

COSTCO WHOLESALE
REPORT NUMBER: CA0059190.9392

COSTCO STONEY CREEK PARKING LOT EXPANSION (FORUM LANDS)

STORMWATER MANAGEMENT DESIGN BRIEF

August 19, 2026





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PROJECT NO.: CA0059190.9392

DATE: AUGUST 19, 2026

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Revision History

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1 INTRODUCTION

1.1 Scope

WSP Canada Inc. (WSP) has been retained by Costco Wholesale Canada Ltd. (Costco) to prepare a stormwater management (SWM) design brief in support of the Site Plan Approval (SPA) application related to the proposed parking lot expansion abutting the northern limit of the existing Costco property located at 1330 South Service Road, in the City of Hamilton (Stoney Creek), Ontario.

The subject site is part of the Winona Crossing lands, for which a stormwater management (SWM) design brief (hereafter 2016 SWM brief) was prepared by A. J. Clarke and Associates Limited (March 2016).

This report examines the potential impacts of the proposed development on water balance, water quality and quantity of the wet weather flows, and presents specific measures to meet the SWM design criteria established in the 2016 SWM brief and in compliance with the guidelines of the City of Hamilton (hereafter the City) and Hamilton Conservation Authority (hereafter HCA).

1.2 Site Location

The subject site is a 0.88 ha parcel of vacant land north of existing Costco property with a street address of 1310 South Service Road, Stoney Creek. The site is bounded by vacant land to the north, commercial properties to the east, existing Costco parking lot to the south, and Vince Mazza Way to the west, as shown in **Figure 1**.

FIGURE 1-COSTCO STONEY CREEK CREEK.dwg Fig 1 C:\Users\stouism\DCI\ACCDocs\WSP Canada projects (AMER)\L DME ON 25 - C23\Project Files\CA0045445.1308 CA-Costco Stoney Creek Fuel Relocation and Parking Expansion Group\01-Civil\SWM\FIGURES\ Aug 18, 2026 - 10:24am



@2026 Google - Map Canada

CLIENT	COSTCO WHOLESALE	<div></div> <div>150 Commerce Valley Dr. West, Thornhill, ON Canada 723 t: 905.882.1100 f: 905.882.0055 wsp.com</div>			
TITLE	COSTCO STONEY CREEK PARKING LOT EXPANSION (FORUM LANDS) SITE LOCATION	Checked J.Z.		Drawn AutoCAD/M.ST.L.	
		Date AUGUST 2026		Proj. No. CA0059190.9392	
		Scale N.T.S.		Figure No. .	Gr.No. 00

1.3 Existing Conditions

The subject site is 0.88 ha vacant land. The site has grade elevations approximately $\pm$ 84.0 m. The subsurface profile consists of granular fill material overlying a native hard clay with sand to sandy clay glacial till layer. Bed rock was not encountered during the investigation. Two monitoring wells were installed and were recorded to be dry upon completion of the well installation. The groundwater elevation is 82.45 m at BH25-02 and 83.05 m at BH25-03.

Refer to the Geotechnical Investigation Report included in **Appendix H** for more information.

1.4 Background Documents

The following background reports, manuals, and guidelines have been reviewed during the preparation of the SWM report:

- ❖ Stormwater Management Planning and Design Manual (MECP, March 2003).
 - ❖ Low Impact Development Stormwater Management Planning and Design Guide (CVC & TRCA, 2010).
 - ❖ Comprehensive Development Guidelines and Financial Policies Manual (City of Hamilton, 2019).
 - ❖ Stormwater Management Brief for Winona Crossing (A. J. Clarke and Associates Limited, March 2016).
 - ❖ Winona Crossing Site G Servicing Plan (A. J. Clarke and Associates Limited, March 2025).
 - ❖ Preliminary Geotechnical Investigation Report, Costco Stoney Creek – Parking Lot Expansion into Forum Lot (Stantec Consulting Ltd., August 2025).
-

1.5 Design Criteria

The subject site is part of the Winona Crossing lands, for which a stormwater management (SWM) brief was prepared by A. J. Clarke and Associates Limited (AJ Clarke, March 2016).

The SWM brief for Winona Crossing lands (Refer to **Appendix F**) has been reviewed and the SWM design criteria applicable to the subject development are summarized as below.

1.5.1 Water Balance

The Stoney Creek Urban Boundary Expansion Area (SCUBE) East Subwatershed Study (SWS) (Aquafer Beech Ltd., May 2013) recommends capture and infiltration of the first 3 mm rainfall on the site with employment / institutional land uses underlain by silt / clayey soils.

1.5.2 Water Quality

The water quality design criteria was established in the SCUBE East Subwatershed Study as normal level of protection or 70% TSS removal.

1.5.3 Water Quantity

As stated in the 2016 SWM brief for Winona Crossing lands, the post-development runoff from Winona Crossing site that drains to Outlet 10.1 (QEW culvert) has been controlled to have an overall discharge of 38 L/s/ha. The subject development has an area of 0.88 ha, and the target flow rate would be 33.4 L/s or 0.033 m³/s.

Table 1.1: Target Flow Rate from Parking Expansion Site

Area (ha)	Unit Flow Rate (L/s/ha)	Target Flow Rate	
		L/s	m ³ /s
0.88	38	33.4	0.033

2 HYDROLOGIC ANALYSIS

2.1 Hydrologic Model

In the SWM brief prepared by AJ Clarke (March 2016), the XPSWMM model was used for the hydrologic and hydraulic analysis for the Winona Crossing lands. The XPSWMM model was developed to deal with the dual drainage (major and minor) system simultaneously and analyze the impact of the backwater from the surcharged downstream stormwater infrastructure on the existing MTO culvert below the Queen Elizabeth Way (QEW).

PCSWMM model is used to simulate the post-development peak flow rates from the subject site, and to size and confirm the performance of the proposed quantity control facility. Note that, same as XPSWMM, PCSWMM model is built on official EPA SWMM engine and can be used for the hydrologic and hydraulic analysis for urban stormwater system.

2.2 Design Storm

To be consistent with the previous study, the 12-hour SCS design storm has been used in the hydrologic / hydraulic analysis.

3 PROPOSED CONDITIONS

3.1 General

Costco Wholesale proposed a parking expansion onto an empty 0.88 ha parcel abutting the northern limit of the existing parking lot of the Costco Wholesale Centre located at 1330 south service road, Stoney Creek, in the City of Hamilton, ON.

Stormwater management (SWM) measures are proposed for the subject site, consisting of underground and surface storage, oil/grit separator (OGS) unit, and bioswale.

Figure 2 presents the proposed drainage plan for the subject site.

3.2 Drainage Delineation

The subject site are delineated into four subcatchments as per the proposed storm drainage and management plan. The catchment area and imperviousness are determined by measuring the areas in the AutoCAD files and presented in **Table 3.1**.

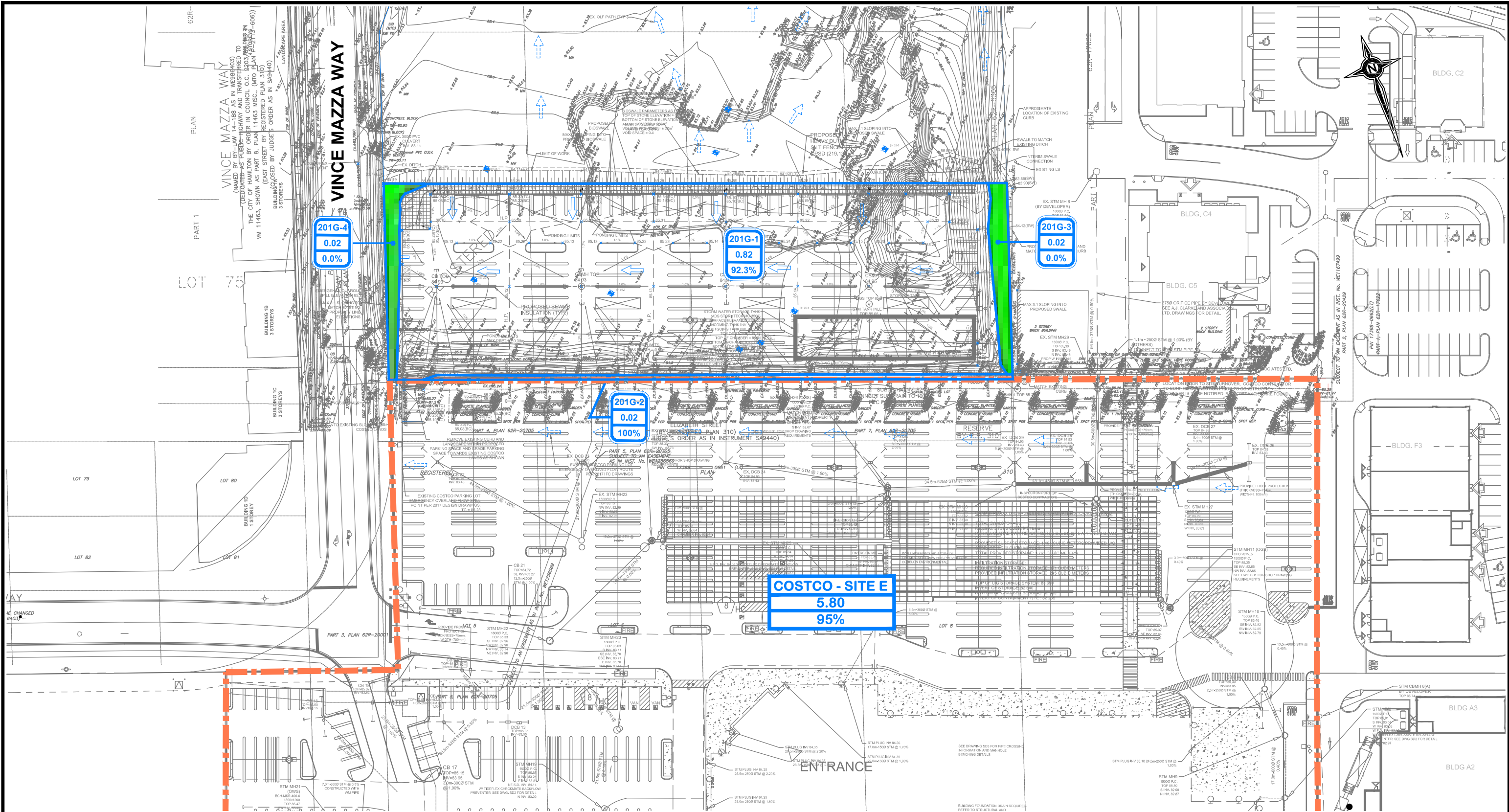
- Subcatchment 201G-1 represents majority of the site, for which on-site SWM controls are to be provided. The controlled flow shall be routed eastward and discharge into an existing 375 mm pipe.
- Subcatchment 201G-2 represents a strip of land along the southern limit of the site. Runoff from Subcatchment 201G-2 shall drain overland to existing Costco site.

The existing Costco site (Site E) will be modelled to evaluate the impacts of the drainage from sub-catchment 201G-2.

- Subcatchment 201G-3 represents pervious area along the east limit. Runoff from Subcatchment 201G-3 is directed to an existing catch basin and then the quantity control storage system beneath the parking lot of Site G.

Assessment will be carried out to demonstrate that quantity control storage system for the existing Site G has adequate capacity to accommodate the runoff from subcatchment 201G-3.

- Subcatchment 201G-4 represents pervious area along the west limit of the site, of which the runoff will leave the site uncontrolled.



LEGEND

EXISTING PROJECT BOUNDARY

SUB-CATCHMENT BOUNDARY

201G-1
0.82
92.3%

SUB-CATCHMENT ID.
DRAINAGE AREA (ha)
IMPERVIOUSNESS

5 0 10 20 30 40 50m

CLIENT

COSTCO WHOLESALE

TITLE

COSTCO STONEY CREEK
PARKING LOT EXPANSION (FORUM LANDS)

PROPOSED DRAINAGE PLAN



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Checked	J.Z.	Drawn	AUTOCAD / M.ST.L.
Date	AUGUST 2026	Proj. No.	CA0059190.9392
Scale	AS SHOWN	Figure No.	2
		Gr.No.	

Table 3.1: Catchment Area and Imperviousness

Catchment	Area (ha)	Imp. (%)
201G-1	0.82	92.3%
201G-2	0.02	100.0%
201G-3	0.02	0.0%
201G-4	0.02	0.0%
Total	0.88	88.3%
Existing Costco, Site E	5.80	95.0%

3.3 Total Allowable Flow Rate

The existing Costco site (Site E) is included the hydrologic analysis for the following reasons:

- 1) Runoff from sub-catchment 201G-2 drains overland to existing Costco site.
- 2) The outlet pipe of the quantity control facility for sub-catchment 201G-1 and that for the existing Costco site shall be connected at existing STM MH29.

The existing Costco site (Site E) has a drainage area of 5.80 ha with an imperviousness of 95%. Total 3,763 m³ storage was provided to detain runoff from Site E, which include 2,272 m³ underground storage and 1,491 m³ surface storage.

The PCSWMM model is simulated for the 12-hour SCS storm and the 100-year controlled flow rate from the existing Costco site (Site E) prior to the parking lot expansion is 0.292 m³/s (flow in the 375 mm pipe downstream of existing STM MH29). **Table 3.2** presents the total allowable flow rate from existing Costco site and proposed parking expansion.

Table 3.2: Total Allowable Release Rate

Return Period (Year)	Allowable Flow Rates (m ³ /s)		
	Existing Costco Site	Parking Expansion	Total
100	0.292	0.033	0.325

3.4 Water Quantity Control

Total 1,274 m³ storage is provided to detain runoff from sub-catchment 201G-1, which include 480 m³ underground storage within ADS StormTech MC-3500 chamber system and 794 m³ is surface storage.

The outlet pipe of the quantity control facility for sub-catchment 201G-1 and that for the existing Costco site shall be connected at existing STM MH29.

PCSWMM model is updated to reflect the proposed drainage and management plan. Refer to **Appendix E** for the PCSWMM model schematic.

3.4.1 Quantity Control Performance of Storage Facilities

PCSWMM model is simulated for the 2-year up to the 100-year storm events. **Table 3.3** presents a summary of the quantity control performance for the storage facilities within the existing Costco Site and proposed parking expansion. As shown, the proposed quantity control storage are adequate for up to the 100-year storm event.

Table 3.3: Quantity Control Performance of Storage Facilities

Return Period (Years)	Total Inflow Rate from Site E, 201G-1, 201G-2) (m ³ /s)	Outflow Rate (375 mm Pipe) (m ³ /s)	Storage Used (m ³)	
			Existing Costco Site	Proposed Parking Expansion
2	1.071	0.183	1,359	171
5	1.482	0.202	1,990	264
10	1.780	0.259	2,301	367
15	1.926	0.285	2,487	453
25	2.182	0.293	2,705	510
50	2.460	0.298	3,112	593
100	2.738	0.303	3,638	710

3.4.2 Post-Development Peak Flow Rates

Table 3.4 presents a comparison of the post-development peak flow rates and the allowable flow rate from the existing Costco site and the proposed parking expansion. As

shown, the 2-year to the 100-year post-development peak flow rates are controlled to the allowable release rate.

Table 3.4: Comparison of Allowable Flow Rate and Post-Development Flow Rates

Return Period (Years)	Total Allowable Flow Rate (m ³ /s)	Post-Development Peak Flow Rate (m ³)			
		Flow Rate in 375 mm Pipe	Flow Rate from 201G-3*	Flow Rate from 201G-4	Total
2	0.325	0.183	0.000	0.000	0.184
5		0.202	0.001	0.001	0.204
10		0.259	0.002	0.002	0.262
15		0.285	0.002	0.002	0.289
25		0.293	0.003	0.003	0.298
50		0.298	0.003	0.003	0.305
100		0.303	0.004	0.004	0.311

* It is conservative to account for the uncontrolled flow rate from subcatchment 201G-3.

3.4.3 Impact on Adjacent Site G

As per Site G servicing plan included in **Appendix G**, the quantity control storage requirement for Site G is 165 m³ during the 100-year storm event and existing ChamberMAXX storage system beneath the parking lot of the existing Site G provide 178 m³ of storage, leaving 13 m³ of available storage capacity.

PCSWMM model indicates that during the 100-year storm event, additional 13 m³ runoff volume shall be directed from subcatchment 201G-3 to Site G. Refer to **Appendix E** for PCSWMM model output for subcatchment 201G-3. Adding flow from subcatchment 201G-3 would result in an increase in the storage requirement for Site G. However, the increase in the storage requirement is expected to be less than 13 m³, considering the outflow rate from the quantity control storage system.

Therefore, the ChamberMAXX system is adequate to accommodate the additional flow without exceeding its design storage capacity.

3.5 Water Balance

The subject development is required to capture and infiltrate runoff from the first 3.0 mm rainfall on the site. With a total area of 0.88 ha, the required infiltration volume is 26.4 m³. Note that the initial abstraction is not included in the calculations which is conservative.

Section 4.5.10 of MECP's Stormwater Management Planning and Design Manual (2003) provides guidance on the design of the infiltration facilities, which should satisfy the minimum infiltration rate, groundwater table depth, and bedrock depth.

Bioswale is proposed along the northern limit of the proposed parking lot to receive surface runoff from portion of the parking lot for infiltration. The infiltration volume will be provided within the voids of the clear stone layer.

The bottom of the clear stone layer is set at 83.04 m, which meets the minimum 1.0 m separation from the groundwater table. Meanwhile, the storage volume is provided with a shallow depth to ensure the stored water can be infiltrated within 48 hours and be ready for next event.

The stone layer will have a footprint of 268 m², a 0.30 m depth, and provide a total storage of 32.2 m³, which is greater than the required volume. **Table 3.5** provides calculations for the infiltration volume. Refer to **Drawing SS1** included in **Appendix A** for location and details of the bioswale.

Table 3.5: Infiltration Volume provided within Bioswale

Footprint (m ²)	Depth (m)	Void Ratio	Available Storage (m ³)	Available Storage (m ³)
268	0.30	0.40	32.3	26.4

3.6 Water Quality

Treatment train approach consists of OGS unit and Isolator Row Plus (IR+) incorporated into the underground (ADS MC-3500) chamber system is proposed to address water quality for runoff generated from subcatchment 201G-2.

As shown in the OGS sizing report, the Stormceptor unit (EFO8) can achieve a 63% TSS removal and treat 90% runoff from a total area of 0.82 ha with an imperviousness of 92.3% or a runoff coefficient of 0.85. However, the OGS unit was certified with 50% TSS removal efficiency only. Refer to **Appendix C** for OGS sizing report.

The Isolator Row plus (IR+) within ADS MC-3500 chamber system will be wrapped entirely in geotextile (Terrafix® 840-2000) to ensure that water entering the system be filtered through the cloth. The required number of chambers within Isolator Rows are determined based on an 80% TSS removal efficiency. Refer to **Appendix D** for ADS MC-3500 chamber system.

The OGS unit and the Isolator Row plus (IR+) within ADS MC-3500 chamber system together could achieve an overall 90% TSS removal efficiency. Refer to **Appendix B** for more detailed calculations.

4 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION PERIOD

During construction, there is potential for short-term sediment wash-off from the site. To protect the downstream receiving sewer system and retained natural features, on-site sediment control measures are necessary during construction.

The proposed sediment and erosion control plan during construction will follow the overall environmentally sound development approach and achieve the highest level of control possible. The proposed sediment and erosion control plan during construction will include the following:

1. Sediment and erosion control works for each phase will be in place prior to the commencement of construction for that phase.
2. Construction will be scheduled to minimize the extent and period to which disturbed soils are exposed to weathering.
3. Access to the site during construction will be limited to a maximum of two locations at any one time. The entrances of the access roads will be paved with gravel to promote the loosening and dislodging of soil attached to construction vehicles prior to them leaving the site.
4. Perimeter silt fencing will be placed and maintained around disturbed areas and around natural features which are to be preserved.
5. Silt traps or temporary sedimentation catchments will be constructed for all overland flow routes. Catchment sizing will be based on TRCA's Erosion and Sediment Control Guidelines for Urban Construction, with a total 250 m³ per hectare of contributing area, of which 125 m³/ha is permanent pool storage and 125 m³/ha is active storage. Perforated riser pipes will be used in the temporary sedimentation catchments to detain the stormwater flows for 24 ~ 48 hours before being discharged to drainage ways.
6. Rock flow check dams will be placed at all sedimentation catchment and temporary swale outlets. These flow check dams are intended as fail-safe controls to trap any sediment which circumvents the other sediment control measures. Erosion protection measures will also be provided at all outfall locations.

5 CONCLUSIONS

A stormwater management plan has been prepared in support of the Site Plan Approval (SPA) application related to parking lot expansion at the existing Costco property in the City of Hamilton, Ontario.

The proposed SWM plan consists of an OGS unit (Stormceptor EFO8), ADS StormTech MC-3500 chamber system with total 480 m³ storage volume and 794 m³ surface storage at parking lot, a bioswale with 32 m³ infiltration volume.

- **Water Balance**

With the proposed bioswale, the infiltration target of 3.0 mm is satisfied for the proposed parking lot expansion area.

- **Water Quality**

Treatment train approach with combination of OGS unit (Stormceptor EFO8 or approved equivalent) and Isolator Row Plus (IR+) incorporated in the ADS MC-3500 chamber system, is proposed to address water quality issue.

- **Water Quantity**

With the SWM facilities on the existing Costco site and proposed parking lot expansion area, the 100-year post-development peak flow rates has been controlled to 0.311 m³/s, which is less than the allowable flow rate of 0.325 m³/s.

The underground storage system underneath the parking lot of the existing Site G has adequate capacity to accommodate the runoff from 0.02 ha area along the east limit of the subject site.

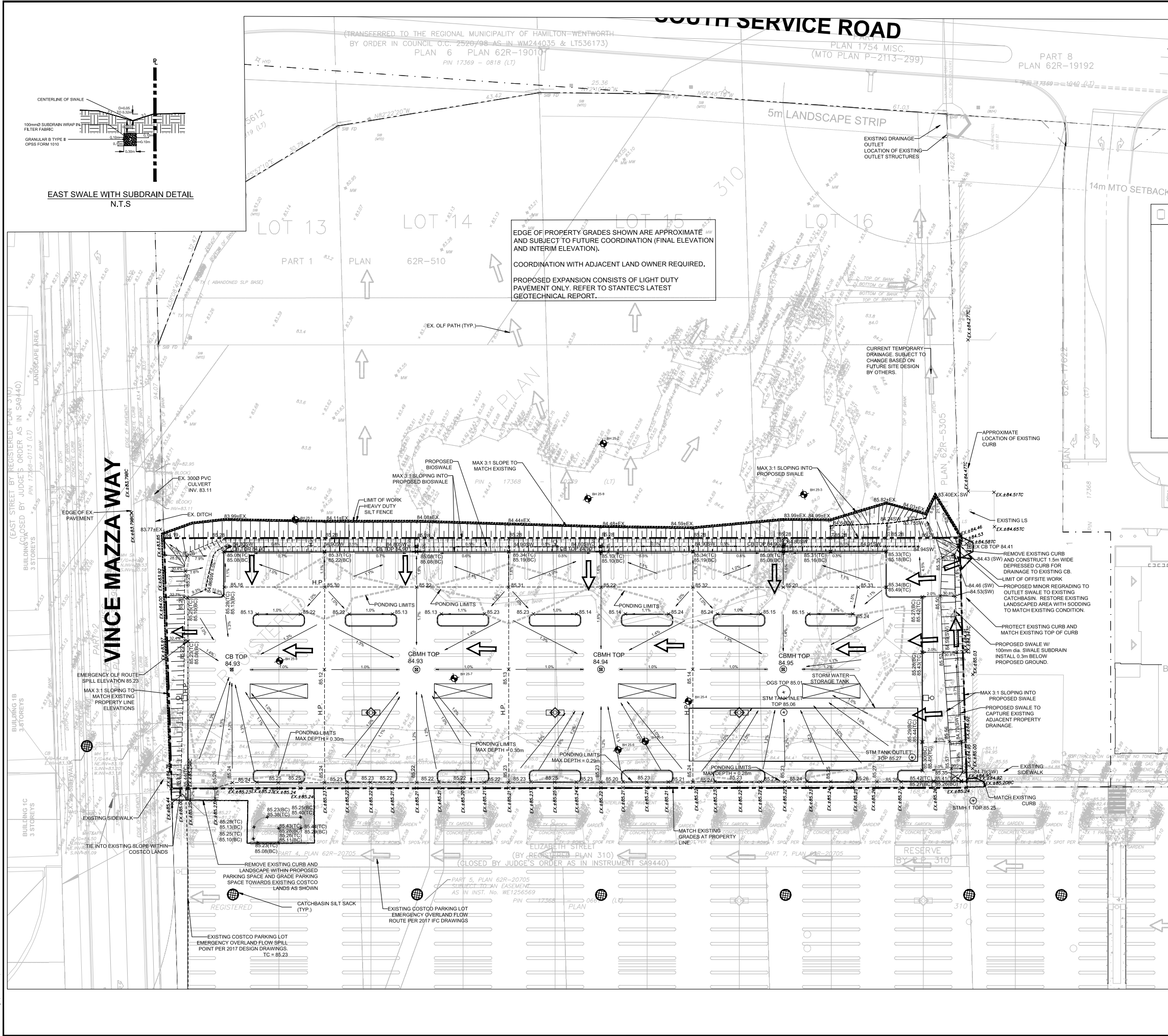
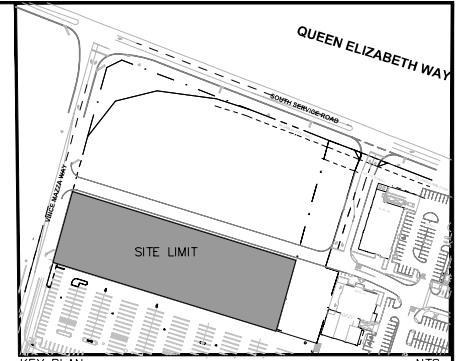
The SWM strategies described in this report are in consistent with the existing SWM brief for Winona Crossing lands and adhere to all regulations from City of Hamilton and Hamilton Conservation Authority (HCA).

APPENDIX

A

ENGINEERING DRAWINGS

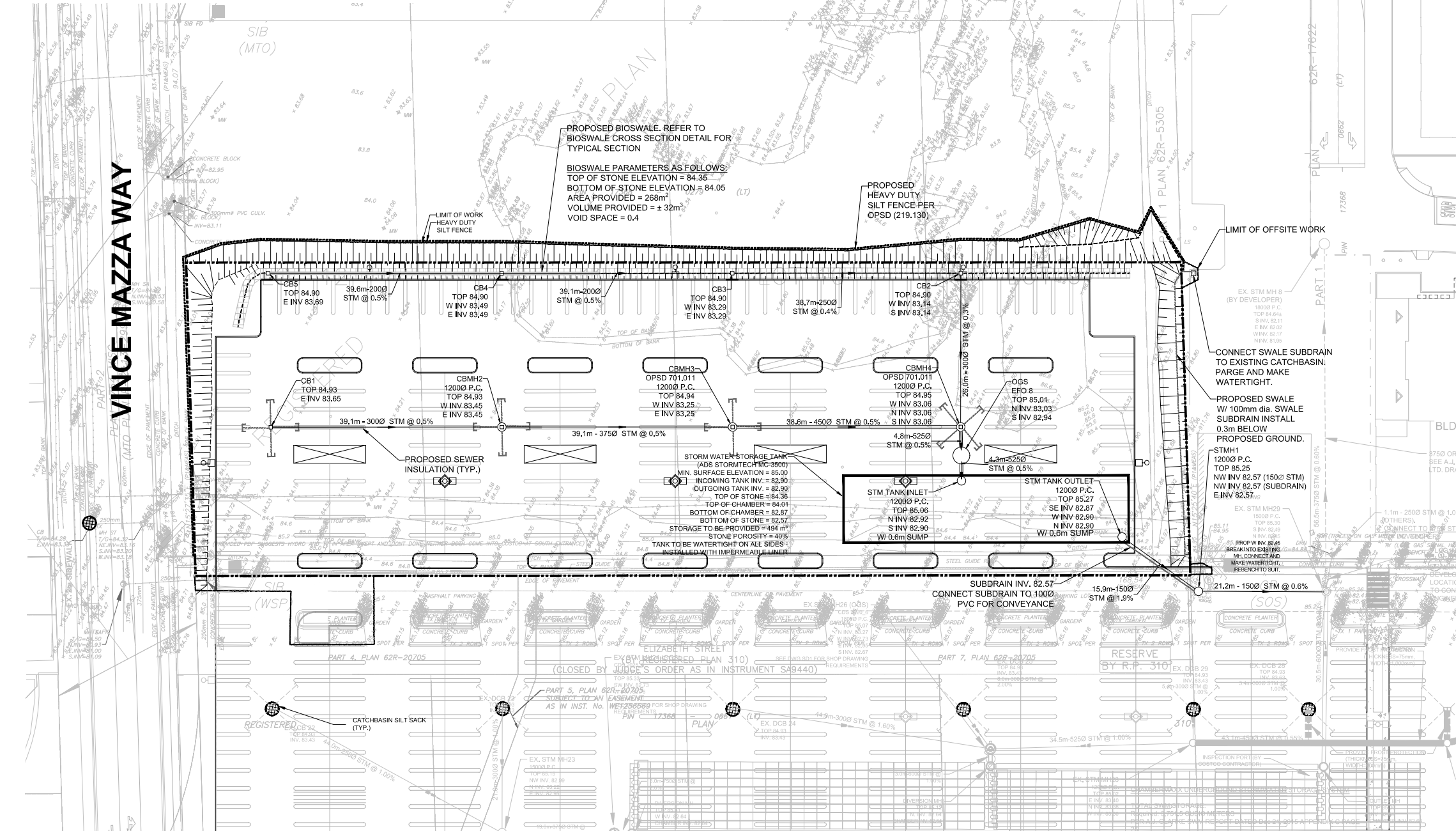




- LEGEND
- FFE
 - FINISHED FLOOR ELEVATION
 - COSTCO PROPERTY LINE
 - PROPOSED CURB
 - CART STORAGE
 - CONC. PAVING (FOR CONC. ADJACENT TO BUILDINGS. SEE ARCHITECTURAL DRAWINGS FOR DETAILS)
 - HEAVY DUTY ASPHALT
 - LIGHTPOLE (B.O. REFER TO ELEC. DRAWINGS)
 - TRAFFIC SIGN (SEE SP1 FOR DETAILS)
 - EXISTING CHAIN LINK FENCE
 - DIRECTION OF DRAINAGE
 - GAS VALVE
 - WATER VALVE
 - HYDRANT
 - CATCHBASIN/DOUBLE CATCHBASIN
 - CATCHBASIN/DOUBLE CATCHBASIN MANHOLE
 - STORM MANHOLE
 - SANITARY MANHOLE
 - OIL/GRASS SEPARATOR (B.O.)
 - EXISTING WATER VALVE
 - EXISTING CATCHBASIN
 - EXISTING MANHOLE
 - EMERGENCY OVERLAND FLOW
 - INSULATION
 - PROPOSED GRADE
 - PROPOSED TOP OF CURB GRADE
 - PROPOSED GRADE BY OTHERS
 - PROPOSED TOP OF CURB GRADE BY OTHERS
 - EXISTING GRADE
 - EXISTING TOP OF CURB GRADE
 - HIGHPOINT
 - MAXIMUM PONDING LIMIT
 - HYDRO
 - GAS
 - PHONE
 - SUBURBAN
 - LIMIT OF WORK
 - HEAVY DUTY SILT FENCE
 - OPSS 218.138
 - PROPOSED CURB CUT
 - PROPOSED BIOSWALE STONE LAYER
 - PROPOSED SWALE
 - CATCHBASIN SILT SACK

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REVISIONS: 1. C:\Users\CA005190\Documents\Costco Stoney Creek\Site Servicing Plan\Site Servicing Plan.dwg, 2024-08-19, 10:00 AM, CA005190, 2024-08-19, 10:00 AM, CA005190

