LS	LS	LS
Traffic Manhole	TMH	TMH	TM
Traffic Handhole	THH	THH	HH
"170" Traffic Controller Foundation	170	170	
Traffic Mast Arm Foundation			
Traffic Distribution Foundation			
Joint Use Pole Foundation			
Traffic Controller Foundation			
Detector Loop			
51mm (2") Conduit, Conc. Encased			
102mm (4") Conduit, Conc. Encased			
3 x 102mm (4") Conduit, Conc. Encased			
127mm (5") Conduit, Conc. Encased			
Steel Hydro Tower			
Trees			
Hedge			
Bush Area			
Property Line			
Centre Line			
Reference Point H. O. T.			
P. I. (Point of Intersection)			
Fence & Gate	(TYPE)	(TYPE)	(TYPE)
Guide Rail		(TYPE)	
Retaining Wall	RET. WALL	(TYPE)	RET. WALL
Adjust Surface Iron Works	MH CB	MH CB	
Sidewalks	ASPH. CONC.	DETAIL NUMBER	CONC. ASPH.
Roadway, Laneways & Entrances	ASPH. CONC.	ASPH.	ASPH
Perforated Pipe Sub - Drain		(SIZE)	
Concrete Precast Curb			

REFERENCE POINTS

BM ELEV.	BENCH MARK
CM	CONCRETE MONUMENT
	ROCK BAR
IP	IRON TUBE OR PIPE
IB	IRON BAR
WS	WOOD STAKE
ISCM 2-	2ND ORDER INTEGRATED SURVEY CONTROL MONUMENT
ISCM 3-	3RD ORDER INTEGRATED SURVEY CONTROL MONUMENT
	CUT CROSS
V	CUT VEE
RIB	ROUND IRON BAR
	REINFORCING BAR
SIB	STANDARD IRON BAR
SSIB	SHORT STANDARD IRON BAR
	WORK POINT

MISCELLANEOUS

	AREA TO BE CLEARED
	AREA TO BE GRUBBED
	AREA TO BE CLEARED AND GRUBBED
	EDGE OF LAKE OR RIVER
	SWAMP AND EDGE OF SWAMP
	ROCK SECTION IN PROFILE
CUT ROADWAY FILL	GRADING
OSF	OVERHEAD SIGN FOOTING
OS OS	OVERHEAD SIGNS
	BOREHOLE
	BUILDING REMOVAL
DC	PROPOSED DEPRESSED CURBS
DCR	PROPOSED DEPRESSED CURB RAMP STYLE

LEGEND

	PAVEMENT REMOVAL
	GRANULAR SURFACE
X	ITEM TO BE REMOVED

Sheet List Table

Drawing Number	Sheet Title
C001	LEGEND AND DRAWING LIST
C002	GENERAL NOTES
C003	REMOVALS PLAN
C004	REMOVALS PLAN
C005	GRADING PLAN
C006	SITE SERVICING PLAN
C007	SOUTH STORM SANITARY AND WATERMAIN PROFILE
C008	WEST STORM PROFILE
C009	EAST STORM PROFILE
C010	SANITARY OUTLET PROFILE
C011	EROSION AND SEDIMENT CONTROL PLANS
C012	STORMWATER STORAGE AND INLET CONTROLS DETAILS
C013	STANDARD DETAILS OPSD
C014	PRE DEVELOPMENT DRAINAGE AREAS PLAN
C015	POST DEVELOPMENT DRAINAGE AREAS PLAN

GENERAL NOTES

BOREHOLE LOCATIONS ARE APPROXIMATE ONLY. FOR FURTHER INFORMATION REFER TO GEOTECHNICAL INVESTIGATION REPORT PREPARED BY EXP DATED NOV 2024

SOIL INFORMATION SHOWN IS NOT GUARANTEED AND CONTRACTORS ARE ADVISED TO COLLECT ADDITIONAL SOILS INFORMATION AS DEEMED NECESSARY.

EXISTING TREES DESIGNATED TO BE RETAINED ARE TO BE PRESERVED AND PROTECTED DURING THE CONSTRUCTION PERIOD.

LIMITS OF GRADING MAY VARY FROM THAT INDICATED, DEPENDING ON THE FIELD CONDITIONS OR AS DIRECTED BY THE ENGINEER.

WHERE AVAILABLE, EXISTING SERVICE INFORMATION TO PRIVATE PROPERTY HAS BEEN SHOWN.

SIGNS TO BE REMOVED BY OTHERS.

WATERMAIN NOTES

ALL WATERMAIN MATERIALS AND CONSTRUCTION METHODS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE CITY STANDARD SPECIFICATION AND STANDARD DRAWINGS.

A MINIMUM 2m SEPARATION IS REQUIRED BETWEEN ALL NEW HYDRANTS AND CATCHBASINS OR OPEN STRUCTURES AND SHALL BE INSULATED PER CITY SPECIFICATION WS-23 AS APPLICABLE.

THE CONTRACTOR SHALL BE RESPONSIBLE TO DETERMINE VIA EXCAVATION THE EXACT LOCATION AND ELEVATION OF THE EXISTING WATERMAINS AS REQUIRED FOR ALL CONNECTIONS, RELOCATIONS AND BLANKINGS.

File Number D07-12-25-0095
Plan Number 19357

Ottawa
INFRASTRUCTURE SERVICES
DESIGN AND CONSTRUCTION

SERVICES D'INFRASTRUCTURE
DIRECTION DE CONCEPTION ET DE CONSTRUCTION

FOR / POUR

Client - Department

Infrastructure and Water Services Department
Design & Construction

CONSULTANT

AECOM

PRIME:
AECOM Canada Architects Ltd.
50 Sportsworld Crossing Road, Suite 290
Kitchener, Ontario, N2P 0A4

grc architects

SUBCONSULTANT:
GRC ARCHITECTS INC.
47 Clarence Street, Suite 401
Ottawa, Ontario, K1N 9K1

NOTE:
IT IS THE RESPONSIBILITY OF THE CONTRACTORS TO INFORM THEMSELVES OF THE EXACT LOCATION OF, AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES, SERVICES AND STRUCTURES WHETHER ABOVE GROUND OR BELOW GRADE BEFORE COMMENCING THE WORK. SUCH INFORMATION IS NOT NECESSARILY SHOWN ON THE DRAWING, AND WHERE SHOWN, THE ACCURACY CANNOT BE GUARANTEED.
WITH THE SOLE EXCEPTION OF THE BENCHMARK(S) SPECIFICALLY DESCRIBED FOR THIS PROJECT, NO ELEVATION INDICATED OR ASSUMED HEREON IS TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

NUMBER / NUMÉRO	MILESTONE/FAIT SAILLANT	DATE: (Y/M/D) (AN/J)	INITIALS INITIALES
3	ISSUED FOR SPA	2026/03/26	TG
2	REISSUED FOR TENDER	2026/03/12	TG
1	ISSUED FOR TENDER	2025/12/15	TG

DESIGNED BY / CONCU PAR: Checker
CHECKED BY / VERIFIÉ PAR: Approver
DRAWN BY / DESSINÉ PAR: SS
SCALE / ÉCHELLE: 1 : 500

1 / A1.1 DRAWING TITLE (DETAIL NUMBER / SHEET NUMBER / SCALE)

THIS DRAWING IS THE PROPERTY OF THE CITY OF OTTAWA AND ALL COPYRIGHT IS RESERVED. DIMENSIONS ON DRAWING ARE FOR ESTIMATING PURPOSES ONLY. IT IS THE RESPONSIBILITY OF EACH CONTRACTOR AND SUB-CONTRACTOR OR CONSULTANT TO CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON SITE. NOTIFY OWNER OF ANY ERRORS OR OMISSIONS PRIOR TO COMMENCING THE WORK. DO NOT SCALE THE DRAWINGS.

CE DESSIN CONSTITUE LA PROPRIÉTÉ DE LA VILLE D'OTTAWA ET TOUT DROIT D'AUTEUR EST RÉSERVÉ. LES DIMENSIONS UTILISÉES LE SONT À DES FINS D'ESTIMATION SEULEMENT. IL INCOMBE À CHAQUE ENTREPRENEUR, SOUS-CONTRACTANT OU CONSULTANT DE VÉRIFIER TOUTES LES DIMENSIONS ET LES CONDITIONS SUR LE CHANTIER. VEUILLEZ INFORMER LE PROPRIÉTAIRE DE TOUTE ERREUR OU OMISSION AVANT D'ENTAMER LES TRAVAUX. NE DRESSEZ PAS LES PLANS À L'ÉCHELLE.

ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER
T. J. GRANT
26 Mar 2026
PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

CONSULTANT / EXPERT-CONSEIL

PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

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OTTAWA, ONTARIO

DRAWING / DESSIN

LEGEND AND DRAWING LIST

BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT
OMF1

SHEET NO. / FEUILLE No.
C001

CITY PROJECT NO. / NUMÉRO DE PROJET
60716350

CONS_PROJECT NO. / NUMÉRO DE PROJET

Last Plotted:
Filename:

ARCH D 24" x 36"

GENERAL NOTES

1. COORDINATE AND SCHEDULE ALL WORK WITH OTHER TRADES AND CONTRACTORS.
2. THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OF ALL EXISTING UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
3. ALL WORKS SHALL BE COMPLETED IN ACCORDANCE WITH THE CURRENT OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS. THE GENERAL CONTRACTOR SHALL BE DEEMED TO BE THE CONSTRUCTOR AS DEFINED IN THE ACT.
4. THE CONTRACTOR AND SUB CONTRACTORS ARE RESPONSIBLE TO ENSURE THAT THEIR CONSTRUCTION MATERIALS AND PRACTICES CONFORM TO THE LATEST CITY OF OTTAWA STANDARDS, SPECIFICATIONS AND DESIGN CRITERIA. IN THE ABSENCE OF CITY OF OTTAWA SPECIFICATIONS, THE ONTARIO PROVINCIAL STANDARD SPECIFICATIONS (OPSS) SHALL APPLY.
5. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA BEFORE COMMENCING CONSTRUCTION.
6. THE CONTRACTOR IS RESPONSIBLE FOR DESIGNING AND IMPLEMENTING TEMPORARY TRAFFIC MANAGEMENT PLANS FOR CONSTRUCTION WITHIN THE PEDESTRIAL AND VEHICLE CIRCULATION AREAS ON SITE , ALL PLANS ARE TO FOLLOW THE REQUIREMENTS OF THE CITY AND PROVINCIAL STANDARDS (OTM BOOK 7).
7. THE CONTRACTOR, AT THEIR EXPENSE AND TO THE SATISFACTION OF THE CITY OF OTTAWA AND THE CONTRACT ADMINISTRATOR, SHALL BE RESPONSIBLE FOR THE RESTORATION AND THE REPAIR OF ALL AREAS DISTURBED DURING CONSTRUCTION ON-SITE AND OFF-SITE, INCLUDING ASPHALT AREAS, TRENCHES AND EXISTING UTILITIES TO EXISTING CONDITIONS OR BETTER.
8. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL, ORGANIC MATERIAL AND DEBRIS UNLESS OTHERWISE INSTRUCTED BY CONTRACT ADMINISTRATOR. EXCAVATE AND REMOVE FROM SITE ANY CONTAMINATED MATERIAL. ALL CONTAMINATED MATERIAL SHALL BE DISPOSED OF AT A LICENSED LANDFILL FACILITY IN ACCORDANCE WITH O. REG. 406/19.
9. THE SUPPORT OF ALL UTILITIES SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
10. ALL BACKFILL FOR SEWERS, WATERMAINS AND UTILITIES ON THE ROAD ALLOWANCE MUST BE MECHANICALLY COMPACTED.
11. CONTRACTOR IS RESPONSIBLE FOR VERIFYING LOCATION AND ELEVATION OF ALL EXISTING UTILITIES AND CITY SERVICES (WATER, SANITARY & STORM) PRIOR TO CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO AECOM CANADA ULC.
12. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
13. ALL ELEVATIONS ARE NAD 83 MTM ZONE 9, VERTICAL DATUM CGVD 28:78
14. REFER TO GEOTECHNICAL REPORT (PROJECT: OTT-22007382-AO DATED NOV 26 2024), PREPARED BY EXP SERVICES INC. FOR SUBSURFACE CONDITIONS, CONSTRUCTION RECOMMENDATIONS, AND GEOTECHNICAL INSPECTION REQUIREMENTS. THE GEOTECHNICAL CONSULTANT RETAINED BY THE CITY IS TO REVIEW ON-SITE CONDITIONS AFTER EXCAVATION PRIOR TO PLACEMENT OF ANY GRANULAR MATERIAL.
15. REFER TO ARCHITECT'S DRAWINGS FOR BUILDING AND HARD SURFACE AREAS AND DIMENSIONS.
16. STORMWATER MANAGEMENT DESIGN IS DOCUMENTED IN THE SITE SERVICING BRIEF PREPARED BY AECOM, DATED APRIL 2025 .
17. CONTRACTOR TO PROVIDE THE CONTRACT ADMINISTRATOR WITH A GENERAL PLAN OF SERVICES INDICATING ALL SERVICING AS-BUILT INFORMATION SHOWN ON THIS PLAN. AS-BUILT INFORMATION MUST INCLUDE: PIPE MATERIAL, SIZES, LENGTHS, SLOPES, INVERT AND T/G ELEVATIONS, STRUCTURE LOCATIONS, VALVE AND HYDRANT LOCATIONS, T/WM ELEVATIONS AND ANY ALIGNMENT CHANGES, ETC.

GRADING NOTES

1. ALL CONSTRUCTION WORK FOR THIS PROJECT SHALL COMPLY WITH THE STANDARD DRAWINGS AND SPECIFICATIONS OF THE CITY OF OTTAWA, THE ONTARIO PROVINCIAL STANDARDS AND SPECIFICATIONS (O.P.S.S.) AND THE ONTARIO BUILDING CODE (O.B.C.)
2. ALL SURFACE DRAINAGE SHALL BE CONTAINED AT SITE, COLLECTED AND DISCHARGED AT A LOCATION TO BE APPROVED PRIOR TO THE ISSUANCE OF A BUILDING PERMIT. DRAINAGE OF ABUTTING PROPERTIES SHALL NOT BE ADVERSELY AFFECTED. UNLESS NOTED OTHERWISE.
3. ALL TOPSOIL, ORGANIC OR DELETERIOUS MATERIAL MUST BE ENTIRELY REMOVED FROM BENEATH THE PROPOSED PAVED AREAS AS DIRECTED BY THE CONTRACT ADMINISTRATOR OR GEOTECHNICAL ENGINEER.
4. THE SUBGRADE SHALL BE COMPACTED TO AT LEAST 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE.
5. EXPOSED SUBGRADES IN PROPOSED PAVED AREAS SHOULD BE PROOF ROLLED WITH A LARGE STEEL DRUM ROLLER AND INSPECTED BY THE GEOTECHNICAL ENGINEER PRIOR TO THE PLACEMENT OF GRANULARS.
6. ANY SOFT AREAS EVIDENT FROM THE PROOF ROLLING SHOULD BE SUB-EXCAVATED AND REPLACED WITH SUITABLE MATERIAL THAT IS FROST RESISTANT AND COMPATIBLE WITH THE EXISTING SOILS AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.
7. MINIMUM OF 2% GRADE FOR ALL GRASS AREAS UNLESS OTHERWISE NOTED.
8. MAXIMUM TERRACING GRADE TO BE 3:1 UNLESS OTHERWISE NOTED.
9. ALL GRADES BY CURBS ARE EDGE OF PAVEMENT GRADES UNLESS OTHERWISE INDICATED.
10. REFER TO LANDSCAPE PLAN FOR PLANTING AND OTHER LANDSCAPE FEATURE DETAILS.
11. CONTRACTOR TO PROVIDE THE CONTRACT ADMINISTRATOR WITH A GRADING PLAN INDICATING AS-BUILT ELEVATIONS OF ALL DESIGN GRADES SHOWN ON THIS PLAN.

WATERMAIN NOTES

1. SUPPLY AND CONSTRUCT ALL WATERMAINS AND APPURTENANCES IN ACCORDANCE WITH THE CITY OF OTTAWA STANDARDS AND SPECIFICATIONS.
2. CONNECTIONS AND SHUT-OFFS AT THE MAIN AND CHLORINATION OF THE WATER SYSTEM SHALL BE PERFORMED BY THE CONTRACTOR IN THE PRESENCE CITY OF OTTAWA REPRESENTATIVES.
3. PVC WATERMAINS SHALL BE MINIMUM DR 18 CLASS 235 (AWWA) C900-07
4. BEDDING SHALL BE AS PER CITY OF OTTAWA STANDARD DRAWING W17.
5. THERMAL INSULATION IN SHALLOW TRENCHES AND ADJACENT TO OPEN STRUCTURES SHALL BE AS PER CITY OF OTTAWA STANDARD DRAWING W22 AND W23.
6. MINIMUM COVER ON WATERMAINS SHALL BE 2.4 METRES.
7. PROVISIONS FOR FLUSHING THE WATER LINE PRIOR TO TESTING AND SO FORTH MUST BE PROVIDED WITH AT LEAST A 50mm OUTLET ON 100mm AND LARGER LINES AS PER OPSD1104.03-1. ALL TEES, PLUGS, HORIZONTAL, VERTICAL BENDS, REDUCERS AND HYDRANTS TO HAVE CONCRETE THRUST BLOCKS AS PER OPSD 1103.010 AND 1103.021.
8. PROPOSED WATER SERVICES ARE TO BE CONSTRUCTED TO WITHIN 1.0m OF FOUNDATION WALL AND CAPPED WATER SERVICES ARE TO BE CONNECTED TO EXISTING PIPING INSTALLED BY WATERMAIN LOOP CONTRACTOR IN Q4 2025., UNLESS OTHERWISE INDICATED.
9. WATERMAINS MUST FOLLOW THE MINISTRY OF THE ENVIRONMENT ENVIRONMENT CONSERVATION AND PARKS (MECP)
10. PROCEDURES THAT GOVERN THE SEPARATION OF SEWERS AND WATERMAINS F-6-1. A MINIMUM VERTICAL CLEARANCE OF 0.30 METER OVER, 0.5 METER UNDER SEWERS AND ALL OTHER UTILITIES WHEN CROSSING. MUST ALSO MAINTAIN 2.5 METRES HORIZONTAL SEPARATION WITH SEWERS.
11. ALL PROPOSED WATER PIPING MUST BE ISOLATED FROM EXISTING LINES IN ORDER TO ALLOW INDEPENDENT PRESSURE TESTING AND CHLORINATING FROM THE EXISTING SYSTEM. FLUSHING, SWABBING AND TESTING OF WATERMAIN AS PER ONTARIO PROVINCIAL STANDARDS AND SPECIFICATIONS (OPSS), AS WELL AS CITY OF OTTAWA SPECIFICATION.
12. AFTER PASSING THE HYDROSTATIC PRESSURE TEST AND LEAKAGE TEST, CHLORINATION CAN PROCEED. SAMPLING OF THE NEW MAINS IS TO BE DONE AT THE REQUIRED LOCATIONS PRIOR TO CONNECTING TO THE CITY WATERMAIN SYSTEM. THE TEE FITTING IS TO BE CUT INTO THE EXISTING WATERMAIN TO MAKE THE CONNECTION. TO MAINTAIN THE PRESSURE IN THE NEW MAIN DURING INSTALLATION OF SERVICE, A 50mm BY-PASS WITH AN APPROVED PRESSURE DIFFERENTIAL BACKFLOW PREVENTER, MOUNTED ABOVE GROUND LEVEL IS TO BE INSTALLED AROUND THE CLOSED ISOLATING VALVE.
13. CITY IN-SERVICE WATER VALVES CAN ONLY BE OPERATED BY CITY OF OTTAWA WATER STAFF.
14. WATERMAINS TO BE INSTALLED TO GRADE AS SHOWN ON APPROVED PLANS, COPY OF GRADE SHEET MUST BE SUPPLIED TO INSPECTOR PRIOR TO COMMENCEMENT OF WORK, WHEN REQUESTED BY INSPECTOR.
15. VALVE IN BOXES SHALL BE INSTALLED AS PER CITY OF OTTAWA STD. MAINLINE VALVES TO BE RESTRAINED AS PER CITY OF OTTAWA STANDARDS.
16. THE CONTRACTOR SHALL COMPLETE THE NECESSARY WATER TESTING (I.E. PRESSURE TEST, FLUSHING, CHLORINATE, SAMPLING, ETC.)

SANITARY AND STORM SEWER NOTES

1. SUPPLY AND CONSTRUCT ALL SEWERS AND APPURTENANCES IN ACCORDANCE WITH THE MOST CURRENT STANDARDS AND SPECIFICATIONS OF CITY OF OTTAWA AND ONTARIO PROVINCIAL STANDARDS.
2. MAIN LINE PVC PIPE SHALL BE DR 35 AND SERVICE CONNECTION PVC PIPE SHALL BE DR 28.
3. SERVICES ARE TO BE CONSTRUCTED TO BUILDING AND SANITARY AND STORM SERVICES ARE TO BE CONNECTED TO PIPING EXTENDING INTO BUILDING AT A MINIMUM SLOPE OF 1.0%.
4. BEDDING FOR FLEXIBLE PIPE SHALL BE AS PER OPSD 802.010, 802.013 OR 802.014.
5. PIPE BEDDING, COVER AND BACKFILL ARE TO BE COMPACTED TO MINIMUM 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY. THE USE OF CLEAR CRUSHED STONE AS A BEDDING LAYER SHALL NOT BE PERMITTED.
6. MAINTENANCE HOLES AS PER OPSD 701.010 (1200mm), 701.011 (1500mm) AND 701.012 (1800mm).
7. FRAME AND COVER AS PER CITY OF OTTAWA STANDARDS S24, S24.1 AND S25
8. BENCHING SHALL BE AS PER OPSD 701.021.
9. TRENCH WIDTH (SEPARATE TRENCH) AT TOP OF THE PIPE SHALL BE TO CITY OF OTTAWA STANDARD S6. CONTRACTOR IS RESPONSIBLE FOR SUPPLYING ADDITIONAL BEDDING AND/OR STRONGER PIPE IF ACTUAL TRENCH WIDTHS EXCEED DESIGN WIDTHS.
10. ALL SEWERS CONSTRUCTED WITH GRADES 0.50% OR LESS, SHALL BE INSTALLED WITH LASER LEVEL AND CHECKED PRIOR TO BACKFILL AT THE CONTRACTOR'S EXPENSE.
11. INSULATE ALL PIPES THAT HAVE LESS THAN 1.5m COVER WITH HI-40 INSULATION PER INSULATION DETAIL FOR SHALLOW SEWERS. PROVIDE 150mm CLEARANCE BETWEEN PIPE AND INSULATION.CONCRETE PIPE TO BE CLASS 100-D
12. SERVICE CONNECTIONS AND UTILITY CUTS TO BE BACKFILLED WITH UNSHRINKABLE FILL.
13. STORM PIPE LENGTHS ARE TO BARREL OF MANHOLE AND DO NOT INCLUDE BENCHING.
14. CONCRETE PIPES ARE TO HAVE WATERTIGHT JOINTS DESIGNED TO CSA A257.3 / ASTM C443
15. ALL STORM MANHOLES AND CATCHBASIN MANHOLES ARE TO HAVE 300mm SUMPS UNLESS OTHERWISE INDICATED. ALL CATCHBASINS ARE TO HAVE 600mm SUMPS UNLESS OTHERWISE INDICATED.
16. ALL CATCHBASINS, MANHOLES AND/OR CATCHBASIN MANHOLES THAT ARE TO HAVE ICD'S INSTALLED WITHIN THEM ARE TO HAVE 600mm SUMPS.
17. THE OWNER SHALL REQUIRE THAT THE SITE SERVICING CONTRACTOR PERFORM FIELD TESTS FOR QUALITY CONTROL OF ALL SANITARY SEWERS. LEAKAGE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 410.07.16, 410.07.16.04 AND 407.07.24. DYE TESTING IS TO BE COMPLETED ON ALL SANITARY SERVICES TO CONFIRM PROPER CONNECTION TO THE SANITARY SEWER MAIN. THE FIELD TESTS SHALL BE PERFORMED IN THE PRESENCE OF A CERTIFIED PROFESSIONAL ENGINEER WHO SHALL SUBMIT A CERTIFIED COPY OF THE TEST RESULTS.
18. CONTRACTOR TO TELEVISE (CCTV) ALL PROPOSED SEWERS, 200mmØ OR GREATER PRIOR TO BASE COURSE ASPHALT. UPON COMPLETION OF CONTRACT, THE CONTRACTOR IS RESPONSIBLE TO FLUSH AND CLEAN ALL SEWERS & APPURTENANCES.

CURB, SIDEWALK, AND PAVEMENT NOTES

1. ALL CURBS SHALL BE BARRIER CURB (150mm) UNLESS OTHERWISE NOTED AND CONSTRUCTED AS PER CITY OF OTTAWA STANDARDS (SC1.1). MOUNTABLE CURBS ARE TO BE PER CITY OF OTTAWA STANDARD (SC1.3).
2. THE GRANULAR SUB-BASE AND BASE SHALL BE COMPACTED TO AT LEAST 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE. ANY ADDITIONAL GRANULAR FILL USED BELOW THE PROPOSED PAVEMENT SHOULD BE COMPACTED TO AT LEAST 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE.
3. PROVIDE LINE/PARKING PAINTINGS.
4. PAVEMENT STRUCTURE FOR PARKING LOT AND BUS ACCESS ROADWAYS
   - 60mm HL3/SP12.5 CAT. D (PG 64-34)
   - 90mm HL8/SP19 CAT. D (PG64-34)
   - 150mm OF OPSS GRANULAR A BASE
   - 600mm OF OPSS GRANULAR B TYPE SUBBASE

GEOTECHNICAL NOTE

1. THE CONTRACTOR SHALL FOLLOW THE RECOMMENDATIONS OF THE GEOTECHINICAL INVESTIGATION REPORT PREPARED BY EXP SERVICES INC., DATED NOV 14 2025 AND OTHER AVAILABLE REPORTS SPECIFIC TO THE SUBJECT SITE.

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STRUCTURE TABLE

STRUCTURE NAME:	DETAILS:	PIPES IN:	PIPES OUT
EX CB-3	EX CB RIM = 70.18 SUMP = 67.20 N INV = 67.798 525mm S INV = 67.800 525mm	525 mm CONC INV N=67.80	525 mm CONC INV S=67.80
EX CB1	EX CB RIM = 68.80 SUMP = 67.58 W INV = 68.183 300mm		300 mm CONC CL 65-D INV W=68.18
EX CB2	EX CB RIM = 68.80 SUMP = 67.45 E INV = 68.125 300mm SW INV = 68.050 375mm	300 mm CONC CL 65-D INV E=68.12	375 mm CONC CL 65-D INV SW=68.05
EX CB3	EX CB RIM = 69.85 SUMP = 67.52 SW INV = 68.125 300mm E INV = 68.183 300mm	300 mm CONC CL 100-D INV SW=68.12	300 mm CONC CL 65-D INV E=68.18
EX CB4	EX CB RIM = 69.43 SUMP = 67.52 S INV = 68.125 300mm NE INV = 68.183 300mm	300 mm CONC CL 100-D INV S=68.12	300 mm CONC CL 100-D INV NE=68.18
EX CB5	EX CB RIM = 69.45 SUMP = 67.58 N INV = 68.183 300mm		300 mm CONC CL 100-D INV N=68.18
EX CB7	EX CB RIM = 70.22 SUMP = 67.30 N INV = 67.902 300mm		300 mm CONC CL 100-D INV N=67.90
EX CB8	EX CB RIM = 70.00 SUMP = 66.19 W INV = 68.186 600mm		600 mm CONC CL 65-D INV W=68.19
EX CBMH2	EX CBMH RIM = 68.97 SUMP = 67.26 N INV = 67.790 375mm S INV = 68.077 600mm W INV = 67.565 600mm	375 mm CONC CL 65-D INV N=67.79 600 mm CONC CL 65-D INV S=68.08	600 mm CONC CL 65-D INV W=67.56
EX CBMH3	OPSD RIM = 68.93 SUMP = 65.77 S INV = 67.810 600mm N INV = 67.770 600mm	600 mm CONC CL 65-D INV S=67.81	600 mm CONC CL 65-D INV N=67.77
EX CBMH4	EX CBMH RIM = 69.71 SUMP = 66.19 S INV = 68.186 600mm N INV = 68.186 600mm		600 mm CONC CL 65-D INV S=68.19 600 mm CONC CL 65-D INV N=68.19
EX CBMH5	EX CB RIM = 69.81 SUMP = 67.48 S INV = 68.077 600mm N INV = 68.077 600mm	600 mm CONC CL 65-D INV S=68.08 600 mm CONC CL 65-D INV N=68.08	
EX CBMH6	EX CB RIM = 69.75 SUMP = 66.08 E INV = 68.077 600mm N INV = 68.186 600mm	600 mm CONC CL 65-D INV E=68.08	600 mm CONC CL 65-D INV N=68.19
EX CBMH10	EX CBMH RIM = 69.85 SUMP = 67.64 W INV = 67.940 250mm	250 mm CONC CL 100-D INV W=67.94	
EX HEADWALL	EX HEADWALL RIM = 67.85 SUMP = ??? S INV = 67.080 600mm	600 mm ULTRA RIB INV S=67.08	
EX IN153524	EX MH RIM = 68.81 SUMP = 67.55 NE INV = 67.925 375mm S INV = 67.850 375mm	375 mm CONC CL 65-D INV NE=67.92	375 mm CONC CL 65-D INV S=67.85
EX IN154123	EX CB RIM = 68.95 SUMP = 67.59 W INV = 68.186 600mm		600 mm CONC CL 65-D INV W=68.19
EX MH1	EX 1500mm MH RIM = 70.04 SUMP = 67.24 E INV = 67.545 600mm S INV = 67.536 600mm N INV = 67.545 600mm	600 mm CONC CL 65-D INV E=67.54 600 mm CONC CL 65-D INV S=67.54	600 mm PVC ULTRA-RIB INV N=67.54
EX MH2	EX 1500mm MH RIM = 69.55 SUMP = 67.14 NW INV = 67.440 600mm N INV = 67.444 600mm	600 mm CONC CL 100-D INV NW=67.44	600 mm ULTRA RIB INV N=67.44
EX MHunk	EX STM MH RIM = 68.59 SUMP = 66.48 SE INV = 66.775 600mm	600 mm PVC ULTRA-RIB INV SE=66.78	

STRUCTURE TABLE

STRUCTURE NAME:	DETAILS:	PIPES IN:	PIPES OUT
EX MH1A	EX SAN MH RIM = 68.86 SUMP = 66.86 NE INV = 67.350 200mm N INV = 67.200 200mm SE INV = 67.160 200mm	200 mm EX PVC INV NE=67.35 200 mm EX PVC INV N=67.20 200 mm EXPVC INV SE=67.16	
EX MHSA30014	EX SAN MH RIM = 69.85 SUMP = 65.58 SE INV = 65.969 200mm NW INV = 65.883 375mm	200 mm EXPVC INV SE=65.97	375 mm EXPVC INV NW=65.88
EX SAMH30012	EX SAN MH RIM = 69.10 SUMP = 66.09 W INV = 66.394 375mm		375 mm EXPVC INV W=66.39
EX SAMH30013	EX SAN MH RIM = 70.43 SUMP = 65.87 E INV = 66.172 375mm NW INV = 66.172 200mm	375 mm EXPVC INV E=66.17	200 mm EXPVC INV NW=66.17
EXMHSA30015	EX SAN MH RIM = 69.31 SUMP = 65.34 SE INV = 65.642 375mm	375 mm EXPVC INV SE=65.64	
MH1A	OPSD 701.010 RIM = 70.37 SUMP = 67.36 NW INV = 67.660 300mm N INV = 67.930 200mm SE INV = 67.830 200mm	300 mm PVC SDR 35 INV NW=67.66 200 mm PVC SDR 35 INV N=67.93	200 mm PVC SDR 35 INV SE=67.83
MH2A	OPSD 701.010 RIM = 70.48 SUMP = 67.01 NW INV = 67.770 200mm N INV = 67.600 200mm W INV = 67.313 200mm	200 mm PVC SDR 35 INV NW=67.77 200 mm PVC SDR 35 INV N=67.60	200 mm PVC SDR 35 INV W=67.31
MH3A	OPSD 701.010 RIM = 70.59 SUMP = 66.51 E INV = 67.190 200mm S INV = 67.108 200mm	200 mm PVC SDR 35 INV E=67.19	200 mm PVC SDR 35 INV S=67.11
MH4A	OPSD 701.010 RIM = 70.38 SUMP = 66.22 N INV = 66.595 200mm S INV = 66.520 200mm	200 mm PVC SDR 35 INV N=66.60	200 mm PVC SDR 35 INV S=66.52
MH5A	OPSD 701.010 RIM = 70.10 SUMP = 65.73 N INV = 66.134 200mm SE INV = 66.033 200mm NW INV = 66.032 200mm	200 mm PVC SDR 35 INV N=66.13 200 mm EXPVC INV SE=66.03	200 mm EXPVC INV NW=66.03

