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DESIGN BRIEF

FOR

HABITAT FOR HUMANITY NATIONAL CAPITAL REGION

PROPOSED RESIDENTIAL SITE PLAN

40 BEECHCLIFFE
CITY OF OTTAWA

PROJECT NO.: 24-1416

SUBMISSION 4
MARCH 2026

DESIGN BRIEF
FOR
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TABLE OF CONTENTS

DRAWINGS

TABLES

APPENDICES

DESIGN BRIEF
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CITY OF OTTAWA
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1.0 INTRODUCTION

David Schaeffer Engineering Limited (DSEL) was retained by Habitat for Humanity National Capital Region to prepare a Design Brief in support of their application for part lot control and site plan control.

The property, located at 40 Beechcliffe Street in Ottawa's Knoxdale/Merivale Ward, is identified as PIN 04657-0598 on the attached City of Ottawa topographic survey included in ***Appendix A***. It covers approximately 1.28 ha currently owned by the City of Ottawa, whom is transferring 0.76 ha of land to Habitat for the purpose of constructing affordable housing.

This report aims to provide detailed information on the availability of site services to support the applications for site plan control application.

1.1 Existing Conditions

The subject property is an undeveloped parcel of land within the Craig Henry community adjacent to Woodroffe Ave. The site is generally flat with elevations ranging between 88.00 and 88.80.

The soil profile of the land typically consists of a large fill deposit (sand, gravel, trace organics) placed above a brown silty clay. Groundwater monitoring wells were installed by Terrapex and groundwater levels were measured around 3.5m below existing grade, however Paterson noted in their Due Diligence report that seasonal fluctuations are to be expected due to the high permeability of the soils.

Existing infrastructure exists in the Beechcliffe Street ROW along the western boundary of the subject property. Plan and profiles are attached in ***Appendix A*** for reference. Storm and sanitary sewers from the existing subdivision outlet via a servicing block which bisect the property in line with Sovereign Avenue.

The subject lands fall within the intake protection zone scored 8.1. See ***Appendix A*** for excerpt from the Mississippi-Rideau Source Protection Plan. The proposed works are not identified a significant drinking water threat in the Source Protection Plan.

1.2 Site Plan Layout

The proposed project includes 33 residential townhome units as shown on the site plan attached in ***Appendix A***. The site will be phased, where Phase 1 consisting of 26 units will be subject to an application for site plan control and the remaining units in Phase 2 will be subdivided through part lot control. Predicted population figures for the site are outlined in ***Table 1***.

Table 1: Development Statistics

Land Use	Total Area (ha)	Projected Residential Units	Residential Population per Unit *	Projected Population
Townhouses	0.76	33	2.7	90
Total	**0.76**	**33**		**90**

** NOTE: Population projections may differ from population estimates used in background Transportation Studies, Planning Rationale, and other studies.*

1.3 Consultation Summary

The client and consultant team met with the City of Ottawa on January 15, 2025 and May 13, 2025. Correspondence summarizing these consultations can be found in ***Appendix A*** for reference.

1.4 Proximity to Future LRT

The subject lands are located adjacent to a future LRT station. Note that the subject lands will be supported by utilities from Beechcliffe and will not have located within the rear yards of the site. All basements will align with the footprint of the home.

1.5 Required Permits / Approvals

Although this project's servicing concept covers the entire property at 40 Beechcliffe Street, Habitat intends on applying for Site Plan Control for the southern 26 lots. The 7 units north of the servicing corridor will be covered under a Part Lot Control application.

The City of Ottawa must approve detailed engineering design drawings and reports prior to construction of the proposed infrastructure identified in this report.

The following additional approvals and permits listed in ***Table 2*** are expected to be required prior to construct municipal infrastructure detailed herein. Other permits and approvals may be required, as detailed in the other studies submitted as part of the Planning Act applications (e.g. *Tree Conservation Report, Phase 1 Environmental Site Assessment, etc*.).

Table 2: Potential Required Permits/Approvals

Agency	Permit/Approval Required	Trigger	Remarks
MECP / City of Ottawa	Environmental Compliance Approval	Construction of new sanitary & storm sewers.	MECP is expected to review the stormwater collection system and wastewater collection system by transfer of review.
MECP	Permit to Take Water	Construction of proposed land uses (e.g. basements for	Pumping of groundwater will be required during construction, given

		residential homes) and services.	groundwater conditions and proposed land uses/ municipal infrastructure.
City of Ottawa	MOE Form 1 – Record of Watermains Authorized as a Future Alteration	Construction of watermains.	The City of Ottawa is expected to review the watermains on behalf of the MECP.

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

The following documents were referenced in the preparation of this report:

- **Ottawa Sewer Design Guidelines**,
  City of Ottawa, *SDG002,* October 2012.
  (City Standards)

  - **Technical Bulletin ISDTB-2014-01, Revisions to Ottawa Design Guidelines – Sewer,**
    City of Ottawa, February 5, 2014.
    (*ISDTB-2014-01*)

  - **Technical Bulletin PIEDTB-2016-01, Revisions to Ottawa Design Guidelines – Sewer,**
    City of Ottawa, September 6, 2016.
    (*PIEDTB-2016-01*)

  - **Technical Bulletin ISTB-2018-01, Revisions to Ottawa Design Guidelines – Sewer,**
    City of Ottawa, March 21, 2018.
    (*ISTB-2018-01*)

  - **Technical Bulletin ISTB-2018-03, Revisions to Ottawa Design Guidelines – Sewer,**
    City of Ottawa, June, 2018.
    (*ISTB-2018-04*)

  - **Technical Bulletin ISTB-2019-02, Revisions to Ottawa Design Guidelines – Sewer,**
    City of Ottawa, July 8, 2019.
    (*ISTB-2019-02*)

  - **Technical Bulletin IWSTB-2024-04, Revisions to Ottawa Design Guidelines – Sewer,**
    City of Ottawa, September 12, 2024.
    (*IWSTB-2024-04*)

- **Ottawa Design Guidelines – Water Distribution**
  City of Ottawa, July 2010.
  (Water Supply Guidelines)

  - **Technical Bulletin ISD-2010-2**
    City of Ottawa, December 15, 2010.
    (*ISD-2010-2*)

  - **Technical Bulletin ISDTB-2014-02**
    City of Ottawa, May 27, 2014.
    (*ISDTB-2014-02*)

- **Technical Bulletin ISTB-2018-02**
  City of Ottawa, March 21, 2018.
  (*ISTB-2018-02*)

- **Technical Bulletin ISTB-2021-03**
  City of Ottawa, August 18, 2021
  (ISTB-2021-03)

- **Technical Bulletin IWSTB-2024-05**
  City of Ottawa, November 18, 2024.
  (IWSTB-2024-05)

➢ **Design Guidelines for Sewage Works,**
Ministry of the Environment, 2016.
(MOE* Design Guidelines*)

➢ **Stormwater Planning and Design Manual,**
Ministry of the Environment, March 2003.
(SWMP Design Manual)

➢ **Ontario Building Code Compendium**
Ministry of Municipal Affairs and Housing Building Development Branch, May 29, 2024.
(OBC)

➢ **Mississippi-Rideau Source Water Protection Plan,**
MVCA & RVCA, April 28, 2022.

➢ **Erosion & Sediment Control Guidelines for Urban Construction,**
Greater Golden Horseshoe Area Conservation Authorities, December 2006.

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The subject property is located within the 2W2C pressure zone and is currently serviced by the existing local watermain network. A 150 mm diameter watermain runs along Beechcliffe Street.

3.2 Water Supply Servicing Design

Proposed water servicing is shown on ***Drawings 4*** and ***5***. It is proposed to remove and replace the existing watermain along the frontage of the subject property. Along Phase 1, the watermain will be upsized to 200 mm diameter; the watermain within Phase 2 will remain at 150 mm diameter.

Per correspondence with the City of Ottawa (***Appendix B***), the hydrant on the existing Phase 1 main currently supports up to 125 L/s, and the hydrant in Phase 2 up to 145 L/s. With the proposed upgrade to a 200 mm diameter watermain in Phase 1, available flows are expected to increase to approximately 150 L/s for Phase 1 and 155 L/s for Phase 2.

The required fire flow was estimated in accordance with ***IWSTB-2024-05*** using the OBC method. Block 5, which has the greatest exposure, was used for the design basis. The resulting required fire flow was calculated to be ***5,400 L/min*** (90 L/s). Refer to Appendix B for detailed demand and fire flow calculations.

Table 3 summarizes the estimated domestic water demands. The City also provided available pressure data for Average Day Demand (ADD), Fire Flow, and Peak Hour scenarios, which are included in ***Appendix B*** and summarized below. These values generally fall within the acceptable design ranges.

Table 3: Water Demand Proposed Conditions

Design Parameter	Estimated Demand[1] (L/min)	Boundary Condition[2] (m H_2O / kPa)
Connection 1		
Average Daily Demand	17.5	(132.6 / 437.5)
Max Day + Fire Flow	85.8 + 5,400 = 5,485.8	(120 / 313.9)
Peak Hour	129.5	(126.2 / 374.7)
Connection 2		
Average Daily Demand	17.5	(132.6 / 431.6)
Max Day + Fire Flow	85.8 + 5,400 = 5,485.8	(118.6 / 294.3)
Peak Hour	129.5	(126.2 / 368.9)

1) Water demand calculation per ***Water Supply Guidelines***. See ***Appendix B*** for detailed calculations.
2) Boundary conditions supplied by the City of Ottawa.

Table 4 summarizes the parameters used in the design of the water supply system.

Table 4: Water Supply Design Criteria

Design Parameter	Value
Residential Stacked Townhome	2.7 P/unit

Residential Average Daily Demand	280 L/d/p
Residential Maximum Daily Demand	4.9 x Average Daily **
Residential Maximum Hourly	7.4 x Average Daily **
System Pressure	Minimum 140kPa at ground level under maximum day demands plus fire flow conditions
Pipe Diameters	For distribution systems designed to provide fire protection, the minimum diameter of watermains shall be 150 mm except beyond the last hydrant on cul-de-sacs where the minimum diameter of watermains may be 25 mm. Watermain diameters shall be such that a flushing velocity of 0.8 m/s can be achieved for cleaning and flushing procedures.
Service Pipes	The minimum diameter of service pipes shall be 19 mm
Fire Hydrants	Fire hydrants shall be dry-barrel type and shall conform to the latest edition of AWWA Standard C502: Dry-Barrel Fire Hydrants. Fire hydrants shall be provided with adequate thrust blocking to prevent movement caused by thrust forces. Fire hydrant leads shall be a minimum diameter of 150 mm. In areas where the water table will rise above the hydrant drain ports, the drain ports shall be plugged.
Minimum operating pressure during normal operation	275 kPa
Maximum operation pressure during normal operation	552 kPa
Desired operating pressure	350 kPa to 480 kPa

Daily average based on Appendix 4-A from **Water Supply Guidelines*
*** Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons.*
-Table updated to reflect ISD-2010-2

3.3 Water Supply Conclusion

The proposed site plan will be serviced by the existing local watermain network. Infrastructure upgrades are expected to help improve fire flow conditions.

Existing houses along the road will be temporarily disconnected and reconnected as the main is reinstalled.

The proposed water supply design will conform with all relevant City of Ottawa Guidelines and Policies.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

A 250mm diameter sanitary sewer exists along the frontage of the subject lands. The existing sewer conveys wastewater to a 525mm diameter sewer to the Woodroffe South Trunk, approximately 80m west of Beechcliffe.

4.2 Wastewater Design

Due to the number of new connections to the existing main, the wastewater design proposes to remove and replace the existing 250mm diameter sanitary sewer in the same location. Detailed layouts are shown in ***Drawings 5 and 6***, with the sanitary drainage area plan in ***Drawing 8***.

Table 5 summarizes the ***City Standards*** to be employed in the design of the proposed wastewater sewer system. See ***Appendix C*** for the wastewater calculation sheet demonstrating that sufficient capacity exists within the existing local sewers to support the proposed development.

Table 5: Wastewater Design Criteria

Design Parameter	Value
Residential – Townhome	2.7 P/unit
Average Daily Demand	280 L/d/per
Peaking Factor	Harmon's Peaking Factor. Max 4.0, Min 2.0 Harmon's Corrector Factor 0.8
Infiltration and Inflow Allowance	0.05 L/s/ha (Dry Weather) 0.28 L/s/ha (Wet Weather) 0.33 L/s/ha (Total)
Park Flows	0.33 L/s/ha
Parking Peaking Factor	9300 L/ha/d
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Minimum Sewer Size	200 mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5 m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6 m/s
Maximum Full Flowing Velocity	3.0 m/s
Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012, and recent residential subdivisions in City of Ottawa (including revisions per ISTB Sewer-2018-01)	

4.3 Wastewater Servicing Conclusions

The subject property will be serviced by local sanitary sewers which will outlet to the Woodroffe South Trunk Sewer. There is residual capacity in the local sewers to accommodate the flow from the proposed development.

The proposed wastewater design conforms to all relevant ***City Standards***.

5.0 STORMWATER MANAGEMENT

5.1 Existing Stormwater Services

Stormwater runoff from the subject property is tributary to the City of Ottawa sewer system located within Beechcliffe and Woodroffe. The Woodroffe storm sewer eventually outlets into Pinecrest Creek and the Ottawa River.

During the review of the Site Plan application, the City of Ottawa identified that the subject lands currently provide localized relief storage for overland drainage originating from Beechcliffe Street. This storage occurs within a shallow depression where runoff from Beechcliffe Street temporarily ponds before entering the municipal storm sewer system or continuing along the City's established overland flow route.

5.2 Post-Development Stormwater Management Target

The following City standards are required for stormwater management within the subject property:

- Storm sewers on private roads are to be designed to provide a minimum 2-year level of service per the City's latest Technical Bulletin PIEDTB-2016-01;
- Quantity Control: Control all storms up to and including the 100-year to the existing 2-year release rate.
- Quality Control: not required for this development.

As discussed above, the existing site currently provides localized relief storage for runoff originating from Beechcliffe Street. The grading modifications required to support the proposed development will remove a portion of this storage volume. As a result, the City of Ottawa requested that the existing storage be quantified and replaced within the development area to maintain the existing drainage function.

5.3 Proposed Minor System

The subject property is proposed to be serviced by the existing storm sewers on Beechcliffe and the existing service easement between Phases 1 and 2. See ***Drawings 4, 5, and 6*** for a detailed layout of the proposed stormwater servicing. ***Drawing 9*** illustrates the storm drainage area plan and ***Drawing 10*** shows the static ponding limits. Design sheets are available for review in ***Appendix D***.

Foundation drainage is proposed to be connected to the existing storm sewer on Beechcliffe. Rear yard and roof drainage will be collected and detained in the rear yard within the City Standard swale and proposed underground storage units. It is proposed to control flow with Hydrovex Vertical Vortex Flow regulators. Manufacturers' details included in ***Appendix D***.

Table 6 summarizes the standards that will be employed in the detailed design of the storm sewer network.

Table 6: Storm Sewer Design Criteria

Design Parameter	Value
Minimum Minor System Design Return Period	2-Year (Private Streets; Park 2-year)
Major System Design Return Period	1:100 year
Intensity Duration Frequency Curve (IDF) 2-year storm event: A = 732.951; B = 6.199; C = 0.810 5-year storm event: A = 998.071; B = 6.053; C = 0.814	$i = \frac{A}{(t_c + B)^C}$
Minimum Time of Concentration	10 minutes
Rational Method	$Q = CiA$
Storm sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Runoff coefficient for paved and roof areas	0.9
Runoff coefficient for landscaped areas	0.2
Minimum Sewer Size	250 mm diameter
Minimum Manning's 'n' for pipe flow	0.013
Minimum Depth of Cover	2.0m from crown of sewer to grade
Minimum Full Flowing Velocity	0.8 m/s
Maximum Full Flowing Velocity	6.0 m/s (where velocities in excess of 3.0 m/s are proposed, provision shall be made to protect against displacement of sewers by sudden movement)
Clearance from highest of 100-Yr HGL or pipe obvert to lowest building opening (USF)	0.30 m
Max. Allowable Flow Depth on Municipal Roads	35 cm above gutter (PIEDTB-2016-01)
Extent of Major System	Water levels must not touch any part of the building envelope and must remain below the lowest building opening during the stress test event (100-year + 20%) and 15cm vertical clearance is maintained between spill elevation on the street and the ground elevation at the nearest building envelope (PIEDTB-2016-01)
Stormwater Management Model	PCSWMM
Model Parameters	Fo = 76.2 mm/hr, Fc = 13.2 mm/hr, DCAY = 4.14/hr, D.Stor.Imp. = 1.57 mm, D.Stor.Per. = 4.67 mm
Imperviousness	Based on runoff coefficient (C) where Percent Imperviousness = (C - 0.2) / 0.7 x 100%.
Design Storms	Chicago 3-hour Design Storms and 24-hour SCS Type II Design Storms. Maximum intensity averaged over 10 minutes.
Historical Events	July 1st, 1979, August 4th, 1988 and August 8th, 1996
Climate Change Street Test	20% increase in the 100-year, 3-hour Chicago storm
Extracted from City of Ottawa Sewer Design Guidelines, October 2012, and Technical Bulletins	

5.4 Quantity Control Analysis

5.4.1 Pre-development

Existing hydrology was analyzed within PCSWMM to establish target release rates for the development. The existing catchments were divided into two sections based on drainage direction, resulting in four sub-catchments in total. One portion drains east, while the other drains west toward the local road, as indicated by the existing grading. Predevelopment model schematic is including in ***Appendix D***.

Subcatchments were modeled using the Alternative Runoff Method (ARM) with the Nash Instantaneous Unit Hydrograph (IUH). Time of concentration was calculated using the FAA/Airport method. A summary of catchment inputs is included in ***Appendix D***.

Under predevelopment conditions, the SCS 2-year storm produced higher peak runoff than the Chicago storm. ***Tables 7 and 8*** summarize the pre-development target release rates for Phases 1(south) and 2(north).

Table 7: Phase 1(South) Target Release rate

Storm	Release Rate (m^3/s)
2-year 3hr Chicago	0.02549
100-year 3hr Chicago	0.1624

Table 8: Phase 2(North) Target Release rate

Storm	Release Rate (m^3/s)
2-year 3hr Chicago	0.00625
100-year 3hr Chicago	0.0428

5.4.2 Post-development

The proposed development includes both controlled and uncontrolled drainage areas. Runoff from areas discharging directly to Beechcliffe Avenue is considered uncontrolled; corresponding increases in flow are offset by applying enhanced control measures elsewhere on-site. The post-development drainage system was modeled using both the 3-hour Chicago storm. A schematic of the post-development model and a summary of subcatchment parameters are provided in ***Appendix D***.

Table 9: Phase 1(South) 100-year 3hr CHI Summary

Area	Release Rate (m^3/s)
Uncontrolled	0.0830
Controlled	0.0066
Total	0.0896
Storage	161

As demonstrated in ***Table 9***, Phase 1 exceeds the 2-year allowable release rate by 0.06411 m^3/s (64 L/s) when evaluated under the 3-hour Chicago storm.

Table 10: Phase 2(North) 100-year 3hr CHI Summary

Area	Release Rate (m^3/s)
Uncontrolled	0.0237
Controlled	0.0067
Total	0.0304
Storage	27

Similarly, for Phase 2, the 3-hour Chicago storm produces an exceedance of the allowable 100-year release rate by 0.02415 m^3/s (24 L/s).

Importantly, both Phase 1 and Phase 2 remain below their respective pre-development 100-year release rates. As such, the proposed development will result in a net reduction in peak runoff under 100-year conditions and improved post-development drainage performance.

5.4.3 Relief Storage Compensation

In response to City review comments, a compensatory storage strategy was developed to replace the relief storage volume removed through site grading. A detailed volumetric analysis was undertaken to compare the existing storage capacity with the proposed design conditions. Under existing conditions, the area behind the Beechcliffe Street curb line provides approximately 980 m^3 of relief storage below the controlling spill elevation. This storage acts as a temporary attenuation area for runoff generated along Beechcliffe Street.

Under post-development conditions, a portion of this storage will be maintained within the landscaped area, providing approximately 550 m^3 of retained storage. Additional surface storage of approximately 140 m^3 will be maintained through proposed grading within the development frontage. To compensate for the remaining volume removed by development, a dry stormwater management pond has been introduced on City-owned lands within the Sovereign Avenue road allowance. A 300 mm diameter storm sewer interconnects the catchbasin located in front of proposed Block 4 with a proposed catchbasin manhole adjacent to the dry pond. This connection hydraulically links the two drainage low points and allows runoff that would otherwise pond at the upstream catchbasin to be conveyed to the dry pond for temporary storage. The facility provides approximately 350 m^3 of dedicated storage below the normalized spill elevation, resulting in a total post-development storage volume of approximately 1,040 m^3, which exceeds the existing storage capacity. The additional storage also compensates for the increase in uncontrolled runoff discharging toward Beechcliffe Street under post-development conditions. A detailed summary of the volumetric assessment and stormwater management facility sizing is provided in the report titled ***Stormwater Management Facility Design and Volumetric Analysis***, included in ***Appendix D*** for reference.

The proposed design was incorporated by DSEL into the City of Ottawa's community PCSWMM model to reflect the updated drainage configuration. The analysis confirms that the proposed conveyance connection and compensatory storage facility function as intended and do not adversely impact the municipal drainage system. Model results also indicate that the peak spill flow along the overland flow route between the houses during the 100-year event is approximately 0.304 m^3/s, representing a reduction of roughly 5% compared to existing conditions.

5.5 Grading and Drainage Design

The following additional grading criteria and guidelines are applied to detailed design, per ***City of Ottawa Guidelines*** and standard industry practices:

- Slope in grassed areas will be between 2% and 7%;
- Grades in excess of 7% will require terracing to a maximum of a 3:1 slope;
- Swales are to be 0.15m deep with 3:1 side slopes unless otherwise indicated on the drawings; and,
- Perforated pipe will be required for drainage swales if they are less than 1.5% in slope;

Drawing 7 illustrates the proposed detailed grading.

5.6 CN Rail Safety Berm

Following the utility circulation, CN Rail requested that a safety berm be implemented on the City of Ottawa lands located north of the subject site. A design memo and associated plans for the berm are provided in ***Appendix D*** for reference.

5.7 Stormwater Servicing Conclusions

Stormwater from the proposed development will discharge to the existing municipal storm sewer system within Beechcliffe Street and the existing servicing block between Phases 1 and 2. Runoff from the site will be controlled through a combination of rear yard underground storage chambers and a compensatory dry stormwater management pond located on adjacent City-owned lands within the Sovereign Avenue road allowance.

The compensatory storage facility replaces relief storage removed through site grading and provides additional capacity to offset increases in uncontrolled runoff directed toward Beechcliffe Street. The proposed conveyance connection and storage system were incorporated into the City of Ottawa's community PCSWMM model, which confirms that the updated drainage configuration functions as intended and does not adversely impact the municipal drainage system. Model results also indicate that peak spill flow along the overland flow route between the houses during the 100-year event is approximately 0.304 m^3/s, representing a reduction of roughly 5% compared to existing conditions.

Accordingly, the proposed stormwater management design maintains or improves existing drainage performance and satisfies the City of Ottawa stormwater management criteria.

6.0 EROSION AND SEDIMENT CONTROL

Soil erosion occurs naturally and is a function of soil type, climate and topography. The extent of erosion losses is exaggerated during construction where vegetation has been removed and the top layer of soil becomes agitated. Prior to topsoil stripping, earthworks or construction, erosion and sediment controls will be implemented and will be maintained throughout construction.

Silt fencing will be installed around the perimeter of the active part of the site (and headwater features) and will be cleaned and maintained throughout construction. The silt fence will remain in place until the working areas have been stabilized and re-vegetated.

Catchbasins will have catchbasin inserts installed during construction to protect from silt entering the storm sewer system.

The following additional recommendations to the Contractor will be included in contract documents:

- Limit extent of exposed soils at any given time.
- Re-vegetate exposed areas as soon as possible.
- Minimize the area to be cleared and grubbed.
- Protect exposed slopes with plastic or synthetic mulches.
- Install silt fence to prevent sediment from entering any existing ditches.
- No refueling or cleaning of equipment near existing watercourses.
- Provide sediment traps and basins during dewatering.

The Contractor will be required to complete regular inspections and guarantee proper performance. The inspection is to include:

- Verification that water is not flowing under silt barriers.
- Clean and change inserts at catch basins.

7.0 CONCLUSION AND RECOMMENDATIONS

David Schaeffer Engineering Ltd. (DSEL) has been retained by Habitat for Humanity National Capital Region to prepare a Design Brief in support of their application for part lot and site plan control. The preceding report outlines the following:

- Water – subject site will replace the existing main within Beechcliffe.
- Wastewater – sanitary sewers are available on Beechcliffe and have sufficient capacity to support the subject property.
- Stormwater – runoff will be managed through a combination of rear yard underground storage chambers and a compensatory dry stormwater management pond located on adjacent City-owned lands within the Sovereign Avenue road allowance.

The submitted materials demonstrate that the existing water, sanitary, and storm services can accommodate the contemplated development.

Prepared by,
David Schaeffer Engineering Ltd.

Per: Jeremy Chouinard, P.Eng.

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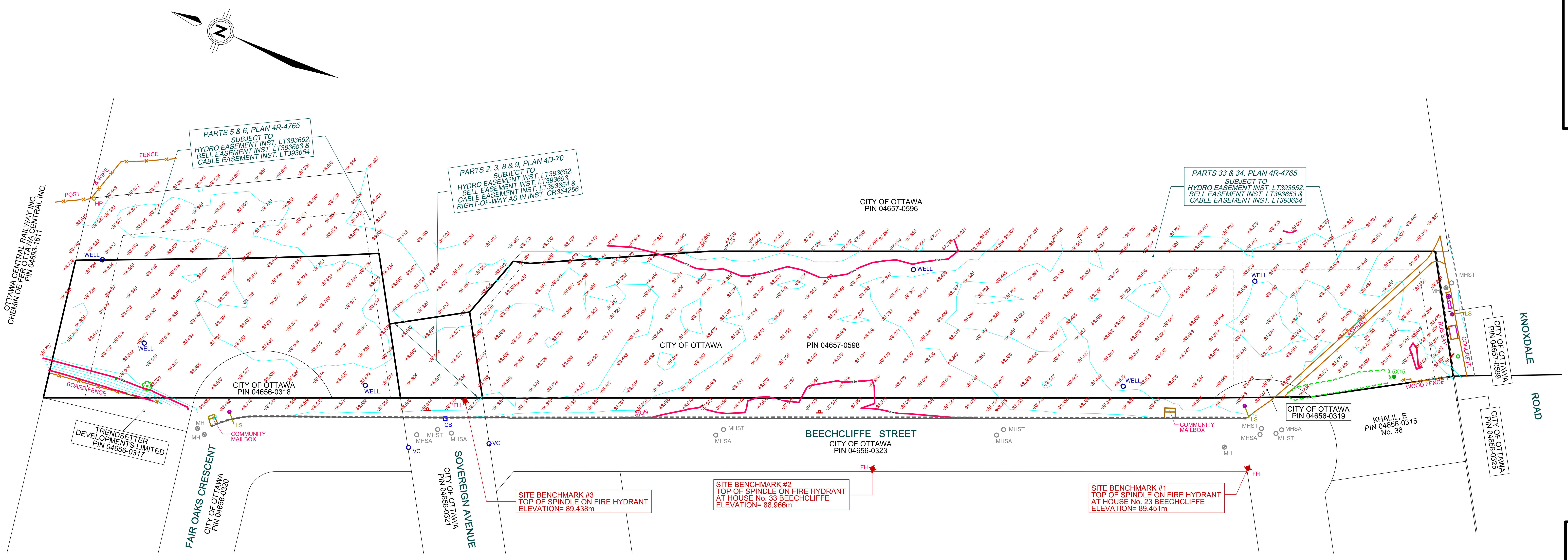
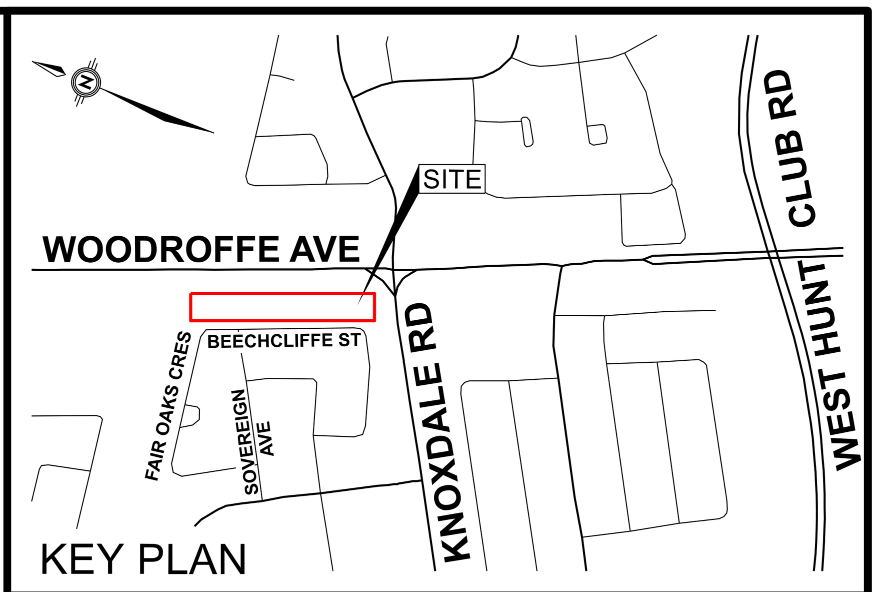
APPENDIX A





NAD83 ORIGINAL
CGVD28

SCALE - 1 : 500

(METRES)

THIS IS NOT A PLAN OF SURVEY
Boundaries shown hereon are NOT based on an actual survey.
Contractors are required to verify boundary locations in the field prior to commencing construction.

WINTER CONDITIONS
Due to the accumulation of ice and snow, it is possible that some elements may have been overlooked during the commission of this survey.

This plan was compiled from plans and documents recorded in the Land Registry System and has been prepared for property indexing purposes only.

Easements are not noted on adjacent properties.

Ottawa

PLANNING, DEVELOPMENT AND
BUILDING SERVICES DEPARTMENT
SURVEYS & MAPPING BRANCH

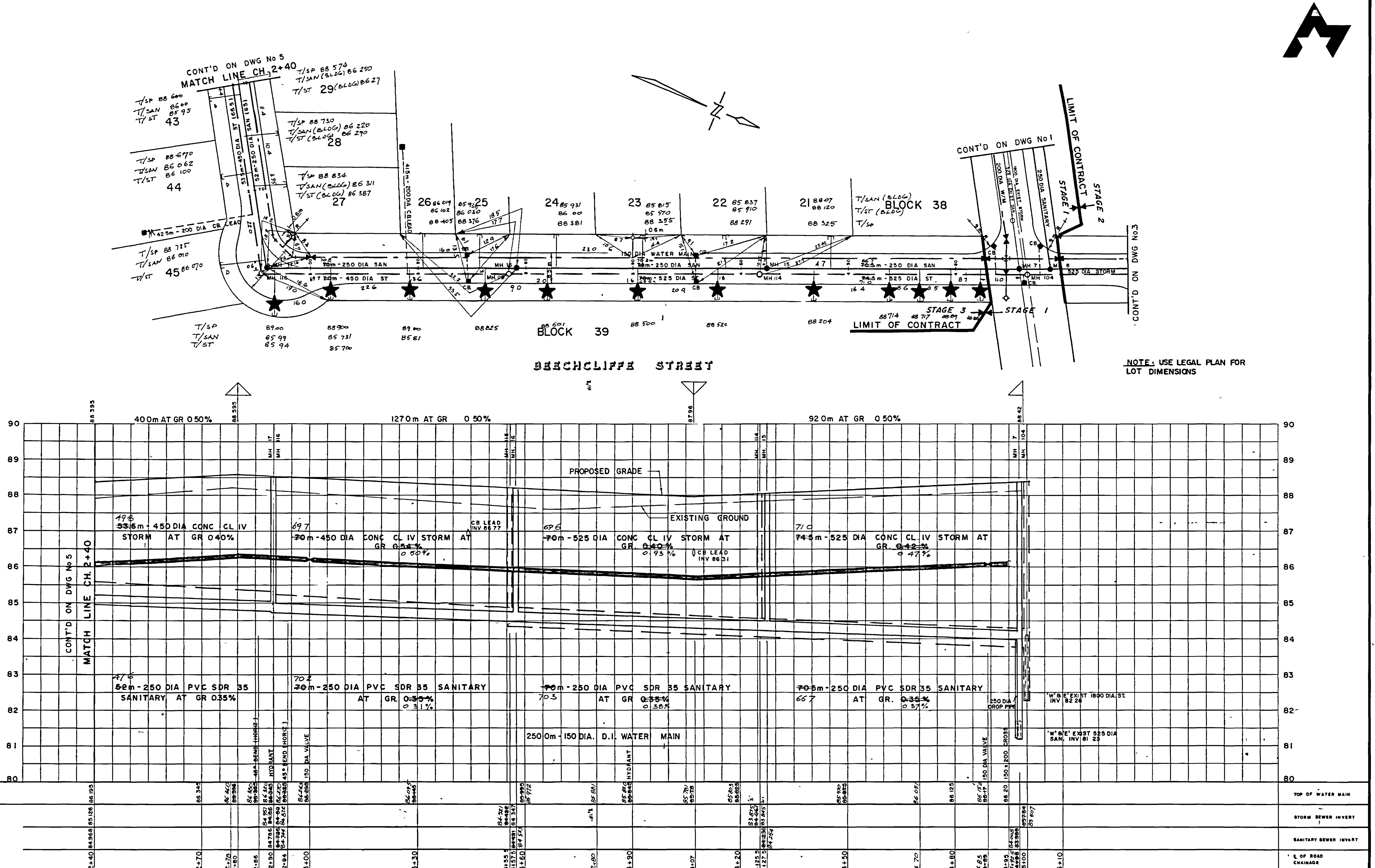
PHONE (613) 580-2400
FAX (613) 580-4764

100 CONSTELLATION DRIVE
OTTAWA, ONTARIO, K2G 6J8

PROJECT : 40 BEECHCLIFFE STREET

DATA COMPILATION :	TOTAL STATION MAPPING		
DATA TYPE :	ELECTRONIC FIELD NOTES		
HORIZONTAL AND VERTICAL DATUM :	NAD 83 (ORIGINAL) ZONE 9 MTM - CGVD28		
HYPSOGRAPHIC MODEL :	BREAKLINES & SPOT HEIGHTS		
RECOMMENDED HARDCOPY SCALE :	1 : 250		
RECOMMENDED CONTOUR INTERVAL :	0.25 m		
A - NUMBER :	A-4746		
COMPUTER GRAPHICS FILE NAME :	ORIG-CVGD28-24018A-m.dgn		
JOB - NUMBER :	24018-A		
FIELD DATE COLLECTED :	T.A. / B.B. / C.M. / D.M.	DATE :	DEC. 2024
CAD / CALC'D :	R.D.	DATE :	JAN. 2025
MAP / CADASTRAL COMPILATION CHECK :	A.R.	DATE :	JAN. 2025
THIS MAP DEPICTS DIGITAL DATA			

A-4746



NOTE
1 SEE NOTE 2 ON DWG 83-3611-1
2 ★ SAN AND ST SERVICE LATERALS DELETED AT LOT LINE; WATER SERVICE LATERALS DELETED AT MAIN (JULY 85)

No.	REVISIONS	DATE	BY
2	AS BUILT	24/9/85	JT
1	ADD REAR YARD CB LOT 26	18/9/84	TJW

CLIENT: THOMAS C. ASSALY CORPORATION LTD.

PROJECT: KNOXDALE AND WOODROFFE SUBDIVISION

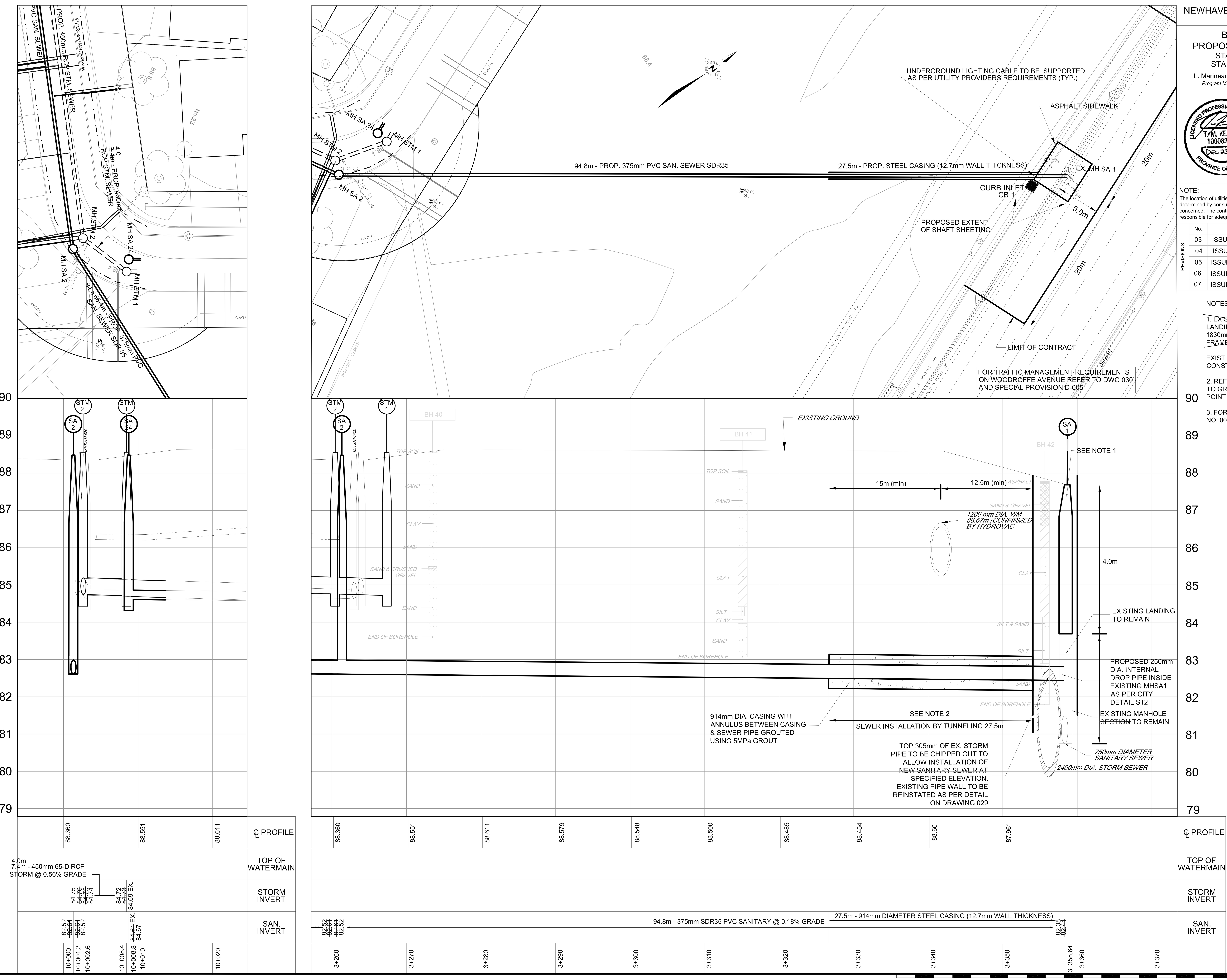
TITLE: BEECHCLIFFE STREET
CH 2+40 to STREET 'A'

OLIVER MANGIONE McCALLA & ASSOCIATES LIMITED
Consulting Engineers, Ottawa

DESIGN S.A.D. DRAWN WDD & JT CHECKED J.B.M.

DATE SEPT, 1984 | SCALE HORIZ 1:500 VERT. 1:50 | DRAWING No 84-4272-6 | REV 2

Consultant Drawing Number



KNOXDALE ROAD

NEWHAVEN ST. TO WOODROFFE AVE.

BEECHCLIFFE STREET PROPOSED INFRASTRUCTURE P&P

STA. 3+260 TO STA 3+370
STA. 10+000 TO STA 10+030

L. Marineau, P.Eng. — Program Manager
Susan Johns, P.Eng. — Project Manager

Ottawa

Contract No.	ISD10-5058
Dwg. No.	016
Sheet	~~17~~ 11 of ~~34~~ 24
Index No.	
Asset Group:	ISD
Des: AM	Chk'd: JK
Dwn: AB	Chk'd: JK
Utility Circ. No.:	-
Const. Inspector:	-
Scale:	HORIZONTAL 0m 2.5 5 10; VERTICAL 0m 1 2

LICENSED PROFESSIONAL ENGINEER T.M. KEALEY 100083622 Dec 23/13 PROVINCE OF ONTARIO

NOTE:
The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

R.V. Anderson Associates Limited
engineering • environment • infrastructure
Project # 102032

REVISIONS

No.	Description	By	Date
03	ISSUED FOR MUNICIPAL CONSENT	JK	30/12/2010
04	ISSUED FOR MOE C of A	JK	30/12/2010
05	ISSUED FOR TENDER	JK	19/08/2011
06	ISSUED FOR CONSTRUCTION	JK	30/09/2011
07	ISSUED FOR AS BUILTS	TMK	23/12/2013

NOTES:

1. ~~EXISTING SANITARY MANHOLE TO BE REPLACED ABOVE THE LANDING ELEVATION USING NEW M-5 MH SECTIONS (1520mm x 1830mm) INCLUDING NEW LADDER, TAPER SECTION, COVER AND FRAME TO CITY OF OTTAWA STANDARDS~~

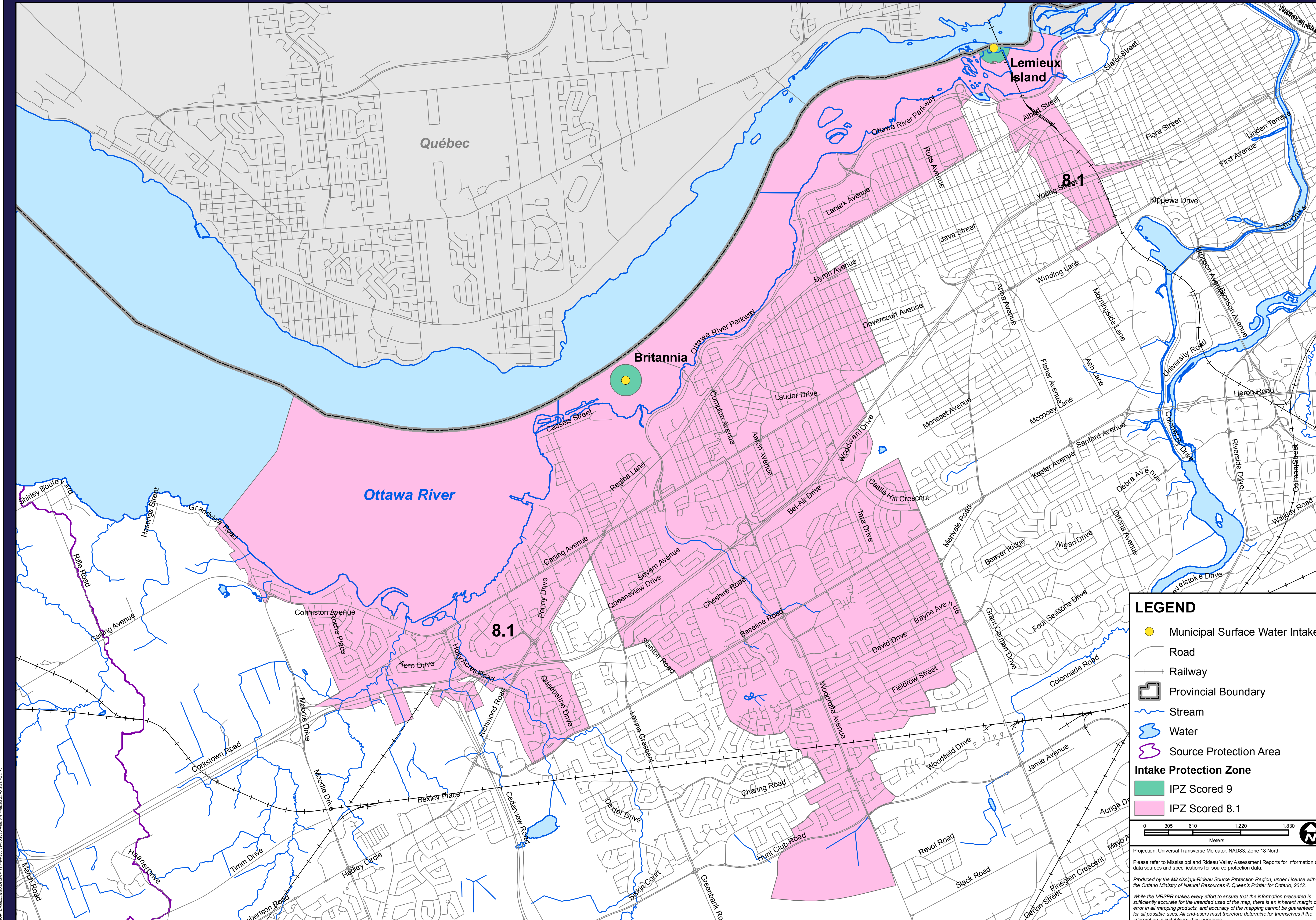
EXISTING SANITARY MANHOLE WAS PROTECTED DURING CONSTUCTION.

2. REFER TO GEOTECHNICAL REPORT FOR INFORMATION RELATING TO GROUND CONDITIONS INCLUDING REQUIREMENTS FOR WELL POINT DEWATERING.

3. FOR OTHER GENERAL NOTES, REFER TO DRAWING NO. 001

AS-BUILT

These drawings have been prepared using information from third parties. Any changes made outside the contract, or after contract completion or the date of issue (whichever is earlier) may not be reflected in the drawings. Users are advised to take sufficient steps to field verify equipment, layout, locations, dimensions and elevations. R.V. Anderson Associates Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions based on, this information.



Mississippi-Rideau Source Protection Plan 2013

Ottawa Intake Protection Zones

Schedule I

ELEVATION NOTES

1. Elevations shown are geodetic and are referred to the CGVD28 geodetic datum.
2. It is the responsibility of the user of this information to verify that the job benchmark has not been altered or disturbed and that it's relative elevation and description agrees with the information shown on this drawing.

Notes & Legend

	Denotes	
○ MH-ST	"	Maintenance Hole (Storm Sewer)
○ MH-S	"	Maintenance Hole (Sanitary)
□ CB	"	Catch Basin
FH	"	Fire Hydrant
+ 65.00	"	Location of Elevations
+ 65.00*	"	Top of Concrete Curb Elevation

DRAFT *PLAN OF SURVEY OF*

ALL OF PART 6 AND PART OF PARTS 1, 4 AND 11 EXPROPRIATION PLAN 4D-70 BLOCK 45 REGISTERED PLAN 4M-468 CITY OF OTTAWA

Surveyed by Annis, O'Sullivan, Vollebekk Ltd.

July 24, 2025

Scale 1 : 300

12 9 6 3 0 6 12 Metres

The intended plot size of this plan is 1219 mm in width by 457 mm in height when plotted at a scale of 1:300.

Metric

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

Surveyor's Certificate

I CERTIFY THAT :

1. This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act and the Land Titles Act and the regulations made under them.
2. The survey was completed on the _ _ day of _ _ _ _ _ _ _ _ _, 2025.

E.H. Herweyer
Date Ontario Land Surveyor

This plan relates to AOLS Plan Submission form number:

Distances shown on this plan are ground distances and can be converted to grid distances by multiplying by the combined scale factor of 0.9999xx.

Bearings are grid, derived from Can-Net 2016 Real Time Network GPS observations on reference points A and B, shown hereon, having a bearing of Nxx°xx'xx"W and are referenced to Specified Control Points 01919680005 and 01919750705, MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

For bearing comparisons, a rotation of 0°00'00" counter-clockwise was applied to bearings on plan

Coordinates are derived from Can-Net 2016 Real Time Network GPS observations referenced to Specified Control Points 01919680005 and 01919750705, MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

Coordinate values are to urban accuracy in accordance with O. Reg. 216/10.

. 01919680005	Northing	5027191.26	Easting	361496.76
. 01919750705	Northing	5016816.93	Easting	360806.84
. Point A	Northing		Easting	
. Point B	Northing		Easting	

Caution: Coordinates cannot, in themselves, be used to re-establish corners or boundaries shown on this plan.

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

Job No. 25159-25 Habitat Ottawa_Pt Blks 39,44,45 PL468 R D5 FS

File No.: PC2025-0152

May 16, 2025

Susan Murphy
Caivan
Via email: susan.murphy@caivan.com

Subject: **Pre-Consultation: Meeting Feedback**
Proposed Site Plan Control Application – 40 Beechcliffe

Please find below consolidated comments from the above-noted pre-consultation meeting held on May 13, 2025.

Pre-Consultation Preliminary Assessment

1 ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☒

One (1) indicates that considerable major revisions are required while five (5) suggests that the proposal appears to meet the City's key land use policies and guidelines. This assessment is purely advisory and does not consider technical aspects of the proposal or in any way guarantee application approval.

Supporting Information and Material Requirements

The attached **Study and Plan Identification List** outlines the information and material that has been identified, during this phase of pre-consultation, as either required (R) or advised (A) as part of a future complete application submission.

The required plans and studies must meet the City's Terms of Reference (ToR) and/or Guidelines, as available on Ottawa.ca. These ToR and Guidelines outline the specific requirements that must be met for each plan or study to be deemed adequate.

Consultation with Technical Agencies

You are encouraged to consult with technical agencies early in the development process and throughout the development of your project concept. A list of technical agencies and their contact information is enclosed.

Planning

Comments:

1. Pursuant to the Official Plan the Subject Site is designated as Mainstreet Corridor and identified as a Protected Major Transit Station Area (PMTSA).

2. The Subject Site is zoned Residential Fourth Density subzone M with an exception - R4M [2995]. Townhouse dwelling is a permitted use. The exception provides additional provisions:

   i) Section 101 – minimum parking space rates does not apply.

   ii) Section 102 – minimum visitor parking space rates does not apply.

   iii) The front yard may contain a driveway with a maximum width of 3m, a walkway with a maximum width of 1.8m, and a garbage enclosure. The remainder of the front yard, with the exception of projections permitted in Section 65, must be landscaped with soft landscaping.

   iv) Minimum rear yard setback: 4.5m.

   v) Minimum rear yard area requirement: No minimum.

   vi) Maximum building height for all permitted dwelling types: the lesser of 14.5m or 4 storeys.

   vii) Communal amenity area required need not be in the rear yard.

   viii) For townhouses:

   - minimum lot width: 5m.

   - minimum lot area: no minimum.

<u>Engineering</u>

Comments:

3. Information regarding the servicing for this site has been previously communicated to the applicant and consultants.

4. Any existing city owned infrastructure must remain within city property.

5. **Water Quality Control**: Not required.