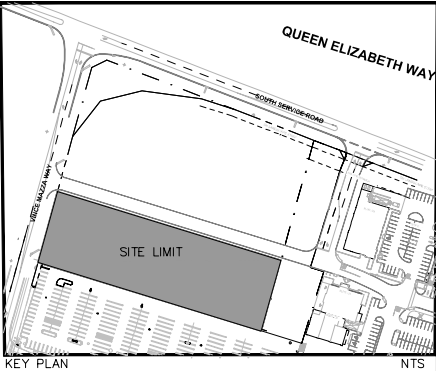


BIOSWALE CROSS-SECTION DETAIL
N.T.S

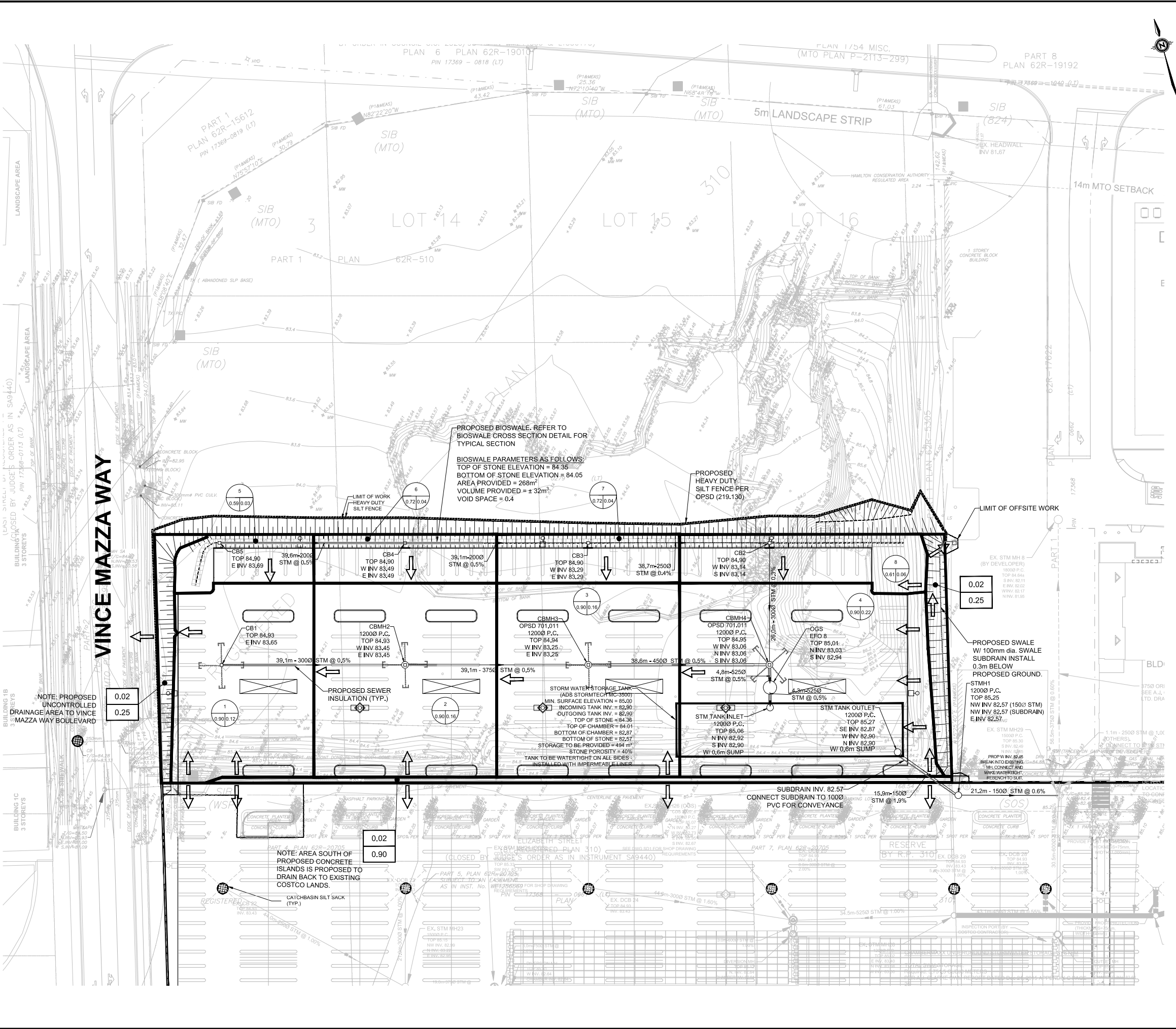
LEGEND

- FFE
- FINISHED FLOOR ELEVATION
- COSTCO PROPERTY LINE
- PROPOSED CURB
- CART STORAGE
- CONC. PAVING (FOR CONC. ADJACENT TO BUILDINGS. SEE ARCHITECTURAL DRAWINGS FOR DETAILS)
- HEAVY DUTY ASPHALT
- LIGHTPOLE (B.O. REFER TO ELEC. DRAWINGS)
- TRAFFIC SIGN (SEE SP1 FOR DETAILS)
- EXISTING CHAIN LINK FENCE
- DIRECTION OF DRAINAGE
- GAS VALVE
- WATER VALVE
- HYDRANT
- CATCHBASIN/DOUBLE CATCHBASIN
- CATCHBASIN/DOUBLE CATCHBASIN MANHOLE
- STORM MANHOLE
- SANITARY MANHOLE
- OIL/GRASS SEPARATOR (B.O.)
- EXISTING WATER VALVE
- EXISTING CATCHBASIN
- EXISTING MANHOLE
- EMERGENCY OVERLAND FLOW
- INSULATION
- PROPOSED GRADE
- PROPOSED TOP OF CURB GRADE
- PROPOSED GRADE BY OTHERS
- PROPOSED TOP OF CURB GRADE BY OTHERS
- EXISTING GRADE
- EXISTING TOP OF CURB GRADE
- HIGHPOINT RIDGE
- MAXIMUM PONDING LIMIT
- HYDRO
- GAS
- PHONE
- SUBDRAIN
- LIMIT OF WORK
- HEAVY DUTY SILT FENCE
- PROPOSED CURB CUT
- PROPOSED BIOSWALE STONE LAYER
- PROPOSED SWALE CATCHBASIN SILT SACK

2	ISSUED FOR 1st SITE PLAN APPLICATION	S.E.	2024-08-19	
1	ISSUE FOR PRICING	S.E.	2024-08-19	
No.	REVISIONS TO DRAWING	BY	DATE	APPR.
ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED				
CLIENT				
CITY OF HAMILTON				
PROJECT TITLE				
COSTCO STONEY CREEK PARKING LOT EXPANSION (FORUM LANDS)				
SHEET TITLE				
SITE SERVICING PLAN				
wsp				
DESIGNED				
ZB	DRAWN	CHECKED	NCW	
SCALE		DATE		AUGUST 2024
PROJECT NUMBER		DWS NUMBER		CA005190.9392
				SS1



- LEGEND**
- COSTCO PROPERTY LINE
 - DRAINAGE DIVIDE
 - CATCHMENT ID
 - STORM DRAINAGE AREA (HA)
 - RUNOFF COEFFICIENT
 - UNCONTROLLED STORM DRAINAGE AREA (HA)
 - RUNOFF COEFFICIENT
 - DIRECTION OF OVERLAND FLOW
 - LIMIT OF WORK
 - HEAVY DUTY SILT FENCE (OPSD 219.130)
 - PROPOSED BIOSWALE
 - PROPOSED SWALE



2	ISSUED FOR 1st SITE PLAN APPLICATION	S.E.	2025-08-19	
1	ISSUE FOR PRICING	S.E.	2025-08-19	
No.	REVISIONS TO DRAWING	BY	DATE	APPR.
ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED.				
CLIENT				
MUNICIPALITY				
CITY OF HAMILTON				
PROJECT TITLE				
COSTCO STONEY CREEK PARKING LOT EXPANSION (FORUM LANDS)				
SHEET TITLE				
STORM DRAINAGE PLAN				
DESIGNED		DRAWN		CHECKED
ZB		NCW		NCW
SCALE		DATE		AUGUST 2025
1:300		PROJECT NUMBER		DWG. NUMBER
CA0059190.9392		ST1		

EROSION AND SEDIMENT CONTROL GENERAL NOTES

THE FOLLOWING GENERAL NOTES ARE FOR EROSION AND SEDIMENT CONTROL WORKS ONLY. ALL NOTES AND GENERAL NOTES SHALL BE READ IN CONJUNCTION WITH THE CONTRACT SPECIFICATIONS.

1. GENERAL

- CONSTRUCTION SHALL CONFORM TO CURRENT LOCAL BY-LAWS, STANDARDS AND THE "ONTARIO OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS".
- ALL UNITS SHOWN ARE IN METRIC.
- THE POSITION OF EXISTING POLES, OVERHEAD LINES, CONDUITS, WATERMANS, SEWERS AND OTHER UNDERGROUND OR ABOVEGROUND UTILITIES, STRUCTURES AND APPURTENANCES ARE NOT NECESSARILY SHOWN ON THE DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES ARE NOT GUARANTEED.
- PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL OBTAIN ALL NECESSARY UTILITY STAKEOUTS TO VERIFY THE LOCATION OF ANY HYDRO, BELL, CABLE TV OR GAS UTILITY LINES, AND WHERE REQUIRED, PROVIDE ADEQUATE PROTECTION OF EXISTING UTILITY LINES AND PLANT. BEFORE COMMENCING CONSTRUCTION, THE CONTRACTOR SHALL SATISFY HIMSELF OF THE EXACT LOCATION OF ALL EXISTING UTILITIES AND STRUCTURES, AND ASSUME ALL LIABILITY RESULTING FROM DAMAGE TO THEM DURING THE COURSE OF CONSTRUCTION.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING POSITIVE SURFACE DRAINAGE FOR THE DURATION OF THE CONSTRUCTION PERIOD. NO SURFACE DRAINAGE SHALL BE PERMITTED DIRECTLY ONTO ADJACENT LANDS INCLUDING EXISTING BLOOR STREET AND TRULLS ROAD.
- FOR GEOTECHNICAL INFORMATION, INCLUDING BOREHOLE LOGS AND ENGINEERED-FILL SPECIFICATIONS, REFER TO GEOTECHNICAL REPORT.
- CONSTRUCTION SHALL NOT COMMENCE UNTIL ALL UTILITY LOCATIONS HAVE BEEN VERIFIED AND ALL PERMITS HAVE BEEN RECEIVED.
- DUST CONTROL TO BE REVIEWED DAILY. WATER TRUCK TO BE PROVIDED ON-SITE AND ALL HAUL ROADS/WORKING AREAS TO BE SPRAYED WITH WATER AS REQUIRED TO ENSURE DUST IS CONTROLLED ON-SITE.
- DURING COLD WEATHER MONTHS THE FOLLOWING MEASURES SHALL BE TAKEN:
 - UTILIZE WIND FENCE AS REQUIRED
 - UTILIZE CALCIUM TO MINIMIZE DUST
 - PLACE TOPSOIL AND WINTER WHEAT SEED MIX ON EXPOSED AREAS

2. SITE CONTROL MEASURES

- ALL EROSION AND SEDIMENT CONTROL MEASURES INCLUDING THE SEDIMENTATION FENCING, AND OTHER EROSION CONTROL MEASURES SHALL BE INSTALLED PRIOR TO COMMENCEMENT OF ANY TOPSOIL STRIPPING OR EARTH MOVING.
- CONTRACTOR SHALL BE RESPONSIBLE FOR REGULARLY INSPECTING AND MAINTAINING ALL EROSION AND SEDIMENT CONTROL DEVICES AND STRUCTURES IN GOOD WORKING ORDER AT ALL TIMES TO THE SATISFACTION OF THE MUNICIPALITY OF CLARINGTON. CONTRACTOR SHALL INSPECT SUCH DEVICES AT LEAST ONCE PER WEEK AND AFTER EACH RAINFALL EVENT OF 10MM OR GREATER, AND MAKE ALL NECESSARY REPAIRS AS REQUIRED.
- ALL SEDIMENTS REMOVED FROM SEDIMENT TRAPS SHALL BE DISPOSED OFF-SITE IN LOCATIONS ACCEPTABLE TO AND IN ACCORDANCE WITH MUNICIPALITY REGULATIONS.
- ALL ROADSIDE CATCHBASINS ARE TO HAVE SEDIMENT PROTECTION AS PER DETAIL INSTALLED IMMEDIATELY AFTER CATCHBASIN INSTALLATION. SEDIMENT PROTECTION BARRIER TO BE MAINTAINED ON A REGULAR BASIS OR THE SATISFACTION OF THE MUNICIPALITY.

3. TRAFFIC CONTROL AND MUDTRACKING

- ALL CONSTRUCTION VEHICLES TO ENTER AND LEAVE THE SITE AT APPROVED LOCATIONS SHOWN ON THE DRAWINGS.
- MUD TRACKING CONTROL, CONSISTING OF FLUSHING AND SWEEPING, ARE TO BE PROVIDED IN ACCORDANCE WITH THE MUNICIPALITY'S MUD AND DUST CONTROL POLICY FOR ALL ROADS, AND THROUGHOUT ALL CONSTRUCTION PHASES.
- THE CONTRACTOR WILL RESTRAIN ITS CONSTRUCTION ACTIVITIES WITHIN THE LIMITS OF EARTHWORKS AS SHOWN ON THE DRAWING. THE CONTRACTOR WILL RESTORE ALL DISTURBED AREAS OUTSIDE THE WORKING AREA TO ORIGINAL CONDITIONS AND TO THE SATISFACTION OF THE MUNICIPALITY.

4. EARTHWORKS AND GRADING

- CLEAR AND GRUB SITE PRIOR TO COMMENCING WORKS. STRIPPED TOPSOIL SHALL BE REMOVED OFF SITE OR STOCKPILED IN LOCATIONS DESIGNATED AND APPROVED BY THE GEOTECHNICAL CONSULTANT. ALL TOPSOIL AND ORGANIC MATERIAL CAPABLE OF PRODUCING METHANE SHALL BE STRIPPED FROM THE SITE AND REMOVED OR USED FOR LANDSCAPING PURPOSES AS APPROVED BY THE GEOTECHNICAL CONSULTANT.
- ALL ENGINEERED FILL ARE TO BE GENERATED, PLACED AND COMPACTED IN ACCORDANCE WITH THE GEOTECHNICAL REPORT, AND AS PER DIRECTION OF THE GEOTECHNICAL CONSULTANT.

5. RESTORE EXISTING PARKING LOT TO PREVIOUS CONDITION OR BETTER.

ESC FENCE LOCATIONS SHOWN ARE APPROXIMATE FOR VISIBILITY AND GENERALLY SHALL BE PLACED OUTSIDE THE LIMITS OF WORK PROPOSED TO COMPLETE THIS PARKING LOT EXPANSION.

ALL TREES OUTSIDE THE LIMIT TO BE PRESERVED TILL COMPLETION OF CONSTRUCTION ACTIVITIES AS REQUIRED BY THE MUNICIPALITY.

ALL AREAS DISTURBED FOR MORE THAN 30 DAYS ARE TO BE STABILIZED USING HYDROSEED OR APPROVED EQUIVALENT AS DIRECTED BY THE CONSULTANT.

LOCATION OF SILT CONTROL FENCING SHOWN ON THIS DRAWING ARE FOR ILLUSTRATIVE PURPOSES ONLY AND SHOULD BE OFFSET BY 1.0M FROM TOE OF SLOPE AT BOUNDARIES DURING CONSTRUCTION.

THE LOCATION OF ALL UNDERGROUND AND ABOVEGROUND UTILITIES AND STRUCTURES IS NOT COMPLETE AND/OR ACCURATE ON THESE DRAWINGS. LOCATION OF SUCH UTILITIES AND STRUCTURES TO BE CONFIRMED BY COSTCO'S GC AND TO ASSUME ALL RESPONSIBILITY.

GENERAL CONTRACTOR TO PROVIDE SEDIMENT CONTROL FENCING AS NECESSARY TO COMPLY WITH ALL NECESSARY REGULATIONS.

COSTCO'S GC SHALL BE RESPONSIBLE FOR MAINTAINING SEDIMENTATION CONTROL MEASURES UNTIL THE SITE IS STABILIZED. MANAGEMENT OF SURFACE RUNOFF INTERNALLY AND MINIMIZING SEDIMENT OFF-SITE IS COSTCO/GC'S RESPONSIBILITY.

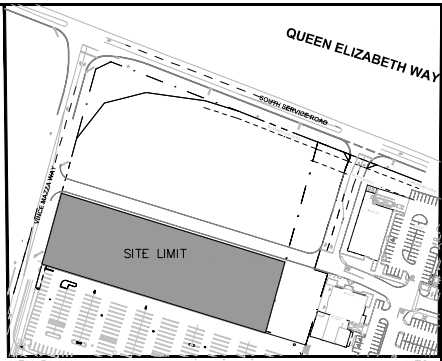
ESC MEASURES ON THIS PLAN ARE NON-STATIC AND MAY NEED TO BE AMENDED/UPGRADED BASED ON SITE CONDITIONS.

SPLILLAGE, EROSION OR MATERIALS EXPORTED OFF-SITE ON A MUNICIPAL/REGIONAL ROAD AND/OR THE EXISTING COSTCO PARKING LOT/SITE TO BE CLEANED.

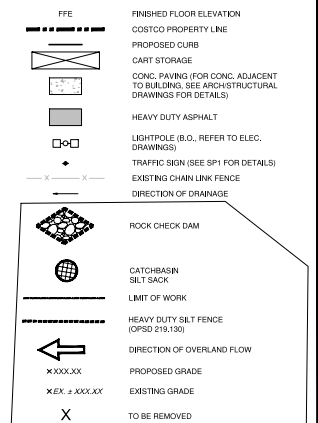
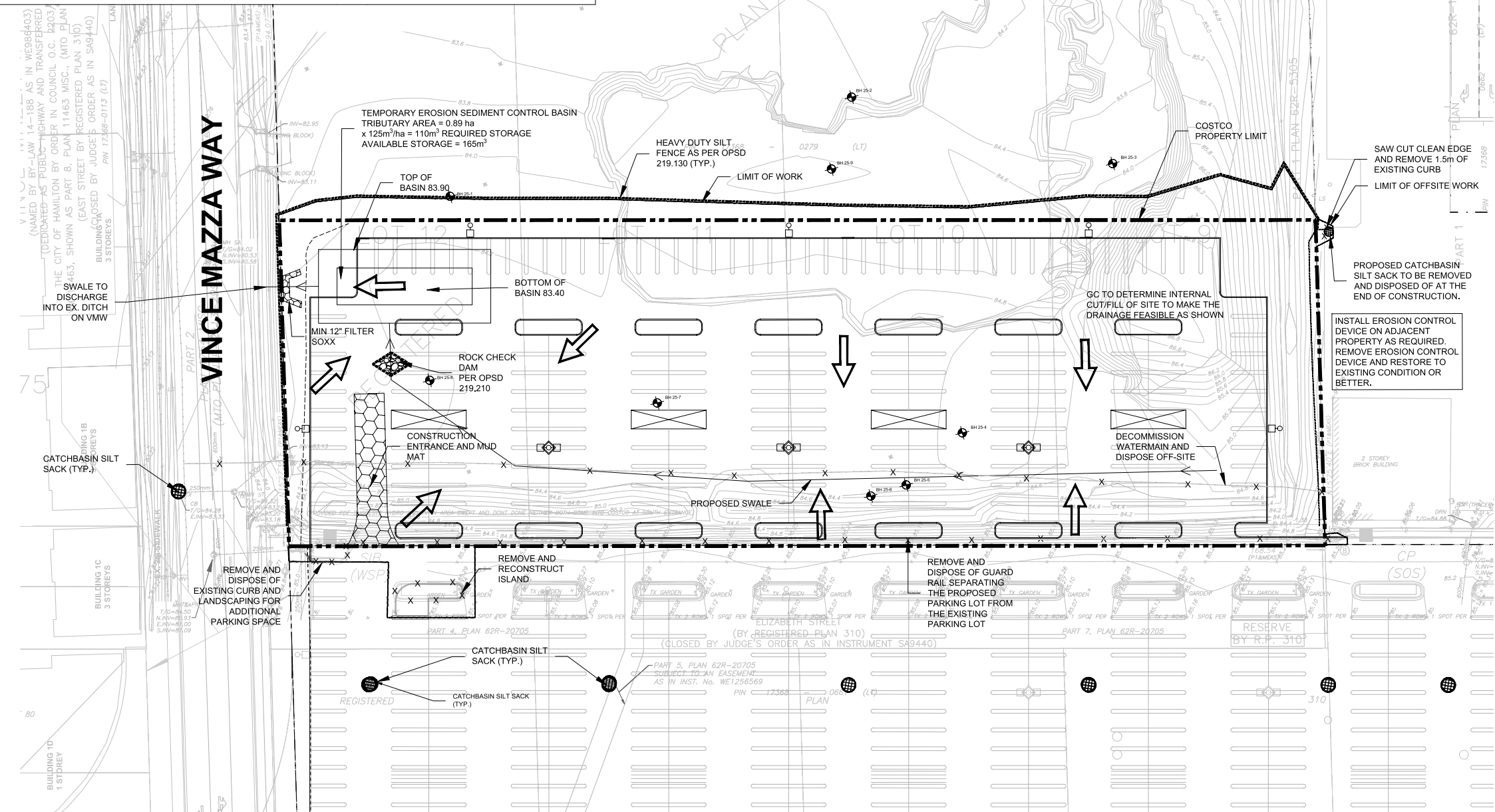
CONSTRUCTION VEHICLES ARE TO ONLY ENTER THE SITE VIA THE MUD MAT LOCATED ON THE APPROVED ESC PLAN, DURING WET SITE CONDITIONS EXCESS MUD SHALL BE REMOVED FROM EQUIPMENT PRIOR TO LEAVING WORK AREA TO PREVENT MUD-TRACKING.

SUE REQUIRED TO INVESTIGATE PURPOSE OF WATERMAIN AND IF IT CONFLICTS WITH PROPOSED DESIGN.

NEED TO CONFIRM WITH MUNICIPALITY IF DECOMMISSIONING WATERMAIN THROUGH PROPOSED PARKING LOT IS POSSIBLE.



LEGEND

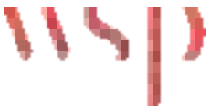


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APPENDIX

B

STORMWATER MANAGEMENT CALCULATIONS

	Project	Costco Stoney Creek Parking Expansion	No.	CA0059190.9392	
	By	James Zhou	Date	2026-08-18	Page 1
	Checked		Date		

Subject	Background Documents and Design Criteria
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1.1 Design Criteria

The subject site is part of the Winona Crossing lands, for which a stormwater management (SWM) brief was prepared by A. J. Clarke and Associates Limited (AJ Clarke, March 2016).

The SWM brief for Winona Crossing lands has been reviewed and the SWM design criteria applicable to the subject development are summarized as below:

1.1.1 Water Balance

The Stoney Creek Urban Boundary Expansion Area (SCUBE) East Subwatershed Study (SWS) (Aquafer Beech Ltd., May 2013) recommends capture and infiltration of the first 3 mm rainfall on the site with employment / institutional land uses underlain by silt / clayey soils. groundwater elevation, etc., shall be evaluated to determine the feasibility of the infiltration facilities.

1.1.2 Water Quality

The water quality design criteria was established in the SCUBE East Subwatershed Study as normal level of protection or 70% TSS removal.

1.1.3 Water Quantity

As stated in the 2016 SWM brief for Winona Crossing lands, the post-development runoff from Winona Crossing site that drains to Outlet 10.1 (QEW culvert) has been controlled to have an overall discharge of 38 L/s/ha. The subject development has an area of 0.88 ha, and the target flow rate would be 33.4 L/s or 0.033 m³/s.

Target Flow Rate from Parking Expansion Site

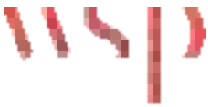
Area (ha)	Unit Flow Rate (L/s/ha)	Target Flow Rate	
		L/s	m ³ /s
0.88	38.0	33.4	0.033

1.2 Hydrologic Model and Rainfall Event

1.2.1 Hydrologic Model - PCSWMM Model

1.2.2 Rainfall Event

To be consistent with the previous study, the 12-hour SCS design storm has been used in the hydrologic / hydraulic analysis.

	Project	Costco Stoney Creek Parking Expansion	No.	CA0059190.9392	
	By	James Zhou	Date	2026-08-18	Page 2
	Checked		Date		

Subject	Proposed Development
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2.1 Proposed Drainage Plan

2.1 Catchment Area and Imperviousness

Catchment No.	Drainage and Management	Area (ha)	RC	IMP (%)
201G-1	UG and Surface Storage, Outlet Pipe connecting to that for Existing Costco Site	0.82	0.85	92.3%
201G-2	Overland to Existing Costco Site with Quantity Control Storage	0.02	0.90	100.0%
201G-3	To existing Site G with Quantity Control Storage	0.02	0.25	0.0%
201G-4	Leave Uncontrolled	0.02	0.25	0.0%
201G - Total		0.88		88.3%
Site E	Existing Costco Site, Underground and Surface Storage	5.80		95.0%

2.2 Total Allowable Flow Rate

2.2.1 Storage Provided in Existing Costco Site

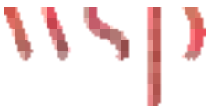
UG Storage for Quantity Control	2,272	m ³
Surface Storage	1,491	m ³
Total Provided Storage	3,763	m ³

2.2.2 Quantity Control for Existing Costco Site Prior to Parking Expansion

Return Period (Years)	Inflow from Site E - Costco (m ³ /s)	Outflow (375 mm Pipe) (m ³ /s)	Used Storage (m ³)
2	0.965	0.182	1,390
5	1.312	0.196	2,028
10	1.560	0.270	2,322
15	1.687	0.285	2,478
25	1.887	0.289	2,688
50	2.131	0.291	2,975
100	2.376	0.292	3,360

2.2.3 Total Allowable Flow Rate from Existing Costco Site and Proposed Parking Expansion

Return Period (Years)	Allowable Flow Rates (m ³ /s)		
	Existing Costco Site	Parking Expansion	Total
100	0.292	0.033	0.325

	Project	Costco Stoney Creek Parking Expansion	No.	CA0059190.9392	
	By	James Zhou	Date	2026-08-18	Page 3
	Checked		Date		

Subject	Proposed Development
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2.3 Quantity Control

2.3.1 Quantity Control Storage for Catchment 201G-1

150mm pipes between 201G storage to Existing STM MH29 (Node J4 in PCSWMM Model)

UG Storage for Quantity Control	480	m ³
Surface Storage	794	m ³
Total Provided Storage	1,274	m ³

2.3.2 Quantity Control Storage for Site E, Existing Costco (Remain As is)

Add drainage from 201G-2

2.3.3 Quantity Control Performance - 375 mm Pipe

Return Period (Years)	Inflow from Costco (Site E) & 201G-1, 201G-2 (m ³ /s)	Outflow (375 mm Pipe) (m ³ /s)	Used Storage (m ³)	
			Existing Costco Site	Proposed Parking Expansion
2	1.071	0.183	1,359	171
5	1.482	0.202	1,990	264
10	1.780	0.259	2,301	367
15	1.926	0.285	2,487	453
25	2.182	0.293	2,705	510
50	2.460	0.298	3,112	593
100	2.738	0.303	3,638	710

2.3.4 Post-Development Peak Flow Rates

Return Period (Years)	Post-Development Flow Rates (m3/s)			
	Flow Rate in 375 mm Pipe	Uncontrolled Flow from 201G-3 *	Uncontrolled Flow from 201G-4	Total
2	0.183	0.000	0.000	0.184
5	0.202	0.001	0.001	0.204
10	0.259	0.002	0.002	0.262
15	0.285	0.002	0.002	0.289
25	0.293	0.003	0.003	0.298
50	0.298	0.003	0.003	0.305
100	0.303	0.004	0.004	0.311

* Runoff from Subcatchment 201G-3 is directed to the underground storage system beneath the parking lot of the existing Site G. It is conservative to account for the uncontrolled flow from Subcatchment 201G-3.

2.4 Water Balance

2.4.1 Water Balance Requirement

Drainage Area (ha)	Capture and Infiltration Rate (mm)	Required Infiltration Volume (m³)
0.88	3.0	26.4

2.4.2 Provided Storage Volume

Footprint of Stone Layer (m²)	Storage Depth (m)	Void Ratio	Provided Storage (m³)
268	0.30	0.40	32.2

2.5 Water Quality

2.5.1 OGS Unit

Drainage Area (ha)	Runoff Coefficient	Imperviousness (%)	OGS Unit	TSS Removal
0.82	0.85	92.3%	Stormceptor EFO8	63.0%

However, the OGS unit was certified with 50% TSS removal efficiency only.

2.5.2 Isolator Row Plus (IR+)

The Isolator Row plus (IR+) within ADS MC-3500 chamber system will provide 80% TSS removal.

2.5.3 TSS Removal for Treatment Train Approach

TSS removal efficiency for treatment train approach with two components are calculated as below:

$T = 1 - (1 - T_A)(1 - T_B)$

TSS Removal		
OGS (A)	IR+ (B)	Overall
50.0%	80.0%	90.0%

APPENDIX

C

OIL/ GRIT SEPARATOR SIZING REPORT

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

04/14/2026

Province:	Ontario
City:	Hamilton
Nearest Rainfall Station:	HAMILTON RBG CS
Climate Station Id:	6153301
Years of Rainfall Data:	20

Site Name:	Costco Stoney Creek
------------	---------------------

Drainage Area (ha):	0.82
Runoff Coefficient 'c':	0.85

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	21.82
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):	675
Estimated Average Annual Sediment Volume (L/yr):	549

Project Name:	Costco Stoney Creek
Project Number:	CA0059190.9392
Designer Name:	Jessica Steffler
Designer Company:	Rinker Materials
Designer Email:	jessica.steffler@RinkerPipe.com
Designer Phone:	519-239-6958
EOR Name:	James Zhou
EOR Company:	WSP Canada Group Ltd.
EOR Email:	James.Zhou@wsp.com
EOR Phone:	289-982-4533

Net Annual Sediment (TSS) Load Reduction Sizing Summary	
Stormceptor Model	TSS Removal Provided (%)
EFO4	51
EFO5	55
EFO6	59
EFO8	63
EFO10	66
EFO12	68

Recommended Stormceptor EFO Model: EFO8
Estimated Net Annual Sediment (TSS) Load Reduction (%): 63
Water Quality Runoff Volume Capture (%): > 90



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	85	250-500	5
250	80	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	9-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

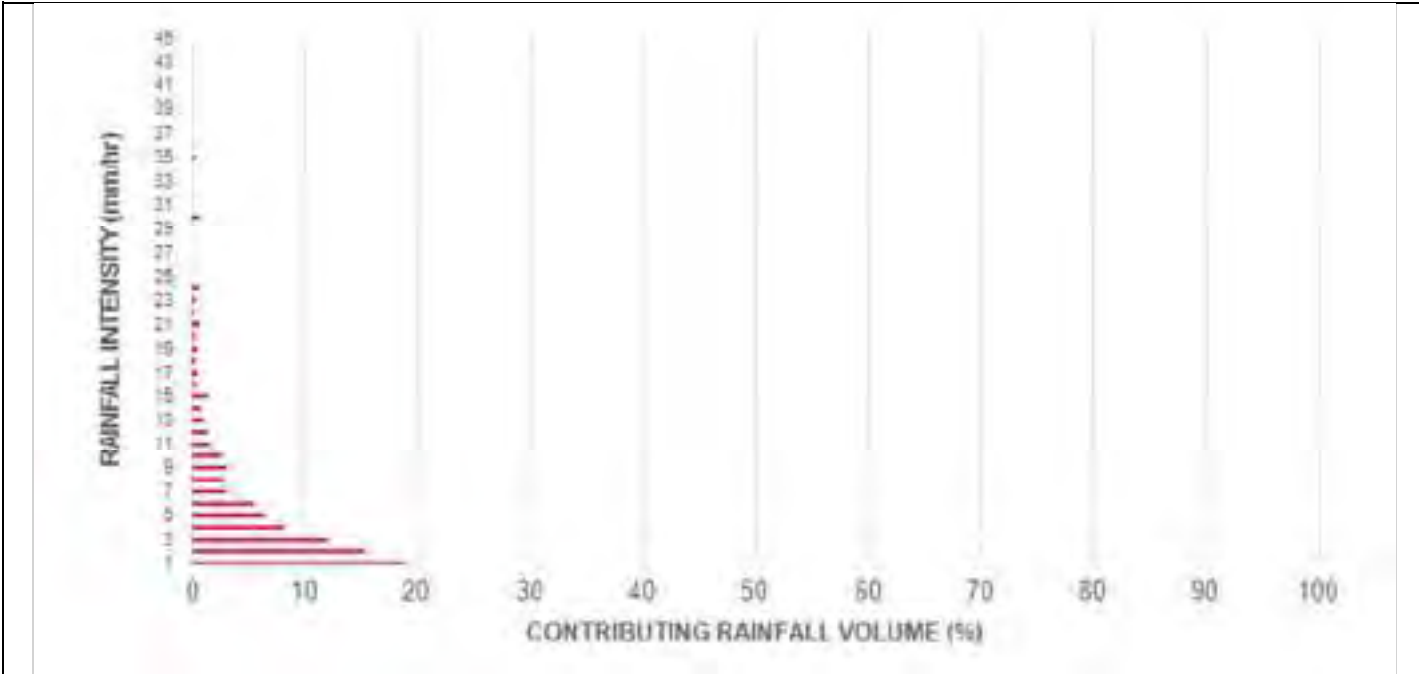


Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	9.1	9.1	0.97	58.0	12.0	70	6.4	6.4
1.00	19.0	28.0	1.94	116.0	25.0	70	13.4	19.7
2.00	15.5	43.5	3.88	233.0	49.0	69	10.7	30.4
3.00	12.1	55.6	5.81	349.0	74.0	66	7.9	38.3
4.00	8.2	63.8	7.75	465.0	99.0	63	5.2	43.5
5.00	6.5	70.4	9.69	581.0	124.0	61	4.0	47.5
6.00	5.5	75.9	11.63	698.0	148.0	59	3.2	50.7
7.00	3.2	79.0	13.56	814.0	173.0	57	1.8	52.5
8.00	2.9	81.9	15.50	930.0	198.0	55	1.6	54.1
9.00	3.2	85.2	17.44	1046.0	223.0	53	1.7	55.8
10.00	2.7	87.9	19.38	1163.0	247.0	53	1.4	57.3
11.00	1.7	89.6	21.31	1279.0	272.0	52	0.9	58.2
12.00	1.5	91.1	23.25	1395.0	297.0	51	0.8	58.9
13.00	1.1	92.2	25.19	1511.0	322.0	50	0.6	59.5
14.00	0.9	93.1	27.13	1628.0	346.0	50	0.5	59.9
15.00	1.4	94.5	29.06	1744.0	371.0	49	0.7	60.6
16.00	0.6	95.1	31.00	1860.0	396.0	48	0.3	60.9
17.00	0.5	95.6	32.94	1976.0	421.0	47	0.2	61.1
18.00	0.3	95.9	34.88	2093.0	445.0	47	0.2	61.3
19.00	0.5	96.4	36.82	2209.0	470.0	46	0.2	61.5
20.00	0.4	96.8	38.75	2325.0	495.0	45	0.2	61.7
21.00	0.8	97.6	40.69	2441.0	519.0	44	0.3	62.1
22.00	0.2	97.8	42.63	2558.0	544.0	44	0.1	62.1
23.00	0.4	98.2	44.57	2674.0	569.0	43	0.2	62.3
24.00	0.7	98.9	46.50	2790.0	594.0	42	0.3	62.6
25.00	0.0	98.9	48.44	2906.0	618.0	42	0.0	62.6
30.00	0.7	99.7	58.13	3488.0	742.0	41	0.3	62.9
35.00	0.3	100.0	67.82	4069.0	866.0	41	0.1	63.1
40.00	0.0	100.0	77.51	4650.0	989.0	40	0.0	63.1
45.00	0.0	100.0	87.19	5232.0	1113.0	38	0.0	63.1
Estimated Net Annual Sediment (TSS) Load Reduction =								63 %

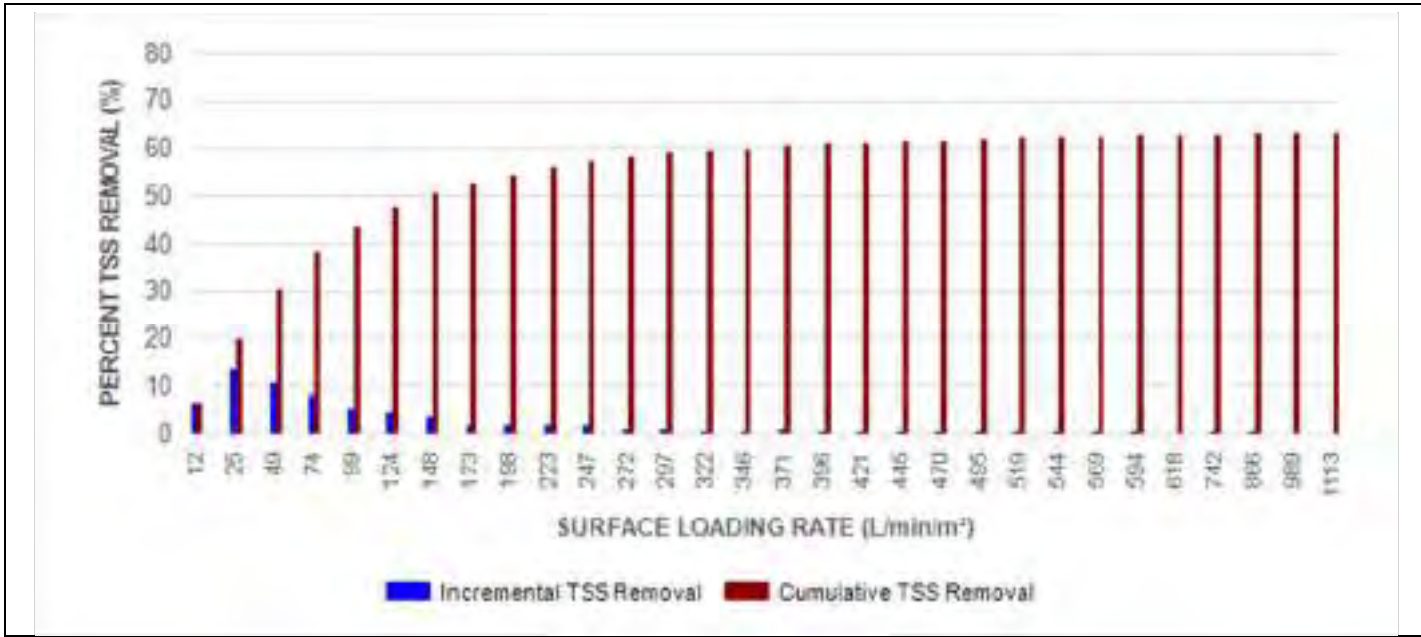
Climate Station ID: 6153301 Years of Rainfall Data: 20



RAINFALL DATA FROM HAMILTON RBG CS 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.