STRUCTURE TABLE

STRUCTURE NAME:	DETAILS:	PIPES IN:	PIPES OUT
EX STMH	EX STM MH RIM = 69.39 SUMP = 67.22 W INV = 67.570 675mm S INV = 67.520 600mm N INV = 67.520 600mm	675 mm CONC CL 100-D INV W=67.57 600 mm PVC ULTRA-RIB INV S=67.52	600 mm CONC CL 100-D INV N=67.52
EX STMH2	EX CBMH RIM = 70.80 SUMP = 67.69 NW INV = 67.987 450mm	450 mm CONC CL 100-D INV NW=67.99	
EX STMH3	EX CBMH RIM = 70.13 SUMP = 67.21 NW INV = 67.508 600mm NE INV = 67.730 375mm SE INV = 67.658 450mm		600 mm CONC CL 100-D INV NW=67.51 375 mm CONC CL 100-D INV NE=67.73 450 mm CONC CL 100-D INV SE=67.66
EX STMH3A	EX CBMH RIM = 69.90 SUMP = 67.45 SW INV = 67.750 375mm E INV = 67.800 250mm	375 mm CONC CL 100-D INV SW=67.75	250 mm CONC CL 100-D INV E=67.80
EX STMH4	EX CBMH RIM = 69.38 SUMP = 66.70 SE INV = 67.048 600mm NW INV = 66.998 600mm	600 mm CONC CL 100-D INV SE=67.05	600 mm PVC ULTRA-RIB INV NW=67.00
PR CB2	OPSD 705.010 RIM = 69.32 SUMP = 67.48 E INV = 68.082 300mm		300 mm CONC CL 100-D INV E=68.08
PR CB3	OPSD 705.010 RIM = 69.54 SUMP = 67.68 NW INV = 68.203 300mm		300 mm CONC CL 100-D INV NW=68.20
PR CBMH1	OPSD 701.010 RIM = 69.92 SUMP = 67.64 N INV = 67.937 600mm S INV = 68.750 450mm		600 mm CONC CL 100-D INV N=67.94 450 mm CONC CL 100-D INV S=68.75
PR CBMH2	OPSD 701.013 RIM = 69.90 SUMP = 67.54 S INV = 67.915 600mm SE INV = 67.840 675mm	600 mm CONC CL 100-D INV S=67.92	675 mm CONC CL 100-D INV SE=67.84
PR CBMH3	OPSD 701.011 RIM = 69.61 SUMP = 67.47 NW INV = 67.820 675mm E INV = 67.770 675mm	675 mm CONC CL 100-D INV NW=67.82	675 mm CONC CL 100-D INV E=67.77
PR CBMH4	OPSD 701.011 RIM = 69.41 SUMP = 67.38 W INV = 67.734 675mm W INV = 67.930 300mm SE INV = 67.681 675mm	675 mm CONC CL 100-D INV W=67.73 300 mm CONC CL 100-D INV W=67.93	675 mm CONC CL 100-D INV SE=67.68
PR CBMH7	OPSD 701.011 RIM = 69.98 SUMP = 67.66 N INV = 68.670 450mm E INV = 68.280 300mm S INV = 68.260 675mm	450 mm CONC CL 100-D INV N=68.67 300 mm PVC INV E=68.26	675 mm CONC CL 100-D INV S=68.26
PR CBMH8	OPSD 701.011 RIM = 69.96 SUMP = 67.69 N INV = 68.220 675mm E INV = 68.198 300mm S INV = 68.186 675mm	675 mm CONC CL 100-D INV N=68.22 300 mm PVC INV E=68.20	675 mm CONC CL 100-D INV S=68.19
PR CBMH9	OPSD 701.013 RIM = 69.95 SUMP = 67.76 N INV = 68.110 675mm SE INV = 68.060 675mm	675 mm CONC CL 100-D INV N=68.11	675 mm CONC CL 100-D INV SE=68.06
PR CBMH11	OPSD 701.011 RIM = 70.33 SUMP = 67.60 NW INV = 67.930 675mm E INV = 67.903 675mm	675 mm CONC CL 100-D INV NW=67.93	675 mm CONC CL 100-D INV E=67.90
PR CBMH12	OPSD 701.012 RIM = 69.76 SUMP = 67.42 N INV = 67.721 600mm		600 mm CONC CL 100-D INV N=67.72
PR CBMH13	OPSD 701.013 RIM = 70.14 SUMP = 67.28 SE INV = 67.584 600mm SW INV = 67.720 450mm N INV = 67.580 600mm	600 mm CONC CL 65-D INV SE=67.58 450 mm CONC CL 100-D INV SW=67.72	600 mm CONC CL 65-D INV N=67.58
PR CBMH15	OPSD 701.012 RIM = 69.54 SUMP = 67.45 NW INV = 67.750 600mm SE INV = 68.050 300mm	600 mm CONC CL 100-D INV NW=67.75 300 mm CONC CL 100-D INV SE=68.05	
PR DCMH5	OPSD 701.012 RIM = 69.28 SUMP = 67.31 NW INV = 67.660 675mm W INV = 67.869 300mm E INV = 67.610 675mm	675 mm CONC CL 100-D INV NW=67.66 300 mm CONC CL 100-D INV W=67.87	675 mm CONC CL 100-D INV E=67.61
PR DICB1	OPSD 705.030 RIM = 69.58 SUMP = 67.30 E INV = 67.900 300mm		300 mm CONC CL 100-D INV E=67.90

STRUCTURE TABLE

STRUCTURE NAME:	DETAILS:	PIPES IN:	PIPES OUT
PR MH10	OPSD 701.012 RIM = 70.06 SUMP = 67.54 W INV = 67.880 675mm N INV = 67.840 675mm S INV = 67.880 300mm	675 mm CONC CL 100-D INV W=67.88 675 mm CONC CL 100-D INV N=67.84 300 mm CONC CL 100-D INV S=67.88	
PR MH12	OPSD 701.012 RIM = 69.78 SUMP = 67.32 S INV = 67.700 600mm W INV = 68.000 300mm SE INV = 67.700 600mm NW INV = 67.620 600mm	600 mm CONC CL 100-D INV S=67.70 300 mm CONC CL 100-D INV W=68.00	600 mm CONC CL 100-D INV SE=67.70 600 mm CONC CL 65-D INV NW=67.62
PR MH14	OPSD 701.010 RIM = 69.86 SUMP = 67.69 E INV = 67.992 450mm		450 mm CONC CL 100-D INV E=67.99
PR MH15	OPSD 701.010 RIM = 70.23 SUMP = 67.72 S INV = 68.070 300mm E INV = 68.018 300mm	300 mm CONC CL 100-D INV S=68.07	300 mm CONC CL 100-D INV E=68.02
PR MH16	OPSD 701.011 RIM = 70.24 SUMP = 67.45 NW INV = 67.830 450mm S INV = 67.800 300mm NE INV = 67.746 450mm	450 mm CONC CL 100-D INV NW=67.83 300 mm PVC INV S=67.80	450 mm CONC CL 100-D INV NE=67.75
PR MH17	OPSD 701.010 RIM = 70.34 SUMP = 67.82 W INV = 68.120 150mm N INV = 68.121 300mm		150 mm PVC INV W=68.12 300 mm CONC CL 100-D INV N=68.12
PR MH18	OPSD 701.012 RIM = 70.08 SUMP = 67.23 S INV = 67.830 675mm		675 mm CONC CL 100-D INV S=67.83
PR MH19	OPSD 701.011 RIM = 69.51 SUMP = 67.55 W INV = 67.853 450mm SE INV = 67.853 450mm	450 mm CONC CL 100-D INV W=67.85	450 mm CONC CL 100-D INV SE=67.85
PR OGS1	STORMCEPTOR EFO10 RIM = 69.42 SUMP = 64.22 S INV = 67.470 600mm SE INV = 67.500 600mm	600 mm CONC CL 100-D INV S=67.47	600 mm CONC CL 100-D INV SE=67.50

File Number D07-12-25-0095
Plan Number 19357

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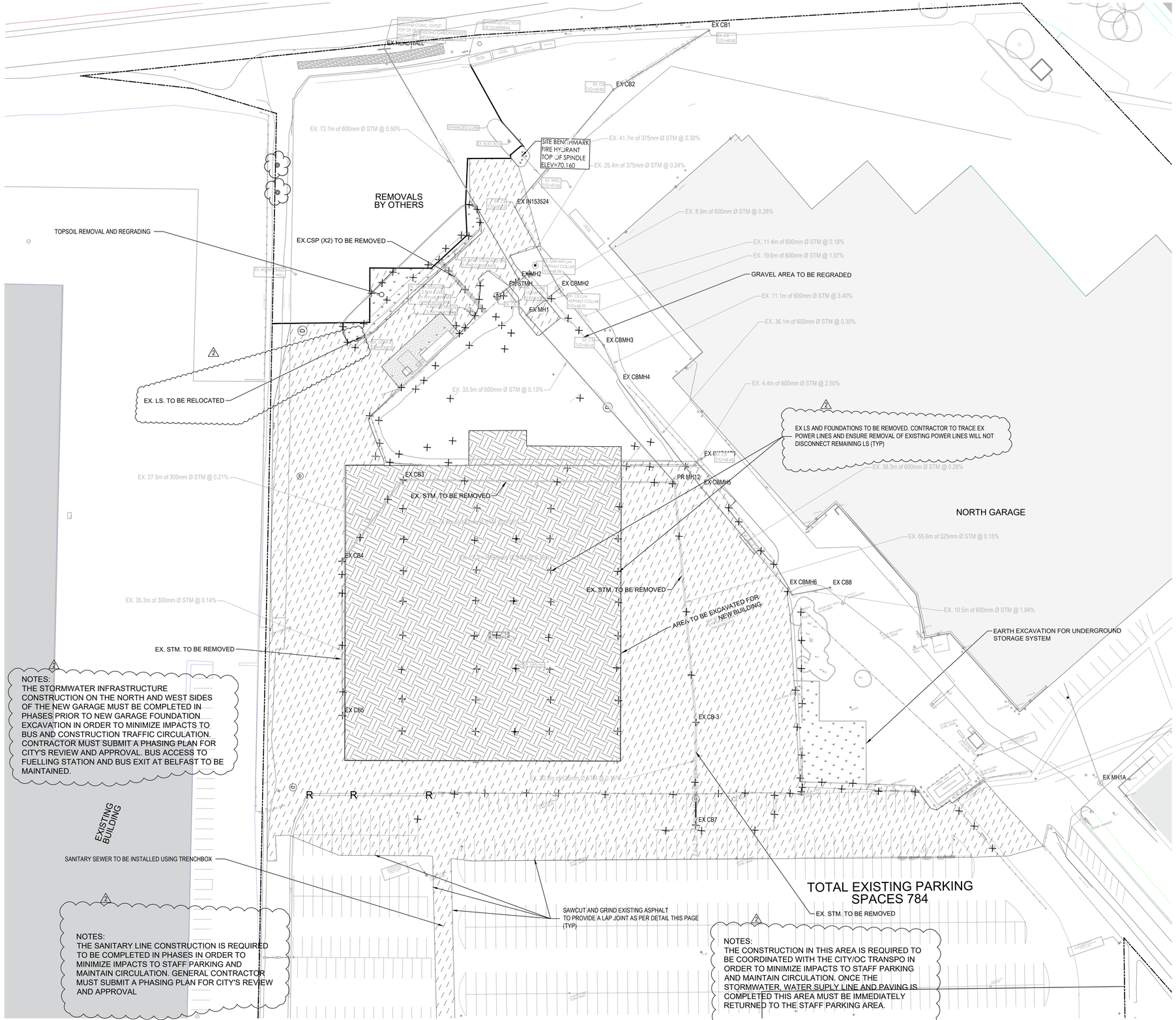
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Checker	Approver
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1 DETAIL NUMBER
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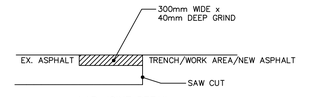
1 REMOVALS PLAN

C003

SCALE: 1 : 500

LEGEND

- ASHPHALT AND GRANULAR A REMOVAL
- ITEM TO BE REMOVED
- R — ITEM TO BE REMOVED AND REPLACED
- EXISTING SOIL BELOW THE LIMITS OF THE NEW GARAGE FOUNDATIONS MUST BE REMOVED TO LEVEL OF THE SHALEY GLACIAL TILL AND BUILT UP WITH ENGINEERED FILL TO THE UNDERSIDE OF THE FOOTING. REFER TO GEOTECHNICAL REPORT.



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N.T.S.

File Number D07-12-25-0095
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ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER
T. J. GRANT
26 Mar 2026
PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

CONSULTANT / EXPERT-CONSEIL

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EXISTING CONDITIONS AND REMOVALS

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SHEET NO. / FEUILLE No.

C003

CITY PROJECT NO. / NUMÉRO DE PROJET

60716350

CONS_PROJECT NO. / NUMÉRO DE PROJET

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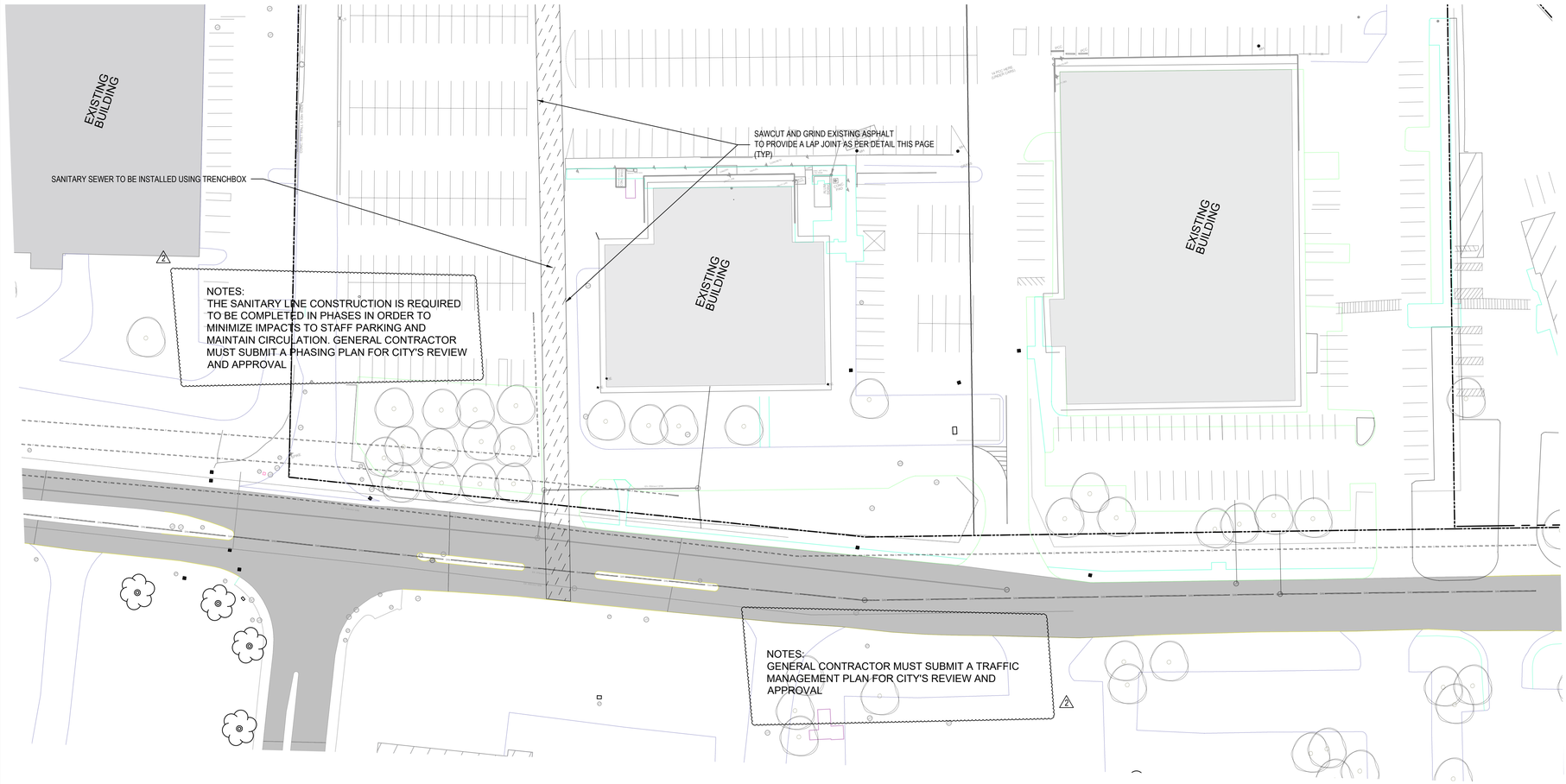
LEGEND

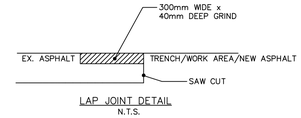
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LAP JOINT DETAIL
N.T.S.

1 REMOVALS PLAN

C004

SCALE: 1 : 500

File Number D07-12-25-0095
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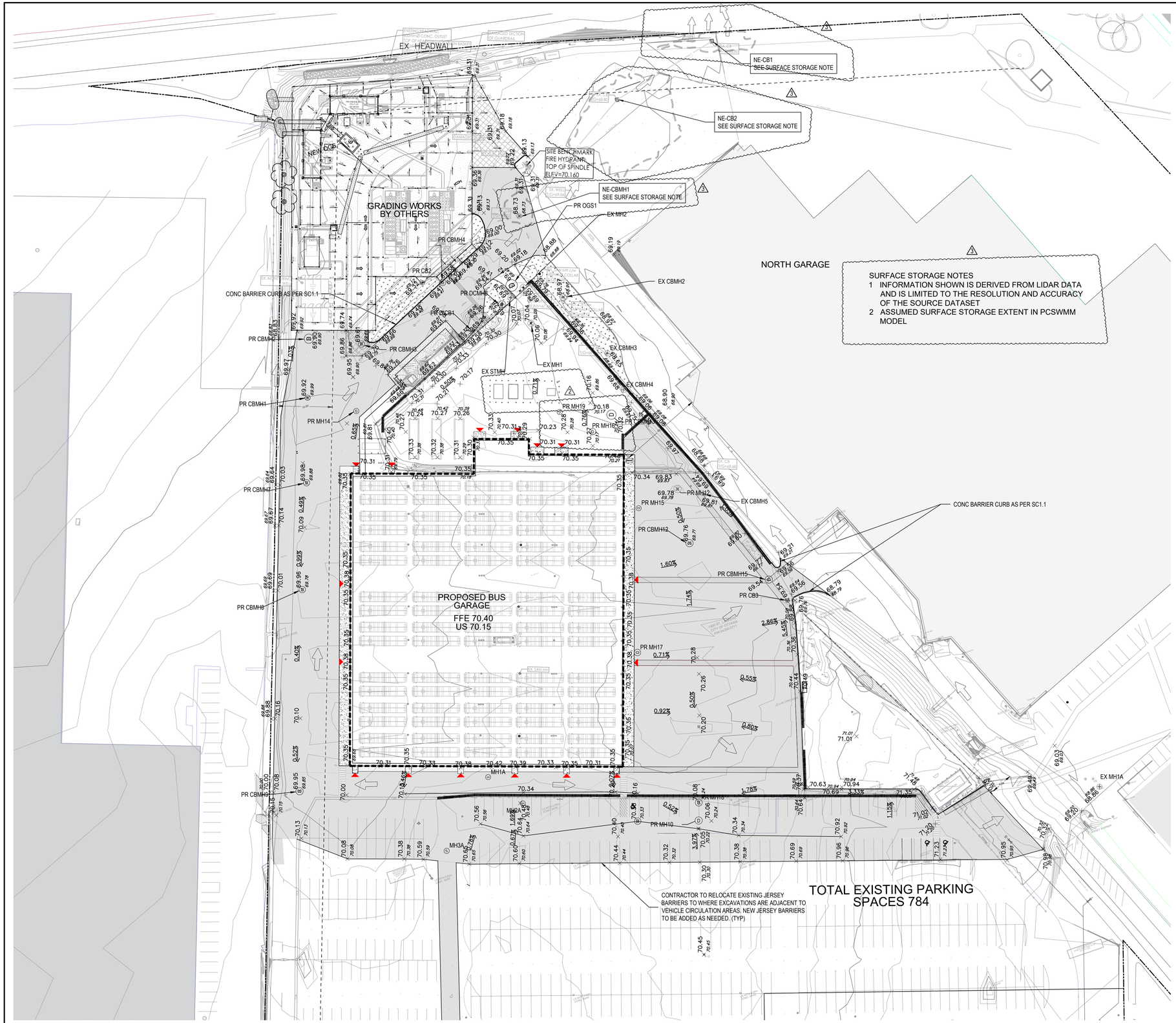
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CITY PROJECT NO. / NUMÉRO DE PROJET: **60716350**

CONS_PROJECT NO. / NUMÉRO DE PROJET:

SHEET NO. / FEUILLE No.: **C004**

ARCH D 24" x 36"



LEGEND

x 291.64 EX GRADE

x 291.64 PROP GRADE

PROP ASPHALT AREA

SURFACE STORAGE LIMITS

OVERLAND FLOW ROUTE

IT IS THE RESPONSIBILITY OF THE USER OF THIS INFORMATION TO VERIFY THAT THE JOB BENCHMARK HAS NOT BEEN ALTERED OR DISTURBED AND ITS RELATIVE ELEVATION AND DESCRIPTION AGREES WITH THE INFORMATION SHOWN ON THIS DRAWING.

TOPOGRAPHIC DATA AND FEATURES SHOWN ON THIS PLAN ARE DERIVED FROM TOTAL STATION FIELD SURVEY PERFORMED DECEMBER 2023.

PROPERTY BOUNDARY DIMENSIONS ARE COMPILED AND CALCULATED FROM INFORMATION ON PLANS 4R-11395 AND 4R-26260.

1 GRADING PLAN

C005

SCALE: 1 : 500

File Number D07-12-25-0095
Plan Number 19357

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SITE GRADING PLAN

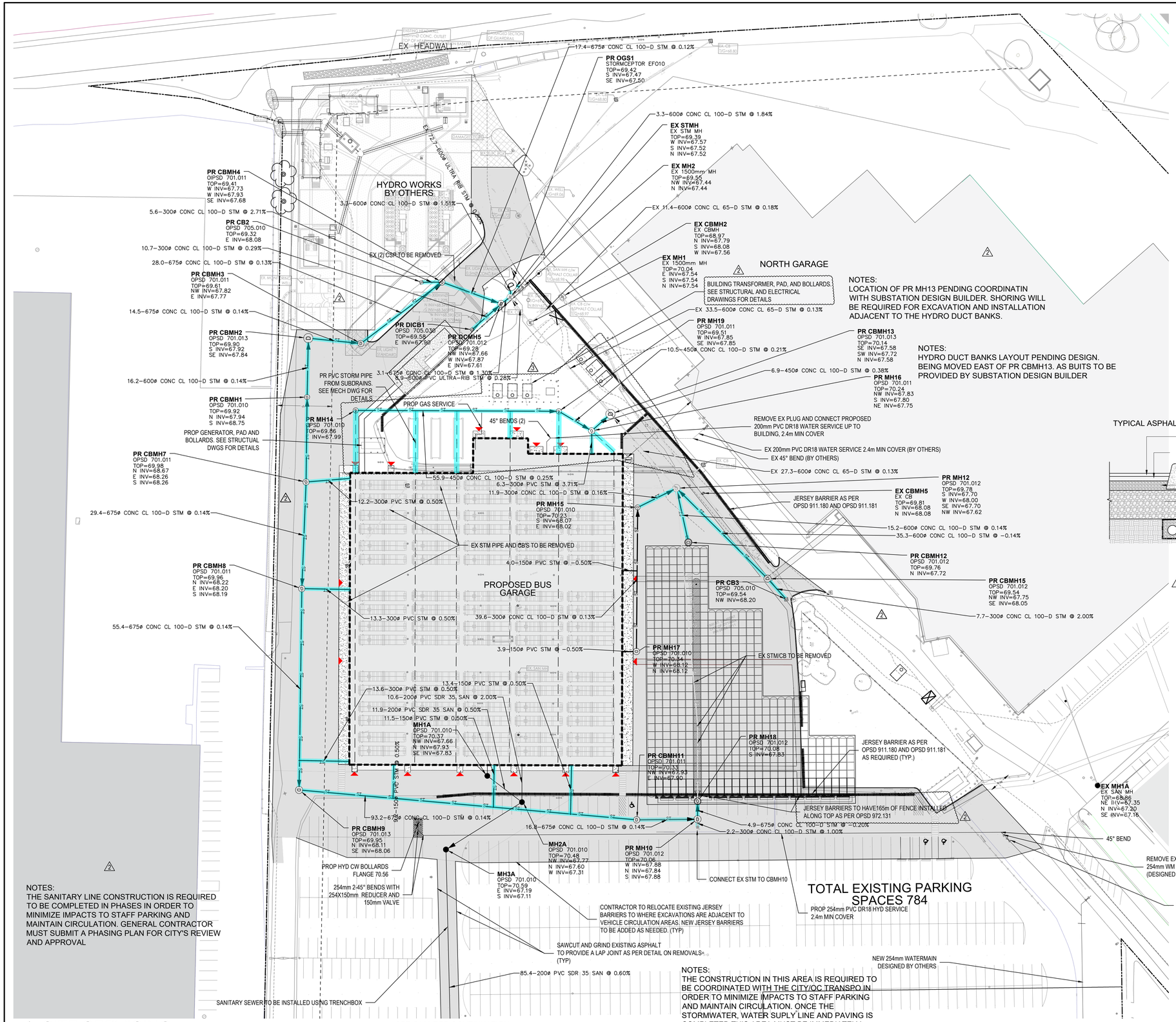
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SHEET NO. / FEUILLE No.
C005

CITY PROJECT NO. / NUMÉRO DE PROJET
60716350

CONS_PROJECT NO. / NUMÉRO DE PROJET

ARCH D 24" x 36"



NOTES:
THE SANITARY LINE CONSTRUCTION IS REQUIRED TO BE COMPLETED IN PHASES IN ORDER TO MINIMIZE IMPACTS TO STAFF PARKING AND MAINTAIN CIRCULATION. GENERAL CONTRACTOR MUST SUBMIT A PHASING PLAN FOR CITY'S REVIEW AND APPROVAL

NOTES:
LOCATION OF PR MH13 PENDING COORDINATIN WITH SUBSTATION DESIGN BUILDER. SHORING WILL BE REQUIRED FOR EXCAVATION AND INSTALLATION ADJACENT TO THE HYDRO DUCT BANKS.

NOTES:
HYDRO DUCT BANKS LAYOUT PENDING DESIGN. BEING MOVED EAST OF PR CBMH13. AS BUITS TO BE PROVIDED BY SUBSTATION DESIGN BUILDER

NOTES:
THE CONSTRUCTION IN THIS AREA IS REQUIRED TO BE COORDINATED WITH THE CITY/OC TRANSPO IN ORDER TO MINIMIZE IMPACTS TO STAFF PARKING AND MAINTAIN CIRCULATION. ONCE THE STORMWATER, WATER SUPLY LINE AND PAVING IS COMPLETED THIS AREA MUST BE IMMEDIATELY RETURNED TO THE STAFF PARKING AREA.

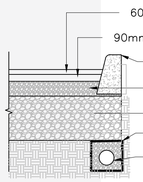
LEGEND

- EX STORM SEWER
- EX SANITARY SEWER
- EX WATERMAIN
- PROP STORM SEWER
- PROP SANITARY SEWER
- PROP WATERMAIN
- PROP ASPHALT AREA
- SEWER TO BE INSULATED AS PER OPSD 1109.030 (NOTE:CONC PIPE CLASS TO BE 100-D)
- PROP FLOOR SUBDRAIN

NOTES:
ORIFICE PLATES TO BE PLACED ON CBMH13, EX MH1 AND DCBMH5. SEE DRAWING C012 FOR ORIFICE PLATE LOCATION, SIZE AND INVERTS.

BUILDING SLAB TO HAVE SUBDAIN DRAINAGE SYSTEM. DRAINAGE SYSTEM TO CONNECT TO STORM SYSTEM. SEE MECHANICAL / STRUCTURAL DRAWINGS FOR DRAINAGE SYSTEM DETAILS.

TYPICAL ASPHALT SECTION



NOTES:
EXISTING UTILITIES, STORM AND SANITARY SYSTEMS TO BE LOCATED AND CONFIRMED IN FIELD PRIOR TO INSTALLATION OF SANITARY OUTLET. DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER.
ALL CROSSINGS OF UTILITIES, SEWERS, WATERMAINS AND STRUCTURES TO BE SUPPORTED AND PROTECTED WITHIN THE TRENCH.
WHERE SANITARY SEWERS, STORM SEWERS AND WATERMAINS TO BE INSTALLED WITHIN EXISTING PAVED AREAS TO BE INSTALLED WITH TRENCH BOX STORM SEWER AND SERVICES ARE TO BE INSULATED AS PER OPSD 1109.030 WHERE COVER IS LESS THAN 1.5m. SEWER CONNECTIONS TO THE BUILDING TO BE TERMINATED 1m FROM BUILDING AND CAPPED.

NOTES:
THE STORMWATER INFRASTRUCTURE CONSTRUCTION ON THE NORTH AND WEST SIDES OF THE NEW GARAGE MUST BE COMPLETED IN PHASES PRIOR TO NEW GARAGE FOUNDATION EXCAVATION IN ORDER TO MINIMIZE IMPACTS TO BUS AND CONSTRUCTION TRAFFIC CIRCULATION. CONTRACTOR MUST SUBMIT A PHASING PLAN FOR CITY'S REVIEW AND APPROVAL. BUS ACCESS TO FUELLING STATION AND BUS EXIT AT BELFAST TO BE MAINTAINED.

File Number D07-12-25-0095
Plan Number 19357

1 | C006 SITE SERVICING PLAN

SCALE: 1 : 500

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2	REISSUED FOR TENDER	2026/03/12	TG
1	ISSUED FOR TENDER	2025/12/15	TG

DESIGNED BY / CONCU PAR: TG/SS
CHECKED BY / VERIFIÉ PAR: TG
DRAWN BY / DESSINÉ PAR: SS
SCALE / ÉCHELLE: 1 : 500

DETAIL NUMBER 1 / A1.1 SHEET NUMBER — DRAWING TITLE

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ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER — T. J. GRANT — 26 Mar 2026 — PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

CONSULTANT / EXPERT-CONSEIL

PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

Enter address here,

OTTAWA, ONTARIO

DRAWING / DESSIN

SITE SERVICING PLAN

BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT: **OMF1**

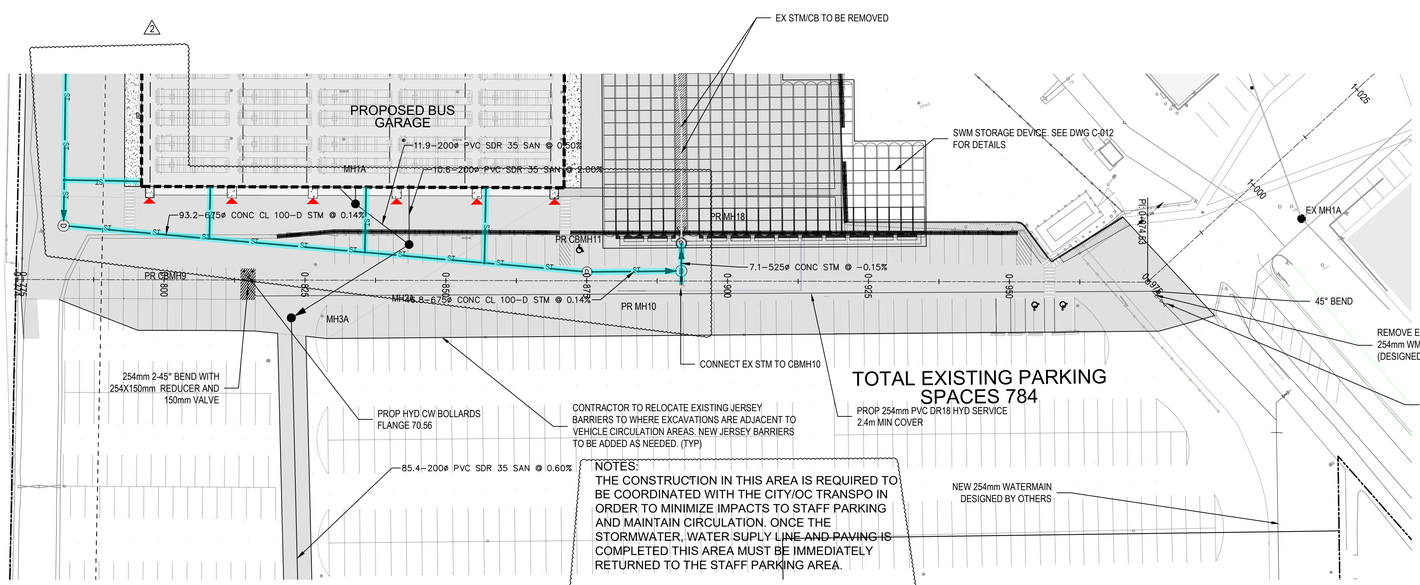
SHEET NO. / FEUILLE No.: **C006**

CITY PROJECT NO. / NUMÉRO DE PROJET: **60716350**

CONS_PROJECT NO. / NUMÉRO DE PROJET:

ARCH D 24" x 36"

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1 | PLAN VIEW
C007

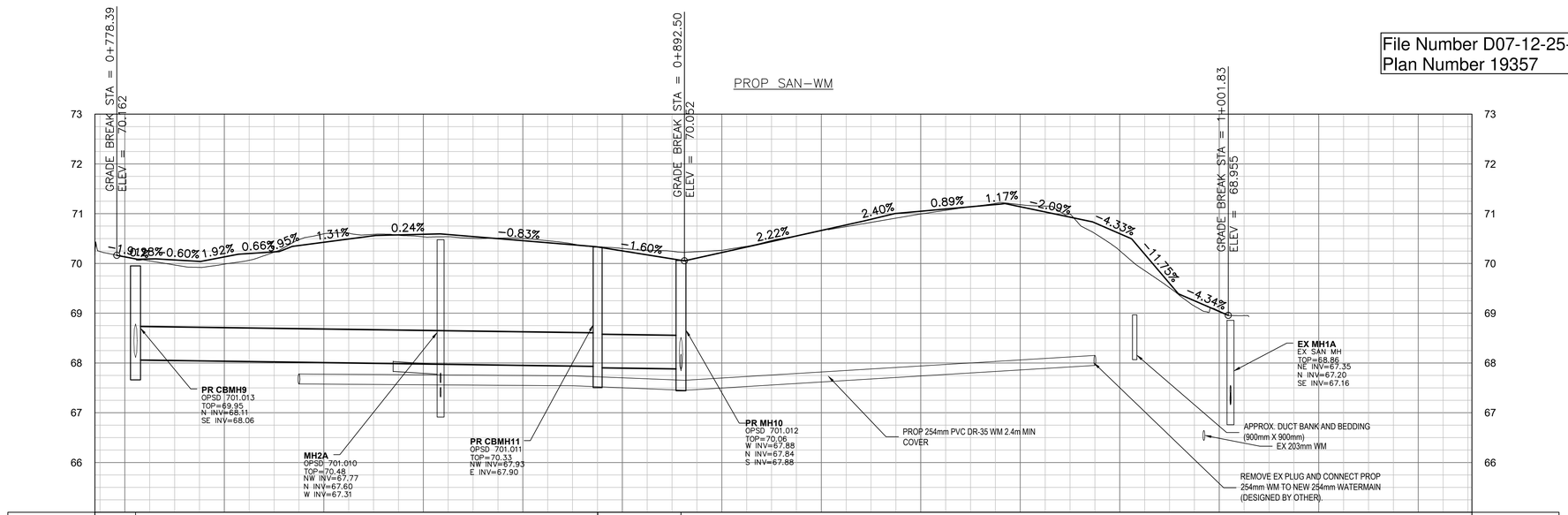
LEGEND

- EX STORM SEWER
- EX SANITARY SEWER
- EX WATERMAIN
- PROP STORM SEWER
- PROP SANITARY SEWER
- PROP WATERMAIN

2 SEWER TO BE INSULATED AS PER OPSD 1109.030 (NOTE:CONC PIPE CLASS TO BE 100-D)

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2 | PROFILE VIEW
C007
SCALE: H 1:500 V 1 : 50