6. **Water Quantity Control**: Given the known capacity constraints of the receiving storm sewer system, please control post-development runoff from the subject site, up to and including the 100-year storm event, to a 2-year pre-development level.

a. The time of concentration (Tc) used to determine the pre-development condition should be calculated. Tc should not be less than 10 min. since IDF curves become unrealistic at less than 10 min; Tc of 10 minutes shall be used for all post-development calculations.

7. An MECP Environmental Compliance Approval **Private Sewage Works** will be required for the proposed development.

    a. Environmental Compliance Approval | Ontario.ca

8. Environmental

a. A Phase I ESA is required to be completed in accordance with Ontario Regulation 153/04 in support of this development proposal to determine the potential for site contamination. Depending on the Phase I recommendations a Phase II ESA may be required.

b. The Phase I ESA shall provide all the required Environmental Source Information as required by O. Reg. 153/04. ERIS records are available to public at a reasonable cost and need to be included in the ESA report to comply with O.Reg. 153/04 and the Official Plan. The City will not be in a position to approve the Phase I ESA without the inclusion of the ERIS reports.

c. Official Plan: Section 10. Protection of Health and Safety (ottawa.ca)

9. Record of Site Condition (RSC)

a. An RSC is required to be filled with the MECP for any property where there is a proposed changes in land use to a more sensitive land use. An RSC will be required for this application.

b. A memorandum prepared by an environmental consultant confirming that no potential contaminating activities have taken place within the RSC area since the filling of the RSC, may also be required.

c. Submitting a record of site condition | Ontario.ca

10. Geotechnical

a. A Geotechnical Study/Investigation shall be prepared in support of this development proposal.

b. Reducing the groundwater level in this area can lead to potential damages to surrounding structures due to excessive differential settlements of the ground. The impact of groundwater lowering on adjacent properties needs to be discussed and investigated to ensure there will be no short term and long-term damages associated with lowering the groundwater in this area.

c. Geotechnical Study shall be consistent with the Geotechnical Investigation and Reporting Guidelines for Development Applications. Geotechnical Investigation and Reporting (ottawa.ca)

d. If Sensitive marine clay soils are present in this area that are susceptible to soil shrinkage that can lead to foundation and building damages. All six (6) conditions listed in the Tree Planting in Sensitive Marine Clay Soils-2017 Guidelines are required to be satisfied. Note that if the plasticity index of the soil is determined to be less than 40% a minimum separation between a street tree and the proposed building foundations of 4.5m will need to be achieved. A memorandum addressing the Tree in Clay Soil Guidelines prepared by a geotechnical engineer is required to be provided to the City. Tree Planting in Sensitive Marine Clay Soils - 2017 Guidelines (ottawa.ca)

11. Slope Stability Assessment Reports

a. A report addressing the stability of slopes, prepared by a qualified geotechnical engineer licensed in the Province of Ontario, should be provided wherever a site has slopes (existing or proposed) steeper than 5 horizontal to 1 vertical (i.e., 11 degree inclination from horizontal) and/or more than 2 meter in height. **The north portion of the site appears to have slopes alongs Woodroffe Avenue requiring a slope stability study.**

b. A report is also required for sites having retaining walls greater than 1 meter high, that addresses the global stability of the proposed retaining walls.

c. Slope Stability Guidelines for Development Applications (ottawa.ca)

Feel free to contact Vincent Duquette, Project Manager, for follow-up questions.

Noise

Comments:

12. Noise Impact Studies required for road and rail.

Feel free to contact Rochelle Fortier-Lesage, Transportation Project Manager, for follow-up questions.

Transportation

Comments:

13. Transportation Impact Assessment not required, but Transportation Demand Management measures are strongly recommended. Fill out and provide TDM Checklists with the submission materials.

    a. TDM-Supportive Development Design and Infrastructure Checklist

    b. TDM Measures Checklist

14. O-Train Proximity Study will be required. The Terms of Reference for a Rail Proximity Study are here: https://documents.ottawa.ca/sites/default/files/rail_proximity_tor_en.pdf

15. Ensure that the development proposal complies with the Right-of-Way protection requirements - See Schedule C16 of the Official Plan.

   a. Property requirements must follow the approved Barrhaven Light Rail Transit (Baseline Station to Barrhaven Town Centre) and Grade-Separations Planning and Environmental Assessment Study, prepared by Parsons, dated October 2024. See screenshot below and please contact Jabbar Siddique for more information.

   b. In addition to the LRT ROW, there is ROW protection listed in Schedule C16 for this section of Woodroffe.

   c. ROW must be unincumbered and conveyed at no cost to the City. Note that conveyance of the ROW will be required prior to registration of the SP agreement. Additional information on the conveyance process can be provided upon request.

   d. Any requests for exceptions to ROW protection requirements must be discussed with Transportation Planning and concurrence provided by Transportation Planning management. The applicant shall submit support evidence and rationale to support any relief to Transportation Planning satisfaction.

Feel free to contact Rochelle Fortier-Lesage, Transportation Project Manager, for follow-up questions.

Parkland

Comments:

16. If you intend to rely on the below exemption in the Parkland Dedication (By-law No. 2022-280), please provide the required documentation. For example, 'Article of Incorporation under the Canada Not-for-profit Corporations Act':

    2. No conveyance of land or payment of cash-in-lieu under this by-law is required in the case of the development or redevelopment of:

    e. residential purposes, or the residential portion of a mixed-use development, that are erected and owned by non-profit housing, provided that satisfactory evidence is provided to the Treasurer that the dwelling units and/or rooming units are intended for persons of low or modest incomes and that the dwelling units and/or rooming units are being made available at values that are initially, and will continue to be, below current market levels in the City;

Feel free to contact James Ireland, Planner III, for follow-up questions.

Other

17. The High Performance Development Standard (HPDS) is a collection of voluntary and required standards that raise the performance of new building projects to achieve sustainable and resilient design and will be applicable to Site Plan Control and Plan of Subdivision applications.

    a. The HPDS was passed by Council on April 13, 2022, but is not in effect at this time, as Council has referred the 2023 HPDS Update Report back to staff with the direction to bring forward an updated report to Committee at a later date. The timing of an updated report to Committee is unknown at this time, and updates will be shared when they are available.

    b. Please refer to the HPDS information at ottawa.ca/HPDS for more information.

18. Under the Affordable Housing Community Improvement Plan, a Tax Increment Equivalent Grant (TIEG) program was created to incentivize the development of affordable rental units. It provides a yearly fixed grant for 20 years. The grant helps offset the revenue loss housing providers experience when incorporating affordable units in their developments.

a. To be eligible for the TIEG program you must meet the following criteria:

    i. the greater of five units OR 15 per cent of the total number of units within the development must be made affordable

ii. provide a minimum of 15 per cent of each unit type in the development as affordable

iii. enter into an agreement with the city to ensure the units maintain affordable for a minimum period of 20 years at or below the city-wide average market rent for the entire housing stock based on building form and unit type, as defined by the Canada Mortgage and Housing Corporation

iv. must apply after a formal Site Plan Control submission, or Building Permit submission for projects not requiring Site Plan Control, and prior to Occupancy Permit issuance

b. Please refer to the TIEG information *at Affordable housing community improvement plan / Plan d'améliorations communautaires pour le logement abordable for more details or contact the TIEG coordinator via email at affordablehousingcip@ottawa.ca.*

Should there be any questions, please do not hesitate to contact myself or the contact identified for the above disciplines.

Sincerely,

James Ireland, Planner III

Encl. O-Train Proximity Study Guidelines
Studies and Plans Identification List (SPIL)
List of Technical Agencies

c.c. Vincent Duquette, Infrastructure Project Manager
Rochelle Fortier-Lesage, Transportation Project Manager
Mary Dickinson, Housing Developer II
Shoma Murshid, Planner II
Erin O'Connor, Habitat for Humanity

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

APPENDIX B

Adam Fobert

From: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Sent: February 12, 2025 5:14 PM
To: Jeremy Chouinard
Cc: Dickinson, Mary; Grift, Justin; Mottalib, Abdul
Subject: RE: Informal boundary Condition Request - City Housing Sites

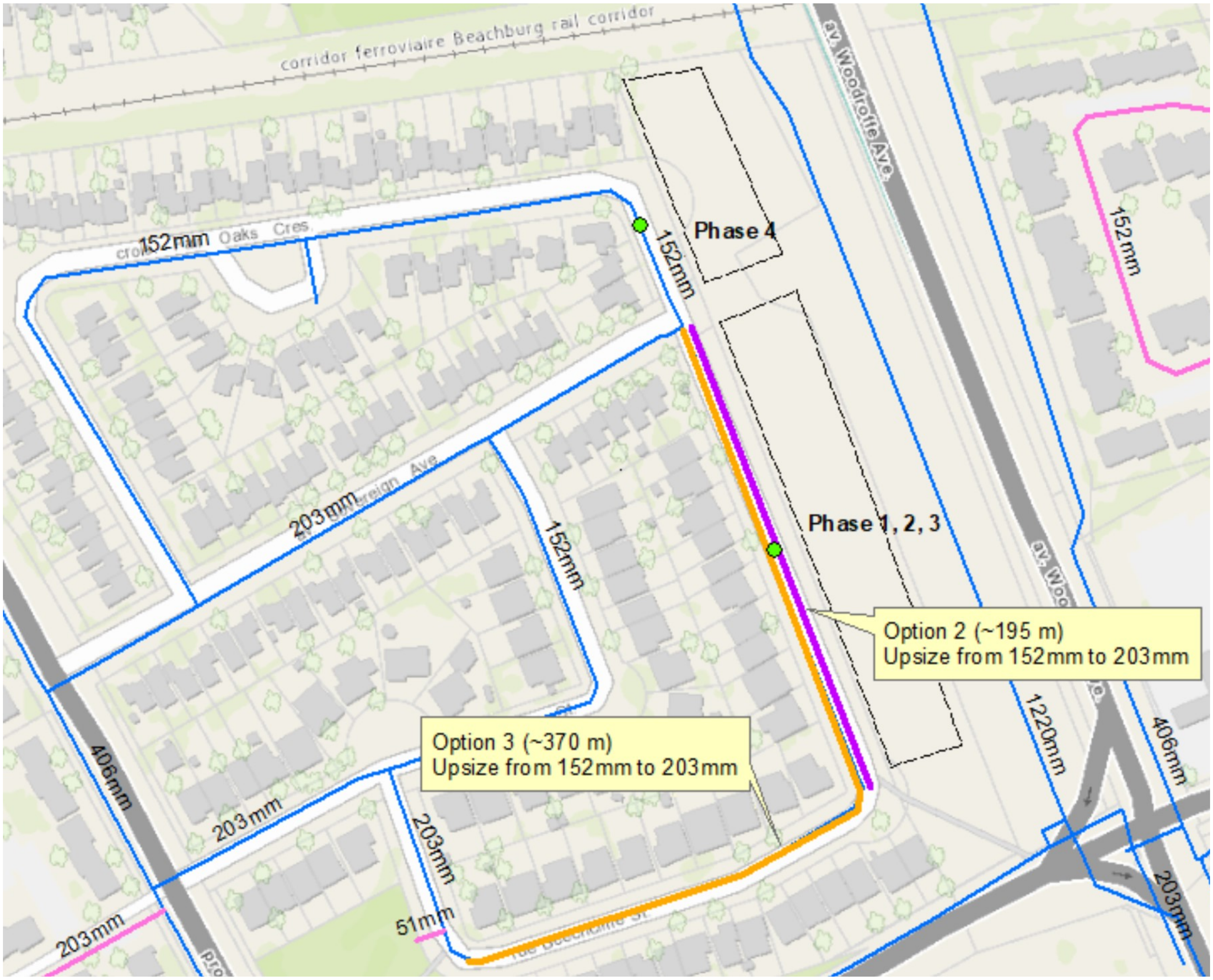
Hi Jeremy,

Thank you for your patience on the boundary condition request. Our water resource group indicated that the first scenario below to interconnect the Beechcliffe and Knoxdale watermains is not permitted because a portion of the lands where the proposed interconnecting watermain is located is reserved for utility relocation related to the future LRT. It's not clear to me how much of this area is needed for utility relocation, so you want to explore this option further, please let us know and out housing planners will reach out to the LRT group.

Below are the boundary conditions results for two watermain upgrade scenarios (refer to table and image below).

Please note that Phase 4 does not meet the 20 psi minimum residual pressure under both the options for 166.66 L/s Fire Flow. For phase 4 available fire flow at 20psi is provided in the table below for both scenario's. Given how close we are to achieving the required flow, I think it would be helpful at this stage to obtain accurate fireflow demand calculations for the proposed buildings instead of using the estimated demand of 167 L/s.

	Option 2 (Purple line) Upsize 152mm to 203mm Length ~ 195 m		Option 3 (Orange line) Upsize 152mm to 203mm Length ~ 370 m	
PHASE	Phase 1,2,3	Phase 4	Phase 1,2,3	Phase 4
Assigned Node	Front of Phase 1 to 3 ground Elevation 88.0 m		Front of Phase 4 ground Elevation 88.6 m	
Fire Flow Demand (requested)	166.66 L/s			
HGL (m)	105.5	NA	111.6	NA
Pressure (psi)	25.6	NA	33.5	NA
Available Fire Flow at 20 psi	-	**150 L/s**	-	**155 L/s**



Let me know if you have any questions.

Bet Regards,

Vincent Duquette, E.I.T
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West | 110 avenue Laurier Ouest
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: Jeremy Chouinard <JChouinard@dsel.ca>
Sent: December 17, 2024 2:11 PM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Subject: RE: Informal boundary Condition Request - City Housing Sites

Water Demand Design Flows per Unit Count
City of Ottawa - Water Distribution Guidelines, July 2010

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4	-	0
Semi-detached	2.7	-	0
Townhouse	2.7	33	90
Apartment			0
Bachelor	1.4	-	0
1 Bedroom	1.4	-	0
2 Bedroom	2.1	-	0
3 Bedroom	3.1	-	0
Average	1.8	-	0

	Pop	Avg. Daily		Max Day		Peak Hour	
		m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Total Domestic Demand	**90**	**25.2**	**17.5**	**123.5**	**85.8**	**186.5**	**129.5**

Required Fire Flow per IWSTB-2024-05 (OBC A-3.2.5.7)
Block 5

$Q = K\ V\ S_{tot}$

Where,

Q	177,808	minimum supply of water in litres
K	23	water supply coefficient from Table 1
V	3,865.39	total building volume in cubic metres
S_{tot}	2.00	total spacial coefficient from property line exposures

Buidling Volume	Area (m^2)	h (m)	V (m^3)
Basement	282.47	3.05	861.5
Ground	381.47	3.4	1297.0
2nd floor	344.82	3.4	1172.4
Attic	172.41	3.1	534.5
			3865.4

Required minimum water supply flow rate, L/min

Q (L)		RFF (L/min)	
	108,000	2700	
108,000	135,000	3600	
135,000	162,000	4500	
162,000	190,000	5400	**<---- Required Fire Flow**
190,000	270,000	6300	
270,000		9000	

Spacial Coefficient

	m	S
North	3.1	0.5
South	3.1	0.5
West	21.3	0
East	100	0

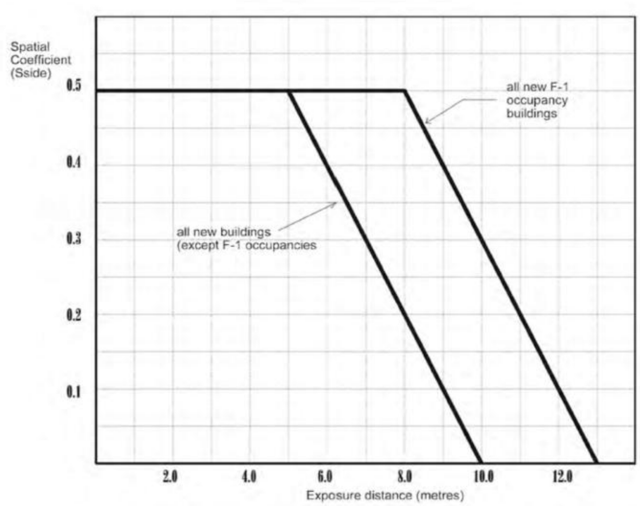


Figure 1
Spatial Coefficient vs Exposure Distance

Jeremy Chouinard

From:	Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Sent:	July 29, 2025 2:13 PM
To:	Jeremy Chouinard
Cc:	Dickinson, Mary; Grift, Justin; Mottalib, Abdul
Subject:	RE: Informal boundary Condition Request - City Housing Sites
Attachments:	40 Beechcliffe Street July 2025.pdf

EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Hi Jeremy,

The following are boundary conditions, HGL, for hydraulic analysis at 40 Beechcliffe Street (zone 2W2C) assumed to be connected via two connections to the 152 mm watermain on Beechcliffe AND 152mm watermain on Fair Oaks *[Scenario 1]* **OR** to the proposed 203 mm watermain on Beechcliffe AND 152mm watermain on Fair Oaks *[Scenario 2]* (see attached PDF for location).

<u>Both Connections:</u>
Scenario 1- Existing 152mm watermain on Beechcliffe, and 152mm watermain on Fair Oaks
Minimum HGL: 126.2 m
Maximum HGL: 132.6 m
Max day + Fire Flow (90 L/s): 113.7 m (Connection 1) and 118.2 m (Connection 2)

Scenario 2- Upsize 152mm watermain on Beechcliffe to 203 mm diameter, from Sovereign Ave. to Beechcliffe St. corner., and keep 152mm watermain on Fair Oaks
Minimum HGL: 126.2 m
Maximum HGL: 132.6 m
Max day + Fire Flow (90 L/s): 120.0 m (Connection 1) and 118.6 m (Connection 2)

Both scenarios are provided but it is not necessary to present both in the servicing report. You only have to show the boundary conditions for the watermain servicing scenario proposed.

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
City of Ottawa | Ville d'Ottawa
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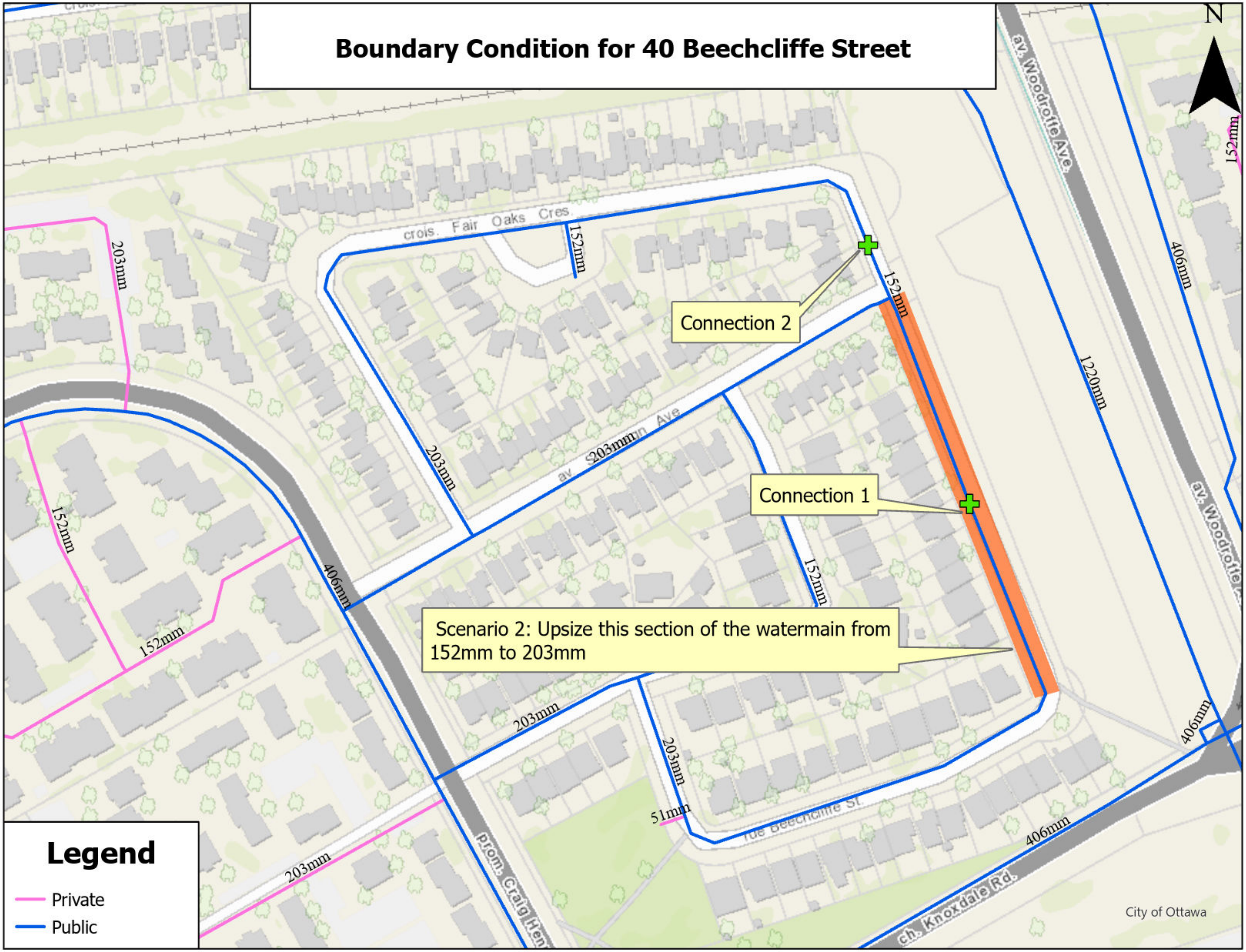
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca


Boundary Condition for 40 Beechcliffe Street
N
Connection 2
Connection 1
Scenario 2: Upsize this section of the watermain from 152mm to 203mm
crois. Fair Oaks Cres.
av. Woodroffe Ave.
rue Beechcliffe St.
prom. Craig Hen
ch. Knoxdale Rd.
152mm
203mm
406mm
1220mm
51mm
Legend
Private
Public
City of Ottawa

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

APPENDIX C

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
FAIR OAKS CRESCENT																													
			0.18	3	3		11	0.18	11				0.00		0.00		0.00		0.18	0.18									
			0.18	7		7	19	0.36	30				0.00		0.00		0.00		0.18	0.36									
	1A	2A	2.15				129	2.51	159	3.55	1.83		0.00		0.00		0.00	0.00	2.15	2.51	0.83	2.66	52.5	250	0.30	32.57	0.08	0.66	0.40
To Ex. Servicing Easement, Ex. Pipe 2A - 3A								2.51	159				0.00		0.00		0.00			2.51									
BEECHCLIFFE STREET																													
			0.15	2	2		7	0.15	7				0.00		0.00		0.00		0.15	0.15									
	6A	5A	0.22	7		7	19	0.37	26	3.69	0.31		0.00		0.00		0.00	0.00	0.22	0.37	0.12	0.43	65.5	250	0.34	34.68	0.01	0.71	0.24
			0.25	10		10	27	0.62	53				0.00		0.00		0.00		0.25	0.62									
	5A	4A	0.28	6	6		21	0.90	74	3.62	0.87		0.00		0.00		0.00	0.00	0.28	0.90	0.30	1.17	69.5	250	0.39	37.14	0.03	0.76	0.34
			0.13	2	2		7	1.03	81				0.00		0.00		0.00		0.13	1.03									
	4A	3A	0.22	9		9	25	1.25	106	3.59	1.23		0.00		0.00		0.00	0.00	0.22	1.25	0.41	1.65	65.5	250	0.38	36.66	0.04	0.75	0.37
To Ex. Servicing Easement, Ex. Pipe 3A - 7A								1.25	106				0.00		0.00		0.00			1.25									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha			
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4	

Designed: A.S.	PROJECT: 40 BEECHCLIFFE STREET		
Checked: W.L.	LOCATION: City of Ottawa		
Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 8	File Ref: 24-1416	Date: 17 Feb 2026	Sheet No. 1 of 1

1416_SAN_Designsheet_Subm4.xlsx

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

APPENDIX D

Legend
Outfalls
predev areas
ARM Subcatchments
N
100 m
S2_North_E
OF1
S1_South_E
S1_South_W
Woodroffe Ave
15
Fair Oaks Crescent
Sovereign Ave
Ivylea St
Beechcliffe St
Beechcliffe Park
Craig Henry Dr
Knoxdale Rd
Brockington Cresc
Abitibi Crescent

Project Name:	Beechcliffe
Project Number:	1416
Designed By:	LH
Checked By:	AL
Date	05-Sep-25

DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

Subcatchments Model Inputs - Predevelopment

Name	S1_South_E	S1_South_W	S2_North_E	S2_North_W
Runoff Method	Nash IUH	Nash IUH	Nash IUH	Nash IUH
Area (ha)	0.22	0.39	0.07	0.10
Flow Length (m)	13	20	13	20
Slope (%)	1.77	1.68	0.79	1.17
Imperv. (%)	14.30	14.30	14.30	14.30
Loss Method	Horton	Horton	Horton	Horton
Dstore Imperv (mm)	1.57	1.57	1.57	1.57
Dstore Perv (mm)	4.67	4.67	4.67	4.67
Max. Infil. Rate (mm/hr)	76.20	76.20	76.20	76.20
Min. Infil. Rate (mm/hr)	13.20	13.20	13.20	13.20
Decay Constant (1/hr)	4.14	4.14	4.14	4.14
TC Method	FAA (Airport)	FAA (Airport)	FAA (Airport)	FAA (Airport)
Runoff Coef.	0.3	0.3	0.3	0.3
Time of Concentration (min)	7.77	9.81	10.17	11.07


Legend
Junctions
Outfalls
Visible
Visible
Storages
Ponding Areas
Storage Tanks
Conduits
Perf.Pipe
Access_Pipe
Orifices
Weirs
Outlets
Visible
Visible
Subcatchments
N
50 m
Fair Oaks Crescent
Fair Oaks Crescent
Sovereign Ave
Ivylea St
Ivylea St
Woodroffe Ave
Woodroffe Ave
Woodroffe Ave
15
RP7
CBMH-1
MC-3500_1-2
RP8
CBMH-2
North_75VHV-1
NorthOutfall
OF2_NorthUnc
SouthOutfall
South_75VHV-1
CBMH-3
RP6
MC-3500_3-4
RP5
CBMH-4
MC-3500_4-5
RP3
CBMH-5
MC-3500_5-6
RP1
CBMH-6
RP2
RYCB-1
OF1_SouthUnc
RP4
RYCB-2
RYCB-3
RYCB4

Project Name:	Beechcliffe
Project Number:	1416
Designed By:	AL
Checked By:	AL
Date	15-Sep-25

DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

Subcatchments Model Inputs - Postdevelopment Uncontrolled areas

Name	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)
A1N	0.05	50	10	5.00	69	0.013	0.25	1.57	4.67
A1S	0.174	174	10	5.00	74	0.013	0.25	1.57	4.67

Subcatchments Model Inputs - Postdevelopment

Name	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)
A1R1	0.027	30.0	9.0	2.0	31	0.013	0.25	1.57	4.67
A2R1	0.034	37.8	9.0	1.8	25	0.013	0.25	1.57	4.67
A3R1	0.060	66.7	9.0	2.1	32	0.013	0.25	1.57	4.67
A4R1	0.050	55.6	9.0	2.5	33	0.013	0.25	1.57	4.67
A5R1	0.046	51.1	9.0	2.1	32	0.013	0.25	1.57	4.67
A6R1	0.047	52.2	9.0	2.1	31	0.013	0.25	1.57	4.67
A7R1	0.074	82.2	9.0	2.0	30	0.013	0.25	1.57	4.67
A8R1	0.027	27.0	10.0	1.5	0	0.013	0.25	1.57	4.67
A9R1	0.060	66.7	9.0	2.0	30	0.013	0.25	1.57	4.67

Project Name:	Beechcliffe
Project Number:	241416
Designed By:	AL
Checked By:	JP
Date:	16-Sep-25

DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

Peak Flow Summary - Chicago 3hr

	Predev South	Predev North	Unc. Postdev South	Unc. Postdev North	Controlled Postdev South	Controlled Postdev North	Controlled Postdev South	Controlled Postdev North
Drainage area (ha)	0.61	0.17	0.174	0.05	0.338	0.087	0.338	0.087
Imp (%)	14.3	14.3	74.0	69.0	28.4	29.9	28.4	29.9
Imp area (ha)	0.09	0.02	0.13	0.03	0.10	0.03	0.10	0.03

<table>
<tr><th rowspan="2">Design Storm</th><th colspan="2">Predev Runoff (m^3/s)</th><th colspan="2">Postdev Uncontrolled Runoff (m^3/s)</th><th colspan="2">HYDROVEX® 75 VHV-1 100-year Controlled Release Rates (m^3/s)</th><th colspan="2">HYDROVEX® 75 VHV-1 100-year +20% Controlled Release Rates (m^3/s)</th><th colspan="2">100-year Total Postdev Release Rates (m^3/s)</th></tr>
<tr><th>South</th><th>North</th><th>South</th><th>North</th><th>South</th><th>North</th><th>South</th><th>North</th><th>South</th><th>North</th></tr>
<tr><td>2 Year Chicago 3hr</td><td>0.0255</td><td>0.0063</td><td>0.0284</td><td>0.0076</td><td rowspan="2">0.0066</td><td rowspan="2">0.0067</td><td rowspan="2">0.0073</td><td rowspan="2">0.0072</td><td rowspan="2">0.0895</td><td rowspan="2">0.0304</td></tr>
<tr><td>100 year Chicago 3hr</td><td>0.1624</td><td>0.0428</td><td>0.0830</td><td>0.0237</td></tr>
</table>

Project Name:	Beechcliffe
Project Number:	24-1416
Designed By:	AL
Checked By:	JP
Date	15-Sep-25

David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

On-Site Storage Volume Requirement

Location	Storage Name	Max Volume Required (m^3)		Storage Provided (m^3)
		100yr Chicago 3hr	100yr Chicago 3h + 20%	
North	MC-3500_1-2	15	23	27
South	MC-3500_3-4	51	68	72
South	MC-3500_4-5	44	61	67
South	MC-3500_5-6	14	20	22

Project Name:	Beechcliffe
Project Number:	24-1416
Designed By:	AL
Checked By:	JP
Date	15-Sep-25

DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

Storage Units Information

Chamber Model: MC-3500

Location	Storage Name	Volume (m3)	Number of Chambers	Number of End Caps
North	MC-3500_1-2	27	5	2
South	MC-3500_3-4	72	14	2
South	MC-3500_4-5	67	13	2
South	MC-3500_5-6	22	4	2

Project:

Chamber Model -	MC-3500	
Units -	**Metric**	
Number of Chambers -	5	
Number of End Caps -	2	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	229	mm

Area of System- 26.04 sq.meters   Min. Area - 26.04 sq.meters

☑ Include Perimeter Stone in Calculations

☑ Click for Stage Area Data

☐ Click to Invert Stage Area Data

Click Here for Imperial

StormTech MC-3500 Cumulative Storage Volumes

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Single End Cap *(cubic meters)*	Incremental Chambers *(cubic meters)*	Incremental End Cap *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch, EC and Stone *(cubic meters)*	Cumulative System *(cubic meters)*	Elevation *(meters)*
1676	0.000	0.000	0.00	0.00	0.26	0.26	27.31	1.68
1651	0.000	0.000	0.00	0.00	0.26	0.26	27.05	1.65
1626	0.000	0.000	0.00	0.00	0.26	0.26	26.78	1.63
1600	0.000	0.000	0.00	0.00	0.26	0.26	26.52	1.60
1575	0.000	0.000	0.00	0.00	0.26	0.26	26.25	1.57
1549	0.000	0.000	0.00	0.00	0.26	0.26	25.99	1.55
1524	0.000	0.000	0.00	0.00	0.26	0.26	25.72	1.52
1499	0.000	0.000	0.00	0.00	0.26	0.26	25.46	1.50
1473	0.000	0.000	0.00	0.00	0.26	0.26	25.19	1.47
1448	0.000	0.000	0.00	0.00	0.26	0.26	24.93	1.45
1422	0.000	0.000	0.00	0.00	0.26	0.26	24.66	1.42
1397	0.000	0.000	0.00	0.00	0.26	0.26	24.40	1.40
1372	0.002	0.000	0.01	0.00	0.26	0.27	24.13	1.37
1346	0.005	0.001	0.03	0.00	0.25	0.28	23.87	1.35
1321	0.008	0.001	0.04	0.00	0.25	0.29	23.58	1.32
1295	0.011	0.001	0.06	0.00	0.24	0.30	23.29	1.30
1270	0.019	0.002	0.10	0.00	0.22	0.33	22.99	1.27
1245	0.029	0.002	0.15	0.00	0.20	0.35	22.67	1.24
1219	0.035	0.003	0.18	0.01	0.19	0.37	22.31	1.22
1194	0.040	0.004	0.20	0.01	0.18	0.39	21.94	1.19
1168	0.045	0.004	0.22	0.01	0.17	0.40	21.55	1.17
1143	0.048	0.005	0.24	0.01	0.16	0.42	21.14	1.14
1118	0.052	0.005	0.26	0.01	0.16	0.43	20.73	1.12
1092	0.055	0.006	0.27	0.01	0.15	0.44	20.30	1.09
1067	0.058	0.006	0.29	0.01	0.14	0.45	19.87	1.07
1041	0.060	0.007	0.30	0.01	0.14	0.45	19.42	1.04
1016	0.063	0.007	0.31	0.01	0.13	0.46	18.97	1.02
991	0.065	0.008	0.33	0.02	0.13	0.47	18.51	0.99
965	0.068	0.008	0.34	0.02	0.12	0.48	18.04	0.97
940	0.070	0.008	0.35	0.02	0.12	0.48	17.56	0.94
914	0.072	0.009	0.36	0.02	0.11	0.49	17.08	0.91
889	0.073	0.009	0.37	0.02	0.11	0.50	16.59	0.89
864	0.075	0.009	0.38	0.02	0.11	0.50	16.09	0.86
838	0.077	0.010	0.38	0.02	0.10	0.51	15.59	0.84
813	0.078	0.010	0.39	0.02	0.10	0.51	15.08	0.81
787	0.080	0.011	0.40	0.02	0.10	0.52	14.57	0.79
762	0.081	0.011	0.41	0.02	0.09	0.52	14.05	0.76
737	0.083	0.011	0.41	0.02	0.09	0.53	13.53	0.74
711	0.084	0.012	0.42	0.02	0.09	0.53	13.00	0.71
686	0.085	0.012	0.43	0.02	0.08	0.53	12.47	0.69
660	0.086	0.012	0.43	0.02	0.08	0.54	11.94	0.66
635	0.088	0.012	0.44	0.02	0.08	0.54	11.40	0.64
610	0.089	0.013	0.44	0.03	0.08	0.55	10.86	0.61
584	0.090	0.013	0.45	0.03	0.07	0.55	10.31	0.58
559	0.091	0.013	0.45	0.03	0.07	0.55	9.76	0.56
533	0.091	0.014	0.46	0.03	0.07	0.56	9.21	0.53
508	0.092	0.014	0.46	0.03	0.07	0.56	8.66	0.51
483	0.093	0.014	0.47	0.03	0.07	0.56	8.10	0.48
457	0.094	0.014	0.47	0.03	0.07	0.56	7.54	0.46
432	0.095	0.015	0.47	0.03	0.06	0.57	6.97	0.43
406	0.095	0.015	0.48	0.03	0.06	0.57	6.41	0.41
381	0.096	0.015	0.48	0.03	0.06	0.57	5.84	0.38
356	0.097	0.015	0.48	0.03	0.06	0.57	5.27	0.36
330	0.097	0.015	0.49	0.03	0.06	0.57	4.69	0.33
305	0.098	0.016	0.49	0.03	0.06	0.58	4.12	0.30
279	0.099	0.016	0.49	0.03	0.05	0.58	3.54	0.28
254	0.099	0.017	0.50	0.03	0.05	0.58	2.96	0.25
229	0.000	0.000	0.00	0.00	0.26	0.26	2.38	0.23
203	0.000	0.000	0.00	0.00	0.26	0.26	2.12	0.20
178	0.000	0.000	0.00	0.00	0.26	0.26	1.85	0.18
152	0.000	0.000	0.00	0.00	0.26	0.26	1.59	0.15
127	0.000	0.000	0.00	0.00	0.26	0.26	1.32	0.13
102	0.000	0.000	0.00	0.00	0.26	0.26	1.06	0.10
76	0.000	0.000	0.00	0.00	0.26	0.26	0.79	0.08
51	0.000	0.000	0.00	0.00	0.26	0.26	0.53	0.05
25	0.000	0.000	0.00	0.00	0.26	0.26	0.26	0.03

Stage Area Data

Depth (meter)	Elevation (meter)	Area (m^2)	Area (hectare)
0.00	0.00	10.42	0.0010
0.05	0.05	10.42	0.0010
0.08	0.08	10.42	0.0010
0.10	0.10	10.42	0.0010
0.13	0.13	10.42	0.0010
0.15	0.15	10.42	0.0010
0.18	0.18	10.42	0.0010
0.20	0.20	10.42	0.0010
0.23	0.23	10.42	0.0010
0.25	0.25	22.93	0.0023
0.28	0.28	22.79	0.0023
0.30	0.30	22.72	0.0023
0.33	0.33	22.64	0.0023
0.36	0.36	22.55	0.0023
0.38	0.38	22.47	0.0022
0.41	0.41	22.38	0.0022
0.43	0.43	22.29	0.0022
0.46	0.46	22.19	0.0022
0.48	0.48	22.09	0.0022
0.51	0.51	21.98	0.0022
0.53	0.53	21.86	0.0022
0.56	0.56	21.75	0.0022
0.58	0.58	21.62	0.0022
0.61	0.61	21.49	0.0021
0.63	0.63	21.35	0.0021
0.66	0.66	21.20	0.0021
0.69	0.69	21.05	0.0021
0.71	0.71	20.89	0.0021
0.74	0.74	20.73	0.0021
0.76	0.76	20.55	0.0021
0.79	0.79	20.36	0.0020
0.81	0.81	20.17	0.0020
0.84	0.84	19.96	0.0020
0.86	0.86	19.75	0.0020
0.89	0.89	19.52	0.0020
0.91	0.91	19.28	0.0019
0.94	0.94	19.03	0.0019
0.97	0.97	18.77	0.0019
0.99	0.99	18.49	0.0018
1.02	1.02	18.19	0.0018
1.04	1.04	17.87	0.0018
1.07	1.07	17.53	0.0018
1.09	1.09	17.17	0.0017
1.12	1.12	16.77	0.0017
1.14	1.14	16.34	0.0016
1.17	1.17	15.87	0.0016
1.19	1.19	15.34	0.0015
1.22	1.22	14.74	0.0015
1.24	1.24	13.97	0.0014
1.27	1.27	12.80	0.0013
1.30	1.30	11.83	0.0012
1.32	1.32	11.45	0.0011
1.35	1.35	11.10	0.0011
1.37	1.37	10.61	0.0011
1.40	1.40	10.42	0.0010
1.42	1.42	10.42	0.0010
1.45	1.45	10.42	0.0010
1.47	1.47	10.42	0.0010
1.50	1.50	10.42	0.0010
1.52	1.52	10.42	0.0010
1.55	1.55	10.42	0.0010
1.57	1.57	10.42	0.0010
1.60	1.60	10.42	0.0010
1.63	1.63	10.42	0.0010
1.65	1.65	10.42	0.0010
1.68	1.68	10.42	0.0010

Project:

Chamber Model -	MC-3500	
Units -	**Metric**	
Number of Chambers -	14	
Number of End Caps -	2	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	229	mm
Area of System-	67.47	sq.meters

Min. Area - 67.47 sq.meters

☑ Include Perimeter Stone in Calculations

☑ Click for Stage Area Data

☐ Click to Invert Stage Area Data

Click Here for Imperial

StormTech MC-3500 Cumulative Storage Volumes

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Single End Cap *(cubic meters)*	Incremental Chambers *(cubic meters)*	Incremental End Cap *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch, EC and Stone *(cubic meters)*	Cumulative System *(cubic meters)*	Elevation *(meters)*
1676	0.000	0.000	0.00	0.00	0.69	0.69	71.90	1.68
1651	0.000	0.000	0.00	0.00	0.69	0.69	71.22	1.65
1626	0.000	0.000	0.00	0.00	0.69	0.69	70.53	1.63
1600	0.000	0.000	0.00	0.00	0.69	0.69	69.85	1.60
1575	0.000	0.000	0.00	0.00	0.69	0.69	69.16	1.57
1549	0.000	0.000	0.00	0.00	0.69	0.69	68.48	1.55
1524	0.000	0.000	0.00	0.00	0.69	0.69	67.79	1.52
1499	0.000	0.000	0.00	0.00	0.69	0.69	67.10	1.50
1473	0.000	0.000	0.00	0.00	0.69	0.69	66.42	1.47
1448	0.000	0.000	0.00	0.00	0.69	0.69	65.73	1.45
1422	0.000	0.000	0.00	0.00	0.69	0.69	65.05	1.42
1397	0.000	0.000	0.00	0.00	0.69	0.69	64.36	1.40
1372	0.002	0.000	0.02	0.00	0.68	0.70	63.68	1.37
1346	0.005	0.001	0.08	0.00	0.65	0.73	62.98	1.35
1321	0.008	0.001	0.12	0.00	0.64	0.76	62.25	1.32
1295	0.011	0.001	0.16	0.00	0.62	0.78	61.49	1.30
1270	0.019	0.002	0.27	0.00	0.57	0.85	60.71	1.27
1245	0.029	0.002	0.41	0.00	0.52	0.93	59.85	1.24
1219	0.035	0.003	0.50	0.01	0.48	0.99	58.92	1.22
1194	0.040	0.004	0.56	0.01	0.46	1.03	57.93	1.19
1168	0.045	0.004	0.62	0.01	0.43	1.06	56.91	1.17
1143	0.048	0.005	0.68	0.01	0.41	1.10	55.84	1.14
1118	0.052	0.005	0.72	0.01	0.39	1.13	54.74	1.12
1092	0.055	0.006	0.77	0.01	0.37	1.15	53.62	1.09
1067	0.058	0.006	0.81	0.01	0.36	1.18	52.46	1.07
1041	0.060	0.007	0.85	0.01	0.34	1.20	51.29	1.04
1016	0.063	0.007	0.88	0.01	0.33	1.22	50.09	1.02
991	0.065	0.008	0.91	0.02	0.31	1.24	48.86	0.99
965	0.068	0.008	0.95	0.02	0.30	1.26	47.62	0.97
940	0.070	0.008	0.97	0.02	0.29	1.28	46.36	0.94
914	0.072	0.009	1.00	0.02	0.28	1.30	45.08	0.91
889	0.073	0.009	1.03	0.02	0.27	1.31	43.78	0.89
864	0.075	0.009	1.05	0.02	0.26	1.33	42.47	0.86
838	0.077	0.010	1.08	0.02	0.25	1.34	41.14	0.84
813	0.078	0.010	1.10	0.02	0.24	1.36	39.79	0.81
787	0.080	0.011	1.12	0.02	0.23	1.37	38.44	0.79
762	0.081	0.011	1.14	0.02	0.22	1.38	37.07	0.76
737	0.083	0.011	1.16	0.02	0.21	1.39	35.68	0.74
711	0.084	0.012	1.18	0.02	0.21	1.41	34.29	0.71
686	0.085	0.012	1.19	0.02	0.20	1.42	32.88	0.69
660	0.086	0.012	1.21	0.02	0.19	1.43	31.47	0.66
635	0.088	0.012	1.23	0.02	0.18	1.44	30.04	0.64
610	0.089	0.013	1.24	0.03	0.18	1.45	28.61	0.61
584	0.090	0.013	1.25	0.03	0.17	1.45	27.16	0.58
559	0.091	0.013	1.27	0.03	0.17	1.46	25.71	0.56
533	0.091	0.014	1.28	0.03	0.16	1.47	24.24	0.53
508	0.092	0.014	1.29	0.03	0.16	1.48	22.77	0.51
483	0.093	0.014	1.30	0.03	0.15	1.49	21.29	0.48
457	0.094	0.014	1.32	0.03	0.15	1.49	19.81	0.46
432	0.095	0.015	1.33	0.03	0.14	1.50	18.32	0.43
406	0.095	0.015	1.34	0.03	0.14	1.50	16.82	0.41
381	0.096	0.015	1.34	0.03	0.14	1.51	15.32	0.38
356	0.097	0.015	1.35	0.03	0.13	1.52	13.80	0.36
330	0.097	0.015	1.36	0.03	0.13	1.52	12.29	0.33
305	0.098	0.016	1.37	0.03	0.12	1.53	10.77	0.30
279	0.099	0.016	1.38	0.03	0.12	1.53	9.24	0.28
254	0.099	0.017	1.39	0.03	0.12	1.54	7.71	0.25
229	0.000	0.000	0.00	0.00	0.69	0.69	6.17	0.23
203	0.000	0.000	0.00	0.00	0.69	0.69	5.48	0.20
178	0.000	0.000	0.00	0.00	0.69	0.69	4.80	0.18
152	0.000	0.000	0.00	0.00	0.69	0.69	4.11	0.15
127	0.000	0.000	0.00	0.00	0.69	0.69	3.43	0.13
102	0.000	0.000	0.00	0.00	0.69	0.69	2.74	0.10
76	0.000	0.000	0.00	0.00	0.69	0.69	2.06	0.08
51	0.000	0.000	0.00	0.00	0.69	0.69	1.37	0.05
25	0.000	0.000	0.00	0.00	0.69	0.69	0.69	0.03

Stage Area Data

Depth (meter)	Elevation (meter)	Area (m²)	Area (hectare)
0.00	0.00	26.99	0.0027
0.05	0.05	26.99	0.0027
0.08	0.08	26.99	0.0027
0.10	0.10	26.99	0.0027
0.13	0.13	26.99	0.0027
0.15	0.15	26.99	0.0027
0.18	0.18	26.99	0.0027
0.20	0.20	26.99	0.0027
0.23	0.23	26.99	0.0027
0.25	0.25	60.61	0.0061
0.28	0.28	60.31	0.0060
0.30	0.30	60.10	0.0060
0.33	0.33	59.90	0.0060
0.36	0.36	59.68	0.0060
0.38	0.38	59.47	0.0059
0.41	0.41	59.23	0.0059
0.43	0.43	58.99	0.0059
0.46	0.46	58.74	0.0059
0.48	0.48	58.47	0.0058
0.51	0.51	58.18	0.0058
0.53	0.53	57.89	0.0058
0.56	0.56	57.58	0.0058
0.58	0.58	57.25	0.0057
0.61	0.61	56.91	0.0057
0.63	0.63	56.55	0.0057
0.66	0.66	56.16	0.0056
0.69	0.69	55.76	0.0056
0.71	0.71	55.34	0.0055
0.74	0.74	54.90	0.0055
0.76	0.76	54.43	0.0054
0.79	0.79	53.94	0.0054
0.81	0.81	53.42	0.0053
0.84	0.84	52.88	0.0053
0.86	0.86	52.31	0.0052
0.89	0.89	51.71	0.0052
0.91	0.91	51.08	0.0051
0.94	0.94	50.41	0.0050
0.97	0.97	49.69	0.0050
0.99	0.99	48.95	0.0049
1.02	1.02	48.15	0.0048
1.04	1.04	47.29	0.0047
1.07	1.07	46.39	0.0046
1.09	1.09	45.40	0.0045
1.12	1.12	44.35	0.0044
1.14	1.14	43.19	0.0043
1.17	1.17	41.91	0.0042
1.19	1.19	40.48	0.0040
1.22	1.22	38.83	0.0039
1.24	1.24	36.74	0.0037
1.27	1.27	33.51	0.0034
1.30	1.30	30.84	0.0031
1.32	1.32	29.79	0.0030
1.35	1.35	28.84	0.0029
1.37	1.37	27.53	0.0028
1.40	1.40	26.99	0.0027
1.42	1.42	26.99	0.0027
1.45	1.45	26.99	0.0027
1.47	1.47	26.99	0.0027
1.50	1.50	26.99	0.0027
1.52	1.52	26.99	0.0027
1.55	1.55	26.99	0.0027
1.57	1.57	26.99	0.0027
1.60	1.60	26.99	0.0027
1.63	1.63	26.99	0.0027
1.65	1.65	26.99	0.0027
1.68	1.68	26.99	0.0027

Project:

ADS StormTech™

Chamber Model -	MC-3500	
Units -	**Metric**	
Number of Chambers -	13	
Number of End Caps -	2	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	229	mm