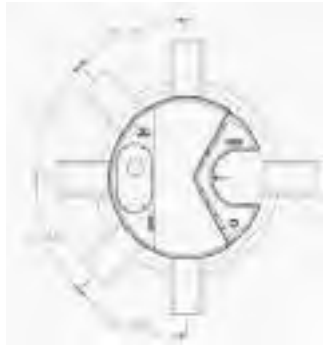
DESIGN FLEXIBILITY

► 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)	(ft³)	(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/ft³)

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>

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m ²)	TSS % REMOVAL	SLR (L/min/m ²)	TSS % REMOVAL	SLR (L/min/m ²)	TSS % REMOVAL	SLR (L/min/m ²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

STANDARD PERFORMANCE SPECIFICATION FOR “OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREATMENT 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/m² to 1400 L/min/m², 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/m² and 1400 L/min/m² 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/m² shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m². No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m².

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² 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/m².

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/m².

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/m² to 2600 L/min/m²) 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.

APPENDIX

D

ADS STORMTECH MC-3500
CHAMBER SYSTEM

StormTech® MC-3500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.



Nominal Chamber Specifications (not to scale)

Size (L x W x H)

90" x 77" x 45"
2286 mm x 1956 mm x 1143 mm

Chamber Storage

109.9 ft³ (3.11 m³)

Min. Installed Storage*

175.0 ft³ (4.96 m³)

Weight

134 lbs (60.8 kg)

Shipping

15 chambers/pallet
7 end caps/pallet
7 pallets/truck

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below chambers, 6" (150 mm) of stone between chambers/ end caps and 40% stone porosity.

Nominal End Cap Specifications (not to scale)

Size (L x W x H)

26.5" x 71" x 45.1"
673 mm x 1803 mm x 1145 mm

End Cap Storage

14.9 ft³ (0.42 m³)

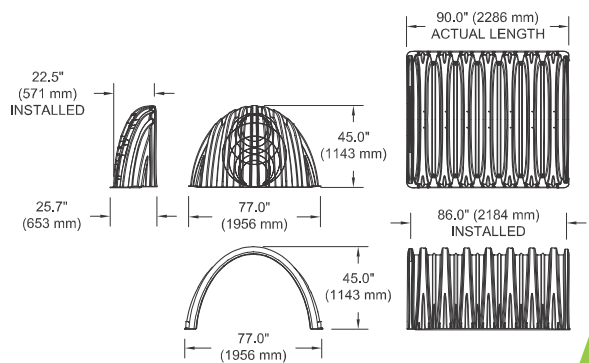
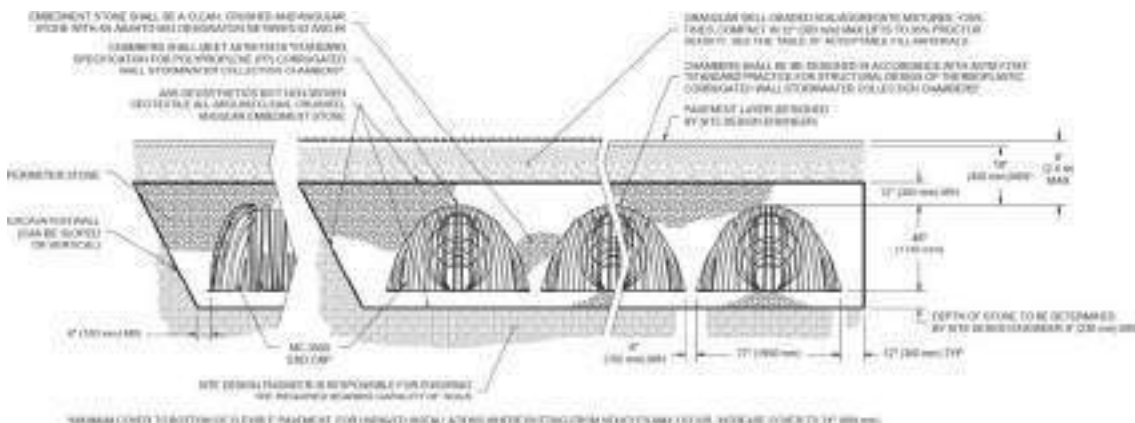
Min. Installed Storage*

45.1 ft³ (1.28 m³)

Weight

49 lbs (22.2 kg)

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below, 6" (150 mm) of stone perimeter, 6" (150 mm) of stone between chambers/ end caps and 40% stone porosity.



StormTech MC-3500 Specifications

Storage Volume Per Chamber

	Bare Chamber Storage ft ³ (m ³)	Chamber and Stone Foundation Depth in. (mm)			
		9 in (230 mm)	12 in (300 mm)	15 in (375 mm)	18 in (450 mm)
Chamber	109.9 (3.11)	175.0 (4.96)	179.9 (5.09)	184.9 (5.24)	189.9 (5.38)
End Cap	14.9 (0.42)	45.1 (1.28)	46.6 (1.32)	48.3 (1.37)	49.9 (1.41)

Note: Assumes 6" (150 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/end cap volume.

Amount of Stone Per Chamber

English Tons (yds ³)	Stone Foundation Depth			
	9 in	12 in	15 in	18 in
Chamber	8.5 (6.0)	9.1 (6.5)	9.7 (6.9)	10.4 (7.4)
End Cap	3.9 (2.8)	4.1 (2.9)	4.3 (3.1)	4.5 (3.2)
Metric Kilograms (m ³)	230 mm	300 mm	375 mm	450 mm
Chamber	7711 (4.6)	8255 (5.0)	8800 (5.3)	9435 (5.7)
End Cap	3538 (2.1)	3719 (2.2)	3901 (2.4)	4082 (2.5)

Note: Assumes 12" (300 mm) of stone above and 6" (150 mm) row spacing and 6" (150 mm) of perimeter stone in front of end caps.

Volume Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth			
	9 in (230 mm)	12 in (300 mm)	15 in (375mm)	18 in (450 mm)
Chamber	11.9 (9.1)	12.4 (9.5)	12.8 (9.8)	13.3 (10.2)
End Cap	4.0 (3.1)	4.1 (3.3)	4.3 (3.3)	4.4 (3.4)

Note: Assumes 6" (150 mm) of separation between chamber rows and 24" (600 mm) of cover. The volume of excavation will vary as depth of cover increases.

ADS StormTech products, manufactured in accordance with ASTM F2418 or ASTM F2922, comply with all requirements in the Build America, Buy America (BABA) Act.

Working on a project?

Visit us at adspipe.com/stormtech and utilize the Design Tool



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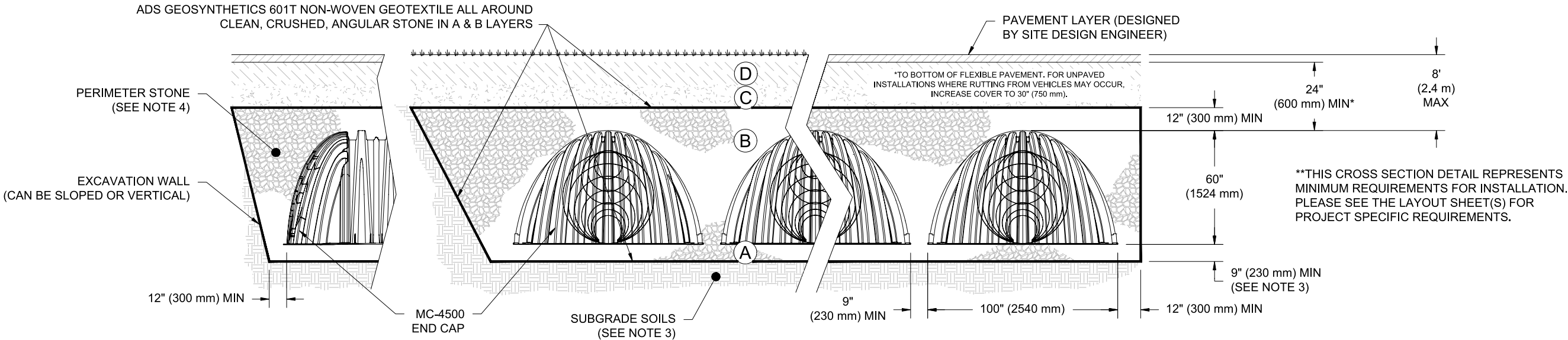
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ACCEPTABLE FILL MATERIALS: STORMTECH MC-4500 CHAMBER SYSTEMS

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 24" (600 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 24" (600 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".



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101
2. MC-4500 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 500 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.

STANDARD CROSS SECTION
MC-4500 CHAMBER
STORMTECH

DATE: 02/17/2025
DRAWING #: 724-420
DRAWN: SMW
CHECKED: JLM

DESCRIPTION
DATE
CHKD

StormTech®
Chamber System

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ADS

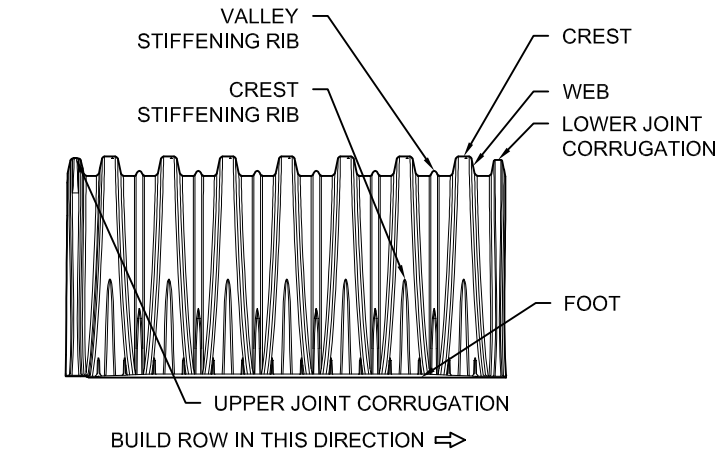
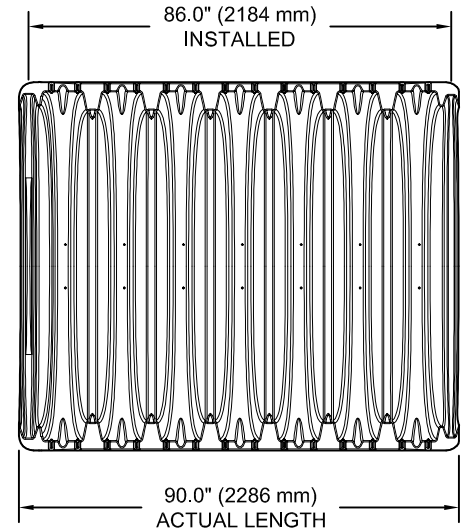
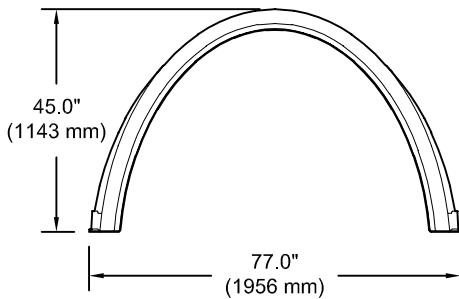
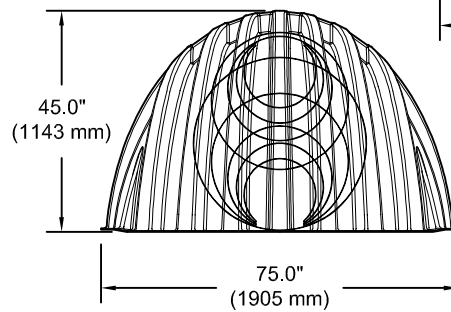
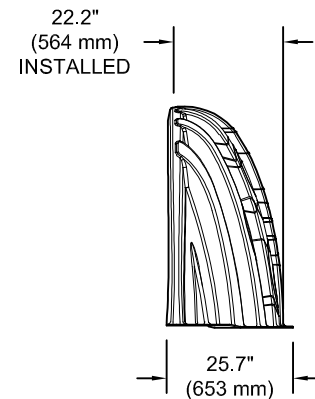
4640 TRUEMAN BLVD
HILLIARD, OH 43026

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS/STORMTECH UNDER THE DIRECTION OF THE PROJECT'S 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.

1 SHEET
OF 1

MC-3500 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)
CHAMBER STORAGE
MINIMUM INSTALLED STORAGE*
WEIGHT

77.0" X 45.0" X 86.0" (1956 mm X 1143 mm X 2184 mm)
109.9 CUBIC FEET (3.11 m³)
175.0 CUBIC FEET (4.96 m³)
134 lbs. (60.8 kg)

NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)
END CAP STORAGE
MINIMUM INSTALLED STORAGE*
WEIGHT

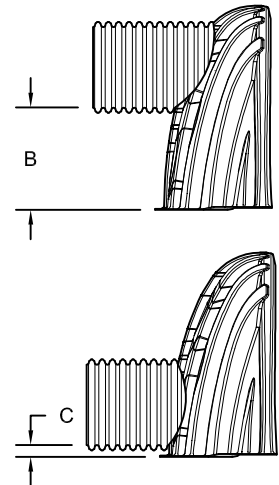
75.0" X 45.0" X 22.2" (1905 mm X 1143 mm X 564 mm)
14.9 CUBIC FEET (0.42 m³)
45.1 CUBIC FEET (1.28 m³)
49 lbs. (22.2 kg)

*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.

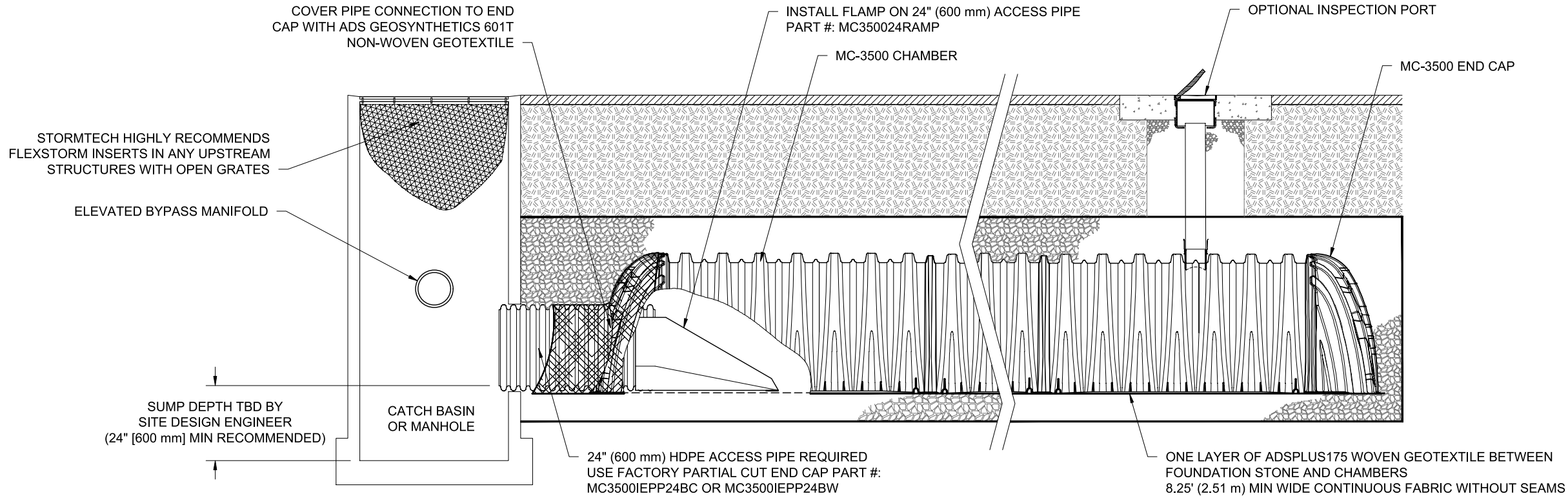
PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"

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.



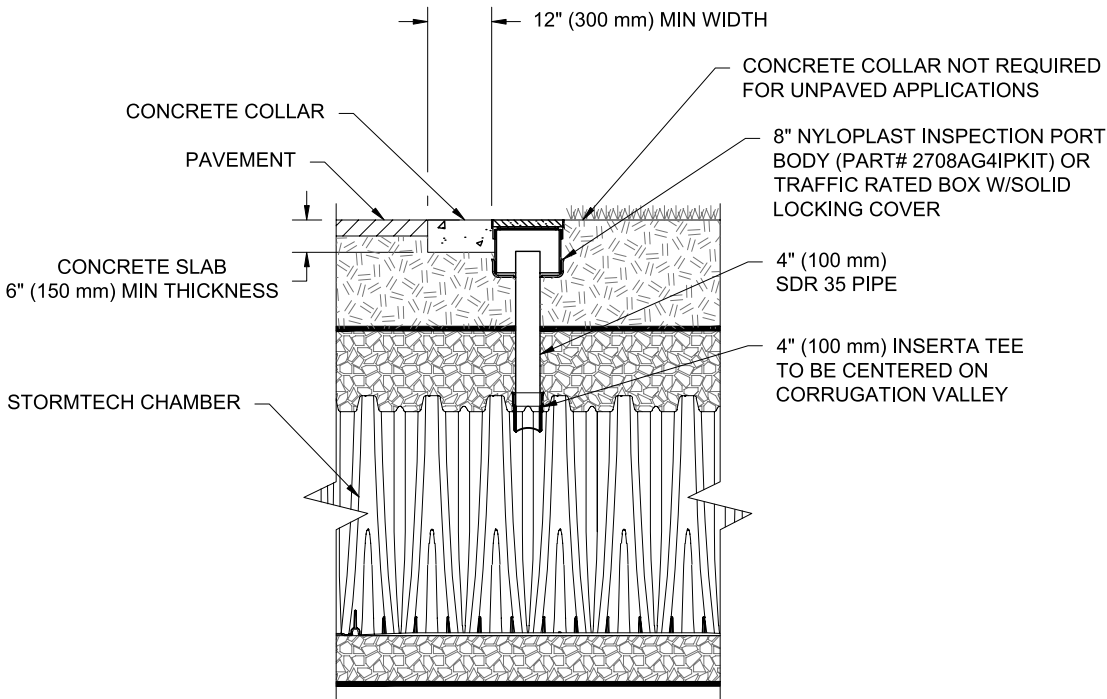
MC-3500 ISOLATOR ROW PLUS DETAIL
NTS

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

- 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.
- CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION VALLEY.

4" PVC INSPECTION PORT DETAIL
(MC SERIES CHAMBER)
NTS

MC-3500

ISOLATOR ROW PLUS DETAILS

DATE:	8/03/22	DRAWN:	KLJ
PROJECT #:		CHECKED:	KLJ

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

StormTech®
Chamber System

888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026

ADS

Isolator[®] Row Plus

O&M Manual



The Isolator[®] Row Plus

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row Plus is a technique to inexpensively enhance Total Suspended Solids (TSS), Total Phosphorus (TP), Total Petroleum Hydrocarbons (TPH) and Total Nitrogen (TN) removal with easy access for inspection and maintenance.

The Isolator Row Plus

The Isolator Row Plus is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, SC-800, MC-3500, MC-4500 or MC-7200 models, are lined with filter fabric and connected to a closely located manhole for easy access. The fabric lined chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row Plus and passes through the filter fabric. The open bottom chambers allow stormwater to flow vertically out of the chambers. Sediments are captured in the Isolator Row Plus protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS Isolator Row and Plus fabric are placed between the stone and the Isolator Row Plus chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting.

The Isolator Row Plus is designed to capture the “first flush” runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row Plus and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row Plus bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row Plus row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row Plus. After Stormwater flows through the Isolator Row Plus and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

The Isolator Row Plus Flamp[™] is a flared end ramp apparatus attached to the inlet pipe on the inside of the chamber end cap. The FLAMP provides a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance by enhancing outflow of solid debris that would otherwise collect at the chamber's end, or more difficult to remove and require confined space entry into the chamber area. It also serves to improve the fluid and solid flow into the access pipe during maintenance and cleaning and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The Isolator Row Plus may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row Plus to minimize maintenance requirements and maintenance costs.

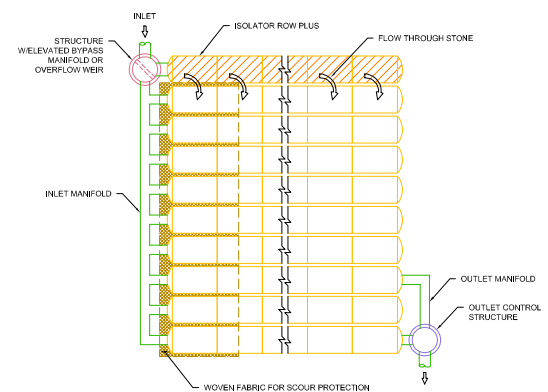
Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row Plus.



Looking down the Isolator Row Plus from the manhole opening, ADS Plus Fabric is shown between the chamber and stone base.



StormTech Isolator Row Plus with Overflow Structure (not to scale)



Isolator Row Plus Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row Plus should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row Plus incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3" (75 mm) throughout the length of the Isolator Row Plus, clean-out should be performed.

Maintenance

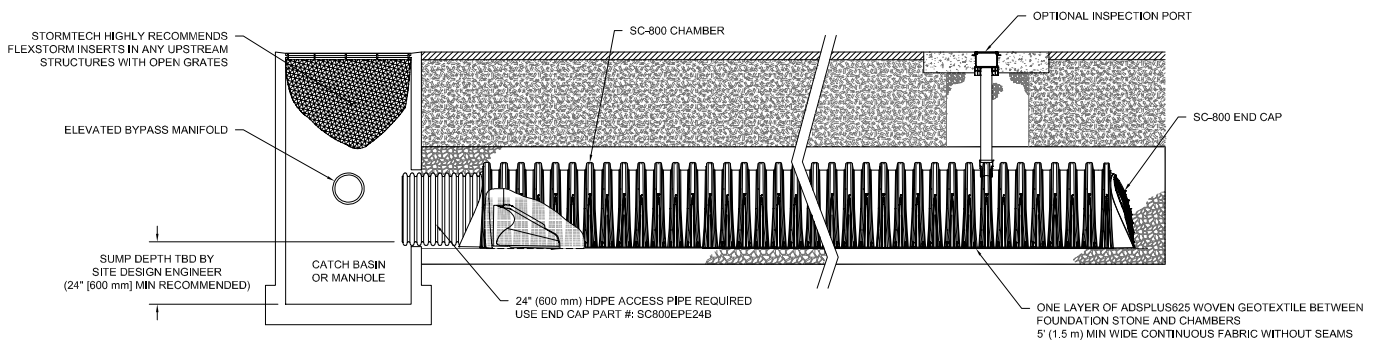
The Isolator Row Plus was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided

via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entry.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row Plus lengths up to 200' (61 m). **The JetVac process shall only be performed on StormTech Isolator Row Plus that have ADS Plus Fabric (as specified by StormTech) over their angular base stone.**



StormTech Isolator Row Plus (not to scale)



Isolator Row Plus Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row Plus for sediment.

- A) Inspection ports (if present)
 - i. Remove lid from floor box frame
 - ii. Remove cap from inspection riser
 - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
 - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
 - B) All Isolator Row Plus
 - i. Remove cover from manhole at upstream end of Isolator Row Plus
 - ii. Using a flashlight, inspect down Isolator Row Plus through outlet pipe
 - 1. Mirrors on poles or cameras may be used to avoid a confined space entry
 - 2. Follow OSHA regulations for confined space entry if entering manhole
 - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2.
- If not, proceed to Step 3.

Step 2

Clean out Isolator Row Plus using the JetVac process.

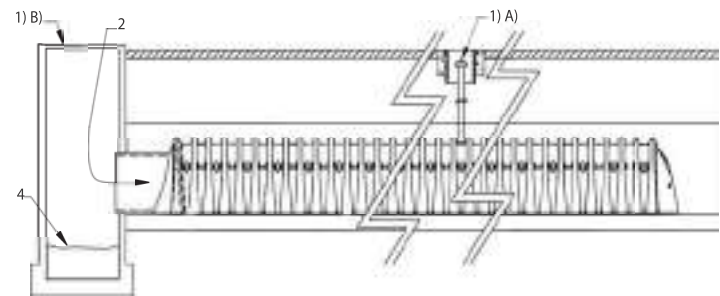
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

Date	Stadia Rod Readings		Sedi- ment Depth (1)-(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row Plus, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

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800-821-6710

StormTech® Installation Guide

MC-3500 & MC-4500 Chamber



StormTech
Installation Video

Required Materials and Equipment List

- Acceptable fill materials per Table 1
- ADS Plus and non-woven geotextile fabrics
- StormTech solid end caps, pre-cored and pre-fabricated end caps
- StormTech chambers, manifolds and fittings

Note: MC-3500 chamber pallets are 77" x 90" (2.0 m x 2.3 m) and weigh about 2010 lbs. (912 kg) and MC-4500 pallets are 100" x 52" (2.5 m x 1.3 m) and weigh about 840 lbs. (381 kg). Unloading chambers requires 72" (1.8 m) (min.) forks and/or tie downs (straps, chains, etc).

Important Notes:

- This installation guide provides the minimum requirements for proper installation of chambers. Nonadherence to this guide may result in damage to chambers during installation. Replacement of damaged chambers during or after backfilling is costly and very time consuming. It is recommended that all installers are familiar with this guide, and that the contractor inspects the chambers for distortion, damage and joint integrity as work progresses.
- 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.
- Care should be taken in the handling of chambers and end caps. End caps must be stored standing upright. Avoid dropping, prying or excessive force on chambers during removal from pallet and initial placement.

Requirements for System Installation



Excavate bed and prepare subgrade per engineer's plans. Plans and specifications should include Best Management Practices (BMPs) to deter contamination of open pits during construction.



Place non-woven geotextile over prepared soils and up excavation walls.



Place clean, crushed, angular stone foundation 9" (230 mm) min. Install underdrains if required. Compact to achieve a flat surface.

Manifold, Scour Fabric and Chamber Assembly



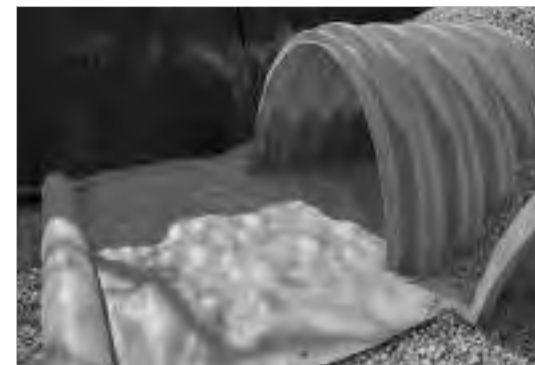
Install manifolds and lay out ADS PLUS fabric at inlet rows [min. 17.5 ft (5.33 m)] at each inlet end cap. Place a continuous piece (no seams) along entire length of Isolator® PLUS Row(s).



Align the first chamber and end cap of each row with inlet pipes. Contractor may choose to postpone stone placement around end chambers and leave ends of rows open for easy inspection of chambers during the backfill process.

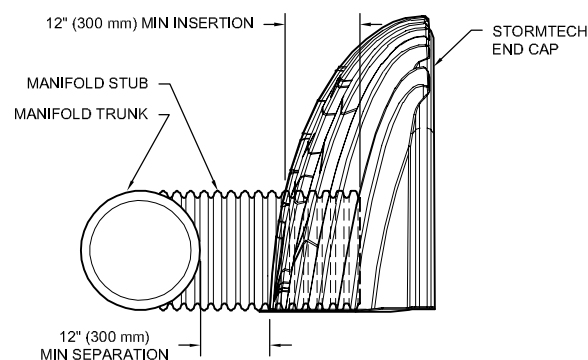


Continue installing chambers by overlapping chamber end corrugations. Chamber joints are labeled "Lower Joint - Overlap Here" and "Build this direction - Upper Joint". Be sure that the chamber placement does not exceed the reach of the construction equipment used to place the stone. Maintain minimum 6" (150 mm) spacing between MC-3500 rows and 9" (230 mm) spacing between MC-4500 rows.



Place a continuous layer of ADS PLUS fabric between the foundation stone and the Isolator Row PLUS chambers, making sure the fabric lays flat and extends the entire width of the chamber feet. When used on an Isolator Row PLUS, a 24" FLAMP (flared end ramp) is attached to the inside of the inlet pipe with a provided threaded rod and bolt. The FLAMP then lays on top of the ADS PLUS fabric.

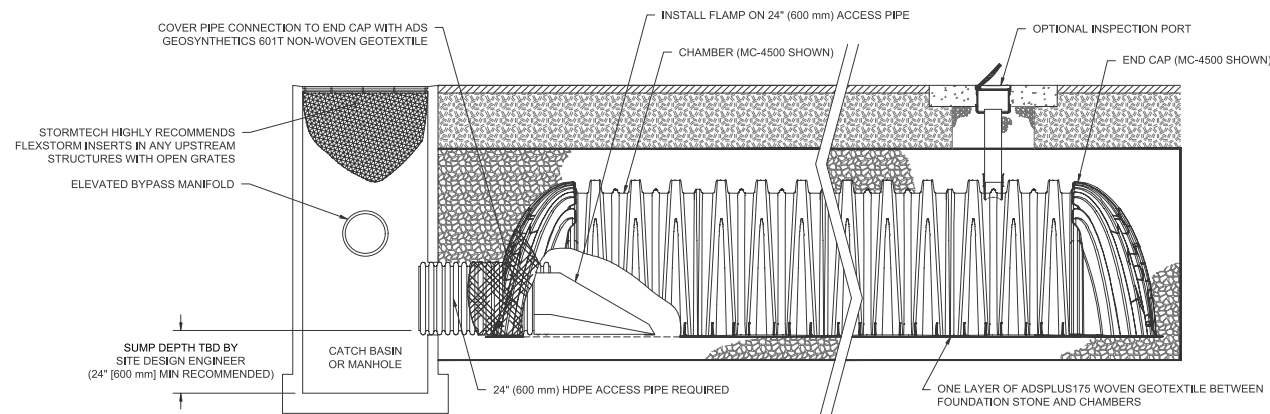
Manifold Insertion



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

Insert inlet and outlet manifolds a minimum 12" (300 mm) into chamber end caps. Manifold header should be a minimum 12" (300 mm) from base of end cap.

StormTech Isolator Row Plus Detail



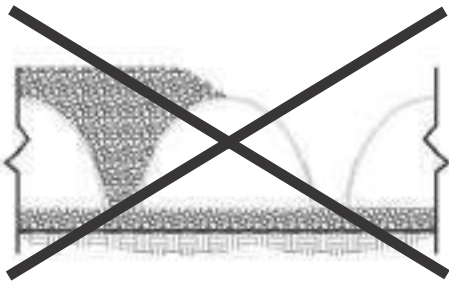
Initial Anchoring of Chambers – Embedment Stone



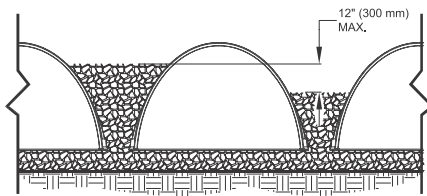
Initial embedment shall be spotted along the centerline of the chamber evenly anchoring the lower portion of the chamber. This is best accomplished with a stone conveyor or excavator reaching along the row.

No equipment shall be operated on the bed at this stage of the installation. Excavators must be located off the bed. Dump trucks shall not dump stone directly on to the bed. Dozers or loaders are not allowed on the bed at this time.