Last Plotted:
Filename:

File Number D07-12-25-0095
Plan Number 19357

Ottawa
INFRASTRUCTURE SERVICES
DESIGN AND CONSTRUCTION

SERVICES D'INFRASTRUCTURE
DIRECTION DE CONCEPTION ET DE CONSTRUCTION

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CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER
T.J. GRANT
26 Mar 2026
PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

CONSULTANT / EXPERT-CONSEIL

PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

Enter address here,

OTTAWA, ONTARIO

DRAWING / DESSIN

SOUTH STORM AND WATERMAIN PROFILE

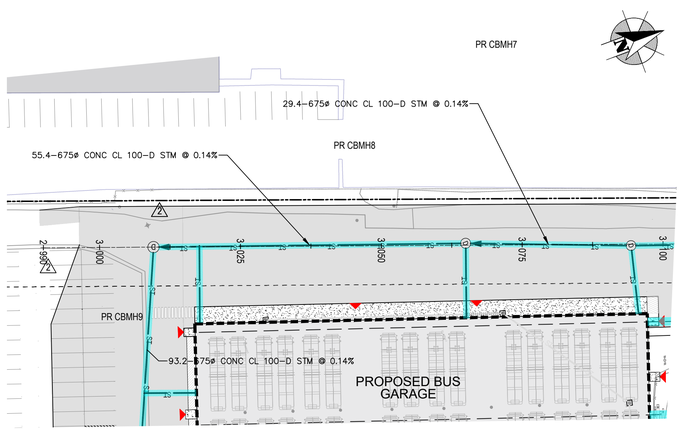
BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT: **OMF1**

SHEET NO. / FEUILLE No. **C007**

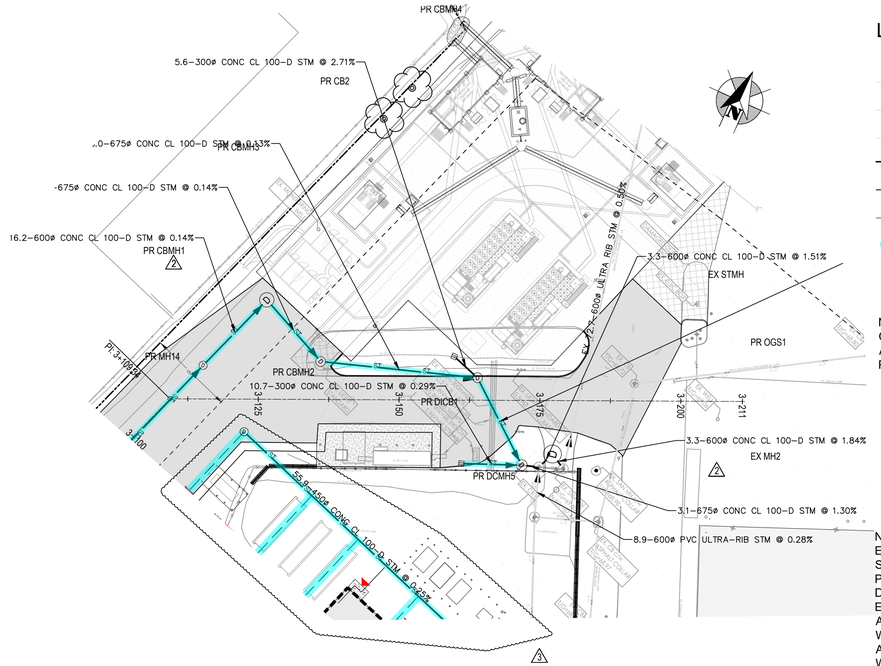
CITY PROJECT NO. / NUMÉRO DE PROJET: **60716350**

CONS. PROJECT NO. / NUMÉRO DE PROJET:

ARCH D 24" x 36"



1 | PLAN VIEW
C008



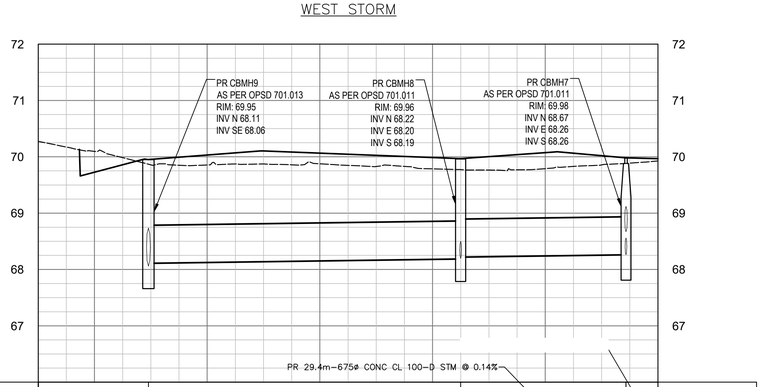
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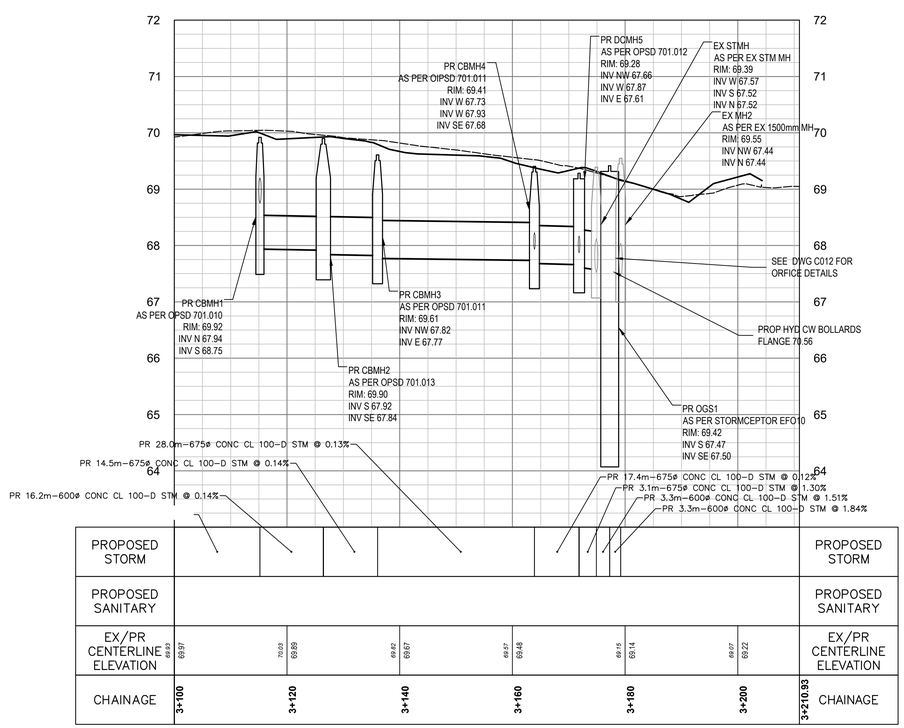
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NOTES:
INSTALLATION OF STORM SEWER ON THE NORTH AND WEST SIDES OF NEW BUILDING TO BE INSTALLED IN PHASES PRIOR TO WORK ON NEW BUILDING. BUS ACCESS TO FUELLING STATION AND BUS EXIT AT BELFAST TO BE MAINTAINED. PHASING AND TRAFFIC MANAGEMENT PLAN TO BE SUBMITTED FOR APPROVAL.





2 | PROFILE VIEW
C008
SCALE: H 1:500 V 1 : 50

File Number D07-12-25-0095
Plan Number 19357

Last Plotted:
Filename:

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PROVINCE OF ONTARIO

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PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

Enter address here,

OTTAWA, ONTARIO

DRAWING / DESSIN

WEST STORM

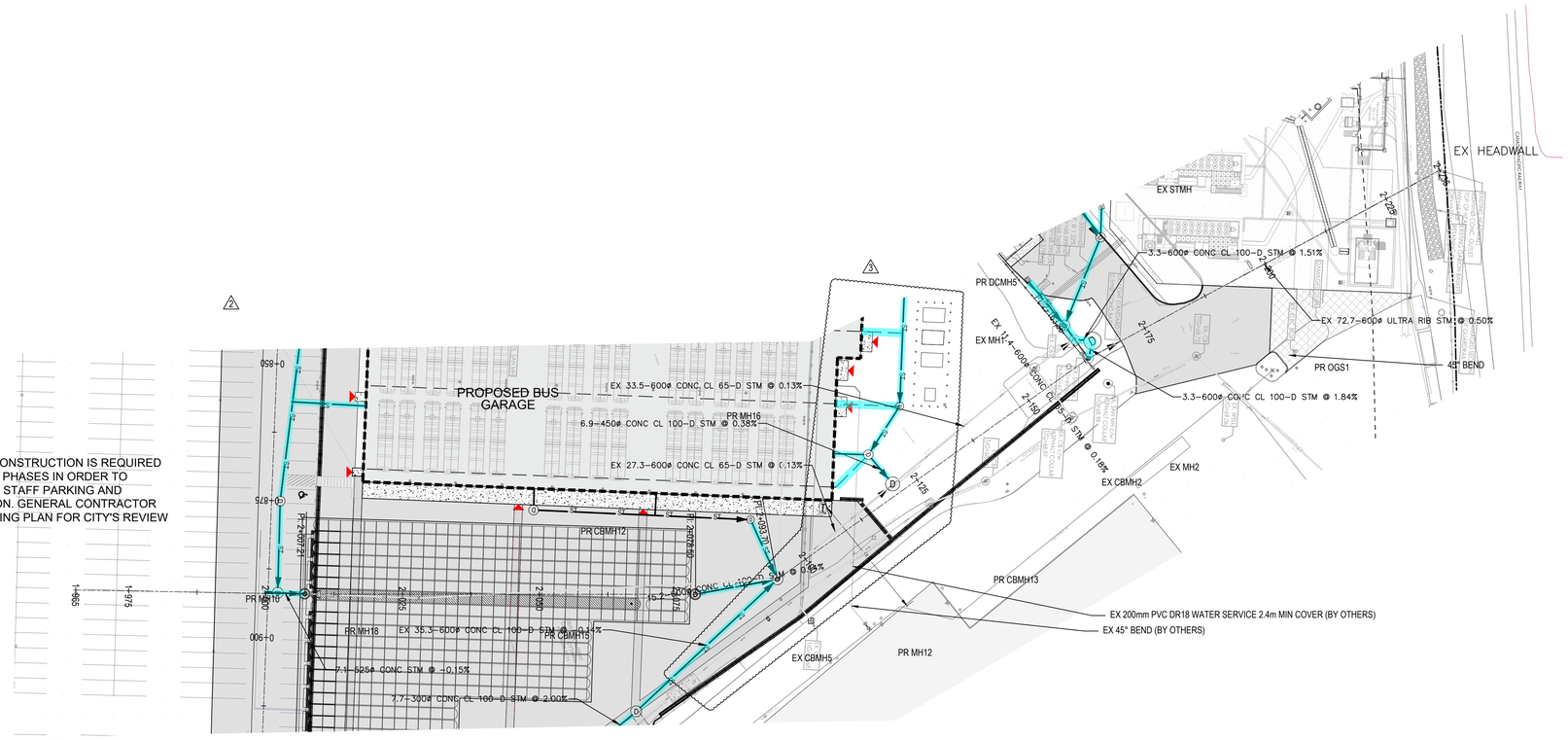
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SHEET NO. / FEUILLE No.
C008

CITY PROJECT NO. / NUMÉRO DE PROJET
60716350

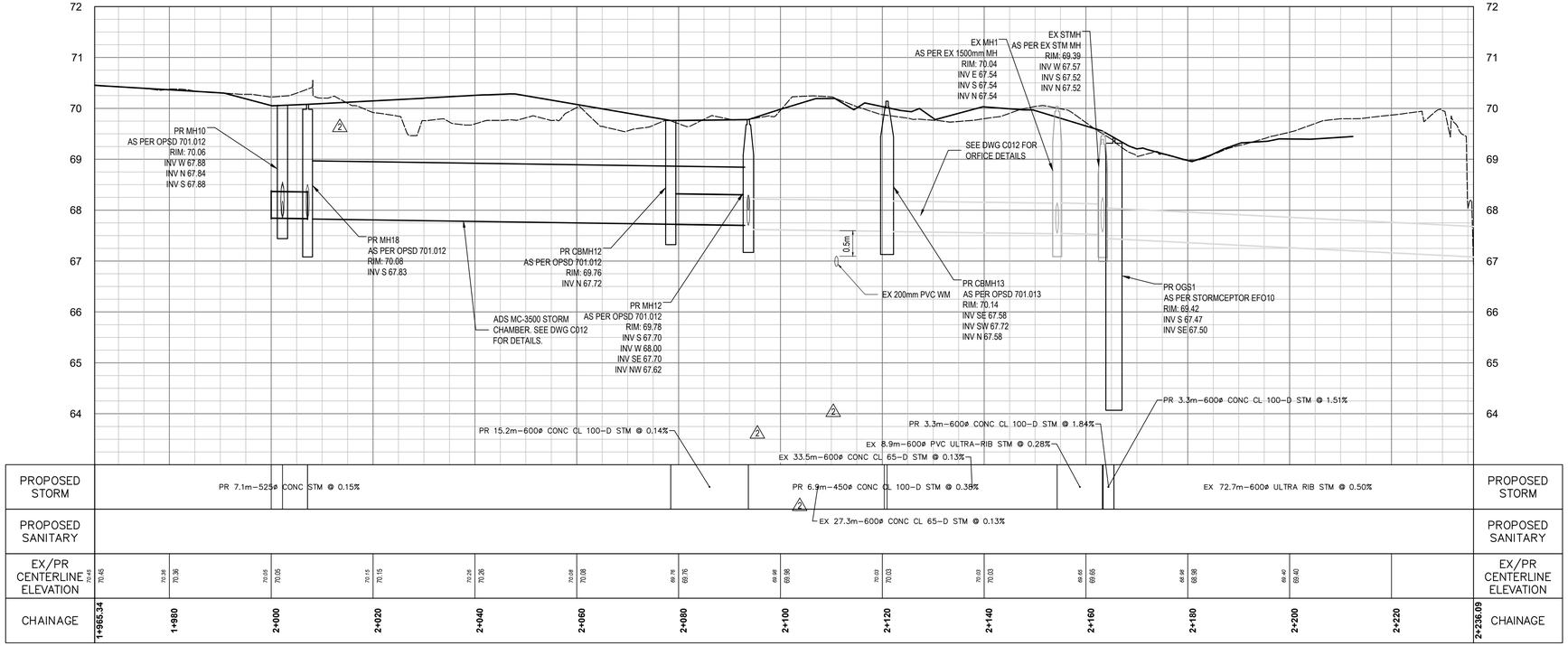
CONS_PROJECT NO. / NUMÉRO DE PROJET

ARCH D 24" x 36"



1 | PLAN VIEW
C009

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2 | PROFILE VIEW
C009
SCALE: H 1:500 V 1 : 50

LEGEND

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- EX SANITARY SEWER
- EX WATERMAIN
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Plan Number 19357

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PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

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OTTAWA, ONTARIO

DRAWING / DESSIN

EAST STORM PROFILE

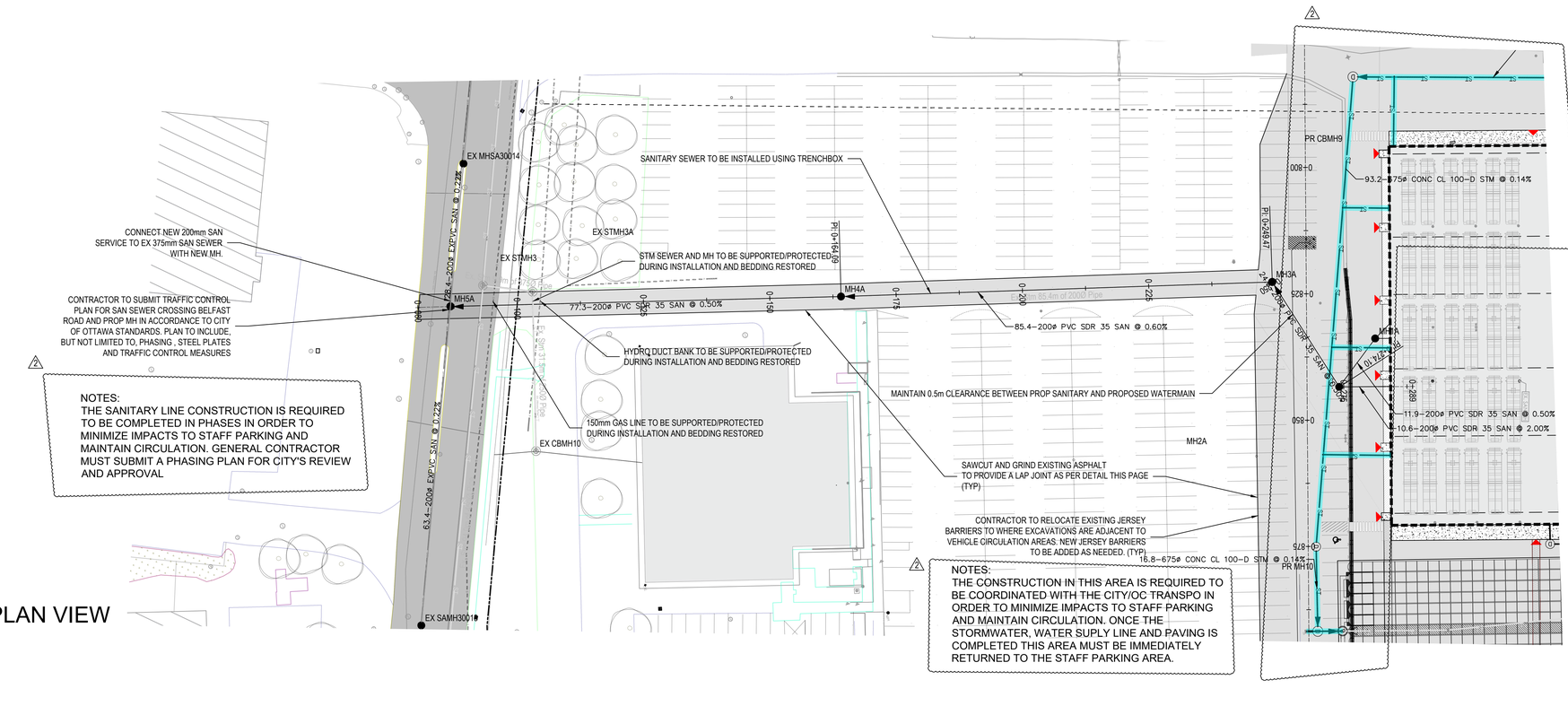
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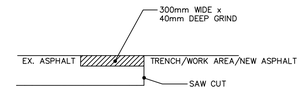


1 | PLAN VIEW
C010

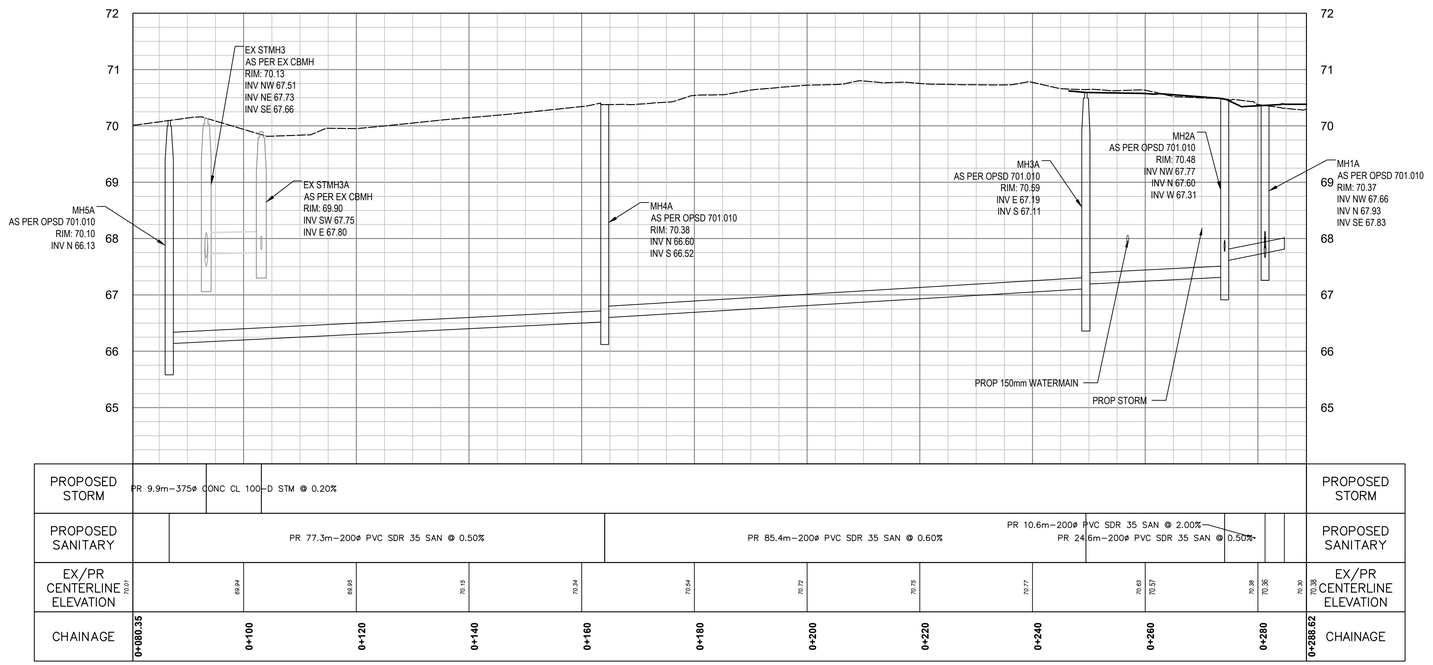
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LAP JOINT DETAIL
N.T.S.



PROPOSED STORM	PR 9.9m–375ø CONC CL 100–D STM @ 0.20%											PROPOSED STORM
PROPOSED SANITARY	PR 77.3m–200ø PVC SDR 35 SAN @ 0.50%				PR 85.4m–200ø PVC SDR 35 SAN @ 0.60%			PR 10.6m–200ø PVC SDR 35 SAN @ 2.00% PR 24.6m–200ø PVC SDR 35 SAN @ 0.50%				PROPOSED SANITARY
EX/PR CENTERLINE ELEVATION	69.64	69.65	70.15	70.34	70.54	70.72	70.78	70.77	70.43	70.57	70.38	70.36	70.30	70.38	EX/PR CENTERLINE ELEVATION
CHAINAGE	0+080.35	0+100	0+120	0+140	0+160	0+180	0+200	0+220	0+240	0+260	0+280	0+288.62	CHAINAGE		

2 | PROFILE VIEW
C010
SCALE: H 1:500 V 1 : 50

File Number D07-12-25-0095
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1	ISSUED FOR TENDER	2025/12/15	TG

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ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER
T. J. GRANT
26 Mar 2026
PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

CONSULTANT / EXPERT-CONSEIL

PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

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OTTAWA, ONTARIO

DRAWING / DESSIN

SANITARY OUTLET

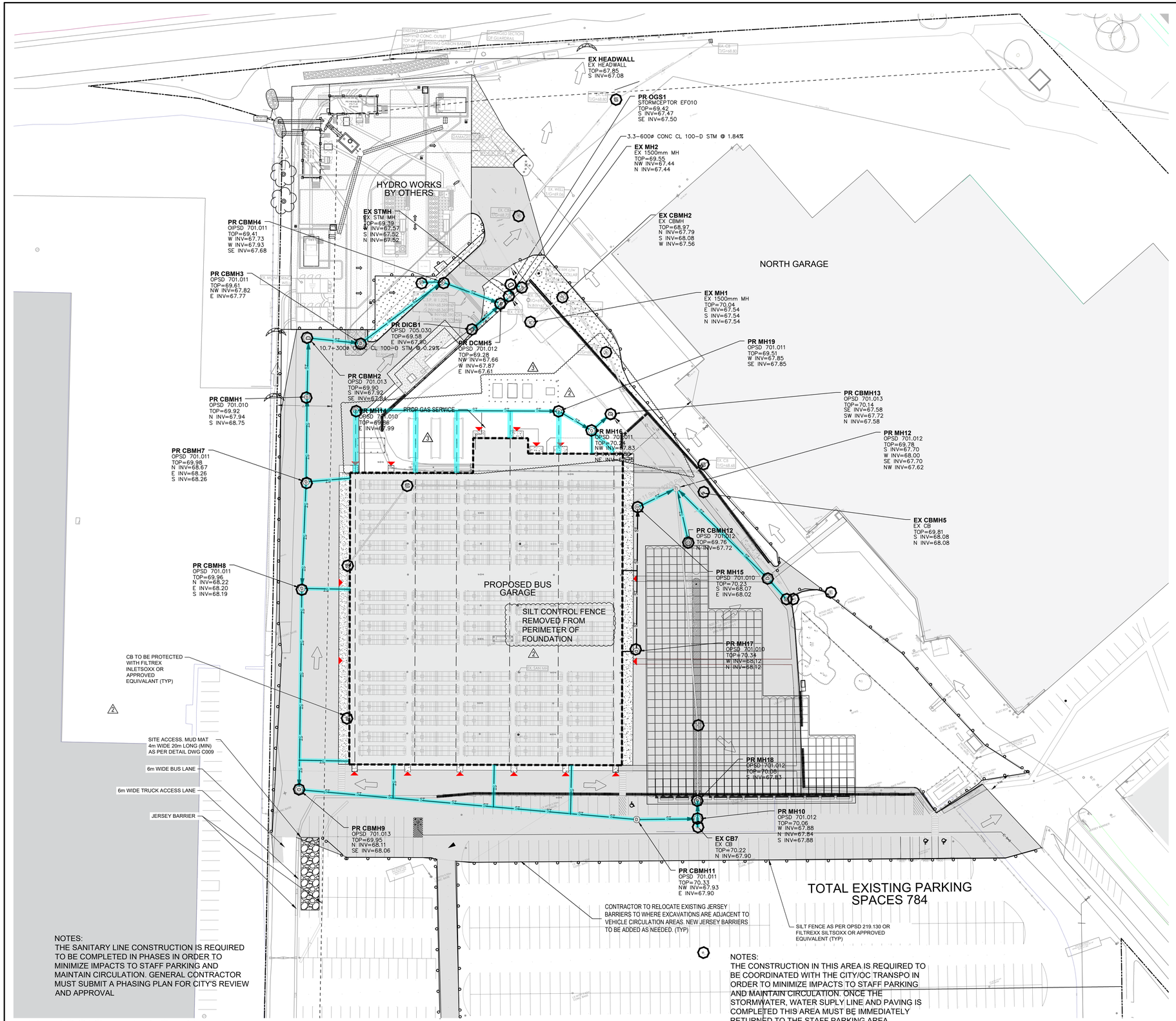
BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT: **OMF1**

SHEET NO. / FEUILLE No. **C010**

CITY PROJECT NO. / NUMÉRO DE PROJET: **60716350**

CONS. PROJECT NO. / NUMÉRO DE PROJET:

ARCH D 24" x 36"



NOTES:
THE SANITARY LINE CONSTRUCTION IS REQUIRED TO BE COMPLETED IN PHASES IN ORDER TO MINIMIZE IMPACTS TO STAFF PARKING AND MAINTAIN CIRCULATION. GENERAL CONTRACTOR MUST SUBMIT A PHASING PLAN FOR CITY'S REVIEW AND APPROVAL

NOTES:
THE CONSTRUCTION IN THIS AREA IS REQUIRED TO BE COORDINATED WITH THE CITY/OC TRANSPO IN ORDER TO MINIMIZE IMPACTS TO STAFF PARKING AND MAINTAIN CIRCULATION. ONCE THE STORMWATER, WATER SUPLY LINE AND PAVING IS COMPLETED THIS AREA MUST BE IMMEDIATELY RETURNED TO THE STAFF PARKING AREA.

LEGEND

- EX STORM SEWER
- EX SANITARY SEWER
- EX WATERMAIN
- PROP STORM SEWER
- PROP SANITARY SEWER
- PROP WATERMAIN
- PROP SILT FENCE
- PROP CB PROTECTION
- PROP MUD MAT
- OVERLAND FLOW ROUTE
- ROCK CHECK DAM/STRAW BAIL

NOTE:
ADDITIONAL ROCK CHECK DAMS/STRAW BAIL DURING CONSTRUCTION AS REQUIRED.

NOTES:
THE STORMWATER INFRASTRUCTURE CONSTRUCTION ON THE NORTH AND WEST SIDES OF THE NEW GARAGE MUST BE COMPLETED IN PHASES PRIOR TO NEW GARAGE FOUNDATION EXCAVATION IN ORDER TO MINIMIZE IMPACTS TO BUS AND CONSTRUCTION TRAFFIC CIRCULATION. CONTRACTOR MUST SUBMIT A PHASING PLAN FOR CITY'S REVIEW AND APPROVAL. BUS ACCESS TO FUELLING STATION AND BUS EXIT AT BELFAST TO BE MAINTAINED.

File Number D07-12-25-0095
Plan Number 19357

1 C011 EROSION AND SEDIMENT CONTROL
SCALE: 1 : 500

Last Plotted:
Filename:

INFRASTRUCTURE SERVICES
DESIGN AND CONSTRUCTION

SERVICES D'INFRASTRUCTURE
DIRECTION DE CONCEPTION ET DE CONSTRUCTION

FOR / POUR
Client - Department
Infrastructure and Water Services Department
Design & Construction

CONSULTANT
AECOM

PRIME:
AECOM Canada Architects Ltd.
50 Sportsworld Crossing Road, Suite 290
Kitchener, Ontario, N2P 0A4

grc architects

SUBCONSULTANT:
GRC ARCHITECTS INC.
47 Clarence Street, Suite 401
Ottawa, Ontario, K1N 9K1

NOTE:
IT IS THE RESPONSIBILITY OF THE CONTRACTORS TO INFORM THEMSELVES OF THE EXACT LOCATION OF, AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES, SERVICES AND STRUCTURES WHETHER ABOVE GROUND OR BELOW GRADE BEFORE COMMENCING THE WORK. SUCH INFORMATION IS NOT NECESSARILY SHOWN ON THE DRAWING, AND WHERE SHOWN, THE ACCURACY CANNOT BE GUARANTEED.
WITH THE SOLE EXCEPTION OF THE BENCHMARK(S) SPECIFICALLY DESCRIBED FOR THIS PROJECT, NO ELEVATION INDICATED OR ASSUMED HEREON IS TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

NUMBER / NUMÉRO	MILESTONE/FAIT SAILLANT	DATE: (Y/M/D) (AMJ)	INITIALS INITIALES
4	ISSUED FOR SPA	2026/03/26	TG
3	REISSUED FOR TENDER	2026/03/26	TG
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PROJECT / LOCATION / PROJET / ENDROIT

OTC ZEB-New Garage

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OTTAWA, ONTARIO

DRAWING / DESSIN

EROSION AND SEDIMENT CONTROL PLAN

BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ / BUILDING NUMBER / NUMÉRO DU BÂTIMENT
OMF1

SHEET NO. / FEUILLE No.
C011

CITY PROJECT NO. / NUMÉRO DE PROJET
60716350

CONS_PROJECT NO. / NUMÉRO DE PROJET

ARCH D 24" x 36"

PROJECT INFORMATION	
ENGINEERING PRODUCT MANAGER:	HAIDER NASRULLAH 647-850-9417 HAIDER.NASRULLAH@ADSPIPE.COM
ADS SALES REP:	BRAD DUNCOP 613-863-7336 BRAD.DUNCOP@ADSPIPE.COM
PROJECT NO:	84444
ONTARIO SITE COORDINATOR:	RYAN RUBENSTEIN 519-710-3687 RYAN.RUBENSTEIN@ADSPIPE.COM

Advanced Drainage Systems, Inc.

SiteAssist® FOR STORMTECH INSTALLATION INSTRUCTIONS VISIT OUR WEBSITE

OTC ZEB NEW GARAGE

OTTAWA, ON.

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL BE CERTIFIED TO CSA B1841, "POLYMERIC SUB-SURFACE STORMWATER MANAGEMENT STRUCTURES", AND MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45476 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LIMIT STATES FOR STRENGTH (YIELDING, BUCKLING AND FATIGUE), SERVICEABILITY, SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE CSA SE CL-625 TRUCK AND THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (>WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 5" (≥ 127 MM).
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%, THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 23° C / 73° F), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD IN THE STRUCTURAL DESIGN METHOD PER ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE LATEST AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, WITH TRIANGULAR LOAD PLACEMENT.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT 5" SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END-CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.
10. MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE. DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
11. ADS DOES NOT DESIGN OR PROVIDE MEMBRANE LINER SYSTEMS. TO MINIMIZE THE LEAKAGE POTENTIAL OF LINER SYSTEMS, THE MEMBRANE LINER SYSTEM SHOULD BE DESIGNED BY A KNOWLEDGEABLE GEOTEXTILE PROFESSIONAL AND INSTALLED BY A QUALIFIED CONTRACTOR.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 150 mm (6") SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 300 mm (12") INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE; AASHTO M43 #3, 357, 4, 467, 5, 56, OR 57.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 900 mm (36") OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-800-821-6710 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

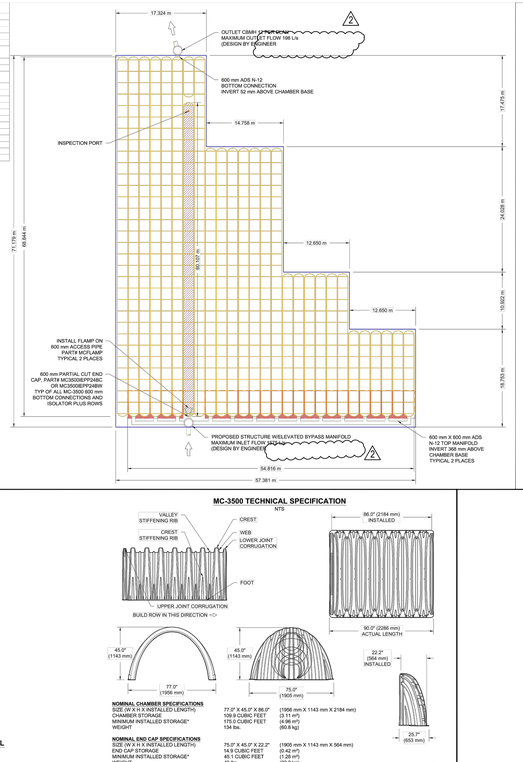
800R ADS, INC.