Area of System- 62.87 sq.meters Min. Area - 62.87 sq.meters

☑ Include Perimeter Stone in Calculations

☑ Click for Stage Area Data

☐ Click to Invert Stage Area Data

Click Here for Imperial

StormTech MC-3500 Cumulative Storage Volumes

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Single End Cap *(cubic meters)*	Incremental Chambers *(cubic meters)*	Incremental End Cap *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch, EC and Stone *(cubic meters)*	Cumulative System *(cubic meters)*	Elevation *(meters)*
1676	0.000	0.000	0.00	0.00	0.64	0.64	66.95	1.68
1651	0.000	0.000	0.00	0.00	0.64	0.64	66.31	1.65
1626	0.000	0.000	0.00	0.00	0.64	0.64	65.67	1.63
1600	0.000	0.000	0.00	0.00	0.64	0.64	65.03	1.60
1575	0.000	0.000	0.00	0.00	0.64	0.64	64.40	1.57
1549	0.000	0.000	0.00	0.00	0.64	0.64	63.76	1.55
1524	0.000	0.000	0.00	0.00	0.64	0.64	63.12	1.52
1499	0.000	0.000	0.00	0.00	0.64	0.64	62.48	1.50
1473	0.000	0.000	0.00	0.00	0.64	0.64	61.84	1.47
1448	0.000	0.000	0.00	0.00	0.64	0.64	61.20	1.45
1422	0.000	0.000	0.00	0.00	0.64	0.64	60.56	1.42
1397	0.000	0.000	0.00	0.00	0.64	0.64	59.92	1.40
1372	0.002	0.000	0.02	0.00	0.63	0.65	59.29	1.37
1346	0.005	0.001	0.07	0.00	0.61	0.68	58.63	1.35
1321	0.008	0.001	0.11	0.00	0.59	0.70	57.95	1.32
1295	0.011	0.001	0.15	0.00	0.58	0.73	57.25	1.30
1270	0.019	0.002	0.25	0.00	0.54	0.79	56.52	1.27
1245	0.029	0.002	0.38	0.00	0.49	0.87	55.72	1.24
1219	0.035	0.003	0.46	0.01	0.45	0.92	54.85	1.22
1194	0.040	0.004	0.52	0.01	0.43	0.96	53.94	1.19
1168	0.045	0.004	0.58	0.01	0.40	0.99	52.98	1.17
1143	0.048	0.005	0.63	0.01	0.38	1.02	51.99	1.14
1118	0.052	0.005	0.67	0.01	0.37	1.05	50.97	1.12
1092	0.055	0.006	0.71	0.01	0.35	1.07	49.92	1.09
1067	0.058	0.006	0.75	0.01	0.33	1.10	48.84	1.07
1041	0.060	0.007	0.79	0.01	0.32	1.12	47.75	1.04
1016	0.063	0.007	0.82	0.01	0.31	1.14	46.63	1.02
991	0.065	0.008	0.85	0.02	0.29	1.16	45.49	0.99
965	0.068	0.008	0.88	0.02	0.28	1.17	44.33	0.97
940	0.070	0.008	0.91	0.02	0.27	1.19	43.16	0.94
914	0.072	0.009	0.93	0.02	0.26	1.21	41.97	0.91
889	0.073	0.009	0.95	0.02	0.25	1.22	40.76	0.89
864	0.075	0.009	0.98	0.02	0.24	1.24	39.54	0.86
838	0.077	0.010	1.00	0.02	0.23	1.25	38.30	0.84
813	0.078	0.010	1.02	0.02	0.22	1.26	37.05	0.81
787	0.080	0.011	1.04	0.02	0.21	1.28	35.79	0.79
762	0.081	0.011	1.06	0.02	0.21	1.29	34.51	0.76
737	0.083	0.011	1.08	0.02	0.20	1.30	33.22	0.74
711	0.084	0.012	1.09	0.02	0.19	1.31	31.93	0.71
686	0.085	0.012	1.11	0.02	0.19	1.32	30.62	0.69
660	0.086	0.012	1.12	0.02	0.18	1.33	29.30	0.66
635	0.088	0.012	1.14	0.02	0.17	1.34	27.97	0.64
610	0.089	0.013	1.15	0.03	0.17	1.35	26.63	0.61
584	0.090	0.013	1.17	0.03	0.16	1.35	25.29	0.58
559	0.091	0.013	1.18	0.03	0.16	1.36	23.94	0.56
533	0.091	0.014	1.19	0.03	0.15	1.37	22.57	0.53
508	0.092	0.014	1.20	0.03	0.15	1.38	21.20	0.51
483	0.093	0.014	1.21	0.03	0.14	1.38	19.83	0.48
457	0.094	0.014	1.22	0.03	0.14	1.39	18.45	0.46
432	0.095	0.015	1.23	0.03	0.13	1.39	17.06	0.43
406	0.095	0.015	1.24	0.03	0.13	1.40	15.66	0.41
381	0.096	0.015	1.25	0.03	0.13	1.41	14.26	0.38
356	0.097	0.015	1.26	0.03	0.12	1.41	12.86	0.36
330	0.097	0.015	1.27	0.03	0.12	1.42	11.45	0.33
305	0.098	0.016	1.27	0.03	0.12	1.42	10.03	0.30
279	0.099	0.016	1.28	0.03	0.11	1.43	8.61	0.28
254	0.099	0.017	1.29	0.03	0.11	1.43	7.18	0.25
229	0.000	0.000	0.00	0.00	0.64	0.64	5.75	0.23
203	0.000	0.000	0.00	0.00	0.64	0.64	5.11	0.20
178	0.000	0.000	0.00	0.00	0.64	0.64	4.47	0.18
152	0.000	0.000	0.00	0.00	0.64	0.64	3.83	0.15
127	0.000	0.000	0.00	0.00	0.64	0.64	3.19	0.13
102	0.000	0.000	0.00	0.00	0.64	0.64	2.56	0.10
76	0.000	0.000	0.00	0.00	0.64	0.64	1.92	0.08
51	0.000	0.000	0.00	0.00	0.64	0.64	1.28	0.05
25	0.000	0.000	0.00	0.00	0.64	0.64	0.64	0.03

Stage Area Data

Depth (meter)	Elevation (meter)	Area (m²)	Area (hectare)
0.00	0.00	25.15	0.0025
0.05	0.05	25.15	0.0025
0.08	0.08	25.15	0.0025
0.10	0.10	25.15	0.0025
0.13	0.13	25.15	0.0025
0.15	0.15	25.15	0.0025
0.18	0.18	25.15	0.0025
0.20	0.20	25.15	0.0025
0.23	0.23	25.15	0.0025
0.25	0.25	56.42	0.0056
0.28	0.28	56.14	0.0056
0.30	0.30	55.95	0.0056
0.33	0.33	55.76	0.0056
0.36	0.36	55.56	0.0056
0.38	0.38	55.36	0.0055
0.41	0.41	55.14	0.0055
0.43	0.43	54.92	0.0055
0.46	0.46	54.68	0.0055
0.48	0.48	54.43	0.0054
0.51	0.51	54.16	0.0054
0.53	0.53	53.89	0.0054
0.56	0.56	53.60	0.0054
0.58	0.58	53.29	0.0053
0.61	0.61	52.97	0.0053
0.63	0.63	52.64	0.0053
0.66	0.66	52.27	0.0052
0.69	0.69	51.90	0.0052
0.71	0.71	51.52	0.0052
0.74	0.74	51.11	0.0051
0.76	0.76	50.67	0.0051
0.79	0.79	50.21	0.0050
0.81	0.81	49.73	0.0050
0.84	0.84	49.22	0.0049
0.86	0.86	48.69	0.0049
0.89	0.89	48.13	0.0048
0.91	0.91	47.54	0.0048
0.94	0.94	46.92	0.0047
0.97	0.97	46.26	0.0046
0.99	0.99	45.56	0.0046
1.02	1.02	44.82	0.0045
1.04	1.04	44.02	0.0044
1.07	1.07	43.19	0.0043
1.09	1.09	42.27	0.0042
1.12	1.12	41.29	0.0041
1.14	1.14	40.21	0.0040
1.17	1.17	39.02	0.0039
1.19	1.19	37.68	0.0038
1.22	1.22	36.16	0.0036
1.24	1.24	34.21	0.0034
1.27	1.27	31.21	0.0031
1.30	1.30	28.73	0.0029
1.32	1.32	27.75	0.0028
1.35	1.35	26.87	0.0027
1.37	1.37	25.65	0.0026
1.40	1.40	25.15	0.0025
1.42	1.42	25.15	0.0025
1.45	1.45	25.15	0.0025
1.47	1.47	25.15	0.0025
1.50	1.50	25.15	0.0025
1.52	1.52	25.15	0.0025
1.55	1.55	25.15	0.0025
1.57	1.57	25.15	0.0025
1.60	1.60	25.15	0.0025
1.63	1.63	25.15	0.0025
1.65	1.65	25.15	0.0025
1.68	1.68	25.15	0.0025

Project:

Chamber Model -	MC-3500	
Units -	**Metric**	
Number of Chambers -	4	
Number of End Caps -	2	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	229	mm

Area of System- 21.43 sq.meters Min. Area - 21.43 sq.meters

☑ Include Perimeter Stone in Calculations

☑ Click for Stage Area Data

☐ Click to Invert Stage Area Data

Click Here for Imperial

StormTech MC-3500 Cumulative Storage Volumes

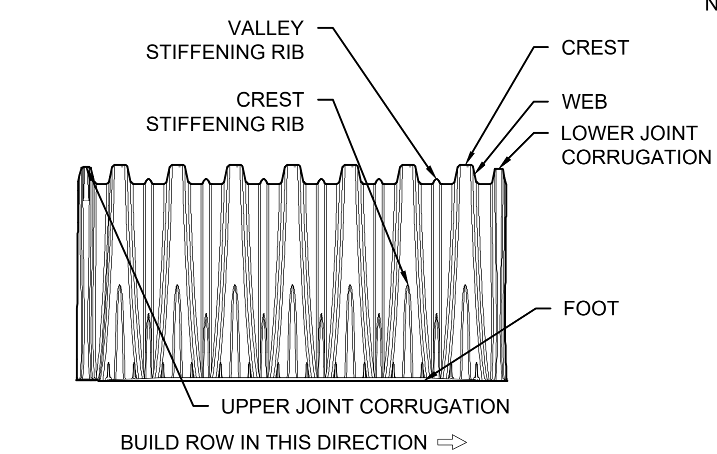
Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Single End Cap *(cubic meters)*	Incremental Chambers *(cubic meters)*	Incremental End Cap *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch, EC and Stone *(cubic meters)*	Cumulative System *(cubic meters)*	Elevation *(meters)*
1676	0.000	0.000	0.00	0.00	0.22	0.22	22.35	1.68
1651	0.000	0.000	0.00	0.00	0.22	0.22	22.13	1.65
1626	0.000	0.000	0.00	0.00	0.22	0.22	21.91	1.63
1600	0.000	0.000	0.00	0.00	0.22	0.22	21.70	1.60
1575	0.000	0.000	0.00	0.00	0.22	0.22	21.48	1.57
1549	0.000	0.000	0.00	0.00	0.22	0.22	21.26	1.55
1524	0.000	0.000	0.00	0.00	0.22	0.22	21.04	1.52
1499	0.000	0.000	0.00	0.00	0.22	0.22	20.83	1.50
1473	0.000	0.000	0.00	0.00	0.22	0.22	20.61	1.47
1448	0.000	0.000	0.00	0.00	0.22	0.22	20.39	1.45
1422	0.000	0.000	0.00	0.00	0.22	0.22	20.17	1.42
1397	0.000	0.000	0.00	0.00	0.22	0.22	19.96	1.40
1372	0.002	0.000	0.01	0.00	0.22	0.22	19.74	1.37
1346	0.005	0.001	0.02	0.00	0.21	0.23	19.52	1.35
1321	0.008	0.001	0.03	0.00	0.20	0.24	19.28	1.32
1295	0.011	0.001	0.05	0.00	0.20	0.25	19.05	1.30
1270	0.019	0.002	0.08	0.00	0.19	0.27	18.80	1.27
1245	0.029	0.002	0.12	0.00	0.17	0.29	18.53	1.24
1219	0.035	0.003	0.14	0.01	0.16	0.31	18.24	1.22
1194	0.040	0.004	0.16	0.01	0.15	0.32	17.93	1.19
1168	0.045	0.004	0.18	0.01	0.14	0.33	17.62	1.17
1143	0.048	0.005	0.19	0.01	0.14	0.34	17.29	1.14
1118	0.052	0.005	0.21	0.01	0.13	0.35	16.95	1.12
1092	0.055	0.006	0.22	0.01	0.13	0.36	16.60	1.09
1067	0.058	0.006	0.23	0.01	0.12	0.36	16.24	1.07
1041	0.060	0.007	0.24	0.01	0.12	0.37	15.88	1.04
1016	0.063	0.007	0.25	0.01	0.11	0.38	15.51	1.02
991	0.065	0.008	0.26	0.02	0.11	0.38	15.13	0.99
965	0.068	0.008	0.27	0.02	0.10	0.39	14.75	0.97
940	0.070	0.008	0.28	0.02	0.10	0.39	14.36	0.94
914	0.072	0.009	0.29	0.02	0.10	0.40	13.96	0.91
889	0.073	0.009	0.29	0.02	0.09	0.40	13.56	0.89
864	0.075	0.009	0.30	0.02	0.09	0.41	13.16	0.86
838	0.077	0.010	0.31	0.02	0.09	0.41	12.75	0.84
813	0.078	0.010	0.31	0.02	0.08	0.42	12.33	0.81
787	0.080	0.011	0.32	0.02	0.08	0.42	11.92	0.79
762	0.081	0.011	0.33	0.02	0.08	0.43	11.49	0.76
737	0.083	0.011	0.33	0.02	0.08	0.43	11.07	0.74
711	0.084	0.012	0.34	0.02	0.07	0.43	10.64	0.71
686	0.085	0.012	0.34	0.02	0.07	0.44	10.20	0.69
660	0.086	0.012	0.35	0.02	0.07	0.44	9.77	0.66
635	0.088	0.012	0.35	0.02	0.07	0.44	9.33	0.64
610	0.089	0.013	0.35	0.03	0.07	0.45	8.88	0.61
584	0.090	0.013	0.36	0.03	0.06	0.45	8.44	0.58
559	0.091	0.013	0.36	0.03	0.06	0.45	7.99	0.56
533	0.091	0.014	0.37	0.03	0.06	0.45	7.54	0.53
508	0.092	0.014	0.37	0.03	0.06	0.46	7.09	0.51
483	0.093	0.014	0.37	0.03	0.06	0.46	6.63	0.48
457	0.094	0.014	0.38	0.03	0.06	0.46	6.17	0.46
432	0.095	0.015	0.38	0.03	0.05	0.46	5.71	0.43
406	0.095	0.015	0.38	0.03	0.05	0.46	5.25	0.41
381	0.096	0.015	0.38	0.03	0.05	0.47	4.78	0.38
356	0.097	0.015	0.39	0.03	0.05	0.47	4.32	0.36
330	0.097	0.015	0.39	0.03	0.05	0.47	3.85	0.33
305	0.098	0.016	0.39	0.03	0.05	0.47	3.38	0.30
279	0.099	0.016	0.39	0.03	0.05	0.47	2.91	0.28
254	0.099	0.017	0.40	0.03	0.05	0.48	2.44	0.25
229	0.000	0.000	0.00	0.00	0.22	0.22	1.96	0.23
203	0.000	0.000	0.00	0.00	0.22	0.22	1.74	0.20
178	0.000	0.000	0.00	0.00	0.22	0.22	1.52	0.18
152	0.000	0.000	0.00	0.00	0.22	0.22	1.31	0.15
127	0.000	0.000	0.00	0.00	0.22	0.22	1.09	0.13
102	0.000	0.000	0.00	0.00	0.22	0.22	0.87	0.10
76	0.000	0.000	0.00	0.00	0.22	0.22	0.65	0.08
51	0.000	0.000	0.00	0.00	0.22	0.22	0.44	0.05
25	0.000	0.000	0.00	0.00	0.22	0.22	0.22	0.03

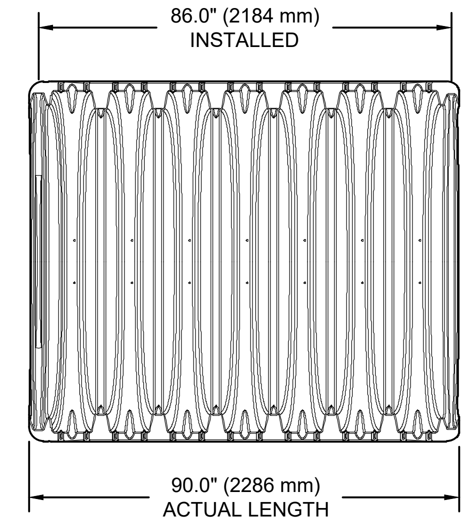
Stage Area Data

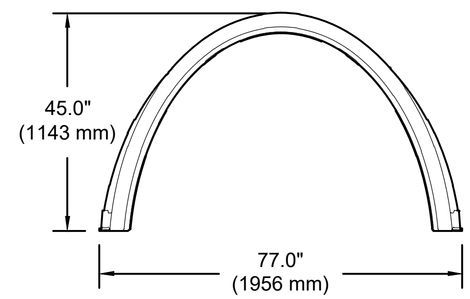
Depth (meter)	Elevation (meter)	Area (m²)	Area (hectare)
0.00	0.00	8.57	0.0009
0.05	0.05	8.57	0.0009
0.08	0.08	8.57	0.0009
0.10	0.10	8.57	0.0009
0.13	0.13	8.57	0.0009
0.15	0.15	8.57	0.0009
0.18	0.18	8.57	0.0009
0.20	0.20	8.57	0.0009
0.23	0.23	8.57	0.0009
0.25	0.25	18.75	0.0019
0.28	0.28	18.62	0.0019
0.30	0.30	18.56	0.0019
0.33	0.33	18.49	0.0018
0.36	0.36	18.43	0.0018
0.38	0.38	18.36	0.0018
0.41	0.41	18.28	0.0018
0.43	0.43	18.21	0.0018
0.46	0.46	18.13	0.0018
0.48	0.48	18.04	0.0018
0.51	0.51	17.95	0.0018
0.53	0.53	17.86	0.0018
0.56	0.56	17.76	0.0018
0.58	0.58	17.66	0.0018
0.61	0.61	17.55	0.0018
0.63	0.63	17.44	0.0017
0.66	0.66	17.32	0.0017
0.69	0.69	17.19	0.0017
0.71	0.71	17.06	0.0017
0.74	0.74	16.93	0.0017
0.76	0.76	16.78	0.0017
0.79	0.79	16.63	0.0017
0.81	0.81	16.47	0.0016
0.84	0.84	16.30	0.0016
0.86	0.86	16.13	0.0016
0.89	0.89	15.94	0.0016
0.91	0.91	15.75	0.0016
0.94	0.94	15.54	0.0016
0.97	0.97	15.33	0.0015
0.99	0.99	15.10	0.0015
1.02	1.02	14.86	0.0015
1.04	1.04	14.60	0.0015
1.07	1.07	14.32	0.0014
1.09	1.09	14.02	0.0014
1.12	1.12	13.71	0.0014
1.14	1.14	13.36	0.0013
1.17	1.17	12.97	0.0013
1.19	1.19	12.55	0.0013
1.22	1.22	12.06	0.0012
1.24	1.24	11.44	0.0011
1.27	1.27	10.50	0.0011
1.30	1.30	9.72	0.0010
1.32	1.32	9.41	0.0009
1.35	1.35	9.12	0.0009
1.37	1.37	8.73	0.0009
1.40	1.40	8.57	0.0009
1.42	1.42	8.57	0.0009
1.45	1.45	8.57	0.0009
1.47	1.47	8.57	0.0009
1.50	1.50	8.57	0.0009
1.52	1.52	8.57	0.0009
1.55	1.55	8.57	0.0009
1.57	1.57	8.57	0.0009
1.60	1.60	8.57	0.0009
1.63	1.63	8.57	0.0009
1.65	1.65	8.57	0.0009
1.68	1.68	8.57	0.0009

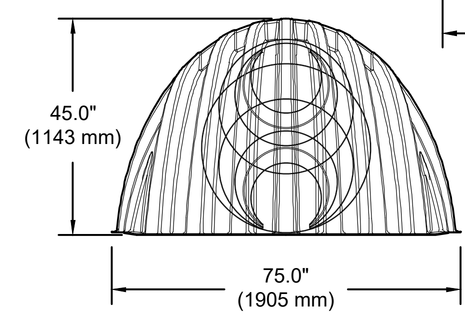
MC-3500 TECHNICAL SPECIFICATION

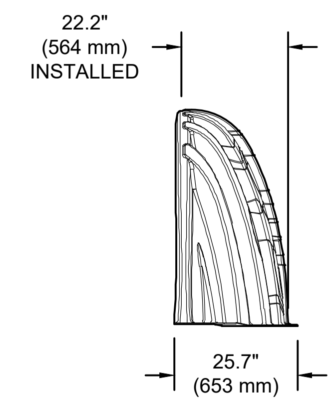
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

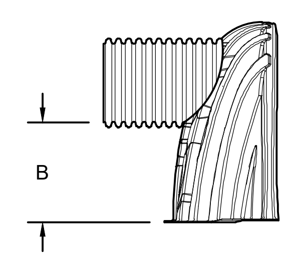
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

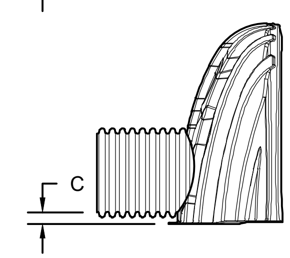
*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" (152 mm) STONE BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

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

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL





CUSTOM PARTIAL CUT INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

TECHNICAL SPECIFICATIONS
MC-3500 CHAMBER

DATE: 05/01/25 DRAWN: SMW
DRAWING #: 724-310 CHECKED: JLM

DATE	DRWN	CHKD	DESCRIPTION

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

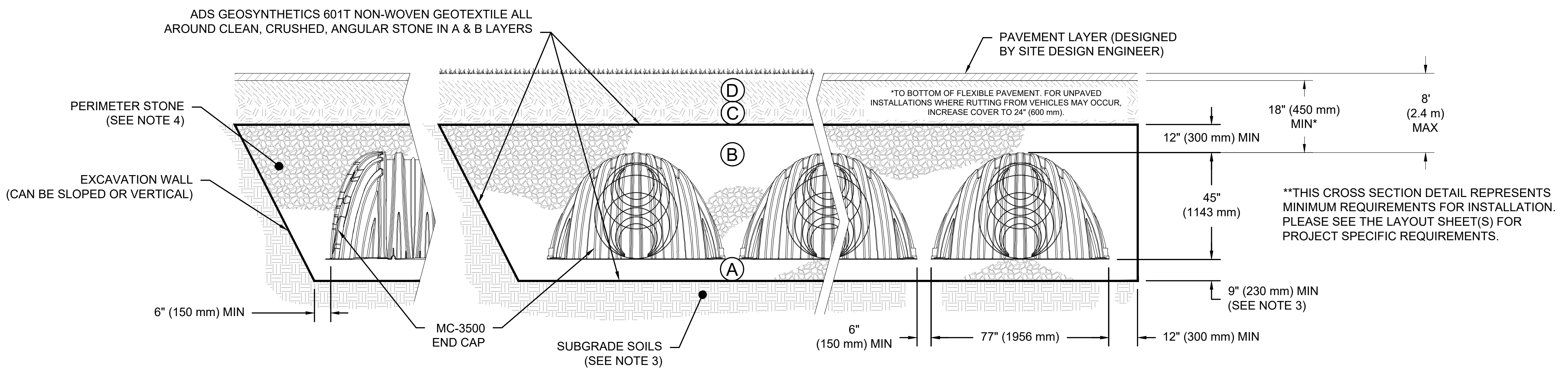
StormTech®
Chamber System

SHEET 1 OF 1

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 18" (450 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[5]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE[5]	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.
5. WHERE RECYCLED CONCRETE AGGREGATE IS USED IN LAYERS 'A' OR 'B' THE MATERIAL SHOULD ALSO MEET THE ACCEPTABILITY CRITERIA OUTLINED IN TECHNICAL NOTE 6.20 "RECYCLED CONCRETE STRUCTURAL BACKFILL".



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS. REFERENCE STORMTECH DESIGN MANUAL FOR BEARING CAPACITY GUIDANCE.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 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-3500 CHAMBER

DATE: 04/30/25
DRAWN: SMW
DRAWING #: 724-320
CHECKED: JLM

DATE	DRWN	CHKD	DESCRIPTION

StormTech®
Chamber System

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SHEET 1 OF 1

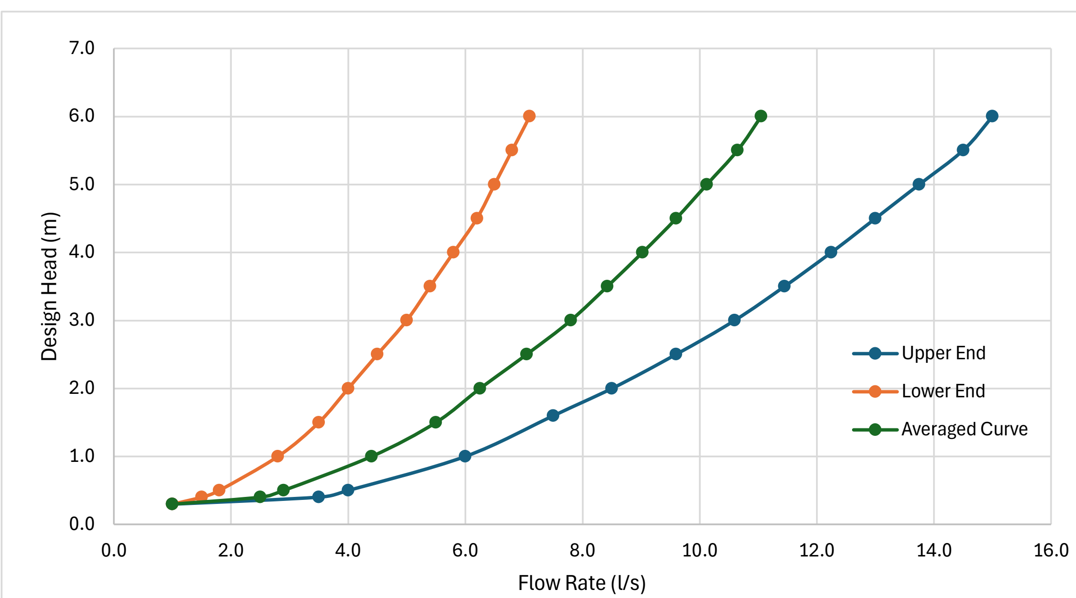
Project Name:	Beechcliffe
Project Number:	241416
Designed By:	LH
Checked By:	AL
Date:	5-Sep-25

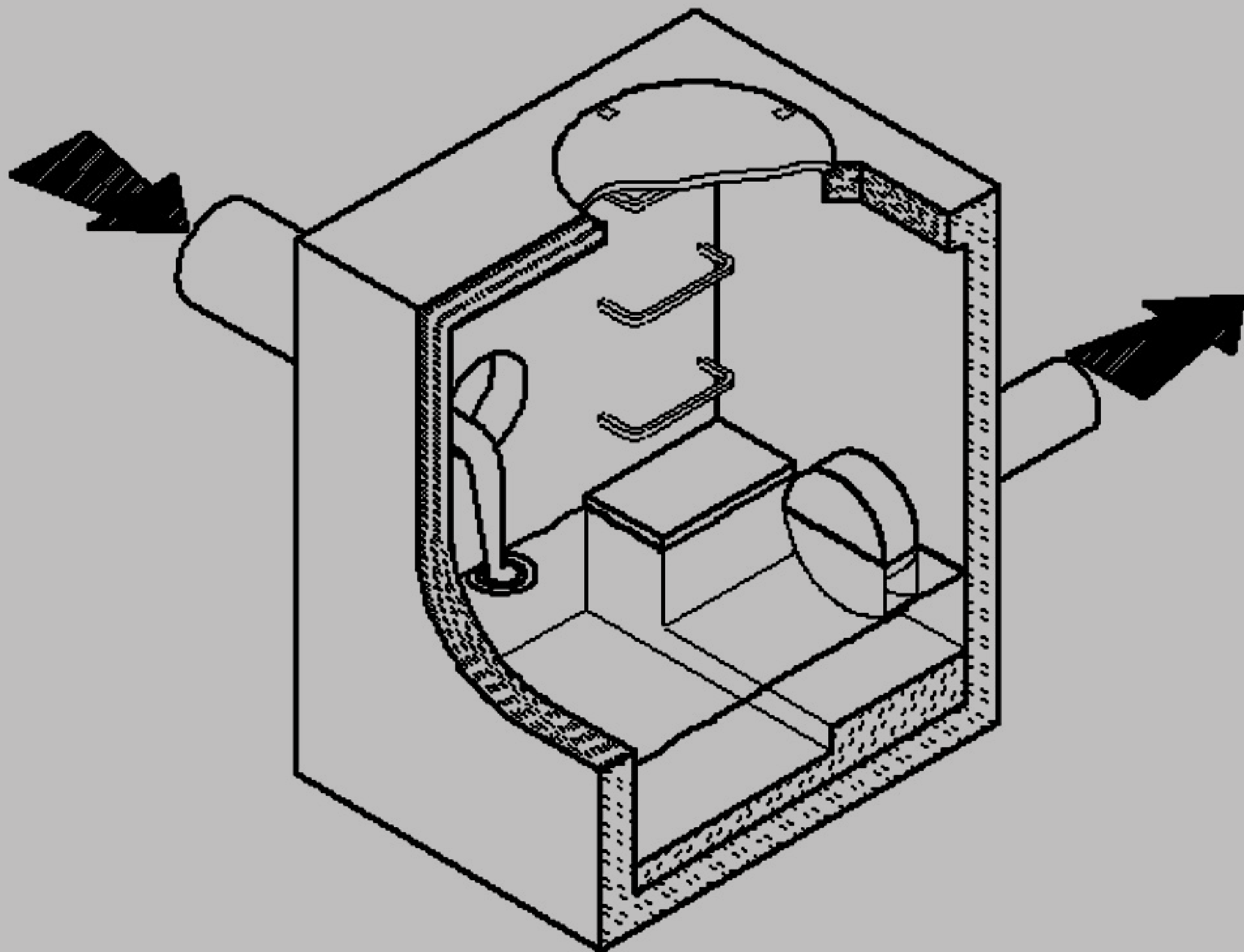
DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

HYDROVEX 75VHV-1 FLOW REGULATOR CURVE

Upper End		Lower End		Averaged Curve	
Flow (l/s)	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**	**Head (m)**
1.0	0.3	1.0	0.3	1.0	0.3
3.5	0.4	1.5	0.4	2.5	0.4
4.0	0.5	1.8	0.5	2.9	0.5
6.0	1.0	2.8	1.0	4.4	1.0
7.5	1.6	3.5	1.5	5.5	1.5
8.5	2.0	4.0	2.0	6.3	2.0
9.6	2.5	4.5	2.5	7.1	2.5
10.6	3.0	5.0	3.0	7.8	3.0
11.5	3.5	5.4	3.5	8.4	3.5
12.25	4.0	5.8	4.0	9.0	4.0
13.0	4.5	6.2	4.5	9.6	4.5
13.8	5.0	6.5	5.0	10.1	5.0
14.5	5.5	6.8	5.5	10.7	5.5
15.0	6.0	7.1	6.0	11.1	6.0

Source: Hydrovex VHV/SVHV Vertical Vortex Flow Regulator SCO, SSO, Stormwater Management, Veolia Water Technologies, 2014





VEOLIA

HYDROVEX® VHV/SVHV
Vertical Vortex Flow Regulator
CSO, SSO, Stormwater Management

WATER TECHNOLOGIES

HYDROVEX® VHV / SVHV Vertical Vortex Flow Regulator

Application

One of the major problems of urban wet weather flow management is the runoff generated by heavy rainfall. During a storm event, uncontrolled flows may overload the drainage system and cause flooding. Wear and deterioration on the network are increased dramatically as a result of increased flow velocities. In a combined sewer system, the wastewater treatment plant will experience a significant increase in flows during storms, thereby losing its treatment efficiency. A simple means of managing excessive storm water runoff is to control the flows at their point of origin, the manhole.

The HYDROVEX® VHV / SVHV line of vortex flow regulators is ideal for point source control of low to medium stormwater flows in manholes, catch basins and other retention structures. The HYDROVEX® VHV / SVHV design is based on the fluid mechanics principle of the forced vortex. The discharge is controlled by an air-filled vortex which reduces the effective water passage area without physically reducing orifice size. This effect grants precise flow regulation without the use of moving parts or electricity, and allows for larger inlet and outlet openings compared to the basic orifice. Although the concept is quite simple, many years of research and testing have been invested to optimize the performance of our vortex technology.

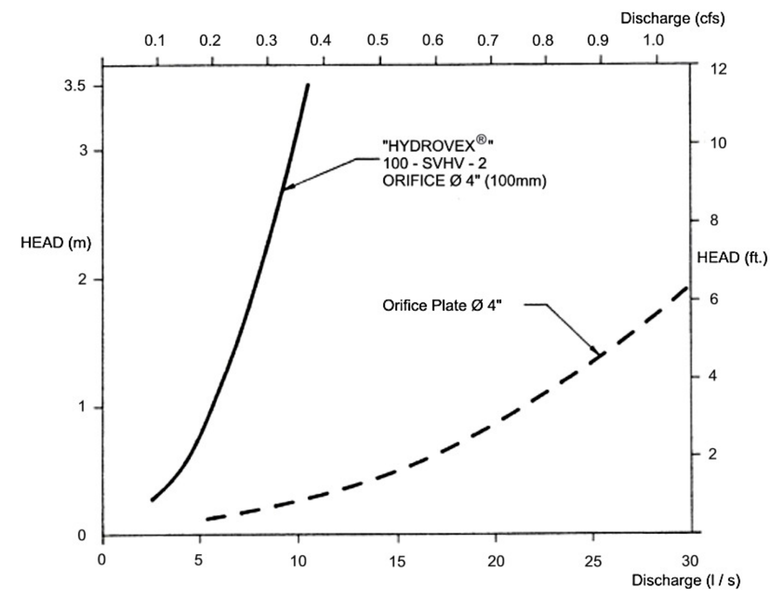


Figure 1:HYDROVEX® VHV/SVHV compared to an orifice plate

Vortex valves have openings typically 4 to 6 times larger than an orifice plate for the same design. Larger opening sizes decrease the chance of blockage caused by sediments and debris found in storm water flows. Figure 1 shows the discharge curve of a vortex regulator compared to an equally sized orifice plate. For an identical opening size, the flow is approximately four times smaller than the orifice plate for the same upstream water pressure.

Advantages

- Large inlet/outlet openings reduce the chance of clogging
- Openings typically 4-6 times larger than the basic orifice (Figure 1)
- Outlet orifice always equal or larger than inlet
- Ideal for precise control of low to medium stormwater flow applications
- Submerged inlet for floatables control
- No moving parts or electricity required
- Durable and robust stainless steel construction
- Minimal maintenance
- Easy to install

Selection

Selecting a VHV/SVHV regulator is easily achieved using Figure 3. Each selection is made using the maximum allowable flow rate and the maximum allowable upstream water pressure (head). The area in which the design point falls will designate the required model. The maximum design head is defined as the difference between the maximum upstream water level and the invert of the outlet pipe. All selections should be verified by a John Meunier Inc. representative prior to fabrication.

Design example:

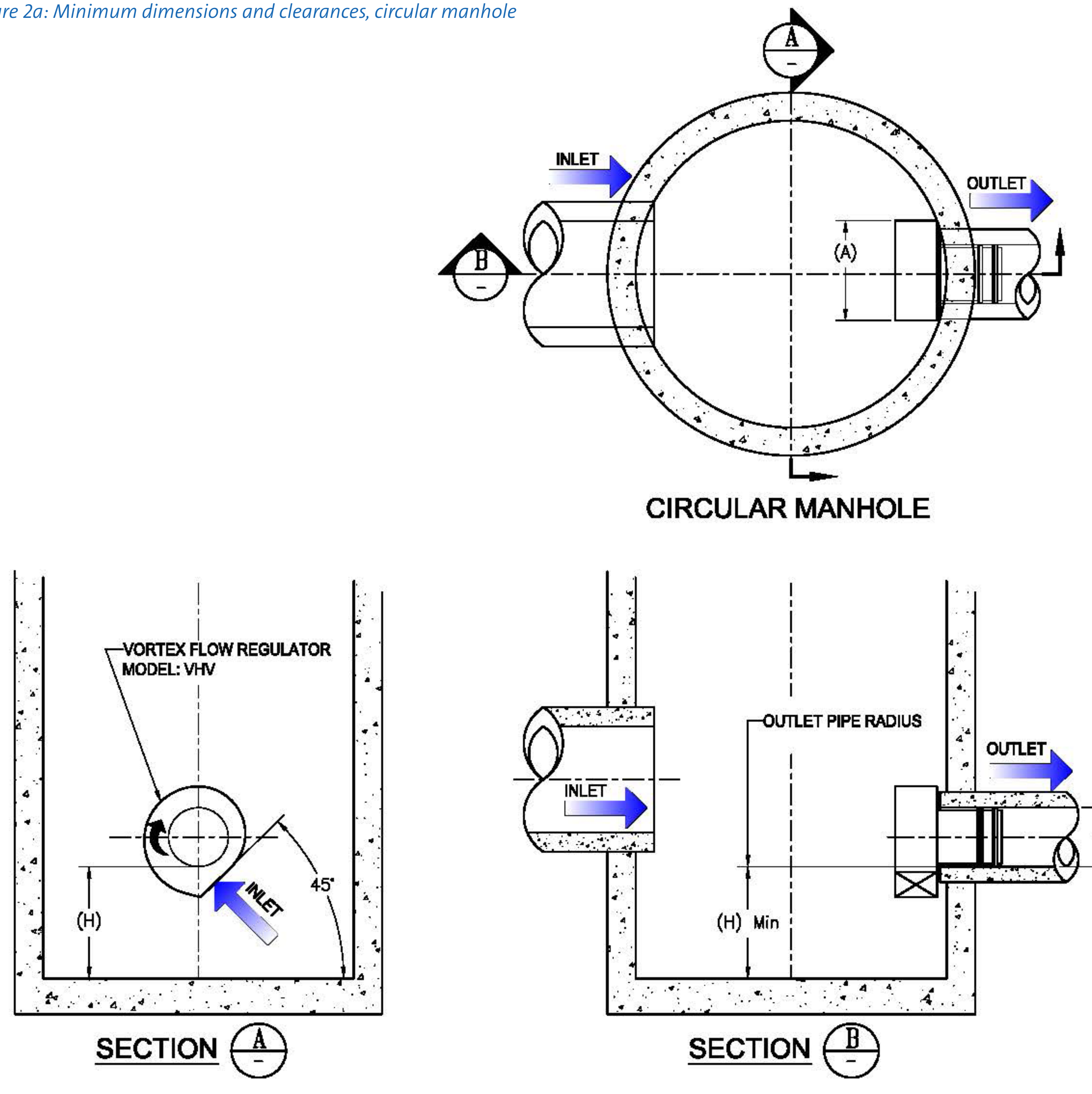
- Maximum discharge: 6 L/s (0.2 cfs)*
- Maximum design head 2m (6.56 ft.)**
- Using Figure 3, model 75 VHV-1 is selected

**The selection chart provided assumes free flowing downstream conditions. Should the outlet pipe be >80% full at design flow, a larger pipe diameter should be used. In the above example, the minimum outlet pipe diameter and slope would be 150mm (6in), 0.3%.*
***The design head is defined as the difference between the maximum upstream water level and the outlet pipe invert.*

The HYDROVEX® VHV / SVHV vortex flow regulators can be installed in circular or square manholes. The table below lists the minimum dimensions and clearances required for each regulator model. It is imperative to respect the minimum clearances shown to ensure ease of installation and proper functioning of the regulator.

Model	Regulator Diameter A (mm) [in]	CIRCULAR Minimum Manhole Diameter B (mm) [in]	SQUARE Minimum Chamber Width B (mm) [in]	Minimum Outlet Pipe Diameter C (mm) [in]	Minimum Clearance H (mm) [in]
25 SVHV-1	125 [5]	600 [24]	600 [24]	150 [6]	150 [6]
32 SVHV-1	150 [6]	600 [24]	600 [24]	150 [6]	150 [6]
40 SVHV-1	200 [8]	600 [24]	600 [24]	150 [6]	150 [6]
50 VHV-1	150 [6]	600 [24]	600 [24]	150 [6]	150 [6]
75 VHV-1	250 [10]	600 [24]	600 [24]	150 [6]	150 [6]
100 VHV-1	325 [13]	900 [36]	600 [24]	150 [6]	200 [8]
125 VHV-2	275 [11]	900 [36]	600 [24]	150 [6]	200 [8]
150 VHV-2	350 [14]	900 [36]	600 [24]	150 [6]	225 [9]
200 VHV-2	450 [18]	1200 [48]	900 [36]	200 [8]	300 [12]
250 VHV-2	575 [23]	1200 [48]	900 [36]	250 [10]	350 [14]
300 VHV-2	675 [27]	1600 [64]	1200 [48]	250 [10]	400 [16]
350 VHV-2	800 [32]	1800 [72]	1200 [48]	300 [12]	500 [20]

Figure 2a: Minimum dimensions and clearances, circular manhole



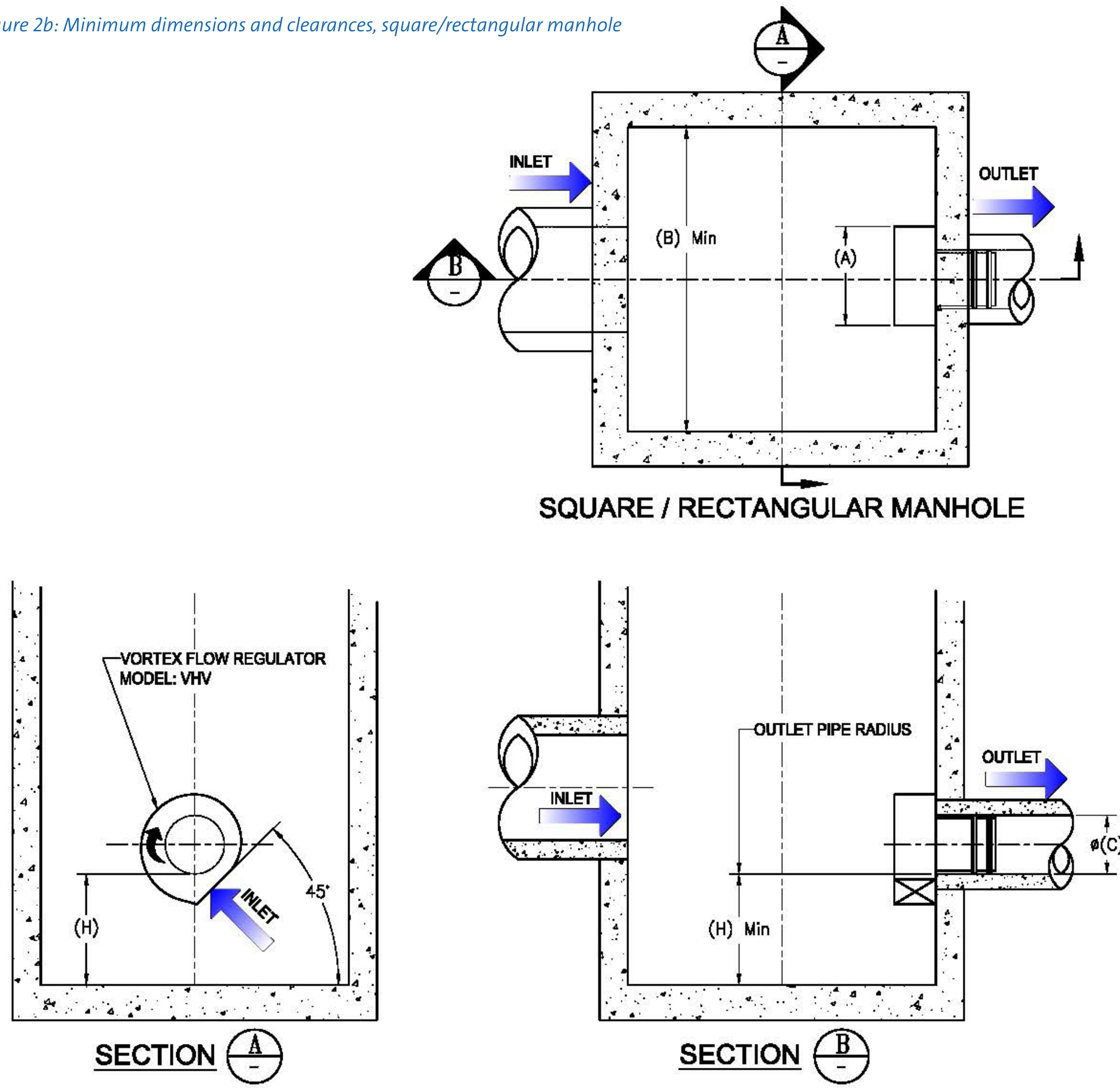


Figure 2b: Minimum dimensions and clearances, square/rectangular manhole

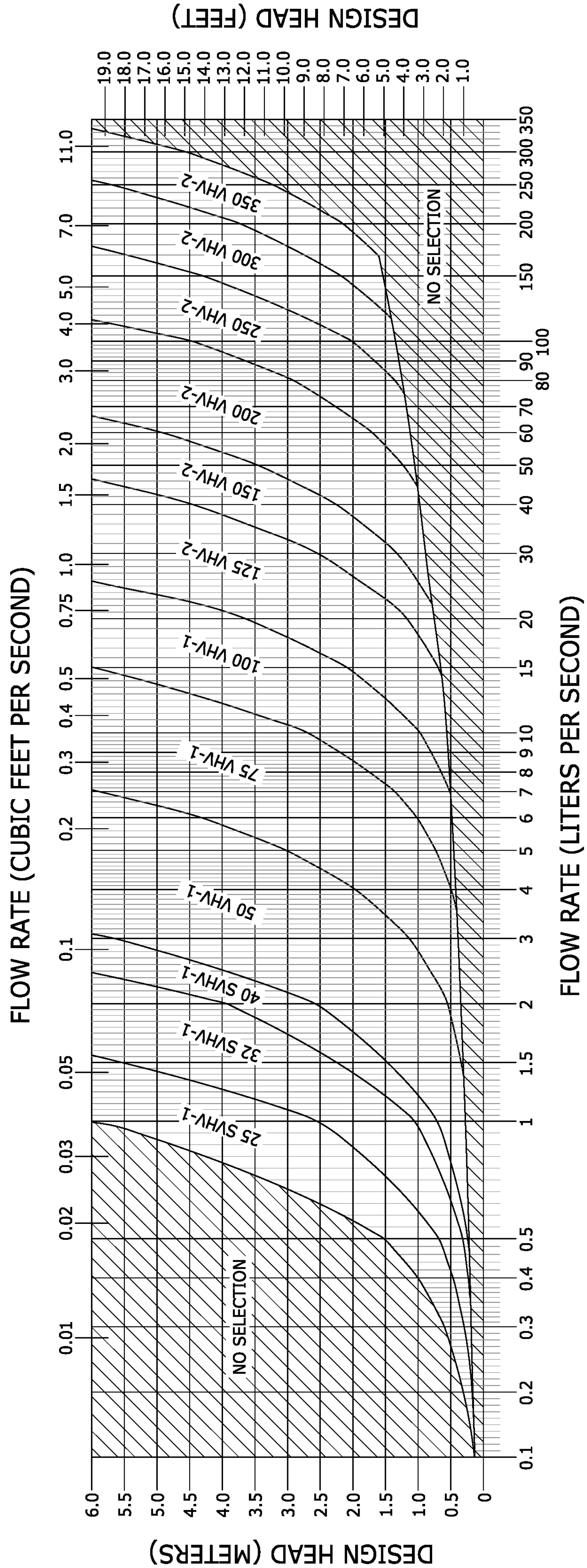


Figure 3 : HYDROVEX® VHV/SVHV Selection Chart

Options

A variety of options are available for the HYDROVEX® VHV / SVHV vortex flow regulators, including:

- Type O: extended inlet for odor control
- FV-VHV: sliding plate mounted
- Gooseneck: for shallow or no sump installations
- Vent: for low slope applications

DT: roof drainage applications

Specifications

In order to specify a HYDROVEX® VHV/SVHV flow regulator, the following parameters must be clearly indicated:

- Model number, ex: 75-VHV-1
- Outlet pipe diameter and type, ex: ø 150mm [6"], SDR 35
- Design discharge rate, ex: 6.0 L/s [0.21 CFS]
- Design head, ex: 2.0 m [6.56 ft] *
- Manhole diameter, ex: ø 900 mm [ø 36"]
- Minimum clearance "H", ex: 150 mm [6 in]
- Construction material type (304 stainless steel standard)

**The design head is defined as the difference between the maximum upstream water level and the outlet pipe invert.*

Installation

The installation of a HYDROVEX® VHV/SVHV flow regulator can be accomplished quickly and does not require any special tools. The sleeve of the vortex flow regulator is simply inserted into the outlet pipe of the manhole and the unit is then secured to the concrete wall using the supplied anchor.

Maintenance

HYDROVEX® regulators are designed to minimize maintenance requirements. We recommend a periodic visual inspection in order to ensure that the unit is free of debris. The manhole sump beneath the unit should be inspected and cleaned with a vacuum truck periodically to remove accumulated sediments.

Guaranty

The HYDROVEX® line of VHV / SVHV regulators are guaranteed against both design and manufacturing defects for a period of 5 years after sale. The unit will be modified or replaced should it be found to be defective within the guarantee period.

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Project Name:	Beechcliffe
Project Number:	24-1416
Designed By:	LH
Checked By:	AL
Date	9-Sep-25

DSEL
David Schaeffer Engineering Limited
600 Alden Road, Suite 606
Markham, ON L3R 0E7

NRC Catch Basin Rating Curve Circular Open Cover (Type B)

Cross Slope (%) 2

Grade (%) 1

Depth (m)	Catchment (m^3/s)
0.017	0.001
0.021	0.002
0.024	0.005
0.032	0.011
0.037	0.016
0.049	0.021
0.061	0.025
0.069	0.028
0.075	0.029
0.086	0.033
0.097	0.036
0.109	0.040
0.116	0.041

Source: Poirer, L., Provan, M., NRC Publications Archive: Catch basin rating cruves; guidance document. OPSD 401.010 -NRC Table A.13. https://doi.org/10.4224/40002984

Catch basin rating curves: guidance document
Poirier, Louis; Provan, Mitchel

For the publisher's version, please access the DOI link below./ Pour consulter la version de l'éditeur, utilisez le lien DOI ci-dessous.

https://doi.org/10.4224/40002984

NRC·CNRC

Catch Basin Rating Curves – Guidance Document

Report No.: NRC-OCRE-2023-TR-003

Prepared for: City of Toronto and Infrastructure Canada

Revision 1.5
Date: 2023/03/07

Author(s): Louis Poirier, Mitchel Provan

Ocean, Coastal, and River Engineering
Research Centre

National Research Council Canada
Conseil national de recherches Canada

Canada

Revision History

Document Version	Name	Affiliation	Date of Changes	Comments
1.0	Louis Poirier	NRC-OCRE	Aug. 22 2022	Draft
1.1	Mitchel Provan	NRC-OCRE	Aug. 23 2022	Draft review
1.2	Ali Khan	NRC-OCRE	Aug. 26 2022	Program review
1.3	Ivana Kubat	NRC-OCRE	Sept. 2 2022	Director Review
1.4	Louis Poirier	NRC-OCRE	Feb. 8, 2023	Update with new data
1.5	MP, AK, IK	NRC-OCRE	Mar. 7, 2023	Internal review

ABSTRACT

A series of 1659 tests were performed measuring the conveyance of twelve (12) different catch basin inlet configurations for various road orientations. The catch inlet combinations include single and double round herringbone grates (OPSD 400.070 and DWG. No. S19), single and double square herringbone grates (OPSD 400.020), square grate with square bars (MT-310), high capacity inlet (Stepcon 5103), circular open cover (type B) (OPSD 401.010), circular closed cover (type A) (OPSD 401.010) and single and double curb mounted inlets (DWG. No. S22 and DWG. No. S28).

These tests resulted in 116 catch basin inlet rating curves which are presented in this document. The experiments were performed using a full scale model roadway at the Ocean, Coastal and River Engineering Research Centre of the National Research Council Canada in Ottawa. Water flows ranging from 0.001 - 0.41 m^3/s were delivered to the model roadway and six (6) road grades ranging from 0.5 - 10.0% and cross-slopes of 0.0, 2.0 and 4.0% were examined.

In this document the experimental setup and methodology are reviewed. The 116 best fit catch basin inlet ratings curves are provided. The experimental data on which the rating curves are based along with the uncertainty analyses are provided. An example of the analysis to obtain the best fit ratings curves from the experimental data is reviewed.

TERMS OF USE

The data in this report is provided as is. Any users of this data should understand that there are differences in obtaining results in a laboratory setting and the application in the field. Those differences include but are not limited to the uniformity of the road surface in advance of and near the inlet and the precise setting of the inlet into the surface of the roadway or curb. The authors do not recommend the extrapolation of these results beyond the maximum incident water depths identified.

Table of Contents

List of Figures

Table of Tables

1. Introduction

The National Research Council of Canada's Ocean, Coastal and River Engineering Research Centre (NRC-OCRE) has prepared this report for Infrastructure Canada as a guide to inform engineers on new catch basin inlet rating curves that have been developed through experimental testing. This document is an update to the original Poirier and Provan (2022) version.