Backfill of Chambers – Embedment Stone

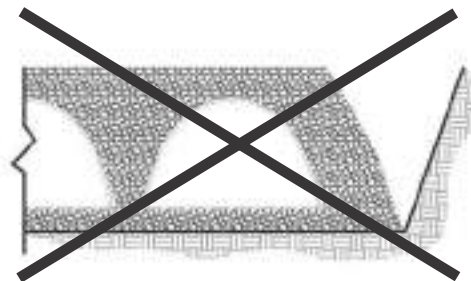


Uneven Backfill

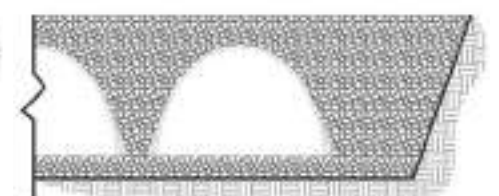


Even Backfill

Backfill chambers evenly. Stone column height should never differ by more than 12" (300 mm) between adjacent chamber rows or between chamber rows and perimeter.



Perimeter Not Backfilled



Perimeter Fully Backfilled

Perimeter stone must be brought up evenly with chamber rows. Perimeter must be fully backfilled, with stone extended horizontally to the excavation wall.

Backfill of Chambers – Embedment Stone and Cover Stone



Continue evenly backfilling between rows and around perimeter until embedment stone reaches tops of chambers and a minimum 12" (300 mm) of cover stone is in place. Perimeter stone must extend horizontally to the excavation wall for both straight or sloped sidewalls. The recommended backfill methods are with a stone conveyor outside of the bed or build as you go with an excavator inside the bed reaching along the rows. Backfilling while assembling chambers rows as shown in the picture will help to ensure that equipment reach is not exceeded.

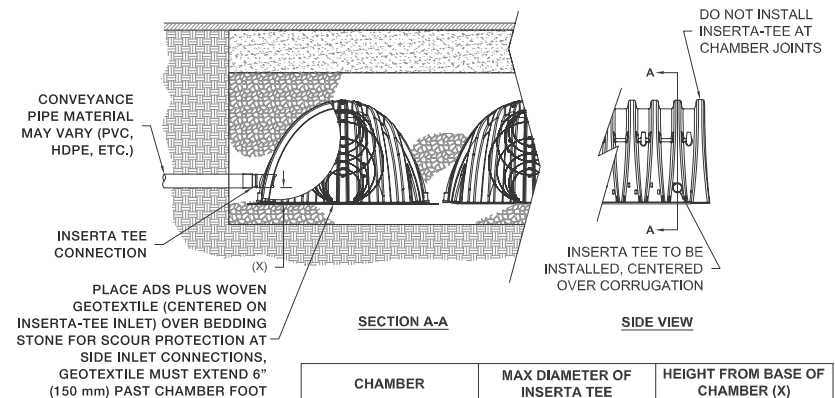
Only after chambers have been backfilled to top of chamber and with a minimum 12" (300 mm) of cover stone on top of chambers can skid loaders and small LGP dozers be used to final grade cover stone and backfill material in accordance with ground pressure limits in Table 2. Equipment must push material parallel to rows only. Never push perpendicular to rows. StormTech recommends the contractor inspect chamber rows before placing final backfill. Any chambers damaged by construction equipment shall be removed and replaced.

Final Backfill of Chambers – Fill Material



Install non-woven geotextile over stone. Geotextile must overlap 24" (600 mm) where edges meet. Compact at 18" (450 mm) of fill for MC-3500 and 24" (600 mm) of fill for MC-4500. Roller travel parallel with rows.

Inserta Tee Detail



NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
MC-3500	12" (250 mm)	6" (150 mm)
MC-4500	12" (250 mm)	8" (200 mm)

INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON

Table 1- Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation ¹	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 the 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) for MC-3500 and 24" (600 mm) for MC-4500 above the top of the chamber. Note that pavement subbase may be 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 compaction after min. 18" (450 mm) for MC-3500 and 24" (600 mm) for MC-4500 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: Embedment Stone surrounding chambers from the foundation stone to the 'C' layer above.	Clean, crushed, angular stone or Recycled Concrete ⁴	AASHTO M43 ¹ 3, 357, 4, 467, 5, 56, 57	No compaction required.
A) Foundation Stone: Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone or Recycled Concrete ⁴	AASHTO M43 ¹ 3, 357, 4, 467, 5, 56, 57	Place and compact in 9" (225 mm) lifts using two full coverages with a vibratory compactor. ^{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 comprised by compaction, for standard installations and 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. Where recycled concrete aggregate is used in layers 'A' or 'B' the material should also meet the acceptable criteria outlined in ADS Technical Note 6.20 "Recycled Concrete Structural Backfill".

Figure 2 - Fill Material Locations

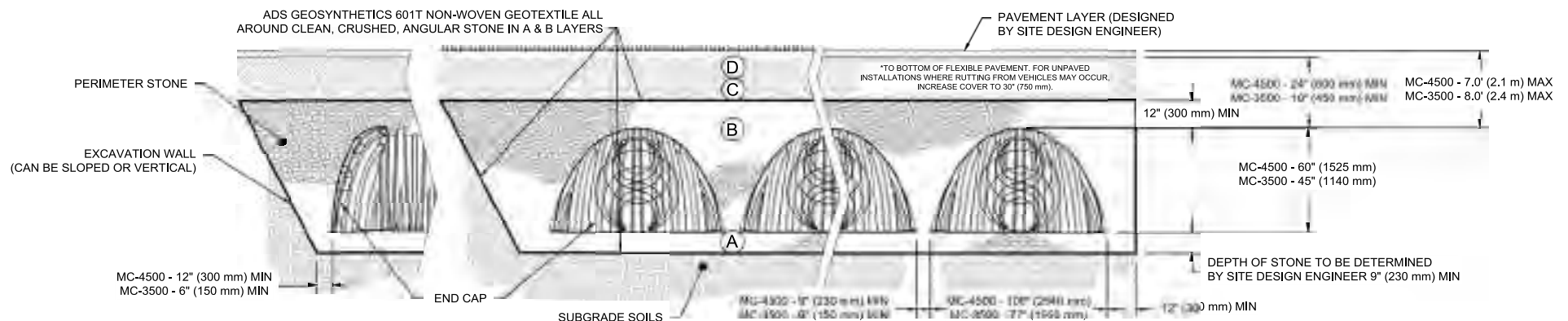
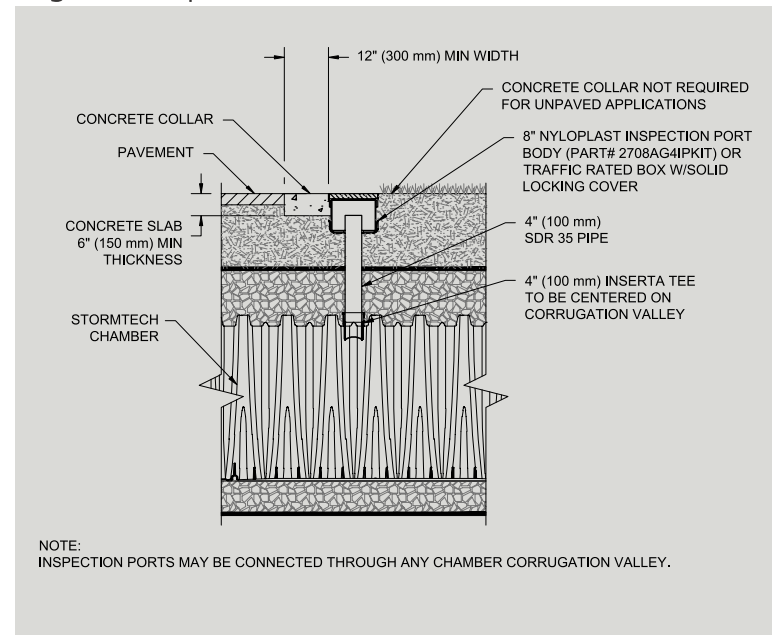


Figure 1- Inspection Port Detail



Notes:

- 36" (900 mm) of stabilized cover materials over the chambers is recommended during the construction phase if general construction activities, such as full dump truck travel and dumping, are to occur over the bed.
- During paving operations, dump truck axle loads on 18" (450mm) of cover for MC-3500s may be necessary. Precautions should be taken to avoid rutting of the road base layer, to ensure that compaction requirements have been met, and that a minimum of 18" (450mm) of cover for MC-3500s exists over the chambers. Contact StormTech for additional guidance on allowable axle loads during paving.
- Ground pressure for track dozers is the vehicle operating weight divided by total ground contact area for both tracks. Excavators will exert higher ground pressures based on loaded bucket weight and boom extension.
- Mini-excavators (<8,000lbs/3,628 kg) can be used with at least 12" (300 mm) of stone over the chambers and are limited by the maximum ground pressures in Table 2 based on a full bucket at maximum boom extension.
- StormTech does not require compaction of initial fill at 18" (450 mm) of cover. However, requirements by others for 6" (150 mm) lifts may necessitate the use of small compactors at 18" (450 mm) of cover.
- Storage of materials such as construction materials, equipment, spoils, etc. should not be located over the StormTech system. The use of equipment over the StormTech system not covered in Table 2 (ex. soil mixing equipment, cranes, etc) is limited. Please contact StormTech for more information.
- Allowable track loads based on vehicle travel only. Excavators shall not operate on chamber beds until the total backfill reaches 3 feet (900 mm) over the entire bed.

Call StormTech at **888.892.2694** for technical and product information or visit www.stormtech.com

Table 2 - Maximum Allowable Construction Vehicle Loads⁶

Material Location	Fill Depth over Chambers in. (mm)	Maximum Allowable Wheel Loads		Maximum Allowable Track Loads ⁶		Maximum Allowable Roller Loads
		Max Axle Load for Trucks lbs (kN)	Max Wheel Load for Loaders lbs (kN)	Track Width in. (mm)	Max Ground Pressure psf (kPa)	Max Drum Weight or Dynamic Force lbs (kN)
Ⓓ Final Fill Material	36" (900) Compacted	32,000 (142)	16,000 (71)	12" (305) 18" (457) 24" (610) 30" (762) 36" (914)	4050 (194) 2760 (132) 2130 (102) 1770 (84) 1530 (73)	38,000 (169)
Ⓒ Initial Fill Material	24" (600) Compacted	32,000 (142)	16,000 (71)	12" (305) 18" (457) 24" (610) 30" (762) 36" (914)	2750 (131) 1920 (92) 1520 (73) 1310 (63) 1180 (56)	20,000 (89)
	24" (600) Loose/Dumped	MC-3500		12" (305)	2430 (116)	16,000 (71)
		32,000 (142)	16,000 (71)	18" (457)	1730 (82)	
		MC-4500		24" (610)	1390 (66)	
		24,000 (107)	12,000 (53)	30" (762)	1210 (58)	
	18" (450)	MC-3500		36" (914)	1100 (52)	5,000 (22) (static loads only) ⁵
		MC-3500		12" (305)	2140 (102)	
		32,000 (142)	16,000 (71)	18" (457)	1530 (73)	
		MC-4500		24" (610)	1260 (60)	
		24,000 (107)	12,000 (53)	30" (762)	1120 (53)	
Ⓑ Embedment Stone	12" (300)	Not Allowed	Not Allowed	12" (305) 18" (457) 24" (610) 30" (762)	1100 (53) 710 (34) 660 (32) 580 (28)	Not Allowed
	6" (150)	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed

Table 3 - Placement Methods and Descriptions

Material Location	Placement Methods/ Restrictions	Wheel Load Restrictions	Track Load Restrictions	Roller Load Restrictions
		See Table 2 for Maximum Construction Loads		
Ⓓ Final Fill Material	A variety of placement methods may be used. All construction loads must not exceed the maximum limits in Table 2.	36" (900 mm) minimum cover required for dump trucks to dump over chambers.	Dozers to push parallel to rows. ⁴	Roller travel parallel to rows only until 36" (900 mm) compacted cover is reached.
Ⓒ Initial Fill Material	Excavator positioned off bed recommended. Small excavator allowed over chambers. Small dozer allowed.	Asphalt can be dumped into paver when compacted pavement subbase reaches 18" (450 mm) for MC-3500 and 24" (600 mm) for MC-4500 above top of chambers.	Small LGP track dozers & skid loaders allowed to grade cover stone with at least 12" (300 mm) stone under tracks at all times. Equipment must push parallel to rows at all times.	Use dynamic force of roller only after compacted fill depth reaches 18" (450 mm) for MC-3500 and 24" (600 mm) for MC-4500 over chambers. Roller travel parallel to chamber rows only.
Ⓑ Embedment Stone	No equipment allowed on bare chambers. Use excavator or stone conveyor positioned off bed or on foundation stone to evenly fill around all chambers to at least the top of chambers.	No wheel loads allowed. Material must be placed outside the limits of the chamber bed.	No tracked equipment is allowed on chambers until a min. 12" (300 mm) cover stone is in place.	No rollers allowed.
Ⓐ Foundation Stone	No StormTech restrictions. Contractor responsible for any conditions or requirements by others relative to subgrade bearing capacity, dewatering or protection of subgrade.			



StormTech® Standard Limited Warranty

STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

- (A) This Limited Warranty applies solely to the StormTech chambers and end plates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and end plates are collectively referred to as the "Products."
- (B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.
- (C) THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.
- (D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.
- (E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.
- (F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.
- (G) THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLECT; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. A PRODUCT ALSO IS EXCLUDED FROM LIMITED WARRANTY COVERAGE IF SUCH PRODUCT IS USED IN A PROJECT OR SYSTEM IN WHICH ANY GEOTEXTILE PRODUCTS OTHER THAN THOSE PROVIDED BY ADVANCED DRAINAGE SYSTEMS ARE USED. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.



Drainage



Filtration



Separation

ADS 0601T/O NONWOVEN GEOTEXTILE SPECIFICATION

Scope

This specification describes ADS 0601T/O nonwoven geotextile.

Filter Fabric Requirements

ADS 0601T/O is an orange nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. ADS 0601T/O is inert to biological degradation and resists naturally encountered chemicals, alkali and acids. ADS 0601T/O conforms to the physical property values listed below:

Filter Fabric Properties

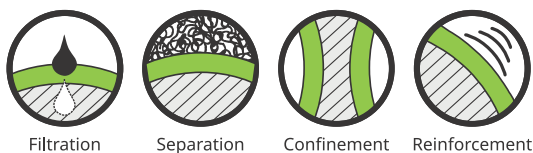
Property	Test Method	Unit	Typical Value ¹ MD	Typical Value ¹ CD
Grab Tensile Strength	ASTM D4632	lbs (N)	175 (779)	175 (779)
Grab Tensile Elongation	ASTM D4632	%	75	75
Trapezoid Tear Strength	ASTM D4533	lbs (N)	85 (378)	85 (378)
CBR Puncture Strength	ASTM D6241	lbs (N)	480 (2136)	480 (2136)
Permittivity	ASTM D4491	sec ⁻¹	1.5	1.5
Flow Rate	ASTM D4491	gal/min/ft ² (l/min/m ²)	105 (4278)	105 (4278)
UV Resistance (at 500 hours) ¹	ASTM D4355	% strength retained	80	80

Physical Properties

Property	Test Method	Unit	Typical Value ²
Weight	ASTM D5161	oz/yd ² (g/m ²)	6.5 (220)
Thickness	ASTM D5199	mils (mm)	65 (1.7)
Roll Dimensions (W x L)	-	ft (m)	15 x 300 (4.5 x 91)
Roll Area	-	yd ² (m ²)	500 (418)
Estimated Roll Weight	-	lb (kg)	220 (100)

¹ Modified, Minimum Test Value

² ASTM D4439 Standard Terminology for Geosynthetics: typical value, *n-for geosynthetics*, the mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with on specific property.



ADS PLUS WOVEN GEOTEXTILE SPECIFICATION

For use with StormTech® Isolator® Row Plus

Scope

This specification describes ADS Plus woven geotextile.

ADS Plus woven geotextile fabrics are woven polypropylene materials offering optimum performance when used in stabilization applications. Produced from first quality raw materials, they provide the perfect balance of strength and separation in styles capable of functioning exceptionally well in a wide range of performance requirements.

Filter Fabric Properties

Property ¹	Test Method	Unit	M.A.R.V. (Minimum Average Roll Value) ²
Weight	ASTM D5261	oz/yd ² (g/m ²)	8.0 (271.25)
Grab Tensile Strength	ASTM D4632	lbs (kN)	325 (1.45)
Grab Elongation	ASTM D4632	%	15
Trapezoidal Tear Strength	ASTM D4533	lbs (kN)	125 (0.89)
CBR Puncture Resistance	ASTM D6241	lbs (kN)	1,124 (5.0)

1. The property values listed above are subject to change without notice.

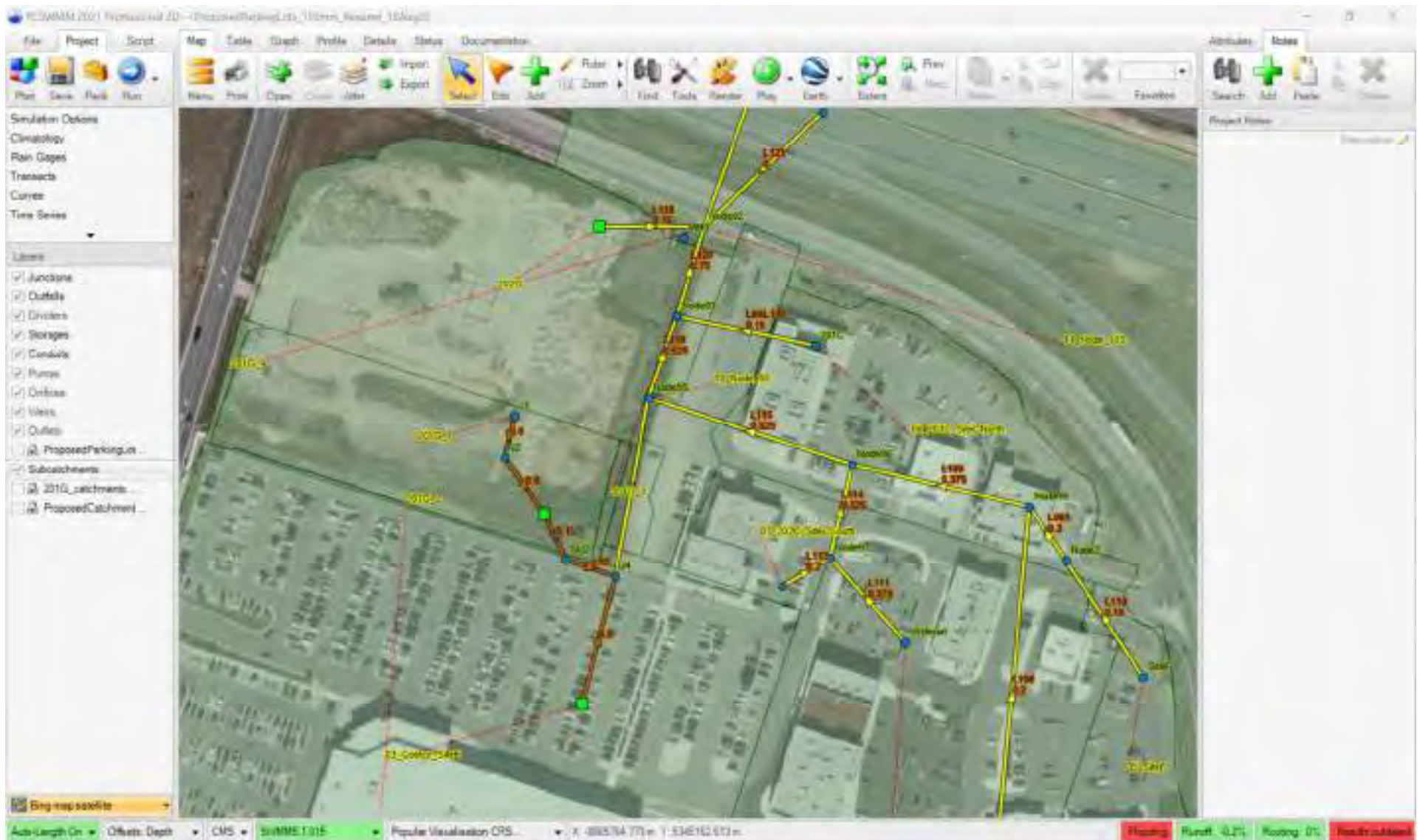
2. Minimum Average Roll Values (MARV) is calculated as the average minus two standard deviations. Statistically, it yields approximately 97.5% degree of confidence that any samples taken from quality assurance testing will meet or exceed the values described above.

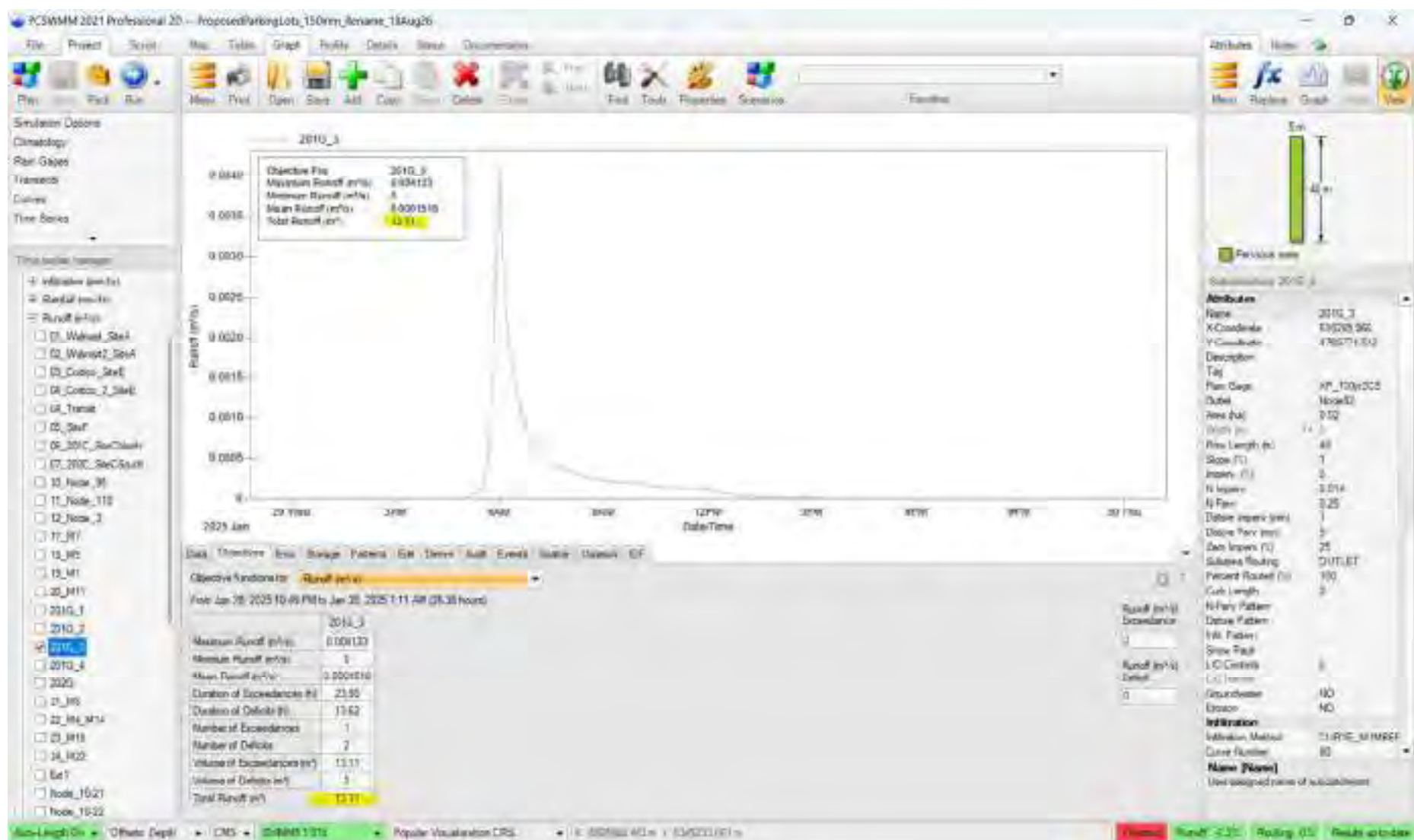
Dimensions

ADS Plus shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 12.5' (3.8 m) width x 360' (110 m) length for Plus125 and 6.25' (1.9 m) width x 360' (110 m) length for Plus625.

APPENDIX

E PCSWMM MODEL SCHEMATIC AND OUTPUT

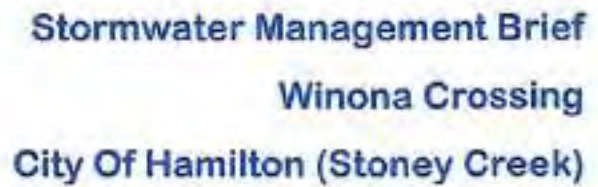
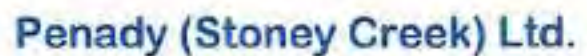




APPENDIX

F

EXCERPT FROM WINONA
CROSSING SWM BRIEF



Updated: March 3, 2016

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Stormwater Management Brief

Winona Crossing City Of Hamilton (Stoney Creek)

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Appendices

Appendix A: Site Plan A1-42 by Turner Fleischer Architects Inc.
Topographic Survey Drawing No. 33391 by A. T. McLaren Ltd. dated March 25, 2011

Appendix B: Engineering Drawings (in separate attachment)

A. J. Clarke and Associates Ltd. Drawings:

AJC Drawing K-12-021 Sheets A & B: Notes and Details

AJC Drawing K-12-021 Sheets S1 to S6: Site Servicing Plans

AJC Drawing K-12-021 Sheets G1 to G5: Site Grading Plans

AJC Drawing K-12-021 Sheets ESC1 to ESC 5: Erosion and Sediment Control Plans

MMM Group Drawings for Costco

14-11239 SS1: Site Servicing Plan

14-11239 SG1: Site Grading Plan

14-11239 ER1: Erosion and Interim Grading Plan

14-11239 ER2: Erosion Control Notes

Contech Engineered Solutions LLC Drawings:

Design of ChamberMAXX Retention Systems

Appendix C: XP-SWMM Model

Appendix D: MTO Flooding Analysis

Appendix E: Geotechnical Investigation, AMEC Foster Wheeler (former AMEC Earth and Environmental Limited) May 2006

Appendix F: Fact Sheets for Permeable Pavers and Bio-swales

Appendix G: Infiltration Calculations based on SCUBE East-SWS

Appendix H: Sediment Pond Calculations

Appendix I: ChamberMaxx Units and Stage-Storage Discharge Curves



1.0 Introduction

1.1 General

Penady (Stoney Creek) Ltd. owns the land located at the southwest corner of the South Service Road and Fifty Road in the City of Hamilton (Stoney Creek). This report addresses the stormwater management constraints and opportunities for these lands [hereinafter referred to as Winona Crossing] only.

Winona Crossing comprises of 17.86 hectares (44 acres) and is bounded by the South Service Road to the north, Fifty Road to the east, Winona Road and the Winona Service Road to the west, and the Hydro One corridor/CN Railway to the south. It is situated in Part of Lot 3, Concession 1, Geographic Township of Saltfleet, now in the City of Hamilton. Refer to **Figure 1**, Site Location Plan for location of the proposed site.



Figure 1: Site Location Plan – Winona Crossing Lands



The lands are located within the SCUBE East subwatershed study (Parcel B) and within the jurisdiction of the Hamilton Conservation Authority. CN Rail and Hydro Lands are approximately 25 metres south of the Winona Crossing lands.

A Geotechnical Investigation report for the site, dated May, 2006, was prepared by AMEC Foster Wheeler (Former AMEC Earth and Environmental Limited). This report identifies the sub-surface soil conditions as generally being a surficial layer of topsoil with underlying silty clay/clayey silt and silt/silt-till on shale-bedrock. The shale bedrock is shallow in the southerly part of the site.

A copy of the geotechnical report is attached as **Appendix E**.

1.2 Proposed Development

The Site Plan prepared by the Turner Fleischer envisages that all the Penady lands are designated for commercial uses consisting mostly of retail stores. The site consists of several parcels of lands with Walmart (possible) and Costco being the prominent retail anchors of the site. A copy of the Site Plan for the project, prepared by Turner Fleischer Architects Inc. (Rev. 38 dated Oct 14, 2014), is attached in **Appendix A**.



1.3 Topography and Drainage

The site generally drains from south to north at low slopes of about 1.0% to 1.5%. Currently, the site drains into three watercourses:

1. Watercourse 10.1 at the center,
2. Watercourse 10.2 to the west, and
3. Watercourse 12 (Fifty Creek) to the east.

The majority of the lands drain into Watercourse 10.1 (Outlet 10.1) at the mid-point between Fifty Road and Winona Road via an overland ditch to a culvert below the QEW and the Service Roads, and then into a storm sewer system to the north of the QEW North Service Road.

The tributary 10.1 drains northerly through an existing 1830 mm x 1240 mm concrete box culvert below QEW and the Service Roads. From there it continues to flow in a northerly direction through a storm sewer system located north of the North Service Road and ultimately drains into Lake Ontario.

A topographic survey was conducted by A.T. McLaren Ltd. Dated March 25 2011, which provides actual field elevations over the site and interpolated contours of the land. The survey plan is attached in **Appendix A**.

The topographic survey information indicates that the surface water runoff from the majority of Penady Lands drains towards Watercourse 10.1.



2.0 Stormwater Management Plan

2.1 Introduction

For new developments, the City of Hamilton, together with the Hamilton Conservation Authority and the Ministry of Environment, requires stormwater management to be implemented to improve stormwater quality levels from urban developments.

The quality of stormwater runoff generally deteriorates with the increase in urban development, which may produce increased levels of suspended solids, nitrogen and phosphorous loadings in the receiving watercourses.

The purpose of the Stormwater Management Plan (SWM Plan) will be to provide guidelines to mitigate negative impacts from post development flows, by proper treatment and control of quality and quantity of the surface runoff.

2.2 Background Information

The following reports were reviewed and used as a basis in preparation of the stormwater management plan for the proposed Winona Crossing development:

1. Drainage Report Marina Point on Baseline, City of Hamilton (Stoney Creek)

A. J. Clarke and Associates Ltd. (August 2007).

This report investigated existing storm drainage issues related to the development of Marina Point on Baseline downstream of Penady Lands, located north of the North Service Road. This report states that the future development to the south of QEW (currently Penady Lands) will need to establish the 100 year peak flows allowed through the MTO QEW culverts on WC 10.1.

2. Stoney Creek Urban Boundary Expansion Area (SCUBE) East Subwatershed Study, City of Hamilton (Stoney Creek)

Aquafor Beech Ltd. (May 2013).

This report investigated the existing natural resources and identifies the constraints and opportunities with existing and proposed land uses in support of urban development in the area (SCUBE East).

3. Functional Servicing Report IO-Winona Lands, City of Hamilton (Stoney Creek) - draft

A. J. Clarke and Associates Ltd. (November 2011).

This report investigated the existing and proposed services for IO-Winona Lands (proposed commercial development) which is located north west of the Penady Lands.



2.3 Stormwater Management Criteria

The subject lands are within the Stoney Creek Watercourse 10.1 as defined in the SCUBE East Sub-Watershed Study conducted by Aquafor Beech Limited on behalf of the City of Hamilton. The receiving water body is Lake Ontario and the sub-watershed area is within the jurisdiction of the Hamilton Conservation Authority.

The following SWM goals and objectives for Watercourse 10 and Fifty Creek has been established from the SCUBE East Subwatershed Study:

- Level 2 (Normal) water quality control;
- Post-to-pre flood control;
- Erosion control for Fifty Creek

The preferred SWM strategy for the SCUBE East watercourses is as follows:

- Low Impact Development (LID) source controls, including capture and infiltration of the first 3mm rainfall on the site with employment/institutional land uses underlain by silt/clayey soils;
- End-of-pipe wet ponds (for sites < 5ha, traditional source controls); and
- Stream restoration

The SCUBE East Subwatershed Study states that

"future stormwater management studies in support of the proposed development could potentially include further detailed hydrologic/hydraulic analyses to investigate the impacts of the future SCUBE developments on the QEW culverts and the major/minor systems north of the QEW. In doing so, these future studies could determine whether quantity control requirements for the SCUBE ponds could be relaxed to any degree.

Further investigation of these systems would require detailed hydraulic grade line analysis of the downstream MTO culverts and the Watercourse 10 storm sewer systems using the City's MIKE-URBAN hydraulic model."

Since the subject property drains through the existing culverts below the QEW, the requirements of the Ministry of Transportation, Ontario (MTO) need to be addressed. MTO criteria based on Ministry Directive B-100 (Design Flood Criteria, MTO 1980) and the Drainage Manual Parts 1 and 2 (MTO 1997) requires a standard freeboard for water crossings of freeways to be 1.0 meter. However, during the reconstruction of the QEW in the late 1990s, the MTO commissioned a *QEW Drainage Report Pinelands to Fifty Road, UMA 1990*, which established the design criteria of 0.5 meter freeboard for the culvert crossings of the QEW. This criteria (0.5m freeboard) has been used in this report.



2.4 Hydrologic Assessment

2.4.1 Soil Classification

The soils within the study area are predominately silty clay/clayey silt of Halton Till overlaying Shale bedrock (of Queenston Formation). The infiltration of these soils is generally low. The shale bedrock under the subgrade soil is fairly shallow at the southerly half of the proposed site. AMEC has conducted a series of borehole analyses which indicate the bedrock to be as shallow as 1.6 m in some areas.

2.4.2 Rainfall Data

The City of Hamilton currently requires that rainfall data from the Mount Hope (Hamilton Airport) rainfall gauge be used in the design of proposed storm sewer systems and stormwater management facilities.

The City's criteria and guidelines for stormwater management infrastructure design indicate that the following storm durations are available for use in the analysis: 3 hour, 6 hour, 12 hour and 24 hour.

2.4.3 Hydrologic Simulation Program – xpswmm Model

The XPSWMM model was chosen to perform the hydrologic and hydraulic analysis for this project. The analysis included both pre and post development scenarios. The model was developed to deal with the dual drainage (minor and major) simultaneously, and to analyze the hydraulic grade line.

The XPSWMM model has been used for this project to analyze the impact of the backwater from the surcharged downstream stormwater infrastructure of the proposed system on the existing MTO culvert below the QEW.

The previous work done by A. J. Clarke and Associates in *Drainage Report Marina Point on Baseline*, 2007, that established approximate existing flows under QEW culvert for Watercourse 10.1, used the 12 hour SCS as the design storm after analyzing the flows from different storm events. For this analysis, the 12 hour SCS design storm has been used to be consistent with the previous study.