PROPOSED LAYOUT

522	STORMTECH MC-3500 CHAMBERS
56	STORMTECH MC-3500 END CAPS
305	STONE ABOVE (mm)
229	STONE BELOW (mm)
40	% STONE VOID
2,499.5	**INSTALLED SYSTEM VOLUME (m³) ABOVE ELEVATION 67.750 (PERIMETER STONE INCLUDED)**
2,638.2	SYSTEM AREA (m²)
207.1	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS

71.279	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
69.451	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
69.298	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
69.298	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
69.298	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
69.146	TOP OF STONE
68.841	TOP OF MC-3500 CHAMBER
68.096	600 mm TOP MANIFOLD/CONNECTION INVERT
67.750	600 mm ISOLATOR ROW PLUS CONNECTION INVERT
67.750	600 mm BOTTOM MANIFOLD/CONNECTION INVERT
67.698	BOTTOM OF MC-3500 CHAMBER
67.469	BOTTOM OF STONE



ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

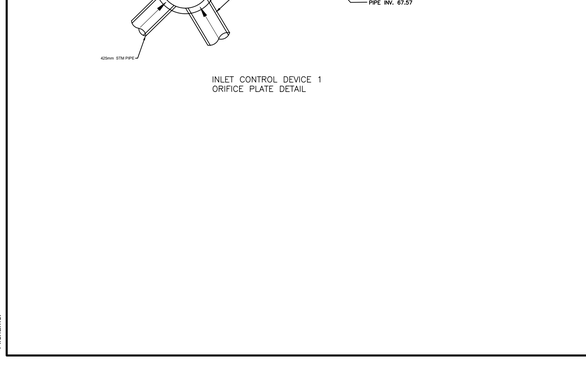
	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FINAL FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE (B LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 18" (450 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE (A LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[2]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[2]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[3,5]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
3. CARE MUST BE TAKEN TO AVOID OVER-COMPACTION OF THE MATERIAL IMMEDIATELY ADJACENT TO THE CHAMBER ROWS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.
5. WHERE RECYCLED CONCRETE AGGREGATE IS USED IN LAYERS 'A' OR 'B' THE MATERIAL SHOULD ALSO MEET THE ACCEPTABILITY CRITERIA OUTLINED IN TECHNICAL NOTE 6.20 "RECYCLED CONCRETE STRUCTURAL BACKFILL".



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45476 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS. REFERENCE STORMTECH DESIGN MANUAL FOR BEARING CAPACITY GUIDANCE.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 5".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.



MC-3500 ISOLATOR ROW PLUS DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45° (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

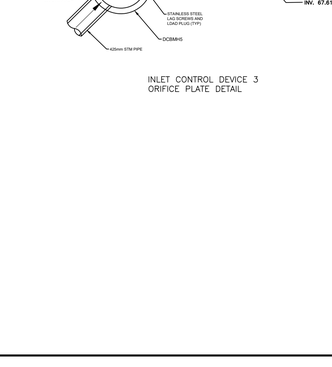
NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

MC-3500 6" (150 mm) INSPECTION PORT DETAIL
NTS

MC-3500 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS
SIZE (W X H X INSTALLED LENGTH): 77.0" X 45.0" X 86.0" (1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE: 109.9 CUBIC FEET (3.11 m³)
MINIMUM INSTALLED STORAGE*: 175.0 CUBIC FEET (4.96 m³)
WEIGHT: 134 lbs. (60.8 kg)

NOMINAL END CAP SPECIFICATIONS
SIZE (W X H X INSTALLED LENGTH): 75.0" X 45.0" X 22.2" (1905 mm X 1143 mm X 564 mm)
END CAP STORAGE: 14.9 CUBIC FEET (0.42 m³)
MINIMUM INSTALLED STORAGE*: 45.1 CUBIC FEET (1.28 m³)
WEIGHT: 49 lbs. (22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" (152 mm) STONE BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"

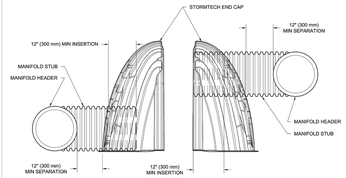
PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.68" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.87" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.38" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL

CUSTOM PARTIAL CUT INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE CIRCULAR CUTS FOR EACH SIZE AND 15-68" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPES SIZED GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN "B" ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

MUD MAT DETAIL

INLET CONTROL DEVICE 1
ORIFICE PLATE DETAIL

S/S ORIFICE PLATE C/W S/S NUTS AND BOLTS ANCHORED TO CONCRETE POSITIVELY. CONTRACTOR TO PROVIDE SIGNED AND STAMPED SHOP DRAWINGS FOR SIZE THICKNESS AND DIMENSIONS
ANCHOR BOLTS FASTENED POSITIVELY
600mmø OPENING AT MANHOLE
75mmø OPENING AT PLATE
ORIFICE INV. 67.57
PIPE INV. 67.57

INLET CONTROL DEVICE 2
ORIFICE PLATE DETAIL

S/S ORIFICE PLATE C/W S/S NUTS AND BOLTS ANCHORED TO CONCRETE POSITIVELY. CONTRACTOR TO PROVIDE SIGNED AND STAMPED SHOP DRAWINGS FOR SIZE THICKNESS AND DIMENSIONS
ANCHOR BOLTS FASTENED POSITIVELY
600mmø OPENING AT MANHOLE
394mmø OPENING AT PLATE
ORIFICE INV. 67.565
PIPE INV. 67.565

INLET CONTROL DEVICE 3
ORIFICE PLATE DETAIL

S/S ORIFICE PLATE C/W S/S NUTS AND BOLTS ANCHORED TO CONCRETE POSITIVELY. CONTRACTOR TO PROVIDE SIGNED AND STAMPED SHOP DRAWINGS FOR SIZE THICKNESS AND DIMENSIONS
ANCHOR BOLTS FASTENED POSITIVELY
600mmø OPENING AT MANHOLE
225mmø OPENING AT PLATE
ORIFICE INV. 67.61
INV. 67.61

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File Number D07-12-25-0095
Plan Number 19357

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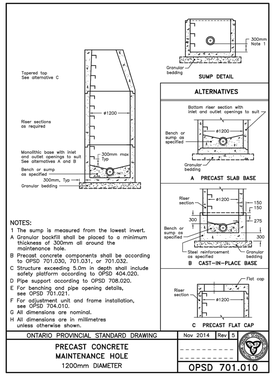
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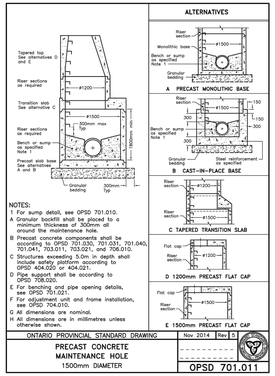
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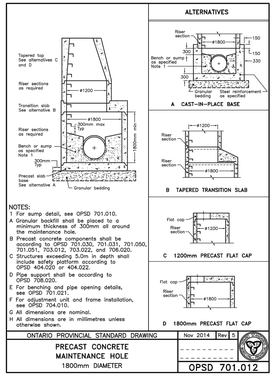
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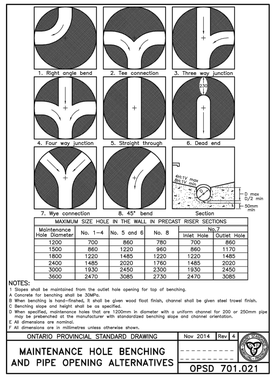
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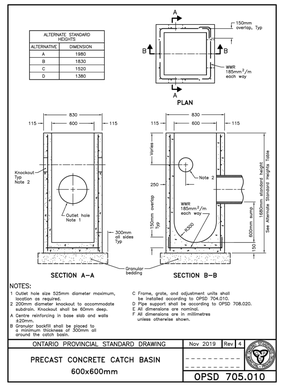
ARCH D 24" x 36"

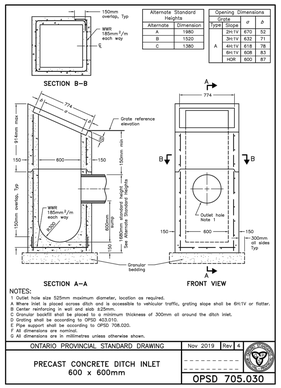


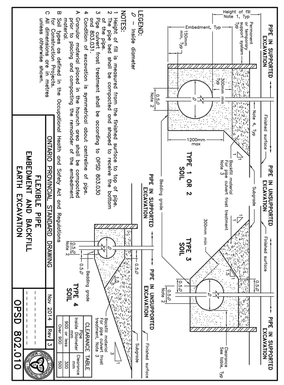


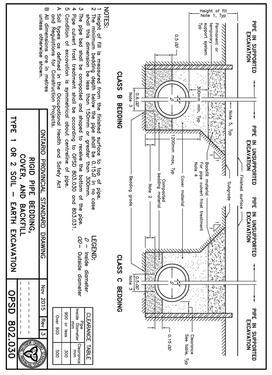


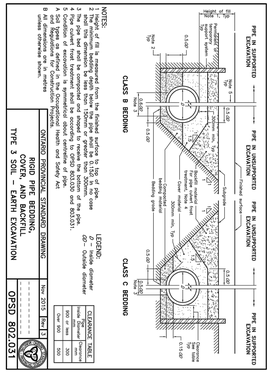


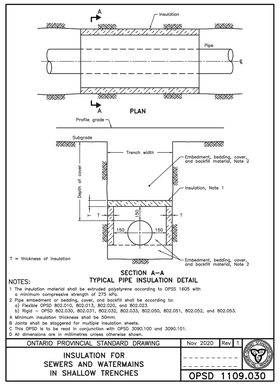


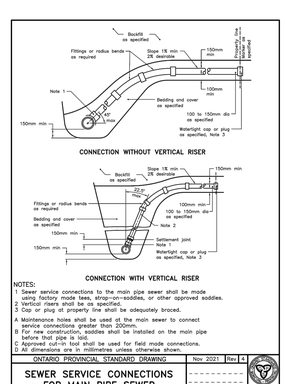


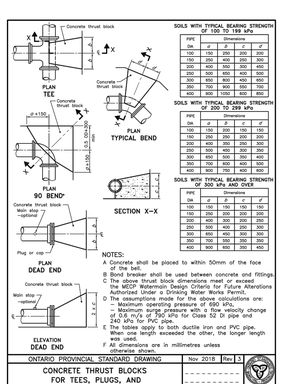


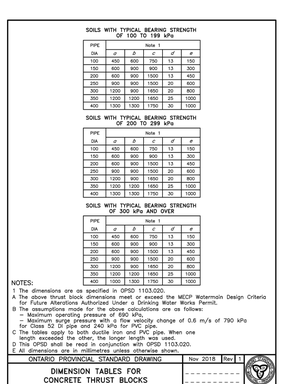


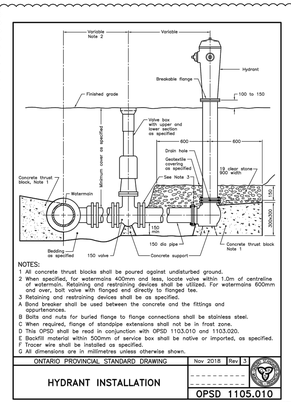


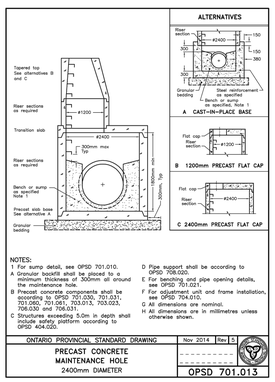


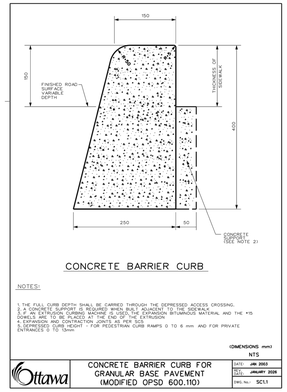


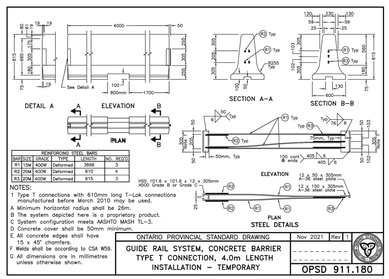


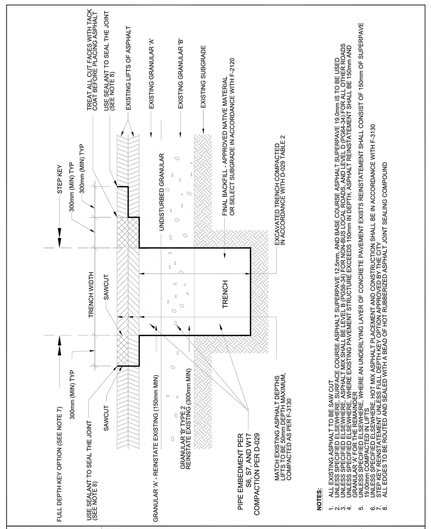












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CONSULTANT

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PRIME:
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50 Sportsworld Crossing Road, Suite 290
Kitchener, Ontario, N2P 0A4

grc architects

SUBCONSULTANT:
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2	REISSUED FOR TENDER	2026/03/12	TG
1	ISSUED FOR TENDER	2025/12/15	TG

DESIGNED BY / CONCU PAR: Checker
CHECKED BY / VERIFIÉ PAR: Approver
DRAWN BY / DESSINÉ PAR: SS
SCALE / ÉCHELLE: 1 : 500

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ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER T. J. GRANT 26 Mar 2026 PROVINCE OF ONTARIO

CONSULTANT / EXPERT-CONSEIL

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OTC ZEB-New Garage

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OTTAWA, ONTARIO

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STANDARD DETAILS OPSD

BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT: **OMF1**

SHEET NO. / FEUILLE No. **C013**

CITY PROJECT NO. / NUMÉRO DE PROJET: **60716350**

CONS. PROJECT NO. / NUMÉRO DE PROJET:

ARCH D 24" x 36"



LEGEND

- EX STORM SEWER
- EX SANITARY SEWER
- EX WATERMAIN
- PROP STORM SEWER
- PROP SANITARY SEWER
- PROP WATERMAIN

1 PRE DEVELOPMENT DRAINAGE AREAS
C014

SCALE: 1 : 500

File Number D07-12-25-0095
Plan Number 19357

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Filename:

INFRASTRUCTURE SERVICES
DESIGN AND CONSTRUCTION

SERVICES D'INFRASTRUCTURE
DIRECTION DE CONCEPTION ET DE CONSTRUCTION

FOR / POUR

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Infrastructure and Water Services Department
Design & Construction

CONSULTANT

AECOM

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grc architects

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3	ISSUED FOR SPA	2026/03/26	TG
2	REISSUED FOR TENDER	2026/03/12	TG
1	ISSUED FOR TENDER	2025/12/15	TG

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TG/SS	TG
DRAWN BY / DESSINÉ PAR	SCALE / ÉCHELLE
SS	1 : 500

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ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER
T. J. GRANT
26 Mar 2026
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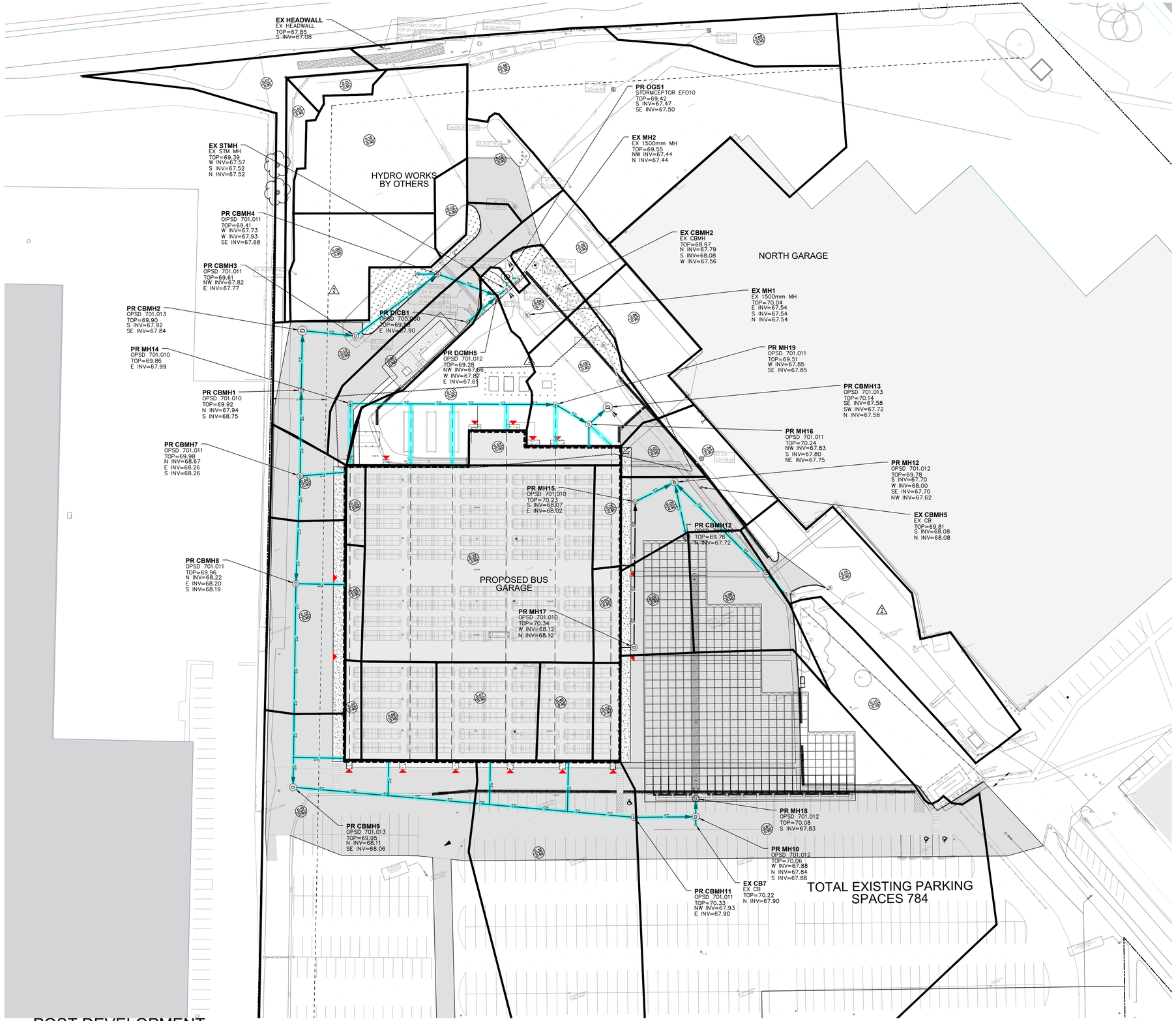
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PRE DEVELOPMENT DRAINAGE AREAS

BUSINESS ENTITY / NUMÉRO DE L'ENTITÉ BUILDING NUMBER / NUMÉRO DU BÂTIMENT	*SHEET NO. / FEUILLE No.*
OMF1	**C014**
CITY PROJECT NO. / NUMÉRO DE PROJET	*CONS. PROJECT NO. / NUMÉRO DE PROJET*
60716350	

ARCH D 24" x 36"



LEGEND

- EX STORM SEWER
- EX SANITARY SEWER
- EX WATERMAIN
- PROP STORM SEWER
- PROP SANITARY SEWER
- PROP WATERMAIN

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Plan Number 19357

1 POST DEVELOPMENT DRAINAGE AREAS
C015
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CHECKED BY / VÉRIFIÉ PAR: TG
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ARCHITECT / ARCHITECTE

CONSULTANT / EXPERT-CONSEIL

LICENSED PROFESSIONAL ENGINEER
T. J. GRANT
26 Mar 2026
PROVINCE OF ONTARIO

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C015

CITY PROJECT NO. / NUMÉRO DE PROJET
60716350

CONS_PROJECT NO. / NUMÉRO DE PROJET

Appendix L Proposed Storm System Model Supporting Information

OC Transpo Zero Emissions Bus Garage
PN 60716350

Proposed Conditions Parameters for PCSWMM Simulation - Catchments and On-Site Storage

Subcatchment ID	Recipient MH or CB	Area (ha)	Impervious %	On-Site Storage Depth (m)	On-Site Storage Maximum Surface Area (m2)*	On-Site Storage Maximum Surface Area (m2) Input into PCSWMM*	Width (m)	Flow Length (m)	Slope (%)
CA3_12	NE-CB1	0.06	100	0.05	86.9	29.0	9.8	60.0	0.5
CA3_4	ExCBMH1	0.04	100	-	-	-	10.6	36.0	0.5
CA3_8	CBMH2	0.05	100	-	-	-	19.9	26.0	0.5
CA3_9	CBMH2	0.04	75	-	-	-	17.9	23.0	0.5
Envari_1	P3_10	0.15	100				71.8	21.0	1.5
Envari_2	CBMH1	0.02	100				6.1	32.0	1.5
Envari_3	NewCBMH3	0.09	100				28.0	32.0	1.5
Envari_4	OF1	0.01	100				7.4	20.0	1.5
Envari_5	OF1	0.02	100				3.6	61.0	1.5
P1_1	OF1	0.07	25	**-**	**-**	**-**	9.8	70.0	0.5
P1_2	NewCBMH2	0.12	100	-	-	-	20.0	60.0	1.0
P2_1	NewCBMH10	0.87	94	-	-	-	119.3	73.1	1.5
P2_10	MH12	0.05	100	-	-	-	22.7	23.4	0.5
P2_11	NewCBMH12	0.05	100	-	-	-	24.0	22.5	1.4
P2_2	NewCBMH11	0.32	100				45.8	70.8	0.5
P2_3	NewCBMH9	0.51	100	-	-	-	70.8	72.7	1.0
P2_4	NewCBMH8	0.12	100				33.3	36.0	1.5
P2_5	NewCBMH7	0.04	100				28.1	14.3	1.5
P2_6	DICB1	0.06	100				12.7	51.0	0.5
P2_7	DICB1	0.05	100	1	11.7	3.9	8.4	54.9	0.5
P2_8	DICB1	0.08	100				23.4	35.2	0.5
P2_9	NewMH16	0.03	100	-	-	-	7.2	39.8	0.5
S1_1	J14	0.33	100	-	-	-	95.7	35.0	0.5
S1_2	J2	0.02	100	-	-	-	4.3	35.0	0.5
S1_3	J1	0.01	100	-	-	-	3.3	35.0	0.5
S1_4	J13	0.02	100	-	-	-	5.9	35.0	0.5
S1_5	J12	0.02	100	-	-	-	5.6	35.0	0.5
S1_6	J3	0.01	100	-	-	-	3.4	35.0	0.5
S1_7	J4	0.06	100	-	-	-	15.7	35.0	0.5
S1_8	J5	0.07	100	-	-	-	21.2	35.0	0.5
S1_9	J6	0.04	100	-	-	-	11.4	35.0	0.5
S1_11	J7	0.02	100	-	-	-	5.7	35.0	0.5
P3_1	ExCB	0.15	100	0.1	13.2	4.4	24.0	64.0	0.5
P3_2	ExCB	0.10	25				14.3	72.0	0.5
P3_10	CBMH1	0.05	100	0.25	43.2	14.4	23.3	20.0	2.0
P3_11	NE-CB2	0.38	100	0.2	545.0	181.7	37.4	101.4	0.5
P3_3	NewCBMH15	0.08	94	-	-	-	29.0	27.0	2.0
P3_5	MH12	0.02	100	-	-	-	15.7	15.0	0.5
P3_7	CBMH3	0.09	95	0.13	36.1	12.0	30.3	30.0	1.0
CA3_6	CBMH3	0.06	100				18.9	33.0	0.5
Total		**4.42**	**95%**						

Applied to all Areas	
N Imperv	0.013
N Perv	0.25
Dstore Imperv (mm)	1.57
Dstore Perv (mm)	4.67
Horton's Parameters	
Max. Infilt. Rate (mm/hr)	76.2
Min. Infilt. Rate (mm/hr)	13.2
Decay Constant (1/hr)	4.14
Drying Time (days)	7

Proposed Conditions Parameters - Storm Sewers

Conduit ID	Inlet Node	Outlet Node	Length (m)	Inlet Elev. (m)	Outlet Elev. (m)	Pipe Diameter (m)	Roughness	Entry Loss Coeff.	Exit Loss Coeff.
Existing Storm Sewer (to remain)									
C6	CBMH1	CBMH2	23.0	67.85	67.57	0.375	0.013	0.20	1.00
C8	CBMH2-DUM	MH1	9.5	67.57	67.55	0.600	0.013	0.67	1.00
C5	CBMH3	CBMH2	19.0	67.66	67.65	0.525	0.013	0.67	0.07
C28	ExCB	ExMH2	10.6	67.86	67.82	0.300	0.013	0.05	0.67
C3	ExCBMH1	ExMH1	10.5	67.74	67.64	0.375	0.013	0.07	0.05
C4	ExMH1	CBMH3	12.6	67.64	67.66	0.375	0.013	0.07	0.07
C2	ExMH2	ExCBMH1	53.0	67.82	67.74	0.300	0.013	0.05	0.67
C10	MH1	MH11	8.9	67.54	67.52	0.600	0.013	0.05	0.67
C12	MH11	OGS-STC2000	3.3	67.52	67.47	0.600	0.013	0.67	0.67
C9_1	MH12	NewCBMH13	35.2	67.62	67.57	0.600	0.013	0.20	0.05
C14	MH2	OUTLET	72.5	67.44	66.93	0.600	0.024	0.67	1.00
C15	NE-CB1	NE-CB2	29.0	68.18	68.13	0.300	0.013	0.05	0.20
C7	NE-CB2	CBMH1	42.0	68.05	67.93	0.375	0.013	0.20	0.20
C13	OGS-STC2000	MH2	3.3	67.50	67.44	0.600	0.013	0.67	0.67
Proposed Storm Sewer									
C1	NewCBMH1	NewCBMH7	23.5	68.75	68.67	0.450	0.013	0.05	0.05
C26	NewCBMH1	NewCBMH2	16.0	67.94	67.92	0.600	0.013	0.05	0.67
C16_3	NewCBMH10	Storage	4.7	67.84	67.72	0.675	0.013	0.67	0.05
C16_5	NewCBMH11	NewCBMH10	16.9	67.90	67.88	0.675	0.013	0.05	0.67
C18	NewCBMH12	MH12	15.2	67.72	67.70	0.600	0.013	0.05	0.20
C9	NewCBMH15	MH12	35.3	67.75	67.70	0.600	0.013	0.05	1.00
C21	NewCBMH2	NewCBMH3	15.8	67.84	67.82	0.675	0.024	0.67	0.20
C19	NewCBMH3	NewCBMH4	26.7	67.77	67.73	0.675	0.024	0.20	0.67
C22	NewCBMH4	DCMH5	16.9	67.68	67.66	0.675	0.024	0.67	0.67
C17	NewCBMH7	NewCBMH8	29.5	68.26	68.22	0.675	0.013	0.05	0.05
C11_1	DICB1	DCMH5	10.7	67.90	67.87	0.300	0.013	0.05	1.00
C11_2	DCMH5-DUM	MH11	3.1	67.61	67.57	0.600	0.013	0.67	1.00
C20_1	NewCBMH8	J8	42.7	68.19	68.13	0.675	0.013	0.05	0.05
C20_2	J8	NewCBMH9	9.5	68.12	68.11	0.675	0.013	0.05	0.67
C16_1	NewCBMH9	J9	28.3	68.06	68.02	0.675	0.013	0.67	0.05
C16_2	J9	J10	20.0	68.02	67.99	0.675	0.013	0.05	0.05
C16_6	J10	J11	17.5	67.99	67.97	0.675	0.013	0.05	0.05
C16_8	J11	NewCBMH11	25.5	67.97	67.93	0.675	0.013	0.05	0.05
C9_2	NewMH14	NewMH16	49.0	68.00	67.90	0.450	0.013	0.05	0.67
C16	NewMH16	NewCBMH13	3.0	67.90	67.87	0.450	0.013	0.20	1.00
C9_4	DUM-NewCBMH13	MH1	25.6	67.57	67.55	0.600	0.013	0.05	0.05
C16_4	Storage	NewCBMH12	2.5	67.72	67.72	0.600	0.013	0.05	0.67
C43	J14	NewMH16	19.8	68.10	67.90	0.300	0.011	0.05	1.00
C36	J1	NewCBMH7	10.8	68.74	68.64	0.300	0.011	0.05	1.00
C37	J2	NewCBMH8	9.2	68.66	68.57	0.300	0.011	0.05	1.00
C38	J3	J8	10.0	68.51	68.50	0.300	0.011	0.05	1.00
C39	J4	J9	5.4	68.60	68.55	0.150	0.011	0.05	1.00
C40	J5	J10	7.4	68.59	68.52	0.150	0.011	0.05	1.00
C41	J6	J11	9.1	68.58	68.49	0.150	0.011	0.05	1.00
C42	J7	MH17	2.9	68.30	68.27	0.150	0.011	0.05	1.00
C46_2	MH17	J17	7.7	68.12	68.11	0.300	0.013	0.05	0.05
C45	J12	J17	2.6	68.29	68.26	0.150	0.011	0.05	1.00
C46_3	J17	MH15	31.4	68.11	68.07	0.300	0.013	0.05	0.05
C44	J13	MH15	3.7	68.26	68.22	0.150	0.011	0.05	1.00
C27	MH15	MH12	11.9	68.02	68.00	0.300	0.013	0.67	1.00

Proposed ICD Characteristics

Name	CB/MH ID	Diameter (m)	Inlet Elev. (m)	Discharge Coeff.	100-Year Discharge (cms)
ICD1	NewCBMH13	0.075	67.57	0.65	0.012
ICD2	CBMH2	0.394	67.57	0.65	0.244
ICD3	DCMH5	0.225	67.61	0.65	0.106
				Total flow	**0.362**

Proposed Conditions Hydraulic Grade Line Results

CB/MH ID	Rim Elevation (m)	Hydraulic Grade Line (m)			Difference Rim Minus HGL (m)			On-Site Ponding Depth (m)
		5-Year	100-year	100-Year + 20%	5-Year	100-year	100-Year + 20%	
Existing Storm Sewer								
CBMH1	68.75	68.87	69.10	69.22	-0.12	-0.35	-0.47	0.00
CBMH2	68.97	68.77	68.83	68.87	0.20	0.14	0.09	-
CBMH2-DUM	68.80	68.41	68.49	68.53	0.39	0.31	0.27	-
CBMH3	68.64	68.78	68.82	68.86	-0.14	-0.18	-0.22	-
DCMH5	69.35	68.87	69.28	69.35	0.48	0.07	0.00	-
DCMH5-DUM	69.35	68.33	68.42	68.46	1.02	0.93	0.89	-
DICB1	69.58	68.94	69.47	69.63	0.64	0.11	-0.05	1.00
ExCB	68.79	69.00	69.18	69.27	-0.21	-0.39	-0.48	0.10
ExCBMH1	68.94	68.94	68.83	68.83	0.00	0.11	0.11	-
ExMH1	68.80	68.80	68.80	68.80	0.00	0.00	0.00	-
ExMH2	69.02	69.02	69.02	69.02	0.00	0.00	0.00	-
MH1	70.04	68.35	68.44	68.47	1.69	1.60	1.57	-
MH11	69.40	68.32	68.41	68.44	1.08	0.99	0.96	-
MH12	69.78	68.17	68.55	68.79	1.61	1.23	0.99	-
MH2	69.50	68.16	68.23	68.27	1.34	1.27	1.23	-
NE-CB1	68.85	68.92	69.22	69.36	-0.07	-0.37	-0.51	0.05
NE-CB2	68.80	68.92	69.21	69.35	-0.12	-0.41	-0.55	0.20
OGS-STC2000	69.45	68.24	68.32	68.35	1.21	1.13	1.10	-
Proposed Storm Sewer								
NewCBMH1	70.41	68.88	69.27	70.41	1.53	1.14	0.00	-
NewCBMH10	70.05	68.24	68.57	68.79	1.81	1.48	1.26	-
NewCBMH11	70.24	68.40	68.88	69.42	1.84	1.36	0.82	-
NewCBMH12	69.76	68.17	68.55	68.79	1.59	1.21	0.97	-
NewCBMH15	69.54	68.17	68.55	68.79	1.37	0.99	0.75	-
NewCBMH2	69.90	68.88	69.28	69.90	1.02	0.62	0.00	-
NewCBMH3	69.63	68.88	69.28	69.63	0.75	0.35	0.00	-
NewCBMH4	69.40	68.87	69.28	69.40	0.53	0.12	0.00	-
NewCBMH7	70.64	68.55	69.55	70.64	2.09	1.09	0.00	-
NewCBMH8	69.82	68.55	69.39	69.82	1.27	0.43	0.00	-
NewCBMH9	69.85	68.54	69.29	69.74	1.31	0.56	0.11	-
NewCBMH13	70.16	68.17	68.55	68.78	1.99	1.61	1.38	-
DUM-NewCBMH13	70.16	68.35	68.44	68.47	1.81	1.72	1.69	-
NewMH14	70.26	68.20	68.55	68.79	2.06	1.71	1.47	-
NewMH16	70.18	68.20	68.55	68.78	1.98	1.63	1.40	-
MH17	70.34	68.23	68.55	68.78	2.11	1.79	1.56	-
J17	70.32	68.23	68.55	68.78	2.09	1.77	1.54	-
MH15	70.23	68.19	68.55	68.79	2.04	1.68	1.44	-
J14	70.04	68.61	69.26	69.81	1.43	0.78	0.23	-
J1	69.90	68.78	69.74	69.90	1.12	0.16	0.00	-
J2	69.84	68.70	69.42	69.84	1.14	0.42	0.00	-
J3	69.85	68.57	69.38	69.85	1.28	0.47	0.00	-
J8	69.85	68.54	69.31	69.85	1.31	0.54	0.00	-
J4	69.98	68.77	69.38	69.91	1.21	0.60	0.07	-
J9	69.98	68.49	69.13	69.54	1.49	0.85	0.44	-
J5	70.06	68.84	69.57	70.06	1.22	0.49	0.00	-
J10	70.06	68.46	69.03	69.51	1.60	1.03	0.55	-
J6	70.13	68.69	69.11	69.70	1.44	1.02	0.43	-
J11	70.13	68.44	68.93	69.38	1.69	1.20	0.75	-
J7	70.34	68.37	68.55	68.78	1.97	1.79	1.56	-
J12	70.32	68.36	68.55	68.78	1.96	1.77	1.54	-
J13	70.22	68.33	68.55	68.79	1.89	1.67	1.43	-
Storage	70.05	68.17	68.55	68.79	1.88	1.50	1.26	-