Municipalities throughout Canada utilize catch basin inlet ratings curves to determine the amount of flow that passes through a certain catch basin inlet under various roadway conditions. These rating curves relate the hydraulic head above the catch basin inlet to the inflow capacity of a specific inlet type and are used in the design of urban roadway drainage. In addition, they are key inputs into urban hydrodynamic flood models. The rating curves play a crucial role in the accuracy of the hydrodynamic model predictions because they govern the conveyance through each catch basin inlet in the model. Some of the rating curves that are currently in use have been adopted from experimental tests completed by Burgi and Gober (1978), Bouchard and Townsend (1983), and Marsalek (1982 and 1986). The selection of inlets covered is different from those performed in the previous studies and the present tests have examined the highest flow rates to date in an effort to better understand potential catch-basin conveyance in extreme flood conditions.

A series of 1140 tests was undertaken in Poirier and Provan (2021) followed by a series of 519 tests undertaken in Poirier and Provan (2023) in an effort to better understand the performance (conveyance) of catch basin inlets that are commonly used in Canadian municipalities. These tests help to improve the capacity to design, analyze and predict the flows through stormwater systems during flood events. The reports by Poirier and Provan (2021, 2023) were focused on the measurements, while this document is focused on the best fit curves. These results aim to help Canadian municipalities improve the resiliency of their infrastructure in the face of a changing climate by better defining input parameters and uncertainties. A total of twelve catch basin inlet configurations were examined at six road grades ranging from 0.5 - 10.0% and cross-slopes of 0.0, 2.0 and 4.0%. Each setup was exposed to 13 flow conditions ranging from 0.001 – 0.41 m^3/s that were sent onto the model roadway.

2. Experimental Overview

The experiments were carried out in the National Research Council's (NRC's) Coastal Wave Basin (CWB) test facility. The facility is located in the NRC's Ocean, Coastal and River Engineering Research Centre (OCRE) in Ottawa, Canada. This section is an overview of the experiments carried out in Poirier and Provan (2021, 2023). For a more detailed description of the experiments and the analysis refer to the original reports. The experimental setup consisted of a model roadway, the water supply system and the measurement tank system. A sketch of the experimental setup is provided in Figure 1.

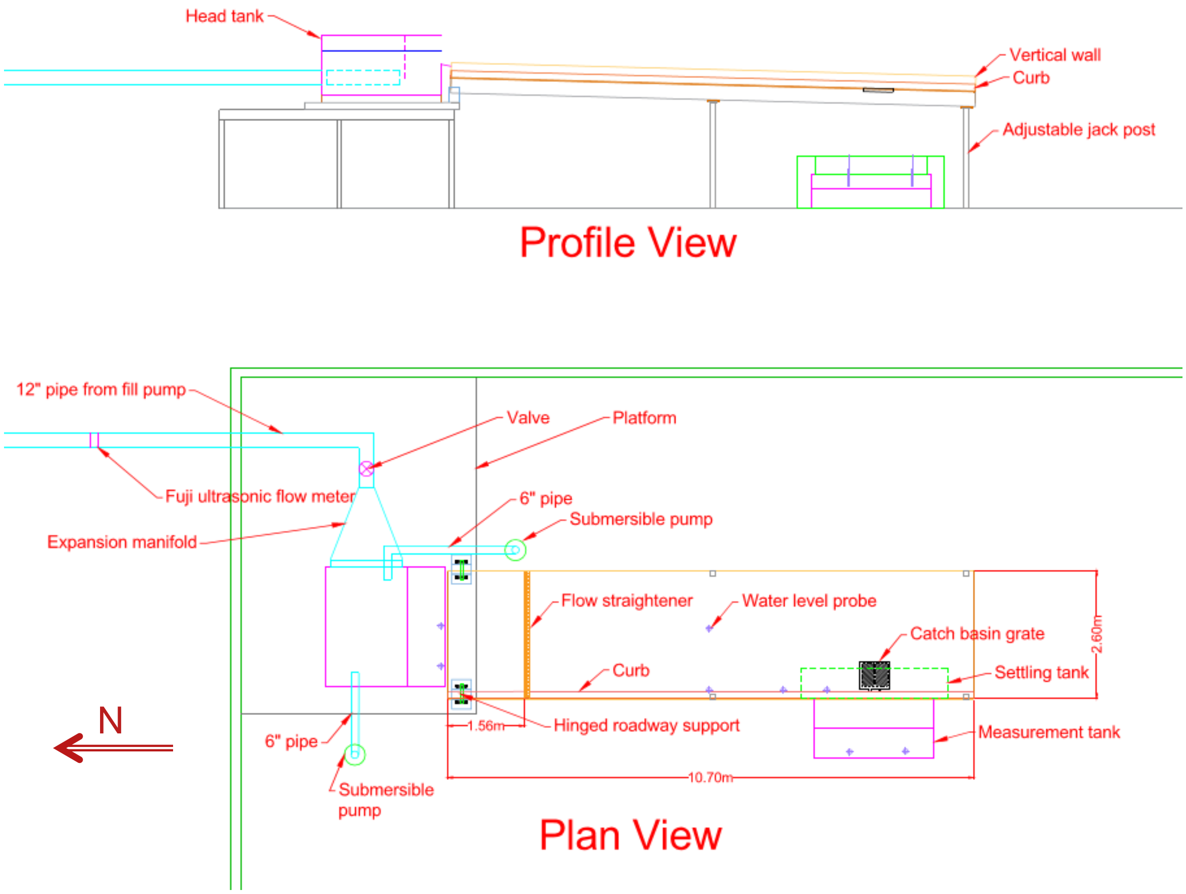

Figure 1. Sketch of the test setup

The full scale model roadway was 10.70 m long and 2.60 m wide and was supported at six locations. Twelve catch basin inlets are discussed in this report. The setup in Figure 1 is used for the 8 inlets studied in Poirier and Provan (2021) and it was used for the first inlet studied in Poirier and Provan (2023). The three subsequent configurations from Poirier and Provan (2023) examined curb mounted inlets. A representation of a sidewalk was constructed along one side of the model roadway to accommodate these inlets resulting in a narrower road surface in the model (1.55 m) as shown in Figure 2. The width of the road surface in Figure 1 is 2.46 m wide when accounting for the width of the curb. The curb height is approximately 14 cm high for the configuration in Figure 1 and approximately 17.5 cm in the configuration in Figure 2.

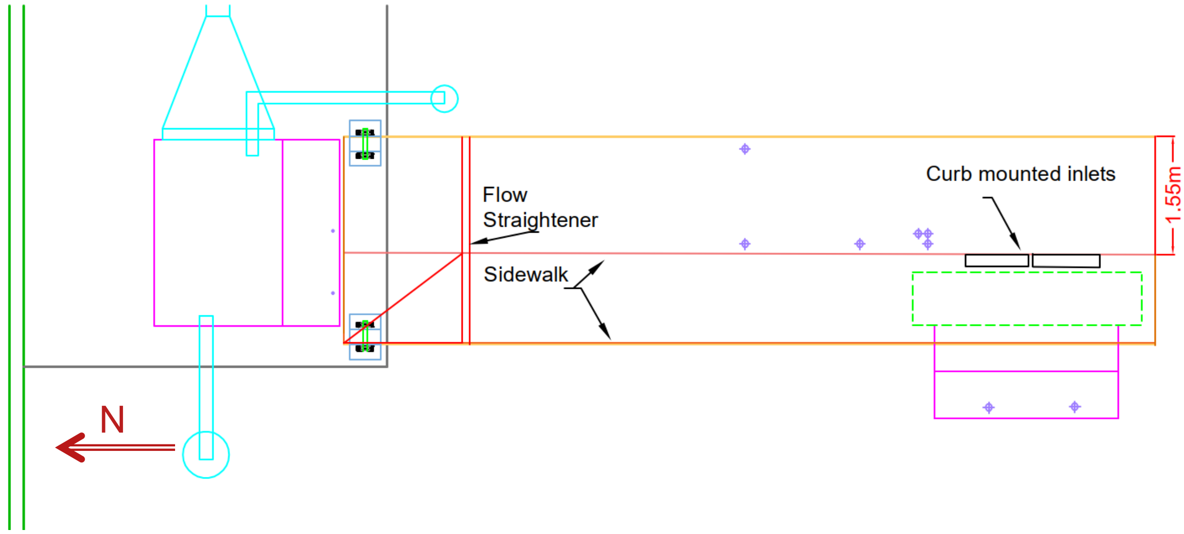

Figure 2. Model roadway sketch with sidewalk for curb inlets

The model was constructed from lumber and the surface was covered with a water-proof material (WeatherWatch) which has a similar manning's roughness coefficient to asphalt (0.013 s/m$^{1/3}$). Walls were installed on each side of the roadway to contain the water within the roadway and were skinned with tin to reduce friction (as much as possible) between the flowing water and the walls. Two hinged roadway supports at the upstream end of the road were situated on an I-beam which was supported by a pair of hinges (see Figure 1). The six supports of the roadway, situated in each corner and one along each long side, were adjusted to provide the road grades of 0.5, 1.0, 2.5, 5.0, 7.5 and 10.0% and the cross-slopes of 0.0, 2.0 and 4.0%. For further details of the road model and the adjustments see Poirier and Provan (2021).

A flow straightener was installed 1.56 m from the upstream end of the model roadway where the head tank is located. The flow straightener is illustrated in the Plan View of Figure 1 as well as in Figure 2 and a photo is provided in Figure 3. In Figure 3a the roadway is shown in the original configuration used for testing catch basin covers. In Figure 3b the roadway is shown in the modified configuration used for testing curb mounted inlets which includes the model sidewalk. A flow diverter was added to the top of the sidewalk, which is partially shown in the bottom right corner of Figure 3b, in order to avoid excessive water flow onto the sidewalk. Figure 3 shows how the installation of the sidewalk for the curb inlets has reduced the road surface width when compared to the catch basin covers.

Figure 3. Photo of the model roadway setup with flow straightener for; a) the catch basin cover tests, and b) the curb inlet tests

Water was supplied to the model via a large pump that pumped water from the laboratory sump into a head tank located at the upstream end of the roadway as illustrated in the Profile View of Figure 1 and shown in Figure 4. Additional flow to the head tank was provided via two 6 inch submersible pumps. This allowed for the model to be supplied with a variable flow rate up to a maximum of 0.41 m^3/s. The water from the head tank flowed onto the roadway and through the flow straightener. For most tests the water traveled freely down the road. Some water flowed through the catch basin inlet and into a measurement tank while the remaining water bypassed the inlet and flowed over the end of the roadway onto the basin floor. One ponding test was performed for each inlet studied in Poirier and Provan (2023). For these tests the road was set to a grade of 0.5% and a 0.0% cross-slope. The end of the model roadway was blocked and all of the water was forced through the inlet. The water level was increased until the water flowed over the end of the roadway, resulting in a water depth of approximately 35 cm in advance of the inlet or the maximum pump capacity of 0.41 m^3/s was achieved. All of the water eventually flowed into the basin and was drained to the sump for reuse.

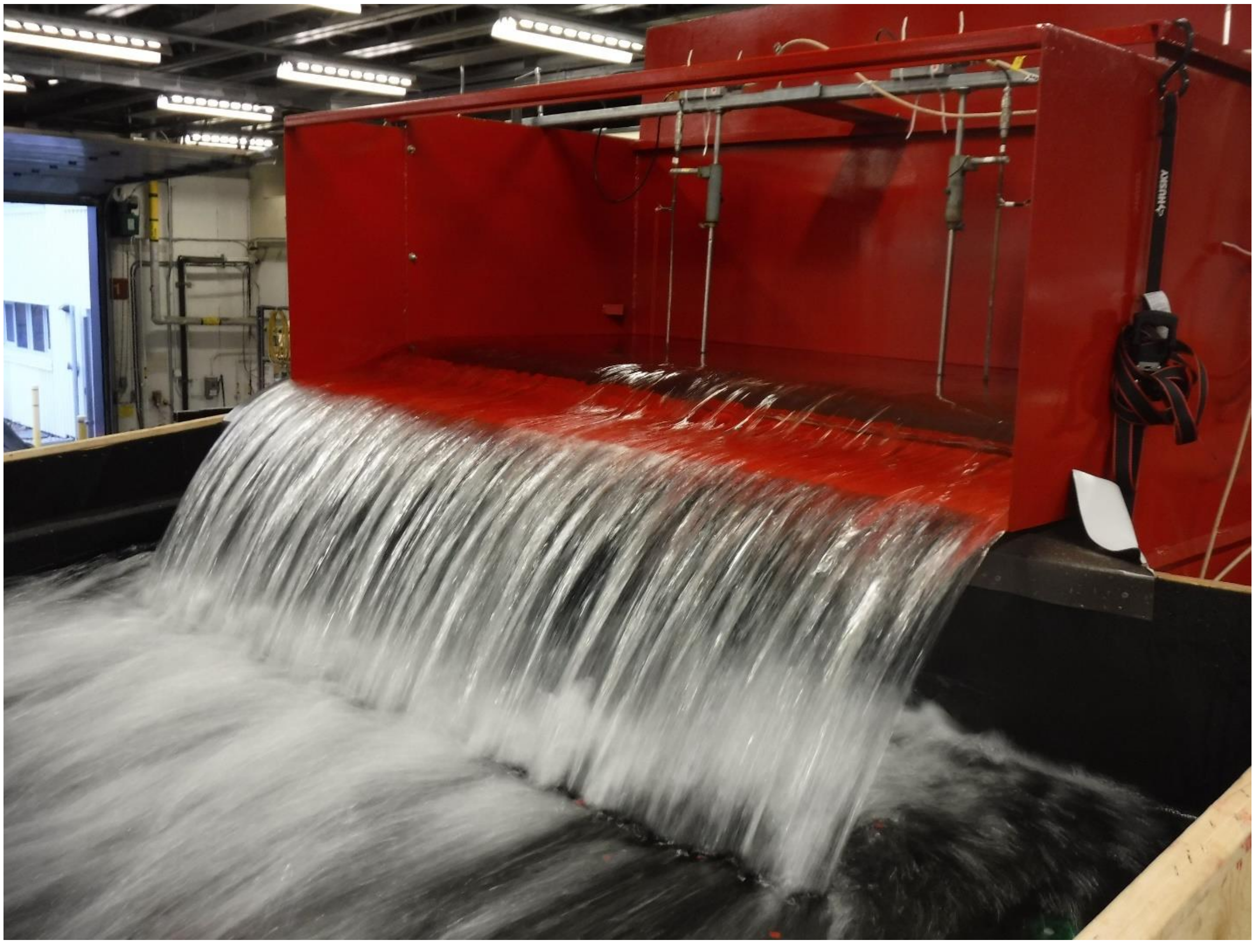

Figure 4. Photo of the head tank supplying water to the upstream end of the model roadway.

2.1. Measurements

The main objective of the experiment was to relate the flow through the catch basin inlets for various water depths upstream of the opening. The water depth upstream of the catch basin inlets was measured using capacitance wire water level gauges (Long 1992, Akamina 2009). Two additional sensors, an acoustic sensor and a point gauge, shown in Figure 5, were used to validate the results recorded by the capacitance wire water level gauges.

The water depth measurements used in this study are defined as the water depth above the road surface at the location of the capacitance wire water level gauge (RD6), 0.03 m from the curb and 2.97 m from the end of the model roadway. Additional capacitance wire water level gauges were also installed in advance (up-stream) of the catch basins to better understand the incoming flow. Those results are only provided in Poirier and Provan (2021, 2023). The primary source of water depth is the RD6 wire gauge. In instances where the water level is too low to be properly measured by the RD6 gauge, data from other sensors are used with the data from RD6 to assess the water depth.

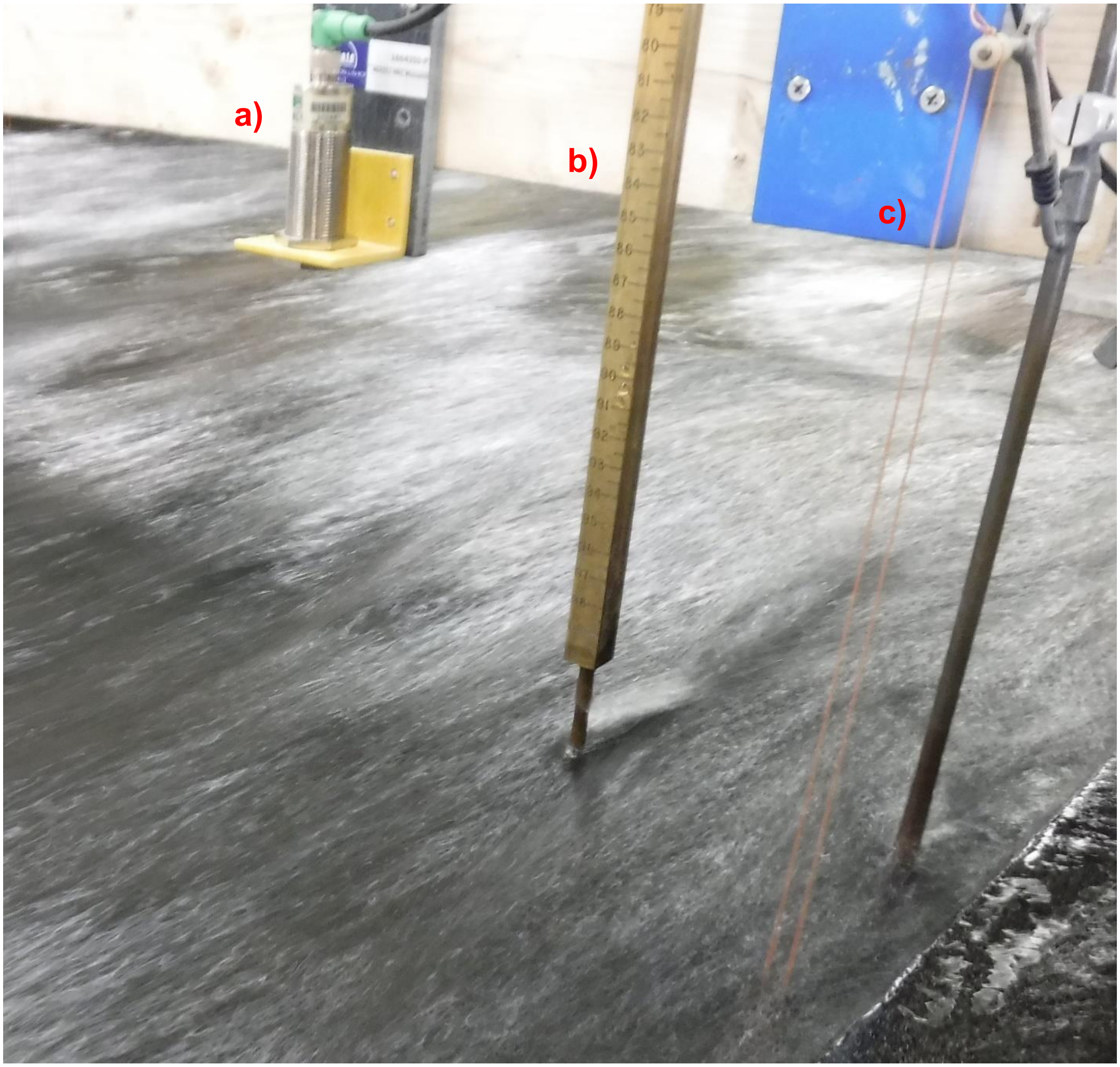

Figure 5. Types of water level gauges used in this study; a) UltraLab ULS, b) point gauge and c) capacitance wire gauge.

The catchment flow, or conveyance, was measured by directing the water captured by the catch basin inlet first into a stainless steel settlement tank and then into a measurement tank, both shown in Figure 6. The measurement tank was equipped with a sharp-crested weir. There was a very wide range of flow rates that were measured by the measurement tank throughout the test program (0.0001 – 0.41 m^3/s). The two primary methods to measure the inlet flow were; measuring the water height above the sharp-crested weir and measuring the fill rate of the tank. All of the measurement techniques used to measure the flow into the catch basin inlet are described in detail in Poirier and Provan (2021, 2023).

Figure 6. Photo of the settlement and measurement tanks that were used to capture the water that flowed through the catch basin inlet.

2.2. The Catch Basin inlets

A total of twelve catch basin inlet combinations were tested. The twelve grates are described in Table 1. All of the catch basin inlets were installed along the curb near the downstream end of the roadway as illustrated in Figure 1 and Figure 2. Because the dimensions for each configuration are different, the limits in the distance of each inlet from the end of the roadway and from the curb are also included in Table 1. Images for each of the twelve catch basin inlet combinations are shown in Figure 7 through Figure 18.

Table 1. Tested catch basin inlet combinations

		From end of road (m)		From curb (m)	
Type of Catch Basin Grate	Catch Basin Grate Specifications	min	max	min	max
Round Frame Single Catch Basin	per OPSD 400.07	1.70	2.32	0.05	0.68
Round Frame Double Catch Basin	per OPSD 400.07	1.69	2.32	0.06	0.68
		0.86	1.49	0.06	0.68
Herringbone Single Catch Basin	per OPSD 400.020	1.68	2.30	0.05	0.66
Herringbone Double Catch Basin	per OPSD 400.020	1.68	2.30	0.05	0.66
		0.87	1.48	0.05	0.65
Horizontal Bars Single Catch Basin	per MT-310	1.68	2.30	0.05	0.66
High Inlet Capacity Catch Basin	per Stepcon 5103 (Galvanized)	0.99	2.21	0.02	0.79
Circular Open Cover (Type B)	per OPSD 401.010	1.70	2.32	0.05	0.68
Circular Closed Cover (Type A)	per OPSD 401.010	1.70	2.32	0.05	0.68
"FISH" Type Round Catch Basin Cover	DWG. No. S19	1.70	2.32	0.05	0.68
Curb Inlet "FISH" Type Catch Basin Frame	DWG. No. S22	1.55	2.32	N/A	N/A
Double Curb Inlet "FISH" Type Catch Basin Frame	DWG. No. S22	1.55	2.32	N/A	N/A
		0.72	1.49	N/A	N/A
Curb Inlet "FISH" Type Catch Basin Frame and Cover for CBMH	DWG. No. S28	1.49	2.28	N/A	N/A

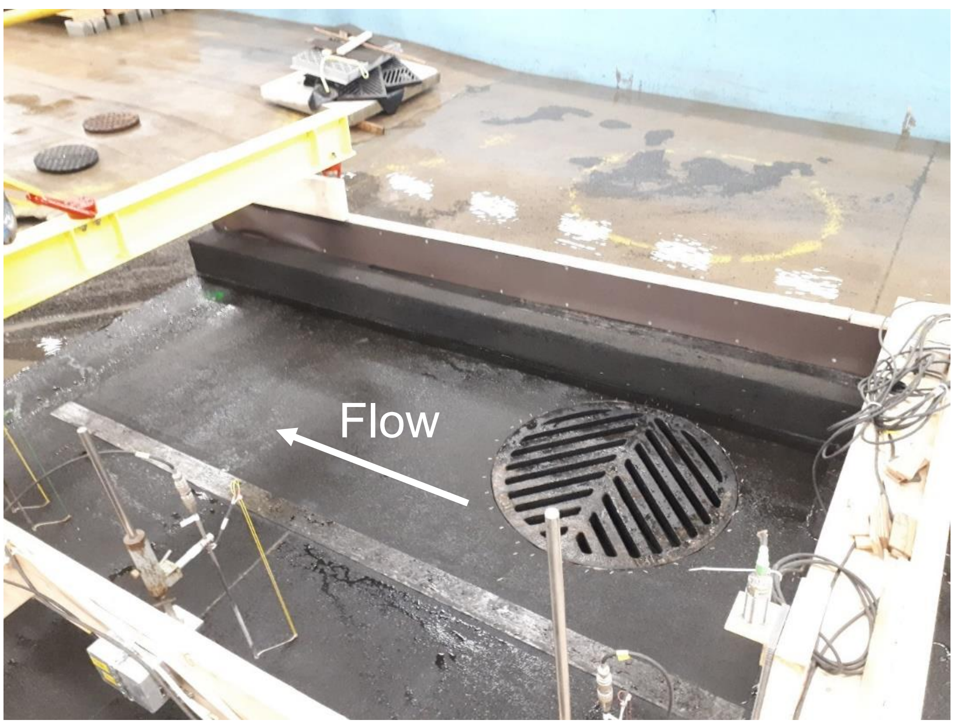

Figure 7. Single round grate with herringbone pattern per OPSD 400.070 (#1)

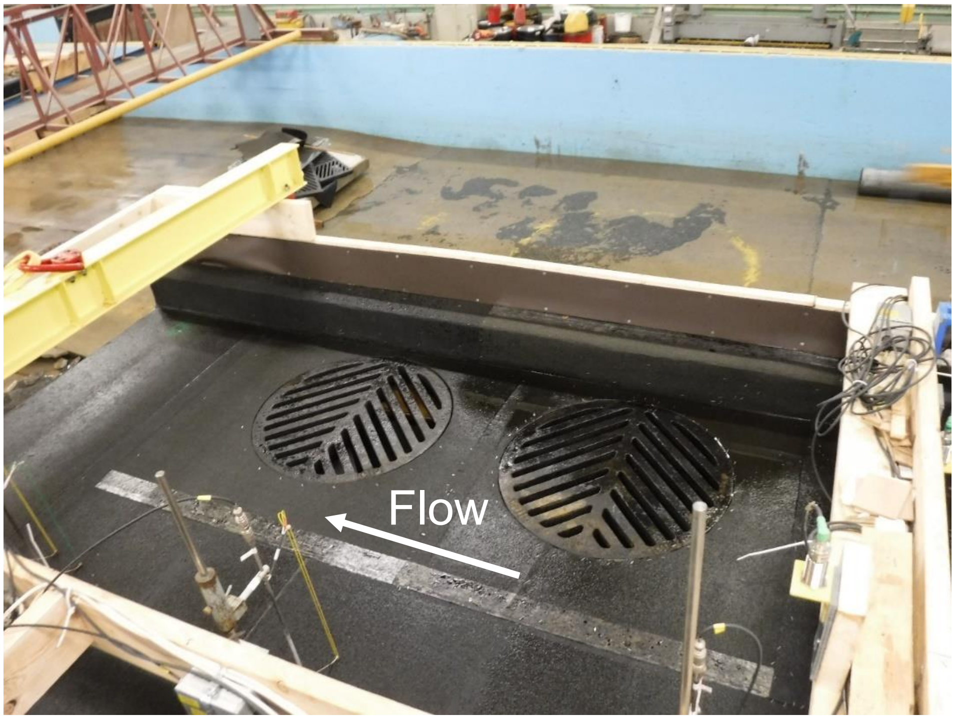

Figure 8. Double round grate with herringbone pattern per OPSD 400.070 (#2)

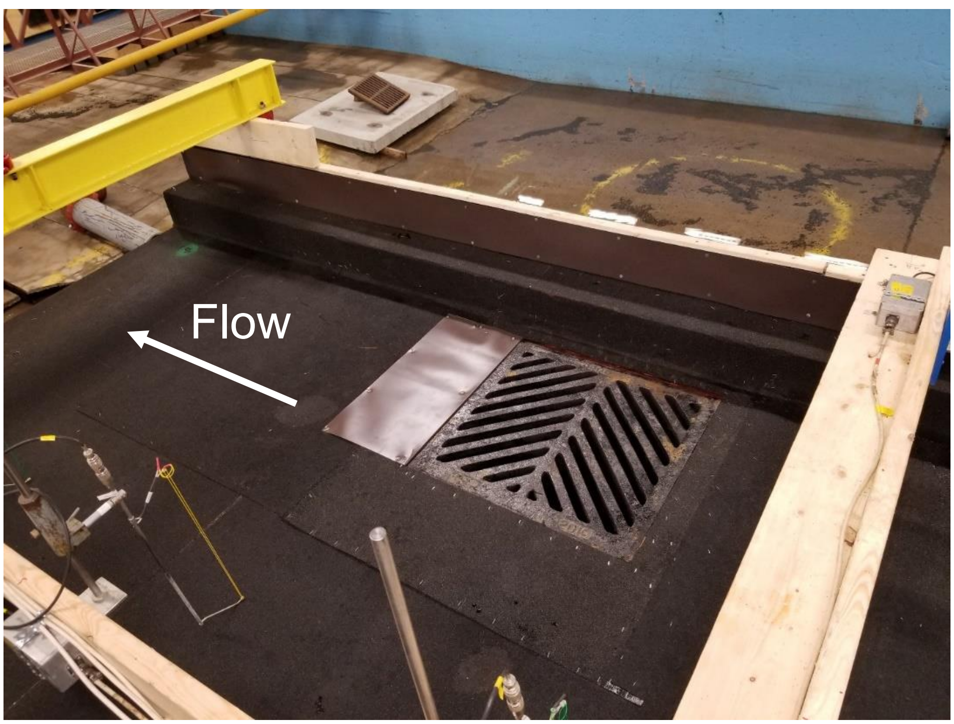

Figure 9. Single square grate with herringbone pattern per OPSD 400.020 (#3)

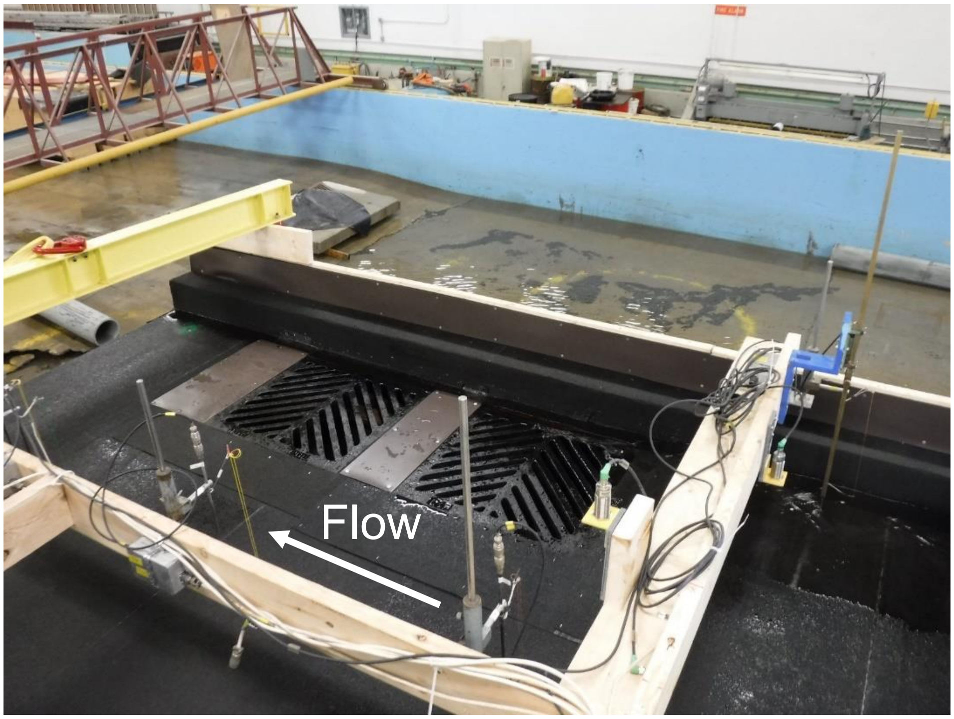

Figure 10. Double square grate with herringbone pattern per OPSD 400.020 (#4)

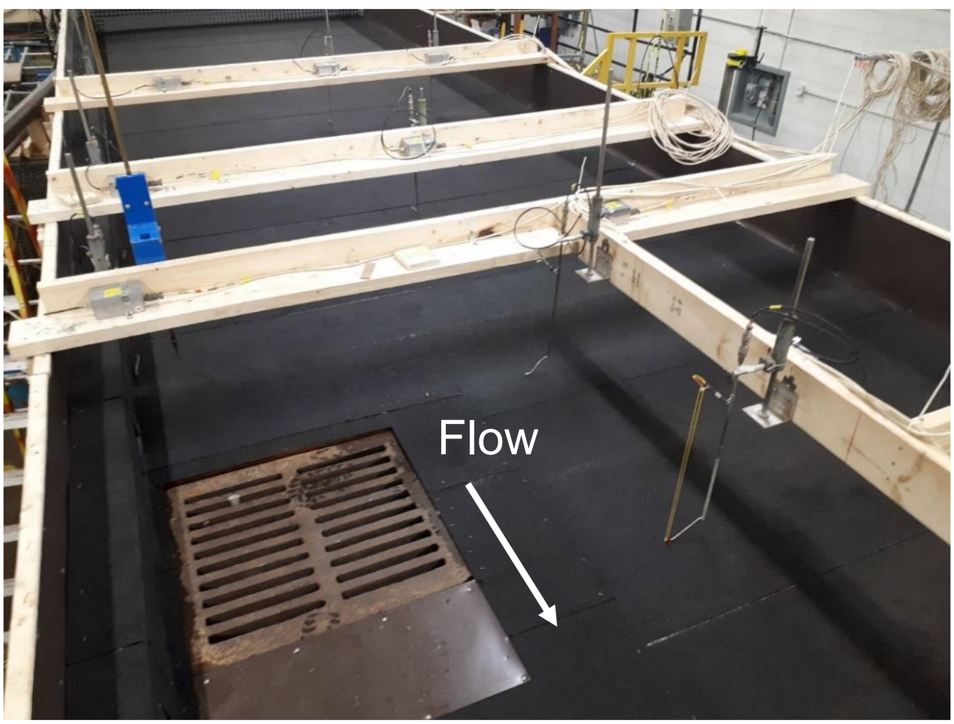

Figure 11. Square grate with horizontal bars per MT-310 (#5)

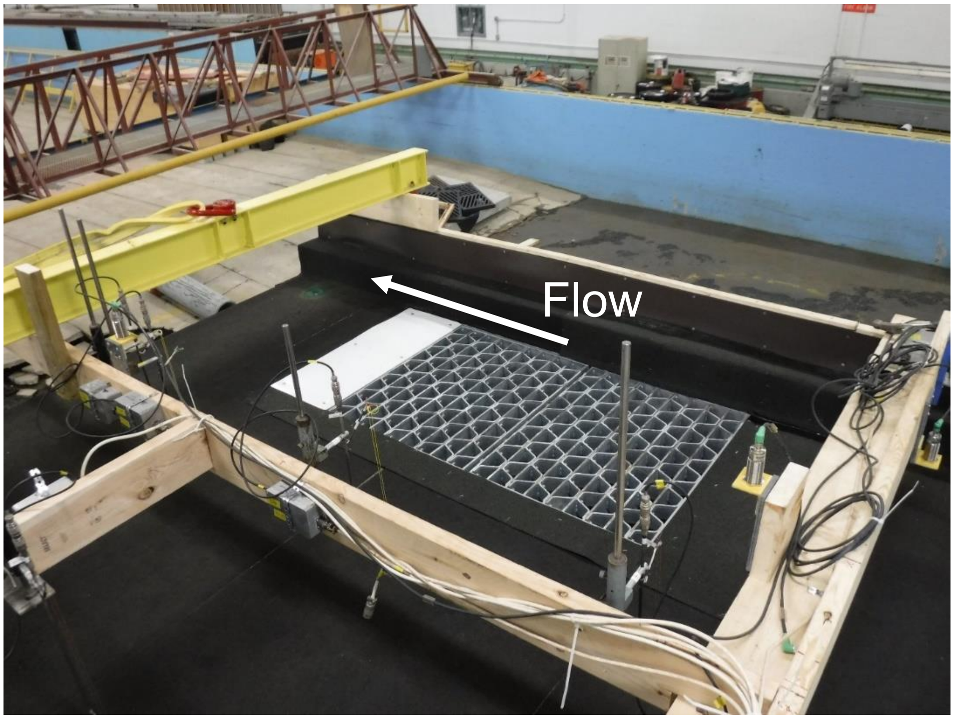

Figure 12. High inlet capacity catch basin per Stepcon 5103 (#6).

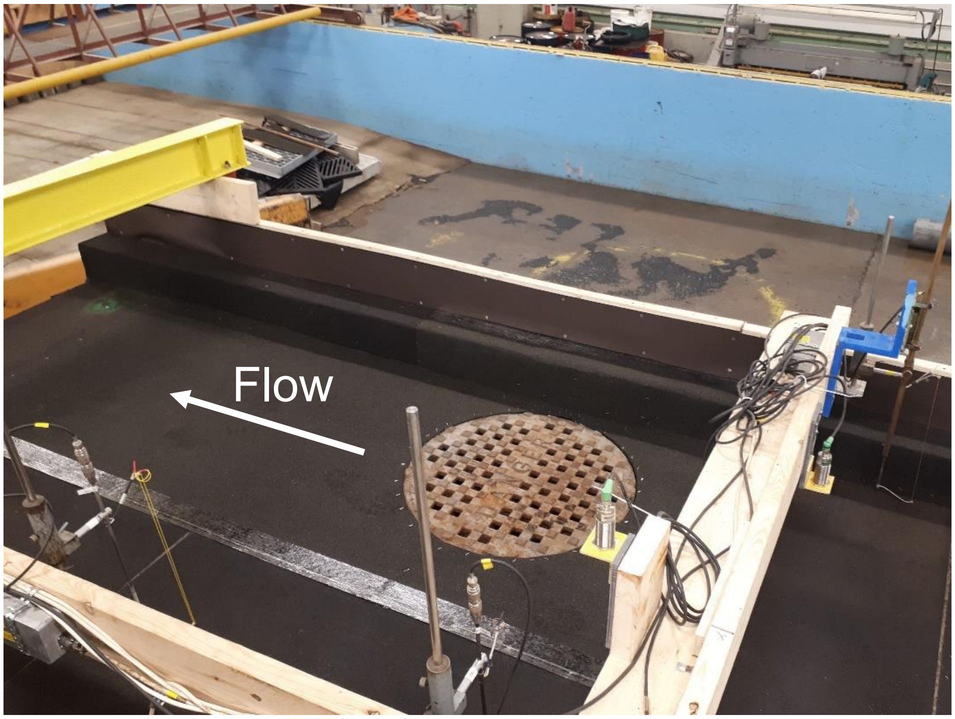

Figure 13. Circular open cover – Type B per OPSD 401.010 (#7)

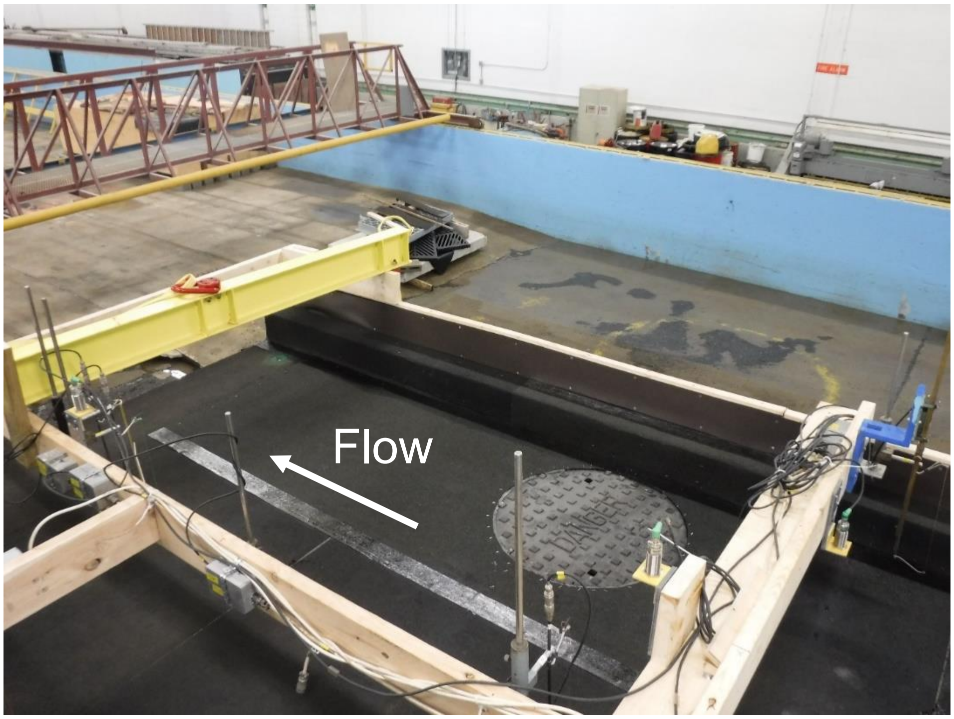

Figure 14. Circular closed cover – Type A per OPSD 401.010 (#8)

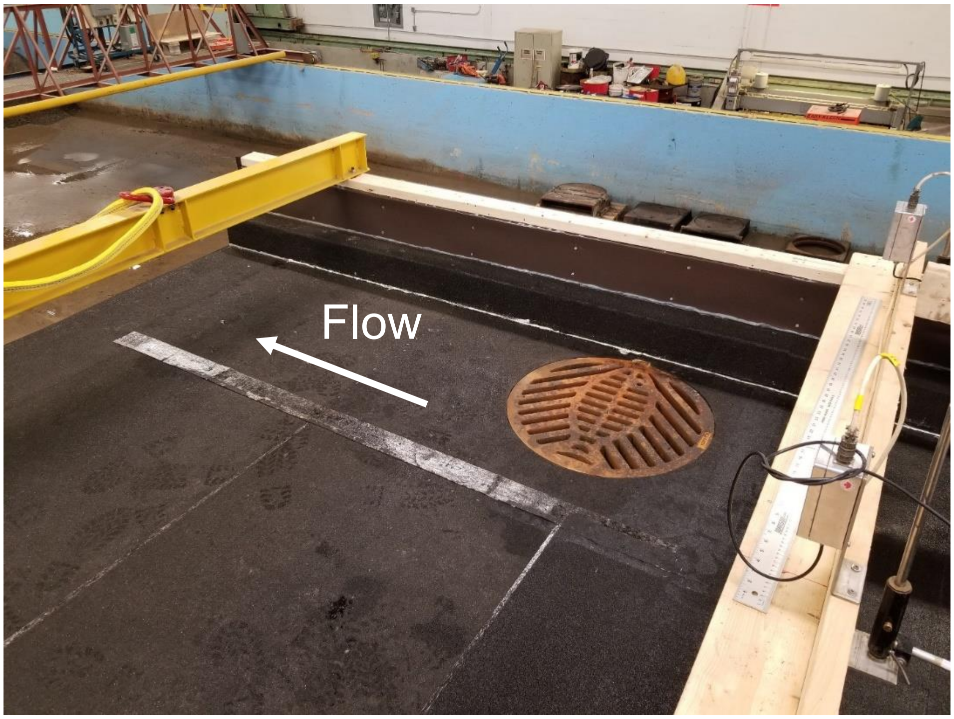

Figure 15. “FISH” type round catch basin cover per DWG. No. S19 (#9)

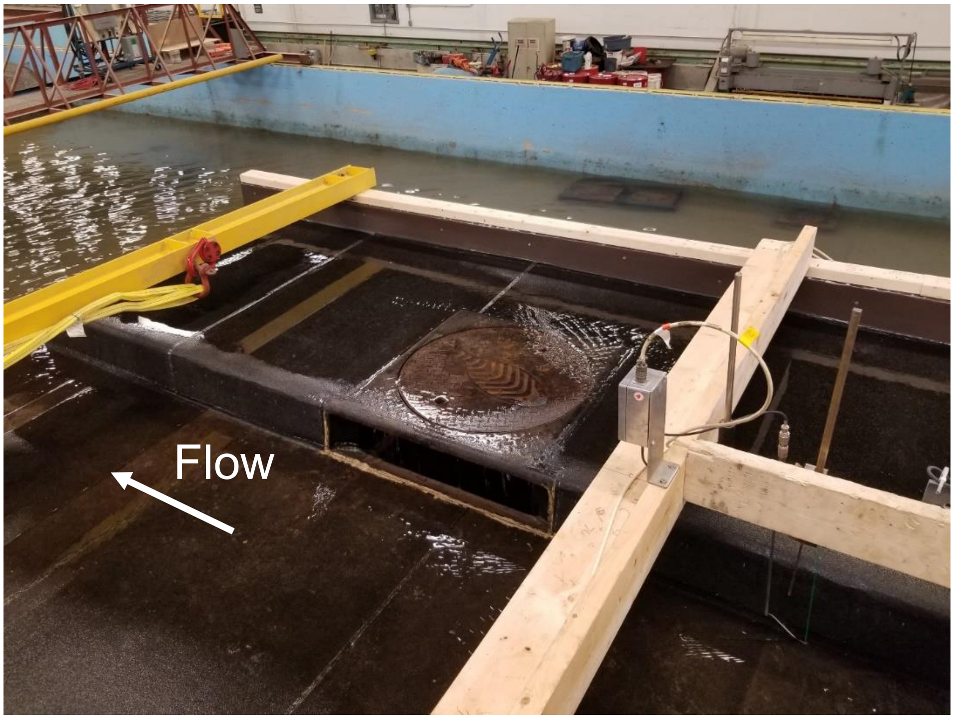

Figure 16. Curb inlet "FISH" type catch basin frame per DWG. No. S22 (#10)

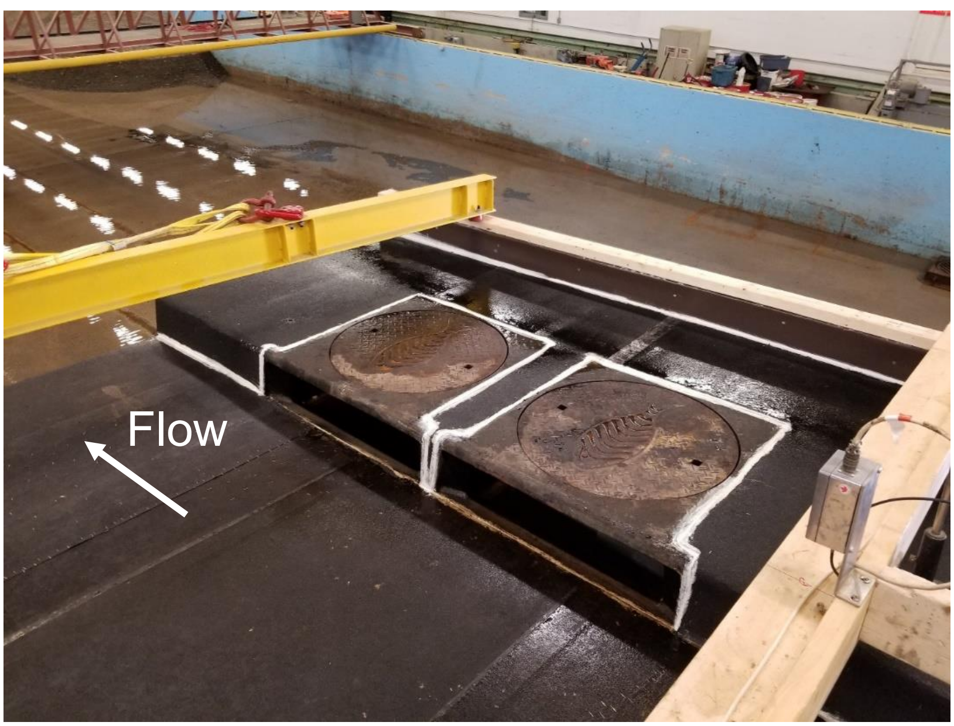

Figure 17. Double curb inlet "FISH" type catch basin frame per DWG. No. S22 (#11)

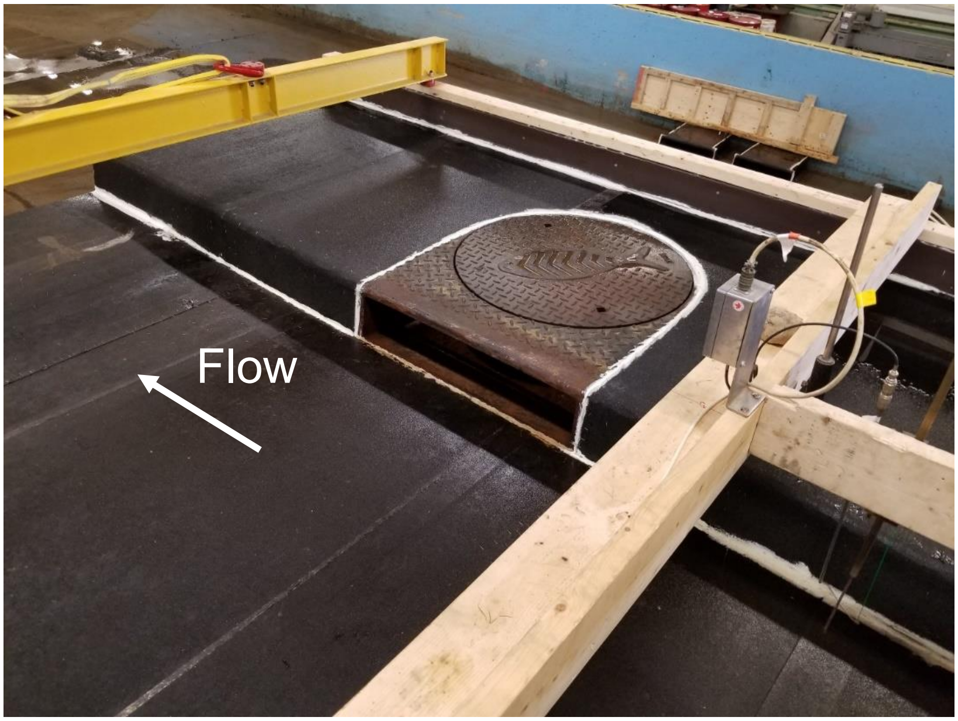

Figure 18. Curb inlet “FISH” type catch basin frame and cover for CBMH per DWG. No. S28 (#12)

Inlets #1 to #5 (Figure 7 - Figure 11) are representative of catch basin grates typically used throughout Canada. Inlet #9, shown in Figure 15, is a minor modification on inlet #1. Inlet #6, shown in Figure 12, is a high capacity inlet which is often used in ditches. It has a much larger open area than the other inlets. Inlets #7 in Figure 13 and #8 in Figure 14 are covers for maintenance holes (as opposed to catch basin grates) and are not designed to drain water from the roadway. They do have openings and can allow water into the sewer system during high flow events. Inlets #10 to #12 (Figure 16 - Figure 18) are curb inlet frames which form no obstacle on the side of the roadway and as such they are more bicycle friendly.

3. Test Parameters

A summary of the controlled test parameters (water flow, catch basin grate, road grade and cross-slope) is provided in Table 2. The head tank water flow was controlled by adjusting the pump settings. For each road configuration 13 flows from 0.001 – 0.41 m^3/s were sent onto the roadway. This allowed the water depth upstream of the catch basin to cover an appropriate range for the tests (~ 0.007 - 0.35 m). An example of the roadway flow under a high flow condition is shown in Figure 19.

Table 2. Summary of the test parameters.