2.5 Pre-Development Conditions

The site is currently generally vacant and consists of some fallow agricultural land and wooded areas. There is an existing gas station/motel on the north-west which is subject to re-development. A single residential dwelling is also located at the east side of the site. Surface water runoff from the majority of the site drains from south to north at low slopes of about 1.0% to 1.5% to the tributary WC 10.1 and drains to the newly upgraded storm sewer system north of the QEW via the QEW 1830mm x 1240mm box culvert located at approximately the mid-point of Winona Road and Fifty Road.



At present, approximately 4.98 ha of the site in the southwest corner drains towards Watercourse 10.2 via road side ditches on Winona Service Road and Winona Road. The southeast corner of the project site drains towards the Fifty Road ditch which eventually drains to Watercourse 12 (Fifty Creek).

The drainage areas have three outlets to watercourses 10.1, 10.2 and 12. The Subcatchment areas are detailed under pre-development conditions in Figure C1 in Appendix C.

The hydrologic parameters used to model the pre-development conditions are shown in Tables 1.

Table 1: Pre-development Conditions Parameters Summary						
Sub-catchment ID	Area (ha)	Imperviousness%	CN (AMCB)	Slope	T _c (min)	Initial Abstraction Coefficient
10-11 (Penady Lands)	12.5	6	80	0.015	43	0.15
Node 2	1.3	5	80	0.01	44	0.15
Node 110	9.51	53	80	0.012	18	0.2
Node 3	0.17	85	80	0.005	5	0.2
M 7	3.04	60	80	0.005	12	0.2
M 5	0.78	60	80	0.005	7	0.2
M 1	3.85	70	80	0.015	7	0.2
M 11	1.01	60	80	0.005	7	0.2
M 8	0.94	60	80	0.005	6	0.2
M 4	4.28	60	80	0.005	17	0.2
M 18	7.46	60	80	0.005	15	0.2
M 22	5.86	60	80	0.005	19	0.2
Node 10-20	4.98	17	80	0.01	39	0.15
Node 12-10	0.9	6	76	0.015	26	0.1

Using the above parameters, the XPSWMM model was simulated for the 12 hour SCS design storm event. A summary of the pre-development peak flows are shown in Table 2 (refer to Appendix C for additional information).

Table 2: Pre-development Peak Flows m ³ /s					
Outlet \ Storm	12 hr- SCS Storm				
	5 yr	10 yr	25 yr	50 yr	100 yr
Outlet WC10.1 (Hydraulic Link 1101)	0.700	0.965	1.320	1.595	1.876
Outlet WC10.2 (Runoff Node 10-20)	0.306	0.414	0.556	0.664	0.775
Outlet WC12 (Runoff Node 12-10)	0.058	0.080	0.109	0.131	0.155



2.6 Post Development Conditions

The post development conditions for the drainage areas draining to WC 10.1 are subdivided by different owners and designated for commercial purposes in accordance with the SCUR East Secondary Plan prepared by the City of Hamilton and the site plan for Winona Crossing prepared by Turner Fleischer (see Appendix A). The drainage areas have three outlets to watercourses 10.1, 10.2 and 12 similar to pre-development conditions. The Subcatchment areas are detailed under post-development conditions in Figure C2 in Appendix C.

The hydrologic parameters used to model the post-development conditions are shown in Tables 3, 4 and 5.

Sub-catchment	Area (ha)	Imperviousness%	Pervious area CN	Slope	T _p (min)	Initial Abstraction Coefficient
Walmart (Site A)	3.3	93	80	0.01	13	0.2
Walmart 2 (Site A)	0.56	29	80	0.01	10	0.15
Costco (Site E)	5.68	93	80	0.01	19	0.2
Costco 2 (Site E)	0.58	0	80	0.01	39	0.15
Transit	0.47	93	80	0.01	5	0.2
Site F	0.45	90	80	0.01	5	0.2
201C (Site C North)	0.93	93	80	0.01	6	0.2
202C (Site C South)	0.21	93	80	0.01	9	0.2
201G (Site G South)	1.16	93	80	0.01	7	0.2
202G (Site G North)	1.13	93	80	0.01	7	0.2
Node95	0.21	75	80	0.01	8.3	0.2
Node110	8.79	53	80	0.012	18	0.2
Node9	0.17	85	80	0.005	5	0.2
Node95	0.13	93	80	0.01	5	0.2
Node97	0.05	93	80	0.01	5	0.2
Node2	0.05	75	80	0.01	5	0.2
CB10(C)	0.1	93	80	0.01	5	0.2
M7	2.04	60	80	0.005	12	0.2
M5	0.78	50	80	0.005	7	0.2
M1	3.83	70	80	0.016	7	0.2
M11	1.01	50	80	0.005	7	0.2
M8	0.94	60	80	0.005	6	0.2
M4	4.29	50	80	0.005	17	0.2
M18	7.46	60	80	0.005	15	0.2
M22	5.86	50	80	0.005	19	0.2



Table 4: Post-development Conditions Parameters Summary for Outlet 10.2

Sub-catchment ID	Area (ha)	Imperviousness%	CN (AMCII)	Slope	T _c (min)	Initial Abstraction Coefficient
Node 10	0.11	95	80	0.02	5	0.20
Node 20	0.19	93	80	0.02	5	0.20
Node 30	0.23	93	80	0.02	5	0.20
Node 40	0.15	66	80	0.02	5	0.20
Node 50	0.17	93	80	0.02	5	0.20
Node 60	0.07	93	80	0.02	5	0.20
Node 70	0.18	93	80	0.02	5	0.20
Node 80	0.29	85	80	0.02	5	0.20
Node 90	0.17	82	80	0.02	5	0.20
Node 100	0.14	65	80	0.02	5	0.20

Table 5: Post-development Conditions Parameters Summary for Outlet 12

Sub-catchment ID	Area (ha)	Imperviousness%	CN (AMCII)	Slope	T _c (min)	Initial Abstraction Coefficient
Node 12-10 (Site B)	0.98	90	76	0.010	10	0.20

2.7 Analysis and Stormwater Management Plan

The swm objectives for **quantity control** will be accomplished with the installation of an underground cistern (ChamberMAXX or Cultec system) and/or utilizing parking lot storage to control the quantity of storm discharge from individual sites.

A copy of the ChamberMAXX design of the underground retention system with containment pipes for all the individual sites in the Winona Crossing project is attached in **Appendix B** with details provided in **Appendix I**. Engineering drawings for the servicing and grading of the site are also attached in **Appendix B**.

For **quality control**, an oil/grit separator(s) shall be installed at the inlet location(s) to the underground storage cistern at each site providing the necessary *Normal Level 2* quality protection. In addition to the Oil Grit Separators (CDS Units or Stormceptor units) the underground storage cisterns shall have *Containment or Separator* rows that will further provide swm quality control.



The underground cisterns are to be designed such that the *containment/separator rows* do not allow for infiltration into the bedding below. However, the remainder of the system will have an open bottom to provide storage for infiltration purposes as required.

Low Impact Development (LID) features in the form of permeable pavers and bio-swales are also proposed at various locations within the Winona Crossing site.

SWM quantity control analyses for each of the outlets are presented below.

2.7.1 Outlet-10.1

Due to downstream storm sewer constraints, the 100 year maximum flow from the Winona Crossing site has been limited to 38 L/s/ha which is less than the 5 year predevelopment flows (51L/s/ha) to W.C 10.1 at Node QEW culvert. A detailed hydraulic grade line analysis of the downstream MTO culverts and the Watercourse 10.1 storm sewer system from the QEW to Lake Ontario was carried out to determine the storage volumes that would be necessary to achieve the following:

- Meet the conveyance and freeboard targets for the QEW as specified by MTO Directive B-100
- Confirmation that the frequency of surcharging within the downstream storm sewer system does not increase, and
- Confirmation that the frequency of surface flooding does not increase.

The detailed hydraulic grade line analysis is shown in Appendix C and as a result of this analysis, the post development runoff from Winona Crossing site that drains to Outlet 10.1 has been controlled to have an overall discharge of 38 L/s/ha. The Subcatchment areas to WC 10.1 are detailed under post-development conditions in **Figure C2 in Appendix C**.

The calculated storage requirements for the Outlet-10.1 swm infrastructure are outlined in **Table 6**:

Table 6: Outlet 10.1 Quantity Control Summary					
Description	Frequency (Years)				
	5 yr	10 yr	25 yr	50 yr	100 yr
Pre-development peak flow (Penady Lands) (m ³ /s) (L101)	0.700	0.965	1.320	1.595	1.876
Post development peak outflow (Penady Lands) (m ³ /s) (L120+L118)	0.426	0.496	0.529	0.551	0.571
Increase in peak flow from pre to post development (m ³ /s)	-0.274	-0.469	-0.791	-1.044	-1.305
Maximum system storage (m ³)	3,613	4,585	5,842	6,798	7,776

Storage for Erosion protection is not considered as necessary since the existing watercourse is proposed to be enclosed in a storm sewer that will outlet to the culvert below the QEW and its service roads. From the North Service Road, the storm drainage flows northerly for a short length before crossing



under another culvert and then a short stretch of open ditch before entering a storm sewer system that outlets to Lake Ontario.

MTO Requirements

1) Design criteria of 0.5 meter freeboard for the culvert crossings of the QEW:

The MTO culvert (1830mm x 1240mm box culvert) below QEW is not affected by the Winona Crossing development, since the post development peak flows are lower than pre-development flows from the site. Table 7 illustrates the QEW culvert's 100 year Water Elevation and peak flows for pre and post development conditions.

Table 7: QEW Culvert Water Levels for 100 Year Storm			
Location	Pre-development	Post-development	Difference
HGL U/S side of QEW at SSR Culvert (m) , (Node 92)	82.616	82.304	-0.312
HGL D/S side of QEW at SSR Culvert (m) , (Node 3)	82.036	81.808	-0.228
Peak flow to QEW (m ³ /s) , (QEW-CUL)	3.398	2.897	-0.501

The maximum water level is 82.62m and 82.304m in the South Service Road culvert under pre and post development conditions, respectively. The existing road elevation of South Service Road is 83.60m providing 1.296 m of freeboard under post development conditions which is an improvement since it is higher than pre development conditions.

2) Impact on MTO culverts in case of Failure of Underground Cistern System:

MTO does not consider cistern systems to be permanent in nature; hence MTO requires an evaluation of the SWM system without the cistern storage system and its effect on MTO culverts. This matter has been addressed prior to this report and the impact on QEW culverts has been analyzed. The results of this analysis are presented in Appendix D.

2.7.2 Outlet-10.2

Site D (Node 10-21) drains to Outlet 10.2 via existing ditches at the intersection of Winona Road and the Winona Service Road, thence northerly towards WC10.2 which eventually outlets to Lake Ontario. A 250 mm storm sewer (connected to an oil/grit separator) has been proposed to control the runoff from the site to pre-development levels for this outlet.

The peak flows for all storms from the 5 year to the 100 year storm are over-controlled from pre to post development conditions. Parking lot and storm sewer storage has been proposed for this site for quantity control.

The calculated storage requirements for the Outlet-10.2 swm infrastructure are outlined in Table 8;



Table 8: Outlet 10.2 Quantity Control Summary					
Description	Frequency (Years)				
	5 yr	10 yr	25 yr	50 yr	100 yr
Post development peak inflow (m ³ /s)	0.357	0.436	0.532	0.604	0.676
Post development peak outflow from 'Site D' (m ³ /s), (Link126)	0.155	0.156	0.157	0.158	0.158
Pre-development peak flow (m ³ /s) (4.98 ha)	0.306	0.414	0.556	0.664	0.775
Increase in peak flow from pre to post development (m ³ /s)	-0.151	-0.258	-0.399	-0.506	-0.617
Maximum parking lot storage for 'Site D' (m ³)	134.031	205.321	314.285	395.219	479.554
Maximum water surface elevation (m)	86.036	86.066	86.101	86.122	86.142
Maximum flooding depth in the parking lot (m)	0.186	0.216	0.251	0.272	0.292

There is a considerable decrease in peak flow especially for 100 year from pre to post development to Outlet 10.2 due to a decrease in the drainage areas to this outlet from pre to post development conditions.

2.7.3 Outlet-12

Surface water runoff from Site B (Node 12-10) drains to Outlet-12 through a proposed storm sewer on Fifty Road which outlets to the east to existing roadside ditches along Fifty Road. The ditch flows north-easterly in the South Service Road ditch and then discharges to Watercourse 12 (Fifty Creek). Runoff storage has also been provided beneath the parking lot using underground cistern systems which provide a maximum storage of 549 m³. A 250mm storm sewer connected to the underground cistern has been proposed to limit the runoff from the site.

The calculated storage requirements for the Outlet-12 swm infrastructure are outlined in Table 9.

Table 9: Outlet 12 Quantity Control Summary					
Description	Frequency (Years)				
	5 yr	10 yr	25 yr	50 yr	100 yr
Post development peak inflow (m ³ /s), (Node 12-10)	0.194	0.235	0.287	0.325	0.363
Post development peak outflow from 'Site B' (m ³ /s), (L12-10)	0.054	0.062	0.071	0.077	0.083
Pre-development peak flow (m ³ /s)	0.058	0.080	0.109	0.131	0.155
Increase in peak flow from pre to post development (m ³ /s)	-0.004	-0.018	-0.038	-0.054	-0.072
Maximum cistern system storage (m ³)	233	288	356	408	459

The proposed stormwater management facilities (underground cistern systems) shall be designed and constructed in accordance with the standards and requirements of the City of Hamilton, the Hamilton Conservation Authority and the Ministry of the Environment.



2.8 Low Impact Development Features

The Low Impact Development (LID) SWM Planning and Design Guide, 2010, CVC and TRCA states that:

The landscape-based approach to stormwater management planning and design is also founded on recognition of the value of land, both as a commodity and as the fundamental basis of a sustainable ecosystem. The approach is focused on utilizing land efficiently and where possible overlaying more than one function on any given piece of land.

Based on the principles outlined in several LID guides and design literature, several types of LID features that could be incorporated in the design of the site works for the Winona Crossing project were investigated. The soils within the project are generally impervious clay-based and shale soils which are not conducive to infiltration strategies. However, we have explored strategies that employ a combination of at-source practices.

An Integrated Treatment Train Approach is integral to providing an effective swm strategy for the site, including lot level and end-of-pipe controls.

The list below provides examples of several LID features with their key characteristics and recommendations for their potential use on the proposed project:

1. **Bio-Retention (Enhanced) Swale**
 - a. Vegetated depression with highly porous soil mixture, provides quality treatment, storage and infiltration
 - b. Installed with subdrain - limited infiltration on site due to the nature of native soils (silty clay)
 - c. **Recommended** for implementation where possible based on City approval
2. **Bio-retention Basin**
 - a. Impermeable reservoir, vegetated with aquatic plants
 - b. Provides SWM Quality treatment
 - c. Limitations caused by permanent water source options:
 - i. Water from underground conveyance system pipes (1.2m min pipe cover required for frost protection);
 - ii. Surface runoff from surrounding grassed and walkway areas via shallow drains
 - iii. Contingency for dry periods to be investigated for water supply from underground storage to sustain wet plant vegetation
 - d. Limitations for maintaining permanent water level to sustain growth of aquatic plant vegetation: bottom lined with impermeable material which is contrary to infiltration of surface water objective
 - e. Inlet/outlet pipe inverts shall be configured with respect to minimum cover and maintaining wet plant vegetation
 - f. **Not Recommended**



3. ***Vegetated Roof***
 - a. Green roof consisting of waterproof barrier, root membrane, growing media, vegetation and overflow drains
 - b. Storage and quality treatment
 - c. Limitations resulting from cost and maintenance issues
 - d. ***Not Recommended***
4. ***Rooftop Storage***
 - a. Quantity control (if required)
 - b. May reduce underground storage requirements
 - c. Not consistent with MTO and City policy
 - d. ***Not Recommended***
5. ***Parking Lot Storage***
 - a. Quantity control (if required)
 - b. Can be used to reduce storm sewer sizes
 - c. Orifice plates (or reduced storm outlets in accordance with MTO criteria) required in catch basins
 - d. ***Recommended***
6. ***Rainwater Cistern***
 - a. Underground tank with restricted outlet storm sewer
 - b. Location - below ground in parking areas
 - c. Temporary storage for water - could be re-used for irrigation purposes but generally not practical
 - d. Optional rainwater reuse in the grey water system (e.g. flushing toilets) but not practical
 - e. Infiltration into ground is encouraged by use of Chamber MAXX or Cultec Recharger System which includes clear stone around cistern as well as open bottom founded on clear stone
 - f. ***Recommended***
7. ***Porous Pavement***
 - a. Design criteria and performance measures have not been established to date
 - b. ***Not recommended***
8. ***Permeable Pavers***
 - a. Applicable for use in parking lot in areas used for parking stalls only
 - b. Quality treatment and infiltration is provided
 - c. Issues with additional cost and long term maintenance
 - d. ***Recommended*** in limited areas (where possible) based on grading of parking stalls only
9. ***SWM Pond (end of pipe):***
 - a. Primary use for quantity, erosion and quality control
 - b. Esthetic and court yard feature
 - c. Land requirements do not allow the opportunity of installation of swm pond
 - d. ***Not recommended for this site***



10. Oil-Grit Separator (end of pipe):

- a. Primary use for quality control
- b. Limitations to provide Normal Level 2 protection i.e. 70% TSS removal
- c. To be used in conjunction with Treatment Train Approach
- d. ***Recommended to be used in addition to Lot Level Treatment Train***

The following features are proposed as being integrated in the design of the SWM system for the Winona Crossing site:

- 1. Oil-Grit Separators
- 2. Permeable Pavers
- 3. Parking Lot Storage of stormwater
- 4. Underground cistern storage systems designed for infiltration
- 5. Enhanced (bio-retention) swales

The design sheets prepared by CVC for permeable pavers and bio-swales are attached in **Appendix F** as guidelines for construction and maintenance functions of these LID features. Observation wells shall be incorporated at the lowest elevation of the permeable pavers within the site so as to facilitate monitoring of the efficiency of the system.

In addition to the above, additional features such as Landscaping within the vegetated setbacks along the west, north and east limits of the site are being proposed.

2.9 Infiltration Requirements

The SCUBE East Sub-watershed Study recommends capture and infiltration of the first 3mm rainfall on the site with employment/institutional land uses underlain by silt/clayey soils. In order to satisfy this requirement, an analysis was carried out for each of the sites, using the infiltration storage available in the permeable pavers as well as below the underground cisterns into the underlying silty clay/clayey silt soils. The underground facilities are located where the shallow shale rock was not encountered.

Calculations based on Appendix C, Tables C-1 and C-2 of the SCUBE East Sub-watershed Study have been presented in **Appendix G**.

Table 10 outlines the results of the calculations for infiltration requirements to satisfy SCUBE criteria.



Table 10 – Infiltration Requirements for SCUBE

Site	Area (ha)	Required infiltration yearly (m ³)	Actual infiltration yearly (m ³)	Actual/Required
Site A	3.3	3847.8	6781.2	1.76
Site B	1.04	1212.6	2440.4	2.01
Site C-North	1.04	1212.6	3064.7	2.53
Site C-South	0.27	314.8	559.6	1.78
Site G-North	0.86	1002.8	2924.2	2.92
Site G-South	1.45	1690.7	2931.5	1.73
Site D	1.71	1993.9	1561.1	0.78
Site E	5.8	6762.8	11899.9	1.76
Site F	0.45	524.7	1253.7	2.39
Transit	0.54	629.6	1061.4	1.69
Remaining of Penady Lands	1.34	1562.4	0.0	0.00
Total	17.8	20754.8	34477.8	1.66

The calculations demonstrate that the requirement of capturing the first 3mm rainfall for infiltration purposes is easily met on the Winona Crossing site.



3.0 Erosion and Sediment Control Procedures

Topsoil and vegetation will be removed from the majority of the site to accommodate lot grading and construction of all municipal services. The resulting disturbed ground will require sedimentation control measures to prevent silt from reaching the receiving waterbody and the stormwater management facility during pregrading operations.

Siltation from surface runoff from the site can be prevented with the use of silt fences placed along the boundaries where runoff will accumulate and the construction of sediment traps/basins at several locations with intercepting swales so as to allow the sediment to settle before discharging to the receiving waterbody.

In accordance with the Erosion and Sediment Control Guidelines [2006], Sediment Basins are being proposed for Sites A, E and G since the disturbed drainage areas for each of these 3 sites exceed two (2) hectares in size. The proposed sediment basins have been designed as two components:

1. Active Storage Volume:

Designed with a minimum of 125 m³/hectare contributing drainage area with a minimum 48-hour drawdown time (minimum 75mm diameter orifice), and a minimum 4:1 L:W ratio of the pond; and,

2. Permanent Pool Volume:

- i. Minimum 125 m³ storage volume/hectare drainage; or,
- ii. Minimum 185 m³ storage volume/hectare drainage area if L:W ratio is less than 4:1 or the drawdown time for active storage is less than 48 hours.

Calculations for the sizing of the Sediment Basins are provided in **Appendix H**.

Other localized areas may also require sedimentation control fencing. This would be determined at the construction stage.

It will also be necessary to prevent silt from entering the storm sewer system via street catch basins, rear yard catch basins and ditch inlets. At rear yard catch basins filter cloth material shall be placed over the grate and covered with clear stone material. For street catch basins a silt sack or equivalent can be inserted under the grate.

Topsoil stockpiles shall be temporarily seeded to help reduce erosion. Where required, erosion control blankets shall be placed as directed. Double lined silt fences and/or temporary rock flow check dams may be required at the drainage outlets.

In order to reduce the amount of sediment reaching the street, it is suggested that the grade at the property line be left approximately 200mm below the top of the curb until such time as ground cover is



about to be established. This will aid in the settlement of sediment, thus reducing sediment flow to the streets. Should building activity over the entire site not commence soon after the underground servicing and the roadworks are complete, arrangements should be made to temporarily seed those areas not covered with vegetation.

Precautions should be exercised during all stages of construction activity. Regular monitoring of the site controls and periodic maintenance will be required to ensure that the erosion and sediment controls remain effective.

All practices shall be in accordance with the "Erosion and Sediment Control Guidelines for Urban Construction", GGHA CAs, December 2006.



4.0 Recommendations and Conclusions

The recommendations and conclusions of this report concerning storm drainage, storm sewers, and stormwater management requirements for the proposed development are as follows:

1. Implement and conform to the requirements and criteria of the SCUBE East Subwatershed Study for SWM quantity and quality control;
2. Provide LID features as shown on the engineering drawings (servicing and site grading);
3. Provide underground cisterns sized to restrict the amount of flow from the site to less than the 5 year pre-development levels, in accordance with the Hydraulic Grade Line analysis presented;
4. Install Oil-grit Separators prior to storm flows from the parking lots entering the underground cisterns to provide Normal Level 2 quality control. Further, provide for containment/separator rows within the cisterns to allow for further removal of the soil particles;
5. Install clear stone bedding below the main portion of the cisterns to encourage capture and infiltration of at least the first 3mm of rainfall on the site;
6. Design the storm sewer system within the project site as a shallow storm sewer system with a minimum cover over the storm sewer of 1.2m (or provide adequate insulation);
7. Ensure Siltation and Erosion Control measures are implemented throughout the construction process.

We conclude that the subject property can be serviced for the proposed development in accordance with the requirements of the City of Hamilton for urban development.

All of which is respectfully submitted.


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Tel: 905 528-8761 Fax: 905 528-2289



The table below contains the summary for the Contech systems/parking lot storages for the sites and the results for 100 year.

Site Name (Node)	Invert of cistern/Top of CB elevation (m)	Provided Maximum Storage in Contech/parking lot (m ³)	Outlet pipe size from the Site (mm)
Walmart (Site A)	82.65	2415.0	375
201C (Site C North)	82.50	754.5	150
202C (Site C South)	83.23	178.8	200
Costco (Site E)	82.64	2272.6 (cistern)+1491(parking lot)	375
Site F	83.05	289.5	150
201G (Site G South)	82.54	1022.0	200
202G (Site G North)	82.32	590.1	200
Transit	83.85	306.0	150
Node 12-10 (Site B)	85.22	549.0	250
Node 10-21 (Site D)	86.10 (T/MH)	409.5 (Parking lot storage)	250
Total	-		-

The 100 year storm flows are contained and conveyed within the storm sewer system at the Penady Lands with some surcharge in the pipes but no overtopping.



LEGEND:

- SUBCATCHMENT
- Node 2
2.76 | 0.02
--- SUBCATCHMENT TO (GROUP)
--- IMPERVIOUSNESS
AREA (ha)
○ Node 2
--- NODE
--- DIRECTION OF FLOW



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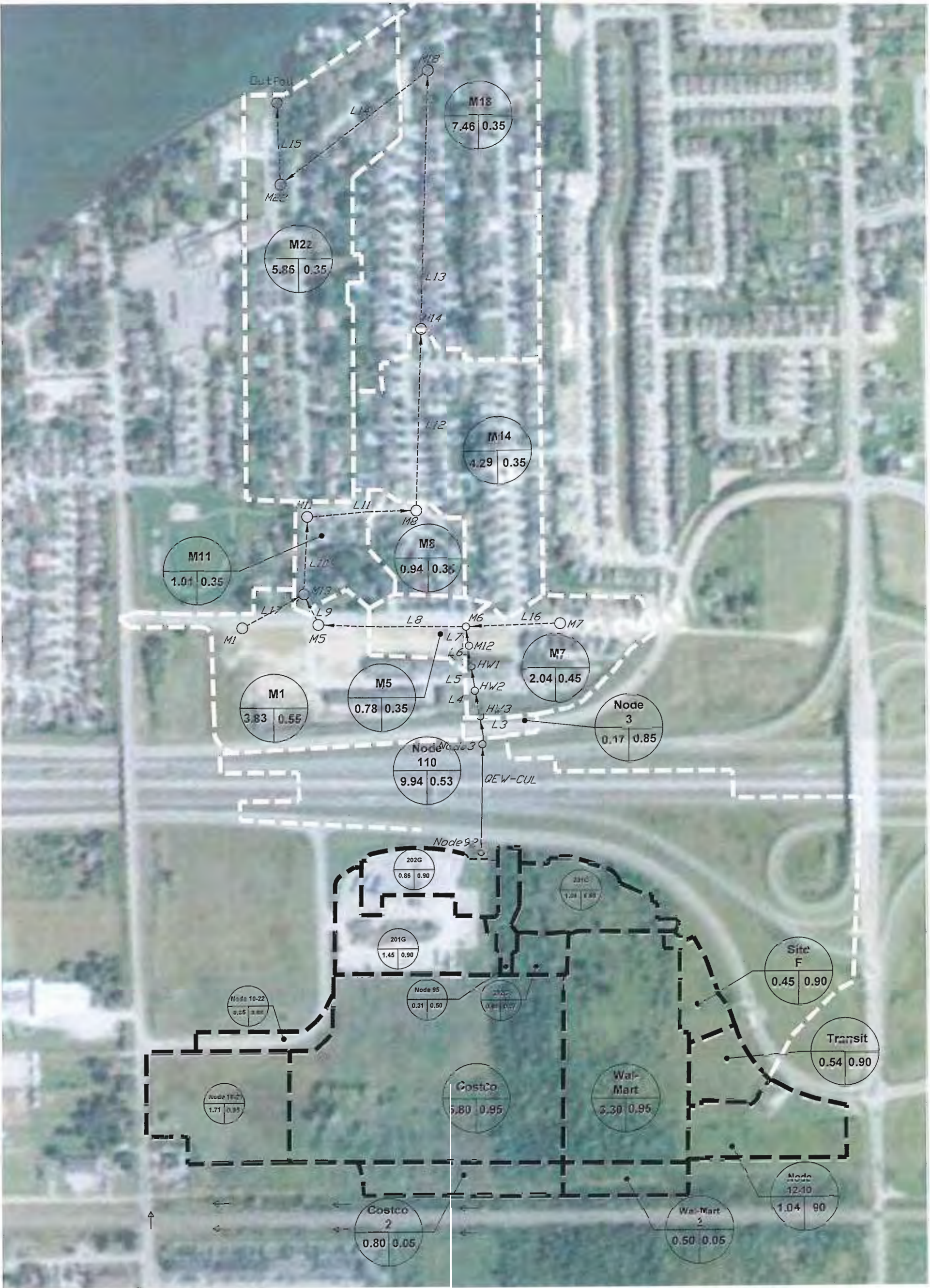
CITY OF HAMILTON (STONEY CREEK)

FIGURE C-1

WINONA CROSSING

EXISTING DRAINAGE AREAS (OVERALL)

SCALE: 1:1000



LEGEND:

- SUBCATCHMENT
- Node 3
0.17 0.85
SUBCATCHMENT ID (Node)
IMPERVIOUSNESS
AREA (ha)
- Node 3
NODE
- L3
LINK, SINGLE
- L11
LINK, MULTIPLE
- ←
DIRECTION OF FLOW
- ▲
STORAGE NODE

SCALE 1:4000



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CITY OF HAMILTON (STONEY CREEK)

FIGURE C-2

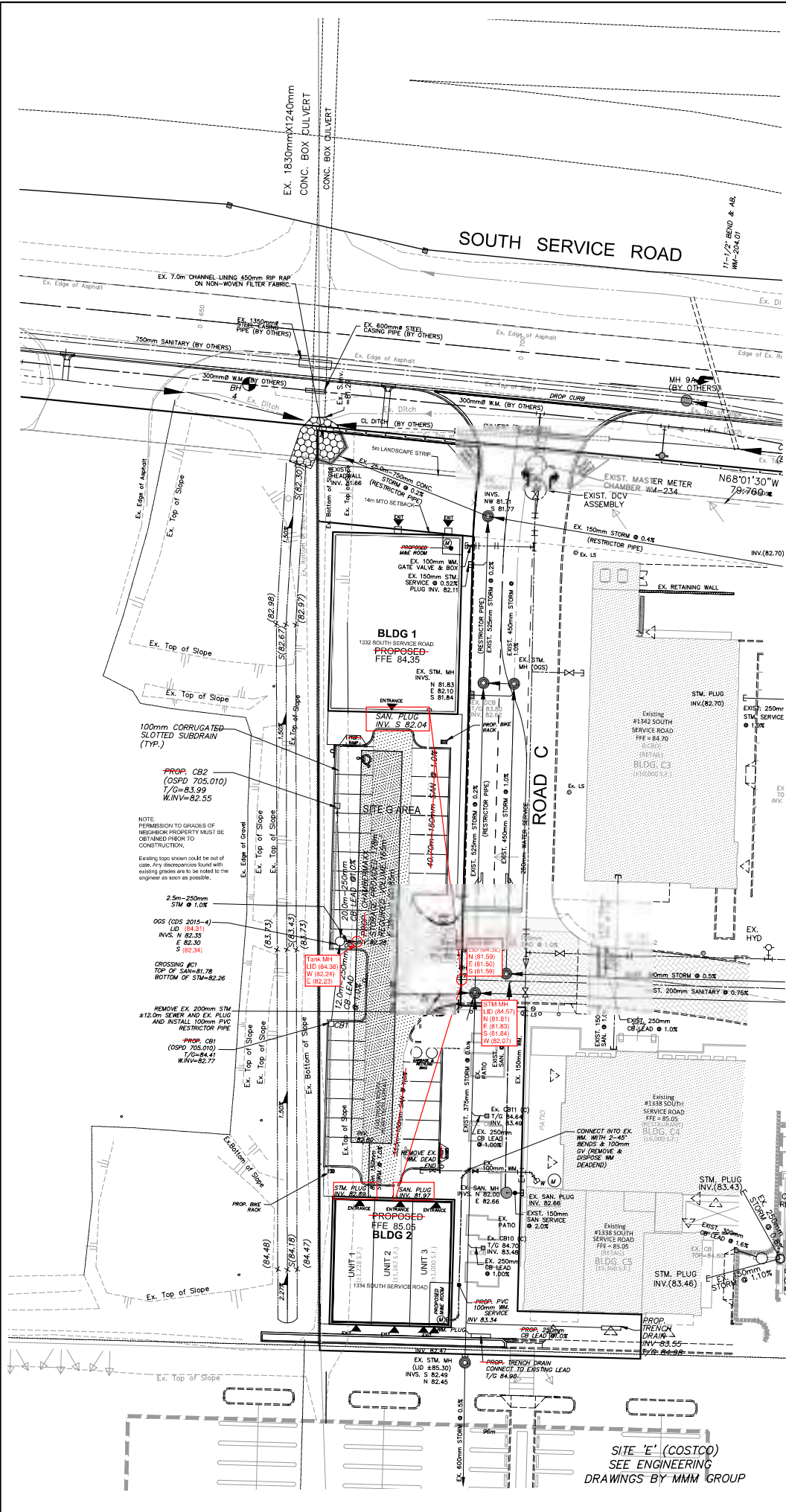
WINONA CROSSING

PROPOSED DRAINAGE AREAS

APPENDIX

G SITE G SERVICING PLAN





STANDARD NOTES

A. SEWERS

1. SANITARY & STORM SEWERS

- Construction of sanitary & storm sewers & private drains shall be in accordance with City standards & specifications Manual (Latest Edition) and Ministry of Environment (MOE) Guidelines (Latest Edition).
- All proposed sewers, throughout their length from the main sewer to the building or place to be drained is to be laid, as nearly as practical, in a straight line in a trench at a right angle to the main sewer.
- Sewer bedding, cover and backfill to be as per OPSD 802.010 with Granular 'A' material for both the bedding and cover.
- On private property the minimum cover is to be no less than 1.2m, unless otherwise detailed.
- Maintenance holes 1200mm diameter to be as per OPSD 701.010 (with no sumps); Maintenance holes 1500mm diameter to be as per OPSD 701.011 (with no sumps); Maintenance holes 1800mm diameter to be as per OPSD 701.012 (with no sumps).
- All sewers to be flushed prior to video inspection.
- Manhole frames and covers shall be as per OPSD 401.010 (Storm-open, Sanitary-closed)
- Sanitary sewer pipe shall be PVC pipe, CSA B182.2, SDR-35
- Storm sewer pipe shall be PVC pipe, CSA B182.2, SDR-35 (unless otherwise specified as concrete pipe, CSA A257.2, 65-D). j) Alternate materials may be acceptable provided approval has first been obtained from the City / Engineer.
- Minimum horizontal separation between sewer and watermain to be 2.5m. Minimum vertical separation for watermain below any sewer to be 0.5m For watermain above any sewer, minimum vertical clearance of 0.15m is required.
- A drop structure is required at all manholes where there is a drop of greater than 600 mm between the invert of the upstream pipe and the invert of the downstream pipe and is to be as per OPSD 1003.010. Generally the size of the drop pipe shall be one size smaller than the connecting sewer, minimum size 200mm, maximum size 300mm.