Comparison of Existing and Proposed Hydraulic Grade Line Results

CB/MH ID	Rim Elev. (m)		Existing Minus Proposed Rim Elev. (m)	100-Year Hydraulic Grade Line (m(		Difference (m)	
	Existing	Proposed		Existing	Proposed	Proposed Rim – Proposed HGL	Existing HGL - Proposed HGL
CBMH1	68.75	68.75	0.00	68.99	69.10	-0.35	-0.11
CBMH2	68.97	68.97	0.00	68.82	68.83	0.14	-0.01
CBMH2-DUM	68.80	68.80	0.00	68.68	68.49	0.31	0.19
CBMH3	68.64	68.64	0.00	68.82	68.82	-0.18	0.00
DICB1	68.00	69.58	-1.58	69.07	69.47	0.11	-0.40
ExCB	68.79	68.79	0.00	69.23	69.18	-0.39	0.05
ExCBMH1	68.94	68.94	0.00	68.83	68.83	0.11	0.00
ExMH1	68.80	68.80	0.00	68.80	68.80	0.00	0.00
ExMH2	69.02	69.02	0.00	69.02	69.02	0.00	0.00
MH1	70.05	70.04	0.01	68.66	68.44	1.60	0.22
MH11	69.40	69.40	0.00	68.60	68.41	0.99	0.19
MH12	69.68	69.78	-0.10	69.68	68.55	1.23	1.13
MH2	69.50	69.50	0.00	68.39	68.23	1.27	0.16
NE-CB1	68.85	68.85	0.00	69.16	69.22	-0.37	-0.06
NE-CB2	68.80	68.80	0.00	69.15	69.21	-0.41	-0.06
OGS-STC2000	69.58	69.45	0.13	68.50	68.32	1.13	0.18

Appendix K Underground Storage Layout and Details Plans from Supplier

Project: OC TRANSPO ZEB GARAGE R1

Chamber Model -	MC-3500	
Units -	**Metric**	
Number of Chambers -	526	
Number of End Caps -	54	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	67.47	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	229	mm

Area of System- 2629.912814 sq.meters Min. Area - 2503.14 sq.meters

☑ Include Perimeter Stone in Calculations

☑ Click for Stage Area Data

☐ Click to Invert Stage Area Data

Click Here for Imperial

StormTech MC-3500 Cumulative Storage Volumes

Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Single End Cap (cubic meters)	Incremental Chambers (cubic meters)	Incremental End Cap (cubic meters)	Incremental Stone (cubic meters)	Incremental Ch, EC and Stone (cubic meters)	Cumulative System (cubic meters)	Elevation (meters)
1676	0.000	0.000	0.00	0.00	26.72	26.72	2759.80	69.15
1651	0.000	0.000	0.00	0.00	26.72	26.72	2733.08	69.12
1626	0.000	0.000	0.00	0.00	26.72	26.72	2706.36	69.09
1600	0.000	0.000	0.00	0.00	26.72	26.72	2679.64	69.07
1575	0.000	0.000	0.00	0.00	26.72	26.72	2652.92	69.04
1549	0.000	0.000	0.00	0.00	26.72	26.72	2626.20	69.02
1524	0.000	0.000	0.00	0.00	26.72	26.72	2599.48	68.99
1499	0.000	0.000	0.00	0.00	26.72	26.72	2572.76	68.97
1473	0.000	0.000	0.00	0.00	26.72	26.72	2546.04	68.94
1448	0.000	0.000	0.00	0.00	26.72	26.72	2519.32	68.92
1422	0.000	0.000	0.00	0.00	26.72	26.72	2492.60	68.89
1397	0.000	0.000	0.00	0.00	26.72	26.72	2465.88	68.87
1372	0.002	0.000	0.87	0.00	26.37	27.24	2439.16	68.84
1346	0.005	0.001	2.89	0.04	25.55	28.48	2411.92	68.82
1321	0.008	0.001	4.38	0.06	24.95	29.38	2383.45	68.79
1295	0.011	0.001	6.01	0.08	24.28	30.37	2354.07	68.76
1270	0.019	0.002	10.24	0.10	22.58	32.92	2323.69	68.74
1245	0.029	0.002	15.32	0.13	20.54	35.99	2290.77	68.71
1219	0.035	0.003	18.61	0.16	19.21	37.98	2254.78	68.69
1194	0.040	0.004	21.18	0.19	18.17	39.55	2216.79	68.66
1168	0.045	0.004	23.43	0.22	17.26	40.91	2177.25	68.64
1143	0.048	0.005	25.43	0.25	16.45	42.13	2136.34	68.61
1118	0.052	0.005	27.23	0.28	15.71	43.23	2094.21	68.59
1092	0.055	0.006	28.86	0.31	15.05	44.22	2050.98	68.56
1067	0.058	0.006	30.40	0.33	14.43	45.16	2006.76	68.54
1041	0.060	0.007	31.80	0.36	13.86	46.01	1961.60	68.51
1016	0.063	0.007	33.13	0.38	13.32	46.83	1915.59	68.49
991	0.065	0.008	34.36	0.41	12.81	47.58	1868.76	68.46
965	0.068	0.008	35.52	0.43	12.34	48.29	1821.19	68.43
940	0.070	0.008	36.63	0.45	11.89	48.97	1772.90	68.41
914	0.072	0.009	37.66	0.47	11.47	49.60	1723.93	68.38
889	0.073	0.009	38.63	0.49	11.07	50.19	1674.34	68.36
864	0.075	0.009	39.56	0.51	10.69	50.76	1624.14	68.33
838	0.077	0.010	40.44	0.53	10.33	51.30	1573.38	68.31
813	0.078	0.010	41.28	0.55	9.99	51.82	1522.08	68.28
787	0.080	0.011	42.07	0.57	9.66	52.30	1470.26	68.26
762	0.081	0.011	42.83	0.59	9.35	52.77	1417.95	68.23
737	0.083	0.011	43.55	0.61	9.06	53.22	1365.18	68.21
711	0.084	0.012	44.24	0.62	8.78	53.63	1311.97	68.18
686	0.085	0.012	44.87	0.64	8.52	54.03	1258.33	68.15
660	0.086	0.012	45.48	0.66	8.27	54.40	1204.31	68.13
635	0.088	0.012	46.09	0.67	8.02	54.78	1149.91	68.10
610	0.089	0.013	46.63	0.69	7.79	55.11	1095.13	68.08
584	0.090	0.013	47.15	0.70	7.58	55.43	1040.02	68.05
559	0.091	0.013	47.65	0.72	7.37	55.74	984.59	68.03
533	0.091	0.014	48.13	0.73	7.18	56.04	928.84	68.00
508	0.092	0.014	48.58	0.75	6.99	56.32	872.81	67.98
483	0.093	0.014	49.01	0.76	6.81	56.58	816.49	67.95
457	0.094	0.014	49.42	0.77	6.64	56.84	759.91	67.93
432	0.095	0.015	49.81	0.79	6.48	57.08	703.08	67.90
406	0.095	0.015	50.17	0.80	6.33	57.30	646.00	67.88
381	0.096	0.015	50.53	0.81	6.18	57.52	588.70	67.85
356	0.097	0.015	50.86	0.82	6.05	57.73	531.17	67.82
330	0.097	0.015	51.19	0.83	5.91	57.93	473.44	67.80
305	0.098	0.016	51.50	0.84	5.78	58.12	415.51	67.77
279	0.099	0.016	51.81	0.85	5.65	58.32	357.39	67.75
254	0.099	0.017	52.21	0.91	5.47	58.59	299.07	67.72
229	0.000	0.000	0.00	0.00	26.72	26.72	240.48	67.70
203	0.000	0.000	0.00	0.00	26.72	26.72	213.76	67.67
178	0.000	0.000	0.00	0.00	26.72	26.72	187.04	67.65
152	0.000	0.000	0.00	0.00	26.72	26.72	160.32	67.62
127	0.000	0.000	0.00	0.00	26.72	26.72	133.60	67.60
102	0.000	0.000	0.00	0.00	26.72	26.72	106.88	67.57
76	0.000	0.000	0.00	0.00	26.72	26.72	80.16	67.55
51	0.000	0.000	0.00	0.00	26.72	26.72	53.44	67.52
25	0.000	0.000	0.00	0.00	26.72	26.72	26.72	67.49

Stage Area Data

Depth (meter)	Elevation (meter)	Area (m²)	Area (hectare)
0.00	67.47	1051.97	0.1052
0.05	67.52	1051.97	0.1052
0.08	67.55	1051.97	0.1052
0.10	67.57	1051.97	0.1052
0.13	67.60	1051.97	0.1052
0.15	67.62	1051.97	0.1052
0.18	67.65	1051.97	0.1052
0.20	67.67	1051.97	0.1052
0.23	67.70	1051.97	0.1052
0.25	67.72	2306.68	0.2307
0.28	67.75	2295.96	0.2296
0.30	67.77	2288.37	0.2288
0.33	67.80	2280.86	0.2281
0.36	67.82	2272.71	0.2273
0.38	67.85	2264.71	0.2265
0.41	67.88	2256.04	0.2256
0.43	67.90	2247.14	0.2247
0.46	67.93	2237.65	0.2238
0.48	67.95	2227.59	0.2228
0.51	67.98	2217.13	0.2217
0.53	68.00	2206.14	0.2206
0.56	68.03	2194.66	0.2195
0.58	68.05	2182.42	0.2182
0.61	68.08	2169.70	0.2170
0.63	68.10	2156.56	0.2157
0.66	68.13	2141.74	0.2142
0.69	68.15	2126.99	0.2127
0.71	68.18	2111.61	0.2112
0.74	68.21	2095.10	0.2095
0.76	68.23	2077.54	0.2078
0.79	68.26	2059.24	0.2059
0.81	68.28	2040.02	0.2040
0.84	68.31	2019.78	0.2020
0.86	68.33	1998.55	0.1999
0.89	68.36	1976.15	0.1976
0.91	68.38	1952.59	0.1953
0.94	68.41	1927.79	0.1928
0.97	68.43	1901.13	0.1901
0.99	68.46	1873.18	0.1873
1.02	68.49	1843.58	0.1844
1.04	68.51	1811.52	0.1812
1.07	68.54	1777.89	0.1778
1.09	68.56	1740.99	0.1741
1.12	68.59	1701.87	0.1702
1.14	68.61	1658.49	0.1658
1.17	68.64	1610.67	0.1611
1.19	68.66	1556.92	0.1557
1.22	68.69	1495.47	0.1495
1.24	68.71	1416.95	0.1417
1.27	68.74	1296.18	0.1296
1.30	68.76	1195.85	0.1196
1.32	68.79	1156.75	0.1157
1.35	68.82	1121.12	0.1121
1.37	68.84	1072.40	0.1072
1.40	68.87	1051.97	0.1052
1.42	68.89	1051.97	0.1052
1.45	68.92	1051.97	0.1052
1.47	68.94	1051.97	0.1052
1.50	68.97	1051.97	0.1052
1.52	68.99	1051.97	0.1052
1.55	69.02	1051.97	0.1052
1.57	69.04	1051.97	0.1052
1.60	69.07	1051.97	0.1052
1.63	69.09	1051.97	0.1052
1.65	69.12	1051.97	0.1052
1.68	69.15	1051.97	0.1052

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	HAIDER NASRULLAH 647-850-9417 HAIDER.NASRULLAH@ADSPIPE.COM
ADS SALES REP:	BRAD DUNLOP 613-893-7336 BRAD.DUNLOP@ADSPIPE.COM
PROJECT NO:	S450946
ONTARIO SITE COORDINATOR:	RYAN RUBENSTEIN 519-710-3687 RYAN.RUBENSTEIN@ADSPIPE.COM

Advanced Drainage Systems, Inc.

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INSTALLATION INSTRUCTIONS
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OTC ZEB NEW GARAGE

OTTAWA, ON.

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL BE CERTIFIED TO CSA B184, "POLYMERIC SUB-SURFACE STORMWATER MANAGEMENT STRUCTURES", AND MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE CSA S6 CL-625 TRUCK AND THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 75 mm (3").
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 23° C / 73° F), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.
10. MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE. DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
11. ADS DOES NOT DESIGN OR PROVIDE MEMBRANE LINER SYSTEMS. TO MINIMIZE THE LEAKAGE POTENTIAL OF LINER SYSTEMS, THE MEMBRANE LINER SYSTEM SHOULD BE DESIGNED BY A KNOWLEDGEABLE GEOTEXTILE PROFESSIONAL AND INSTALLED BY A QUALIFIED CONTRACTOR.

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IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 150 mm (6") SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 300 mm (12") INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE; AASHTO M43 #3, 357, 4, 467, 5, 56, OR 57.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 900 mm (36") OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

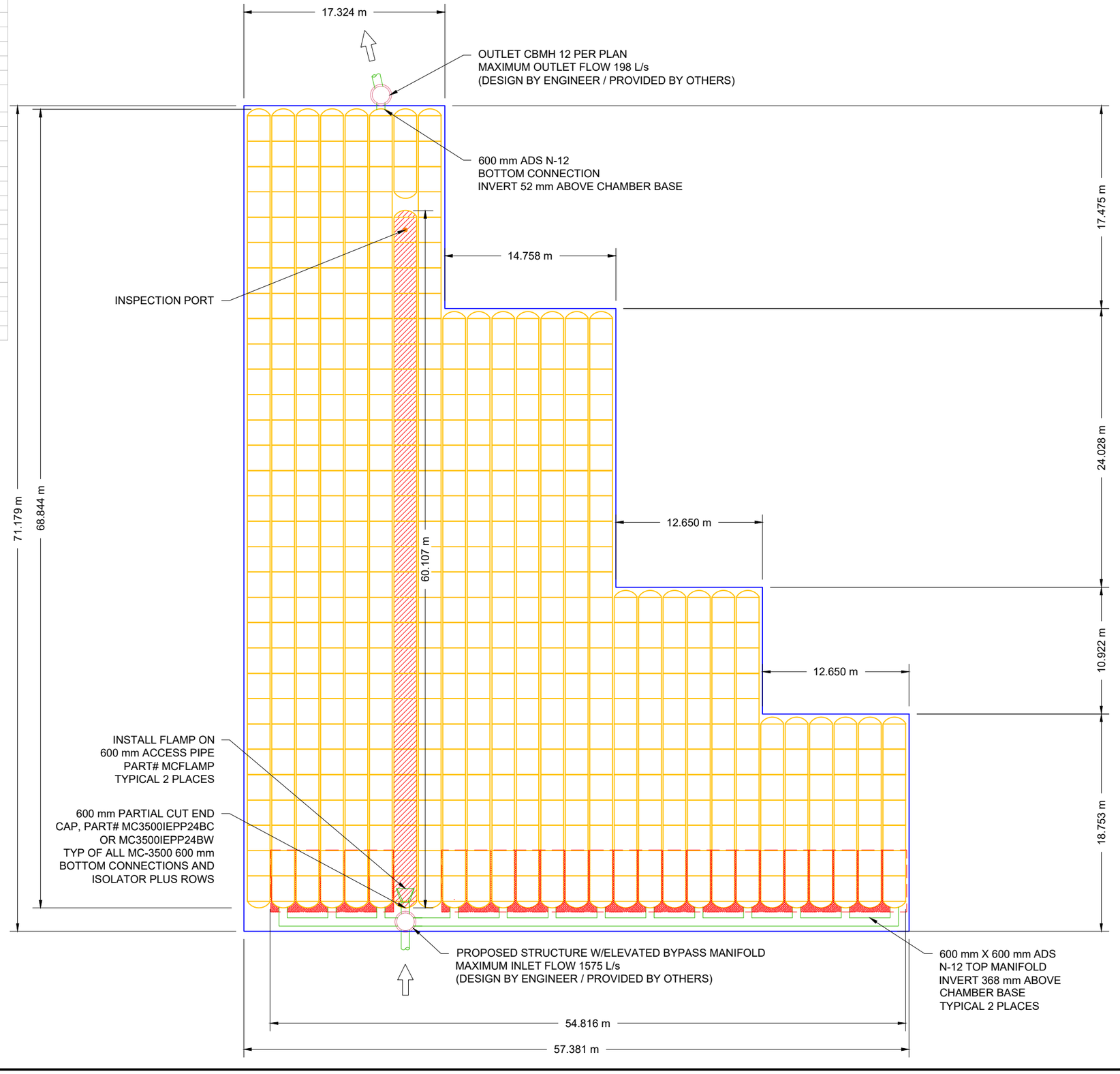
CONTACT STORMTECH AT 1-800-821-6710 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT

522	STORMTECH MC-3500 CHAMBERS
56	STORMTECH MC-3500 END CAPS
305	STONE ABOVE (mm)
229	STONE BELOW (mm)
40	% STONE VOID
2,400.5	**INSTALLED SYSTEM VOLUME (m³) ABOVE ELEVATION 67.750 (PERIMETER STONE INCLUDED)**
2,638.2	SYSTEM AREA (m²)
257.1	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS

71.279	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
69.451	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
69.298	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
69.298	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
69.298	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
69.146	TOP OF STONE
68.841	TOP OF MC-3500 CHAMBER
68.066	600 mm TOP MANIFOLD/CONNECTION INVERT
67.750	600 mm ISOLATOR ROW PLUS CONNECTION INVERT
67.750	600 mm BOTTOM MANIFOLD/CONNECTION INVERT
67.698	BOTTOM OF MC-3500 CHAMBER
67.469	BOTTOM OF STONE



ISOLATOR ROW PLUS (SEE DETAIL)

PLACE MINIMUM 5.33 m OF ADSPLUS125 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

THERMOPLASTIC LINER (SEE TECHNICAL NOTE 6.50 / PROVIDED BY OTHERS / DESIGN BY OTHERS)

OTC ZEB NEW GARAGE
OTTAWA, ON.

DATE: 3/17/25 | DRAWN: RCT | CHECKED: RCT
PROJECT #: S450946

DATE	DRWN	CHKD	DESCRIPTION

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4640 TRUEMAN BLVD
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ADS

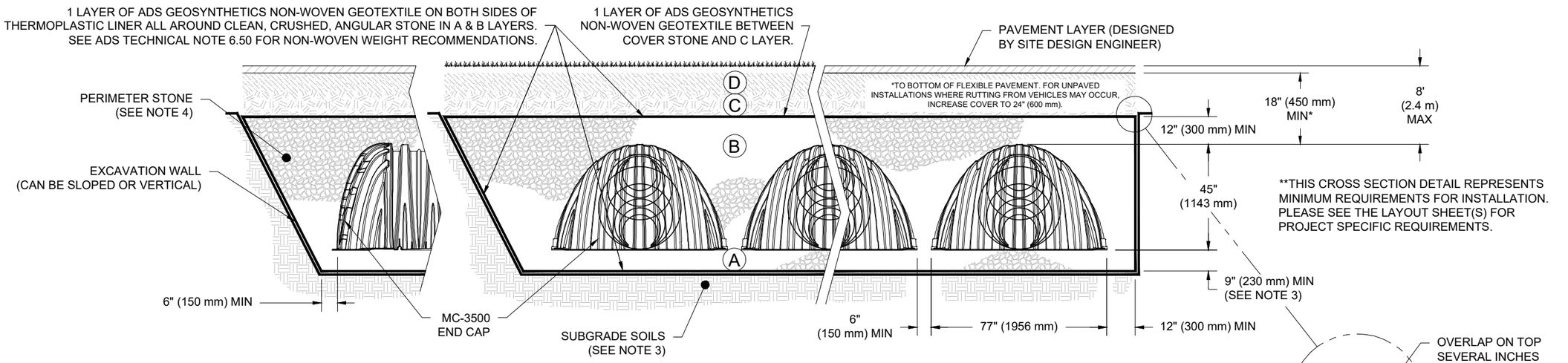
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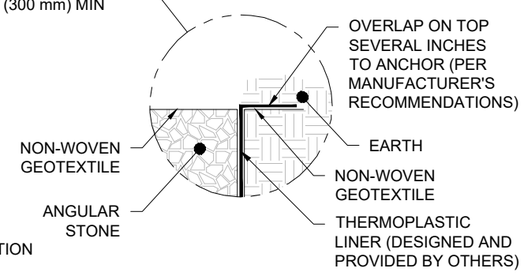
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ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 18" (450 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[5]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[5]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.
5. WHERE RECYCLED CONCRETE AGGREGATE IS USED IN LAYERS 'A' OR 'B' THE MATERIAL SHOULD ALSO MEET THE ACCEPTABILITY CRITERIA OUTLINED IN TECHNICAL NOTE 6.20 "RECYCLED CONCRETE STRUCTURAL BACKFILL".





THERMOPLASTIC LINER DETAIL

NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS. REFERENCE STORMTECH DESIGN MANUAL FOR BEARING CAPACITY GUIDANCE.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

OTC ZEB NEW GARAGE
OTTAWA, ON.
DATE: 3/17/25 | DRAWN: RCT | CHECKED: RCT
PROJECT #: S450946

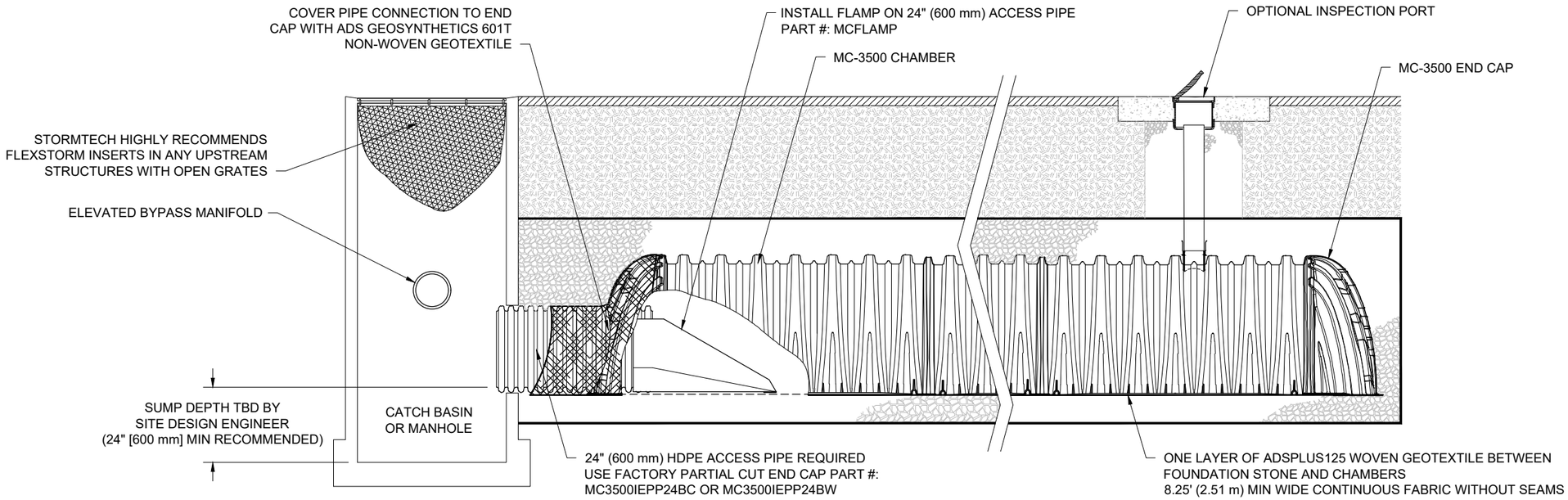
DATE	DRWN	CHKD	DESCRIPTION

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ADS

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MC-3500 ISOLATOR ROW PLUS DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

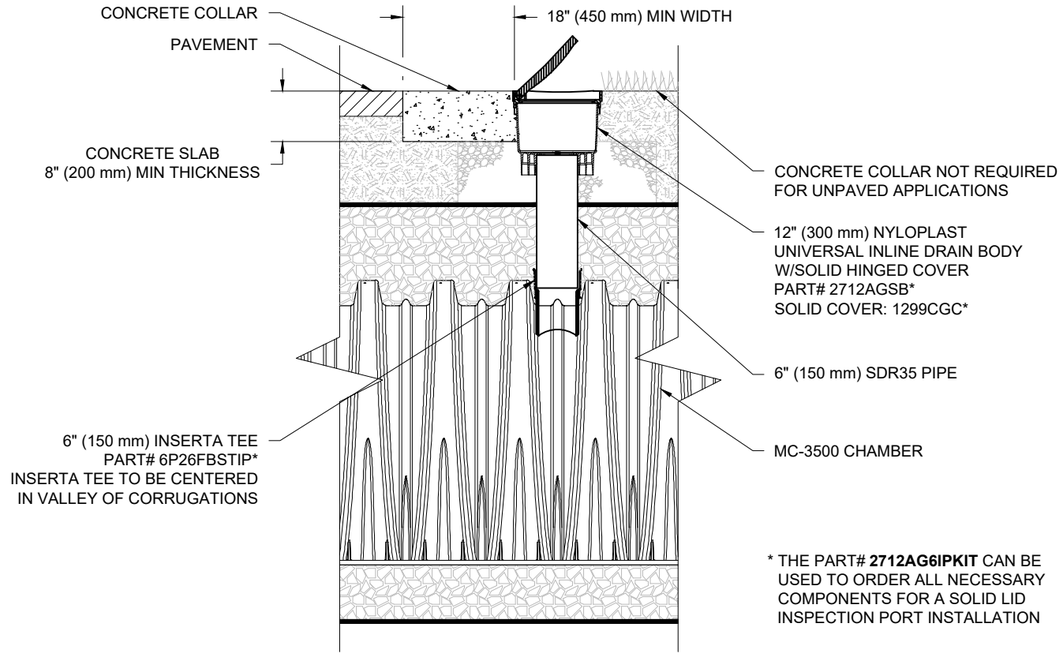
STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



MC-3500 6" (150 mm) INSPECTION PORT DETAIL
NTS

OTC ZEB NEW GARAGE
OTTAWA, ON.
DATE: 3/17/25 | DRAWN: RCT | CHECKED: RCT
PROJECT #: S450946

DATE	DRWN	CHKD	DESCRIPTION

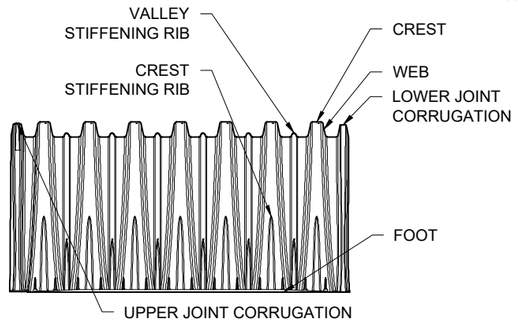
THE ENGINEER OF RECORD ('EOR') OR OTHER PROJECT REPRESENTATIVE. THIS DRAWING IS NOT INTENDED FOR USE IN BIDDING OR CONSTRUCTION WITHOUT THE EOR'S PRIOR APPROVAL. EOR SHALL REVIEW THIS DRAWING PRIOR TO BIDDING AND/OR CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE EOR TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

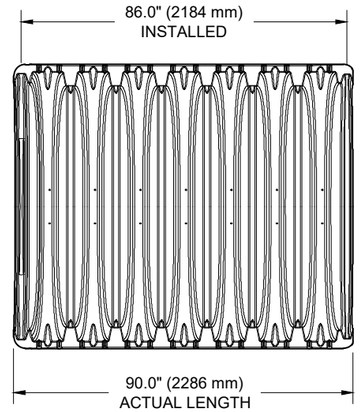
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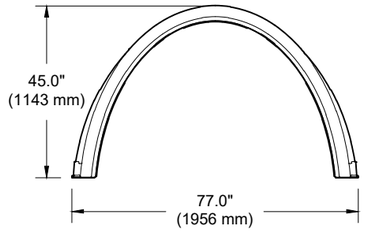
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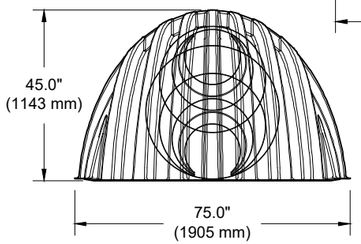
MC-3500 TECHNICAL SPECIFICATION

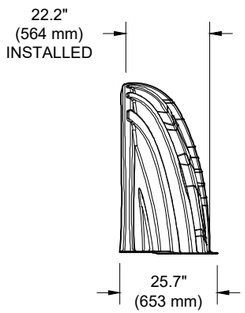
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

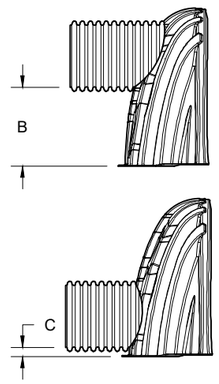
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" (152 mm) STONE BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

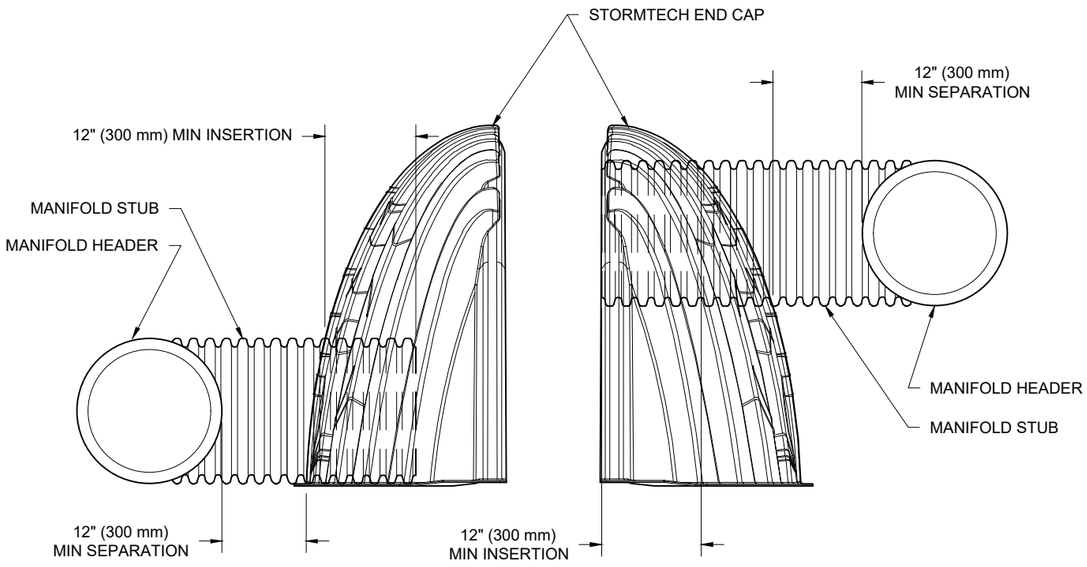
NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PARTIAL CUT INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

OTC ZEB NEW GARAGE
OTTAWA, ON.
DATE: 3/17/25 | DRAWN: RCT | CHECKED: RCT
PROJECT #: S450946

DATE	DRWN	CHKD	DESCRIPTION

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Underground Storage

5 m setback from building

PROPOSED BUS GARAGE

14.1–600ø CONC STM @ 0.14%

EX 35.3–600ø CONC STM @ –0.

CBMH12
OPSD 701.012
TOP=70.02
STA.=???
N INV=67.72

ST

CB3
OPSD 705010
TOP=69.22
STA.=???

7.7–

EX STM/CB TO BE REMOVED

Fence
the cl
the u
excav

5 m setback from building

12.8–200ø PVC SDR 35 SA %

6.00 FIRE TRUCK PATH

ST ST ST ST ST ST

52.8–200ø PVC SDR 35 SAN @ 0.62%

16.9–600ø CONC STM @ 0.14%–

CBMH10
OPSD 701.012
TOP=70.22
STA.=???
NW INV=67.88
N INV=67.84

61.6–200ø PVC SDR 35 SAN @ 0.48%

46.2–

MH1A
OPSD 701.010
TOP=70.39

Inlet to Underground Storage

EX STM TO CBMH10

MH2A
OPSD 701.010

Appendix L Supporting Information for Proposed Conditions Model Simulation

Appendix M Supporting Design Information for Stormceptor

Existing Stormceptor STC200 - Sizing Report

Detailed Stormceptor Sizing Report – 1500 St. Laurent Blvd.