Water Depth	Type of Catch Basin Grate	Road Grade	Cross Slope
At least 13 different incident water depths for each test series. Water depths vary with test parameters.	#1 - Round Frame Single Catch Basin	0.50%	0.00%
	#2 - Round Frame Double Catch Basin	1.00%	2.00%
	#3 - Herringbone Single Catch Basin	2.50%	4.00%
	#4 - Herringbone Double Catch Basin	5.00%	
	#5 - Horizontal Bars Single Catch Basin	7.50%	
	#6 - High Inlet Capacity Catch Basin	10.00%	
	#7 - Circular Open Cover (Type B)		
	#8 - Circular Closed Cover (Type A)		
	#9 - "FISH" Round Catch Basin Cover (S19)		
	#10 - Single Curb Inlet Frame (S22)		
	#11 - Double Curb Inlet Frame (S22x2)		
	#12 - Single Curb Inlet Frame for CBMH (S28)		

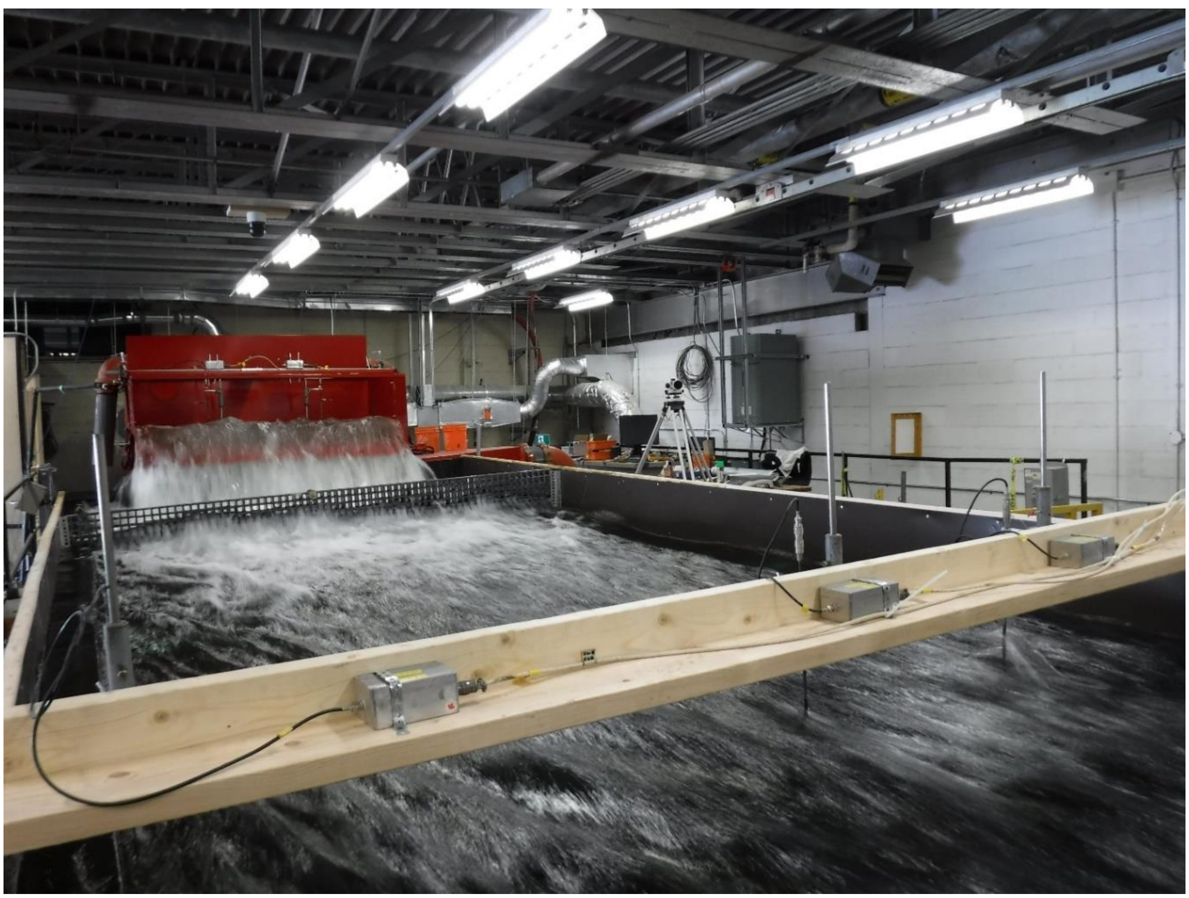

Figure 19. Water flowing from the head tank to the roadway during a high flow condition.

4. Example Catch Basin Rating Curve

This section will show one example of the calculation of a catch basin rating curve and the associated best fit curve parameters. In this report the experimental measurements of catch basin inlet flow versus incident water depth on the roadway are provided from Poirier and Provan (2021, 2023). The RD6 measurements are utilized as the water depth unless the water depth is too low for the sensor. In those cases the RD6 results are used with the acoustic sensor and the point gauge data to provide an appropriate confidence interval for the water depth measurement.

The calculation of the catch basin rating curve begins with the experimental measurements including uncertainties such as shown in Table 3. The measurements from Table 3 correspond to inlet #1, the round herringbone single catch basin at a 2.0% cross-slope and a 2.5% grade. Similar measurements for all of the tested catch basin inlets can be found in Appendix A and the data from Table 3 is specifically found in Table A.1. The data from Table 3 is also plotted in Figure 20.

Table 3. Sample of experimental measurements of incident water depth and catchment flow with uncertainties for inlet #1 (single round herringbone grate)

cross-slope (%)	2.0			
Grade (%)	2.5			
	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)
	0.017	0.0009	0.001	5.8E-06
	0.020	0.0021	0.001	1.3E-05
	0.023	0.0050	0.001	3.1E-05
	0.028	0.012	0.001	0.003
	0.034	0.019	0.001	0.004
	0.048	0.031	0.002	0.005
	0.058	0.038	0.003	0.005
	0.064	0.044	0.004	0.006
	0.068	0.047	0.005	0.006
	0.076	0.053	0.006	0.007
	0.086	0.059	0.006	0.007
	0.095	0.065	0.007	0.008
	0.103	0.069	0.008	0.008

No simple equation is capable of providing an appropriate fit to the data illustrated in Figure 20. As a result, two quadratic equations were chosen to fit to the data which intersect at their inflection point, approximately 0.03 m of incident water depth. Not every data set is fit to the same model. In fact the simplest model possible is used in each case. The various models used in this report include a single linear equation, a single quadratic equation, two linear equations, one linear and one quadratic equation as well as the pair of quadratic equations used in this example.

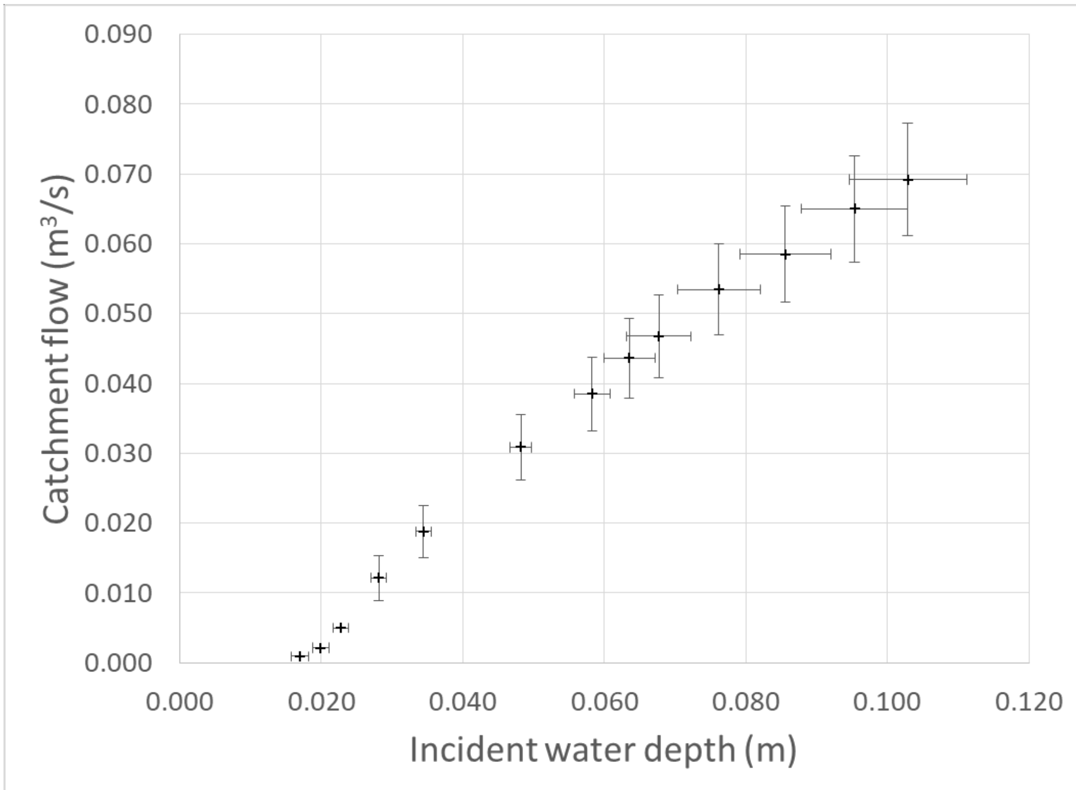

Figure 20. Example of experimental measurements with uncertainties for inlet #1 (single round herringbone grate) at a 2.0% cross-slope and 2.5% road grade.

In order to fit the model equation, $f(x)$ to the experimental data a weighted least squares method is used. r_i is the difference between the i^{th} measured inflow, y_i and the model value at the i^{th} measured incident water depth, x_i as shown in equation (1).

$$r_i = y_i - f(x_i) \tag{1}$$

The least squares equation to be minimized is shown in equation (2). For each of the i measurements the weighting factor W_{ii} is the inverse of the sum of the inflow measurement uncertainty σ_{y_i} and the product of the slope at i, m_i and the measurement uncertainty on the water depth, σ_{x_i} all squared.

$$S = \sum_{i}^{n} W_{ii} \cdot {r_i}^2 = \sum_{i}^{n} \frac{1}{\left(\sigma_{y_i} + m_i \sigma_{x_i}\right)^2} \cdot {r_i}^2 \tag{2}$$

For analyses where two functions are used, the data points on each side of the intersection of the two curves are generally used in each analysis. The sum in equation (2) is minimized using the GRG Nonlinear function in the excel solver add-in. Each function is minimized separately unless this leads to a result where the two functions do not intercept. In that case the intercept is forced and the sum from the two functions is solved concurrently to obtain all of the parameters for both functions. The best fit functions for the illustrated example are included in Table 4 along with all others for inlet #1.

In Table 4 we note that all of the examples for inlet #1 have a quadratic best fit function for incident water depths from the minimum to the intercept as described by equation (3).

$$f_1(x_i) = a_1{x_i}^2 + b_1x_i + c_1 \tag{3}$$

While seven road orientations have a quadratic best fit function from the intercept to the maximum incident water depth as described by equation (4) five others are described by the linear fit shown in equation (5).

$$f_2(x_i) = a_2{x_i}^2 + b_2x_i + c_2 \tag{4}$$

$$f_2(x_i) = a_2x_i + b_2 \tag{5}$$

Table 4: Best fit parameters for inlet #1, single round herringbone grate. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
a1	3.96E+01	3.77E+01	4.13E+01	6.75E+01	1.45E+01	1.34E+01	1.14E+01	1.09E+01	1.59E+01	2.02E+01	1.36E+02	1.86E+01
b1	-1.47E+00	-1.12E+00	-1.01E+00	-1.61E+00	-1.54E-01	-1.24E-01	-3.62E-01	-1.25E-01	-2.82E-01	-3.89E-01	-4.35E+00	-3.17E-01
c1	1.44E-02	9.11E-03	6.12E-03	1.03E-02	8.21E-04	6.93E-04	3.27E-03	-3.82E-04	1.24E-03	1.79E-03	3.55E-02	1.30E-03
a2	2.36E+00	7.39E-01	-2.97E+00	-3.16E+00	-5.77E+00	-8.39E+00	6.65E-01	5.93E-01	6.34E-01	6.75E-01	-1.72E+00	-2.28E+00
b2	4.65E-01	-9.73E-03	1.15E+00	1.06E+00	1.25E+00	1.48E+00	-1.99E-02	-6.02E-03	-4.86E-03	-9.05E-03	8.80E-01	9.20E-01
c2	-1.06E-02		-1.76E-02	-1.20E-02	-1.66E-02	-2.06E-02					-1.40E-02	-1.62E-02
depth (m)												
intercept	0.025	0.035	0.032	0.025	0.053	0.017	*0.045*	0.056	0.050	0.039	0.020	0.024
min	0.018	0.016	0.017	0.013	0.011	0.009	0.022	0.018	0.016	0.016	0.015	0.015
max	0.123	0.116	0.103	0.091	0.082	0.079	0.152	0.144	0.129	0.119	0.112	0.105

In Figure 21 the best fit data resulting from the illustrated example is overlaid onto the measurement data for inlet #1 at a cross-slope of 2.0% and a road grade of 2.5%. The orange triangles range from the minimum measured water depth to one measurement beyond the intercept and the grey points range from one point below the intercept to the maximum incident water depth. This highlights the data used to produce the two best fit curves. The data tables in Appendix B and the figures in Section 5 include the minimum, maximum, intercept and regular points in between. A point at zero depth and zero flow was also included as a reasonable assumption however the roughness of the roadway and the height of installation of the inlet could impact that value.

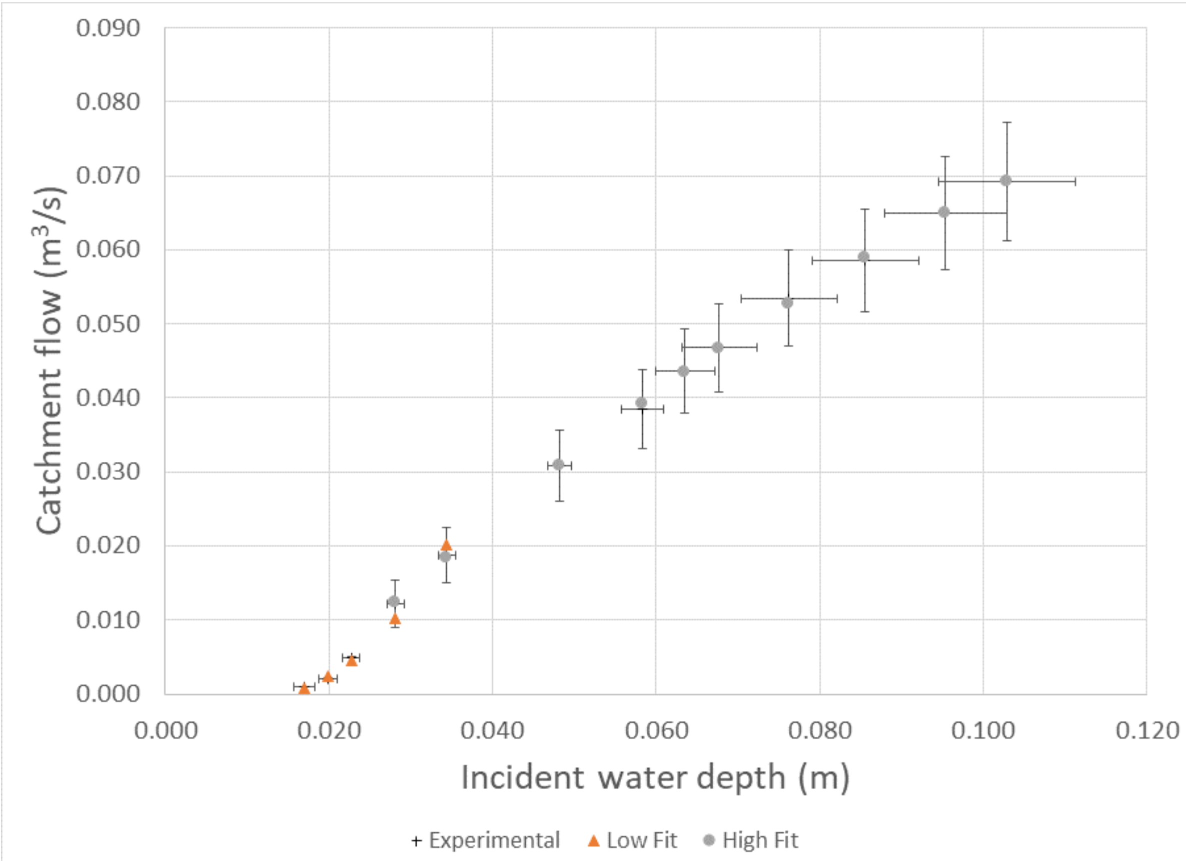

Figure 21. Example of best fit data overlaid onto experimental measurements for inlet #1 (single round herringbone grate) at a 2.0% cross-slope and 2.5% road grade. Experimental measurements with error bars are shown as crosses, orange triangles indicate the fit from minimum to the intercept and the grey points indicate the fit from intercept to the maximum.

5. Results

This section includes the best fit function parameters for all twelve of the different catch basin inlets tested for each of the various road orientations examined during the tests performed in the National Research Council's Coastal Wave Basin.

5.1. Catch Basin Inlet #1 – Single Round Herringbone

The best fit function parameters corresponding to the single round grate with herringbone pattern, inlet #1 can be found in Table 4. The one instance where the intercept value is underlined and italicized indicates that the original best fit curves for the two best fit functions resulted in no intercept and the intercept of the incident water depth values had to be forced when solving the weighted least squares equation. The best fit parameters for inlet #1 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 22.

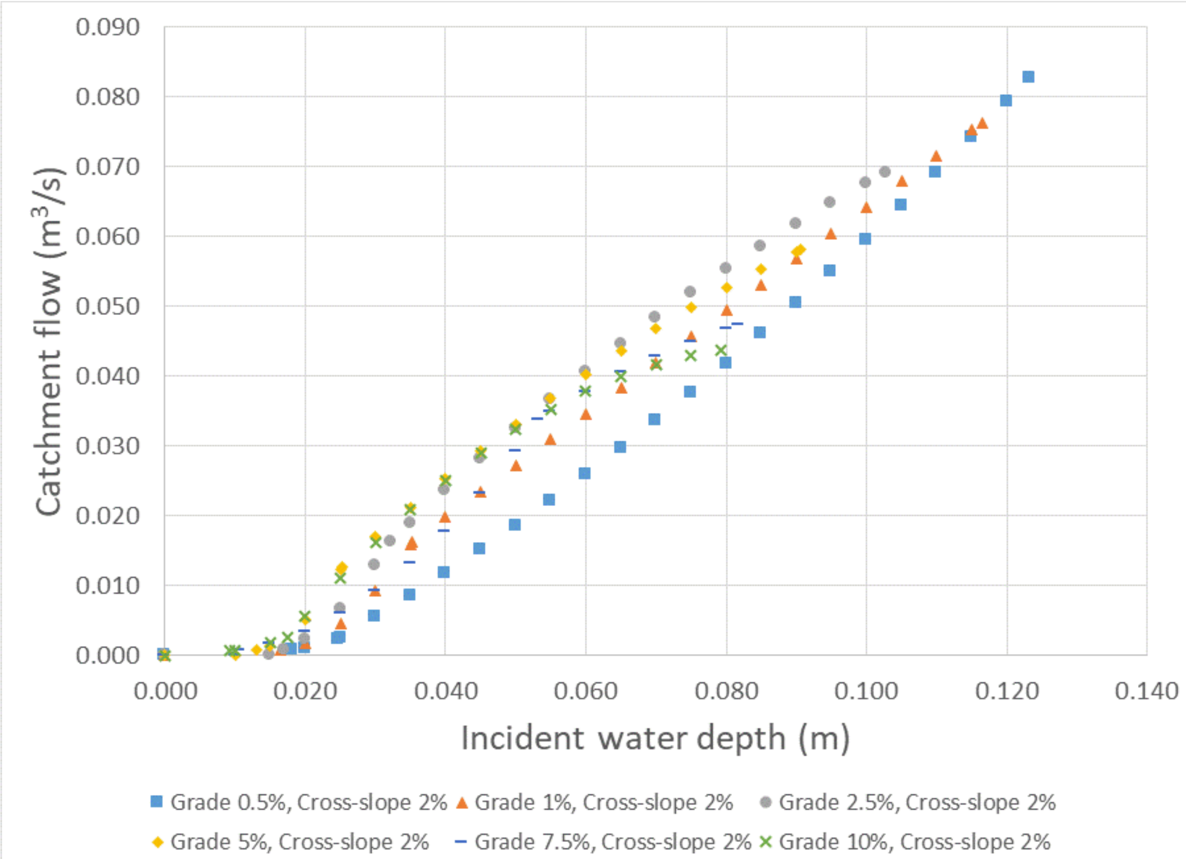

Figure 22. Best fit curves of inlet flow 2.0% cross-slope, single round herringbone grate (#1) – OPSD 400.070

The Table 4 best fit parameters for inlet #1, single round grate with herringbone pattern at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 23. The calculated best fit catchment flow values illustrated in Figure 22 and Figure 23 were included in Appendix B (Table B.1).

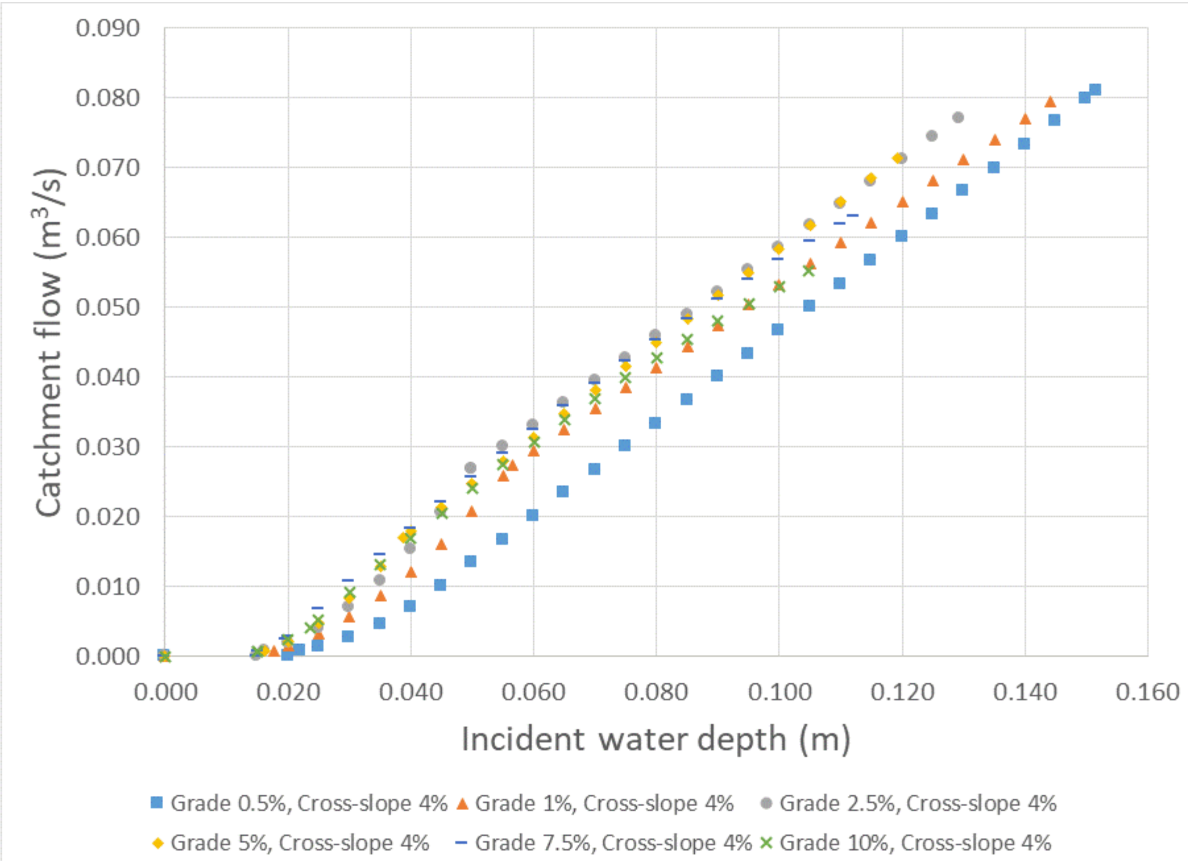

Figure 23. Best fit curves of inlet flow 4.0% cross-slope, single round herringbone grate (#1) – OPSD 400.070

5.2. Catch Basin Inlet #2 – Double Round Herringbone

The best fit function parameters corresponding to the double round grate with herringbone pattern, inlet #2 can be found in Table 5. Instances where the intercept value is underlined and italicized indicate that the original best fit curves for the two best fit functions resulted in no intercept and the intercept of the incident water depth values had to be forced in solving the weighted least squares equation. The best fit parameters for inlet #2 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 24.

Table 5: Best fit parameters for inlet #2, double round herringbone grate. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
a1	1.04E+01	3.02E+01	1.50E+01	4.63E+01	3.24E+01	4.83E+01	1.24E+01	1.15E+01	3.25E+01	7.90E+00	1.47E+01	2.16E+01
b1	-1.55E-01	-5.83E-01	4.78E-02	-1.07E+00	-5.52E-01	-1.06E+00	-4.37E-01	3.02E-03	-1.19E+00	3.69E-01	6.59E-02	-1.35E-01
c1	2.91E-04	2.91E-03	-2.44E-03	6.95E-03	3.03E-03	6.49E-03	4.62E-03	-3.11E-03	1.15E-02	-8.01E-03	-4.68E-03	-2.35E-04
a2	-1.78E+01	1.25E+00	-1.08E+01	-3.14E-01	-1.07E+01	-1.03E+01	1.33E+00	5.89E+00	1.30E+00	1.67E+00	1.58E+00	1.57E+00
b2	5.29E+00	-2.48E-02	3.03E+00	1.73E+00	2.87E+00	2.73E+00	-5.72E-02	3.16E-01	-3.24E-02	-5.77E-02	-4.39E-02	-3.33E-02
c2	-2.56E-01		-8.84E-02	-3.51E-02	-6.48E-02	-5.48E-02		1.03E-03				
depth (m)												
intercept	0.082	*0.030*	*0.058*	*0.030*	*0.040*	*0.032*	0.061	0.067	0.028	0.061	*0.052*	0.034
min	0.017	0.015	0.012	0.011	0.011	0.010	0.021	0.018	0.016	0.017	0.017	0.010
max	0.125	0.117	0.102	0.089	0.081	0.078	0.153	0.143	0.131	0.119	0.110	0.091

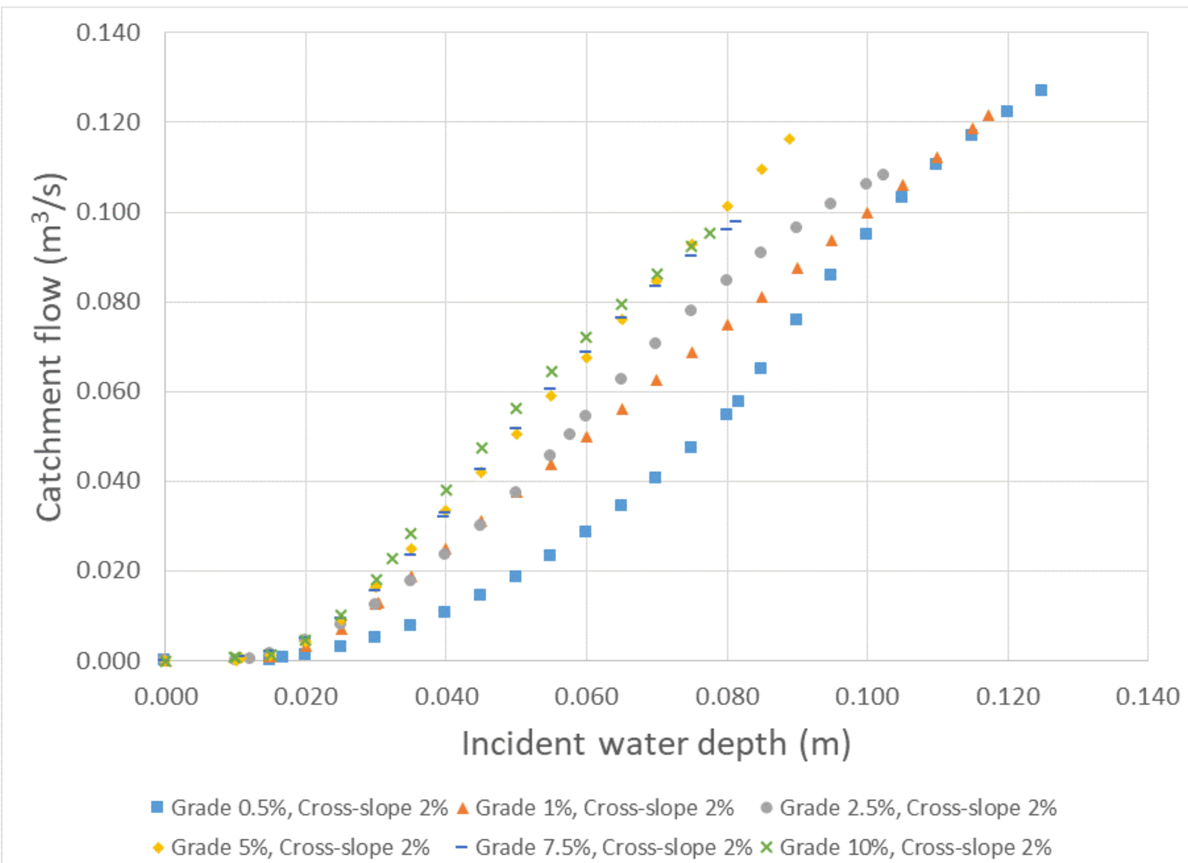

Figure 24. Best fit curves of inlet flow 2.0% cross-slope, double round herringbone grate (#2) – OPSD 400.070

The Table 5 best fit parameters for inlet #2, double round grate with herringbone pattern at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 25. The calculated best fit catchment flow values illustrated in Figure 24 and Figure 25 were included in Appendix B (Table B.2).

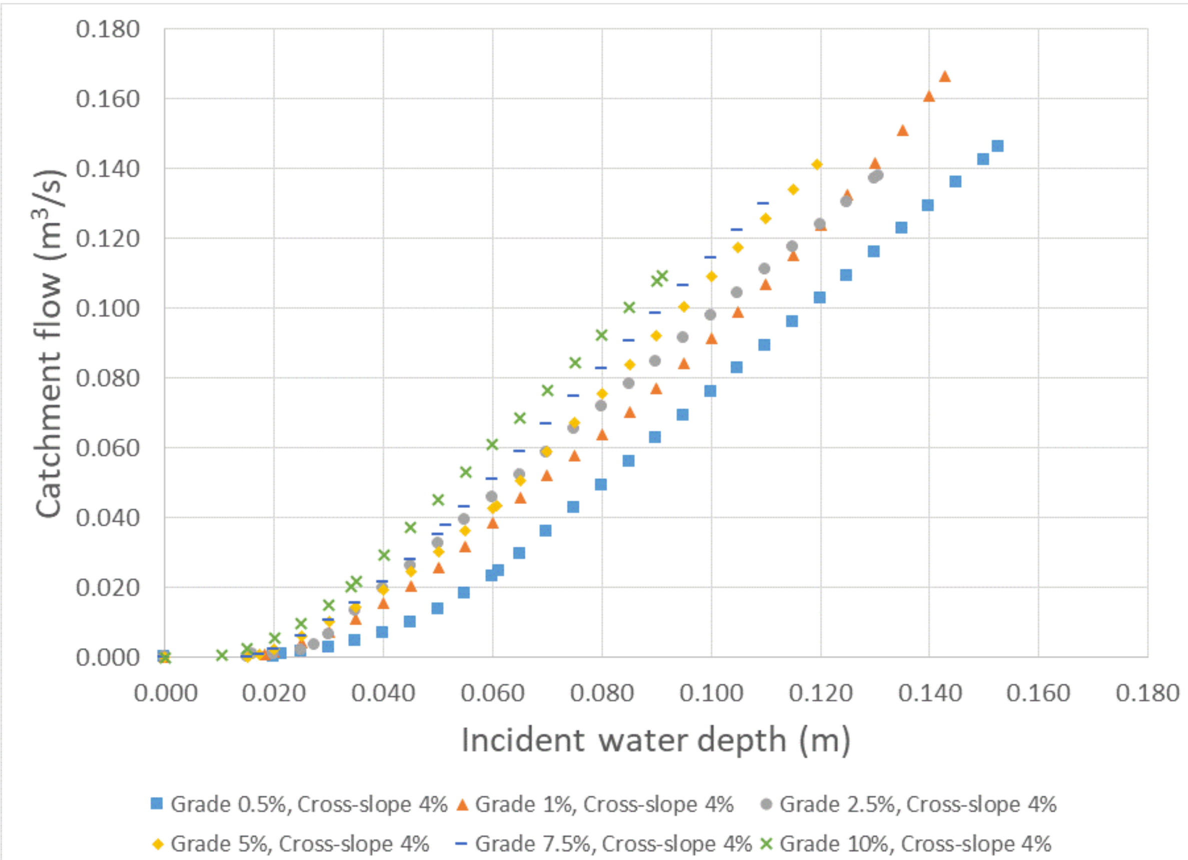

Figure 25. Best fit curves of inlet flow 4.0% cross-slope, double round herringbone grate (#2) – OPSD 400.070

5.3. Catch Basin Inlet #3 – Single Square Herringbone

The best fit function parameters corresponding to the single square grate with herringbone pattern, inlet #3 can be found in Table 6. The one instance where the intercept value is underlined and italicized indicates that the original best fit curves for the two best fit functions resulted in no intercept and the intercept of the incident water depth values had to be forced when solving the weighted least squares equation. The best fit parameters for inlet #3 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 26.

Table 6: Best fit parameters for inlet #3, single square herringbone grate. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
a1	1.19E+01	7.39E+00	1.71E+01	5.36E+01	3.67E-01	2.97E-01	1.08E+01	1.28E+01	2.85E+01	3.66E+01	2.02E+01	1.89E+01
b1	-2.75E-01	1.15E-01	-1.28E-02	-1.09E+00	-2.43E-03	-1.41E-03	-2.95E-01	-1.92E-01	-6.84E-01	-8.74E-01	-4.04E-01	-3.73E-01
c1	1.35E-03	-2.81E-03	-1.79E-03	6.39E-03			2.17E-03	5.56E-04	4.91E-03	6.18E-03	2.78E-03	3.03E-03
a2	8.49E-01	-3.75E+00	-4.05E+00	-5.86E+00	-8.43E+00	-8.12E+00	-7.12E-01	-2.39E+00	7.07E-01	-2.46E+00	-4.02E+00	-5.09E+00
b2	-2.50E-02	1.36E+00	1.32E+00	1.50E+00	1.75E+00	1.74E+00	8.63E-01	1.11E+00	-4.48E-03	1.12E+00	1.37E+00	1.54E+00
c2		-3.25E-02	-2.13E-02	-2.18E-02	-2.74E-02	-2.79E-02	-2.69E-02	-2.60E-02		-1.88E-02	-2.98E-02	-3.52E-02
depth (m)												
intercept	0.043	0.035	0.023	0.021	0.021	0.021	0.047	0.034	0.041	0.022	*0.037*	0.038
min	0.021	0.016	0.013	0.010	0.009	0.008	0.022	0.016	0.012	0.011	0.010	0.011
max	0.122	0.112	0.098	0.092	0.080	0.078	0.148	0.140	0.123	0.113	0.107	0.100

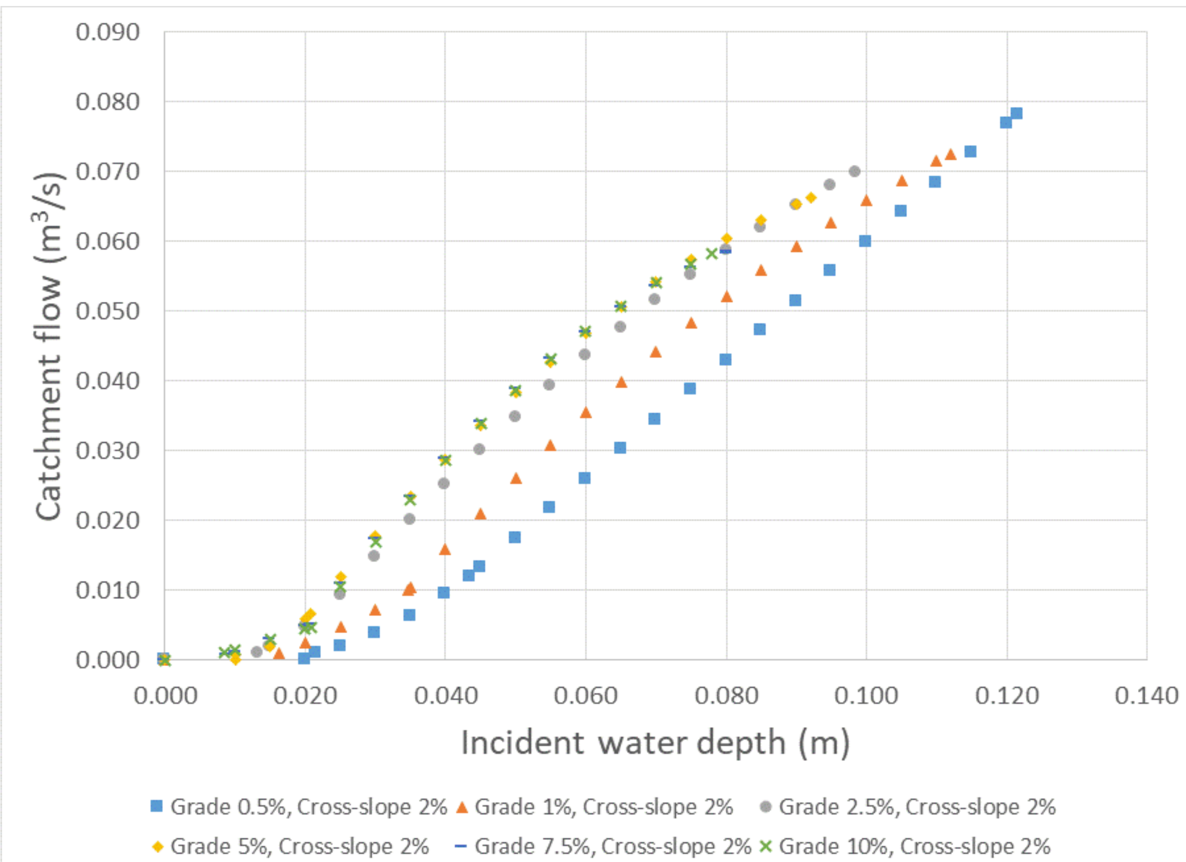

Figure 26. Best fit curves of inlet flow 2.0% cross-slope, single square herringbone grate (#3) – OPSD 400.020

The Table 6 best fit parameters for inlet #3, single square grate with herringbone pattern at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 27. The calculated best fit catchment flow values illustrated in Figure 26 and Figure 27 were included in Appendix B (Table B.3).

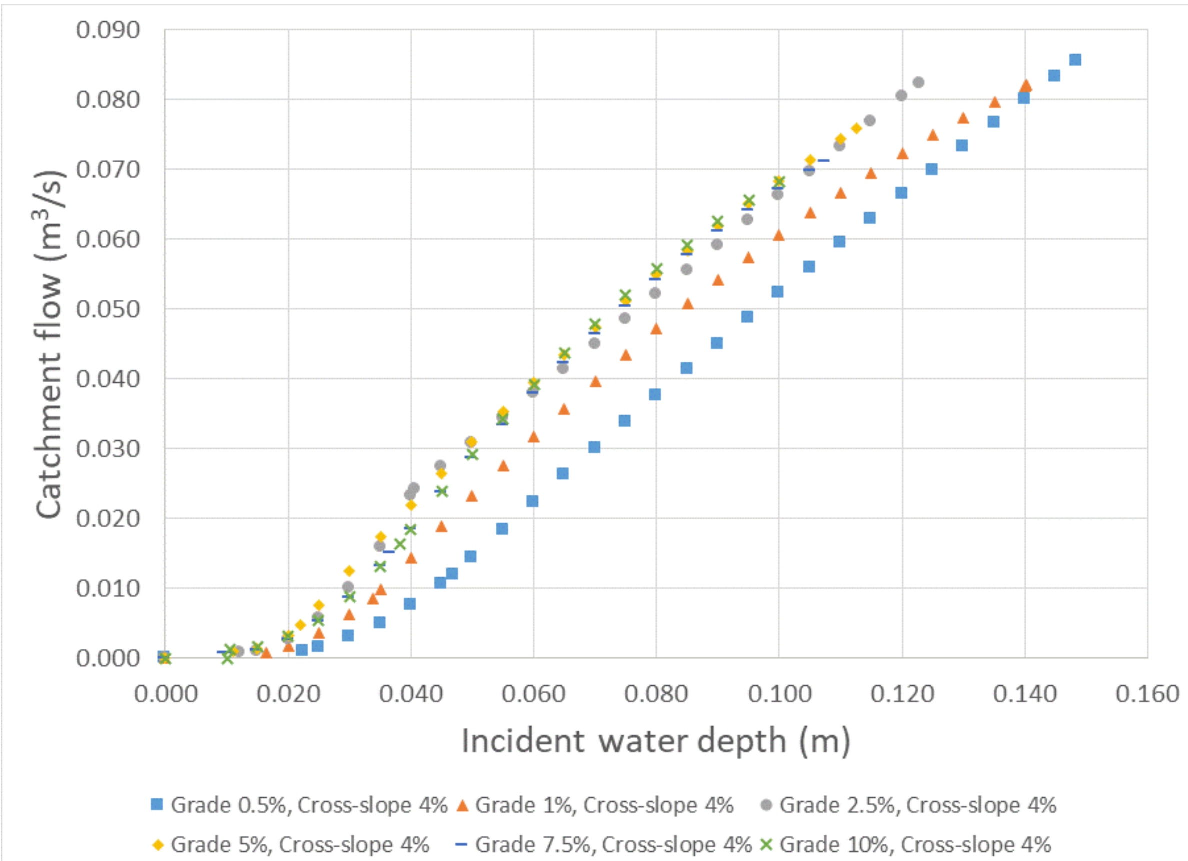

Figure 27. Best fit curves of inlet flow 4.0% cross-slope, single square herringbone grate (#3) – OPSD 400.020

5.4. Catch Basin Inlet #4 – Double Square Herringbone

The best fit function parameters corresponding to the double square grate with herringbone pattern, inlet #4 can be found in Table 7. Instances where the intercept values are underlined and italicized indicate that the original best fit curves for the two best fit functions resulted in no intercept and the intercept of the incident water depth values had to be forced when solving the weighted least squares equation. The best fit parameters for inlet #4 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 28.

Table 7: Best fit parameters for inlet #4, double square herringbone grate. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
a1	1.51E+01	1.46E+01	5.83E+01	2.61E+01	3.30E+01	3.83E+01	9.40E+00	1.40E+01	2.69E+01	1.29E+01	1.79E+01	2.30E+01
b1	-2.08E-01	7.60E-02	-1.15E+00	2.95E-02	-2.63E-01	-5.13E-01	-1.24E-01	-1.66E-01	-5.10E-01	1.77E-01	-5.71E-02	-3.52E-01
c1	3.19E-04	-2.40E-03	6.37E-03	-2.19E-03	2.42E-04	2.65E-03	-2.43E-04	-1.66E-05	2.44E-03	-3.65E-03	-1.81E-03	1.55E-03
a2	1.10E+01	1.34E+00	1.41E+00	1.78E+00	-1.73E+01	-1.22E+01	1.77E+00	1.47E+00	1.44E+00	-2.40E+01	-1.24E+01	-1.65E+01
b2	-1.97E-01	-2.95E-02	-2.14E-02	-3.03E-02	3.56E+00	2.87E+00	-9.24E-02	-4.70E-02	-3.27E-02	6.24E+00	3.56E+00	3.97E+00
c2	6.08E-03				-7.25E-02	-5.18E-02				-2.44E-01	-1.08E-01	-1.17E-01
depth (m)												
intercept	0.039	*0.043*	0.025	0.040	*0.038*	0.027	0.082	0.051	*0.036*	0.066	0.067	*0.055*
min	0.015	0.012	0.010	0.010	0.009	0.009	0.018	0.017	0.016	0.013	0.013	0.012
max	0.123	0.112	0.096	0.086	0.078	0.074	0.144	0.141	0.125	0.112	0.105	0.098

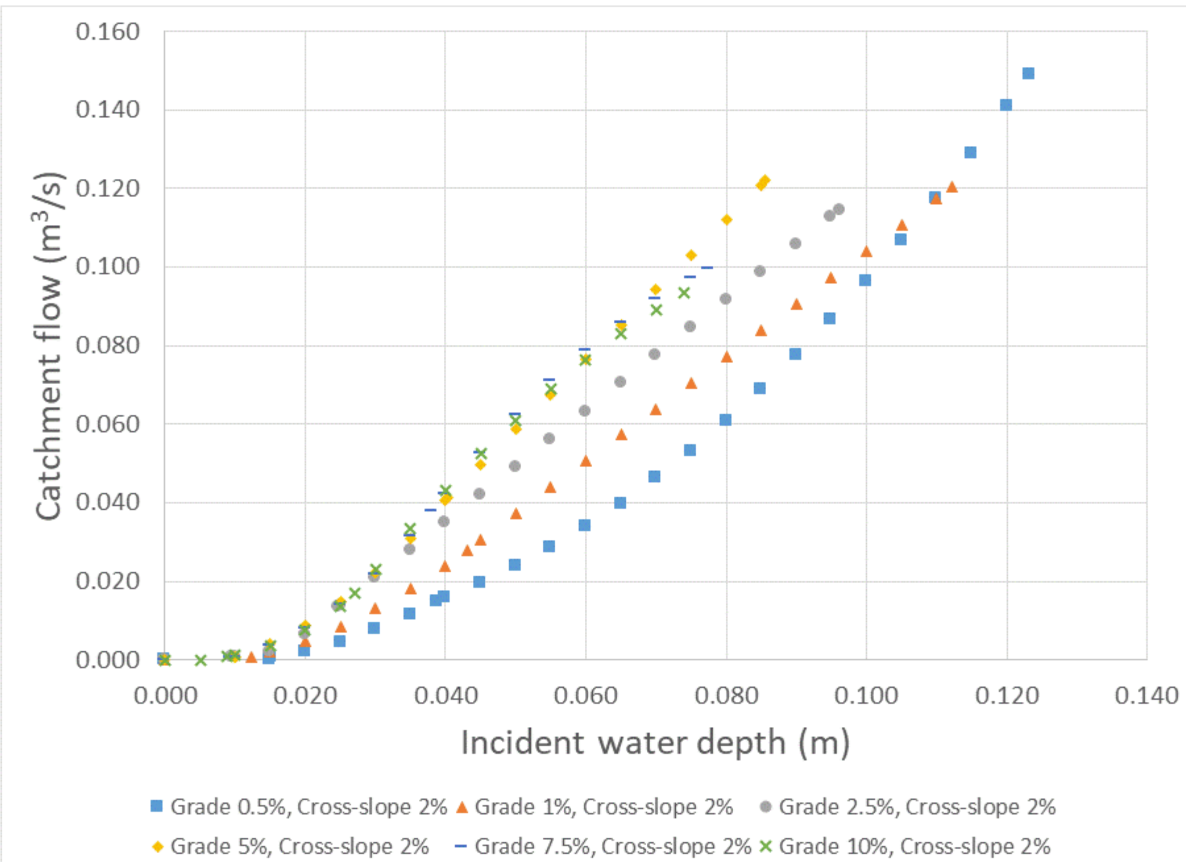

Figure 28. Best fit curves of inlet flow 2.0% cross-slope, double square herringbone grate (#4) – OPSD 400.020

The best fit parameters for inlet #4, double square grate with herringbone pattern at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 29. The calculated best fit catchment flow values illustrated in Figure 28 and Figure 29 were included in Appendix B (Table B.4).

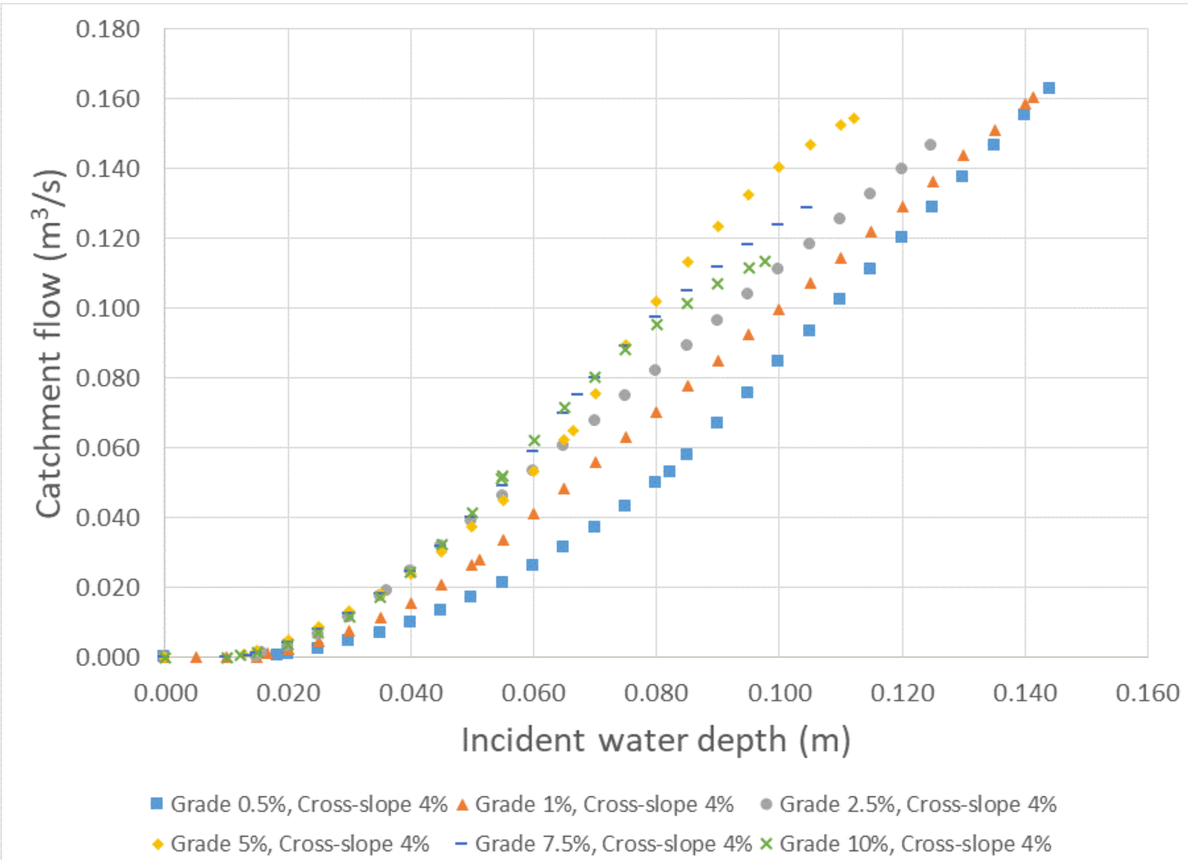

Figure 29. Best fit curves of inlet flow 4.0% cross-slope, double square herringbone grate (#4) – OPSD 400.020

5.5. Catch Basin Inlet #5 – Single Square with Horizontal Bars

The best fit function parameters corresponding to the single square grate with horizontal bars, inlet #5 can be found in Table 8. The best fit parameters for inlet #5 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 30.