2. PRIVATE DRAINS

- Testing of sewers as per City specifications (ie. deflection, infiltration/exfiltration).
- "Sa" denotes sanitary private drain connection. "St" denotes storm private drain connection.
- Private drains to be 150mm dia, PVC SDR 28 as per Form 500. Storm shall be white in color. Sanitary shall be any color other than white. Wood marking at end of sanitary private drain shall be painted red. Cover and bedding material for private drains shall be Granular 'A' installed as per OPSD 802.010.
- Minimum fall for private drains to be 2.0%, unless otherwise detailed.
- Invert of private drains at building to be 2.00m below proposed first floor elevation (or as detailed).
- Storm private drains to have 1.2m minimum cover within site.
- Roofwater leaders shall be connected by gravity to the storm sewers.

B. WATERMAINS AND WATER SERVICES

1. WATERMAIN

- Construction of watermains & private services shall be in accordance with City standards & Specifications Manual (latest edition) and Ministry of Environment (MOE) Guidelines (latest edition).
- Water services are to be installed perpendicular to the existing City watermain and straight into the building.
- Minimum 1.60m cover over proposed watermain (unless otherwise specified).
- PVC pipe in sizes 100mm through 300mm shall be Class 150 DR18 conforming to AWWA C900. Services 50mm and less must be copper, however, PVC or an alternate material approved for use under the Ontario Building Code may be used on private property. PVC water main/service material, cathodic protection, tracer wire etc. must be as per Form 400.
- Watermain bedding and cover material to be installed as per WM-200.01 with Granular 'A' for both bedding and cover. Bedding and cover for small diameter services (i.e. 50mm and under) to be installed as per WM-200.01 with Granular 'D' for both bedding and cover.
- For watermain deflection (PVC pipe)
 - maximum allowable deflection of 1.5 degrees per joint for up to 250mm diameter and 1.2 degrees for up to 300mm diameter shall not be exceeded. (the maximum allowable pipe deflection to be 1/2 the manufacturer's recommendations).
 - each joint shall be deflected an equal amount.
- Where water services are to be looped on a property, check valves are required on the system at the property lines on private property.
- All system components are to be either to City of Hamilton Standards, or Ontario Provincial Standard Drawing (OPSD). Where a City Standard exists it shall be used in the place of the OPSD standard.
- A scheduled Watermain shut down shall be at the discretion of the City and subject to the following:
 - Maximum 4 hours shut down of existing main at a time convenient to the City of Hamilton and abutting users.
 - Contractor to give 48 hour prior notification using the "City of Hamilton Notice of Shutdown" for all affected areas.
 - In the event a scheduled shutdown is canceled by the City of Hamilton, the contractor shall have no claims against the City.

2. FLUSHING, SWABBING AND TESTING

- All new watermains are to be swabbed in accordance with City specifications.
- A reduced pressure zone Backflow Preventer (WATTS SERIES 909 or approved equal) is required on the temporary supply lines used for filling and flushing/swabbing of watermains.
- Upon completion of installation, the Contractor shall perform a pressure test on the watermains as per Form 400. Watermain is to be tested prior to connection to existing watermains using temporary caps or plugs. Pipe closures, where required, are to be supplied by the Contractor. The Contractor will also supply and install all adaptor pieces in order to connect existing watermains.

3. WATER SERVICES

- Curb stops are to be installed on all water services as shown on Site Servicing Plan.
- Granular bedding as per WM-200.01 to be Granular 'D' as per Form 600.
- Water services to be installed with a minimum cover of 1.6m.

4. VALVE & VALVE BOX

- All valve boxes to be set to proposed boulevard grade or driveway grades.
- Gate valves and valve boxes for 100mm to 300mm as per WM-202.

5. ANCHOR BLOCKS

- For 100mm to 300mm watermains, standard concrete blocks as per WM-204.01.
- For 100mm to 300mm watermains, vertical bend concrete blocks as per WM-204.10 and WM-204-11.

C. ROADWORKS

1. GENERAL

- Construction of roadways & related works shall be in accordance with City standards and specifications (Latest Revision)
- Following the installation of sewers, all roadways shall be rough graded to subgrade for the installation of watermains & utilities.

2. CATCH BASINS

- Catch basin connections to be 250mm PVC. Pipe CSA B182.2, DR 35
- Single street catch basins as per OPSD 705.010 'A' with goss trap as per SEW-304.
- Street catch basin covers as per OPSD 400.100

3. FINAL ROADWAYS

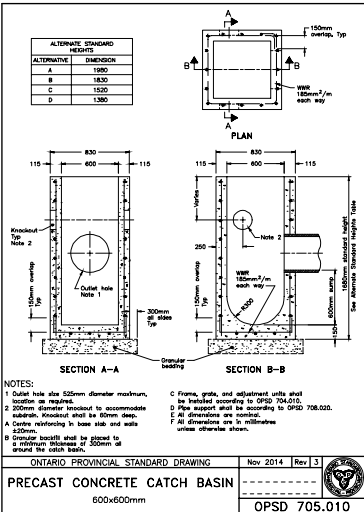
- Heavy duty pavement design shall be 40mm SP9.5, 80mm SP19 on 150mm compacted Granular 'A' and 400mm compacted granular 'B'. Type II 100% crushed aggregate for main roadways. For location of main roadways, see Site Plan for "Fire and Truck Route Heavy Duty Asphalt."
- Pavement design shall be 40mm HM3, 50mm HL8 on 150mm compacted Granular 'A' & 300mm compacted granular 'B' Type II 100% crushed aggregate for parking areas.
- Manholes and catch basins shall be installed flush with the base course asphalt (HL8).
- Manholes to be adjusted to match final lift of asphalt.
- Final asphalt course (SP9.5) shall be placed a min. of 1 year after the installation of the asphalt binder course on main roadways.
- For manhole and catchbasin top adjustments, all permanent adjustments are to be poured-in-place.
- Restoration of road over utility cuts in Hamilton to be as per Standard drawings RD-100.01 and RD-100.02, with granular "A" bedding.

4. WALKS, CURBS & SUBDRAINS

- Barrier curb as per OPSD 600.110. (See Also "Concrete Curb Section" and "Curb Depression" on Site Plan.)
- 100mm filter wrapped corrugated plastic subdrains to be installed where noted as per City Standards (RD-101).

5. COMPACTION REQUIREMENTS

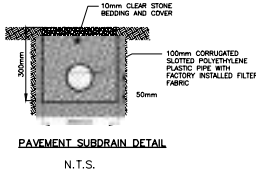
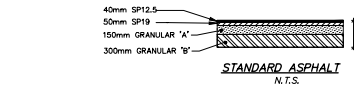
- All bedding and backfill material, road sub-grades, and generally all material used for lot grading and fill sections etc., shall be compacted to min. 100% SPD unless otherwise specified.
- All granular road base materials shall be compacted to 100% S.P.D.
- For all sewers and watermains in fill sections, the compaction shall be verified prior to laying of pipe.



NOTE: CONTRACTOR SHALL NOT SCALE FROM THIS DRAWING, ANY INCONSISTENCIES AND OMISSIONS FOUND ON THE DRAWINGS MUST BE REPORTED TO THE ENGINEER FOR CLARIFICATION BEFORE COMMENCING WORK.

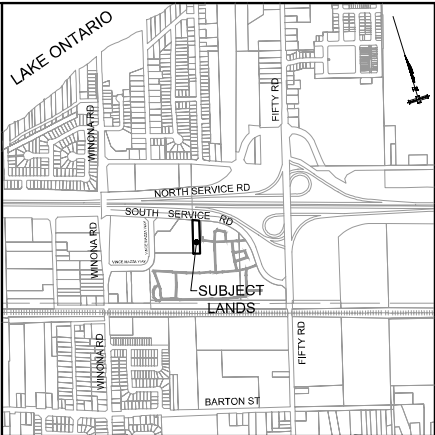
- PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND ELEVATIONS, REPORT ALL FINDINGS TO THE ENGINEER.
- ONCE CONSTRUCTION HAS COMMENCED THE CONTRACTOR ACCEPTS RESPONSIBILITY FOR ALL DIMENSIONS, ELEVATIONS AND SITE CONDITIONS.
- THE LOCATION OF UTILITY LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND/ABOVE GROUND UTILITIES ARE NOT NECESSARILY SHOWN ON THE DRAWINGS, WHERE SHOWN ON THE DRAWING THE ACCURACY OF THE POSITION IS NOT GUARANTEED.
- BEFORE START OF WORK THE CONTRACTOR SHALL VERIFY EXACT LOCATION OF ALL SUCH UTILITIES AND ASSUME LIABILITY FOR DAMAGE TO THEM.

NOTE: CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE ENGINEER 48 HRS PRIOR TO COMMENCING WORK TO ARRANGE FOR INSPECTION. FAILURE TO NOTIFY ENGINEER WILL RESULT IN EXTENSIVE POST CONSTRUCTION INSPECTION AT CONTRACTORS EXPENSE.



LEGEND

- | | | |
|-------------------------|------------------------------|--------------------------------------|
| FFE | FINISHED FLOOR ELEVATION | PROPOSED CURB & GUTTER |
| CB/MH | PROPOSED CATCH BASIN MANHOLE | PROPOSED 1.5m SIDEWALK |
| MH A/B | PROPOSED SANITARY MANHOLE | EXISTING CURB & GUTTER |
| PMH | PROPOSED STORM MANHOLE | PROPOSED 150mm SUBDRAIN |
| Ex. MH | EXISTING SANITARY MANHOLE | PROPOSED 50mm DISPLACEMENT |
| Ex. MH | EXISTING STORM MANHOLE | WATER METER |
| Ex. CB | EXISTING CATCH BASIN | PROPOSED BUILDING |
| CB | PROPOSED CATCH BASIN | ENTRANCE/EXIT POINT |
| DCB | PROPOSED DUAL CATCH BASIN | OIL GRIT SEPARATOR |
| PROPOSED WATERMAIN | PROPOSED WATERMAIN | MANHOLE COVER ELEV |
| PROPOSED SANITARY SEWER | PROPOSED SANITARY SEWER | TOP OF GRATE ELEV |
| PROPOSED STROM SEWER | PROPOSED STROM SEWER | PROPOSED STM, SAN, OR WM PLUG |
| EXISTING WATERMAIN | EXISTING WATERMAIN | PROPOSED WM ELBOW / BEND |
| EXISTING SANITARY SEWER | EXISTING SANITARY SEWER | PROPOSED WATERMAIN TEE |
| EXISTING STROM SEWER | EXISTING STROM SEWER | PROPOSED GATE VALVE |
| PROPOSED SWALE OR DITCH | PROPOSED SWALE OR DITCH | PROPOSED RADIUS OF CURB |
| EXISTING SWALE OR DITCH | EXISTING SWALE OR DITCH | PROPOSED HANDICAPPED PARKING |
| PROPOSED CURB CUT | PROPOSED CURB CUT | PROPOSED LIGHT STANDARD |
| PROPOSED HYDRANT | PROPOSED HYDRANT | EXISTING LIGHT STANDARD / HYDRO POLE |
| EXISTING HYDRANT | EXISTING HYDRANT | PROPOSED PROPERTY LINE |
| EXISTING WATER VALVE | EXISTING WATER VALVE | |
| PROPOSED WATER VALVE | PROPOSED WATER VALVE | |



KEY PLAN

BENCH MARK

Station number 00819748494

Elevation: 84.254

Description: Concrete bridge carrying Glover Road over QEW, 1.8km east of concrete bridge carrying Fruitland Road (Hamilton-Wentworth Regional Road 55) over QEW in the town of Stoney Creek and 0.8km west of McNeilly Road. Tablet is set horizontally in north face of south concrete abutment, 34cm east of N.W. corner, 27cm above concrete apron and 39.0m south of centreline of eastbound lane of QEW.

SITE BENCH MARK

Elevation : 84.90m

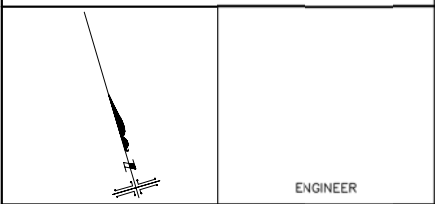
Description: Top of existing fire hydrant on Winona Road

No.	Revision	Date	By
5.	Rankin As-Built	March 18, 2025	B.K
4.	ISSUED FOR CONSTRUCTION /GRADING REVISED	NOVEMBER 29, 2023	J.C
3.	ISSUED FOR TENDER	SEPTEMBER 21, 2023	J.C
2.	SECOND SUBMISSION	AUGUST 31, 2023	J.C
1.	FIRST SUBMISSION	June 19, 2023	J.C

REVISIONS

GENERAL NOTES

- TENDERERS SHALL SATISFY THEMSELVES AS TO THE NATURE OF THE GROUND AND BID ACCORDINGLY.
- CONTRACTOR SHALL VERIFY LOCATIONS AND INVERTS OF ALL EXISTING SANITARY AND STORM SEWERS AND WATERMAINS, PRIVATE SEWER DRAINS AND WATER SERVICES, GASMAINS, CABLE TV, HYDRO AND TELEPHONE DUCTS, ETC., AT START OF CONSTRUCTION.



PROJECT OWNER:

PENADY (STONEY CREEK) LTD.

ISSUED FOR CONSTRUCTION

MUNICIPALITY:

CITY OF HAMILTON
(STONEY CREEK)

PROJECT NAME:

WINONA CROSSING SITE G
FILE No. SPA - 22 - 141

TITLE:

SITE SERVICING PLAN

SCALE: 1:400

DATE: JANUARY 2023

DESIGN: J.C./A.N

DRAWN: T.L./A.N

DWG: 228252

SHT: 1

APPENDIX

H

GEOTECHNICAL
INVESTIGATION REPORT



Preliminary Geotechnical Investigation Report

Costco Stoney Creek – Parking Lot
Expansion into Forum Lot
1310 Self Service Road, Stoney Creek,
Ontario

Prepared for:

Costco Wholesale Canada Ltd.
c/o
Louie Loberti, Director of Real Estate
Development
730 Lake Dr. Issaquah, WA 98027

Prepared by:

Stantec Consulting Ltd.
1331 Clyde Ave, Suite 400
Ottawa, ON K2C 3G4

Project No. 121626532

August 2025



GEOTECHNICAL INVESTIGATION REPORT

This document entitled Preliminary Geotechnical Investigation Report - Costco Stoney Creek – Parking Lot Expansion into Forum Lot was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of **Costco Wholesale Corporation** (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgement in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, in any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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GEOTECHNICAL INVESTIGATION REPORT

EXECUTIVE SUMMARY

Stantec Consulting Ltd. conducted geotechnical investigation as part of a proposed parking lot expansion onto an empty 2.48-acre parcel (Site) abutting the northern limit of the existing parking lot of the Costco Wholesale Center located at 1330 South Service Road, Stoney Creek, in the City of Hamilton, Ontario. The investigation was completed to obtain information on the existing subsurface soil and groundwater conditions and provide geotechnical design recommendations for the proposed construction. The Site is located at the vacant land north of the existing Costco facility with a street address of 1310 South Service Road, Stoney Creek, is bounded by commercial properties to the east, Costco parking lot to the south, the Queen Elizabeth Highway to the north, and a vacant land parcel across Vince Mazza Way to the west. The proposed parking expansion will be located in the southern half of the vacant lot.

The geotechnical investigation consisted of drilling nine (9) geotechnical boreholes to depths ranging from 2.9 m below ground surface (mbgs) to 6.1 mbgs. Two (2) monitoring wells were installed in two of the deeper boreholes. Laboratory testing of soil samples for gradation, corrosivity, and moisture contents was conducted as part of the investigation.

The investigation revealed subsurface conditions consisting of cohesionless fill over a cohesive till layer. The cohesive fill thickness ranged from 0.4 m to 2.9 m and the till was observed beneath the fill down to refusal and target depth. Organic material was observed within the fill layer and had moisture contents ranging from 2% to 12%. A historical building was located in the center of the site that was demolished and backfilled. BH25-9 was drilled within the building footprint and was observed to cohesive backfill beneath the sand and gravel fill extending to 2.9 mbgs. Bedrock was not cored or encountered during this investigation. A shale and soil matrix was observed at a depth of 5.3 mbgs, suggesting bedrock could be encountered slightly deeper. The bedrock is expected to consist of shale of the Queenston formation. The depth to bedrock in the area is expected to be 4 m to 10 mbgs with the bedrock surface sloping down northwards towards Lake Ontario.

The geotechnical recommendations include removing topsoil and fill containing organics from the site prior to grading and replacing the material with approved on-site soils compacted to 98% Standard Proctor maximum Dry Density (SPMDD) or imported well-graded granular soils meeting OPSS Granular A and Granular B Type II specifications compacted to 100% SPMDD. Temporary excavations should follow the OHSA guidelines for excavation safety, and sump pumping should be used for groundwater control. The parking lot pavement structure used for this construction should follow the specifications outlined in Table 6-2 for Heavy Duty and Standard pavement types based on a 20-year design life, with 30 trucks per day on heavy duty pavement and 6,600 cars per day on standard duty pavement.

Construction considerations for frost penetration, use of appropriate shoring systems and dewatering methods for temporary excavations, following OPSD standards for pipe installation and backfill, and ensuring proper pavement transitions, drainage, and subgrade preparation should be applied as outlined within this report.



GEOTECHNICAL INVESTIGATION REPORT

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GEOTECHNICAL INVESTIGATION REPORT

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GEOTECHNICAL INVESTIGATION REPORT

Introduction
August 2025

1.0 INTRODUCTION

Stantec Consulting Ltd. was retained by Costco Wholesale Corporation (“the Client”) to carry out a geotechnical investigation as part of a proposed parking lot expansion onto an empty 2.48-acre parcel (Site) abutting the northern limit of the existing parking lot of the Costco Wholesale Center located at 1330 South Service Road, Stoney Creek, in the City of Hamilton, Ontario. The site location is shown in **Drawing No. 1 – Borehole Location Plan, Appendix B.**

The work was carried out in general accordance with the scope of work for a geotechnical investigation as outlined in Stantec’s proposal dated May 9, 2025, addressed to Costco Wholesale Corporation.

The combined geotechnical and environmental investigation was carried out to provide design and construction recommendations for the proposed parking lot and access roads. The findings of the environmental investigation will be provided in a separate report.

This report has been prepared specifically and solely for the project described herein. It presents the factual results of the geotechnical investigation and provides geotechnical recommendations for the design and construction of the proposed parking lot and access roads.

Limitations associated with this report and its contents are provided in the statement of general conditions included in **Appendix A.**

2.0 PROJECT DESCRIPTION AND BACKGROUND

The 2.48-acre parcel of vacant land north of the existing Costco facility with a street address of 1310 South Service Road, Stoney Creek, is bounded by commercial properties to the east, Costco parking lot to the south, the Queen Elizabeth Highway to the north, and a vacant land parcel across Vince Mazza Way to the west. The proposed parking expansion will be located in the southern half of the vacant lot.

The Site has grade elevations range between approximately between ± 84 m and ± 85 m. A significant portion comprising approximately northwest quadrant of the proposed parking lot expansion footprint is covered with a stockpile.

A review of the aerial photos shows that a structure (a motel) located at the Site was removed sometimes prior to 2020.



GEOTECHNICAL INVESTIGATION REPORT

Scope of Work
August 2025

2.1 AVAILABLE SUBSURFACE INFORMATION

Stantec has conducted a review of the available information from the following sources provided by the Client:

- Blue Frog Environmental Consulting Inc. Report No. 0138-001.02, titled “Supplemental Phase II Environmental Site Assessment, Former Retail Fuel Outlet, Cardlock and Motel, 1310 South Service Rd, Stoney Creek”, and dated August 10, 2022.
- Blue Frog Environmental Consulting Inc. Report No. 0138-001.02, titled “Geotechnical Assessment, 1310 South Service Road, Stoney Creek, Ontario”, and dated August 15, 2025.

According to Ontario Geological Survey (OGS) mapping (Ontario Geological Survey 2010. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release - Data 128-REV), the surficial geology in the area consists of clay to silt-textured till. According to the bedrock geological mapping (Ontario Geological Survey 2011, 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release - Data 126 Revision 1), the underlying bedrock consists of shale, limestone, dolostone, and siltstone of the Queenston formation. The depth to bedrock in the area is expected to be 4 m to 10 m below ground surface (BGS) with the bedrock surface sloping down northwards towards Lake Ontario¹.

3.0 SCOPE OF WORK

The scope of work for this geotechnical investigation is presented below:

- Advance nine (9) boreholes at the site; two (2) boreholes to a maximum depth 6.0 m BGS or auger refusal, and seven (7) boreholes to a maximum depth of 3.0 m BGS.
- Install two (2) monitoring wells in the 6 m boreholes to measure the stabilized groundwater level.
- Conduct Standard Penetration Tests (SPT) at regular intervals while collecting soil samples.
- Perform laboratory tests including moisture content, grain size analysis, Atterberg Limits, and soil organic content testing.
- Preparation of a geotechnical investigation report that summarizes the results of the field investigations and laboratory test results and provides recommendations for design and construction of the proposed fuel facility addition.

¹ Feenstra B.H. (1981): Bedrock Topography of the Grimsby Area, Southern Ontario; Ontario Geological Survey Preliminary Map P.2401, Scale 1:50,000.



GEOTECHNICAL INVESTIGATION REPORT

Method of Investigation
August 2025

4.0 METHOD OF INVESTIGATION

4.1 GEOTECHNICAL FIELD INVESTIGATION

The field investigation for this project was carried out over the course of two days between July 29th and July 30th, 2025. A total of nine (9) boreholes, identified as BH25-01 to BH25-09, were advanced at the locations shown in **Drawing No. 1 – Borehole Location Plan, Appendix B**. The boreholes were advanced using a track mounted Geoprobe 7822 DT drill rig supplied and operated by Strata Drilling Group. The boreholes were advanced to depths ranging from 2.9 m to 6.1 m BGS. Auger refusal was not encountered in any of the nine boreholes.

Soil samples were collected at regular intervals while conducting Standard Penetration Tests (SPT) in accordance with the procedures outlined in ASTM specification D1586.

Standpipe style monitoring wells were installed in two boreholes (MW25-2 and MW25-3) to allow for groundwater level measurement. The monitoring wells consisted of a 51 mm inside diameter, Schedule 40 PVC pipe, with a No.10 slot screen (0.01-inch slot) and screen length of 1.5 m. The annular space between the monitoring well pipe and surrounding geological formation was backfilled with sand to 0.3 m above the top of screen, with bentonite seal filling the remaining annular space. The bentonite seal minimizes the potential for hydraulic connection from occurring between the soil layers along the length of the casing. The remaining boreholes were backfilled with bentonite and excess soil cuttings were placed in soil drums.

The fieldwork was supervised by Stantec's geotechnical personnel who located the boreholes, directed the drilling operations, and recorded the subsurface stratigraphy encountered in each borehole. All recovered soil samples were transported to the Stantec Markham laboratory for detailed geotechnical classification and testing.

The coordinates and elevations of the boreholes were collected by Stantec's geomatics team.

4.2 LABORATORY TESTING

All samples returned to the laboratory were subjected to detailed visual examination and classification by a geotechnical engineer. Selected soil samples were tested for moisture content, grain size analyses, Atterberg Limits testing, and organic content testing. All laboratory testing was completed at Stantec's geotechnical and materials testing laboratory to determine engineering properties in accordance with American Society for Testing and Materials (ASTM) and Canadian Council of Independent Laboratories (CCIL) applicable standards.

The results of the laboratory tests are discussed in the text of this report and are provided on the Borehole Records in Appendix C, and on the laboratory test result figures in **Appendix D**.



GEOTECHNICAL INVESTIGATION REPORT

Results of Investigation
August 2025

Soil samples will be stored for three (3) months after the issuance of the final report unless directed by the client.

4.3 SURVEYING

Stantec's geomatics team was retained to complete a property survey including the services and the surrounding streets. The borehole surface elevations were also recorded as part of this survey event. The survey was completed on July 22nd, 2025, and the resulting borehole elevations are recorded in Table 4-1.

Table 4-1 : Borehole elevations based on survey completed July 22nd, 2025

Borehole ID	Northing	Easting	Elevation (m)
BH25-01	4785841	610142.7	84.1
MW25-02*	4785837	610209.9	83.6
MW25-03	4785814	610247.3	83.9
BH25-04	4785779	610211	84.1
BH25-05	4785774	610199.8	84.2
BH25-06	4785774	610193.9	84.6
BH25-07	4785799	610165	84.3
BH25-08	4785813	610130.7	84.2
BH25-09	4785827	610203.3	84.4

*Borehole elevations and coordinates measured off site features.

5.0 RESULTS OF INVESTIGATION

5.1 SUBSURFACE INFORMATION

The subsurface conditions observed in the boreholes and results of the laboratory tests performed on representative soil samples are presented on the Borehole Records provided in Appendix C. An explanation of the symbols and terms used to describe the Borehole Records is also provided in Appendix C.

The stratigraphic boundaries on the borehole records are inferred from non-continuous sampling and therefore represent transitions between soil types rather than exact boundaries between geological units. The subsoil conditions will vary between and beyond the borehole locations.

The subsurface profile encountered at the boreholes generally consists of granular fill material overlying a native hard clay with sand to sandy clay glacial till layer. Auger refusal was not encountered in any of the boreholes completed during the investigation.



GEOTECHNICAL INVESTIGATION REPORT

Results of Investigation
August 2025

5.1.1 Ground cover

The ground surface cover at the locations of borehole BH25-01 consisted of 25 mm thick topsoil. The topsoil consisted of dark brown silty sand with trace gravel and contained rootlets and organic matters.

The ground cover contacted at the remaining borehole locations comprised of silty sand with gravel, and sand and gravel.

5.1.2 Fill

A granular fill material consisting of brown silty sand with gravel to sand with gravel was encountered beneath the topsoil in borehole BH25-01 and at ground surface at the remaining boreholes. The granular fill extended to depths ranging from 0.2 to 2.9 m.

The Standard Penetration Test (SPT) 'N'-values in the fill ranged from 7 to more than 50. The higher SPT 'N' values were recorded where the boreholes were advanced through the existing sand and gravel ground cover.

The moisture content of the samples of the fill tested ranged from 2% to 12%.

Two (2) samples of the fill were selected for organic content analysis. The results of the testing are included in Table 5-1 and the laboratory certificates of analysis are included in Appendix D.

Table 5-1: Summary of Organic Content Analysis of the Fill

Borehole	Sample	Depth (m)	Organic Content (%)
BH25-7	SS1	0 – 0.61	2.0
BH25-9	SS1	0.31 – 0.61	1.2

5.1.3 Till

A deposit of glacial till was encountered beneath the fill material in all boreholes. The till layer was encountered at beneath the fill layer. Boreholes were terminated in the till layer with the exception of boreholes BH25-1 and BH-25-2 that were terminated in fill and bedrock respectively. The mottled brown to grey lean clay with sand to sandy lean clay till is expected to extend to the bedrock surface. Shale bedrock fragments were observed within the till layer at borehole BH25-03. The till was inferred to contain cobbles and boulders.

The SPT N-values for the till ranged from 3 to 40 indicating a soft to hard consistency. The moisture content of the samples of the till soils tested ranged from 10% to 18%.

Seven (7) representative samples were selected for grain size analysis testing. The results are summarized below in Table 5-2 and the grain size distribution curves are shown on Figure No. D1 in Appendix D.



GEOTECHNICAL INVESTIGATION REPORT

Results of Investigation
August 2025

Table 5-2: Summary of Grain Size Analysis of Till

Borehole No.	Sample ID	Depth (m)	Water Content %	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH25-01	SS3	1.52 – 2.13	15	12	13	43	32
BH25-02	SS3	1.52 – 2.13	14	2	20	78	
BH25-02	SS4	2.29 – 2.90	15	2	18	44	36
BH25-03	SS3	1.52 – 2.13	14	5	13	43	39
BH25-04	SS2	0.76 – 1.37	16	0	34	39	27
BH25-08	SS2	0.76 – 1.37	10	2	18	47	33
BH25-09	SS3B	1.68 – 2.13	16	0	21	79	

Silt – fraction of particles with sizes smaller than 0.075 mm and greater than 0.002 mm.

Clay – fraction of particles with sizes smaller than 0.002 mm.

Samples SS3 from BH25-01 and BH25-03 were also selected for Atterberg Limits testing. The test results for the samples indicated that the soil had a liquid limit (LL) ranging from 31% to 33% and a plastic limit (PL) of 19%. The results are summarized in Table 5-3 below and the respective plasticity index chart is shown on Figure No. D2 in Appendix D.

Table 5-3: Summary of Atterberg Limits Testing of Till

Borehole No.	Sample ID	Depth (m)	Liquid Limit %	Plastic Limit %	Plasticity Index
BH25-01	SS3	1.52 – 2.13	31	19	12
BH25-03	SS3	1.52 – 2.13	33	19	14

According to the Unified Soil Classification System (USCS), the till samples tested can be classified as lean clay with sand (CL).

5.1.4 Bedrock

Bedrock was not cored during the investigation. A highly weathered shale-clay matrix was observed in BH25-2 at a depth of 5.6 m BGS. This weathered zone is typical to the region and is weak enough to be augered through without refusal. The target depth of the borehole was reached prior to auger refusal.

5.1.5 Groundwater

Monitoring wells were installed in BH25-02 and BH25-03. The monitoring wells were recorded to be dry upon completion of the well installation. Additional details on the groundwater level in the monitoring well installation and observed groundwater levels are provided in the borehole logs presented in Appendix C.

Table 5-4: Summary of Monitoring Well Readings

Borehole No.	Ground Surface Elevation (m)	Date of Measurement	Depth to Groundwater (m)	Groundwater Elevation (m)
BH25-02	83.6	2025-08-20	1.15	82.45
BH25-03	83.9	2025-08-20	0.85	83.05



GEOTECHNICAL INVESTIGATION REPORT

Results of Investigation
August 2025

It should be noted that groundwater levels at the site will be subject to fluctuations due to seasonal changes, snowmelt, water level in the river and precipitation events. The water levels should be expected to be higher during the spring season, as well as during and following periods of heavy precipitation or snow melt.

5.2 CHEMICAL ANALYSIS

One (1) representative soil sample and one (1) representative groundwater sample were submitted to Paracel Laboratories in Ottawa, Ontario, for analysis of pH, water soluble sulphate, chloride concentrations, and resistivity. The testing was completed to determine the potential for degradation of the concrete in the presence of soluble sulphates and the potential for corrosion of exposed steel used in foundations and buried infrastructure.

The analysis results are summarized in the following table and are provided in **Appendix D**.

Table 5-5: Summary of the Chemical Analysis

Borehole No.	Sample No.	Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ohm-m)
BH25-05	SS3	1.52 – 2.23	7.84	44.4	1010	1020

The neutral pH value is 7.0 and the normal range of soils is 4.0 to 8.5. The pH value of 7.84 measured on the soil sample is within the normal range.

The chloride concentration threshold value of 500 µg/g is typically used to designate soil or water as being corrosive. The chloride concentration for the sample is 44.4 µg/g, indicating a low corrosivity potential. The sulphate concentrations inferior to 1000 ppm indicates a soil that is susceptible to sulphate attacks. The risk of sulfate attacks in this case may require the use of sulphate resistant cement for the Site.

The resistivity of the soils is generally a parameter with the most influence on the evaluation of the corrosion potential for steel elements. The results of the resistivity testing conducted on the soil sample are >100 Ohm-m indicating a slightly corrosive environment as per the corrosion criteria from the British Standard BS-1377. Mitigation for corrosion of steel components is therefore deemed not applicable for this site.

The pH, chloride, sulphate, and resistivity values presented in the table above may be used by structural designers in assessing the potential for chemical attacks on buried steel and as an aid in selecting coating and corrosion protection systems for buried steel objects.



GEOTECHNICAL INVESTIGATION REPORT

Discussion and Recommendations
August 2025

6.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides geotechnical engineering input related to the design and construction of the parking lot expansion at the Costco Wholesale Center located at 1310 South Service Road, Stoney Creek, Ontario. It is understood that the proposed pavement structure is to be designed for the following traffic loading provided by Costco:

- Thirty (30) trucks per day (Traffic Index of seven (7.0) or Asphalt Equivalent Single Axle Load (ESAL) of 121,010).
- Six thousand six hundred (6,600) cars per day (Traffic Index of (5.0) or Asphalt ESALs of 7,159).

The following geotechnical input is based on the subsurface information that was available at the time of writing this report and our understanding of the project requirements. Where comments are made on construction, they are provided to highlight the aspects which could affect the design. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data with respect to the profile provided at the time of tendering, as it affects their proposed construction techniques, schedule, safety, and equipment capabilities.

The Site is currently vacant, and the general soil stratigraphy at the proposed parking expansion location comprises of fill ranging in thickness from approximately 0.2 to more than 2.9 m (BH25-1), underlain by a glacial clayey till. The glacial till was assessed as having a soft to firm consistency at shallow depths becoming stiff to very stiff with increase in depths within the depths of exploration of up to 6.1 m BGS.

Groundwater was not encountered during the borehole drilling program.

6.1 SITE GRADING AND PREPARATION

6.1.1.1 General

The program for grading and earthworks should be designed in advance and carefully executed in consideration of the time of year of execution, prevailing weather conditions, construction stormwater management control and associated issues and concerns, and the intended end-use of the subject property as described herein.

We understand that the majority of the site grading work will generally involve minor gradation changes within the footprint of the parking expansion, except the footprint of the existing dirt pile where significant earthworks could be required. Compacted fill will be required within the footprint of the parking lot to replace the poor-quality existing fill and exiting soft to firm clayey soils.

The native soils at this Site are predominantly cohesive clay with a high silt content. Due to the significant silt content, the native soils are susceptible to softening when exposed to water and during construction activities. Therefore, site grading activities should be monitored and maintained in stable conditions. Prepared surfaces should be protected to minimize the amount of degradation during wet weather



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conditions. In addition, the native soils that have been successfully compacted and approved, may require removal should they become wet and softened from water infiltration, precipitation or thawing. Therefore, it is recommended to plan and control ground surface runoff away from areas of construction.