Project Information & Location			
Project Name	1500 St. Laurent Blvd.	**Project Number**	60746350
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	1/16/2025
Designer Information		**EOR Information (optional)**	
Name	Brandon O'Leary	**Name**	Rikke Brown
Company	Rinker Pipe	**Company**	AECOM
Phone #	905-630-0359	**Phone #**	613-820-1282
Email	brandon.oleary@RinkerPipe.com	**Email**	rikke.brown@aecom.com

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	1500 St. Laurent Blvd.
Recommended Stormceptor Model	STC 2000
Target TSS Removal (%)	65.0
TSS Removal (%) Provided	68
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	35	46
STC 750	61	67
STC 1000	63	67
STC 1500	62	67
STC 2000	68	80
STC 3000	69	80
STC 4000	74	90
STC 5000	75	90
STC 6000	77	94
STC 9000	81	97
STC 10000	81	97
STC 14000	84	99
StormceptorMAX	Custom	Custom

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Ontario	**Total Number of Rainfall Events**	4093
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	2202.9
Elevation (ft)	370	**Total Infiltration (mm)**	0.0
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	18775.2

Notes
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	4.38
Imperviousness %	100

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.0000	0.000
0.0800	0.245
0.1100	0.314
0.2410	0.318

Water Quality Objective	
TSS Removal (%)	65.0
Runoff Volume Capture (%)	80.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	318
Water Quality Flow Rate (L/s)	245

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	1500 St. Laurent Blvd.

Site Details

Drainage Area

Total Area (ha)	4.38
Imperviousness %	100

Surface Characteristics

Width (m)	419.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (lps)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	Build Up/ Wash-off

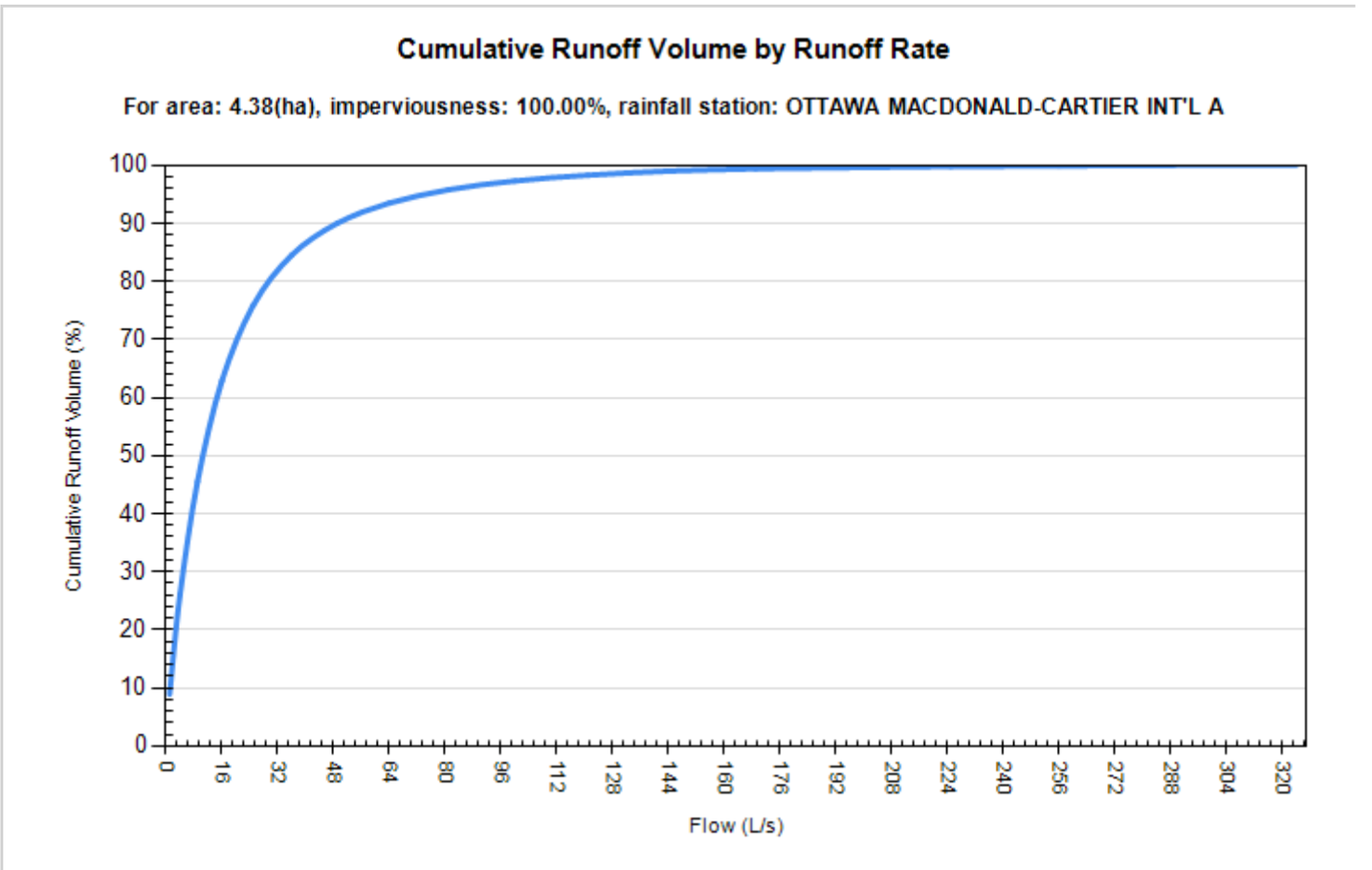
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

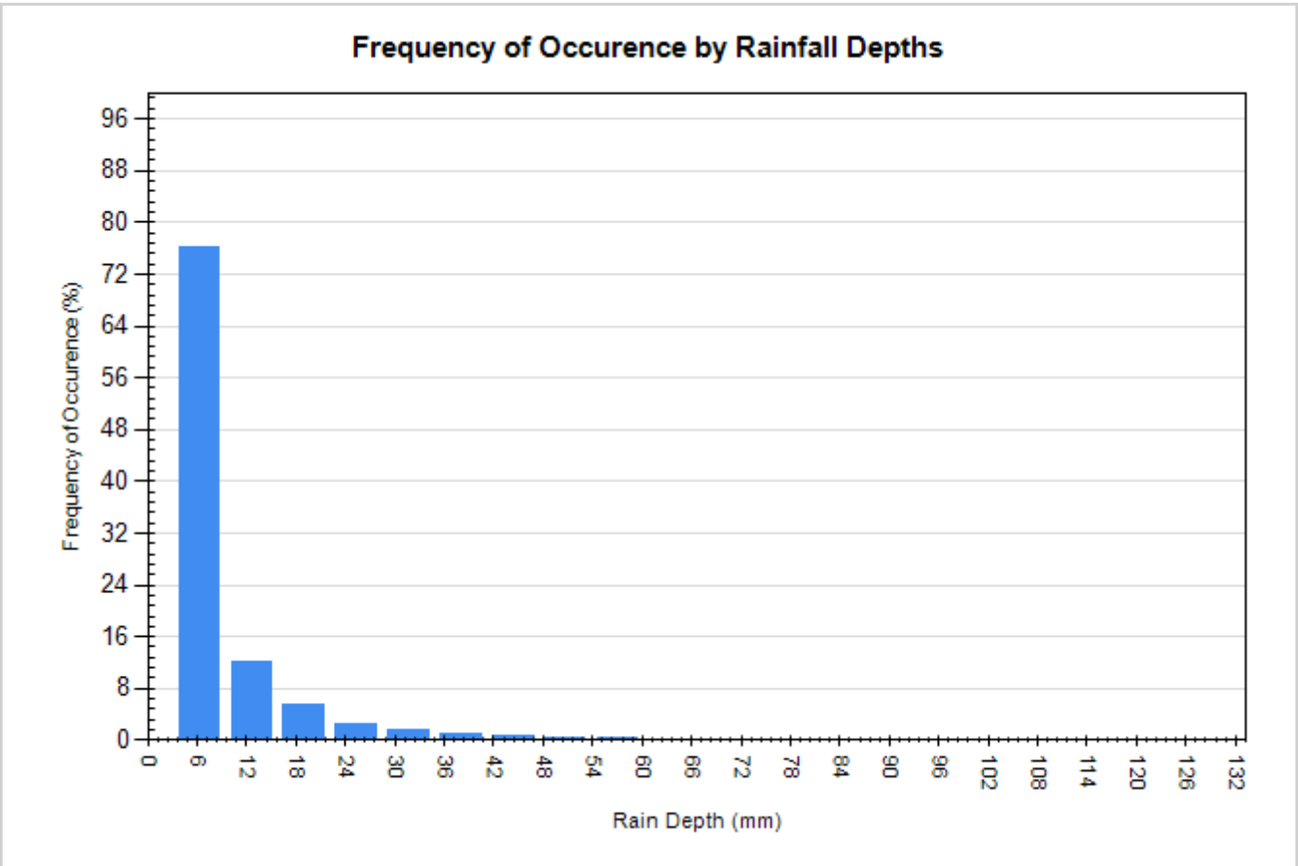
TSS Availability Parameters

Availability Constant A	0.057
Availability Factor B	0.04
Availability Exponent C	1.10
Min. Particle Size Affected by Availability (micron)	400

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m^3)**	**Volume Over (m^3)**	**Cumulative Runoff Volume (%)**
1	73168	752583	8.9
4	215410	610259	26.1
9	375444	450052	45.5
16	519137	306446	62.9
25	626059	199272	75.9
36	697625	127977	84.5
49	742976	82457	90.0
64	772091	53303	93.5
81	790896	34493	95.8
100	803366	22025	97.3
121	811439	13929	98.3
144	816775	8593	99.0
169	820233	5132	99.4
196	822431	2936	99.6
225	823804	1561	99.8
256	824717	647	99.9
289	825173	191	100.0
324	825364	0	100.0


Cumulative Runoff Volume by Runoff Rate
For area: 4.38(ha), imperviousness: 100.00%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A
Cumulative Runoff Volume (%)
100
90
80
70
60
50
40
30
20
10
0
0
16
32
48
64
80
96
112
128
144
160
176
192
208
224
240
256
272
288
304
320
Flow (L/s)

Rainfall Event Analysis				
Rainfall Depth (mm)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (mm)**	**Percentage of Annual Volume (%)**
6.35	3113	76.1	5230	24.9
12.70	501	12.2	4497	21.4
19.05	225	5.5	3469	16.5
25.40	105	2.6	2317	11.0
31.75	62	1.5	1765	8.4
38.10	35	0.9	1206	5.8
44.45	28	0.7	1163	5.5
50.80	12	0.3	557	2.7
57.15	7	0.2	378	1.8
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Proposed Stormceptor for Site Service

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/13/2025

Province:	Ontario
City:	Ottawa
Nearest Rainfall Station:	OTTAWA CDA RCS
Climate Station Id:	6105978
Years of Rainfall Data:	20

Site Name:	EFO rev

Drainage Area (ha):	4.31
% Imperviousness:	100.00

Runoff Coefficient 'c': 0.90

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	125.20
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	4692
Estimated Average Annual Sediment Volume (L/yr):	3815

Project Name:	1500 St. Laurent
Project Number:	60746350
Designer Name:	Kent Campbell
Designer Company:	Rinker Pipe
Designer Email:	stanley.campbell@rinkerpipe.com
Designer Phone:	519-622-7574
EOR Name:	Bita Pihani
EOR Company:	AECOM
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	44
EFO5	54
EFO6	61
EFO8	72
EFO10	80
EFO12	85

Recommended Stormceptor EFO Model: EFO10

Estimated Net Annual Sediment (TSS) Load Reduction (%): 80

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

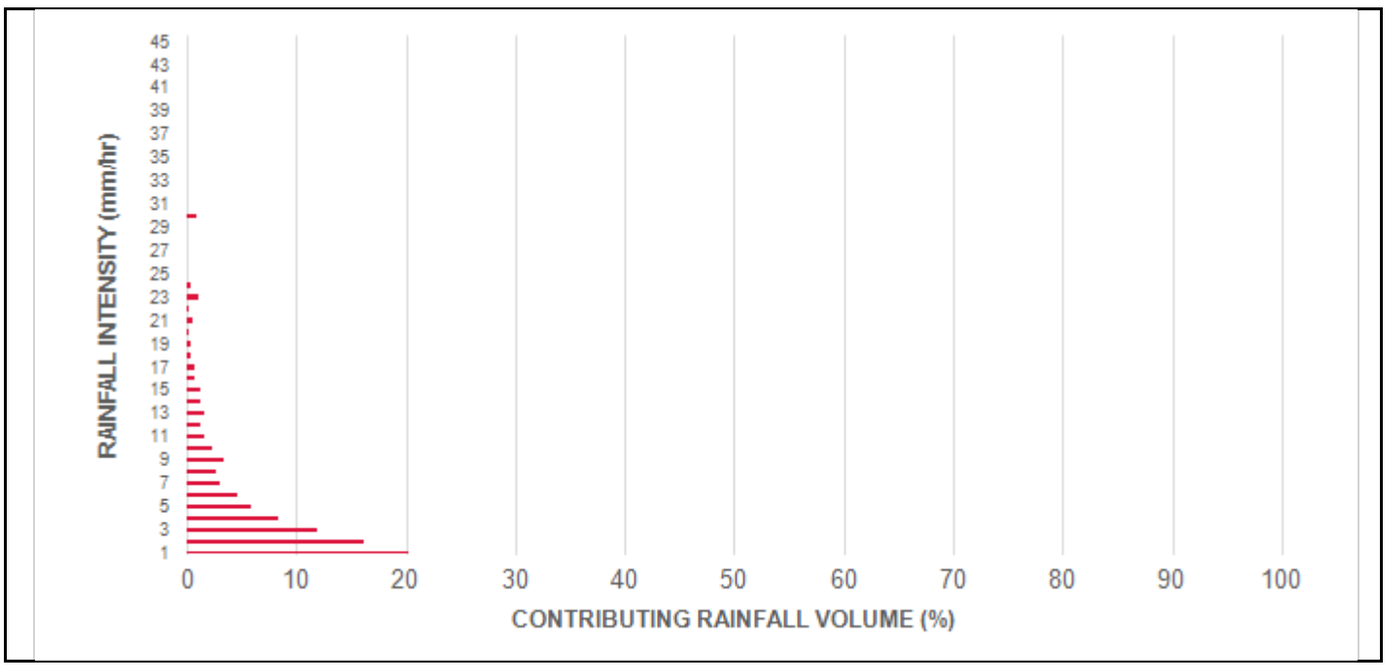
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

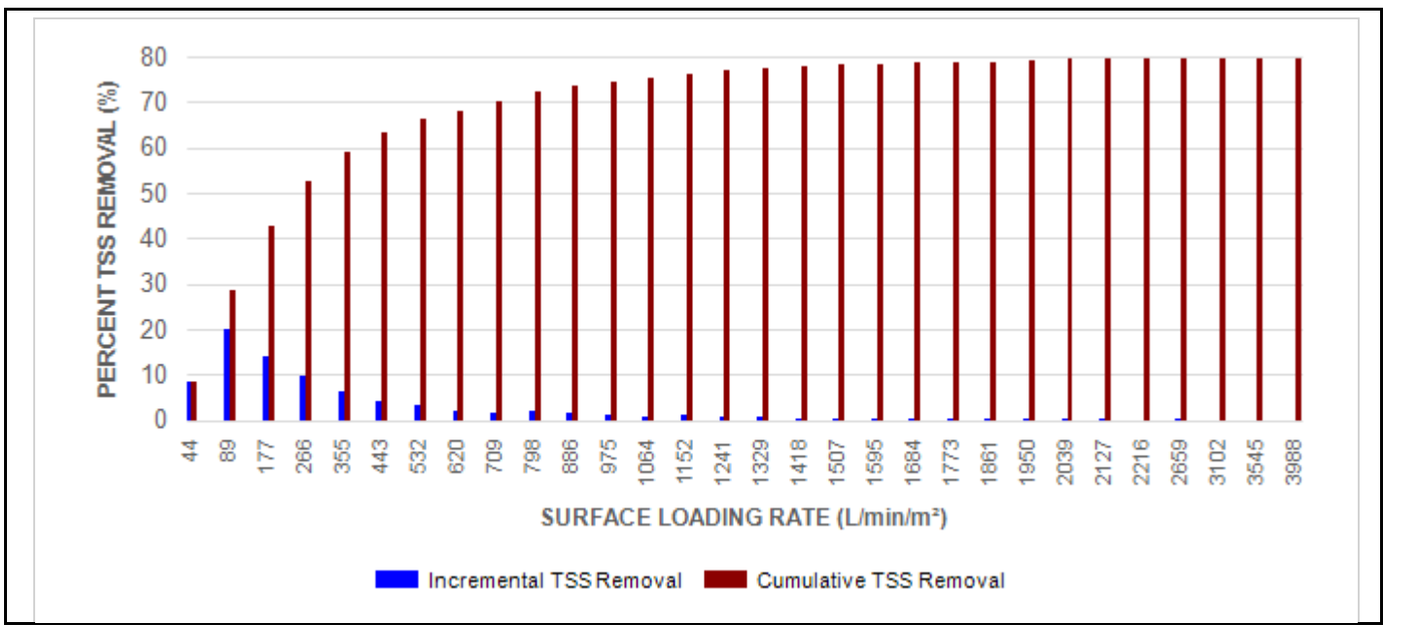
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.6	8.6	5.39	324.0	44.0	100	8.6	8.6
1.00	20.3	29.0	10.78	647.0	89.0	98	20.0	28.6
2.00	16.2	45.2	21.57	1294.0	177.0	87	14.1	42.7
3.00	12.0	57.2	32.35	1941.0	266.0	80	9.6	52.4
4.00	8.4	65.6	43.13	2588.0	355.0	76	6.4	58.8
5.00	5.9	71.6	53.92	3235.0	443.0	72	4.3	63.1
6.00	4.6	76.2	64.70	3882.0	532.0	68	3.1	66.2
7.00	3.1	79.3	75.49	4529.0	620.0	64	2.0	68.2
8.00	2.7	82.0	86.27	5176.0	709.0	64	1.7	70.0
9.00	3.3	85.3	97.05	5823.0	798.0	63	2.1	72.1
10.00	2.3	87.6	107.84	6470.0	886.0	62	1.4	73.5
11.00	1.6	89.2	118.62	7117.0	975.0	62	1.0	74.5
12.00	1.3	90.5	129.40	7764.0	1064.0	60	0.8	75.3
13.00	1.7	92.2	140.19	8411.0	1152.0	58	1.0	76.3
14.00	1.2	93.5	150.97	9058.0	1241.0	56	0.7	76.9
15.00	1.2	94.6	161.75	9705.0	1329.0	54	0.6	77.6
16.00	0.7	95.3	172.54	10352.0	1418.0	52	0.4	77.9
17.00	0.7	96.1	183.32	10999.0	1507.0	49	0.4	78.3
18.00	0.4	96.5	194.11	11646.0	1595.0	46	0.2	78.5
19.00	0.4	96.9	204.89	12293.0	1684.0	44	0.2	78.7
20.00	0.2	97.1	215.67	12940.0	1773.0	41	0.1	78.7
21.00	0.5	97.5	226.46	13587.0	1861.0	39	0.2	78.9
22.00	0.2	97.8	237.24	14234.0	1950.0	38	0.1	79.0
23.00	1.0	98.8	248.02	14881.0	2039.0	36	0.4	79.4
24.00	0.3	99.1	258.81	15528.0	2127.0	35	0.1	79.5
25.00	0.0	99.1	269.59	16175.0	2216.0	33	0.0	79.5
30.00	0.9	100.0	323.51	19411.0	2659.0	28	0.3	79.7
35.00	0.0	100.0	377.43	22646.0	3102.0	24	0.0	79.7
40.00	0.0	100.0	431.34	25881.0	3545.0	21	0.0	79.7
45.00	0.0	100.0	485.26	29116.0	3988.0	19	0.0	79.7
Estimated Net Annual Sediment (TSS) Load Reduction =								**80 %**

Climate Station ID: 6105978 *Years of Rainfall Data*: 20

RAINFALL DATA FROM OTTAWA CDA RCS RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF5 / EFO5	1.5	5	90	762	30	762	30	710	25
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

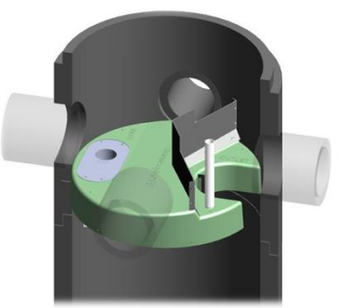
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

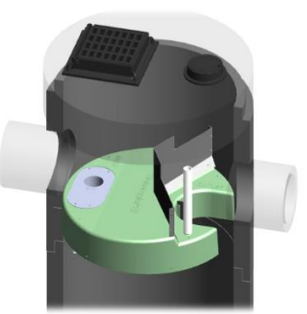
DESIGN FLEXIBILITY

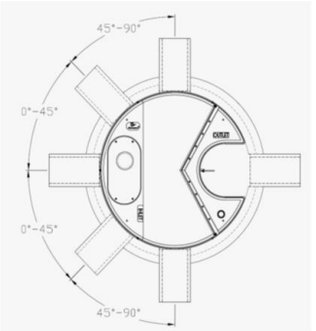
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF5 / EFO5	1.5	5	1.62	5.3	420	111	305	10	2124	75	2612	5758
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREAMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	5 ft (1524 mm) Diameter OGS Units:	1.95 m^3 sediment / 420 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance

results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Manhole Buoyancy

MH name: *EFO10 - OGS Unit - 3000mm*

$\rho s := 2650 \frac{kg}{m^3}$ Density of Solid Portion of Soil material. Particle density (kg/m3)

$\rho dry := 2080 \frac{kg}{m^3}$ Dry soil density (kg/m3)

$\rho w := 1000 \frac{kg}{m^3}$ Water density (kg/m3)

$\rho c := 2350 \frac{kg}{m^3}$ Concrete Density (kg/m3)

$\delta w := 9.81 \frac{kN}{m^3}$ Unit weight of water (kN/m3)

$SG := \frac{\rho s}{\rho w} = 2.65$ Specific Gravity

$Ka := 0.33$ Lateral earth pressure coefficient

$f := 0.3$ Coefficient of friction

$\delta s := \rho dry \cdot 9.81 \frac{N}{kg} = 20.4 \frac{kN}{m^3}$ Unit weight of dry soil (kN/m3)

$\delta sub := \delta s \cdot \left(1 - \frac{1}{SG}\right) = 12.7 \frac{kN}{m^3}$ Unit weight of submerged soil (kN/m3)

MH Details

$Mm := 48978\ kg$ Manhole mass including benching/ballast (kg)

$We := 68.32\ m$ Water elevation (m)

$TG := 69.42\ m$ Ground elevation (m)

$TS := 69.42\ m$ Elevation at top of transition slab (m). Same as **TG** if there is no Transtion.

$BS := 63.884\ m$ Elevation at bottom of base slab (m)

$ODt := 3.608\ m$ Outside diam. of top section if applicable (m). **0.0m** if Rectangular Section

$ODb := 3.608\ m$ Outside diam. of bottom section if applicable (m). **0.0m** if Rectangular Section

$Lt := 0.0\ m$ Length of top section if applicable (m). **0.0m** if Round Section

$Wt := 0.0\ m$ Width of top section if applicable (m). **0.0m** if Round Section

$Lb := 0.0\ m$ Length of bottom section if applicable (m). **0.0m** if Round Section

$Wb := 0.0\ m$ Width of bottom section if applicable (m). **0.0m** if Round Section

$EBw := 0.200\ m$ Width of extended base (m)

$EBd := 0.300\ m$ Depth of extended base (m)

$Hdry := TG - We = 1.1\ m$ height of dry soil (m)

$Hsub := We - BS = 4.44\ m$ height of submerged soil (m)

$Pt := \max\left(\begin{bmatrix} \pi \cdot ODt \\ 2 \cdot (Lt + Wt) \end{bmatrix}\right) = 11.33\ m$ Perimeter of top section (m)

$Pb := \max\left(\begin{bmatrix} \pi \cdot ODb \\ 2 \cdot (Lb + Wb) \end{bmatrix}\right) = 11.33\ m$ Perimeter of bottom section (m)

$At := \max\left(\begin{bmatrix} \pi \cdot (0.5 \cdot ODt)^2 \\ Lt \cdot Wt \end{bmatrix}\right) = 10.22\ m^2$ Exterior Area of top section (m2)

$Ab := \max\left(\begin{bmatrix} \pi \cdot (0.5 \cdot ODb)^2 \\ Lb \cdot Wb \end{bmatrix}\right) = 10.22\ m^2$ Exterior Area of bottom section (m2)

$Alip := \text{if } EBw = 0\ m \quad 0\ m^2 \text{ else } \max\left(\begin{bmatrix} \pi \cdot (0.5 \cdot ODb + EBw)^2 - Ab \\ (2 \cdot EBw + Lb) \cdot (2 \cdot EBw + Wb) - Ab \end{bmatrix}\right) = 2.39\ m^2$ Area of lip of extended base (m2)

$Meb := Alip \cdot EBd \cdot \rho c = 1686.8\ kg$ Mass of extended base (kg)

ZONE 1 : From Top of Grade to top of Transition Slab (chimney)

$HZ1 := TG - TS = 0$ Height of zone 1

$HZ1dry := \min\left(\begin{bmatrix} TG - We \\ TG - TS \end{bmatrix}\right) = 0$ Height of Zone 1 above water (m)

$HZ1sub := HZ1 - HZ1dry = 0$ Height of Zone 1 below water (m)

ZONE 2 : From Transition Slab to Base Slab

$HZ2 := TS - BS = 5.54\ m$ Height of zone 2

$HZ2dry := \max\left(\begin{bmatrix} TS - We \\ 0\ m \end{bmatrix}\right) = 1.1\ m$ Height of Zone 2 above water (m)

$HZ2sub := HZ2 - HZ2dry = 4.44\ m$ Height of Zone 2 below water (m)

Pressure acting on the MH

$Pdry := 0.5 \cdot Ka \cdot \delta s \cdot HZ1dry^2 + 0.5 \cdot Ka \cdot \delta s \cdot HZ2dry^2 = 4.1\ \frac{kN}{m}$

$Psub := Hsub \cdot (\delta s \cdot Hdry \cdot Ka) + 0.5 \cdot \delta sub \cdot Hsub^2 \cdot Ka = 74.1\ \frac{kN}{m}$

Sliding Resistance *(Assume dimensions of top MH section for entire MH stack. This is a more conservative approach)*

$S := 0.0$ sliding resistance factor. 1.0 if full sliding resistance is to be considered. 0.0 if sliding resistance is to be omitted

$Rsliding := S \cdot f \cdot Pt \cdot (Pdry + Psub) = 0\ kN$

Weight of backfill above Transition Slab and Extended Base

$Rfsc := 0.9$ factor of safety of concrete weight. Default value is 0.9

$Rfss := 0.8$ factor of safety of soil weight. Default Value is 0.8

$Wdry := Hdry \cdot \delta s \cdot Alip + HZ1dry \cdot \delta s \cdot (Ab - At) = 53.7\ kN$ dry soil weight above extended base and transition slab

$Wsub := Hsub \cdot \delta sub \cdot Alip + HZ1sub \cdot \delta sub \cdot (Ab - At) = 134.8\ kN$ submerged soil weight above extended base and transition slab

$Wbackfill := Wdry + Wsub = 188.5\ kN$ total weight of backfill on extended base and transition slab

Total Resistance Downward Force

$Fr := Rfsc \cdot (Mm + Meb) \cdot 9.81\ \frac{N}{kg} + Rfss \cdot (Rsliding + Wbackfill) = 598.2\ kN$

Total Buoyant Force

$Bfs := 1.1$ Buoyancy factor of safety. 1.5 when considering Sliding Resistance, 1.1 when not.

$V := Alip \cdot EBd + Ab \cdot HZ2sub + At \cdot HZ1sub = 46.1\ m^3$ Volume of soil displaced including extended base, if applicable

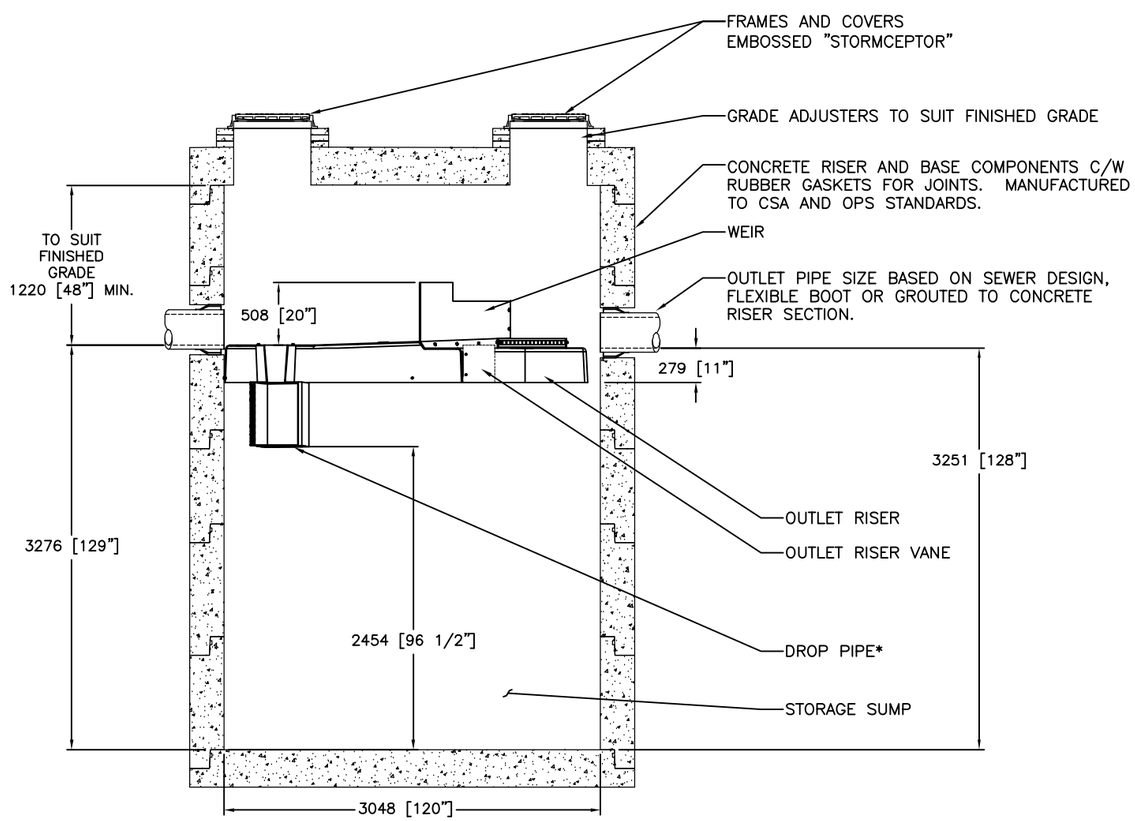
$B := Bfs \cdot (\delta w \cdot V) = 497.2\ kN$ Buoyancy Force

$SF := \frac{Fr}{B} = 1.2$ Safety Factor

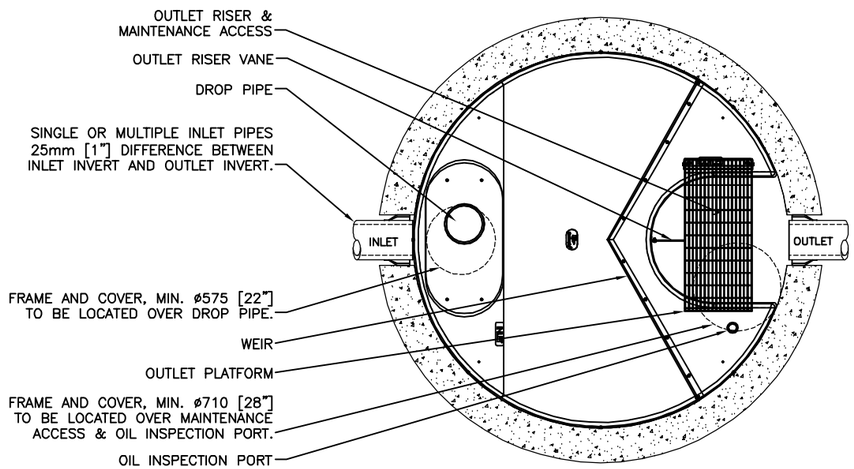
```
Conclussion := if Fr > B
                 "Resistance is greater than Buoyancy Force, MH will not float"
               else
                 "Buoyancy is greater than Resistance Force, MH will Float"
```

$Conclussion = \text{"Resistance is greater than Buoyancy Force, MH will not float"}$

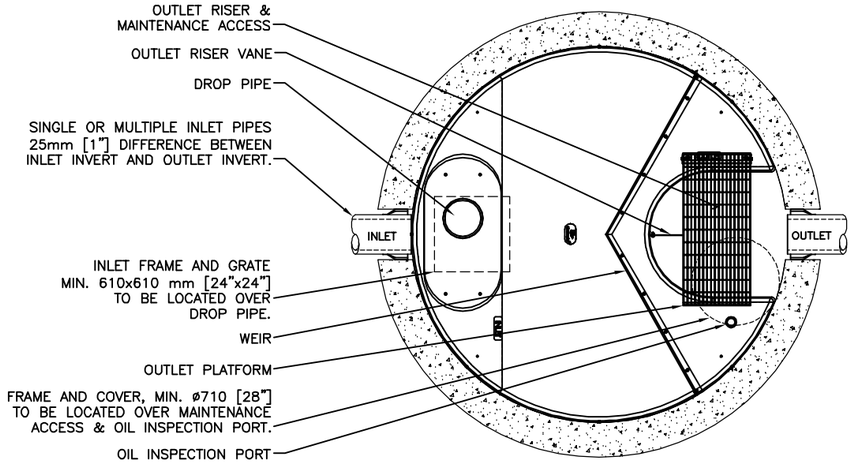
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF10 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO10 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO10				
STRUCTURE ID					*
HYDROCARBON STORAGE REQ'D (L)					*
WATER QUALITY FLOW RATE (L/s)					
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

The design and information shown on this drawing is provided as a service to the project owner, engineer and contractor by Imbrium Systems ("Imbrium"). Neither this drawing, nor any part thereof, may be used, reproduced or modified in any manner without the prior written consent of Imbrium. Failure to comply is done at the user's own risk and Imbrium expressly disclaims any liability or responsibility for such use.

If discrepancies between the supplied information upon which this drawing is based and actual conditions are encountered, these discrepancies must be reported to Imbrium immediately for re-evaluation of the design. Imbrium accepts no liability for design changes made by others without its express written consent.