Table 8: Best fit parameters for inlet #5, single square grate with horizontal bars. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
a1	3.51E+00	1.45E+01	1.01E+02	2.67E+01	-4.34E+00	8.27E-01	8.36E+00	1.43E+01	9.32E+01	5.92E-01	5.38E+00	6.75E-01
b1	2.33E-01	-1.42E-01	-2.82E+00	-3.04E-01	1.27E+00	-1.02E-02	-2.23E-01	-3.90E-01	-3.52E+00	-7.59E-03	2.07E-01	-9.97E-03
c1	-5.59E-03	-7.91E-04	2.08E-02	6.91E-04	-1.75E-02		1.62E-03	2.75E-03	3.40E-02		-2.77E-03	
a2		-3.93E+00	-5.23E+00	-6.55E+00		-1.20E+01	6.90E-01	-7.46E-01	7.14E-01	-1.86E+00	-4.25E+00	-6.06E+00
b2		1.39E+00	1.43E+00	1.54E+00		2.13E+00	-2.33E-02	8.27E-01	-1.09E-02	9.69E-01	1.33E+00	1.57E+00
c2		-3.24E-02	-2.07E-02	-2.31E-02		-4.08E-02		-2.13E-02		-1.62E-02	-2.95E-02	-3.73E-02
depth (m)												
intercept		0.037	0.023	0.035		0.034	0.051	0.034	0.029	0.026	0.033	0.043
min	0.020	0.017	0.014	0.011	0.015	0.013	0.012	0.014	0.018	0.015	0.014	0.016
max	0.123	0.112	0.099	0.091	0.083	0.079	0.154	0.140	0.124	0.114	0.109	0.102

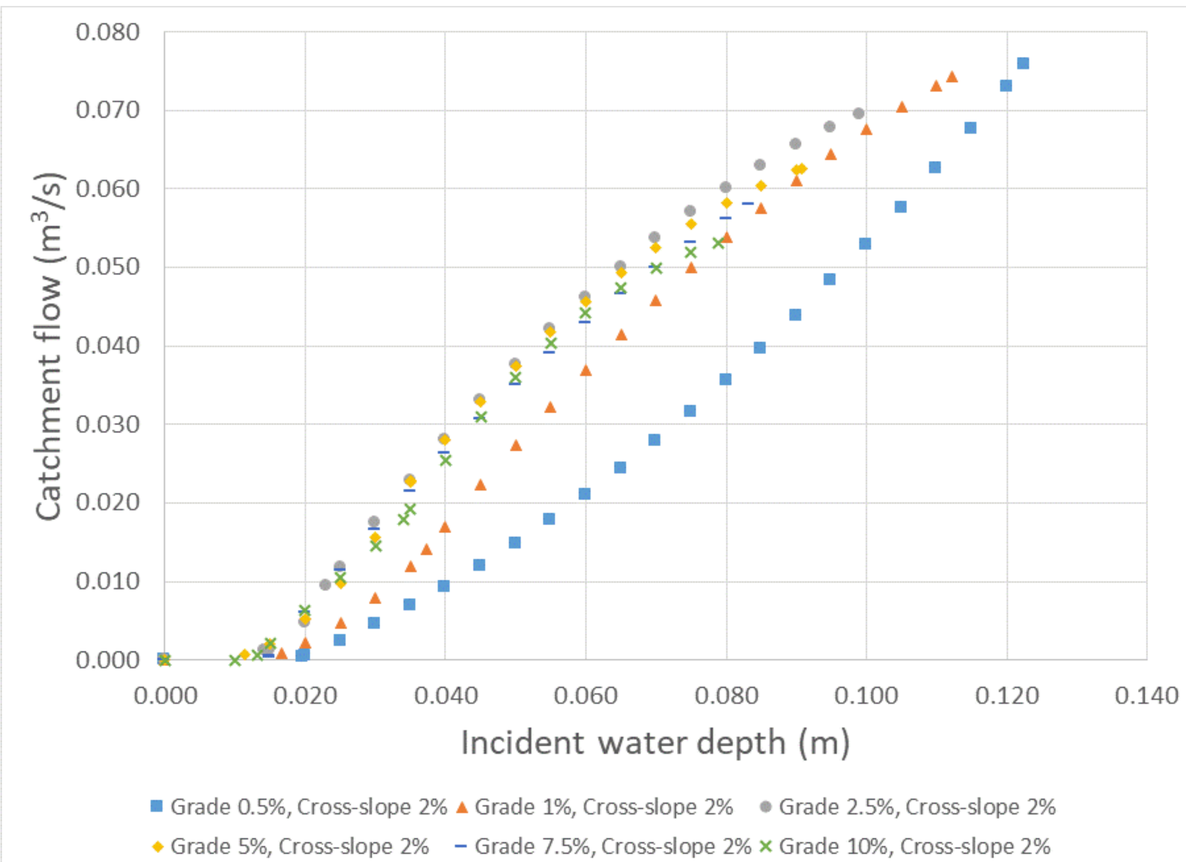

Figure 30. Best fit curves of inlet flow 2.0% cross-slope, single square grate with horizontal bars (#5) – MT-310

The best fit parameters for inlet #5, single square grate with horizontal bars at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 31. The calculated best fit catchment flow values illustrated in Figure 30 and Figure 31 were included in Appendix B (Table B.5).

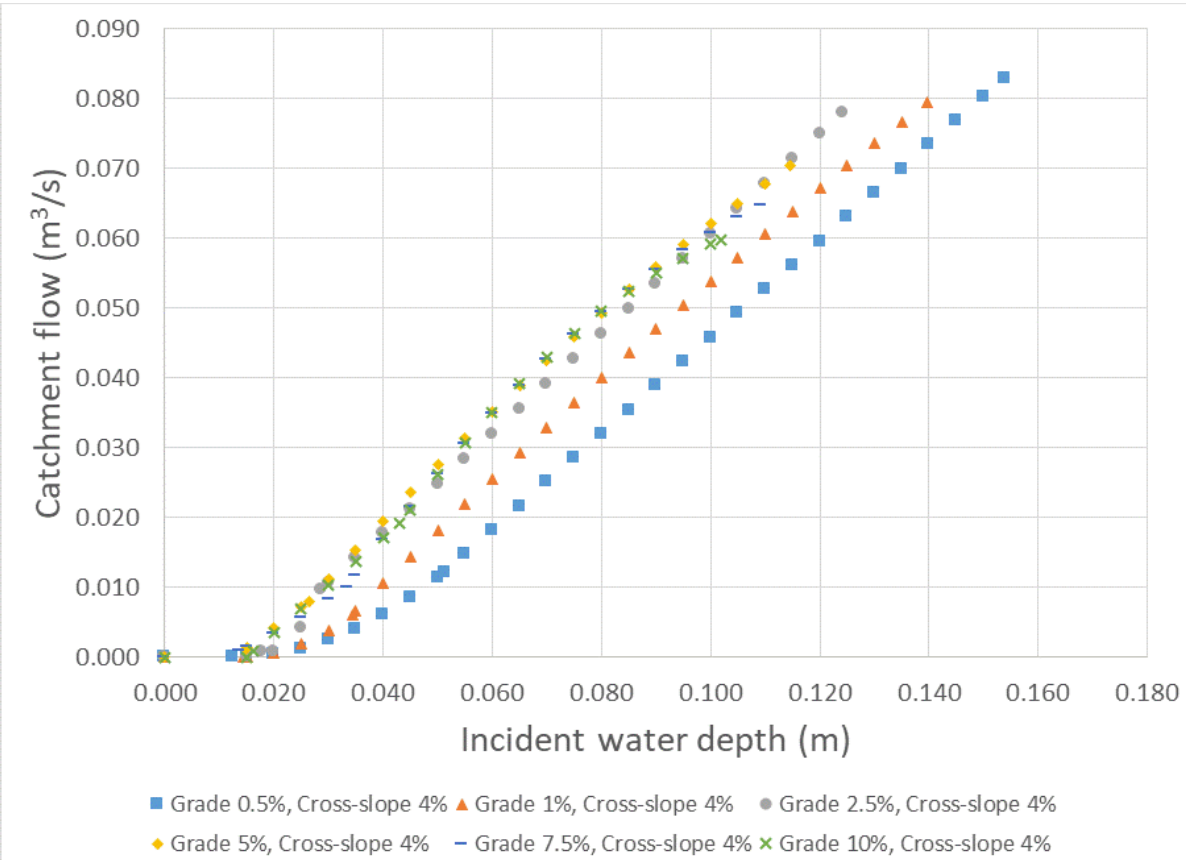

Figure 31. Best fit curves of inlet flow 4.0% cross-slope, single square grate with horizontal bars (#5) – MT-310

5.6. Catch Basin Inlet #6 – High Capacity Inlet

The best fit function parameters corresponding to the high capacity inlet, inlet #6 can be found in Table 9. Instances where the intercept values are underlined and italicized indicate that the original best fit curves for the two best fit functions resulted in no intercept and the intercept of the incident water depth values had to be forced when solving the weighted least squares equation. The best fit parameters for inlet #6 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 32.

Table 9: Best fit parameters for inlet #6, high capacity inlet. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
a1	1.09E+01	1.46E+01	1.87E+01	3.96E+01	4.80E+01	3.29E+01	1.22E+01	1.19E+01	1.61E+01	1.56E+01	2.65E+01	2.44E+01
b1	1.55E-02	1.21E-01	2.41E-01	-6.52E-01	-8.85E-01	-3.95E-01	-3.71E-01	5.67E-02	-1.68E-02	1.91E-01	-4.53E-01	-4.04E-01
c1	-2.62E-03	-4.21E-03	-6.63E-03	3.24E-03	5.37E-03	2.15E-03	3.51E-03	-4.68E-03	-3.27E-03	-6.01E-03	2.19E-03	1.51E-03
a2	2.76E+00			3.29E+00	3.50E+00	3.51E+00				4.06E+00	3.75E+00	4.11E+00
b2	-1.47E-01			-9.48E-02	-9.50E-02	-9.13E-02				-2.05E-01	-1.53E-01	-1.68E-01
c2												
depth (m)												
intercept	0.075			*0.050*	*0.046*	0.033				0.072	0.059	0.052
min	0.016	0.016	0.015	0.011	0.011	0.007	0.021	0.018	0.016	0.016	0.013	0.015
max	0.122	0.113	0.101	0.090	0.084	0.081	0.151	0.144	0.129	0.116	0.111	0.104

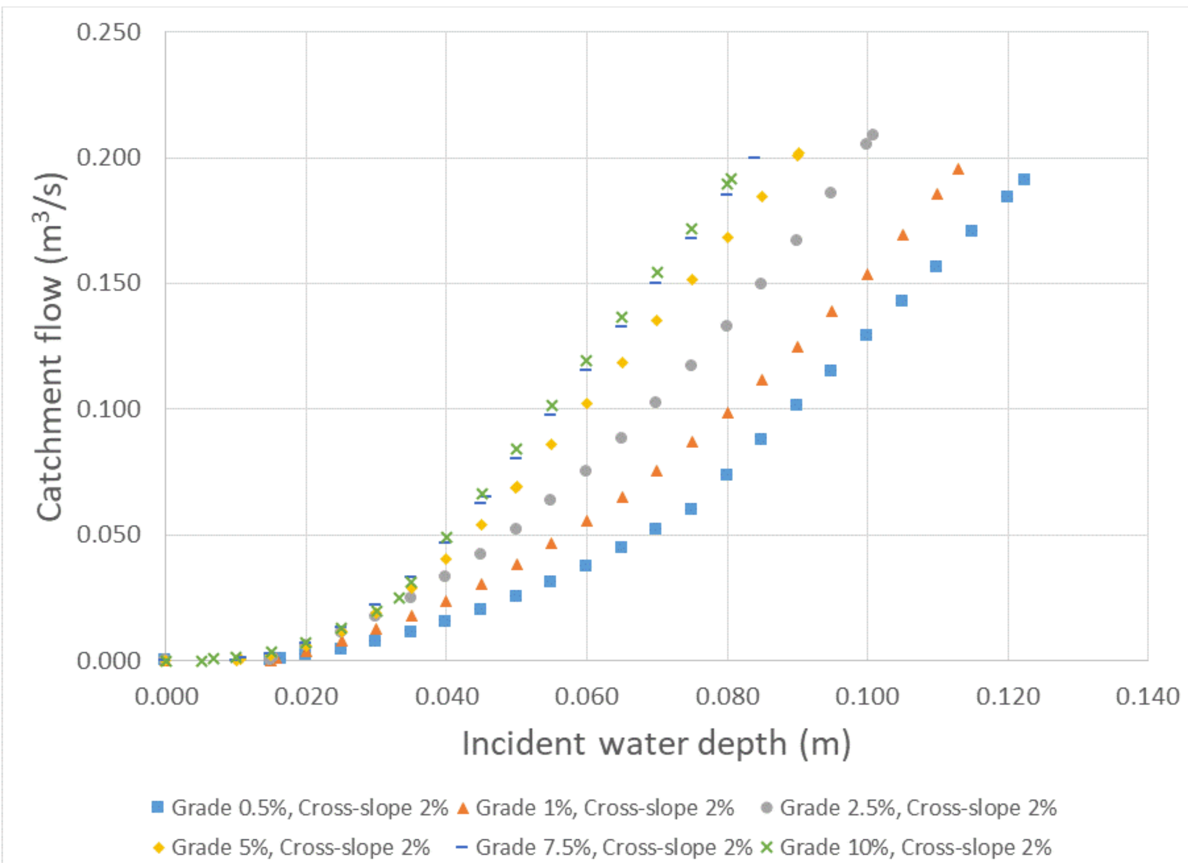

Figure 32. Best fit curves of inlet flow 2.0% cross-slope, high capacity inlet (#6) – Stepcon 5103

The best fit parameters for inlet #6, high capacity inlet at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 33. The calculated best fit catchment flow values illustrated in Figure 32 and Figure 33 were included in Appendix B (Table B.6).

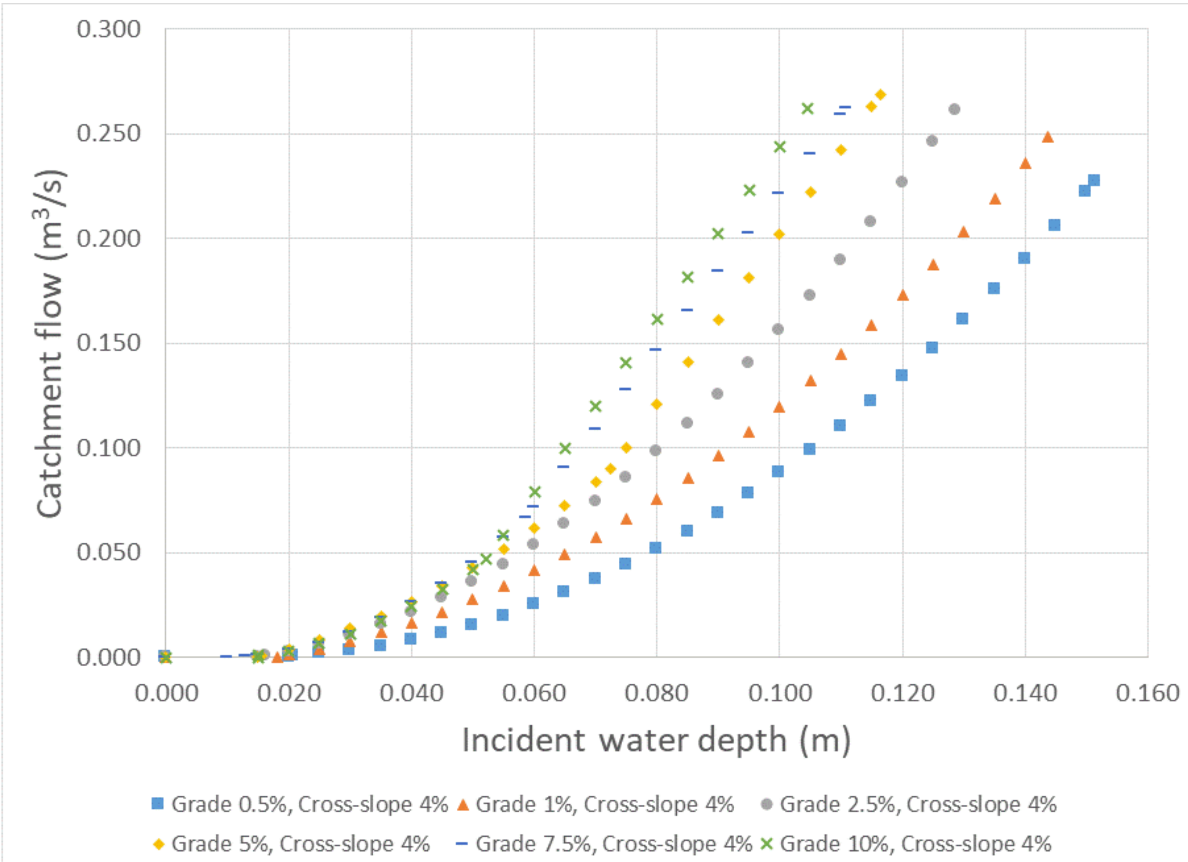

Figure 33. Best fit curves of inlet flow 4.0% cross-slope, high capacity inlet (#6) – Stepcon 5103

5.7. Catch Basin Inlet #7 – Circular Open Cover (Type B)

The best fit function parameters corresponding to the circular open cover (#7) can be found in Table 10. The best fit parameters for inlet #7 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 34.

Table 10: Best fit parameters for inlet #7, circular open cover. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0
a1	1.47E+01	6.58E-01	1.55E+01	8.18E-01	1.07E+02	4.88E-01
b1	-3.37E-01	-1.08E-02	9.22E-03	-1.05E-02	-2.74E+00	-4.24E-03
c1	2.22E-03		-2.52E-03		1.83E-02	
a2	-7.45E-01	-1.99E+00	-1.73E+00	-2.10E+00	-5.54E+00	-5.09E+00
b2	5.15E-01	6.30E-01	5.63E-01	5.53E-01	9.63E-01	8.93E-01
c2	-7.64E-03	-5.92E-03	-1.66E-03	-4.81E-05	-1.16E-02	-1.05E-02
depth (m)						
intercept	0.038	0.043	0.034	0.032	0.019	0.021
min	0.016	0.017	0.014	0.014	0.012	0.010
max	0.124	0.116	0.104	0.091	0.084	0.081

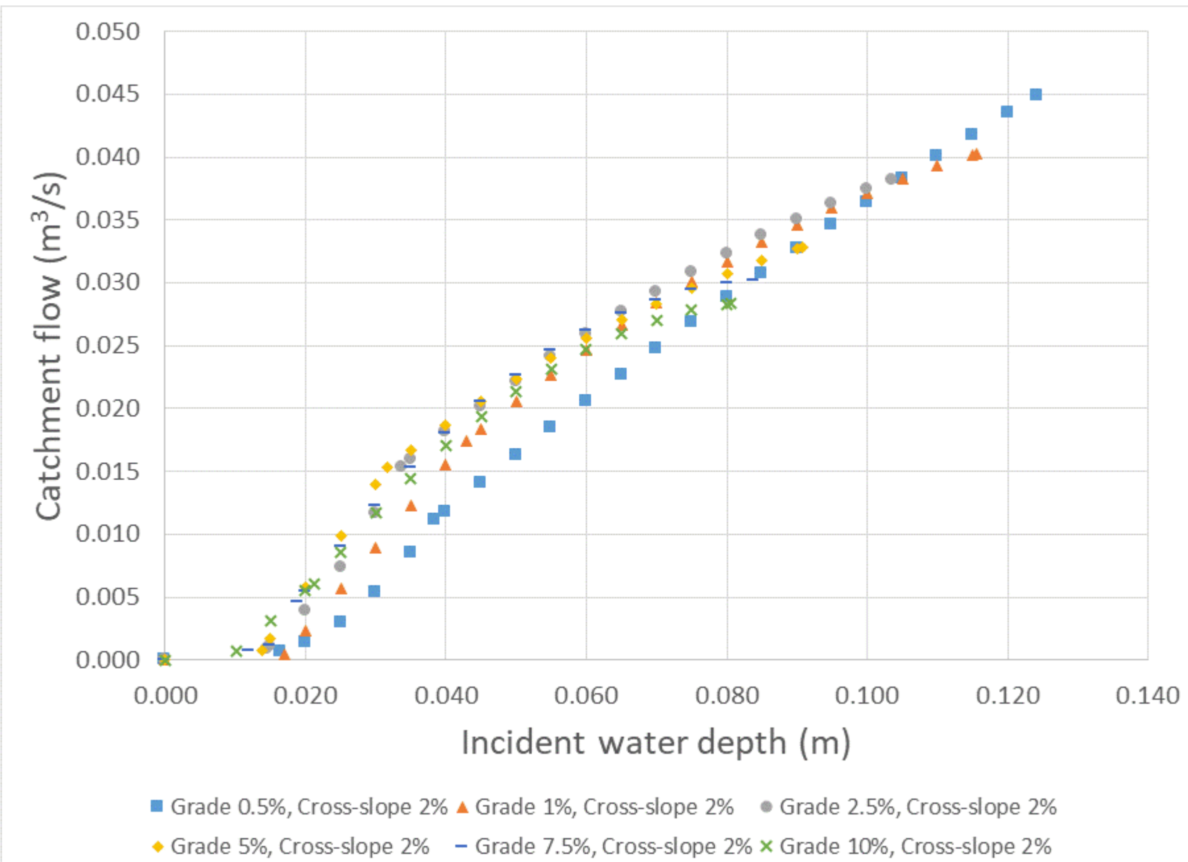

Figure 34. Best fit curves of inlet flow 2.0% cross-slope, circular open cover (#6) – OPSD 401.010

The calculated best fit catchment flow values illustrated in Figure 34 were included in Appendix B (Table B.7).

5.8. Catch Basin Inlet #8 – Circular Closed Cover (Type A)

The best fit function parameters corresponding to the circular closed cover (#8) can be found in Table 11. The best fit parameters for inlet #8 at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 35. The calculated best fit catchment flow values illustrated in Figure 35 were included in Appendix B (Table B.8).

Table 11: Best fit parameters for inlet #8, circular closed cover. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	2.0	2.0
Grade (%)	0.5	2.5
a1	6.22E-02	-3.29E-01
b1	-6.66E-04	4.19E-02
c1		-1.89E-04
a2	1.49E-02	9.07E-03
b2	5.62E-04	5.06E-04
c2		
depth (m)		
intercept	0.026	0.069
min	0.019	0.015
max	0.123	0.103

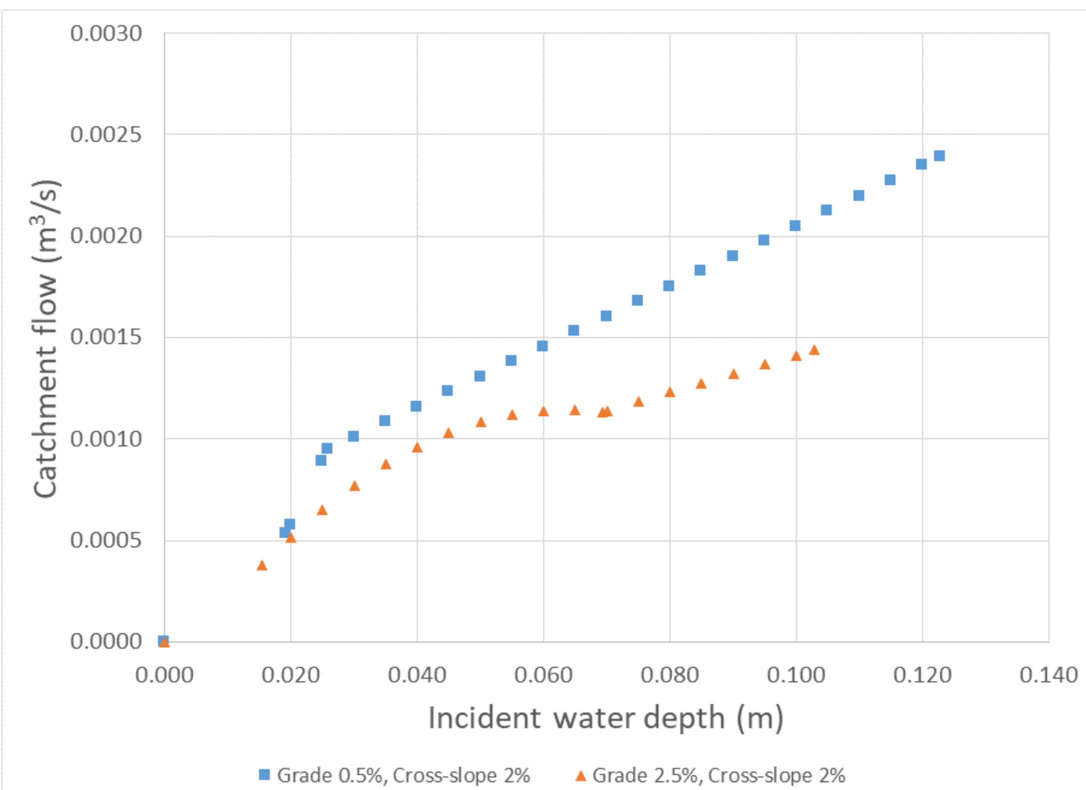

Figure 35. Best fit curves of inlet flow 2.0% cross-slope, circular closed cover (#8) – OPSD 401.010

5.9. Catch Basin Inlet #9 – S19 "FISH" Round Catch Basin Cover

The best fit function parameters corresponding to the "FISH" round catch basin cover (S19) can be found in Table 12. The intercept value for a cross-slope of 4.0% and a 0.5% grade is underlined and italicized. This indicates that the original two best fit functions resulted in no intercept and the intercept of the curves had to be forced when solving the weighted least squares equation.

Table 12: Best fit parameters for the S19 inlet, "FISH" round catch basin cover. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
a1	9.96E-01	2.77E+01	4.22E+01	8.08E+01	6.88E-01	1.82E+01	1.90E+01	6.68E+01	6.49E+01
b1	-1.11E-02	-8.10E-01	-1.03E+00	-2.29E+00	-7.47E-03	-6.52E-01	-4.26E-01	-2.61E+00	-2.21E+00
c1		6.02E-03	6.53E-03	1.66E-02		6.90E-03	2.11E-03	2.64E-02	2.01E-02
a2	3.42E-01	6.77E-01	-1.57E+00	-3.27E+00	-5.86E+00	-2.03E+00	-2.76E+00	5.76E-01	6.40E-01
b2	7.40E-02	-1.01E-02	8.46E-01	1.03E+00	1.32E+00	9.88E-01	1.08E+00	-2.00E-03	-4.16E-03
c2			-6.79E-03	-1.04E-02	-1.70E-02	-2.64E-02	-2.17E-02		
depth (m)									
intercept	0.077	0.039	0.034	0.028	0.018	*0.041*	0.035	0.036	0.032
min	0.015	0.016	0.010	0.014	0.013	0.023	0.010	0.021	0.018
max	0.119	0.124	0.114	0.101	0.086	0.162	0.114	0.129	0.113

The best fit parameters for the S19 inlet ponding test at a road grade of 0.5% and a cross-slope of 0.0% were used to produce the best fit curve which is illustrated in Figure 36.

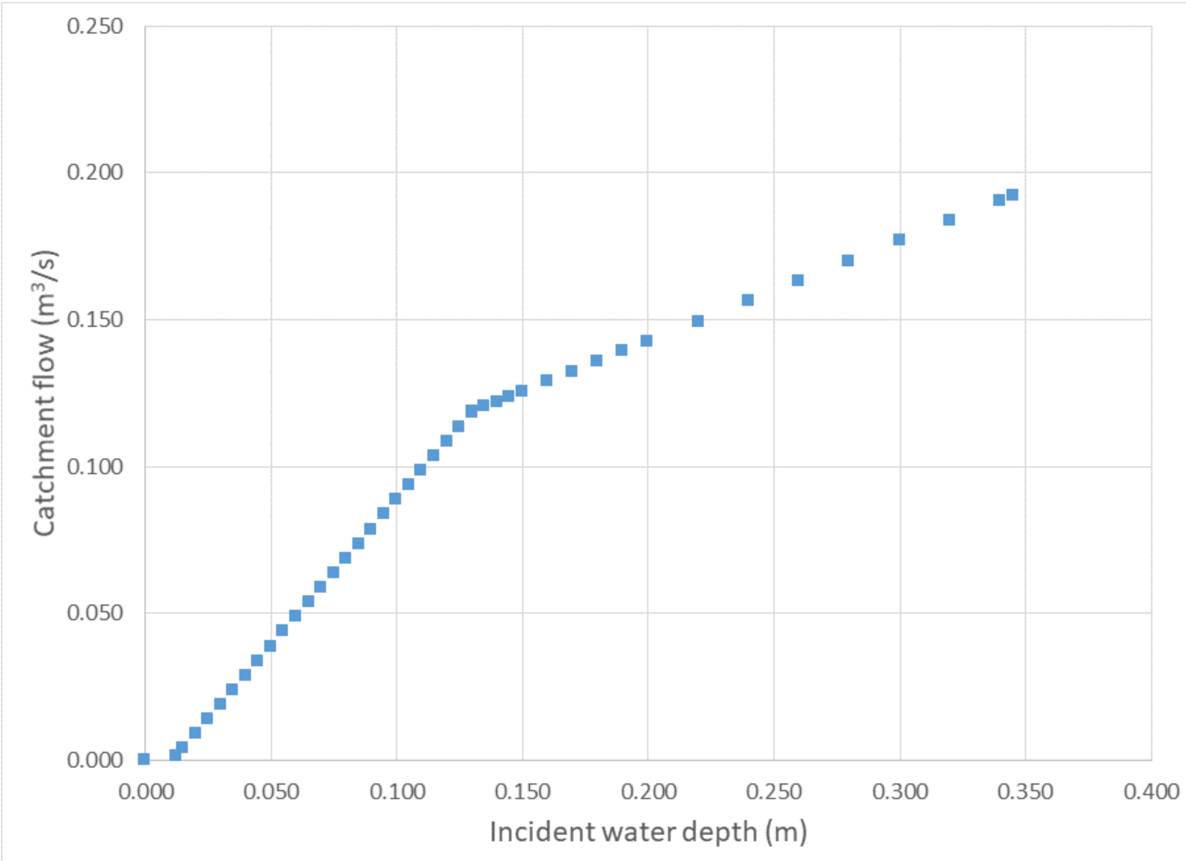

Figure 36. Best fit curve of inlet flow during ponding, “FISH” round catch basin cover (#9) – DWG. No. S19

The best fit parameters for the S19 inlet at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 37.

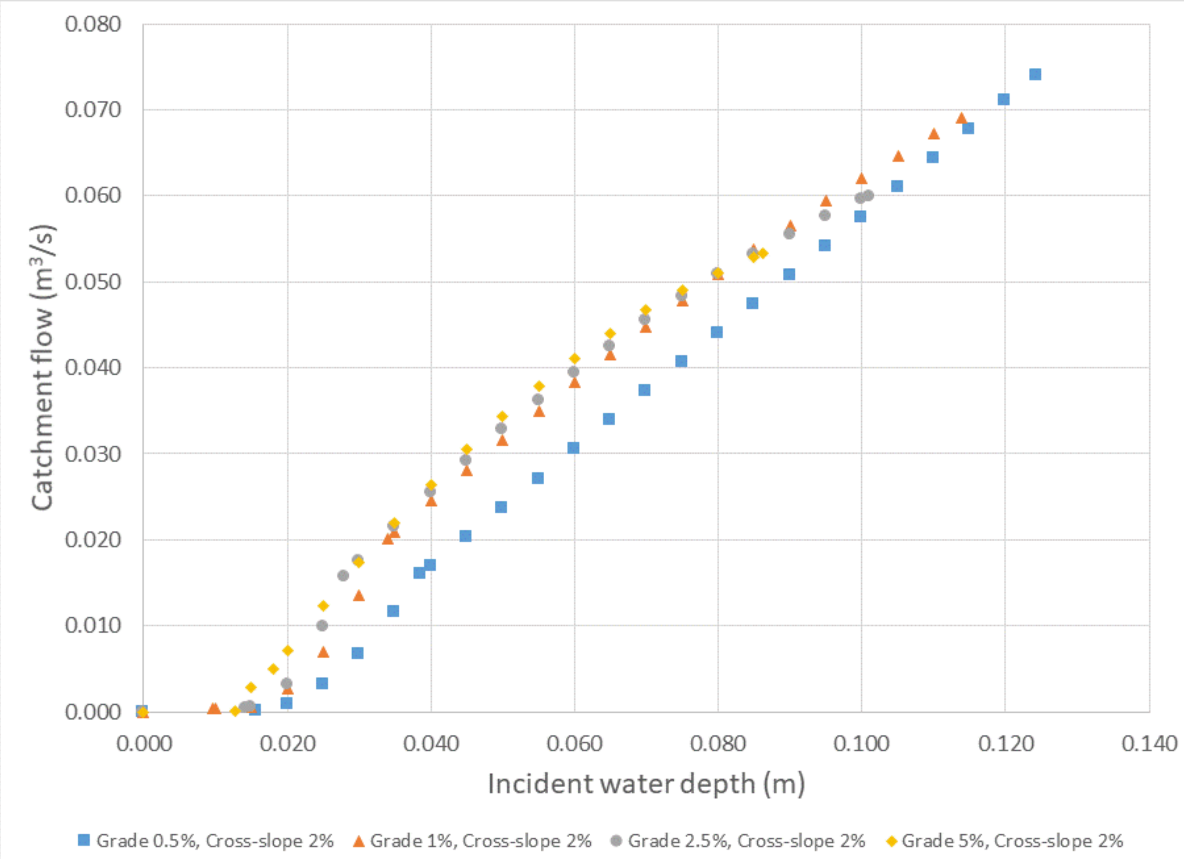

Figure 37. Best fit curves of inlet flow 2.0% cross-slope, “FISH” round catch basin cover (#9) – DWG. No. S19

The best fit parameters for the S19 inlet at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 38. The calculated best fit catchment flow values illustrated in Figure 36, Figure 37 and Figure 38 were included in Appendix B (Table B.9).

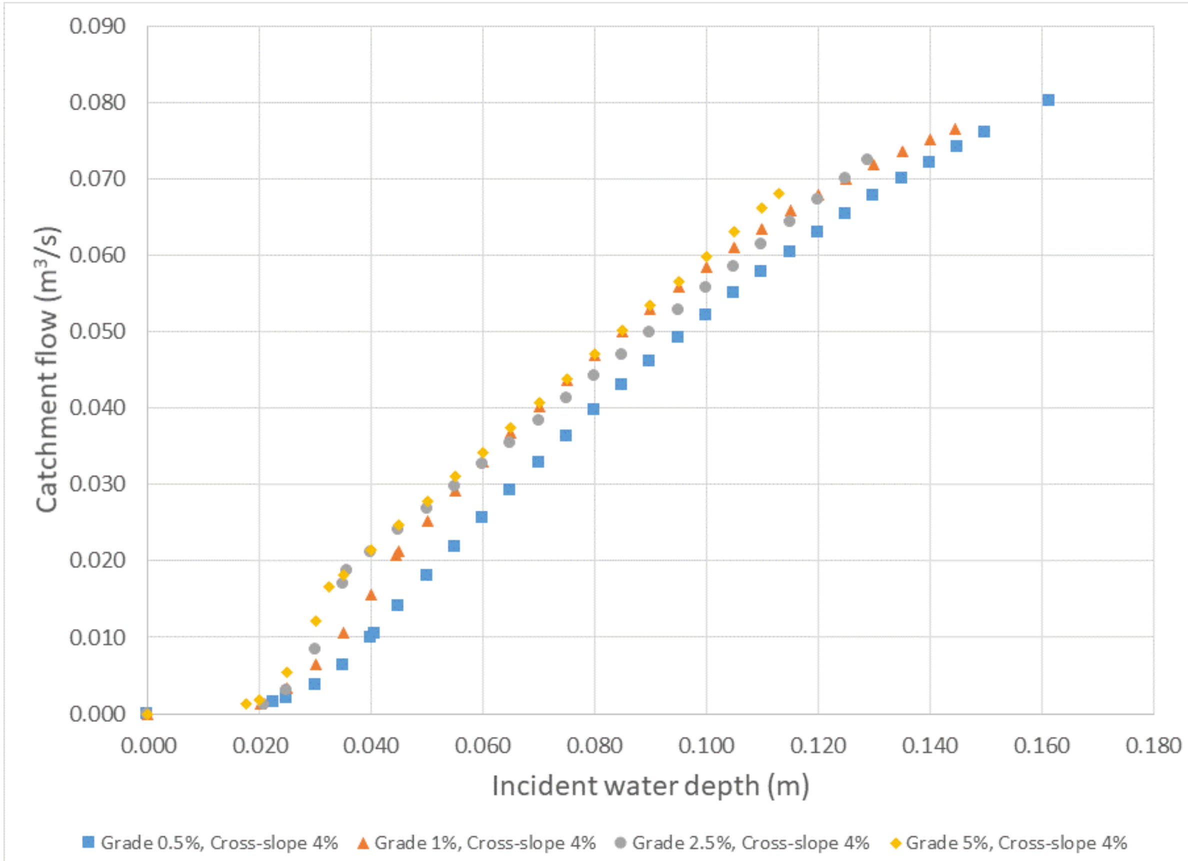

Figure 38. Best fit curves of inlet flow 4.0% cross-slope, “FISH” round catch basin cover (#9) – DWG. No. S19

5.10.Catch Basin Inlet #10 – S22 Single Curb Inlet Frame

The best fit function parameters corresponding to the single curb inlet frame (S22) can be found in Table 13. For a grade of 5.0% and a cross-slope of 2.0% the intercept values is underlined and italicized indicating that the original best fit curves resulted in no intercept and the intercept of the incident water depth values had to be forced when solving the weighted least squares equation. The two instances where the max values are underlined and bold indicate that there was an asymptote in the experimental data corresponding approximately to the height of the curb as discussed in Poirier and Provan (2023). A similar asymptote may also be observed in the field but it is difficult to assess if it would have the same shape with the limited data available. For this reason the curves presented in this guidance document exclude the asymptote.

Table 13: Best fit parameters for the S22 single curb inlet frame. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
a1	7.80E-01	2.38E-01	5.49E-01	1.56E+00	2.47E+00	2.73E-01	1.78E-01	4.40E+00	2.27E+00
b1	5.35E-01	-3.07E-03	1.48E-01	7.84E-02	-3.30E-02	-3.94E-03	-2.25E-03	-1.23E-02	1.06E-02
c1	-4.45E-03		-1.98E-03	-6.81E-04	7.07E-04			-2.58E-04	-1.49E-04
a2	9.26E-02	6.60E-01		1.93E-01	2.09E-01		2.63E-01	2.48E-01	2.68E-01
b2	1.38E-01	1.06E-01		-1.86E-04	-2.88E-03		-5.15E-03	-3.63E-03	-7.28E-03
c2		2.45E-03							
depth (m)									
intercept	0.229	0.060		0.078	*0.018*		0.034	0.040	0.049
min	0.012	0.017	0.017	0.013	0.007	0.019	0.018	0.018	0.018
max	0.348	**0.171**	0.168	0.126	0.116	**0.187**	0.175	0.137	0.128

The best fit parameters for the S22 single curb inlet frame ponding test at a road grade of 0.5% and a cross-slope of 0.0% were used to produce the best fit curve which is illustrated in Figure 39.

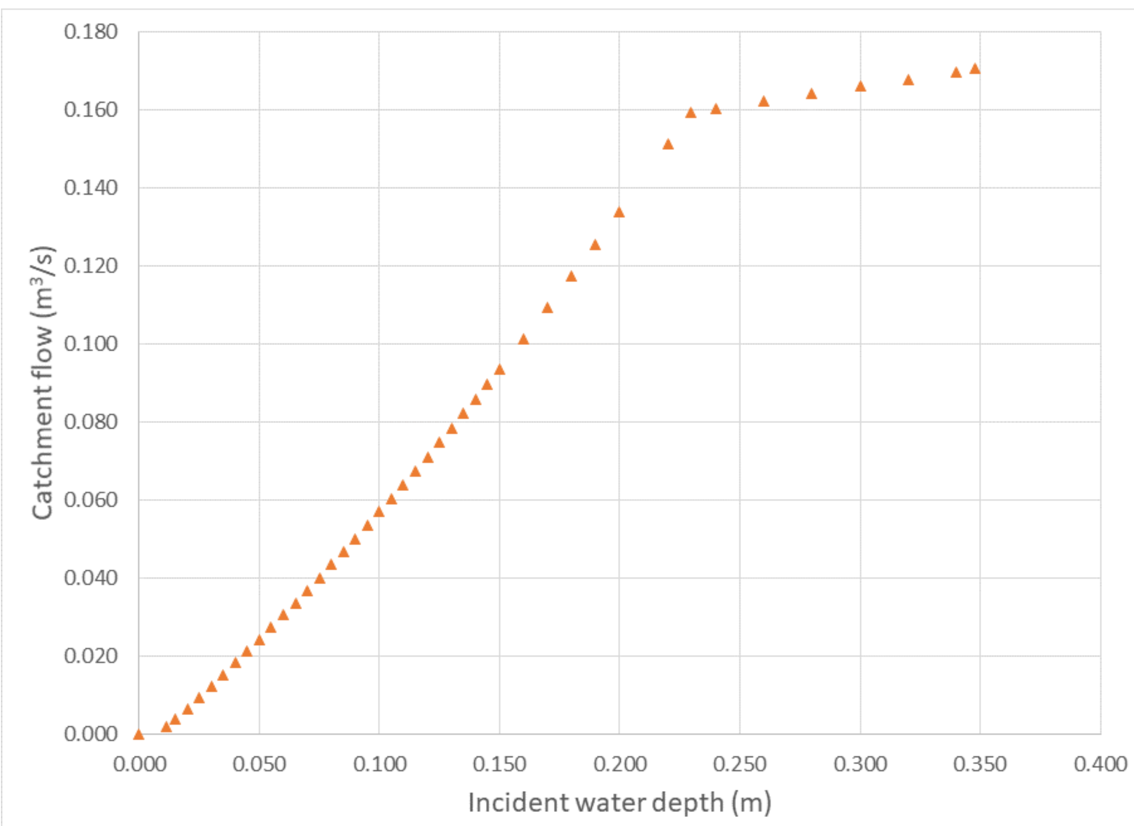

Figure 39. Best fit curve of inlet flow during ponding, single curb inlet frame (#10) – DWG. No. S22

The best fit parameters for the S22 single curb inlet frame at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 40.

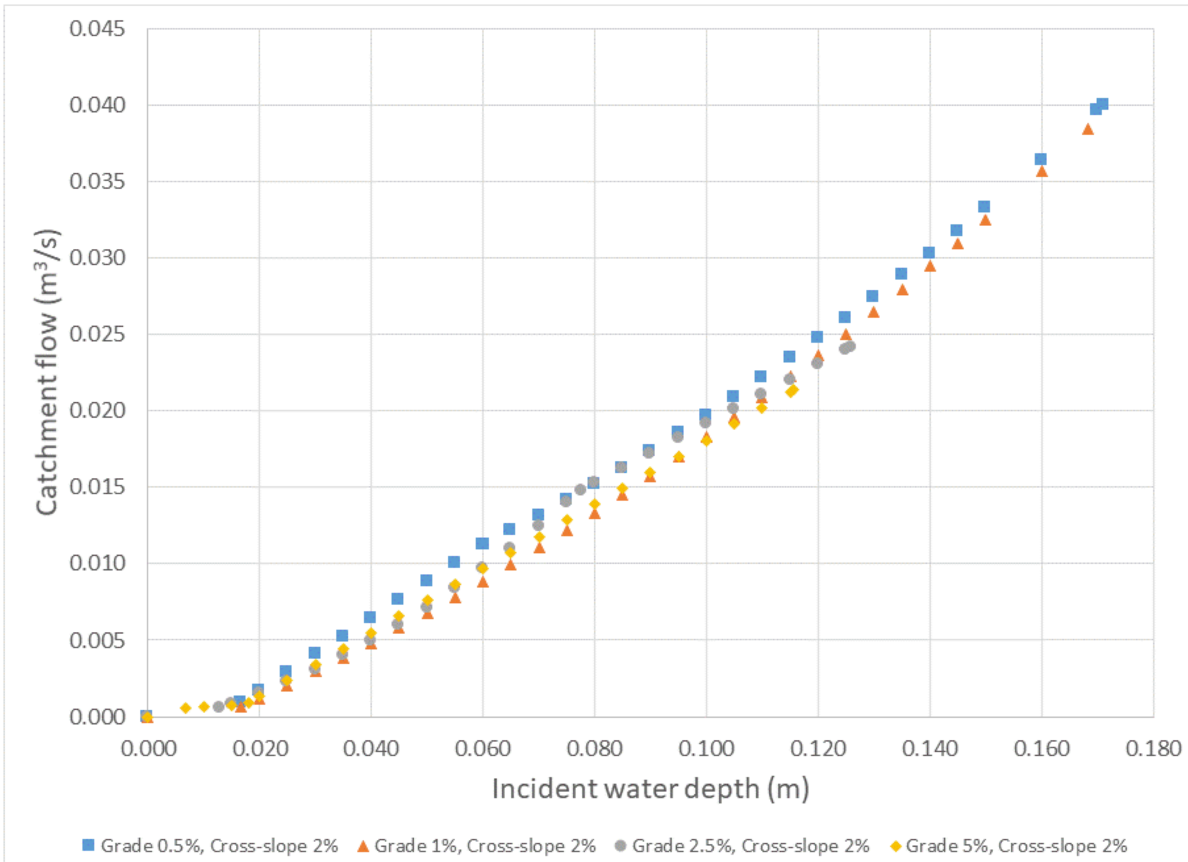

Figure 40. Best fit curves of inlet flow 2.0% cross-slope, single curb inlet frame (#10) – DWG. No. S22

The best fit parameters for S22 single curb inlet frame at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 41. The calculated best fit catchment flow values illustrated in Figure 39, Figure 40 and Figure 41 were included in Appendix B (Table B.10).

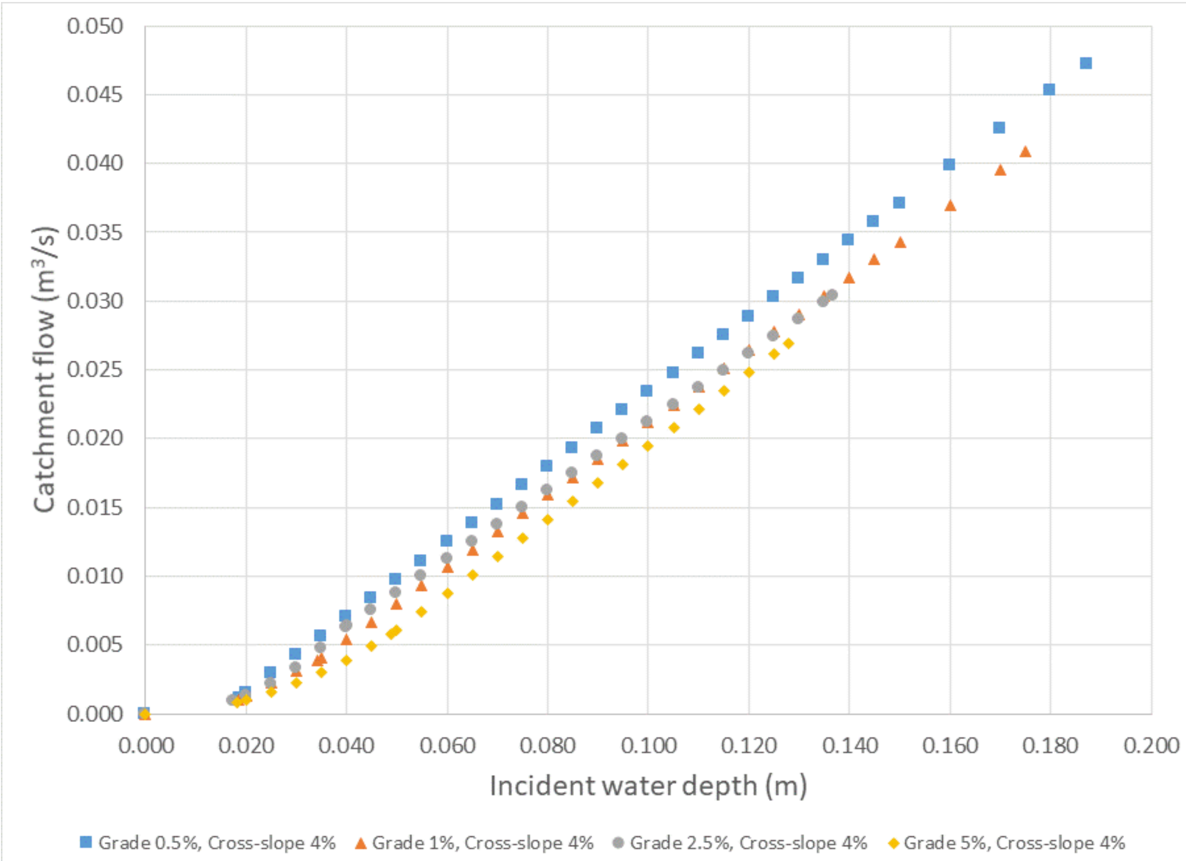

Figure 41. Best fit curves of inlet flow 4.0% cross-slope, single curb inlet frame (#10) – DWG. No. S22

5.11.Catch Basin Inlet #11 – S22(x2) Double Curb Inlet Frame

The best fit function parameters corresponding to the S22(x2) double curb inlet frame can be found in Table 14. The best fit parameters for the S22(x2) double curb inlet frame ponding test at a road grade of 0.5% and a cross-slope of 0.0% were used to produce the best fit curve which is illustrated in Figure 42.