In addition to meeting Costco's requirements, all fill materials imported must comply to all applicable municipal, provincial, and federal guidelines and requirements associated with environmental characterization of the materials.

6.1.2 Erosion and Sediment Control and Regulatory Constraints

As erosion and sediment control should be developed and implemented prior to commencement of construction, to direct precipitation and ground surface runoff away from the areas of construction. Identification of an outfall/discharge location will be required for this purpose. All erosion sedimentation control should be conducted in accordance with the approved for construction design drawings.

6.1.3 Grading and Earthworks

6.1.3.1 Sub-Excavation and Proof Rolling

The Site is comprised of backfill and stockpiled soils from previous developments and historical land uses. At the time of this report, utilities (electrical, gas, water, wastewater, storm water) for historical buildings within the Site are assumed to be abandoned. Costco's requirements for engineered fill are shown below in Table 6-1. If a stockpile of material meeting Costco's engineered fill gradation requirements is to be created on-site, the earthworks contractor must ensure that fines from the underlying native soils are not mixed into the fill during stockpiling operations.

The perimeter and columns foundations of the demolished commercial building, if present, should be completely removed. If foundations extend deep as to make their complete removal technically and economically unfeasible, these must be removed to a depth of at least 0.75 m below the new design pavement subgrade level.

All buried utilities abandoned in-place must be at a depth of 0.75 m or below the new design subgrade level. If the utilities are shallower than 1 m, if shallower must be removed completely.

All pre-existing fill must be removed from construction area footprints prior to grading. In the areas of the boreholes where fill was observed to be silty, the fill material will not be suitable for reuse as engineered fill. These materials should be inspected by geotechnical personnel at the time of construction. It is recommended that any traces of topsoil, organics, and/or rootlets noted within the fill at the time of removal operations be removed prior to placing engineered fill.

Following stripping, the subgrades in areas of proposed fill are to be inspected by geotechnical personnel to ensure that all unsuitable materials are removed. Any fill, organics, excessively loose/soft materials, wet zones, or disturbed/softened areas identified during site preparation or during general construction activities, are to be removed and replaced with approved engineered fill, as referenced in Section 6.2.3.2. Engineered Fill Placement



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Prior to compacted fill placement, any existing fill material and unsuitable native soils must be removed plus a horizontal distance beyond the periphery sufficient to allow compacted fill pad construction. Geotechnical comments with respect to excavations are provided in Section 7.4.

The existing fill that is not silty, such as gravel with sand fill may be suitable for reuse as engineered fill, but further testing during construction is recommended. Native soils will generally not meet Costco's gradation requirements for engineered fill, which is summarized in Table 6-1. The on-Site clean, inorganic mineral clayey soils, free of deleterious materials approved by the geotechnical engineer, may however be used as compacted fill in the pavement subgrade.

Table 6-1: Costco Engineered Fill Gradation Requirements

Sieve Size	Percent Passing
75 mm	100%
0.075 mm	0 – 10%

OPSS.MUNI 1010 Granular 'A' or Granular 'B' with 100% passing the 75 mm sieve are commonly used materials in Ontario that would meet Costco's requirements for engineered fill. Once site grading is complete, additional care would be needed to protect the finished surface from the environment during building construction.

The finished subgrade should be proofrolled in the presence of the geotechnical engineer. Any loose or soft areas identified during the proof roll must be rectified as directed by the geotechnical engineer before granular course of the pavement layer is placed.

We refer to Section 7.1 of this report for additional commentary on the re-use of on-site materials.

The engineered fill material should be within 2% of optimum moisture for compaction at the time of placement. If on-site materials are to be re-used as engineered fill, earth grading operations should only be carried out during the dry summer months to minimize the exposure to rain and promote drying of soil.

6.2 PAVEMENT DESIGN RECOMMENDATIONS

New pavement will be constructed for this project. Based on the Costco's development requirements, the pavement is to be designed for a 20-year life, with 30 trucks per day on heavy duty pavement and 6,600 cars per day on standard duty pavement.



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Based on the provided traffic data, the parameters selected, and frost considerations, and the required Structural Number (SN) of 95 for truck traffic and 60 mm for passenger car traffic, the recommended pavement structures are summarized in the following table.

Table 6-2: Pavement Structures

Material	Design Pavement Structure Thicknesses	
	Heavy Duty	Standard Duty
Wearing Course: Costco Surface Asphalt Mix PG 58-28 for standard duty PG 64-28 for heavy duty Surface course	45 mm	45 mm
Binder Course: Costco Base Asphalt Mix PG 58-28 for standard duty PG 64-28 for heavy duty	80 mm	50 mm
Base Course: OPSS MUNI 1010 Granular 'A' or 19 mm Crusher Run Limestone	150 mm	150 mm
Subbase Course: OPSS MUNI 1010 Granular 'B' Type II or 50 mm Crusher Run Limestone	400 mm	300 mm
Total Thickness	570 mm	440 mm

The pavement subgrade must be proof rolled under the supervision of geotechnical personnel prior to Granular 'B' placement to confirm whether the design subbase thickness is sufficient. Any soft areas identified during proof rolling may require sub-excavation and replacement with additional Granular 'B' subbase.

The base and subbase materials should be compacted to a minimum of 100% SPMDD. The asphaltic concrete should be compacted to a minimum of 92% of Maximum Relative Density (MRD). Asphalt compaction must be carried out as required by Costco's specifications.

Asphalt mixes must meet the requirements of Costco's specifications, and the proposed Job Mix Formula must be reviewed and approved by Costco's consultants.

A tack coat is recommended between all asphalt layers and should meet OPSS 308 – Construction Specifications for Tack Coating and Joint Painting.

The finished subgrade surface and the pavement surface should be crowned and graded to direct runoff water away from the development and associated infrastructure. The pavement subgrade will comprise primarily of native sandy silt to silty sand. These non-cohesive, generally coarse-grained materials will not require the installation of pavement subdrains due to the sufficient hydraulic conductivity and drainage capabilities.



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For pavement drainage full length subdrains should be placed beneath the curbs in accordance with OPSD 216.020 and OPSD 216.021. At catch basins and manholes drainage shall also be provided as illustrated in OPSD 216.021. The top of pavement shall be sloped (normally 2%) and the pavement subgrade shall be sloped at 3% towards the sides.

All earthworks must be carried out during warm, dry weather conditions with ambient temperatures of 5°C and rising, under the supervision of a geotechnical engineer.

6.2.1 Pavement Transitions

Where new grades do not match existing at the end limits of the project, the new grade will need to be tapered out at the project ends. The transition from the new pavement surfaces and the existing asphalt should be carried out in accordance with Costco's specifications.



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7.0 GEOTECHNICAL CONSIDERATIONS AND CONSTRAINTS

7.1 FROST DESIGN

The design frost depth for the Stoney Creek Area is 1.2 m below grade.

Frost resistant fill may be required in some areas. Costco's gradation requirements for frost-free fill are provided in the Table 7-1 below.

Table 7-1: Costco Frost Resistant Fill Gradation Requirements

	Sieve Size	Percent Passing
	37.5 mm	100%
	19.0 mm	40 – 80%
	13.2 mm	30 – 70%
	4.75 mm	0 – 10%
	0.075 mm	0 – 3%

The above-noted gradation does not align with common aggregates typically available in Ontario. As such, it is recommended utilizing OPSS MUNI 10 Granular 'B', with 100% of the material passing the 75 mm sieve, as frost-resistant pavement base and subbase. It is recommended that where required, frost resistant fill extend 1.2 m below finished grade. Transitions between frost-resistant fill and soils that are not frost resistant should be made at 3H:1V. If the transition between frost-resistant fill and soils that are not frost resistant is in a landscaped area, the transition may be made at 1 horizontal to 1 vertical.

7.2 SITE MATERIAL REUSE

7.2.1 Topsoil

The existing topsoil, visually identified at the ground surface at the parking lot and road shoulders would need to be stripped from below the proposed pavement, road structures, and site servicing areas, where present. The topsoil can either be removed from site or be re-used in landscaped areas. Organic soils are not suitable for reuse as engineered fill, trench backfill, granular base, and sub-base materials.

7.2.2 Fill and Native Soils

The fill contacted at the site ranged in composition from silty sand, silty sand with gravel, and sand with gravel fill. The predominant native soils were comprised of lean clay with sand to sandy lean clay.

Based on Costco requirements for subgrade fill, the silty fill as well as inorganic on-site native soils may not be considered suitable for reuse during the site preparation, other than potentially in landscaping areas. Where site servicing excavations extend into native soils, the native soils may be re-used in a portion of the trench as backfill. Refer to Section 7.5 for further details on the suitability of native soils as trench backfill.



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Provided additional gradation analyses are completed during construction and the results satisfy Costco requirements, the existing sand with gravel fill can be reused as subgrade fill.

High percentages of silt observed in some of the stratigraphy could make these soils difficult to handle, place, and compact, in any “less-than-ideal” weather conditions. Disturbance and loss of strength in the presence of excess moisture and/or construction traffic is a concern. It is recommended that the reuse of this soil be limited to prevailing “dry” conditions and during favorable seasons. The material can be blocky and if used will require breaking down during placement. It should be ensured that the material be placed in thin lifts and compacted using a sheepsfoot roller. If these soils are placed without being sufficiently broken down or placed in thick lifts, inter-lump voids could occur which will cause long term settlement.

This material should be placed with moisture contents that are within +/- 2.0% of the optimum moisture content level. It is recommended that the material be approved at the time of placement by qualified geotechnical personnel.

The fill material is assessed as having a low to moderate frost susceptibility in accordance with Section 3.2.5 of the MTO's Pavement Design and Rehabilitation Manual. The lean clay with sand to sandy lean clay material is assessed as having a high frost susceptibility. This layer was observed to be within the frost depth for the Stoney Creek area at some areas at the site. Where the lean clay with sand was observed beneath the frost depth and the material is exposed to the atmosphere in the winter months during excavations, care should be taken to limit the time of exposure to minimize frost penetration.

7.3 IMPORTED FILL MATERIALS

All materials imported to the Site must meet all applicable municipal, provincial, and federal guidelines and requirements associated with environmental characterization of the materials.

Imported soils for use as engineered fill and subgrade fill should comprise OPSS.MUNI 1010 Granular 'A' or Granular 'B' with 100% passing the 75 mm sieve to meet Costco's requirements. Imported fill materials should contain no recycled materials such as concrete or asphalt. The imported fill material should be tested and approved by geotechnical personnel prior to delivery to the Site.

7.4 TEMPORARY EXCAVATIONS

Temporary excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety (OH&S) Act & Regulations for Construction Projects.

The fill materials should be classified as Type 3 soils. In accordance with the OH&S Act, the maximum excavation side slope for a Type 3 soil is 1H:1V (Horizontal: Vertical) extending from the base of the excavation or the top of the trench box.

The undisturbed native soils comprising largely very stiff to hard lean clay with sand to sandy lean clay till encountered in the boreholes can be classified as Type 3 soils. The excavation side slopes for a Type 3 soil must have a maximum inclination of 1H:1V, in accordance with the OHSA regulation, in accordance with the OSHA regulation.



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Any excavations that extend into soft to very soft soils or below the groundwater level and exhibit seepage should be classified as Type 4 soil. The maximum excavation side slope for a Type 4 soil is 3H:1V in accordance with the OSHA regulation.

If an excavation contains more than one soil type, the soil shall be classified as the type with the highest soil type number.

The side slopes of the excavations should be protected from exposure to precipitation and associated ground surface runoff, to prevent further softening and loss of strength of native soils and fill materials placed during the area grading activities that could lead to additional sloughing and caving.

Some sloughing and caving must be anticipated for excavations without lateral support, particularly where excess moisture (precipitation, ground surface runoff, and/or presence of groundwater table) is present. Unsupported excavation slopes that extend below the groundwater table may slough to angles as flat as 3H:1V. If localized instability is noted at the time of excavation or while an excavation remains open, or if wet conditions are encountered, the side slopes of the excavations should be flattened as required to maintain safe working conditions.

For the purpose of this report and the comments provided above, we have presumed that temporary excavations without lateral support will remain open for relatively short periods (e.g. typically 48 hours to 72 hours).

For excavations without lateral support that remain open for longer periods (such as for construction of the underground storage tanks at the gas bar) sloughing and caving of side slopes must be anticipated, particularly if left exposed to periods of precipitation, ground surface runoff, or freeze-thaw cycles. The slopes of these excavations should be protected from erosion and the slopes should be inspected frequently for signs or indications of erosion and/or instability.

Stockpiling of any materials adjacent to excavations should be avoided. Similarly, traffic should not be permitted in proximity to open excavations. For this purpose, it is recommended that all storage of materials and traffic be restricted from a 3 m wide strip around the excavations, measured from the crest of the excavation designed and constructed in accordance with the OH&S Act.

A temporary shoring system can be used to maintain safe working conditions if space is restricted such that the side slope cannot be safely cut back in accordance with the OH&S Act & Regulations, if sloughing and cave-in are encountered in the excavations, or if the excavations are to remain open for a longer period. Reference is made to Section 6.6 for recommendations regarding temporary shoring.

7.5 BACKFILL MATERIALS AND METHODS

7.5.1 Bedding and Cover Material for Buried Services & Utilities

Should the uncovering or replacement of services be required, bedding for those services should consist of OPSS.MUNI 1010 Granular 'A' material. In general, a minimum of 150 mm of bedding and 300 mm of cover material is recommended.



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The bedding and cover material should be placed in loose lifts that do not exceed 300 mm. Each lift should be uniformly compacted to achieve a minimum of 100% of the material's SPMDD. Cover material should be placed and compacted to 900 mm over the crown of the pipe / utility prior to permitting ride-on compaction equipment to be used. Care must be taken in all cases to avoid incurring damage to the services and utilities. This may require the use of alternative equipment from the norm and/or adjustment to the typical placement and compaction methodologies.

These recommendations should be confirmed with the pipe manufacturer and care must be taken to avoid incurring damage to the services. Pipe manufactures may have additional / alternative requirements that should be reviewed by the Designer and Contractor prior to installation of the services.

A discussion of seepage, infiltration, accumulation, and the general presence of groundwater is provided in Section 7.5. If standing water is present in any open excavation where services and utilities are to be installed, the use of a geosynthetic separator fabric and clear stone bedding/cover is recommended to mitigate concerns with handling, placing and compacting granular bedding and backfill materials.

7.5.2 Service and Utility Trench Backfill

Service trench backfill placed over the pipe bedding and cover material can consist of the excavated non-organic soils, or approved imported backfill, subject to inspection and approval by the geotechnical consultant to confirm the condition at the time of backfilling. The comments provided in Section 7.1 with respect to the reuse of the onsite soils apply in this respect.

The trench backfill should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

All trench backfill placed beyond the limits of planned development, such as in landscaped areas, should be placed in 300 mm thick loose lifts and compacted to a minimum of 95% SPMDD up to 1.0 m below the sub-grade level and 98% above this level.

Sewer and storm lines installed outside of heated areas should be provided with a minimum of 1.2 m of soil cover for adequate frost protection.

7.5.3 Municipal Infrastructure Backfill

Where manholes and catch basins are required or where construction or grading is required around existing manholes, these components should be constructed and backfilled in accordance with the City of Ottawa standards.

Due care should be taken in compacting backfill materials around structures to achieve the required compaction, thus avoiding future settlement around the installations.



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Closure
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8.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in Appendix A. This report documents work that was performed in accordance with generally accepted professional standards at the time and location in which the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This report provides an evaluation of selected geotechnical conditions associated with the identified portion of the property that was assessed at the time the work was conducted and is based on information obtained by and/or provided to Stantec at that time. There are no assurances regarding the accuracy and completeness of this information. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report and are based solely on the scope of work described in the report, the limited data available and the results of the work. They are not a certification of the property's environmental condition. This report should not be construed as legal advice.

This report has been prepared for the exclusive use of the client identified herein and any use by any third party is prohibited. Stantec assumes no responsibility for losses, damages, liabilities, or claims, howsoever arising, from third party use of this report.

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec requests that this information be brought to our attention so that we may reassess the conclusions provided herein.

We trust that the information contained in this report is adequate for your present purposes. If you have any questions about the contents of the report or if we can be of any other assistance, please contact us at your convenience.

Respectfully submitted;

STANTEC CONSULTING LTD.

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APPENDIX A

A.1 STATEMENT OF GENERAL CONDITIONS

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STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This professional work product ("hereinafter referred to as the Report") has been prepared for the sole benefit of the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance, or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

BASIS OF THIS REPORT: This Report relates solely to the site-specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The information, opinions, conclusions and/or recommendations made in this Report are in accordance with Stantec's present understanding of the site-specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time the scope of work was conducted and do not take into account any subsequent changes. If the proposed site-specific project differs or is modified from what is described in this Report or if the site conditions are altered, this Report is no longer valid unless Stantec is requested by the Client to review and revise the Report to reflect the differing or modified project specifics and/or the altered site conditions. This Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose or site, and any unauthorized use or reliance is at the recipient's own risk.

STANDARD OF CARE: Preparation of this Report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

PROVIDED INFORMATION: Stantec has assumed all information received from the Client and third parties in the preparation of this Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this Report are based on site conditions encountered by Stantec at the time of the scope of work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behaviour. Extrapolation of in-situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this Report or encountered at the test and/or sample locations, Stantec must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the Report conclusions or recommendations are required. Stantec will not be responsible to any party for damages incurred as a result of failing to notify Stantec that differing site or subsurface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec geotechnical engineers, sufficiently ahead of initiating the next project stage (e.g., property acquisition, tender, construction, etc.), to confirm that this Report completely addresses the elaborated project specifics and that the contents of this Report have been properly interpreted. Specialty quality assurance services (e.g., field observations and testing) during construction are a necessary part of the evaluation of subsurface conditions and site work. Site work relating to the recommendations included in this Report should only be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present.

APPENDIX B

B.1 DRAWING NO. 1 – BOREHOLE LOCATION PLAN

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Printed: Aug 28, 2025 By: G. Briones



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LEGEND

-  BOREHOLE
-  MONITORING WELL

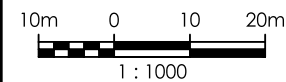


KEY PLAN

1 : 20 000

NOTES

- COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
- SCREEN SHOT FROM GOOGLE EARTH PRO, © 2025.



Client/Project
COSTCO WHOLESALE CORPORATION
GEOTECHNICAL INVESTIGATION
1330 S SERVICE ROAD, STONEY CREEK, ONTARIO

Drawing No.
1

Title
BOREHOLE LOCATION PLAN

AUGUST 2025
Proposal No. 121686915

APPENDIX C

C.1 SYMBOLS AND TERMS USED ON BOREHOLE RECORDS

C.2 BOREHOLE RECORDS

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SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Rootmat</i>	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- <2 mm in thickness

Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 - 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	Very Poor Quality
25-50	Poor Quality
50-75	Fair Quality
75-90	Good Quality
90-100	Excellent Quality

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	Crushed
Severely Fractured	Shattered or Very Blocky
Fractured	Blocky
Moderately Jointed	Sound
Intact	Very Sound

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	Extremely Wide	-
2000-6000	Very Wide	Very Thick
600-2000	Wide	Thick
200-600	Moderate	Medium
60-200	Close	Thin
20-60	Very Close	Very Thin
<20	Extremely Close	Laminated
<6	-	Thinly Laminated

Terminology describing rock strength:

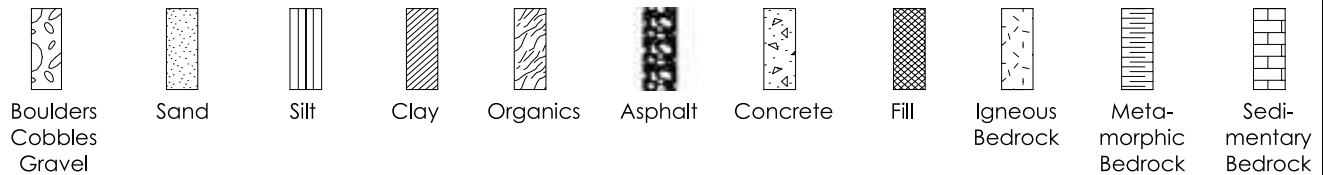
Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 - 5
Weak	R2	5 - 25
Medium Strong	R3	25 - 50
Strong	R4	50 - 100
Very Strong	R5	100 - 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

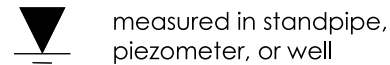
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits

WATER LEVEL MEASUREMENT



RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test; the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer



Boring: BH25-8

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	84.2 m	TOC:	
Project Number:	121626532	Coordinates:	43.217070 / -79.644066	Start Date:	29-Jul-2025	Finish Date:	29-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	SSA						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
	84.0	FILL: grey, SAND and GRAVEL moist TILL: stiff to very stiff, Lean CLAY with sand (CL), trace gravel, moist, contains cobbles		SS	1	530	24				84
1				SS	2	130	19				83
2				SS	3	610	14				82
	81.3			SS	4	300	28				
3		Refusal at 2.9 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
4											80
5											79
6											78
7											77
8											76

☒ Water Level Observed During Drilling

▼ Water Level Measured At the End Of Drilling



Boring: BH25-1

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	84.1 m	TOC:	
Project Number:	121626532	Coordinates:	43.217317 / -79.643913	Start Date:	29-Jul-2025	Finish Date:	29-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	HSA 4.25"						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/ REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
	84.1	TOPSOIL - 25 mm FILL: grey-red, SILT, trace gravel, moist		SS	1	400	8				84
	83.4	FILL: firm, grey-red, Lean CLAY with sand (CL), moist		SS	2	380	8				83
				SS	3	560	5				82
				SS	4	610	5				
	81.2	Refusal at 2.9 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
											80
											79
											78
											77
											76

☒ Water Level Observed During Drilling

▼ Water Level Measured At the End Of Drilling

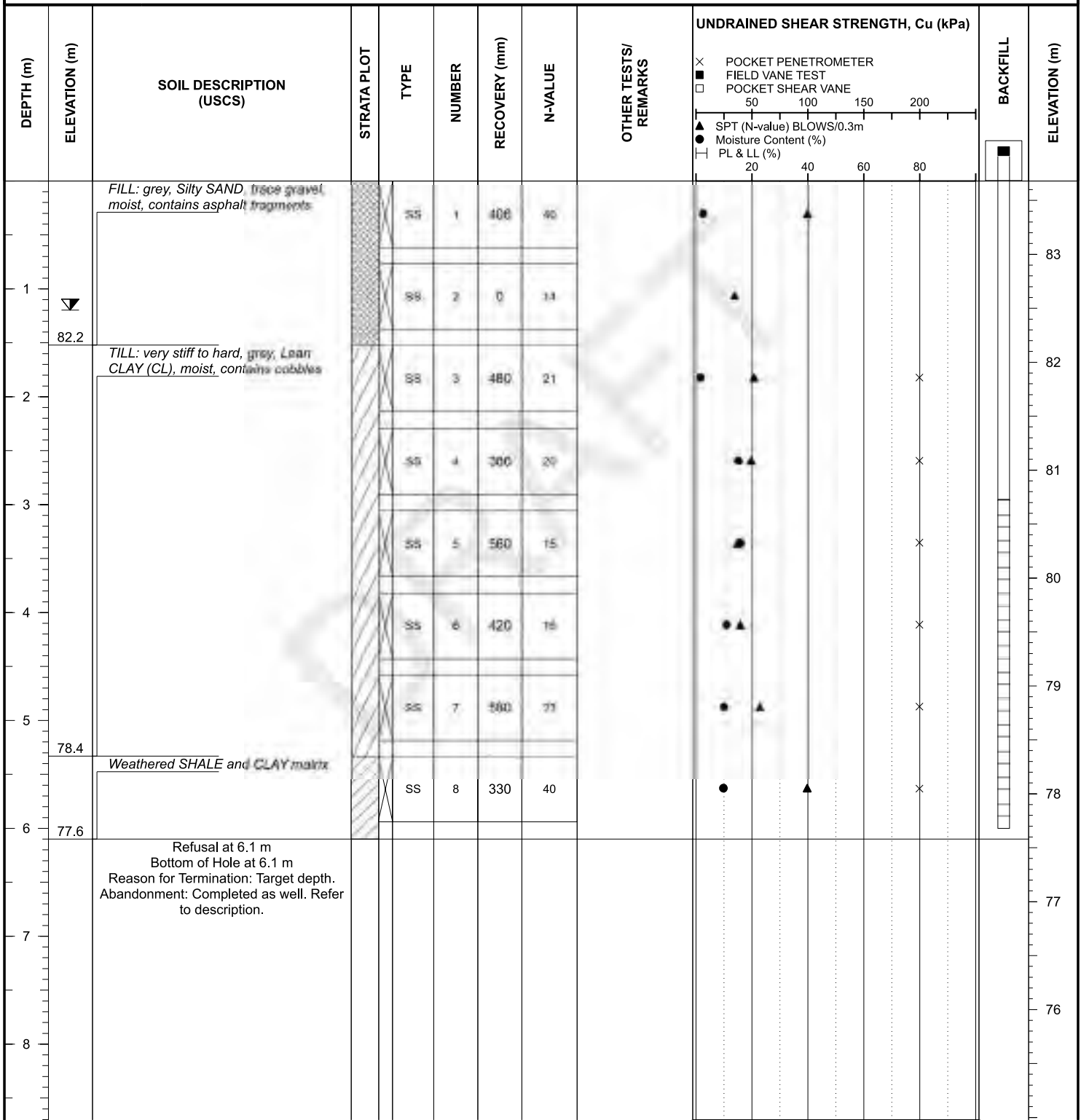


Boring: BH25-2

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	83.7 m	TOC:	84.6m
Project Number:	121626532	Coordinates:	43.217273 / -79.643087	Start Date:	29-Jul-2025	Finish Date:	29-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	1.2 m / 20-Aug-2025
Drill Rig:	Geoprobe 7822DT	Depth Total:	6.1 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	HSA 4.25"						



Water Level Observed During Drilling Water Level Measured At the End Of Drilling

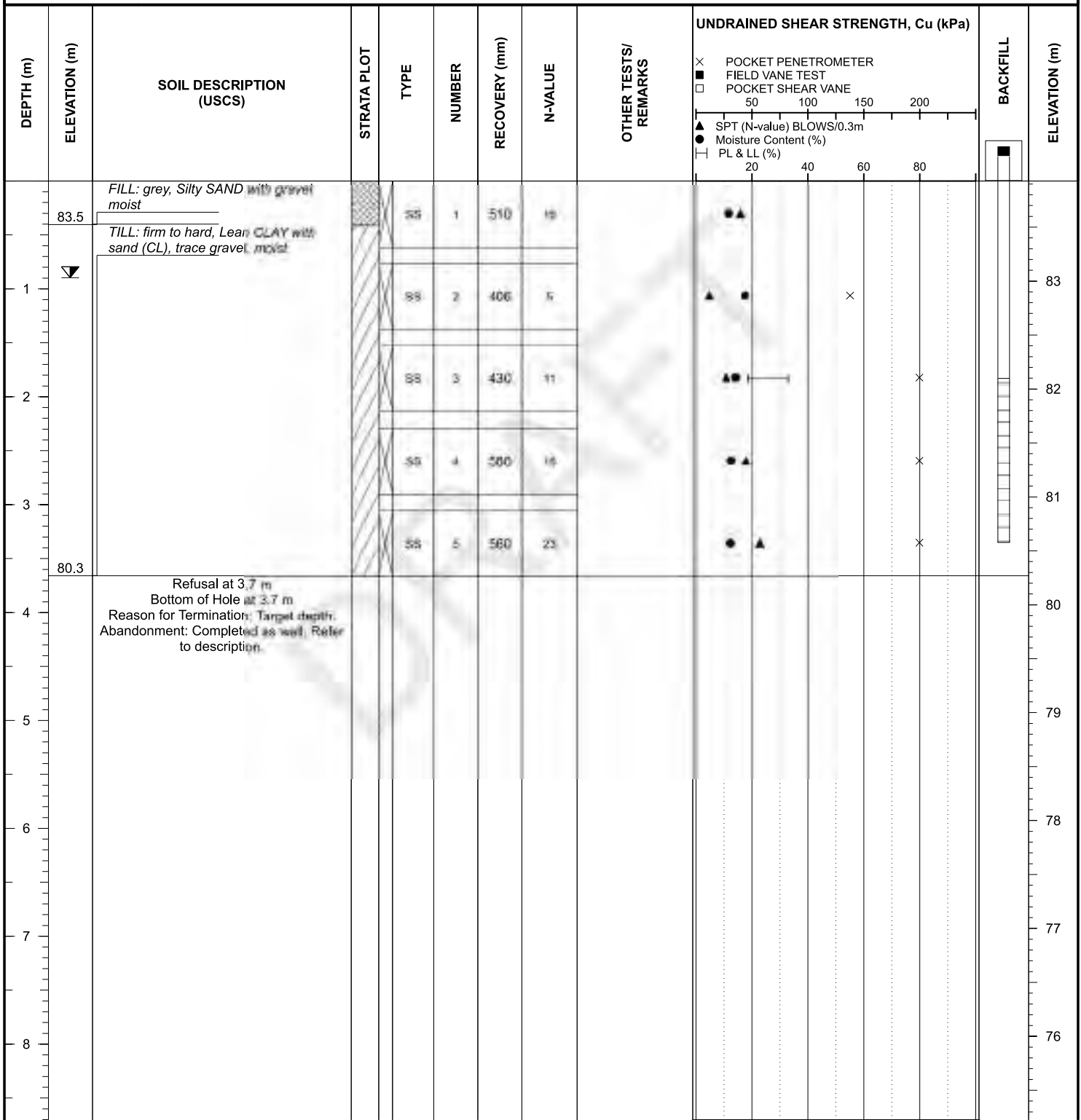


Boring: BH25-3

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	83.9 m	TOC:	84.9m
Project Number:	121626532	Coordinates:	43.217062 / -79.642631	Start Date:	30-Jul-2025	Finish Date:	30-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	0.9 m / 20-Aug-2025
Drill Rig:	Geoprobe 7822DT	Depth Total:	3.66 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	HSA 4.25"						



☒ Water Level Observed During Drilling ▼ Water Level Measured At the End Of Drilling



Boring: BH25-4

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	84.1 m	TOC:	
Project Number:	121626532	Coordinates:	43.216755 / -79.643085	Start Date:	29-Jul-2025	Finish Date:	29-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	SSA						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/ REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
									<div><div><div>✕</div><div>■</div><div>□</div></div><div>POCKET PENETROMETER FIELD VANE TEST POCKET SHEAR VANE</div><div>50100150200</div></div> <div><div>▲</div><div>●</div><div>┌─┐</div></div> <div>SPT (N-value) BLOWS/0.3m Moisture Content (%) PL & LL (%)</div> <div>20406080</div>		
	83.3	FILL: grey, SAND and GRAVEL moist		SS	1	510	27				84
1		TILL: soft to stiff, grey with red mottling, Sandy Lean CLAY (CL) moist		SS	2	406	4				83
2				SS	3	610	10				82
	81.2			SS	4	610	18				
3		Refusal at 2.9 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
4											80
5											79
6											78
7											77
8											76

☒ Water Level Observed During Drilling

▼ Water Level Measured At the End Of Drilling



Boring: BH25-5

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stony Creek Parking Expansion	Project Location:	1310 Self Service Road, Stony Creek, ON	Surface Elevation:	84.2 m	TOC:	
Project Number:	121626532	Coordinates:	43.216708 / -79.643224	Start Date:	30-Jul-2025	Finish Date:	30-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	SSA						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/ REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
									<div><div>POCKET PENETROMETER</div><div>FIELD VANE TEST</div><div>POCKET SHEAR VANE</div><div>SPT (N-value) BLOWS/0.3m</div><div>Moisture Content (%)</div><div>PL & LL (%)</div></div>		
	83.4	FILL: brown, SAND and GRAVEL moist, contains cobbles		SS	1	305	28				84
1		TILL: stiff to very stiff, brown with grey mottling, Silty CLAY (CL-ML), moist		SS	2	510	8				83
2				SS	3	610	17				82
	81.3			SS	4	610	16				
3		Refusal at 2.9 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
4											80
5											79
6											78
7											77
8											76

☒ Water Level Observed During Drilling

▼ Water Level Measured At the End Of Drilling



Boring: BH25-6

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	84.6 m	TOC:	
Project Number:	121626532	Coordinates:	43.216709 / -79.643297	Start Date:	30-Jul-2025	Finish Date:	30-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	SSA						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/ REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
									<div><div>✕ POCKET PENETROMETER</div><div>■ FIELD VANE TEST</div><div>□ POCKET SHEAR VANE</div><div>50 100 150 200</div><div>▲ SPT (N-value) BLOWS/0.3m</div><div>● Moisture Content (%)</div><div>┌─┐ PL & LL (%)</div><div>20 40 60 80</div></div>		
	83.7	FILL: brown, SAND and GRAVEL moist, contains cobbles		SS	1	330	50/150 mm				84
1	83.5	TILL: firm, grey, Silty CLAY (CL-ML), moist		SS	2	510	0				
	83.1	TILL: firm, grey, SILT (ML), moist to wet		SS							
2		TILL: soft, grey, Silty CLAY (CL-ML) with sand, wet		SS	3	350	3				83
	82.3										
		TILL: very stiff, grey, Silty CLAY (CL-ML), wet		SS	4	610	25				82
3	81.7	Refusal at 2.9 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
4											80
5											79
6											78
7											77
8											76

☒ Water Level Observed During Drilling

▼ Water Level Measured At the End Of Drilling



Boring: BH25-7

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	84.3 m	TOC:	
Project Number:	121626532	Coordinates:	43.216935 / -79.643647	Start Date:	29-Jul-2025	Finish Date:	29-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	SSA						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/ REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
									<div><div><div>✕</div><div>■</div><div>□</div></div><div><div>POCKET PENETROMETER</div><div>FIELD VANE TEST</div><div>POCKET SHEAR VANE</div></div><div><div>50</div><div>100</div><div>150</div><div>200</div></div></div> <div><div>▲</div><div>●</div><div>┌─┐</div></div> <div><div>SPT (N-value) BLOWS/0.3m</div><div>Moisture Content (%)</div><div>PL & LL (%)</div></div> <div><div>20</div><div>40</div><div>60</div><div>80</div></div>		
	83.9	FILL: grey, SAND and GRAVEL moist		SS	1	510	55				84
1		TILL: stiff, grey, Silty CLAY (CL-ML) moist		SS	2	280	8				83
2				SS	3	380	14				82
	81.5			SS	4	610	15				
3		Refusal at 2.9 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
4											80
5											79
6											78
7											77
8											76