MARK	DATE	REVISION DESCRIPTION	BY
####	####	####	####
####	####	####	####
####	####	####	####
1	6/8/18	OUTLET PLATFORM	JSK
0	5/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium
407 FAIRVIEW DRIVE, WHITBY, ON L1N 9A9
TF 800-565-4967 CA +1-416-960-9000 INTL +1-416-960-9000

DATE: 10/24/2017

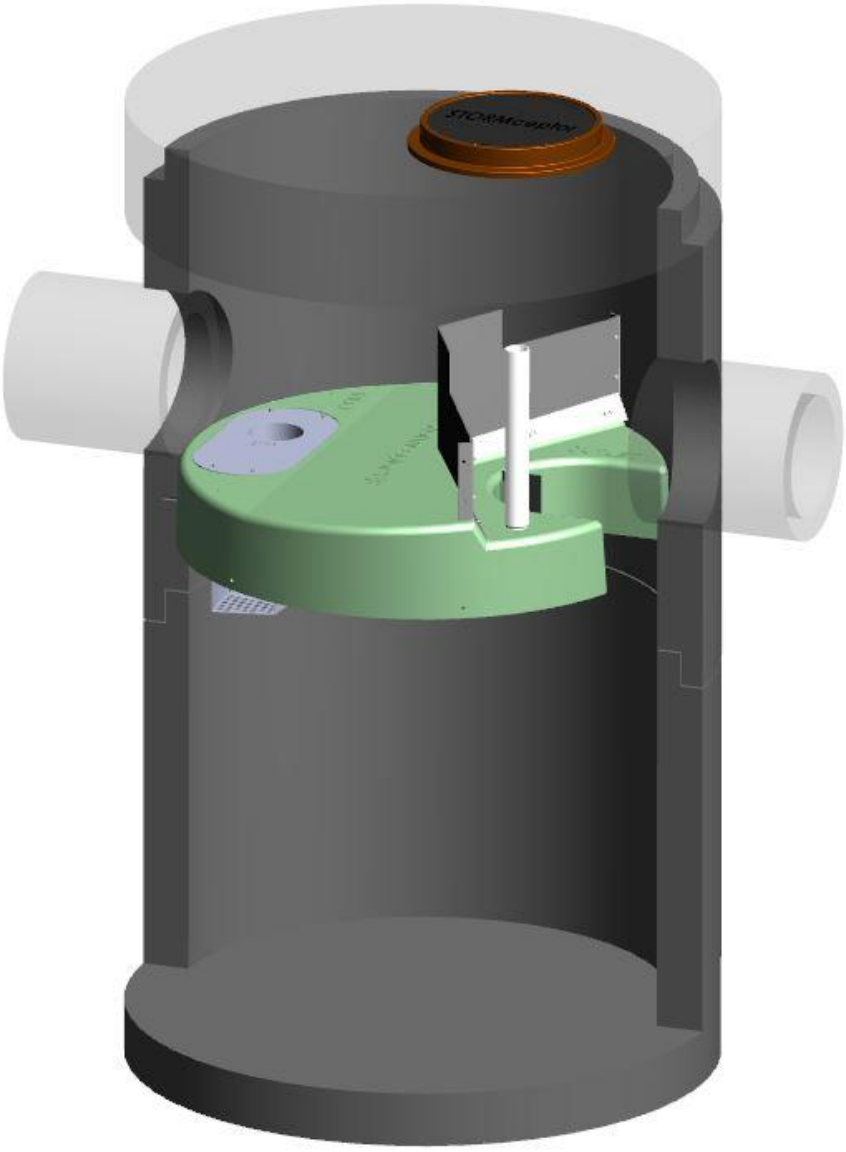
DESIGNED:	DRAWN:
JSK	JSK
CHECKED:	APPROVED:
BSF	SP
PROJECT No.:	SEQUENCE No.:
EFO10	*

SHEET: 1 OF 1

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Stormceptor® EF

Owner's Manual



Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942
Canadian Patent No. 2,180,305
Canadian Patent No. 2,327,768
Canadian Patent No. 2,694,159
Canadian Patent No. 2,697,287
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 729,096
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Japanese Patent No. 5,997,750
Japanese Patent No. 5,555,160
Korean Patent No. 0519212
Korean Patent No. 1451593
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Patent pending

Table of Contents:

1 - Stormceptor EF Overview

2 - Stormceptor EF Operation, Components

3 - Stormceptor EF Model Details

4 - Stormceptor EF Identification

5 - Stormceptor EF Inspection & Maintenance

6 – Stormceptor Contacts

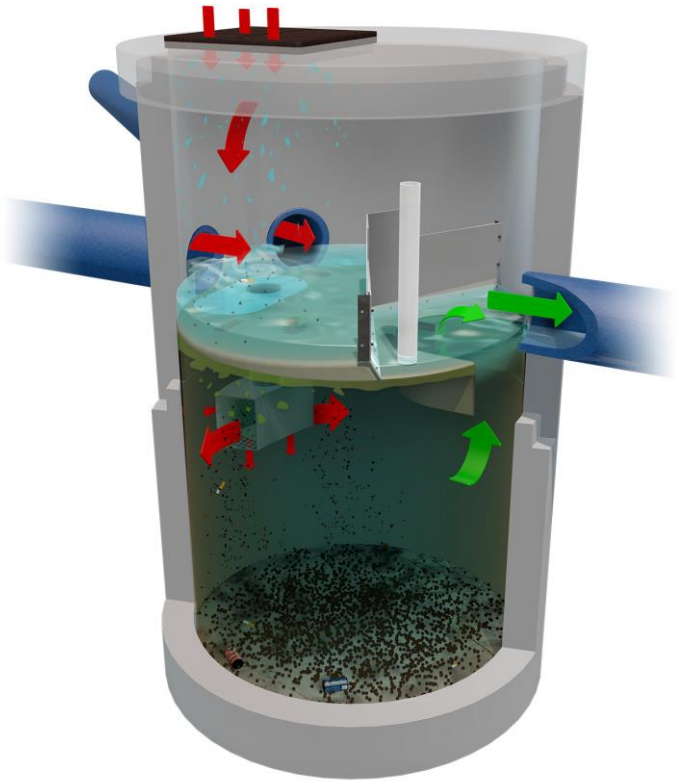
OVERVIEW

Stormceptor® EF is a continuation and evolution of the most globally recognized oil grit separator (OGS) stormwater treatment technology - ***Stormceptor®***. Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at flow rates higher than the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention platform ensures sediment is retained during all rainfall events.

Stormceptor EF offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe, multiple inlet pipes, and/or from the surface through an inlet grate. Stormceptor EF can also serve as a junction structure, accommodate a 90-degree inlet to outlet bend angle, and be modified to ensure performance in submerged conditions. With its scour prevention and internal bypass, Stormceptor EF can be installed online, eliminating the need for costly additional bypass structures.

OPERATION

- Stormwater enters the Stormceptor upper chamber through the inlet pipe(s) or a surface inlet grate. A specially designed insert reduces the influent velocity by creating a pond upstream of the insert's weir. Sediment particles immediately begin to settle. Swirling flow sweeps water, sediment, and floatables across the sloped surface of the insert to the inlet opening of the drop pipe, where a strong vortex draws water, sediment, oil, and debris down the drop pipe cone.
- Influent exits the cone into the drop pipe duct. The duct has two large rectangular outlet openings as well as perforations in the backside and floor of the duct. Influent is diffused through these various opening in multiple directions and at low velocity into the lower chamber.
- Free oils and other floatables rise up within the channel surrounding the central riser pipe and are trapped beneath the insert, while sediment settles to the sump. Pollutants are retained for later removal during maintenance cleaning.
- Treated effluent enters the outlet riser, moves upward, and discharges to the top side of the insert downstream of the weir, where it flows out the outlet pipe.
- During intense storm events with very high influent flow rates, the pond height on the upstream side of the weir may exceed the height of the weir, and the excess flow passes over the top of the weir to the downstream side of the insert, and exits through the outlet pipe. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, the pond separates sediment from all incoming flows, while full treatment in the lower chamber continues at the maximum flow rate.
- Stormceptor EF's patent-pending enhanced flow and scour prevention technology ensures pollutants are captured and retained, allowing excess flows to bypass during infrequent, high intensity storms.



COMPONENTS

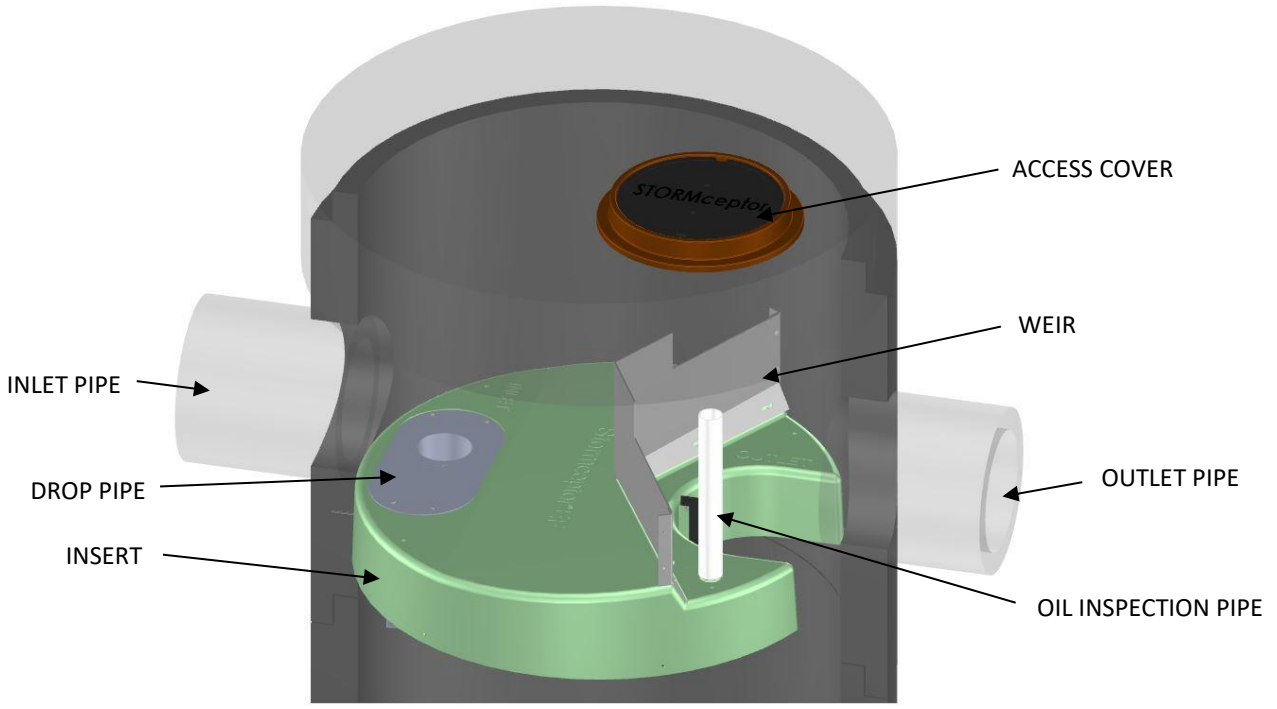


Figure 1

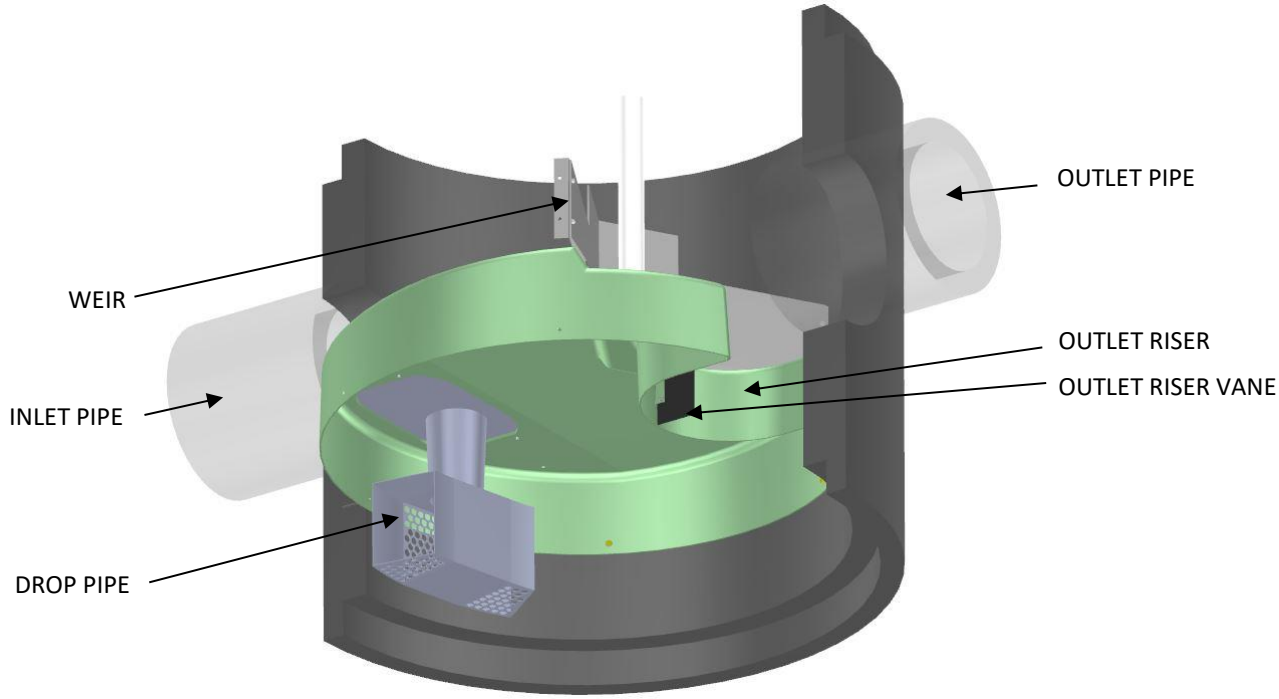


Figure 2

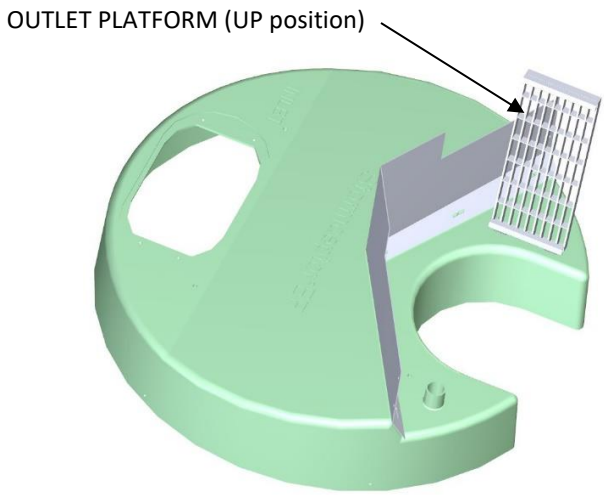


Figure 3A

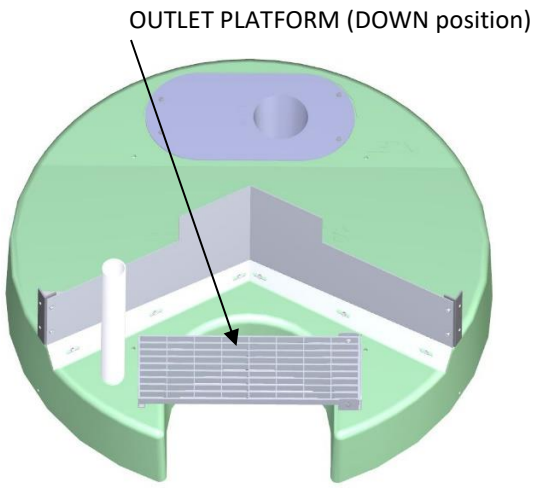


Figure 3B

- **Insert** – separates vessel into upper and lower chambers, and provides double-wall containment of hydrocarbons
- **Weir** – creates stormwater ponding and driving head on top side of insert
- **Drop pipe** – conveys stormwater and pollutants into the lower chamber
- **Outlet riser** – conveys treated stormwater from the lower chamber to the outlet pipe, and provides primary inspection and maintenance access into the lower chamber
- **Outlet riser vane** – prevents formation of a vortex in the outlet riser during high flow rate conditions
- **Outlet platform (optional)** – safety platform in the event of manned entry into the unit
- **Oil inspection pipe** – primary access for measuring oil depth

PRODUCT DETAILS

METRIC DIMENSIONS AND CAPACITIES

Table 1

Stormceptor Model	Inside Diameter (m)	Minimum Surface to Outlet Invert Depth (mm)	Depth Below Outlet Pipe Invert (mm)	Wet Volume (L)	Sediment Capacity [1] (m^3)	Hydrocarbon Storage Capacity [2] (L)	Maximum Flow Rate into Lower Chamber [3] (L/s)	Peak Conveyance Flow Rate [4] (L/s)
EF4 / EFO4	1.22	1219/914	1524	1780	1.19	265	22.1 / 10.4	425
EF5/EFO5	1.52	1219	1626	3150	1.95	420	34.6 / 16.2	708
EF6 / EFO6	1.83	1219	1930	5070	3.47	610	49.6 / 23.4	990
EF8 / EFO8	2.44	1219	2591	12090	8.78	1070	88.3 / 41.6	1700
EF10 / EFO10	3.05	1219	3251	23700	17.79	1670	138 / 65	2830
EF12 / EFO12	3.66	1219	3886	40800	31.22	2475	198.7 / 93.7	2830

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe duct. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 1135 L/min/m^2.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 535 L/min/m^2.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 1.5 m/s.

U.S. DIMENSIONS AND CAPACITIES

Table 2

Stormceptor Model	Inside Diameter (ft)	Minimum Surface to Outlet Invert Depth (in)	Depth Below Outlet Pipe Invert (in)	Wet Volume (gal)	Sediment Capacity [1] (ft^3)	Hydrocarbon Storage Capacity [2] (gal)	Maximum Flow Rate into Lower Chamber [3] (cfs)	Peak Conveyance Flow Rate [4] (cfs)
EF4 / EFO4	4	48 / 36	60	471	42	70	0.78 / 0.37	15
EF5 / EFO5	5	48	64	833	75	111	1.22 / 0.57	25
EF6 / EFO6	6	48	76	1339	123	160	1.75 / 0.83	35
EF8 / EFO8	8	48	102	3194	310	280	3.12 / 1.47	60
EF10 / EFO10	10	48	128	6261	628	440	4.87 / 2.30	100
EF12 / EFO12	12	48	153	10779	1103	655	7.02 / 3.31	100

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe duct. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 27.9 gpm/ft^2.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 13.1 gpm/ft^2.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 5 fps.

IDENTIFICATION

Each Stormceptor EF/EFO unit is easily identifiable by the trade name ***Stormceptor***® embossed on the access cover at grade as shown in **Figure 3**. The tradename ***Stormceptor***® is also embossed on the top of the insert upstream of the weir as shown in **Figure 3**.

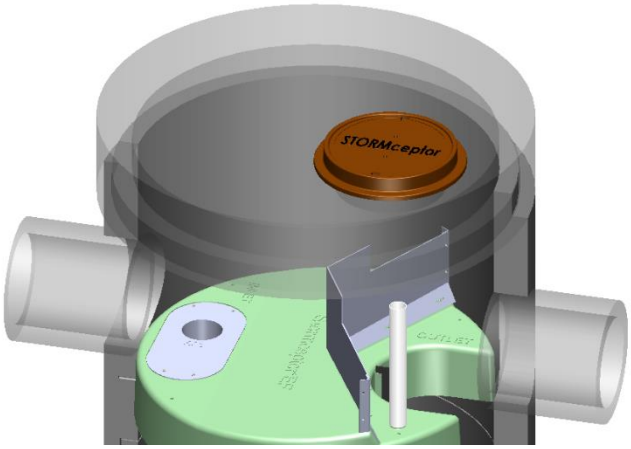


Figure 4

The specific Stormceptor EF/EFO model number is identified on the top of the aluminum Drop Pipe as shown in **Figure 4**. The unit serial number is identified on the top of the insert upstream of the weir as shown in **Figure 4**.

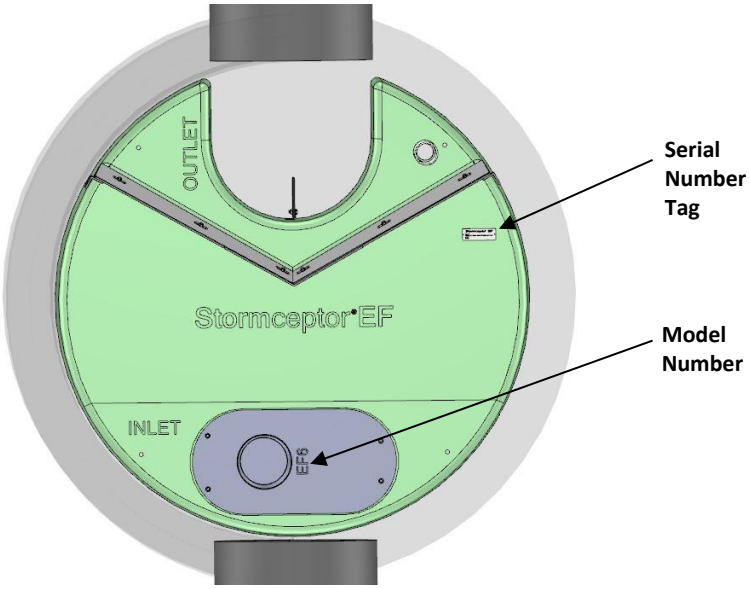


Figure 5

INSPECTION AND MAINTENANCE

It is very important to perform regular inspection and maintenance. Regular inspection and maintenance ensures maximum operation efficiency, keeps maintenance costs low, and provides continued of natural waterways.

Quick Reference

- Typical inspection and maintenance is performed from grade
- Remove manhole **cover(s)** or **inlet grate** to access insert and lower chamber
  NOTE: EF4/EFO4 & EF5/EFO5 require the removal of a **flow deflector** beneath inlet grate
- Use Sludge Judge® or similar sediment probe to check sediment depth through the **outlet riser**
- Oil dipstick can be inserted through the **oil inspection pipe**
- Visually inspect the **insert** for debris, remove debris if present
- Visually inspect the **drop pipe** opening for blockage, remove blockage if present
- Visually inspect **insert** and **weir** for damage, schedule repair if needed
- Insert vacuum hose and jetting wand through the outlet riser and extract sediment and floatables
- Replace flow deflector (EF4/EFO4 & EF5/EFO5), inlet grate, and cover(s)
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess pollutant accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

When is maintenance cleaning needed?

- If the post-construction inspection indicates presence of construction sediment of a depth greater than a few inches, maintenance is recommended at that time.
- For optimum performance and normal operation the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, see **Table 3**.
- Maintain immediately after an oil, fuel, or other chemical spill.

Table 3

Recommended Sediment Depths for Maintenance Service*	
MODEL	Sediment Depth (in/mm)
EF4 / EFO4	8 / 203
EF5 / EFO5	12 /305
EF6 / EFO6	12 /305
EF8 / EFO8	24 / 610
EF10 / EFO10	24 / 610
EF12 / EFO12	24 / 610

* Based on a minimum distance of 41 inches (1,041 mm) from bottom of outlet riser to top of sediment bed

The frequency of inspection and maintenance may need to be adjusted based on site conditions to ensure the unit is operating and performing as intended. Maintenance costs will vary based on the size of the unit, site conditions, local requirements, disposal costs, and transportation distance.

What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required (adhere to all OSHA / CCOSH standards)

What conditions can compromise Stormceptor performance?

- Presence of construction sediment and debris in the unit prior to activation
- Excessive sediment depth beyond the recommended maintenance depth
- Oil spill in excess of the oil storage capacity
- Clogging or restriction of the drop pipe inlet opening with debris
- Downstream blockage that results in a backwater condition

Maintenance Procedures

- Maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is maintained from grade through a standard surface manhole access cover or inlet grate.
- In the case of submerged or tailwater conditions, extra measures are likely required, such as plugging the inlet and outlet pipes prior to conducting maintenance.
- Inspection and maintenance of upstream catch basins and other stormwater conveyance structures is also recommended to extend the time between future maintenance cycles.

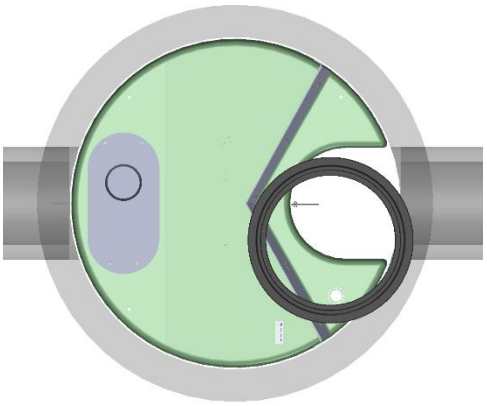


Figure 6

- Sediment depth inspections are performed through the **Outlet Riser** and oil presence can be determined through the **Oil Inspection Pipe**.
- Oil presence and sediment depth are determined by inserting a Sludge Judge® or measuring stick to quantify the pollutant depths.

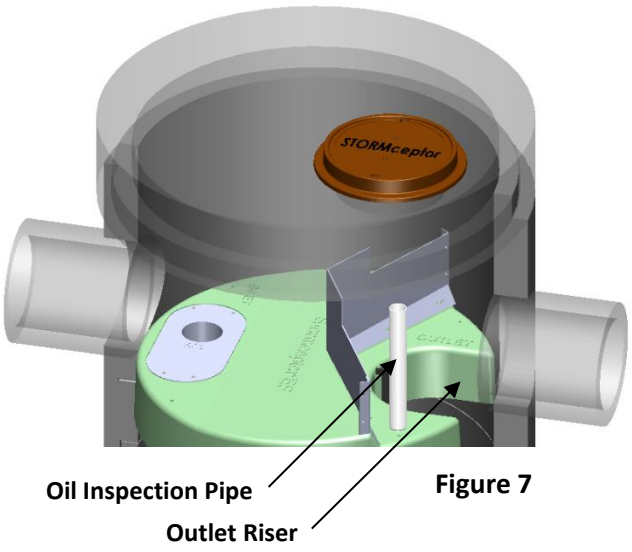


Figure 7



Figure 8

- Visually inspect the insert, weir, and drop pipe inlet opening to ensure there is no damage or blockage.
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

- When maintenance is required, a standard vacuum truck is used to remove the pollutants from the lower chamber of the unit through the **Outlet Riser**.



Figure 9

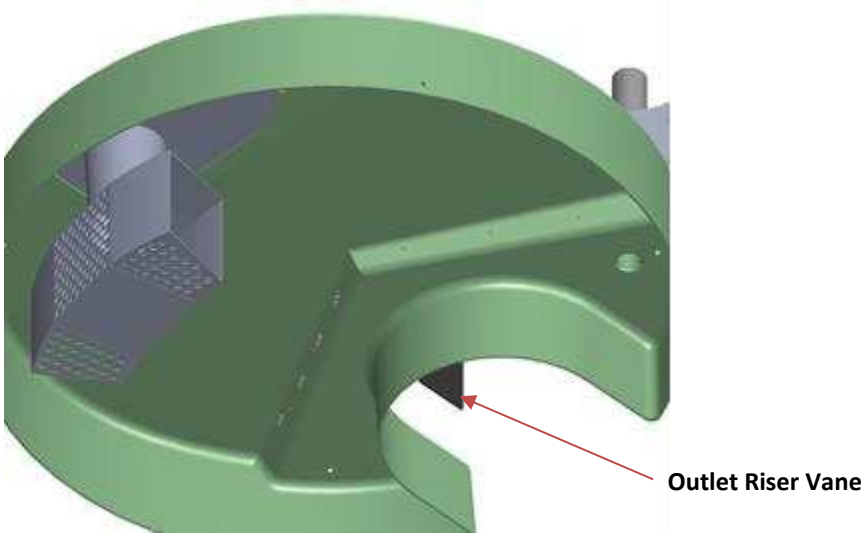


Figure 10

NOTE: The Outlet Riser Vane is durable and flexible and designed to allow maintenance activities with minimal, if any, interference.

Removable Flow Deflector

- Top grated inlets for the Stormceptor EF4/EFO4 & EF5/EFO5 models require a removable flow deflector staged underneath a 24-inch x 24-inch (600 mm x 600 mm) square inlet grate to direct flow towards the inlet side of the insert, and avoid flow and pollutants from entering the outlet side of the insert from grade. The EF6/EFO6 and larger models do not require the flow deflector.

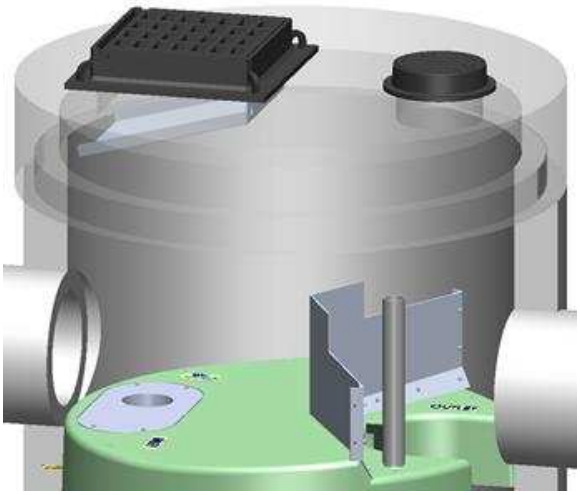
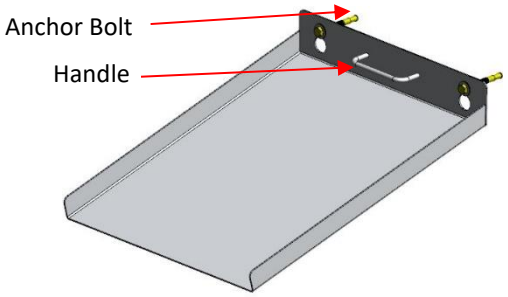


Figure 11

How to Remove:

1. Loosen anchor bolts
2. Pull up and out using the handle



Removable Flow Deflector

Hydrocarbon Spills

Stormceptor is often installed on high pollutant load hotspot sites with vehicular traffic where hydrocarbon spill potential exists. Should a spill occur, or presence of oil be identified within a Stormceptor EF/EFO, it should be cleaned immediately by a licensed liquid waste hauler.

Disposal

Maintenance providers are to follow all federal, state/ provincial, and local requirements for disposal of material.

Oil Sheens

When oil is present in stormwater runoff, a sheen may be noticeable at the Stormceptor outlet. An oil rainbow or sheen can be noticeable at very low oil concentrations (< 10 mg/L). Despite the appearance of a sheen, Stormceptor EF/EFO may still be functioning as intended.

Oil Level Alarm

To mitigate spill liability with 24/7 detection, an electronic monitoring system can be employed to trigger a visual and audible alarm when a pre-set level of oil is captured within the lower chamber or when an oil spill occurs. The oil level alarm is available as an optional feature to include with Stormceptor EF/EFO as shown in **Figure 11**. For additional details about the Oil Level Alarm please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-systems.

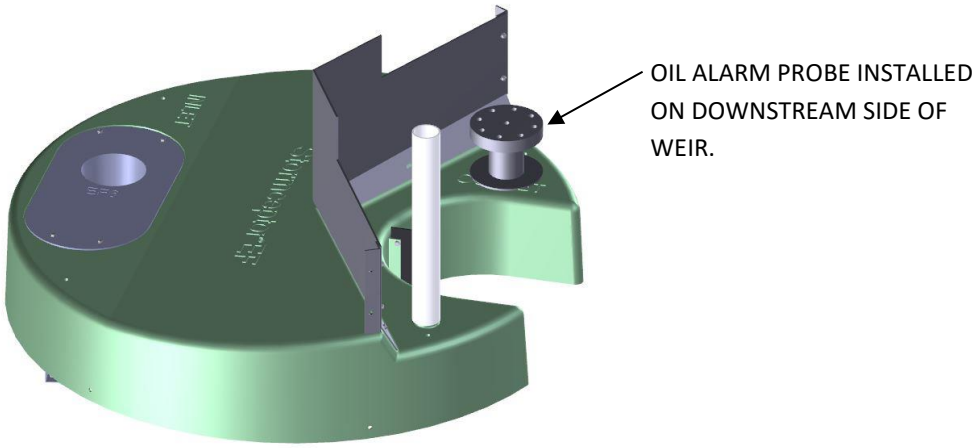


Figure 12

Replacement Parts

Stormceptor has no moving parts to wear out. Therefore inspection and maintenance activities are generally focused on pollutant removal. Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. However, if replacement parts are necessary, they may be purchased by contacting your local Stormceptor representative.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: _____

Serial Number: _____

Installation Date: _____

Location Description of Unit: _____

Recommended Sediment Maintenance Depth: _____

DATE	SEDIMENT DEPTH (inch or mm)	OIL DEPTH (inch or mm)	SERVICE REQUIRED (Yes / No)	MAINTENANCE PERFORMED	MAINTENANCE PROVIDER	COMMENTS

Other Comments:

Contact Information

Questions regarding Stormceptor EF/EFO can be addressed by contacting your local Imbrium representative or by visiting our website at www.imbriumsystems.com**.**

Imbrium Systems Inc. & Imbrium Systems LLC

Canada	1-416-960-9900 / 1-800-565-4801
United States	1-301-279-8827 / 1-888-279-8826
International	+1-416-960-9900 / +1-301-279-8827

www.imbriumsystems.com
info@imbriumsystems.com

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Stormceptor® EF and EFO Oil-Grit Separators

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

Registration: GPS-ETV_VR2023-11-15_Imbrium-SC

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 15, 2023
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The Stormceptor® EF and EFO are treatment devices designed to remove oil, sediment, trash, debris, and pollutants attached to particulates from Stormwater and snowmelt runoff. The device takes the place of a conventional manhole within a storm drain system and offers design flexibility that works with various site constraints. The EFO is designed with a shorter bypass weir height, which accepts lower surface loading rate into the sump, thereby reducing re-entrainment of captured free floating light liquids.