Table 14: Best fit parameters for the S22(x2) double curb inlet frame. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
a1	7.80E-01	2.38E-01	5.49E-01	1.56E+00	2.47E+00	2.73E-01	1.78E-01	4.40E+00	2.27E+00
b1	5.35E-01	-3.07E-03	1.48E-01	7.84E-02	-3.30E-02	-3.94E-03	-2.25E-03	-1.23E-02	1.06E-02
c1	-4.45E-03		-1.98E-03	-6.81E-04	7.07E-04			-2.58E-04	-1.49E-04
a2	9.26E-02	6.60E-01		1.93E-01	2.09E-01		2.63E-01	2.48E-01	2.68E-01
b2	1.38E-01	1.06E-01		-1.86E-04	-2.88E-03		-5.15E-03	-3.63E-03	-7.28E-03
c2		2.45E-03							
depth (m)									
intercept	0.229	0.060		0.078	*0.018*		0.034	0.040	0.049
min	0.012	0.017	0.017	0.013	0.007	0.019	0.018	0.018	0.018
max	0.348	**0.171**	0.168	0.126	0.116	**0.187**	0.175	0.137	0.128

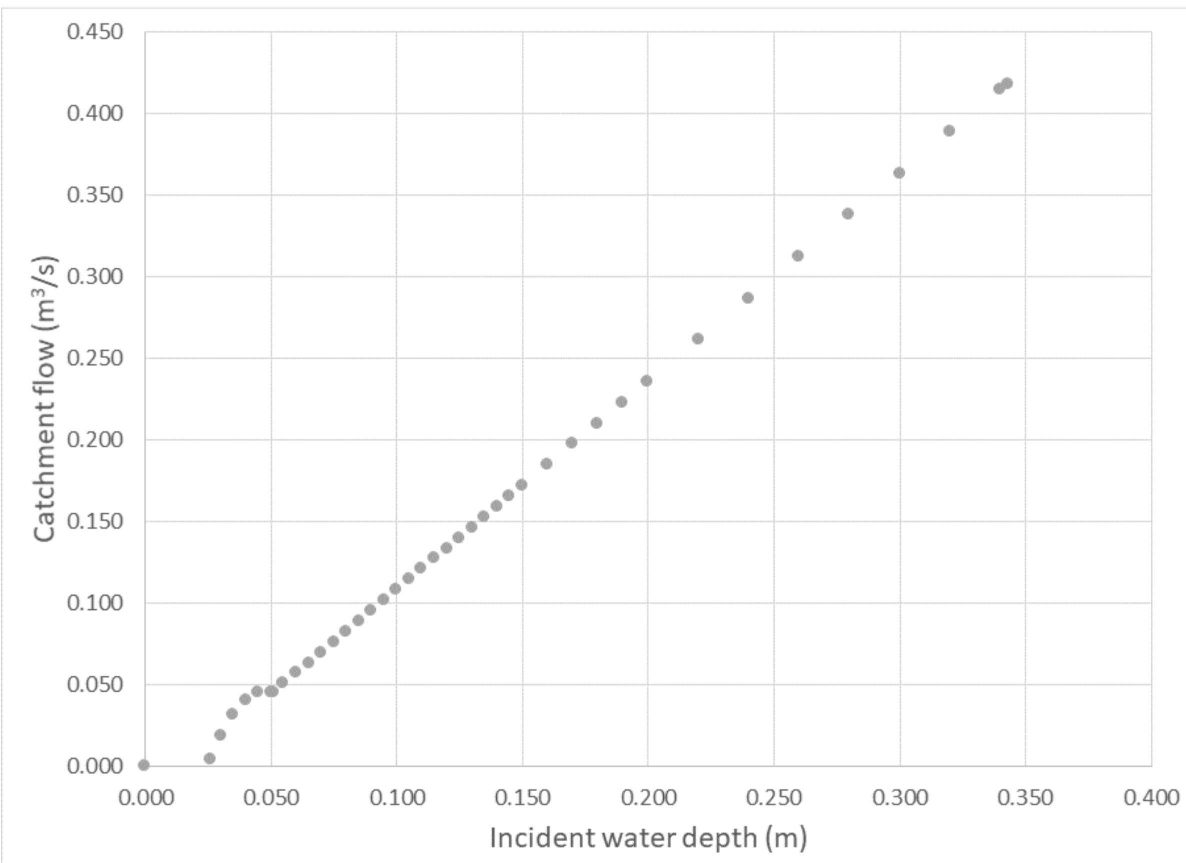

Figure 42. Best fit curve of inlet flow during ponding, double curb inlet frame (#11) – DWG. No. S22

The best fit parameters for S22(x2) double curb inlet frame at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 43.

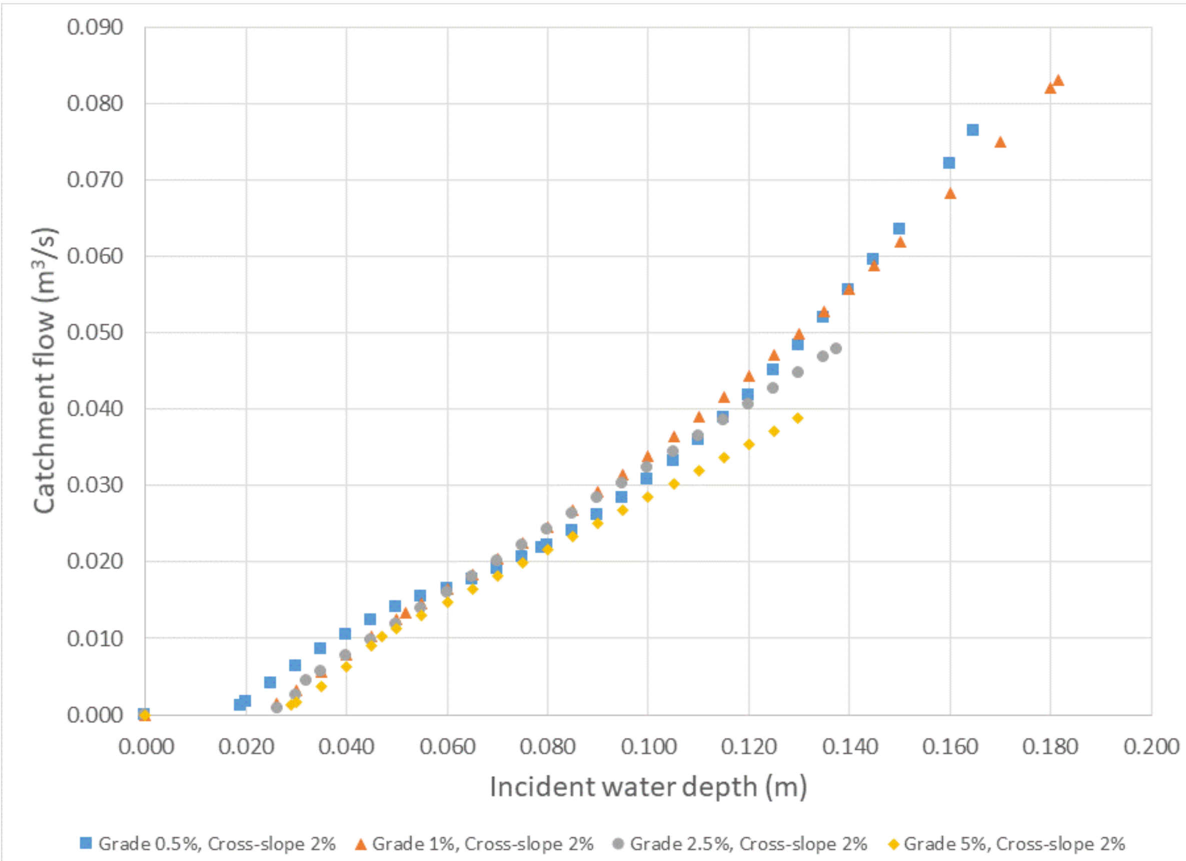

Figure 43. Best fit curves of inlet flow 2.0% cross-slope, double curb inlet frame (#11) – DWG. No. S22

The best fit parameters for the S22(x2) double curb inlet frame at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 44. The calculated best fit catchment flow values illustrated in Figure 42, Figure 43 and Figure 44 were included in Appendix B (Table B.11).

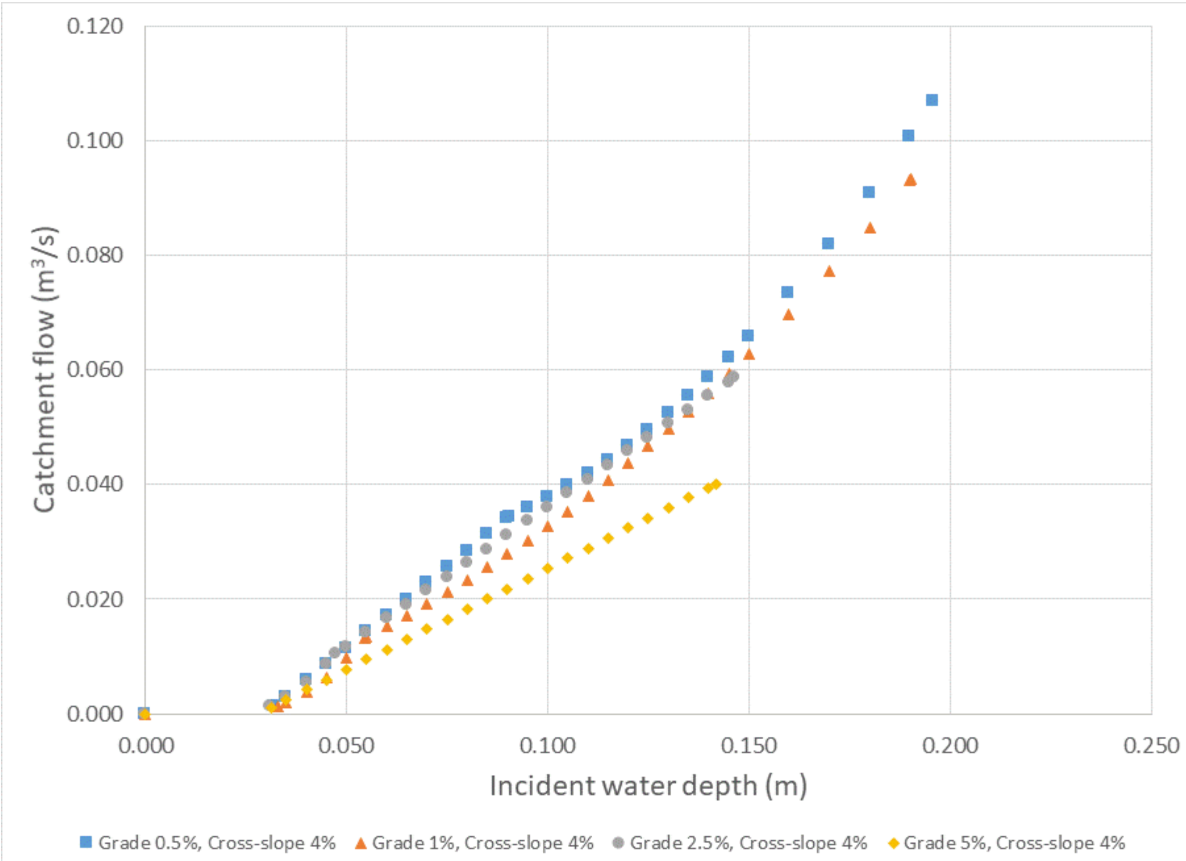

Figure 44. Best fit curves of inlet flow 4.0% cross-slope, double curb inlet frame (#11) – DWG. No. S22

5.12.Catch Basin Inlet #12 – S28 Single Curb Inlet Frame for CBMH

The best fit function parameters corresponding to the S28 single curb inlet frame for CBMH can be found in Table 15. For a grade of 5.0% and a cross-slope of 2.0% the intercept values is underlined and italicized indicating that the original best fit curves resulted in no intercept and the intercept of the incident water depth values had to be forced when solving the weighted least squares equation. The best fit parameters for the S28 single curb inlet frame for CBMH ponding test at a road grade of 0.5% and a cross-slope of 0.0% were used to produce the best fit curve which is illustrated in Figure 45.

Table 15: Best fit parameters for S28 single curb inlet frame for CBMH. Minimum and maximum measured incident water depths are included along with the water depths where the two functions intercept.

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
a1	2.13E-01	-1.21E+00	7.06E-01	3.49E+00	8.14E+00	3.62E-01	3.36E-01	3.05E-01	2.78E-01
b1	6.16E-01	3.57E-01	1.63E-01	1.28E-01	4.98E-02	-5.85E-03	-5.24E-03	-4.14E-03	-4.08E-03
c1	-3.73E-03	-3.54E-03	-1.19E-03	-1.81E-03	-1.81E-03				
a2	2.24E-01	2.63E-01		-9.04E-01	2.82E-01	2.09E+00	1.03E+00		3.35E-01
b2	1.37E-01	-3.69E-03		4.10E-01	-7.38E-04	-2.08E-01	1.05E-01		-6.23E-03
c2				-6.32E-03		2.42E-02	2.06E-03		
depth (m)									
intercept	0.308	0.079		*0.032*	0.033	0.071	0.038		0.038
min	0.012	0.016	0.015	0.014	0.014	0.020	0.019	0.017	0.018
max	0.352	0.195	0.167	0.127	0.112	0.183	0.176	0.133	0.124

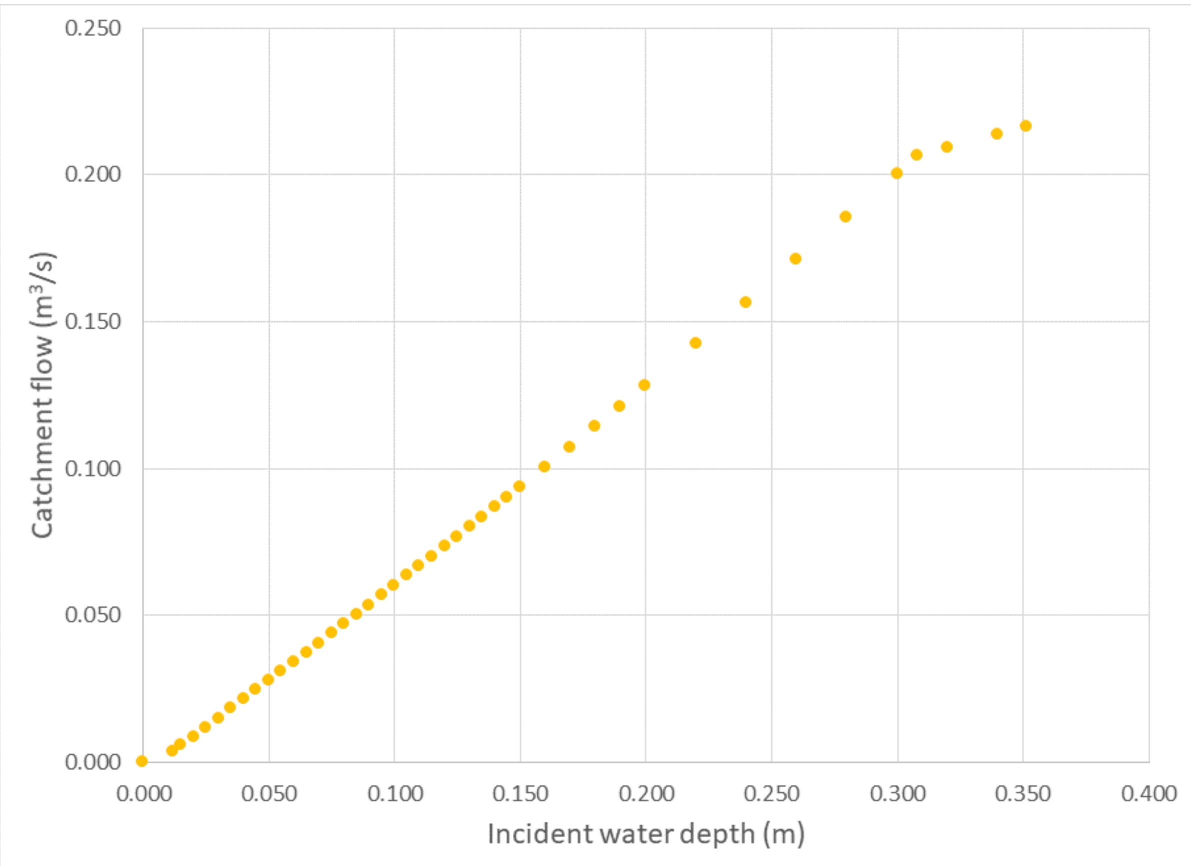

Figure 45. Best fit curve of inlet flow during ponding, single curb inlet frame for CBMH (#12) – DWG. No. S28

The best fit parameters for the S28 single curb inlet frame for CBMH at a cross-slope of 2.0% were used to produce the best fit curves illustrated in Figure 46.

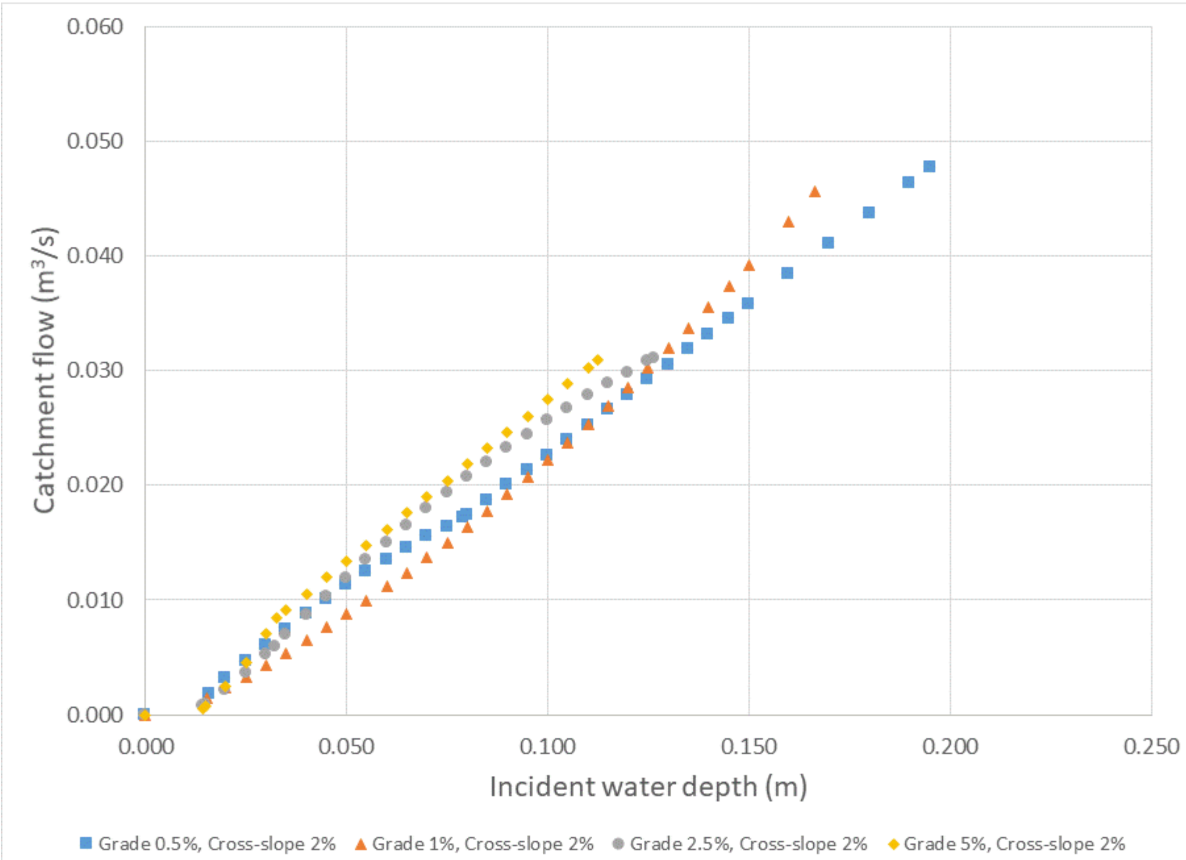

Figure 46. Best fit curves of inlet flow 2.0% cross-slope, single curb inlet frame for CBMH (#12) – DWG. No. S28

The best fit parameters for the S28 single curb inlet frame for CBMH at a cross-slope of 4.0% were used to produce the best fit curves illustrated in Figure 47. The calculated best fit catchment flow values illustrated in Figure 45, Figure 46 and Figure 47 were included in Appendix B (Table B.12).

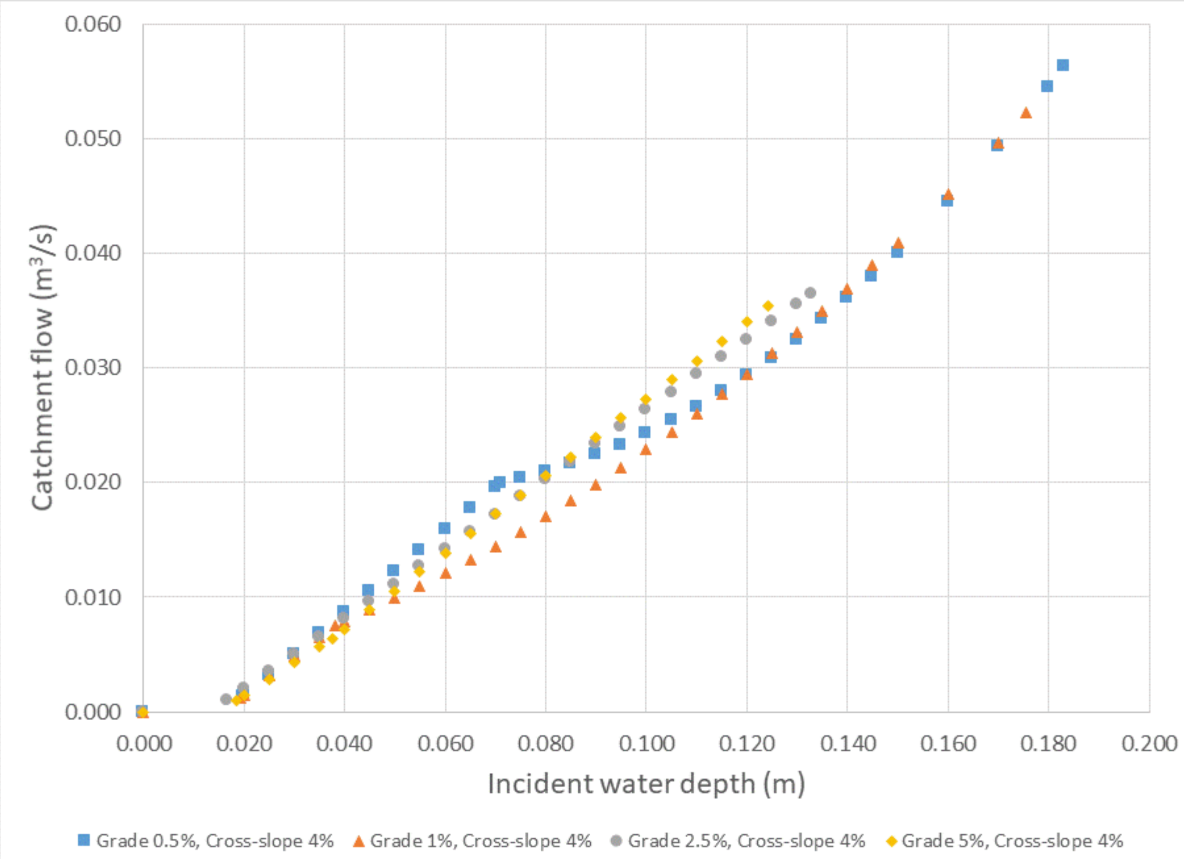

Figure 47. Best fit curves of inlet flow 4.0% cross-slope, single curb inlet frame for CBMH (#12) – DWG. No. S28

6. Summary and Recommendations

A series of 1659 tests was completed at the National Research Council of Canada's Ocean, Coastal and River Engineering Research Centre's Coastal Wave Basin of a full scale model roadway to study the conveyance of catch basin inlets. A total of twelve catch basin inlet configurations were examined at six road grades ranging from 0.5 - 10.0% and cross-slopes of 0.0, 2.0 and 4.0% and for each setup at least 13 water flows from 0.001 – 0.41 m^3/s were sent onto the model roadway. Inflows through the catch basin inlets as high as 0.41 m^3/s were measured through the double curb inlet (S22x2) during the ponding tests with the end of the roadway blocked and as low as 0.0001 m^3/s were measured on the 'FISH' type round catch basin cover (S19) at a grade of 0.5% and a cross-slope of 2.0%.

The main outputs from this work are Table 4 - Table 15 of best fit function parameters, Table A.1 - Table A.22 of experimental measurements with uncertainties and Table B.1 - Table B.12 of best fit data tables which allow the reader to relate the incident water depth to the conveyance through of the twelve catch basin inlets.

The series of experiments performed here provides a tool for municipal engineers to better understand the conveyance capacity of different commonly used catch basin inlets under various roadway configurations.

7. Acknowledgements

The authors would like to acknowledge the financial support for this work from the City of Ottawa, the City of Toronto and Infrastructure Canada. Yehuda Kleiner from the NRC was instrumental in coordinating support from Infrastructure Canada to the benefit of other municipalities. Both municipal partners were active participants in ensuring that our work met the needs of Canadian Municipalities, who are the target audience for the work, by providing both their direct input and contacts from other municipalities to add their own input.

The authors would like to acknowledge the support from the team at the NRC-OCRE in Ottawa without whom the project would not be possible. We would also like to acknowledge the support, mentorship and help of Dr. Andrew Cornett to initiate the project.

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A. Appendix – Measured catch basin inflow data tables

This appendix includes all of the measured incident water depths and catchment, or catch basin inflow data tables along with the measurement uncertainties. The data from these tables are obtained from Poirier and Provan (2021, 2023); further details can be found in those reports. The incident water depths reported here are obtained from the RD6 capacitance wire probe except where the water depth is too low to obtain a reliable measurement. In those cases the RD6 measurements are used with data from other probes to provide upper and lower bounds on the measurement.

Table A.1: Measurements for catch basin inlet #1 (OPSD 400.070) - single round herringbone with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.018	0.0008	0.001	5.3E-06	0.016	0.0008	0.001	5.2E-06	0.017	0.0009	0.001	5.8E-06	0.0131	0.0009	0.0017	5.6E-06	0.013	0.0009	0.002	5.6E-06	0.009	0.0007	0.001	4.4E-06
	0.023	0.0018	0.001	1.1E-05	0.021	0.0021	0.001	1.3E-05	0.020	0.0021	0.001	1.3E-05	0.017	0.0025	0.001	1.6E-05	0.017	0.0025	0.001	1.6E-05	0.017	0.0024	0.001	1.5E-05
	0.027	0.0038	0.001	2.4E-05	0.024	0.0037	0.001	2.3E-05	0.023	0.0050	0.001	3.1E-05	0.019	0.0057	0.001	3.6E-05	0.019	0.0057	0.001	3.6E-05	0.019	0.0048	0.001	3.0E-05
	0.039	0.012	0.001	0.003	0.032	0.012	0.001	0.003	0.028	0.012	0.001	0.003	0.026	0.014	0.001	0.003	0.026	0.014	0.001	0.003	0.026	0.012	0.001	0.003
	0.049	0.017	0.001	0.004	0.037	0.019	0.001	0.004	0.034	0.019	0.001	0.004	0.032	0.018	0.001	0.004	0.032	0.018	0.001	0.004	0.032	0.018	0.002	0.004
	0.063	0.027	0.002	0.005	0.049	0.028	0.001	0.005	0.048	0.031	0.002	0.005	0.042	0.028	0.002	0.004	0.042	0.028	0.002	0.004	0.038	0.025	0.002	0.004
	0.073	0.034	0.004	0.005	0.061	0.036	0.003	0.005	0.058	0.038	0.003	0.005	0.050	0.033	0.003	0.005	0.050	0.033	0.003	0.005	0.045	0.029	0.004	0.004
	0.079	0.043	0.005	0.006	0.069	0.042	0.004	0.006	0.064	0.044	0.004	0.006	0.051	0.034	0.003	0.005	0.051	0.034	0.003	0.005	0.050	0.032	0.004	0.005
	0.082	0.047	0.006	0.006	0.074	0.046	0.005	0.006	0.068	0.047	0.005	0.006	0.055	0.037	0.004	0.005	0.055	0.037	0.004	0.005	0.053	0.034	0.005	0.005
	0.092	0.056	0.008	0.007	0.086	0.054	0.007	0.007	0.076	0.053	0.006	0.007	0.059	0.040	0.004	0.005	0.059	0.040	0.004	0.005	0.061	0.037	0.005	0.005
	0.102	0.064	0.008	0.008	0.096	0.060	0.008	0.007	0.086	0.059	0.006	0.007	0.068	0.045	0.006	0.006	0.068	0.045	0.006	0.006	0.067	0.040	0.006	0.005
	0.116	0.074	0.010	0.009	0.109	0.069	0.009	0.008	0.095	0.065	0.007	0.008	0.076	0.049	0.006	0.006	0.076	0.049	0.006	0.006	0.075	0.043	0.006	0.006
	0.123	0.080	0.011	0.010	0.116	0.075	0.010	0.009	0.103	0.069	0.008	0.008	0.084	0.056	0.007	0.007	0.084	0.056	0.007	0.007	0.079	0.045	0.007	0.006
													0.091	0.059	0.008	0.007	0.091	0.059	0.008	0.007				

Table A.2: Measurements for catch basin inlet #1 (OPSD 400.070) - single round herringbone with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.022	0.0009	0.001	5.3E-06	0.018	0.0009	0.001	5.5E-06	0.016	0.0008	0.001	4.9E-06	0.016	0.0008	0.001	4.9E-06	0.015	0.0008	0.001	5.2E-06	0.015	0.0008	0.002	4.7E-06
	0.029	0.0023	0.001	1.4E-05	0.023	0.0022	0.001	1.4E-05	0.020	0.0021	0.001	1.3E-05	0.019	0.0017	0.001	1.0E-05	0.019	0.0022	0.001	1.4E-05	0.019	0.0021	0.001	1.3E-05
	0.034	0.0045	0.001	2.8E-05	0.027	0.0043	0.001	2.7E-05	0.027	0.0048	0.001	3.0E-05	0.025	0.0045	0.001	2.8E-05	0.021	0.0043	0.001	2.7E-05	0.024	0.0044	0.001	2.7E-05
	0.050	0.013	0.002	0.003	0.041	0.014	0.001	0.003	0.036	0.014	0.001	0.003	0.032	0.013	0.001	0.003	0.033	0.012	0.001	0.003	0.033	0.011	0.001	0.003
	0.064	0.021	0.002	0.004	0.050	0.022	0.001	0.004	0.042	0.022	0.001	0.004	0.042	0.020	0.002	0.004	0.042	0.020	0.002	0.004	0.041	0.018	0.002	0.004
	0.078	0.033	0.003	0.005	0.063	0.034	0.002	0.005	0.055	0.032	0.002	0.005	0.062	0.032	0.002	0.005	0.058	0.030	0.002	0.005	0.055	0.028	0.003	0.004
	0.096	0.042	0.004	0.006	0.078	0.042	0.003	0.006	0.078	0.042	0.002	0.006	0.078	0.041	0.003	0.005	0.069	0.038	0.004	0.005	0.065	0.033	0.004	0.005
	0.103	0.049	0.005	0.007	0.091	0.047	0.004	0.006	0.090	0.050	0.004	0.006	0.084	0.049	0.004	0.006	0.075	0.043	0.004	0.006	0.070	0.038	0.004	0.005
	0.108	0.053	0.006	0.008	0.100	0.052	0.005	0.007	0.096	0.056	0.005	0.007	0.088	0.052	0.005	0.006	0.079	0.046	0.005	0.006	0.074	0.041	0.005	0.005
	0.120	0.061	0.007	0.009	0.114	0.061	0.007	0.008	0.105	0.064	0.006	0.008	0.096	0.058	0.006	0.007	0.088	0.051	0.006	0.006	0.083	0.046	0.006	0.006
	0.130	0.069	0.008	0.010	0.125	0.067	0.007	0.009	0.113	0.069	0.007	0.009	0.104	0.062	0.007	0.008	0.097	0.055	0.007	0.007	0.092	0.049	0.006	0.006
	0.145	0.077	0.008	0.011	0.135	0.075	0.008	0.010	0.123	0.075	0.007	0.009	0.113	0.067	0.007	0.008	0.105	0.059	0.007	0.007	0.100	0.053	0.007	0.006
	0.152	0.082	0.009	0.012	0.144	0.079	0.009	0.010	0.129	0.078	0.008	0.010	0.119	0.070	0.008	0.008	0.112	0.063	0.008	0.008	0.105	0.055	0.007	0.007

Table A.3: Measurements for catch basin inlet #2 (OPSD 400.070) - double round herringbone with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.017	0.0008	0.002	5.1E-06	0.015	0.0009	0.001	5.9E-06	0.012	0.0009	0.003	5.9E-06	0.011	0.0008	0.001	4.9E-06	0.011	0.0008	0.001	5.3E-06	0.010	0.0008	0.001	4.9E-06
	0.024	0.0023	0.001	1.4E-05	0.018	0.0023	0.001	1.4E-05	0.017	0.0025	0.001	1.5E-05	0.018	0.0025	0.001	1.6E-05	0.017	0.0025	0.001	1.6E-05	0.017	0.0026	0.002	1.6E-05
	0.028	0.0052	0.001	3.2E-05	0.021	0.0047	0.001	2.9E-05	0.020	0.0047	0.001	2.9E-05	0.020	0.0049	0.001	3.0E-05	0.020	0.0050	0.001	3.1E-05	0.020	0.0051	0.001	3.2E-05
	0.039	0.011	0.001	0.003	0.031	0.012	0.001	0.003	0.028	0.011	0.001	0.003	0.027	0.013	0.001	0.003	0.025	0.011	0.001	0.003	0.025	0.013	0.001	0.003
	0.050	0.019	0.001	0.004	0.035	0.020	0.001	0.004	0.035	0.018	0.001	0.004	0.033	0.021	0.001	0.004	0.032	0.019	0.002	0.004	0.031	0.021	0.002	0.004
	0.063	0.031	0.002	0.005	0.046	0.032	0.001	0.005	0.046	0.032	0.001	0.005	0.042	0.035	0.002	0.005	0.032	0.021	0.002	0.004	0.038	0.033	0.003	0.005
	0.074	0.043	0.004	0.006	0.058	0.044	0.003	0.006	0.055	0.046	0.003	0.006	0.049	0.048	0.003	0.006	0.039	0.032	0.003	0.005	0.043	0.044	0.004	0.006
	0.081	0.055	0.005	0.007	0.067	0.059	0.004	0.008	0.062	0.058	0.004	0.008	0.054	0.058	0.004	0.007	0.045	0.041	0.003	0.006	0.048	0.053	0.004	0.007
	0.085	0.064	0.006	0.009	0.073	0.068	0.005	0.009	0.067	0.066	0.004	0.009	0.058	0.065	0.004	0.008	0.046	0.044	0.003	0.006	0.052	0.060	0.004	0.007
	0.094	0.085	0.007	0.012	0.086	0.084	0.006	0.011	0.075	0.078	0.006	0.011	0.067	0.080	0.006	0.010	0.049	0.051	0.004	0.007	0.060	0.073	0.005	0.009
	0.102	0.100	0.008	0.015	0.095	0.097	0.007	0.013	0.085	0.090	0.007	0.012	0.075	0.095	0.007	0.012	0.053	0.056	0.004	0.007	0.066	0.081	0.006	0.010
	0.117	0.118	0.009	0.018	0.110	0.113	0.009	0.015	0.095	0.098	0.007	0.013	0.083	0.105	0.007	0.013	0.054	0.060	0.004	0.007	0.074	0.091	0.006	0.011
	0.125	0.127	0.011	0.019	0.117	0.121	0.010	0.017	0.102	0.112	0.008	0.015	0.089	0.114	0.008	0.014	0.061	0.075	0.005	0.009	0.078	0.096	0.006	0.012
																	0.067	0.085	0.006	0.011				
																	0.076	0.092	0.006	0.012				
																	0.081	0.098	0.007	0.012				

Table A.4: Measurements for catch basin inlet #2 (OPSD 400.070) - double round herringbone with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)	depth	Catchme	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.021	0.0009	0.001	5.7E-06	0.018	0.0008	0.001	5.2E-06	0.016	0.0008	0.001	5.0E-06	0.017	0.0009	0.001	5.7E-06	0.017	0.0010	0.001	6.1E-06	0.010	0.0008	0.002	4.9E-06
	0.029	0.0026	0.001	1.6E-05	0.022	0.0026	0.001	1.6E-05	0.026	0.0024	0.002	1.5E-05	0.020	0.0026	0.001	1.6E-05	0.020	0.0023	0.001	1.4E-05	0.015	0.0026	0.001	1.6E-05
	0.036	0.0048	0.001	3.0E-05	0.026	0.0049	0.001	3.0E-05	0.031	0.0052	0.002	3.3E-05	0.025	0.0056	0.001	3.4E-05	0.024	0.0052	0.001	3.2E-05	0.019	0.0053	0.001	3.3E-05
	0.048	0.013	0.001	0.003	0.040	0.013	0.001	0.003	0.037	0.016	0.001	0.004	0.033	0.014	0.001	0.003	0.034	0.015	0.001	0.003	0.028	0.013	0.001	0.003
	0.063	0.028	0.002	0.005	0.047	0.024	0.001	0.004	0.043	0.028	0.001	0.004	0.041	0.024	0.001	0.004	0.042	0.025	0.002	0.004	0.036	0.023	0.002	0.004
	0.076	0.044	0.002	0.006	0.061	0.042	0.001	0.006	0.056	0.043	0.002	0.006	0.042	0.025	0.002	0.004	0.058	0.043	0.002	0.006	0.048	0.040	0.003	0.006
	0.094	0.062	0.003	0.008	0.075	0.061	0.002	0.008	0.079	0.065	0.002	0.008	0.056	0.037	0.002	0.005	0.068	0.063	0.004	0.007	0.061	0.070	0.004	0.009
	0.104	0.079	0.004	0.010	0.089	0.076	0.003	0.010	0.091	0.083	0.003	0.011	0.059	0.040	0.002	0.005	0.075	0.077	0.004	0.009	0.064	0.057	0.004	0.007
	0.108	0.090	0.006	0.012	0.099	0.087	0.005	0.012	0.097	0.094	0.005	0.012	0.076	0.063	0.003	0.008	0.079	0.084	0.005	0.010	0.064	0.076	0.005	0.010
	0.120	0.107	0.007	0.014	0.113	0.110	0.006	0.015	0.106	0.109	0.006	0.014	0.076	0.064	0.003	0.009	0.087	0.095	0.006	0.012	0.072	0.087	0.006	0.011
	0.131	0.121	0.008	0.017	0.124	0.130	0.007	0.019	0.114	0.119	0.007	0.016	0.084	0.083	0.004	0.011	0.095	0.106	0.006	0.014	0.079	0.094	0.006	0.012
	0.144	0.139	0.008	0.020	0.134	0.153	0.008	0.023	0.124	0.129	0.007	0.018	0.087	0.092	0.005	0.012	0.103	0.121	0.007	0.017	0.086	0.104	0.006	0.014
	0.153	0.148	0.009	0.022	0.143	0.168	0.009	0.026	0.131	0.138	0.009	0.019	0.092	0.100	0.005	0.014	0.110	0.132	0.008	0.019	0.091	0.111	0.007	0.014
													0.096	0.105	0.006	0.015								
													0.097	0.106	0.006	0.014								
													0.103	0.112	0.006	0.015								
													0.105	0.121	0.007	0.017								
													0.106	0.117	0.007	0.016								
													0.114	0.134	0.007	0.019								
													0.119	0.140	0.008	0.020								

Table A.5: Measurements for catch basin inlet #3 (OPSD 400.020) - single square herringbone with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.021	0.0009	0.001	0.0002	0.016	0.0009	0.002	0.0002	0.013	0.0009	0.005	0.0002	0.010	0.0008	0.002	0.0002	0.009	0.0007	0.003	0.0002	0.008	0.0010	0.002	0.0002
	0.027	0.0026	0.001	0.0002	0.020	0.0028	0.002	0.0002	0.016	0.0028	0.004	0.0002	0.016	0.0028	0.001	0.0002	0.015	0.0029	0.002	0.0002	0.013	0.0024	0.002	0.0002
	0.033	0.004	0.001	0.002	0.026	0.0051	0.001	0.0002	0.022	0.0054	0.001	0.0002	0.020	0.0053	0.001	0.0002	0.021	0.0051	0.001	0.0002	0.020	0.0041	0.002	0.0002
	0.041	0.010	0.001	0.003	0.033	0.009	0.001	0.003	0.025	0.010	0.001	0.003	0.023	0.010	0.001	0.003	0.024	0.010	0.001	0.003	0.024	0.009	0.001	0.003
	0.050	0.017	0.001	0.004	0.034	0.008	0.001	0.003	0.032	0.017	0.001	0.004	0.029	0.016	0.001	0.003	0.030	0.017	0.002	0.004	0.030	0.016	0.002	0.003
	0.062	0.026	0.002	0.004	0.042	0.016	0.001	0.004	0.043	0.028	0.001	0.005	0.038	0.026	0.002	0.004	0.038	0.026	0.002	0.004	0.037	0.025	0.003	0.004
	0.070	0.033	0.003	0.005	0.047	0.024	0.002	0.004	0.055	0.038	0.002	0.005	0.047	0.037	0.002	0.005	0.044	0.033	0.003	0.005	0.042	0.031	0.003	0.005
	0.083	0.045	0.005	0.007	0.056	0.031	0.002	0.005	0.060	0.045	0.003	0.007	0.048	0.036	0.001	0.005	0.044	0.032	0.003	0.005	0.048	0.037	0.004	0.005
	0.087	0.051	0.006	0.008	0.068	0.043	0.003	0.006	0.065	0.048	0.004	0.007	0.053	0.042	0.003	0.006	0.049	0.038	0.004	0.006	0.052	0.041	0.004	0.006
	0.097	0.060	0.007	0.009	0.074	0.048	0.005	0.007	0.074	0.055	0.005	0.008	0.057	0.046	0.004	0.006	0.049	0.038	0.004	0.005	0.060	0.047	0.005	0.007
	0.104	0.064	0.008	0.009	0.086	0.056	0.006	0.009	0.083	0.060	0.006	0.009	0.066	0.052	0.006	0.007	0.052	0.041	0.004	0.006	0.067	0.051	0.006	0.007
	0.116	0.074	0.009	0.011	0.095	0.061	0.007	0.009	0.092	0.066	0.006	0.010	0.075	0.058	0.006	0.008	0.060	0.047	0.005	0.007	0.074	0.056	0.007	0.008
	0.122	0.079	0.010	0.011	0.105	0.069	0.008	0.011	0.098	0.070	0.007	0.010	0.077	0.057	0.006	0.008	0.067	0.051	0.006	0.007	0.078	0.059	0.007	0.008
					0.112	0.074	0.008	0.011					0.081	0.062	0.006	0.008	0.067	0.053	0.006	0.007				
													0.086	0.062	0.007	0.009	0.075	0.056	0.006	0.008				
													0.088	0.067	0.007	0.009	0.080	0.059	0.007	0.009				
													0.092	0.066	0.007	0.009								

Table A.6: Measurements for catch basin inlet #3 (OPSD 400.020) - single square herringbone with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.022	0.0010	0.001	0.0002	0.016	0.0009	0.002	0.0002	0.012	0.0008	0.004	0.0002	0.011	0.0010	0.004	0.0002	0.010	0.0008	0.004	0.0002	0.011	0.0010	0.004	0.0002
	0.029	0.0026	0.001	0.0002	0.023	0.0027	0.001	0.0002	0.018	0.0021	0.001	0.0002	0.020	0.0035	0.001	0.0002	0.021	0.0028	0.001	0.0002	0.016	0.0025	0.006	0.0002
	0.035	0.0052	0.002	0.0002	0.026	0.0041	0.001	0.0002	0.023	0.0041	0.001	0.0002	0.023	0.0058	0.001	0.0002	0.022	0.0044	0.001	0.0002	0.025	0.0053	0.001	0.0002
	0.048	0.0132	0.002	0.0002	0.037	0.012	0.001	0.003	0.030	0.010	0.001	0.003	0.030	0.0133	0.001	0.0002	0.029	0.009	0.001	0.003	0.032	0.010	0.002	0.003
	0.058	0.021	0.002	0.004	0.048	0.020	0.001	0.004	0.038	0.020	0.001	0.004	0.039	0.020	0.002	0.004	0.039	0.017	0.002	0.004	0.032	0.011	0.002	0.003
	0.073	0.032	0.002	0.005	0.059	0.032	0.001	0.005	0.043	0.028	0.001	0.005	0.055	0.034	0.002	0.005	0.051	0.029	0.002	0.005	0.039	0.019	0.002	0.004
	0.089	0.044	0.003	0.007	0.069	0.042	0.002	0.006	0.047	0.031	0.001	0.005	0.071	0.047	0.003	0.007	0.055	0.033	0.002	0.005	0.041	0.019	0.002	0.004
	0.101	0.052	0.004	0.008	0.085	0.051	0.003	0.008	0.067	0.041	0.002	0.006	0.078	0.054	0.004	0.009	0.063	0.042	0.003	0.006	0.052	0.032	0.003	0.005
	0.105	0.057	0.005	0.009	0.096	0.056	0.004	0.009	0.083	0.053	0.003	0.008	0.082	0.058	0.004	0.009	0.066	0.043	0.003	0.006	0.063	0.041	0.004	0.006
	0.117	0.065	0.007	0.010	0.110	0.065	0.006	0.011	0.090	0.059	0.004	0.009	0.091	0.064	0.006	0.010	0.071	0.048	0.004	0.007	0.068	0.047	0.004	0.006
	0.129	0.072	0.007	0.011	0.122	0.072	0.007	0.011	0.100	0.067	0.005	0.011	0.099	0.068	0.006	0.010	0.072	0.048	0.004	0.007	0.072	0.051	0.005	0.007
	0.142	0.081	0.008	0.013	0.131	0.080	0.008	0.013	0.108	0.073	0.006	0.011	0.108	0.073	0.007	0.011	0.076	0.052	0.004	0.007	0.081	0.057	0.006	0.008
	0.148	0.086	0.008	0.013	0.140	0.084	0.008	0.013	0.117	0.078	0.006	0.012	0.113	0.076	0.007	0.011	0.076	0.052	0.005	0.007	0.088	0.061	0.006	0.008
									0.123	0.082	0.007	0.012					0.085	0.059	0.006	0.009	0.096	0.066	0.007	0.009
																	0.085	0.058	0.006	0.008	0.100	0.069	0.007	0.009
																	0.092	0.063	0.006	0.009				
																	0.094	0.063	0.006	0.009				
																	0.101	0.068	0.006	0.010				
																	0.101	0.068	0.007	0.011				
																	0.107	0.071	0.008	0.011				
																	0.107	0.070	0.007	0.010				

Table A.7: Measurements for catch basin inlet #4 (OPSD 400.020) - double square herringbone with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.015	0.0007	0.001	0.0002	0.012	0.0008	0.001	0.0002	0.010	0.0007	0.001	0.0002	0.010	0.0006	0.001	0.0002	0.009	0.0007	0.001	0.0002	0.009	0.0011	0.001	0.0002
	0.022	0.0029	0.001	0.0002	0.016	0.0024	0.001	0.0002	0.016	0.0027	0.001	0.0002	0.016	0.0026	0.001	0.0002	0.014	0.0023	0.001	0.0002	0.013	0.0029	0.001	0.0002
	0.027	0.0059	0.001	0.0002	0.020	0.0053	0.001	0.0002	0.019	0.0053	0.001	0.0002	0.017	0.0060	0.001	0.0002	0.017	0.0055	0.001	0.0002	0.019	0.0051	0.001	0.0002
	0.038	0.0145	0.001	0.0002	0.027	0.011	0.001	0.003	0.025	0.0142	0.001	0.0002	0.024	0.013	0.001	0.003	0.022	0.011	0.001	0.003	0.021	0.010	0.001	0.003
	0.046	0.021	0.002	0.004	0.036	0.018	0.001	0.004	0.031	0.020	0.001	0.004	0.029	0.021	0.001	0.004	0.027	0.017	0.002	0.004	0.027	0.018	0.001	0.004
	0.058	0.031	0.002	0.005	0.043	0.029	0.001	0.005	0.041	0.034	0.001	0.005	0.036	0.034	0.002	0.005	0.035	0.031	0.002	0.005	0.033	0.028	0.002	0.005
	0.068	0.045	0.004	0.006	0.054	0.041	0.003	0.006	0.052	0.049	0.002	0.007	0.044	0.049	0.003	0.007	0.040	0.043	0.003	0.006	0.039	0.041	0.003	0.007
	0.078	0.058	0.005	0.008	0.065	0.056	0.004	0.008	0.058	0.063	0.003	0.009	0.050	0.060	0.004	0.009	0.046	0.057	0.004	0.008	0.045	0.053	0.004	0.009
	0.083	0.066	0.006	0.009	0.070	0.065	0.005	0.010	0.062	0.071	0.004	0.010	0.054	0.068	0.004	0.009	0.050	0.063	0.004	0.009	0.049	0.060	0.004	0.009
	0.094	0.087	0.008	0.012	0.083	0.083	0.007	0.012	0.071	0.085	0.006	0.011	0.062	0.080	0.006	0.011	0.058	0.075	0.005	0.010	0.056	0.072	0.006	0.011
	0.103	0.106	0.008	0.014	0.093	0.096	0.008	0.013	0.080	0.097	0.006	0.012	0.071	0.096	0.007	0.012	0.065	0.084	0.006	0.011	0.063	0.078	0.007	0.012
	0.116	0.129	0.010	0.017	0.105	0.113	0.009	0.015	0.090	0.108	0.007	0.014	0.079	0.110	0.007	0.015	0.073	0.095	0.007	0.013	0.070	0.089	0.007	0.015
	0.117	0.132	0.010	0.017	0.112	0.121	0.010	0.017	0.096	0.116	0.008	0.014	0.086	0.119	0.008	0.016	0.078	0.101	0.007	0.014	0.074	0.093	0.008	0.016
	0.123	0.149	0.011	0.021																				

Table A.8: Measurements for catch basin inlet #4 (OPSD 400.020) - double square herringbone with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.018	0.0008	0.002	0.0002	0.017	0.0010	0.001	0.0002	0.016	0.0010	0.002	0.0002	0.013	0.0010	0.003	0.0002	0.013	0.0007	0.001	0.0002	0.012	0.0009	0.002	0.0002
	0.028	0.0032	0.001	0.0002	0.021	0.0027	0.001	0.0002	0.020	0.0029	0.001	0.0002	0.017	0.0031	0.001	0.0002	0.018	0.0026	0.001	0.0002	0.019	0.0024	0.001	0.0002
	0.035	0.0074	0.001	0.0002	0.029	0.0069	0.001	0.0002	0.025	0.0066	0.001	0.0002	0.022	0.0067	0.001	0.0002	0.022	0.0056	0.001	0.0002	0.021	0.0046	0.001	0.0002
	0.052	0.017	0.002	0.004	0.042	0.014	0.001	0.003	0.033	0.014	0.001	0.003	0.031	0.014	0.001	0.003	0.030	0.012	0.002	0.003	0.031	0.0135	0.002	0.0002
	0.061	0.028	0.002	0.005	0.049	0.025	0.001	0.004	0.039	0.026	0.001	0.004	0.040	0.025	0.002	0.004	0.039	0.024	0.002	0.004	0.038	0.021	0.002	0.004
	0.079	0.049	0.003	0.007	0.060	0.045	0.002	0.006	0.053	0.044	0.001	0.006	0.055	0.044	0.002	0.007	0.052	0.044	0.003	0.006	0.038	0.021	0.002	0.004
	0.094	0.068	0.004	0.010	0.076	0.064	0.003	0.009	0.075	0.068	0.003	0.009	0.068	0.069	0.003	0.010	0.063	0.064	0.004	0.010	0.050	0.040	0.003	0.006
	0.099	0.082	0.005	0.011	0.080	0.068	0.003	0.010	0.086	0.087	0.004	0.012	0.070	0.071	0.003	0.010	0.070	0.081	0.004	0.012	0.058	0.056	0.004	0.008
	0.104	0.093	0.006	0.013	0.091	0.082	0.004	0.011	0.091	0.098	0.005	0.013	0.075	0.088	0.004	0.011	0.073	0.089	0.005	0.013	0.063	0.069	0.004	0.010
	0.117	0.115	0.007	0.015	0.100	0.094	0.005	0.012	0.099	0.117	0.006	0.016	0.079	0.101	0.005	0.014	0.082	0.102	0.006	0.015	0.068	0.077	0.005	0.012
	0.127	0.133	0.008	0.018	0.112	0.118	0.007	0.017	0.108	0.127	0.006	0.019	0.089	0.121	0.006	0.016	0.090	0.110	0.007	0.017	0.077	0.091	0.006	0.014
	0.140	0.156	0.008	0.022	0.122	0.136	0.007	0.019	0.118	0.142	0.007	0.021	0.098	0.138	0.007	0.020	0.097	0.121	0.007	0.019	0.085	0.100	0.007	0.015
	0.144	0.166	0.009	0.024	0.122	0.137	0.007	0.019	0.125	0.149	0.008	0.022	0.106	0.146	0.007	0.022	0.105	0.129	0.008	0.020	0.093	0.110	0.007	0.017
					0.133	0.160	0.008	0.023					0.112	0.157	0.008	0.025					0.098	0.114	0.008	0.017
					0.141	0.164	0.009	0.024																