☒ Water Level Observed During Drilling

▼ Water Level Measured At the End Of Drilling



Boring: BH25-9

BOREHOLE RECORD

Page: 1 of 1

Project Name:	Costco - Stoney Creek Parking Expansion	Project Location:	1310 Self Service Road, Stoney Creek, ON	Surface Elevation:	84.4 m	TOC:	
Project Number:	121626532	Coordinates:	43.217182 / -79.643170	Start Date:	30-Jul-2025	Finish Date:	30-Jul-2025
Client:	Costco Wholesale Ltd.	Coordinate System:	NAD83 / UTM zone 17N				
Contractor:	Strata Drilling Group	Field Technician:	DV	Water 1:		Water 2:	
Drill Rig:	Geoprobe 7822DT	Depth Total:	2.9 m	Inclined from Horizontal:		Azimuth:	
Drilling Method:	SSA						

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm)	N-VALUE	OTHER TESTS/ REMARKS	UNDRAINED SHEAR STRENGTH, Cu (kPa)	BACKFILL	ELEVATION (m)
									<div><div><div>X</div>POCKET PENETROMETER</div><div><div>■</div>FIELD VANE TEST</div><div><div>□</div>POCKET SHEAR VANE</div><div><div>50</div><div>100</div><div>150</div><div>200</div></div></div> <div><div>▲</div>SPT (N-value) BLOWS/0.3m</div> <div><div>●</div>Moisture Content (%)</div> <div><div>┌─┐</div>PL & LL (%)</div> <div><div>20</div><div>40</div><div>60</div><div>80</div></div>		
		FILL: grey, Silty SAND with gravel moist, contains asphalt debris		SS	1	406	7				84
1				SS	2	180	8				83
82.7				SS	3	580	8				
2		TILL: firm to stiff, grey, Lean CLAY with sand (CL), moist		SS	4	610	16				82
81.5											
3		Refusal at 2.0 m Bottom of Hole at 2.9 m Reason for Termination: Target depth. Abandonment: Backfilled with bentonite chips..									81
4											80
5											79
6											78
7											77
8											76

☒ Water Level Observed During Drilling

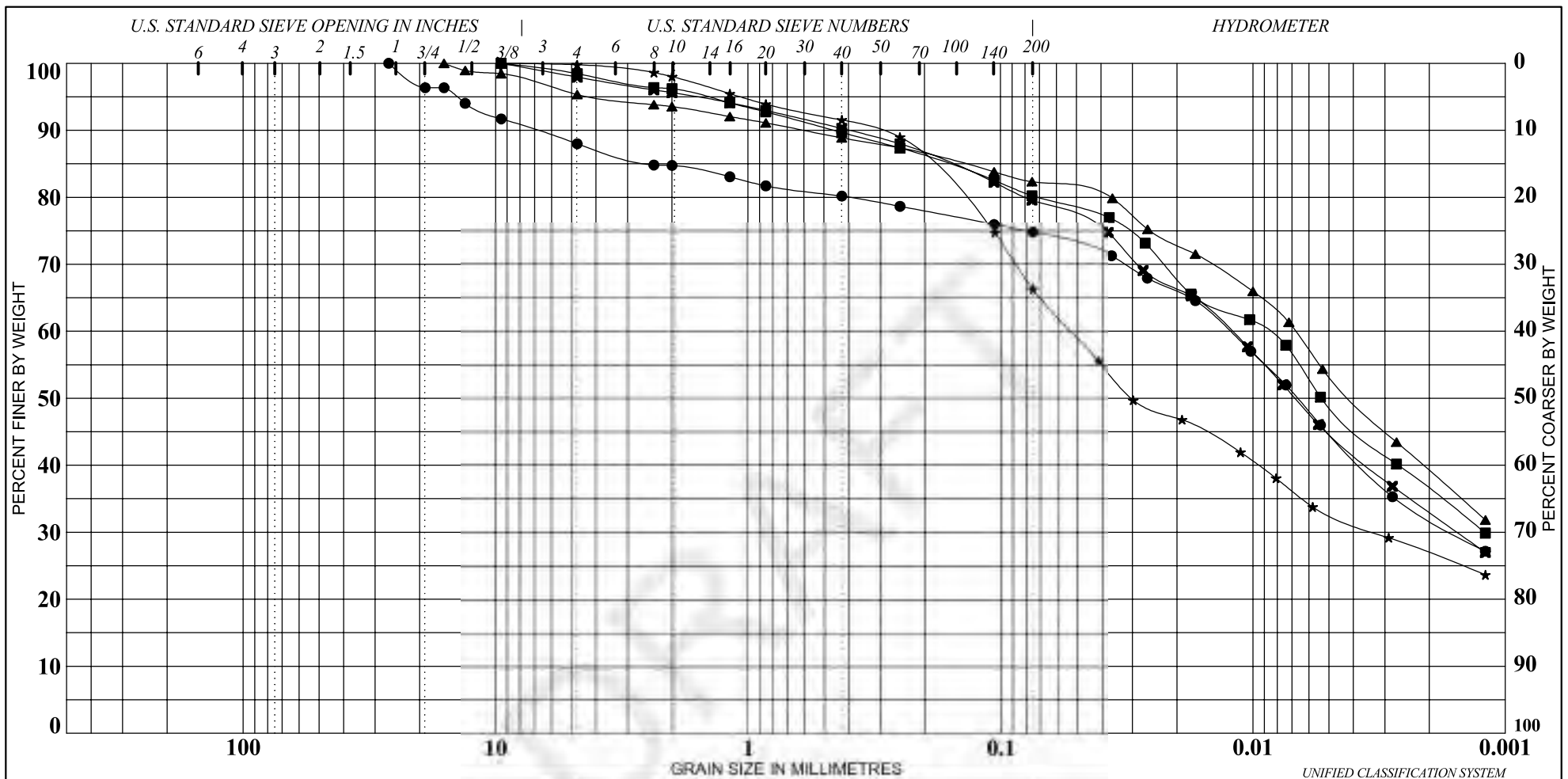
▼ Water Level Measured At the End Of Drilling

APPENDIX D

D.1 LABORATORY RESULT

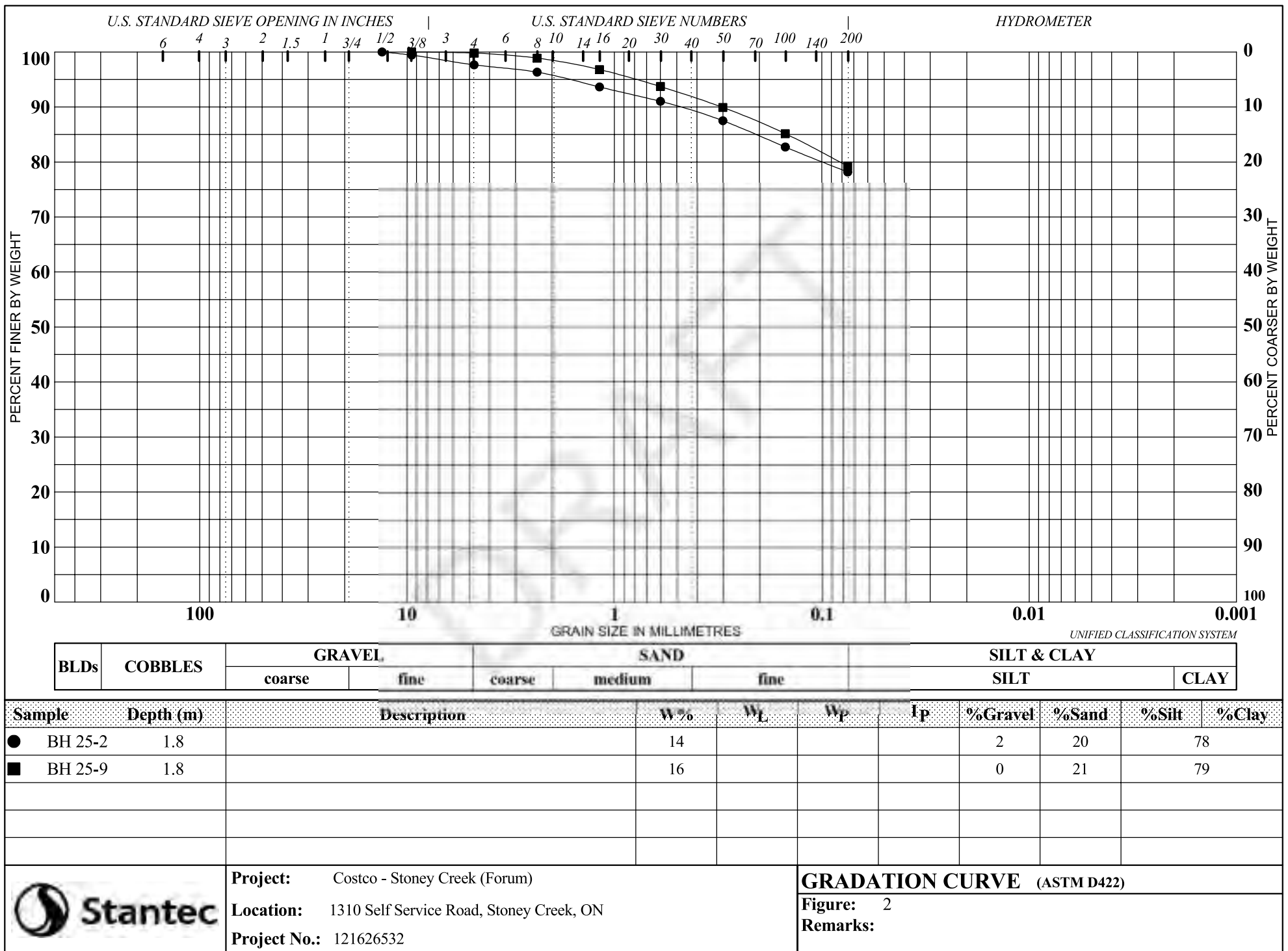
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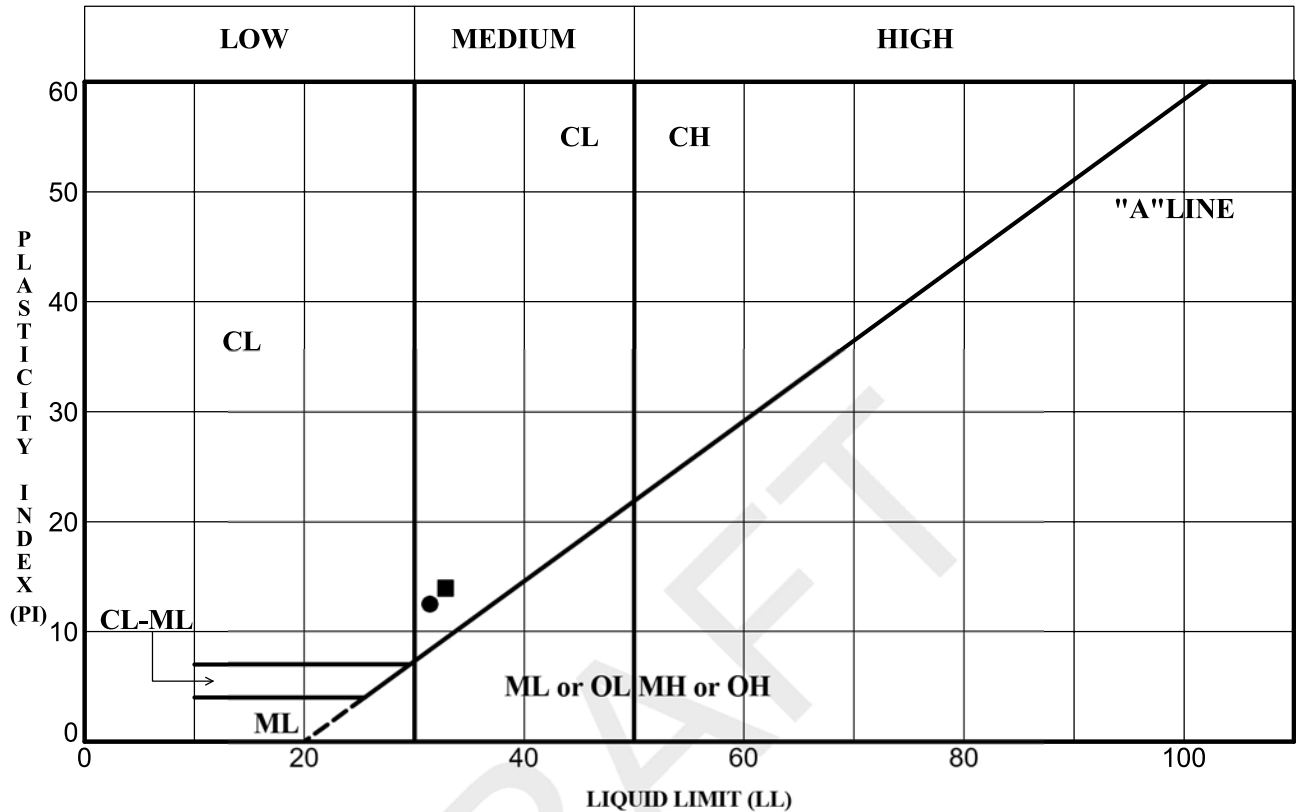


Sample	Depth (m)	Description	W%	W _L	W _p	I _p	%Gravel	%Sand	%Silt	%Clay
● BH 25-1	1.8	LEAN CLAY with SAND(CL)	15	31	19	12	12	13	43	32
■ BH 25-2	2.6		15				2	18	44	36
▲ BH 25-3	1.8	LEAN CLAY with SAND(CL)	14	33	19	14	5	13	43	39
★ BH 25-4	1.1		16				0	34	39	27
✕ BH 25-8	1.1		10				2	18	47	33

	Project:	Costco - Stoney Creek (Forum)	GRADATION CURVE (ASTM D422)	
	Location:	1310 Self Service Road, Stoney Creek, ON	Figure: 1	
	Project No.:	121626532	Remarks:	



PLASTICITY CHART



Specimen	Depth (m)	LL	PL	PI	Fines	W%	Classification
● BH 25-1	1.8	31	19	12	75	15	LEAN CLAY with SAND(CL)
■ BH 25-3	1.8	33	19	14	82	14	LEAN CLAY with SAND(CL)



Project: Costco - Stoney Creek (Forum)
Location: 1310 Self Service Road, Stoney Creek, ON
Project No.: 121626532

ATTERBERG LIMITS
 (ASTM D4318)

Figure: 3
Remarks:

PROJECT: Costco - Stoney Creek (Forum)

MOISTURE CONTENT

BH	DEPTH (ft)	SAMPLE	Moisture Content %
BH 25-1	1.0	1	10.9
BH 25-1	3.5	2	13.5
BH 25-1	6.0	3	14.6
BH 25-1	8.5	4	17.4
BH 25-2	1.0	1	2.7
BH 25-2	6.0	3	13.9
BH 25-2	8.5	4	15.3
BH 25-2	11.0	5	16.0
BH 25-2	13.5	6	11.1
BH 25-2	16.0	7	10.2
BH 25-2	18.5	8	10.1
BH 25-3	1.0	1	11.9
BH 25-3	3.5	2	17.7
BH 25-3	6.0	3	14.4
BH 25-3	8.5	4	12.8
BH 25-3	11.0	5	12.6
BH 25-4	1.0	1	10.6
BH 25-4	3.5	2	15.8
BH 25-4	6.0	3	11.7
BH 25-4	8.5	4	13.6
BH 25-5	1.0	1	4.4
BH 25-5	3.5	2	14.9
BH 25-5	6.0	3	13.9
BH 25-5	8.5	4	13.2
BH 25-6	1	1	4.3
BH 25-6	3.5	2	15.7
BH 25-6	6	3	16.8
BH 25-6	8.5	4	14.5
BH 25-7	3.5	2	13.0
BH 25-7	6	3	14.1



PROJECT # 121626532

LAB#: 1734

DATE: 8-Aug-25

PROJECT: Costco - Stoney Creek (Forum)

MOISTURE CONTENT

BH	DEPTH (ft)	SAMPLE	Moisture Content %
BH 25-7	8.5	4	13.8
BH 25-8	1	1	10.4
BH 25-8	3.5	2	10.0
BH 25-8	6	3	12.2
BH 25-8	8.5	4	10.4
BH 25-9	1	1	6.6
BH 25-9	3.5	2	9.2
BH 25-9	6	3	14.3
BH 25-9	8.5	4	13.4

Unified Soil Classification System



Lean CLAY with Sand (CL) to Lean Clay (CL) to Sandy Lean CLAY (CL)

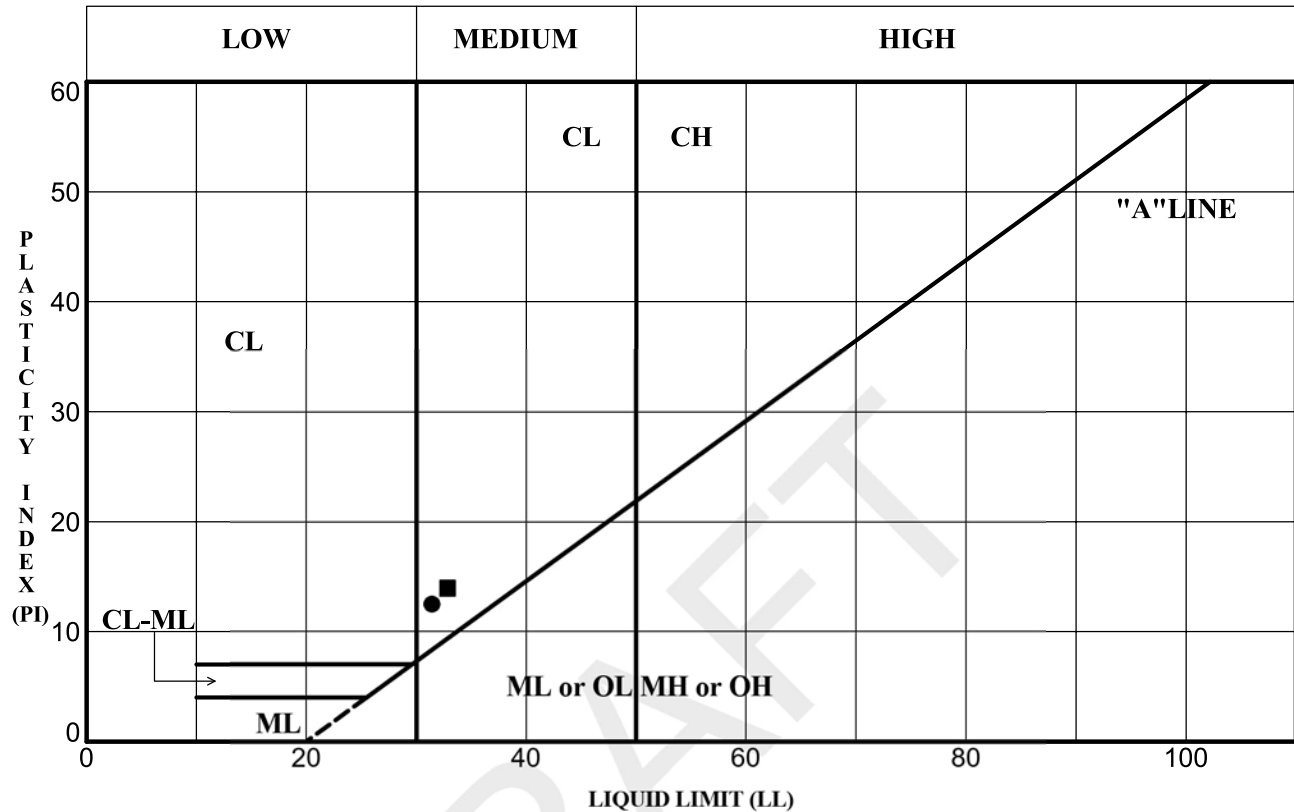
Costco Wholesale Corporation

Stoney Creek - Parking Lot Expansion (Forum Lot)

Figure No. D1

Project No. 121626532

PLASTICITY CHART



Specimen	Depth (m)	LL	PL	PI	Fines	W%	Classification
● BH 25-1	1.8	31	19	12	75	15	LEAN CLAY with SAND(CL)
■ BH 25-3	1.8	33	19	14	82	14	LEAN CLAY with SAND(CL)



Project: Costco - Stoney Creek (Forum)
Location: 1310 Self Service Road, Stoney Creek, ON
Project No.: 121626532

ATTERBERG LIMITS
 (ASTM D4318)

Figure: D2

Remarks:

CERTIFICATE OF ANALYSIS

Work Order : **WT2521019**
Client : **Stantec Consulting Ltd.**
Contact : Essa Nimer
Address : 100-300 Hagey Blvd.
 Waterloo Ontario Canada N2L 0A4
Telephone : ----
Project : 121626532.200
PO : ----
C-O-C number : ----
Sampler : CLIENT
Site : ----
Quote number : Stantec 2025-2026 MSA Price List
No. of samples received : 3
No. of samples analysed : 3

Laboratory : ALS Environmental - Waterloo
Account Manager : Mathy Mahadeva
Address : 60 Northland Road, Unit 1
 Waterloo ON Canada N2V 2B8
E-mail : Mathy.Mahadeva@alsglobal.com
Telephone : +1 519 886 6910
Date Samples Received : 01-Aug-2025 13:15
Date Analysis Commenced : 01-Aug-2025
Issue Date : 11-Aug-2025 18:46

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Josphin Masihi		Centralized Prep, Waterloo, Ontario
Natasha Ollenberger		Sask Soils, Saskatoon, Saskatchewan
Nik Perkio		Inorganics, Waterloo, Ontario



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
LOR: Limit of Reporting (detection limit).

Unit	Description
%	percent
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units
µS/cm	microsiemens per centimetre

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.



Analytical Results

Sub-Matrix: Soil
(Matrix: Soil/Solid)

					Client sample ID	BH25-7-SS1-0'-2'	BH25-9-SS1-0.5'-2'	BH25-5-SS3-5'-7'	---	---
					Client sampling date / time	29-Jul-2025 15:00	30-Jul-2025 11:30	29-Jul-2025 13:20	---	---
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2521019-001	WT2521019-002	WT2521019-003	---	---	---
					Result	Result	Result	---	---	---
Physical Tests										
Conductivity (1:2 leachate)	---	E100-L/WT	5.00	µS/cm	---	---	985	---	---	---
Loss on ignition @ 440°C	---	E205E/SK	1.0	%	2.0	1.2	---	---	---	---
Moisture	---	E144/WT	0.25	%	---	---	12.5	---	---	---
Oxidation-reduction potential [ORP]	---	E125/WT	0.10	mV	---	---	452	---	---	---
pH (1:2 soil:CaCl2-aq)	---	E108A/WT	0.10	pH units	---	---	7.84	---	---	---
Resistivity	---	EC100R/WT	100	ohm cm	---	---	1020	---	---	---
Ash content @ 440°C	---	E205E/SK	1.0	%	97.9	98.8	---	---	---	---
Inorganics										
Sulfides, acid volatile	---	E395-L/WT	0.20	mg/kg	---	---	0.53	---	---	---
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236 Cl/WT	5.0	mg/kg	---	---	44.4	---	---	---
Sulfate, soluble ion content	14808-79-8	E238 SO4/WT	20	mg/kg	---	---	1010	---	---	---

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2521019	Page	: 1 of 7
Client	: Stantec Consulting Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Essa Nimer	Account Manager	: Mathy Mahadeva
Address	: 100-300 Hagey Blvd. Waterloo ON Canada N2L 0A4	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 121626532.200	Date Samples Received	: 01-Aug-2025 13:15
PO	: ----	Issue Date	: 11-Aug-2025 18:46
C-O-C number	: ----		
Sampler	: CLIENT		
Site	: ----		
Quote number	: Stantec 2025-2026 MSA Price List		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "—" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

DRAFT



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method		Method	Sampling Date	Extraction / Preparation			Eval	Analysis			
Container / Client Sample ID(s)				Preparation Date	Holding Times			Analysis Date	Holding Times		Eval
					Rec	Actual			Rec	Actual	
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)											
LDPE bag BH25-5-SS3-5'-7'		E396-L	29-Jul-2025	11-Aug-2025	0 hrs	314 hrs	✖ UCP	11-Aug-2025	0 hrs	314 hrs	✖ UCP
Leachable Anions & Nutrients : Water Extractable Chloride by IC											
LDPE bag BH25-5-SS3-5'-7'		E236.Cl	29-Jul-2025	08-Aug-2025	30 days	10 days	✓	08-Aug-2025	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC											
LDPE bag BH25-5-SS3-5'-7'		E236.SO4	29-Jul-2025	08-Aug-2025	30 days	10 days	✓	08-Aug-2025	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)											
LDPE bag BH25-5-SS3-5'-7'		E100-L	29-Jul-2025	07-Aug-2025	30 days	9 days	✓	07-Aug-2025	30 days	9 days	✓
Physical Tests : Loss On Ignition (440°C)											
LDPE bag BH25-9-SS1-0.5'-2'		E205E	30-Jul-2025	---	---	---		07-Aug-2025	365 days	8 days	✓
Physical Tests : Loss On Ignition (440°C)											
LDPE bag BH25-7- SS1-0'-2'		E205E	29-Jul-2025	---	---	---		07-Aug-2025	365 days	9 days	✓
Physical Tests : Moisture Content by Gravimetry											
LDPE bag BH25-5-SS3-5'-7'		E144	29-Jul-2025	---	---	---		01-Aug-2025	---	---	



Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation					Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Physical Tests : ORP by Electrode											
LDPE bag BH25-5-SS3-5'-7'	E125	29-Jul-2025	08-Aug-2025	180 days	10 days	✓	11-Aug-2025	180 days	10 days	✓	
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received											
LDPE bag BH25-5-SS3-5'-7'	E103A	29-Jul-2025	08-Aug-2025	30 days	10 days	✓	11-Aug-2025	30 days	10 days	✓	

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type				Count	Frequency (%)			
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)								
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	2145519	1	4	25.0	5.0	✓	
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	2150240	1	19	5.2	5.0	✓	
ORP by Electrode	E125	2149685	1	19	5.2	5.0	✓	
Moisture Content by Gravimetry	E144	2140858	1	20	5.0	5.0	✓	
Loss On Ignition (440°C)	E205E	2146977	1	2	50.0	5.0	✓	
Water Extractable Chloride by IC	E236.Cl	2145523	1	1	100.0	5.0	✓	
Water Extractable Sulfate by IC	E236.SO4	2145522	1	1	100.0	5.0	✓	
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	2153885	1	6	16.6	4.7	✓	
Laboratory Control Samples (LCS)								
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	2145519	2	4	50.0	10.0	✓	
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	2150240	1	19	5.2	5.0	✓	
ORP by Electrode	E125	2149685	1	19	5.2	5.0	✓	
Moisture Content by Gravimetry	E144	2140858	1	20	5.0	5.0	✓	
Loss On Ignition (440°C)	E205E	2146977	1	2	50.0	5.0	✓	
Water Extractable Chloride by IC	E236.Cl	2145523	2	1	200.0	10.0	✓	
Water Extractable Sulfate by IC	E236.SO4	2145522	2	1	200.0	10.0	✓	
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	2153885	1	6	16.6	4.7	✓	
Method Blanks (MB)								
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	2145519	1	4	25.0	5.0	✓	
Moisture Content by Gravimetry	E144	2140858	1	20	5.0	5.0	✓	
Loss On Ignition (440°C)	E205E	2146977	1	2	50.0	5.0	✓	
Water Extractable Chloride by IC	E236.Cl	2145523	1	1	100.0	5.0	✓	
Water Extractable Sulfate by IC	E236.SO4	2145522	1	1	100.0	5.0	✓	
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	2153885	1	6	16.6	4.7	✓	



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSRS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP 63630	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
ORP by Electrode	E125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Oxidation Reduction Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	OCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Loss On Ignition (440°C)	E205E ALS Environmental - Saskatoon	Soil/Solid	ASTM D2974 Method A	Loss On Ignition (LOI) is determined by drying a portion of an air dried and ground sample at 105°C overnight, then igniting at 440°C for 16-20 hours. The weight loss after ignition is reported as % loss on ignition. LOI is reported on a dry weight basis. LOI at 440°C can be used as an estimation of Organic Matter (ASTM D2974 Method A).
Water Extractable Chloride by IC	E236.Cl ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO ₄ ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD. PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl2 - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP238 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Distillation for Acid Volatile Sulfide in Soil	EP306-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.
Dry and Grind in Soil/Solid <60°C	EPP442 ALS Environmental - Saskatoon	Soil/Solid	Soil Sampling and Methods of Analysis. Carter 2006	After removal of any coarse fragments and reservation of wet subsamples a portion of homogenized sample is set in a tray and dried at less than 60°C until dry. The sample is then particle size reduced with an automated crusher or mortar and pestle, typically to <2 mm. Further size reduction may be needed for particular tests.



QUALITY CONTROL REPORT

Work Order	: WT2521019	Page	: 1 of 5
Client	: Stantec Consulting Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Essa Nimer	Account Manager	: Mathy Mahadeva
Address	: 100-300 Hagey Blvd. Waterloo ON Canada N2L 0A4	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 121626532.200	Date Samples Received	: 01-Aug-2025 13:15
PO	: ----	Date Analysis Commenced	: 01-Aug-2025
C-O-C number	: ----	Issue Date	: 11-Aug-2025 18:46
Sampler	: CLIENT		
Site	: ----		
Quote number	: Stantec 2025-2026 MSA Price List		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Josphin Masihi	Supervisor I	Waterloo Centralized Prep, Waterloo, Ontario
Natasha Ollenberger	Laboratory Assistant	Saskatoon Sask Soils, Saskatoon, Saskatchewan
Nik Perkio	Senior Analyst	Waterloo Inorganics, Waterloo, Ontario



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "--" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Page : 3 of 5
 Work Order : WT2521019
 Client : Stantec Consulting Ltd.
 Project : 121626532.200



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 2140858)											
WT2520541-003	Anonymous	Moisture	—	E144	0.25	%	8.54	8.55	0.0580%	20%	—
Physical Tests (QC Lot: 2145519)											
TY2508482-002	Anonymous	Conductivity (1:2 leachate)	—	E100-L	500	µS/cm	0.238 mS/cm	250	4.92%	20%	—
Physical Tests (QC Lot: 2146977)											
WT2521019-001	BH25-7- SS1-0'-2'	Loss on ignition @ 440°C	—	E205E	1.0	%	2.0	2.1	0.02	Diff <2x LOR	—
Physical Tests (QC Lot: 2149685)											
WT2521182-001	Anonymous	Oxidation-reduction potential (ORP)	—	E125	0.10	mV	312	313	0.320%	25%	—
Physical Tests (QC Lot: 2150240)											
WT2520657-002	Anonymous	pH (1:2 soil:CaCl ₂ -aq)	—	E108A	0.10	pH units	7.60	7.39	2.80%	5%	—
Inorganics (QC Lot: 2153885)											
WT2518571-004	Anonymous	Sulfides, acid volatile	—	E296-L	0.21	mg/kg	<0.21	<0.21	0	Diff <2x LOR	—
Leachable Anions & Nutrients (QC Lot: 2145522)											
WT2521019-003	BH25-5-SS3-5'-7'	Sulfate, soluble ion content	14808-75-8	E236.S04	20	mg/kg	1010	971	3.85%	30%	—
Leachable Anions & Nutrients (QC Lot: 2145523)											
WT2521019-003	BH25-5-SS3-5'-7'	Chloride, soluble ion content	16887-00-6	E236.C2	5.0	mg/kg	44.4	45.6	2.65%	30%	—



Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 2140858)						
Moisture	---	E144	0.25	%	<0.25	---
Physical Tests (QCLot: 2145519)						
Conductivity (1:2 leachate)	---	E100-L	5	µS/cm	<5.00	---
Inorganics (QCLot: 2153885)						
Sulfides, acid volatile	---	E106-L	0.2	mg/kg	<0.20	---
Leachable Anions & Nutrients (QCLot: 2145522)						
Sulfate, soluble ion content	14808-79-8	E236.S04	20	mg/kg	<20	---
Leachable Anions & Nutrients (QCLot: 2145523)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	---

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid

Sub-Matrix: Soil/Solid					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 2140858)									
Moisture	---	E144	0.20	%	50 %	89.2	90.0	110	----
Physical Tests (QCLot: 2145519)									
Conductivity (1:2 leachate)	---	E100-L	5	µS/cm	3410 µS/cm	96.7	90.0	110	----
Physical Tests (QCLot: 2150240)									
pH (1:2 soil:CaCl2-aq)	---	E108A	---	pH units	7 pH units	100	98.0	102	----
Inorganics (QCLot: 2153885)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	100 mg/kg	77.0	70.0	130	----
Leachable Anions & Nutrients (QCLot: 2145522)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	1000 mg/kg	100	80.0	120	----
Leachable Anions & Nutrients (QCLot: 2145523)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	1000 mg/kg	100	80.0	120	----



Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Sub-Matrix:					Reference Material (RM) Report				
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Physical Tests (QCLot: 2145519)									
QC-2145519-003	RM	Conductivity (1:2 leachate)	—	E100-L	598 µS/cm	02	70.0	130	---
Physical Tests (QCLot: 2146977)									
QC-2146977-002	RM	Loss on ignition @ 440°C	—	E205E	8.78 %	03	80.0	120	---
Physical Tests (QCLot: 2149685)									
QC-2149685-001	RM	Oxidation-reduction potential [ORP]	—	E125	475 mV	8.5	90.0	110	---
Leachable Anions & Nutrients (QCLot: 2145522)									
QC-2145522-003	RM	Sulfate, soluble ion content	14808-79-8	E236.SD4	647 mg/kg	1.8	70.0	130	---
Leachable Anions & Nutrients (QCLot: 2145523)									
QC-2145523-003	RM	Chloride, soluble ion content	16887-00-6	E238.Cl	382 mg/kg	2.3	70.0	130	---



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Environmental Division

Waterloo

Work Order Reference

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