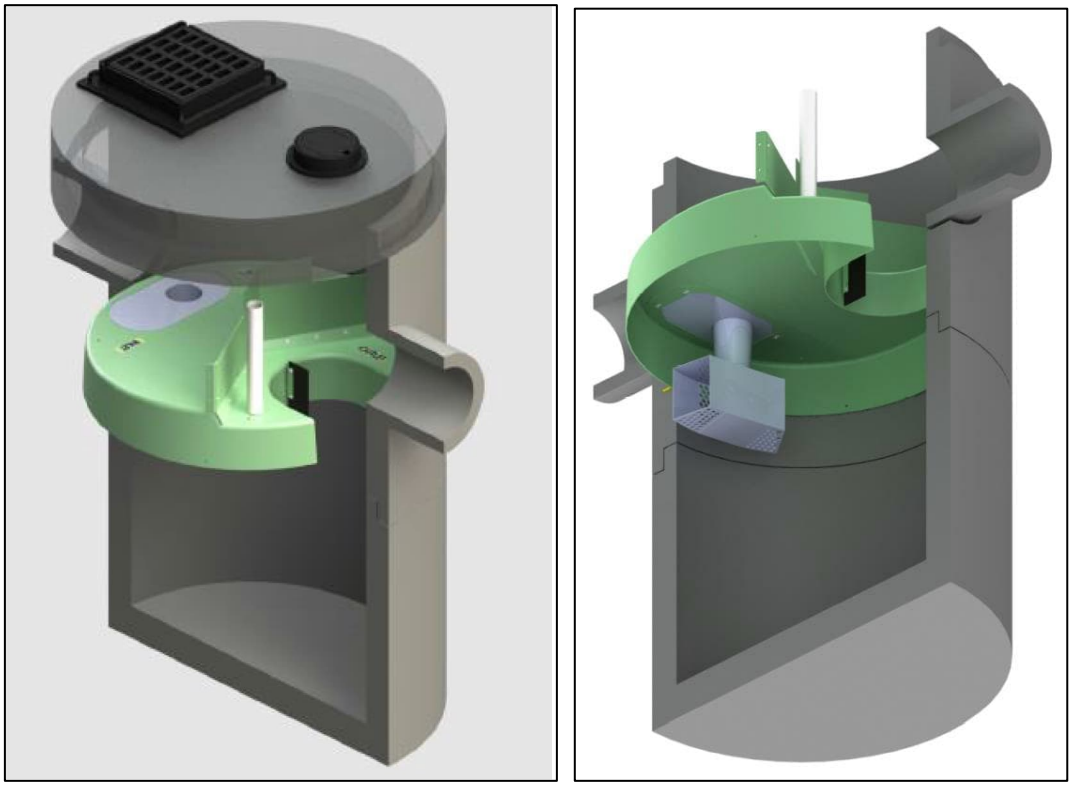


Figure 1. Graphic of typical inline Stormceptor® unit and core components.

Stormwater and snowmelt runoff enters the Stormceptor® EF/EFO's upper chamber through the inlet pipe(s) or a surface inlet grate. An insert divides the unit into lower and upper chambers and incorporates a weir to reduce influent velocity and separate influent (untreated) from effluent (treated) flows. Influent water ponds upstream of the insert's weir providing driving head for the water flowing downwards into the drop pipe where a vortex pulls the water into the lower chamber. The water diffuses at lower velocities in multiple directions through the drop pipe outlet openings. Oil and other floatables rise up and are trapped beneath the insert, while sediments undergo gravitational settling to the sump's bottom. Water from the sump can exit by flowing upward to the outlet riser onto the top side of the insert and downstream of the weir, where it discharges through the outlet pipe.

Maximum flow rate into the lower chamber is a function of weir height and drop pipe orifice diameter. The Stormceptor® EF and EFO are designed to allow a surface loading rate of 1135 L/min/m^2 (27.9 gal/min/ft^2) and 535 L/min/m^2 (13.1 gal/min/ft^2) into the lower chamber, respectively. When prescribed surface loading rates are exceeded, ponding water can overtop the weir height and bypass the lower treatment chamber, exiting directly through the outlet pipe. Hydraulic testing and scour testing demonstrate that the internal bypass effectively prevents scour at all bypass flow rates. Increasing the bypass flow rate does not increase the orifice-controlled flow rate into the lower treatment chamber where sediment is stored. This internal bypass feature allows for in-line installation, avoiding the cost of

additional bypass structures. During bypass, treatment continues in the lower chamber at the maximum flow rate. The Stormceptor® EFO's lower design surface loading rate is favorable for minimizing re-entrainment and washout of captured light liquids. Inspection of Stormceptor® EF and EFO devices is performed from grade by inserting a sediment probe through the outlet riser and an oil dipstick through the oil inspection pipe. The unit can be maintained by using a vacuum hose through the outlet riser.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Imbrium Systems Inc.'s Stormceptor® EF4 and EFO4 Oil-Grit Separators, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test [a]:

During the capture test, the Stormceptor® EF4 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 46, 44, and 49 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Stormceptor® EFO4, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 42, 40, and 34 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test [a]:

During the scour test, the Stormceptor® EF4 and Stormceptor® EFO4 OGS devices, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment storage depth, generate corrected effluent concentrations of 4.6, 0.7, 0, 0.2, and 0.4 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Stormceptor® EFO4 OGS device with surrogate low-density polyethylene beads preloaded within the lower chamber oil collection zone, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.5, 99.8, 99.8, and 99.9 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2.

[a] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)

Performance results

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the three sample average of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 2 indicates that the test sediment used for the capture and scour tests met this condition.

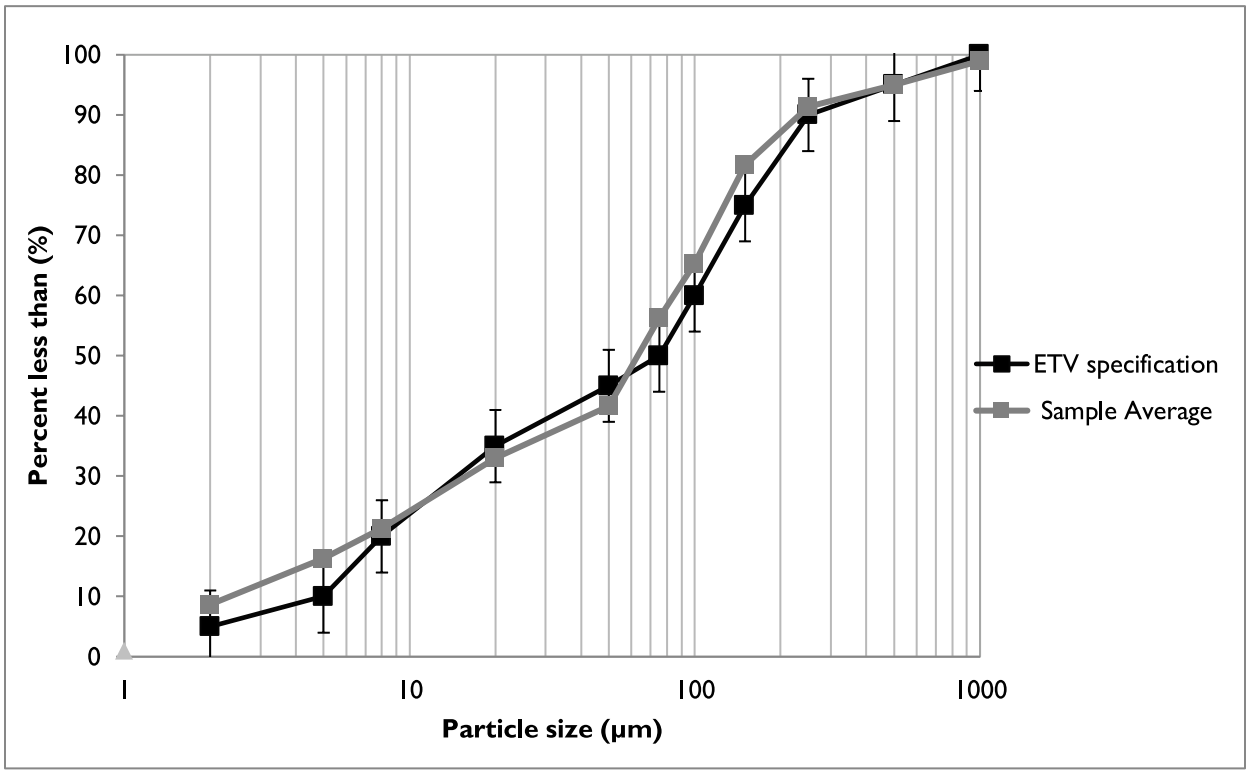


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1). Since the EF and EFO models are identical except for the weir height, which bypasses flows from the EFO model at a surface loading rate of 535 L/min/m^2 (13.1 gpm/ft^2), sediment capture tests at surface loading rates from 40 to 400 L/min/m^2 were only performed on the EF unit. Surface loading rates of 600, 1000, and 1400 L/min/m^2 were tested on both units separately. Results for the EFO model at these higher flow rates are presented in Table 2.

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and may be attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory

analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1 and 2) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Table 1. Removal efficiencies (%) of the EF4 at specified surface loading rates

Particle size fraction (µm)	**Surface loading rate (L/min/m²)**						
	40	80	200	400	600	1000	1400
>500	90	58	58	100*	86	72	100*
250 - 500	100*	100*	100	100*	100*	100*	100*
150 - 250	90	82	26	100*	100*	67	90
105 - 150	100*	100*	100*	100*	100*	100*	100
75 - 105	100*	92	74	82	77	68	76
53 - 75	Undefined [a]	56	100*	72	69	50	80
20 - 53	54	100*	54	33	36	40	31
8 - 20	67	52	25	21	17	20	20
5 – 8	33	29	11	12	9	7	19
<5	13	0	0	0	0	0	4
All particle sizes by mass balance	**70.4**	**63.8**	**53.9**	**47.5**	**46.0**	**43.7**	**49.0**

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Table 2. Removal efficiencies (%) of the EFO4 at surface loading rates above the bypass rate of 535 L/min/m²

Particle size fraction (µm)	**Surface loading rate (L/min/m²)**		
	600	1000	1400
>500	89	83	100*
250 - 500	90	100*	92
150 - 250	90	67	100*
105 - 150	85	92	77
75 - 105	80	71	65
53 - 75	60	31	36
20 - 53	33	43	23
8 - 20	17	23	15
5 – 8	10	3	3
<5	0	0	0
All particle sizes by mass balance	**41.7**	**39.7**	**34.2**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 111% (average 107%). See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the EF4 at each of the tested surface loading rates. Figure 4 shows the same graph for the EFO4 unit at surface loading rates above the bypass rate of 535 L/min/m².

As expected, the capture efficiency for fine particles in both units was generally found to decrease as surface loading rates increased.

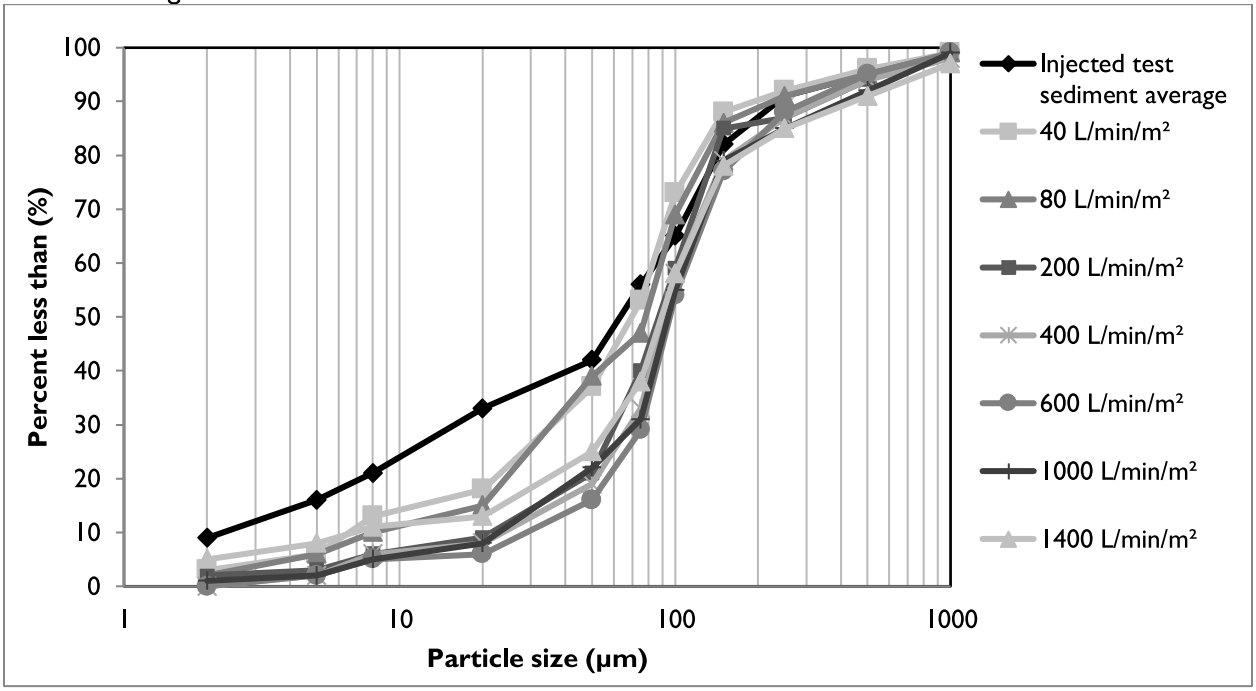


Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

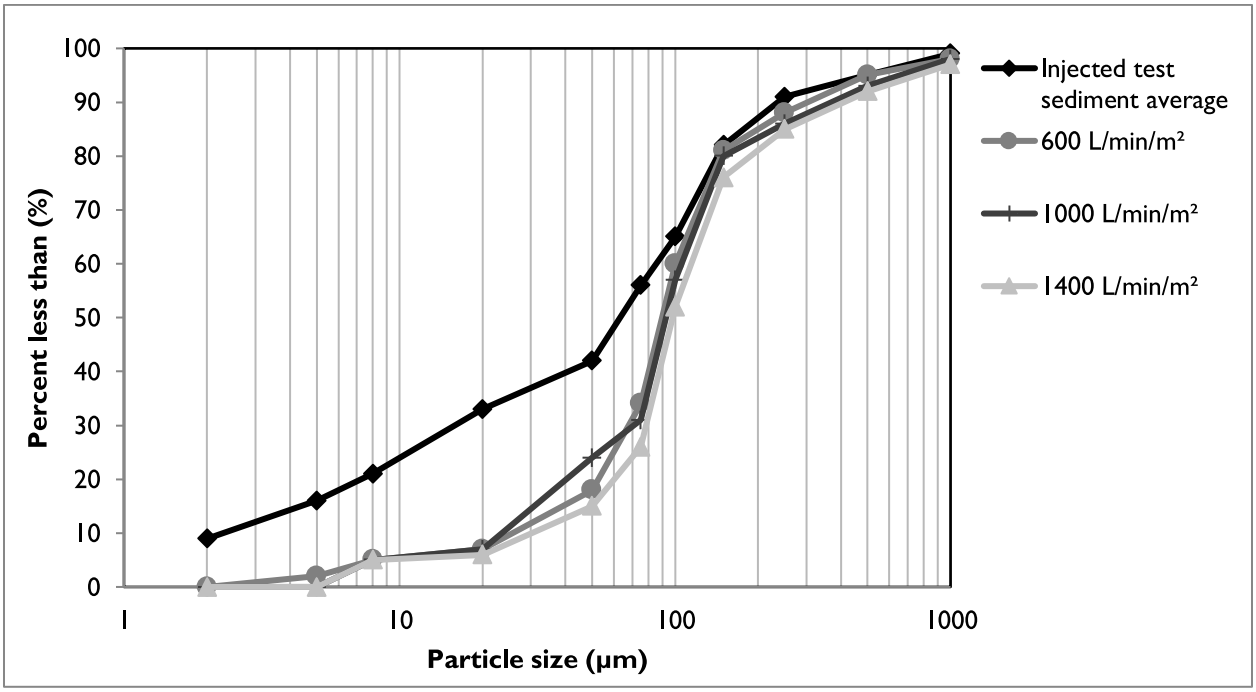


Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm of fresh test sediment into

the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. Typically, the smallest 5% of particles captured during the 40 L/min/m² sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m², potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m²)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L) [a]	Average (mg/L)
1	200	1:00	<RDL	11.9	4.6
		2:00		7.0	
		3:00		4.4	
		4:00		2.2	
		5:00		1.0	
		6:00		1.2	
2	800	7:00	<RDL	1.1	0.7
		8:00		0.9	
		9:00		0.6	
		10:00		1.4	
		11:00		0.1	
		12:00		0	
3	1400	13:00	<RDL	0	0
		14:00		0.1	
		15:00		0	
		16:00		0	
		17:00		0	
		18:00		0	
4	2000	19:00	1.2	0.2	0.2
		20:00		0	
		21:00		0	
		22:00		0.7	
		23:00		0	
		24:00		0.4	

5	2600	25:00	1.6	0.3	0.4
		26:00		0.4	
		27:00		0.7	
		28:00		0.4	
		29:00		0.2	
		30:00		0.4	

[a] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 5. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m^2) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m^2). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 5. Light liquid re-entrainment test results for the EFO4.

Surface Loading Rate (L/min/m2)	Time Stamp	Amount of Beads Re-entrained			
		Mass (g)	Volume (L)[a]	% of Pre-loaded Mass Re-entrained	% of Pre-loaded Mass Retained
200	62	0	0	0.00	100
800	247	168.45	0.3	0.52	99.48
1400	432	51.88	0.09	0.16	99.83
2000	617	55.54	0.1	0.17	99.84
2600	802	19.73	0.035	0.06	99.94
Total Re-entrained		295.60	0.525	0.91	--
Total Retained		32403	57.78	--	99.09
Total Loaded		32699	58.3	--	--

[a] Determined from bead bulk density of 0.56074 g/cm^3

Variances from testing Procedure

The following minor deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. During the capture test, the 40 L/min/m^2 and 80 L/min/m^2 surface loading rates were evaluated over 3 and 2 days respectively due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit at these lower flow rates. Pumps were shut down at the end of each intermediate day, and turned on again the following morning. The target flow rate was re-established within 30 seconds of switching on the pump. This procedure may have allowed sediments to be captured that otherwise may have exited the unit if the test was continuous. On the basis of practical considerations, this variance was approved by the verifier prior to testing.

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m^2) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m^2 run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m^2 for the Stormceptor® EF4 and 1000 and 1400 L/min/m^2 for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories, and dated September 8, 2017; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Stormceptor® EF and EFO OGS please contact:

Imbrium Systems, Inc.
407 Fairview Drive
Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
World Trade Centre
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com

Limitation of verification - Registration: GPS-ETV_VR2023-11-15_Imbrium-SC
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

Rinker Materials Quality Assurance Program (QAP)

Rinker Materials is committed to providing the most effective, environmentally friendly, and economical Oil Grit Separators (OGS), leading the way in protecting our water resources.

We've got you covered

Your QAP starts with post construction inspection to ensure the unit has been installed as designed. The unit is recorded in our expansive database summarizing all installed units with their GPS locations. When you inspect and maintain these OGS units, you play an important part in protecting the environment, while ensuring your stormwater assets remain in compliance with environmental regulations

Rinker Materials's industry leading line of Stormceptor products are one of the lowest-cost OGS units in the market, functioning effectively in all aspects of keeping pollutants out of our waterways. The Forterra Quality Assurance Program is in place at no extra cost to the asset's owner, providing inspections for up to 5 years.



Improving products, improving service.

Our commitment to providing the best storm water quality devices continues as we have recently expanded our already impressive line of Stormceptor® products with the addition of the ISO14034/ETV verified Stormceptor EF and EFO - simply the most cost competitive stormwater quality device on the market. Now we're improving our service by ensuring inspections on our entire Stormceptor product line for up to 5 years after installation.

At Rinker Materials, we understand that maintaining a high standard of water quality is crucial to the environment and to our lives. That's why, 20 years ago, we introduced a 2-year inspection plan with every Stormceptor unit sold. As municipalities continue to focus on OGS units operating as designed, we felt it was time to strengthen our program even further. We are now offering at no additional cost to the asset's owner, a 5-year QAP with every Stormceptor unit to ensure water quality continues to be at its best.

Stormceptor® Quality Assurance Program

Based on initial inspection results, there are two ways to ensure Stormceptor® performance:

First way (5 years, cleaning not included)

- Six inspections over a 5-year period, cleaning not included
- First inspection when installed
- At 6 months a second inspection.
- Inspections every 12 months thereafter for 5 years
- Oil and sediment level are documented along with maintenance recommendations,

Second way (2.5 years, includes one cleaning)

- Initial inspection of the unit
- One post construction sediment (clean material) cleaning at 6 months
- Two additional annual inspections, resulting in the unit being maintained for the first 30 months

All QAP programs are Completed by Minotaur

Rinker Materials | 2099 Roseville Road, Cambridge, On N1R 5S3 | 519-622-7574

Rinker MATERIALS® A QUIKRETE® COMPANY

Pihani, Bita

From: Kent Campbell <stanley.campbell@RinkerPipe.com>
Sent: September 12, 2025 9:16 AM
To: Pihani, Bita; Brandon O'Leary
Cc: Grant, Todd; Esfandiari, Pouyan; Eric Carmona-Epp
Subject: RE: Re: Re: OGS Unit - 1500 St Laurent Blvd, Ottawa
Attachments: EFO10 - OGS Unit - 3000mm_cleaned.pdf

This Message Is From an External Sender

This message came from outside your organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Report Suspicious

Hello Bita,

Please see the comments below from our structural engineer and attached buoyancy calculations. I would advise adding the extended base to your spec as the tank can be emptied during maintenance pump outs.

> *""It looks like we might need an extension on this one if tank is empty before it goes on service. Once the water is in the tank then we should not have any issues. I calculate a minimum base extension of 200mm all around and 300mm thick. Find attached calculations.""*

Regards,
Kent Campbell
Stormwater Specialist
Cambridge Plant
Cell 519 588-7473
stanley.campbell@rinkerpipe.com

Rinker MATERIALS A QUIKRETE COMPANY
Stormceptor
Protecting water for future generations

From: Kent Campbell <stanley.campbell@rinkerpipe.com>
Sent: Wednesday, September 10, 2025 4:24 PM
To: Pihani, Bita <Bita.YousefiPihani@aecom.com>; Brandon O'Leary <brandon.oleary@RinkerPipe.com>
Cc: Grant, Todd <Todd.Grant@aecom.com>; Esfandiari, Pouyan <pouyan.esfandiari@aecom.com>
Subject: RE: [EXTERNAL] Re: Re: OGS Unit - 1500 St Laurent Blvd, Ottawa

Hi Bita,

Please see the updated report attached.

The recommended model remains the EFO 10, budget for the EFO 10 is $80,634.

Stormceptor EFO10 Capacities
Maximum Treatment Flow Rate: 65.0 L/s
Maintenance Sediment Volume: 3,560 L
Maximum Sediment Capacity: 17,790 L
Maximum Hydrocarbon Storage Capacity: 1,670 L
Total Storage Volume: 23,700 L

I will send you the buoyancy analysis when I receive it. Take care and let me know if there is anything else.

Regards,
Kent Campbell
Stormwater Specialist
Cambridge Plant
Cell 519 588-7473
stanley.campbell@rinkerpipe.com

Rinker MATERIALS A QUIKRETE COMPANY
Stormceptor
Protecting water for future generations

From: Pihani, Bita <Bita.YousefiPihani@aecom.com>
Sent: Wednesday, September 10, 2025 11:32 AM
To: Kent Campbell <stanley.campbell@rinkerpipe.com>; Brandon O'Leary <brandon.oleary@RinkerPipe.com>
Cc: Grant, Todd <Todd.Grant@aecom.com>; Esfandiari, Pouyan <pouyan.esfandiari@aecom.com>
Subject: [EXTERNAL] Re: Re: OGS Unit - 1500 St Laurent Blvd, Ottawa

CAUTION: This email originated from outside of the organization. Exercise caution when opening attachments or clicking links, especially from *UNKNOWN* senders.

Hi Kent,

Thank you for your response. I have attached the OGS sizing report that was designed previously. I have attached the site servicing plan drawing for the site and circled the location for the OGS in red.

As for the groundwater levels, I have attached 2 images from the geotechnical report we have from the site. One photo includes the map of the borehole/monitoring wells and the other includes the groundwater levels based on the monitoring wells on the site. I have circled in blue the monitoring well available that is near the OGS unit. The monirtoring well near to the OGS is BH/MW 22-16 where there are 2 groundwater levels reported, to be conservative the higher ground water level is best to use. Below I have summarized the information you requested:

T/G: 69.42 m
OGS Invert: 67.50 m
OGS Outlet Invert: 67.44 m
Groundwater level: 1.1 m below ground

Please let me know if you need any additional information.

Thank you,

Bita

Bita Pihani, M.A.S.c, Civil EIT
she, her, hers
Civil Engineering, Water M +1-647-973-1375
Bita.yousefipihani@aecom.com

AECOM
1150 Morrison Drive, Suite 302
Ottawa, Ontario, K2H 8S9, Canada
T +1-613-820-8282
aecom.com

Delivering a better world

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From: Kent Campbell <stanley.campbell@rinkerpipe.com>
Sent: September 10, 2025 9:37 AM
To: Pihani, Bita <Bita.YousefiPihani@aecom.com>; Brandon O'Leary <brandon.oleary@RinkerPipe.com>
Cc: Grant, Todd <Todd.Grant@aecom.com>; Esfandiari, Pouyan <pouyan.esfandiari@aecom.com>
Subject: RE: Re: OGS Unit - 1500 St Laurent Blvd, Ottawa

Good morning Bita,

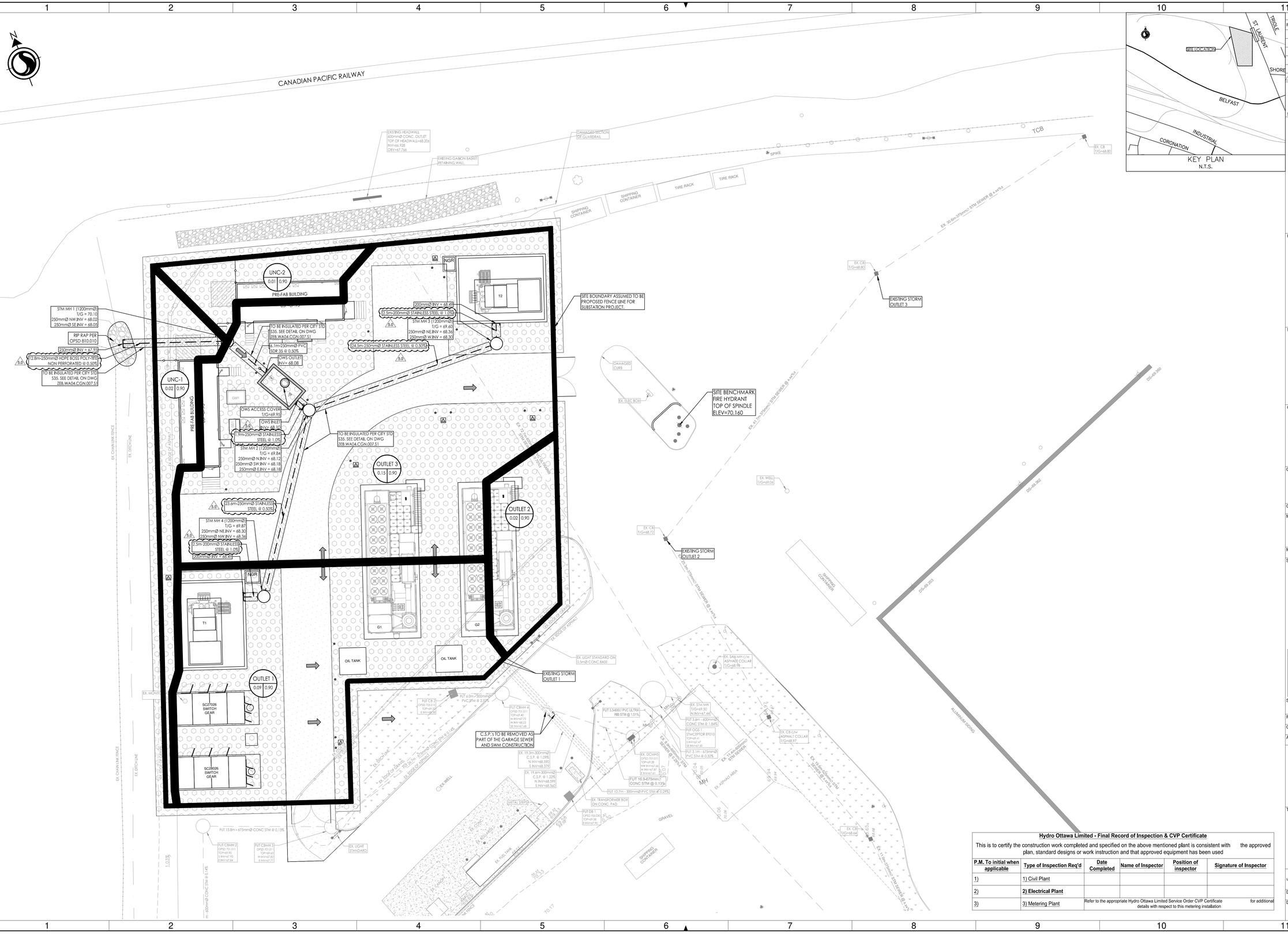
Apologies that I missed your earlier email. Can you please forward the report you mention below? I can work on the updated report today.

In the meantime, for the two items below:
Is there a technical data sheet available for the proposed OGS unit? – see attached O&M manual
Is this unit designed to resist buoyancy forces caused by high groundwater levels? – we can check for buoyancy if you can send us the; T/G, groundwater level, and outlet invert elevations at the EFO location.

Regards,
Kent Campbell
Stormwater Specialist
Cambridge Plant
Cell 519 588-7473
stanley.campbell@rinkerpipe.com

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Stormceptor
Protecting water for future generations

Appendix N Stantec Substation Drainage Plan


CANADIAN PACIFIC RAILWAY
EXISTING HEADWALL 600mmØ CONC. OUTLET TOP OF HEADWALL=68.20± INV=66.50± OBV=67.766
EXISTING GABION BASKET RETAINING WALL
DAMAGED SECTION OF GUARDRAIL
TCB
EX. CB T/G=68.80
SHIPPING CONTAINER
TIRE RACK
EX. GUARDRAIL
UNC-2
0.01 0.90
PRE-FAB BUILDING
NGR
T2
SITE BOUNDARY ASSUMED TO BE PROPOSED FENCE LINE FOR SUBSTATION PROJECT.
STM MH 1 (1200mmØ) T/G = 70.10
250mmØ NW.INV = 68.02
250mmØ SE.INV = 68.05
RIP RAP PER OPSD 810.010
250mmØ INV = 67.70
12.8m-250mmØ HDPE BOSS POLY-TITE NON PERFORATED @ 0.50%
TO BE INSULATED PER CITY STD S35, SEE DETAIL ON DWG ZEB.WA04.CGN.007.S1
TO BE INSULATED PER CITY STD S35, SEE DETAIL ON DWG ZEB.WA04.CGN.007.S1
6.1m-250mmØ PVC SDR 35 @ 0.50%
OWS OUTLET INV= 68.08
200mmØ INV = 68.49
2.5m-200mmØ STAINLESS STEEL @ 1.0%
STM MH 3 (1200mmØ) T/G = 69.40
250mmØ NE.INV = 68.36
250mmØ W.INV = 68.30
24.5m-250mmØ STAINLESS STEEL @ 0.50%
UNC-1
0.02 0.90
PRE-FAB BUILDING
OWS ACCESS COVER T/G=69.95
OWS INLET INV= 68.10
9m-250mmØ STAINLESS STEEL @ 1.0%
STM MH 2 (1200mmØ) T/G = 69.84
250mmØ N.INV = 68.12
250mmØ SW.INV = 68.18
250mmØ E.INV = 68.18
TO BE INSULATED PER CITY STD S35, SEE DETAIL ON DWG ZEB.WA04.CGN.007.S1
OUTLET 3
0.15 0.90
OUTLET 2
0.02 0.90
20.6m-250mmØ STAINLESS STEEL @ 0.50%
STM MH 4 (1200mmØ) T/G = 69.87
250mmØ NE.INV = 68.30
250mmØ NW.INV = 68.36
6.3m-200mmØ STAINLESS STEEL @ 1.0%
200mmØ INV = 68.43
NGR
T1
G1
G2
OUTLET 1
0.09 0.90
OIL TANK
OIL TANK
SC27026 SWITCH GEAR
SC28026 SWITCH GEAR
EX. MONOPOLE
EX. CHAIN LINK FENCE
EX. DITCH LINE
EX. EDGE OF ASPHALT
EX. SHOULDER
EX. EDGE OF GRAVEL
EX. SHOULDER
EX. EDGE OF GRAVEL
EXISTING STORM OUTLET 1
EX. LIGHT STANDARD ON 0.5m Ø CONC. BASE
C.S.P.'s TO BE REMOVED AS PART OF THE GARAGE SEWER AND SWM CONSTRUCTION
FUT CB/MH 2 OPSD 705.010 TOP=68.90 E.INV=68.60
FUT CB/MH 3 OPSD 705.010 TOP=68.40 W.INV=67.93 SE.INV=67.88
FUT 6.0m-300mmØ PVC.STM @ 2.50%
FUT 15.8m - 675mmØ CONC STM @ 0.13%
FUT CB/MH 1 OPSD 705.010 TOP=68.90 E.INV=67.84
FUT CB/MH 5 OPSD 705.010 TOP=68.40 W.INV=67.82 E.INV=67.77
EX. LIGHT STANDARD
1.03%
m - 600mmØ CONC STM @ 0.14%
EX. 19.3m-300mmØ C.S.P. @ 1.29% N.INV=68.590 S.INV=68.379
EX. 19.6m-300mmØ C.S.P. @ 1.22% N.INV=68.599 S.INV=68.360
FUT 16.9-675mm CONC STM @ 0.13%
FUT 10.7m - 300mmØ PVC STM @ 0.29%
EX. TRANSFORMER BOX ON CONC. PAD
FUT CB OPSD 705.030 TOP=68.98 E.INV=67.86
DISTAL STEPS
EX. CHAIN LINK FENCE
EX. RAIL BANK
EX. ASPHALT AREA
GRAVEL
EX. WELL
EX. CB T/G=68.72
EXISTING STORM OUTLET 2
EX. 30.4m-375mmØ STM SEWER @ 4.41%
EX. 30.4m-375mmØ STM SEWER @ 4.41%
EX. 30.4m-375mmØ STM SEWER @ 4.41%

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