Table A.9: Measurements for catch basin inlet #5 (MT-310) - single square with square bars and a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.020	0.0009	0.007	0.0002	0.017	0.0009	0.002	0.0002	0.014	0.0011	0.002	0.0002	0.011	0.0008	0.004	0.0002	0.015	0.0007	0.002	0.0002	0.013	0.0007	0.001	0.0002
	0.024	0.0021	0.001	0.0002	0.022	0.0030	0.001	0.0002	0.017	0.0026	0.003	0.0002	0.016	0.0027	0.001	0.0002	0.017	0.0028	0.001	0.0002	0.016	0.0018	0.001	0.0002
	0.029	0.0040	0.001	0.0002	0.026	0.0056	0.001	0.0002	0.020	0.0045	0.001	0.0002	0.018	0.004	0.001	0.002	0.018	0.004	0.001	0.002	0.017	0.0043	0.001	0.0002
	0.031	0.0049	0.001	0.0002	0.034	0.011	0.001	0.003	0.025	0.0130	0.001	0.0002	0.021	0.007	0.001	0.003	0.022	0.007	0.001	0.003	0.021	0.0073	0.001	0.0002
	0.033	0.0061	0.001	0.0002	0.039	0.016	0.001	0.004	0.031	0.018	0.001	0.004	0.033	0.019	0.001	0.004	0.034	0.020	0.002	0.004	0.034	0.018	0.002	0.004
	0.033	0.0064	0.001	0.0002	0.052	0.030	0.002	0.005	0.043	0.030	0.001	0.005	0.038	0.027	0.001	0.005	0.040	0.026	0.002	0.005	0.044	0.029	0.003	0.005
	0.040	0.006	0.001	0.003	0.062	0.040	0.003	0.006	0.056	0.040	0.003	0.006	0.048	0.036	0.003	0.005	0.045	0.032	0.003	0.005	0.049	0.036	0.004	0.006
	0.050	0.013	0.001	0.003	0.072	0.047	0.004	0.007	0.062	0.048	0.004	0.007	0.060	0.046	0.004	0.006	0.052	0.038	0.004	0.006	0.050	0.037	0.004	0.007
	0.062	0.021	0.002	0.004	0.077	0.051	0.005	0.008	0.067	0.052	0.004	0.008	0.070	0.052	0.006	0.007	0.056	0.040	0.004	0.006	0.055	0.040	0.005	0.007
	0.068	0.027	0.003	0.005	0.088	0.059	0.007	0.009	0.076	0.058	0.005	0.008	0.076	0.055	0.006	0.008	0.064	0.046	0.005	0.007	0.062	0.045	0.006	0.010
	0.082	0.040	0.005	0.006	0.095	0.063	0.007	0.009	0.082	0.061	0.006	0.009	0.084	0.060	0.006	0.008	0.069	0.050	0.006	0.007	0.067	0.048	0.006	0.013
	0.087	0.045	0.006	0.008	0.106	0.071	0.008	0.011	0.091	0.067	0.006	0.009	0.091	0.063	0.007	0.008	0.077	0.054	0.006	0.008	0.074	0.052	0.006	0.018
	0.097	0.052	0.007	0.009	0.112	0.076	0.009	0.011	0.099	0.070	0.007	0.010					0.083	0.057	0.007	0.008	0.079	0.054	0.007	0.021
	0.103	0.057	0.008	0.009																				
	0.117	0.066	0.009	0.011																				
	0.123	0.072	0.010	0.011																				

Table A.10: Measurements for catch basin inlet #5 (MT-310) - single square with square bars and a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0		4.0		4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5		2.5		5.0				7.5				10.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.012	0.00013	0.001	2.7E-06	0.014	0.0001	0.002	0.0002	0.018	0.0009	0.004	0.0002	0.015	0.0010	0.004	0.0002	0.014	0.0010	0.004	0.0002	0.016	0.0010	0.004	0.0002
	0.018	0.0004	0.002	8.0E-06	0.018	0.0005	0.002	0.0002	0.024	0.0032	0.001	0.0002	0.017	0.0030	0.002	0.0002	0.016	0.0011	0.005	0.0002	0.017	0.0010	0.004	0.0002
	0.023	0.001	0.001	1.6E-05	0.023	0.0014	0.001	0.0002	0.027	0.0066	0.001	0.0002	0.024	0.0063	0.001	0.0002	0.018	0.0037	0.004	0.0002	0.017	0.0024	0.003	0.0002
	0.026	0.001	0.001	2.8E-05	0.023	0.0013	0.001	7.8E-06	0.029	0.0109	0.001	0.0002	0.026	0.0069	0.001	0.0000	0.031	0.0068	0.001	0.0002	0.020	0.0030	0.001	0.0002
	0.027	0.002	0.001	3.6E-05	0.023	0.0013	0.001	7.8E-06	0.041	0.022	0.001	0.004	0.028	0.0102	0.001	0.0002	0.035	0.0131	0.002	0.0001	0.021	0.0044	0.001	0.0002
	0.028	0.002	0.001	3.0E-05	0.024	0.0014	0.001	0.0002	0.053	0.032	0.001	0.005	0.045	0.024	0.002	0.004	0.050	0.026	0.002	0.005	0.025	0.0060	0.001	0.0002
	0.037	0.009	0.001	0.004	0.032	0.0044	0.001	0.0002	0.074	0.040	0.002	0.006	0.058	0.032	0.002	0.005	0.059	0.033	0.002	0.005	0.027	0.0081	0.001	0.0002
	0.038	0.005	0.001	1.0E-04	0.037	0.0082	0.001	0.0002	0.087	0.049	0.003	0.007	0.069	0.041	0.003	0.006	0.068	0.041	0.004	0.006	0.029	0.0100	0.001	0.0002
	0.044	0.007	0.001	1.4E-04	0.058	0.021	0.001	0.004	0.092	0.054	0.004	0.008	0.080	0.049	0.004	0.008	0.078	0.047	0.004	0.007	0.040	0.0176	0.002	0.0001
	0.053	0.013	0.002	2.6E-04	0.068	0.034	0.002	0.006	0.101	0.062	0.005	0.009	0.084	0.053	0.004	0.008	0.080	0.050	0.005	0.008	0.046	0.022	0.002	0.004
	0.054	0.015	0.002	2.9E-04	0.069	0.034	0.002	0.006	0.107	0.066	0.006	0.010	0.093	0.059	0.006	0.009	0.089	0.055	0.006	0.008	0.052	0.028	0.003	0.005
	0.058	0.018	0.002	0.005	0.071	0.039	0.002	0.006	0.117	0.072	0.006	0.010	0.098	0.062	0.006	0.009	0.094	0.058	0.006	0.009	0.053	0.029	0.003	0.005
	0.060	0.022	0.002	2.0E-04	0.087	0.046	0.004	0.007	0.124	0.075	0.007	0.012	0.109	0.067	0.007	0.010	0.102	0.063	0.006	0.009	0.060	0.036	0.004	0.006
	0.063	0.018	0.002	3.7E-04	0.099	0.053	0.005	0.008					0.114	0.070	0.007	0.010	0.105	0.063	0.007	0.009	0.064	0.037	0.004	0.006
	0.065	0.024	0.002	4.7E-04	0.113	0.063	0.006	0.009									0.109	0.065	0.007	0.010	0.068	0.042	0.004	0.007
	0.066	0.028	0.002	0.005	0.123	0.069	0.007	0.010													0.072	0.045	0.005	0.007
	0.070	0.024	0.002	4.8E-04	0.131	0.074	0.007	0.011													0.079	0.049	0.006	0.007
	0.073	0.032	0.002	0.005	0.140	0.078	0.008	0.012													0.080	0.050	0.006	0.008
	0.075	0.028	0.002	0.005																	0.083	0.051	0.006	0.008
	0.086	0.039	0.003	0.006																	0.086	0.053	0.006	0.008
	0.088	0.042	0.003	0.006																	0.089	0.053	0.006	0.008
	0.102	0.053	0.004	0.008																	0.090	0.054	0.006	0.009
	0.102	0.053	0.004	0.008																	0.094	0.057	0.007	0.009
	0.109	0.056	0.005	0.008																	0.096	0.057	0.007	0.009
	0.122	0.063	0.006	0.010																	0.100	0.060	0.007	0.009
	0.123	0.066	0.007	0.010																	0.102	0.060	0.007	0.009
	0.131	0.066	0.007	0.010																				
	0.133	0.070	0.007	0.011																				
	0.133	0.073	0.007	0.011																				
	0.144	0.076	0.008	0.011																				
	0.151	0.080	0.008	0.012																				
	0.154	0.083	0.008	0.012																				

Table A.11: Measurements for catch basin inlet #6 (Stepcon 5103) - high capacity inlet with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.016	0.0008	0.001	0.0002	0.016	0.0010	0.001	0.0002	0.015	0.0011	0.001	0.0002	0.011	0.0008	0.001	0.0002	0.011	0.0015	0.001	0.0002	0.007	0.0009	0.001	0.0002
	0.022	0.0025	0.001	0.0002	0.018	0.0027	0.001	0.0002	0.017	0.0028	0.001	0.0002	0.017	0.0033	0.001	0.0002	0.016	0.0026	0.001	0.0002	0.013	0.0028	0.002	0.0002
	0.027	0.0050	0.001	0.0002	0.023	0.0061	0.001	0.0002	0.021	0.0062	0.001	0.0002	0.021	0.0062	0.001	0.0002	0.020	0.0055	0.001	0.0002	0.020	0.0055	0.001	0.0002
	0.038	0.0145	0.001	0.0002	0.033	0.0153	0.001	0.0002	0.027	0.013	0.001	0.003	0.025	0.013	0.001	0.003	0.024	0.0136	0.001	0.0002	0.024	0.012	0.001	0.003
	0.048	0.019	0.001	0.004	0.037	0.022	0.001	0.004	0.033	0.023	0.001	0.004	0.032	0.025	0.001	0.005	0.031	0.022	0.002	0.004	0.030	0.021	0.002	0.004
	0.060	0.033	0.002	0.006	0.049	0.039	0.002	0.006	0.045	0.041	0.001	0.007	0.041	0.044	0.002	0.007	0.038	0.038	0.002	0.005	0.037	0.039	0.003	0.006
	0.071	0.049	0.004	0.008	0.060	0.056	0.003	0.009	0.057	0.064	0.003	0.010	0.050	0.067	0.003	0.011	0.045	0.059	0.003	0.009	0.041	0.054	0.003	0.008
	0.077	0.065	0.004	0.010	0.069	0.072	0.004	0.011	0.062	0.082	0.004	0.012	0.055	0.085	0.004	0.012	0.050	0.078	0.004	0.012	0.048	0.077	0.004	0.010
	0.080	0.082	0.006	0.014	0.074	0.085	0.005	0.013	0.066	0.096	0.005	0.014	0.059	0.100	0.005	0.015	0.054	0.093	0.004	0.013	0.052	0.092	0.005	0.012
	0.092	0.107	0.007	0.015	0.086	0.113	0.007	0.016	0.075	0.124	0.006	0.017	0.068	0.129	0.006	0.019	0.062	0.121	0.005	0.016	0.060	0.116	0.005	0.016
	0.103	0.133	0.008	0.021	0.096	0.138	0.008	0.020	0.084	0.145	0.006	0.022	0.076	0.155	0.006	0.024	0.069	0.150	0.006	0.020	0.067	0.145	0.006	0.021
	0.117	0.173	0.009	0.026	0.107	0.177	0.008	0.027	0.094	0.184	0.007	0.026	0.085	0.178	0.007	0.029	0.077	0.172	0.007	0.024	0.075	0.178	0.006	0.027
	0.122	0.195	0.010	0.031	0.113	0.198	0.009	0.029	0.101	0.204	0.008	0.032	0.090	0.206	0.008	0.033	0.084	0.199	0.007	0.032	0.081	0.195	0.007	0.031

Table A.12: Measurements for catch basin inlet #6 (Stepcon 5103) - high capacity inlet with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.021	0.0009	0.003	0.0002	0.018	0.0010	0.003	0.0002	0.016	0.0010	0.001	0.0002	0.016	0.0009	0.001	0.0002	0.013	0.0008	0.001	0.0002	0.015	0.0010	0.001	0.0002
	0.029	0.0028	0.001	0.0002	0.023	0.0026	0.001	0.0002	0.020	0.0029	0.001	0.0002	0.019	0.0029	0.001	0.0002	0.020	0.0030	0.001	0.0002	0.019	0.0027	0.001	0.0002
	0.034	0.0057	0.001	0.0002	0.027	0.0059	0.001	0.0002	0.026	0.0066	0.001	0.0002	0.022	0.0055	0.001	0.0002	0.023	0.0061	0.001	0.0002	0.023	0.0055	0.001	0.0002
	0.052	0.0160	0.001	0.0002	0.040	0.0161	0.001	0.0002	0.034	0.0154	0.001	0.0002	0.031	0.0155	0.001	0.0002	0.032	0.0150	0.001	0.0002	0.033	0.0145	0.002	0.0002
	0.063	0.0291	0.002	0.0002	0.050	0.029	0.001	0.005	0.041	0.027	0.001	0.004	0.040	0.027	0.001	0.004	0.041	0.027	0.002	0.004	0.034	0.016	0.002	0.003
	0.079	0.051	0.002	0.007	0.054	0.050	0.001	0.007	0.048	0.043	0.001	0.006	0.057	0.050	0.002	0.006	0.054	0.051	0.002	0.007	0.040	0.023	0.002	0.004
	0.095	0.074	0.003	0.010	0.076	0.074	0.002	0.010	0.054	0.050	0.001	0.006	0.072	0.087	0.003	0.012	0.066	0.088	0.003	0.011	0.041	0.028	0.002	0.004
	0.103	0.097	0.005	0.013	0.090	0.096	0.004	0.012	0.075	0.077	0.003	0.010	0.080	0.123	0.004	0.017	0.073	0.120	0.004	0.016	0.052	0.044	0.003	0.007
	0.103	0.095	0.005	0.013	0.100	0.111	0.005	0.014	0.088	0.110	0.004	0.014	0.084	0.146	0.005	0.022	0.078	0.142	0.005	0.019	0.053	0.051	0.003	0.006
	0.108	0.110	0.005	0.015	0.113	0.145	0.006	0.020	0.095	0.133	0.004	0.018	0.093	0.187	0.006	0.028	0.087	0.179	0.006	0.026	0.068	0.111	0.004	0.014
	0.119	0.138	0.007	0.020	0.125	0.180	0.007	0.027	0.104	0.173	0.006	0.026	0.101	0.215	0.007	0.029	0.096	0.207	0.006	0.032	0.072	0.133	0.005	0.018
	0.130	0.168	0.008	0.025	0.135	0.218	0.008	0.030	0.112	0.212	0.006	0.033	0.111	0.241	0.007	0.034	0.104	0.243	0.007	0.034	0.082	0.170	0.006	0.025
	0.145	0.207	0.009	0.033	0.144	0.235	0.009	0.031	0.122	0.235	0.007	0.031	0.116	0.256	0.008	0.037	0.111	0.260	0.008	0.038	0.090	0.204	0.006	0.033
	0.151	0.222	0.009	0.031					0.129	0.246	0.008	0.034									0.098	0.234	0.006	0.035
																					0.104	0.260	0.007	0.041

Table A.13: Measurements for catch basin inlet #7 (OPSD 401.010) – circular open cover (type B) with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				1.0				2.5				5.0				7.5				10.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.016	0.001	0.002	0.0002	0.017	0.001	0.001	0.0002	0.014	0.001	0.001	0.0002	0.014	0.001	0.001	0.00001	0.012	0.001	0.001	0.0002	0.010	0.001	0.001	0.000
	0.025	0.003	0.001	0.0002	0.021	0.002	0.001	0.0002	0.016	0.001	0.001	0.0002	0.017	0.002	0.001	0.00002	0.017	0.003	0.001	0.0002	0.013	0.002	0.001	0.000
	0.029	0.005	0.001	0.0002	0.024	0.005	0.001	0.0002	0.016	0.002	0.001	0.0002	0.019	0.005	0.001	0.00003	0.020	0.006	0.001	0.0002	0.014	0.002	0.002	0.000
	0.040	0.012	0.001	0.003	0.032	0.011	0.001	0.003	0.020	0.003	0.001	0.0002	0.026	0.013	0.001	0.003	0.026	0.010	0.001	0.003	0.021	0.006	0.001	0.000
	0.050	0.017	0.001	0.004	0.037	0.016	0.001	0.004	0.021	0.005	0.001	0.0002	0.032	0.015	0.001	0.003	0.031	0.014	0.001	0.003	0.025	0.009	0.001	0.003
	0.064	0.023	0.002	0.004	0.049	0.021	0.002	0.004	0.023	0.006	0.001	0.0002	0.032	0.016	0.001	0.004	0.031	0.014	0.001	0.003	0.030	0.013	0.002	0.003
	0.073	0.025	0.004	0.004	0.061	0.025	0.003	0.004	0.026	0.011	0.001	0.003	0.041	0.019	0.002	0.004	0.040	0.018	0.002	0.004	0.038	0.016	0.003	0.004
	0.075	0.025	0.004	0.004	0.069	0.028	0.004	0.005	0.027	0.011	0.001	0.003	0.049	0.022	0.003	0.004	0.046	0.020	0.004	0.004	0.043	0.018	0.004	0.004
	0.079	0.029	0.005	0.005	0.075	0.029	0.005	0.005	0.034	0.015	0.001	0.003	0.050	0.023	0.003	0.004	0.051	0.023	0.004	0.004	0.049	0.021	0.004	0.004
	0.082	0.031	0.006	0.005	0.086	0.033	0.007	0.005	0.034	0.016	0.001	0.003	0.055	0.024	0.004	0.004	0.055	0.024	0.004	0.004	0.053	0.022	0.005	0.004
	0.093	0.036	0.007	0.006	0.097	0.036	0.008	0.005	0.048	0.022	0.002	0.004	0.059	0.026	0.005	0.004	0.062	0.027	0.005	0.004	0.061	0.024	0.005	0.004
	0.104	0.038	0.008	0.006	0.109	0.040	0.009	0.006	0.048	0.021	0.002	0.004	0.069	0.028	0.006	0.004	0.069	0.028	0.006	0.004	0.068	0.026	0.006	0.004
	0.117	0.043	0.010	0.006	0.116	0.041	0.009	0.006	0.056	0.024	0.003	0.004	0.077	0.029	0.006	0.004	0.069	0.028	0.006	0.004	0.076	0.028	0.007	0.004
	0.124	0.044	0.011	0.006					0.058	0.025	0.002	0.004	0.085	0.032	0.007	0.005	0.077	0.030	0.006	0.005	0.081	0.029	0.007	0.004
									0.063	0.027	0.004	0.005	0.091	0.033	0.008	0.005	0.084	0.031	0.007	0.005				
									0.064	0.028	0.003	0.005												
									0.067	0.028	0.005	0.005												
									0.068	0.030	0.004	0.005												
									0.075	0.031	0.006	0.005												
									0.077	0.033	0.006	0.005												
									0.084	0.033	0.007	0.005												
									0.086	0.034	0.007	0.005												
									0.094	0.036	0.007	0.005												
									0.096	0.037	0.007	0.005												
									0.102	0.037	0.008	0.005												
									0.104	0.039	0.008	0.006												

Table A.14: Measurements for catch basin inlet #8 (OPSD 401.010) – circular closed cover (type A) with a cross-slope of 2.0%

cross-slope (%)	2.0				2.0			
Grade (%)	0.5				2.5			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.019	0.00053	0.001	0.00001	0.015	0.00038	0.001	0.00001
	0.025	0.00086	0.001	0.00001	0.018	0.00046	0.001	0.00001
	0.028	0.00105	0.001	0.00001	0.023	0.00055	0.001	0.00001
	0.025	0.00086	0.001	0.00001	0.027	0.00072	0.001	0.00001
	0.028	0.00105	0.001	0.00001	0.034	0.00084	0.001	0.00001
	0.039	0.00114	0.001	0.00001	0.049	0.00108	0.002	0.00001
	0.049	0.00127	0.001	0.00001	0.060	0.00113	0.002	0.00001
	0.063	0.00150	0.002	0.00001	0.064	0.00115	0.004	0.00001
	0.074	0.00164	0.004	0.00001	0.069	0.00113	0.005	0.00001
	0.079	0.00178	0.005	0.00001	0.064	0.00115	0.004	0.00001
	0.083	0.00183	0.006	0.00001	0.069	0.00113	0.005	0.00001
	0.093	0.00197	0.008	0.00001	0.077	0.00119	0.006	0.00001
	0.103	0.00211	0.008	0.00001	0.086	0.00127	0.007	0.00001

Table A.15: Measurements for catch basin inlet #9 (S19) – "FISH" single round catch basin cover with a cross-slope of 0.0% or 2.0%

cross-slope (%)	0.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				0.5				1.0				2.5				5.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.012	0.0010	0.001	2.0E-05	0.016	0.0001	0.001	2.3E-06	0.010	0.0004	0.005	8.8E-06	0.014	0.0004	0.0010	8.1E-06	0.013	0.0012	0.001	2.4E-05
	0.031	0.025	0.002	0.005	0.019	0.0007	0.001	1.5E-05	0.016	0.0008	0.001	1.6E-05	0.017	0.0009	0.0011	1.8E-05	0.015	0.0028	0.001	5.5E-05
	0.041	0.033	0.002	0.005	0.024	0.0013	0.001	2.7E-05	0.021	0.0015	0.001	3.0E-05	0.022	0.0017	0.0011	3.4E-05	0.018	0.0050	0.001	9.9E-05
	0.063	0.052	0.005	0.008	0.036	0.014	0.001	0.004	0.028	0.014	0.001	0.003	0.026	0.014	0.001	0.004	0.022	0.0079	0.001	1.6E-04
	0.065	0.054	0.005	0.008	0.046	0.021	0.001	0.004	0.035	0.021	0.001	0.005	0.034	0.021	0.001	0.004	0.022	0.010	0.001	0.003
	0.080	0.069	0.005	0.010	0.061	0.031	0.003	0.005	0.048	0.031	0.002	0.005	0.047	0.032	0.001	0.005	0.024	0.013	0.001	0.003
	0.093	0.081	0.007	0.012	0.070	0.038	0.004	0.005	0.060	0.038	0.003	0.005	0.057	0.036	0.002	0.006	0.032	0.021	0.001	0.004
	0.095	0.084	0.007	0.013	0.081	0.044	0.005	0.007	0.069	0.044	0.004	0.006	0.064	0.042	0.003	0.007	0.041	0.028	0.001	0.004
	0.105	0.091	0.007	0.013	0.085	0.047	0.006	0.007	0.074	0.047	0.005	0.006	0.070	0.045	0.004	0.007	0.046	0.033	0.002	0.005
	0.124	0.107	0.008	0.016	0.093	0.054	0.007	0.007	0.084	0.053	0.006	0.006	0.076	0.049	0.005	0.007	0.053	0.038	0.003	0.005
	0.144	0.123	0.007	0.018	0.102	0.059	0.008	0.008	0.093	0.058	0.007	0.007	0.084	0.053	0.006	0.007	0.057	0.041	0.003	0.006
	0.166	0.131	0.006	0.017	0.103	0.060	0.008	0.008	0.101	0.063	0.008	0.008	0.092	0.056	0.006	0.008	0.064	0.043	0.005	0.005
	0.204	0.144	0.006	0.020	0.111	0.065	0.009	0.009	0.114	0.069	0.009	0.009	0.101	0.060	0.007	0.009	0.072	0.048	0.005	0.006
	0.251	0.163	0.005	0.023	0.124	0.072	0.010	0.010									0.079	0.051	0.006	0.006
	0.311	0.18	0.005	0.03	0.124	0.073	0.010	0.010									0.086	0.056	0.007	0.007
	0.315	0.18	0.005	0.03																
	0.345	0.19	0.005	0.03																

Table A.16: Measurements for catch basin inlet #9 (S19) – “FISH” single round catch basin cover with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.023	0.0013	0.002	2.7E-05	0.020	0.0013	0.001	2.5E-05	0.021	0.0011	0.001	2.2E-05	0.018	0.0010	0.004	2.0E-05
	0.028	0.0030	0.001	6.1E-05	0.024	0.0029	0.001	5.7E-05	0.024	0.0024	0.001	4.7E-05	0.021	0.0023	0.001	4.6E-05
	0.035	0.0056	0.001	1.1E-04	0.029	0.0058	0.001	1.2E-04	0.027	0.0046	0.001	9.3E-05	0.025	0.0041	0.001	8.3E-05
	0.046	0.018	0.001	0.004	0.041	0.018	0.001	0.004	0.034	0.015	0.001	0.004	0.030	0.014	0.001	0.003
	0.061	0.028	0.002	0.005	0.053	0.027	0.001	0.005	0.043	0.024	0.001	0.004	0.037	0.022	0.001	0.004
	0.081	0.039	0.002	0.006	0.067	0.040	0.002	0.006	0.052	0.032	0.001	0.005	0.055	0.030	0.002	0.005
	0.095	0.049	0.004	0.006	0.079	0.048	0.002	0.006	0.075	0.039	0.002	0.006	0.072	0.041	0.002	0.006
	0.107	0.053	0.004	0.007	0.093	0.052	0.003	0.008	0.089	0.049	0.003	0.007	0.083	0.046	0.003	0.007
	0.112	0.056	0.005	0.008	0.100	0.056	0.004	0.008	0.095	0.053	0.003	0.008	0.087	0.052	0.004	0.007
	0.122	0.064	0.006	0.008	0.114	0.064	0.006	0.008	0.105	0.058	0.005	0.009	0.093	0.057	0.005	0.007
	0.133	0.071	0.007	0.009	0.123	0.069	0.006	0.009	0.115	0.063	0.005	0.009	0.101	0.061	0.005	0.008
	0.146	0.076	0.007	0.010	0.132	0.073	0.006	0.010	0.121	0.067	0.006	0.010	0.108	0.063	0.006	0.009
	0.162	0.082	0.007	0.010	0.145	0.078	0.007	0.010	0.129	0.072	0.007	0.011	0.113	0.068	0.007	0.009

Table A.17: Measurements for catch basin inlet #10 (S22) – single curb inlet frame with a cross-slope of 0.0% or 2.0%

cross-slope (%)	0.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				0.5				1.0				2.5				5.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.012	0.0018	0.001	3.5E-05	0.017	0.0008	0.001	1.6E-05	0.017	0.0006	0.001	1.2E-05	0.013	0.0006	0.001	1.2E-05	0.007	0.0006	0.002	1.2E-05
	0.024	0.012	0.001	0.004	0.019	0.0015	0.001	3.0E-05	0.020	0.0011	0.001	2.2E-05	0.016	0.0010	0.001	2.0E-05	0.016	0.0007	0.001	1.5E-05
	0.048	0.024	0.002	0.005	0.022	0.0022	0.002	4.5E-05	0.023	0.0017	0.001	3.5E-05	0.020	0.0015	0.001	3.0E-05	0.019	0.0012	0.001	2.4E-05
	0.078	0.040	0.004	0.007	0.035	0.005	0.001	0.003	0.034	0.003	0.001	0.002	0.026	0.003	0.001	0.002	0.025	0.003	0.001	0.003
	0.102	0.054	0.006	0.007	0.045	0.007	0.002	0.003	0.046	0.005	0.002	0.002	0.034	0.004	0.001	0.002	0.034	0.004	0.001	0.003
	0.142	0.087	0.006	0.012	0.063	0.012	0.003	0.003	0.060	0.008	0.002	0.003	0.048	0.007	0.002	0.003	0.045	0.006	0.002	0.003
	0.149	0.091	0.005	0.012	0.079	0.015	0.004	0.004	0.075	0.012	0.003	0.003	0.059	0.010	0.002	0.003	0.055	0.007	0.003	0.003
	0.174	0.115	0.005	0.017	0.084	0.015	0.004	0.004	0.085	0.015	0.004	0.004	0.068	0.010	0.004	0.003	0.062	0.010	0.003	0.003
	0.189	0.128	0.005	0.019	0.095	0.019	0.004	0.004	0.094	0.018	0.005	0.004	0.073	0.014	0.004	0.003	0.067	0.011	0.004	0.003
	0.209	0.137	0.004	0.023	0.107	0.021	0.005	0.004	0.114	0.022	0.006	0.004	0.082	0.016	0.006	0.004	0.079	0.014	0.005	0.004
	0.226	0.16	0.008	0.03	0.129	0.027	0.006	0.005	0.135	0.027	0.008	0.005	0.096	0.019	0.007	0.004	0.095	0.017	0.007	0.004
	0.230	0.16	0.009	0.03	0.150	0.034	0.008	0.005	0.147	0.033	0.008	0.005	0.113	0.021	0.007	0.004	0.107	0.020	0.008	0.004
	0.237	0.16	0.009	0.03	0.151	0.035	0.008	0.005	0.148	0.033	0.008	0.005	0.126	0.024	0.008	0.004	0.116	0.023	0.008	0.005
	0.254	0.15	0.004	0.03	0.171	0.048	0.009	0.006	0.168	0.037	0.010	0.006								
	0.267	0.15	0.004	0.03	0.171	0.039	0.008	0.005												
	0.303	0.17	0.004	0.04	0.171	0.040	0.008	0.006												
	0.348	0.18	0.004	0.05	0.172	0.048	0.009	0.006												
	0.348	0.17	0.004	0.04																

Table A.18: Measurements for catch basin inlet #10 (S22) – single curb inlet frame with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.019	0.0011	0.001	2.2E-05	0.018	0.0011	0.001	2.2E-05	0.018	0.0008	0.001	1.6E-05	0.018	0.0008	0.001	1.5E-05
	0.022	0.0021	0.001	4.1E-05	0.022	0.0017	0.001	3.3E-05	0.019	0.0012	0.001	2.3E-05	0.020	0.0010	0.001	2.1E-05
	0.025	0.0029	0.001	5.8E-05	0.026	0.0021	0.001	4.2E-05	0.023	0.0017	0.001	3.4E-05	0.025	0.0015	0.001	3.0E-05
	0.028	0.0036	0.002	7.1E-05	0.026	0.0025	0.001	5.0E-05	0.035	0.005	0.001	0.002	0.034	0.003	0.001	0.002
	0.040	0.009	0.001	0.003	0.042	0.006	0.001	0.003	0.043	0.008	0.001	0.003	0.044	0.005	0.001	0.002
	0.042	0.009	0.001	0.003	0.042	0.006	0.001	0.003	0.058	0.010	0.001	0.003	0.061	0.009	0.002	0.003
	0.055	0.013	0.002	0.004	0.053	0.009	0.001	0.003	0.073	0.014	0.002	0.004	0.068	0.011	0.002	0.003
	0.073	0.018	0.002	0.004	0.074	0.014	0.001	0.003	0.083	0.017	0.003	0.004	0.079	0.014	0.003	0.003
	0.095	0.021	0.004	0.005	0.091	0.018	0.002	0.004	0.088	0.018	0.004	0.004	0.084	0.015	0.004	0.003
	0.095	0.022	0.004	0.005	0.105	0.021	0.004	0.004	0.099	0.021	0.006	0.004	0.093	0.017	0.005	0.003
	0.107	0.027	0.004	0.004	0.111	0.024	0.005	0.004	0.112	0.024	0.007	0.004	0.105	0.021	0.006	0.004
	0.122	0.028	0.005	0.005	0.126	0.029	0.005	0.005	0.124	0.027	0.007	0.004	0.119	0.024	0.007	0.004
	0.123	0.027	0.006	0.005	0.144	0.033	0.007	0.005	0.137	0.031	0.008	0.005	0.128	0.027	0.008	0.004
	0.148	0.036	0.007	0.005	0.157	0.037	0.008	0.005								
	0.162	0.043	0.008	0.006	0.175	0.042	0.008	0.006								
	0.186	0.046	0.007	0.006												
	0.187	0.046	0.007	0.006												
	0.190	0.057	0.008	0.007												

Table A.19: Measurements for catch basin inlet #11 (S22x2) – double curb inlet frame with a cross-slope of 0.0% or 2.0%

cross-slope (%)	2.0				2.0				2.0				2.0				2.0			
Grade (%)	0.0				0.5				1.0				2.5				5.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.026	0.0033	0.001	6.6E-05	0.019	0.0011	0.001	2.0E-04	0.026	0.0015	0.005	3.0E-05	0.026	0.0008	0.005	1.6E-05	0.029	0.0011	0.003	2.3E-05
	0.032	0.025	0.001	0.004	0.022	0.0027	0.001	2.0E-04	0.030	0.0032	0.005	6.3E-05	0.029	0.0022	0.005	4.4E-05	0.031	0.0014	0.003	2.9E-05
	0.041	0.040	0.001	0.005	0.026	0.005	0.001	0.002	0.037	0.006	0.001	0.002	0.032	0.005	0.001	0.002	0.031	0.0023	0.001	4.7E-05
	0.051	0.046	0.002	0.006	0.033	0.008	0.001	0.003	0.046	0.011	0.001	0.003	0.039	0.007	0.001	0.003	0.035	0.0036	0.001	7.2E-05
	0.066	0.064	0.004	0.008	0.042	0.011	0.002	0.003	0.057	0.015	0.002	0.003	0.046	0.010	0.001	0.003	0.036	0.005	0.001	0.002
	0.106	0.107	0.006	0.014	0.060	0.017	0.003	0.003	0.073	0.021	0.003	0.004	0.059	0.015	0.002	0.003	0.041	0.008	0.001	0.003
	0.129	0.140	0.007	0.019	0.079	0.022	0.005	0.004	0.086	0.028	0.004	0.004	0.072	0.020	0.003	0.003	0.049	0.011	0.001	0.003
	0.150	0.17	0.008	0.02	0.080	0.022	0.005	0.004	0.098	0.033	0.005	0.005	0.080	0.023	0.004	0.004	0.055	0.013	0.002	0.003
	0.167	0.20	0.009	0.03	0.092	0.027	0.006	0.004	0.106	0.037	0.006	0.005	0.086	0.027	0.005	0.004	0.061	0.016	0.002	0.003
	0.181	0.22	0.009	0.03	0.101	0.030	0.007	0.005	0.126	0.047	0.007	0.006	0.095	0.032	0.006	0.004	0.066	0.017	0.003	0.003
	0.181	0.22	0.010	0.03	0.116	0.040	0.008	0.005	0.146	0.058	0.008	0.007	0.110	0.037	0.007	0.005	0.074	0.021	0.004	0.003
	0.195	0.23	0.010	0.03	0.133	0.052	0.008	0.007	0.155	0.068	0.008	0.008	0.125	0.041	0.008	0.005	0.080	0.022	0.004	0.004
	0.217	0.26	0.009	0.04	0.157	0.065	0.010	0.008	0.181	0.081	0.010	0.010	0.137	0.048	0.008	0.006	0.092	0.025	0.006	0.004
	0.246	0.29	0.010	0.04	0.165	0.083	0.009	0.010									0.093	0.025	0.006	0.004
	0.281	0.33	0.017	0.05													0.108	0.030	0.007	0.004
	0.343	0.41	0.019	0.07													0.108	0.030	0.007	0.004
																	0.119	0.035	0.008	0.005
																	0.130	0.042	0.008	0.005

Table A.20: Measurements for catch basin inlet #11 (S22x2) – double curb inlet frame with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.032	0.0013	0.001	2.5E-05	0.033	0.0013	0.001	2.6E-05	0.031	0.0013	0.001	2.6E-05	0.031	0.0012	0.001	2.4E-05
	0.036	0.0026	0.001	5.1E-05	0.038	0.0027	0.001	5.4E-05	0.035	0.0027	0.001	5.4E-05	0.035	0.0024	0.001	4.8E-05
	0.042	0.007	0.001	0.003	0.042	0.006	0.001	0.002	0.040	0.006	0.001	0.002	0.038	0.0035	0.001	7.1E-05
	0.055	0.016	0.001	0.003	0.055	0.013	0.001	0.003	0.048	0.011	0.001	0.003	0.046	0.006	0.001	0.002
	0.070	0.024	0.002	0.004	0.070	0.019	0.001	0.003	0.055	0.016	0.001	0.003	0.056	0.009	0.001	0.003
	0.088	0.033	0.002	0.005	0.087	0.027	0.001	0.004	0.071	0.021	0.002	0.004	0.073	0.016	0.002	0.003
	0.109	0.042	0.004	0.005	0.106	0.035	0.003	0.005	0.086	0.028	0.002	0.004	0.081	0.019	0.003	0.003
	0.123	0.049	0.005	0.006	0.116	0.041	0.004	0.005	0.095	0.033	0.003	0.004	0.090	0.022	0.003	0.004
	0.130	0.054	0.005	0.006	0.124	0.045	0.005	0.005	0.101	0.036	0.004	0.005	0.094	0.024	0.004	0.004
	0.156	0.067	0.007	0.008	0.141	0.058	0.006	0.007	0.107	0.041	0.006	0.005	0.104	0.027	0.005	0.004
	0.171	0.081	0.008	0.009	0.160	0.069	0.008	0.008	0.121	0.047	0.007	0.005	0.119	0.032	0.006	0.004
	0.185	0.095	0.007	0.011	0.171	0.078	0.008	0.009	0.133	0.051	0.007	0.006	0.132	0.036	0.007	0.005
	0.196	0.112	0.009	0.013	0.190	0.092	0.009	0.010	0.147	0.059	0.008	0.007	0.142	0.042	0.008	0.005

Table A.21: Measurements for catch basin inlet #12 (S28) – single curb inlet frame for CBMH with a cross-slope of 0.0% or 2.0%

cross-slope (%)	0.0				2.0				2.0				2.0				2.0			
Grade (%)	0.5				0.5				1.0				2.5				5.0			
	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)	depth	Catchment	Δ(depth)	Δ(flow)
	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)	(m)	(m^3/s)
	0.012	0.0034	0.001	6.8E-05	0.016	0.0015	0.002	3.0E-05	0.015	0.0014	0.005	2.8E-05	0.014	0.0007	0.001	1.4E-05	0.014	0.0006	0.004	1.2E-05
	0.021	0.013	0.002	0.003	0.018	0.0028	0.002	5.6E-05	0.019	0.0022	0.003	4.4E-05	0.017	0.0015	0.001	3.0E-05	0.017	0.0013	0.001	2.5E-05
	0.046	0.026	0.002	0.004	0.024	0.0041	0.001	8.2E-05	0.024	0.0032	0.001	6.4E-05	0.021	0.0023	0.001	4.6E-05	0.018	0.0020	0.001	3.9E-05
	0.083	0.049	0.006	0.009	0.034	0.008	0.001	0.003	0.034	0.0051	0.001	1.0E-04	0.027	0.0041	0.001	8.2E-05	0.023	0.0037	0.001	7.3E-05
	0.109	0.060	0.005	0.011	0.043	0.010	0.002	0.003	0.034	0.007	0.001	0.003	0.034	0.008	0.001	0.003	0.031	0.008	0.001	0.003
	0.135	0.081	0.005	0.017	0.063	0.015	0.003	0.003	0.046	0.009	0.002	0.003	0.047	0.011	0.002	0.003	0.042	0.011	0.002	0.003
	0.153	0.093	0.005	0.019	0.086	0.018	0.004	0.004	0.064	0.012	0.003	0.003	0.061	0.014	0.003	0.003	0.052	0.013	0.002	0.003
	0.164	0.099	0.005	0.020	0.086	0.018	0.004	0.004	0.078	0.015	0.004	0.003	0.062	0.015	0.003	0.003	0.058	0.016	0.004	0.003
	0.204	0.13	0.004	0.03	0.096	0.021	0.005	0.004	0.089	0.019	0.005	0.004	0.069	0.017	0.004	0.004	0.063	0.018	0.004	0.004
	0.252	0.16	0.005	0.03	0.107	0.023	0.005	0.004	0.098	0.022	0.005	0.004	0.074	0.019	0.004	0.004	0.078	0.021	0.005	0.004
	0.292	0.20	0.005	0.04	0.132	0.028	0.007	0.005	0.116	0.027	0.006	0.004	0.083	0.022	0.006	0.004	0.093	0.025	0.007	0.004
	0.331	0.21	0.005	0.04	0.132	0.028	0.007	0.005	0.133	0.032	0.008	0.004	0.083	0.022	0.006	0.004	0.103	0.028	0.008	0.004
	0.352	0.22	0.004	0.03	0.141	0.035	0.007	0.006	0.141	0.038	0.007	0.005	0.097	0.026	0.007	0.004	0.112	0.031	0.009	0.005
					0.141	0.035	0.007	0.006	0.167	0.044	0.009	0.005	0.098	0.025	0.007	0.004				
					0.142	0.036	0.007	0.006					0.098	0.025	0.007	0.004				
					0.154	0.042	0.008	0.007					0.099	0.026	0.006	0.004				
					0.194	0.046	0.010	0.007					0.113	0.028	0.007	0.005				
					0.195	0.048	0.009	0.008					0.125	0.032	0.008	0.005				
					0.195	0.048	0.009	0.008					0.126	0.031	0.008	0.005				
													0.126	0.030	0.008	0.005				
													0.127	0.030	0.008	0.005				

Table A.22: Measurements for catch basin inlet #12 (S28) – single curb inlet frame for CBMH with a cross-slope of 4.0%

cross-slope (%)	4.0				4.0				4.0				4.0			
Grade (%)	0.5				1.0				2.5				5.0			
	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)	depth (m)	Catchment (m^3/s)	Δ(depth) (m)	Δ(flow) (m^3/s)
	0.020	0.0013	0.001	2.6E-05	0.019	0.0012	0.001	2.4E-05	0.017	0.0009	0.001	1.8E-05	0.018	0.0008	0.001	1.6E-05
	0.024	0.0028	0.001	5.5E-05	0.023	0.0025	0.001	5.0E-05	0.019	0.0017	0.001	3.5E-05	0.020	0.0015	0.001	3.1E-05
	0.029	0.0048	0.001	9.6E-05	0.027	0.0037	0.001	7.4E-05	0.023	0.0028	0.001	5.6E-05	0.023	0.0024	0.001	4.8E-05
	0.029	0.006	0.001	0.003	0.041	0.008	0.001	0.003	0.035	0.007	0.001	0.002	0.032	0.0044	0.001	8.7E-05
	0.043	0.010	0.001	0.003	0.057	0.011	0.001	0.003	0.043	0.009	0.001	0.003	0.041	0.009	0.001	0.003
	0.056	0.014	0.001	0.003	0.074	0.016	0.002	0.003	0.056	0.013	0.001	0.003	0.057	0.013	0.002	0.003
	0.075	0.020	0.002	0.004	0.093	0.020	0.003	0.004	0.067	0.016	0.002	0.003	0.065	0.015	0.002	0.003
	0.098	0.024	0.004	0.004	0.104	0.024	0.004	0.004	0.079	0.019	0.003	0.004	0.075	0.018	0.003	0.004
	0.112	0.027	0.005	0.004	0.110	0.026	0.005	0.004	0.085	0.021	0.003	0.004	0.081	0.020	0.004	0.004
	0.117	0.029	0.005	0.004	0.127	0.032	0.006	0.005	0.094	0.025	0.006	0.004	0.089	0.023	0.005	0.004
	0.145	0.035	0.006	0.005	0.147	0.039	0.007	0.005	0.107	0.029	0.007	0.004	0.100	0.028	0.006	0.004
	0.157	0.043	0.007	0.006	0.155	0.045	0.007	0.005	0.120	0.033	0.008	0.005	0.114	0.032	0.007	0.005
	0.171	0.050	0.007	0.007	0.176	0.051	0.008	0.006	0.133	0.037	0.008	0.005	0.124	0.036	0.007	0.005
	0.183	0.057	0.009	0.008												

B. Appendix – Calculated catch basin rating curve data tables

This appendix includes all of the calculated catch basin rating curve data. The data has been calculated using the parameters that were obtained in Table 4 and Section 5. We assume zero inflow at a zero incident water depth. This is a reasonable assumption but may not be perfect due to surface roughness of the roadway and the height at which the inlet is installed.

The calculated best fit catchment flow values for inlet #1, single round herringbone are included in Table B.1. They were obtained using the function parameters from Table 4. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 4.

Table B.1: Catch Basin inlet #1 (OPSD 400.070) – Single round herringbone

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)											
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010						0.0008						
0.015				0.0014	0.0018	0.0019						0.0007
0.020	0.0009	0.0017	0.0024	0.0052	0.0035	0.0056		0.0015	0.0020	0.0021	0.0029	0.0024
0.025	0.0025	0.0046	0.0066	0.012	0.0060	0.011	0.0013	0.0033	0.0041	0.0047	0.0069	0.0053
0.030	0.0055	0.0093	0.013	0.017	0.0093	0.016	0.0027	0.0057	0.0071	0.0083	0.011	0.0093
0.035	0.0086	0.016	0.019	0.021	0.013	0.021	0.0046	0.0087	0.011	0.013	0.015	0.013
0.040	0.012	0.020	0.024	0.025	0.018	0.025	0.0070	0.012	0.015	0.018	0.018	0.017
0.045	0.015	0.024	0.028	0.029	0.023	0.029	0.010	0.016	0.021	0.021	0.022	0.021
0.050	0.019	0.027	0.032	0.033	0.029	0.032	0.013	0.021	0.027	0.025	0.026	0.024
0.055	0.022	0.031	0.037	0.037	0.035	0.035	0.017	0.026	0.030	0.028	0.029	0.027
0.060	0.026	0.035	0.041	0.040	0.038	0.038	0.020	0.030	0.033	0.031	0.033	0.031
0.065	0.030	0.038	0.045	0.044	0.041	0.040	0.023	0.033	0.036	0.035	0.036	0.034
0.070	0.034	0.042	0.048	0.047	0.043	0.042	0.027	0.036	0.039	0.038	0.039	0.037
0.075	0.038	0.046	0.052	0.050	0.045	0.043	0.030	0.038	0.043	0.042	0.042	0.040
0.080	0.042	0.049	0.055	0.053	0.047		0.033	0.041	0.046	0.045	0.045	0.043
0.085	0.046	0.053	0.059	0.055			0.037	0.044	0.049	0.048	0.048	0.045
0.090	0.050	0.057	0.062	0.058			0.040	0.047	0.052	0.052	0.051	0.048
0.095	0.055	0.061	0.065				0.043	0.050	0.055	0.055	0.054	0.051
0.100	0.060	0.064	0.068				0.047	0.053	0.058	0.058	0.057	0.053
0.105	0.064	0.068					0.050	0.056	0.062	0.062	0.059	
0.110	0.069	0.072					0.053	0.059	0.065	0.065	0.062	
0.115	0.074	0.075					0.057	0.062	0.068	0.069		
0.120	0.079						0.060	0.065	0.071			
0.125							0.063	0.068	0.074			
0.130							0.067	0.071				
0.135							0.070	0.074				
0.140							0.073	0.077				
0.145							0.077					
0.150							0.080					
intercept	0.0024	0.016	0.016	0.013	0.0339	0.0026	0.010	0.027	0.027	0.017	0.0026	0.0041
min	0.0008	0.0008	0.0008	0.0008	0.0008	0.0007	0.0008	0.0008	0.0008	0.0008	0.0008	0.0007
max	0.083	0.076	0.069	0.058	0.047	0.044	0.081	0.079	0.077	0.071	0.063	0.055

The calculated best fit catchment flow values for inlet #2, double round herringbone are included in Table B.2. They were obtained using the function parameters from Table 5. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 5.

Table B.2: Catch Basin inlet #2 (OPSD 400.070) – Double round herringbone

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)											
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010						0.0008						
0.015		0.0010	0.0016	0.0013	0.0020	0.0015						0.0026
0.020	0.0014	0.0033	0.0045	0.0041	0.0050	0.0047		0.0016	0.0007	0.0025	0.0025	0.0057
0.025	0.0029	0.0072	0.0081	0.0091	0.0095	0.010	0.0015	0.0042	0.0021	0.0062	0.0062	0.010
0.030	0.0050	0.013	0.012	0.017	0.016	0.018	0.0027	0.0073	0.0066	0.010	0.011	0.015
0.035	0.0077	0.019	0.018	0.025	0.023	0.028	0.0045	0.011	0.013	0.015	0.016	0.022
0.040	0.011	0.025	0.023	0.034	0.033	0.038	0.0070	0.015	0.020	0.019	0.021	0.029
0.045	0.014	0.031	0.030	0.042	0.043	0.047	0.010	0.020	0.026	0.025	0.028	0.037
0.050	0.019	0.038	0.037	0.051	0.052	0.056	0.014	0.026	0.033	0.030	0.035	0.045
0.055	0.023	0.044	0.046	0.059	0.061	0.064	0.018	0.032	0.039	0.036	0.043	0.053
0.060	0.029	0.050	0.054	0.068	0.069	0.072	0.023	0.039	0.046	0.043	0.051	0.061
0.065	0.034	0.056	0.063	0.076	0.076	0.079	0.029	0.046	0.052	0.051	0.059	0.069
0.070	0.041	0.062	0.070	0.084	0.084	0.086	0.036	0.052	0.059	0.059	0.067	0.077
0.075	0.047	0.069	0.078	0.093	0.090	0.092	0.043	0.058	0.065	0.067	0.075	0.084
0.080	0.055	0.075	0.084	0.101	0.096		0.049	0.064	0.072	0.076	0.083	0.092
0.085	0.065	0.081	0.091	0.110			0.056	0.070	0.078	0.084	0.091	0.100
0.090	0.076	0.087	0.096				0.063	0.077	0.085	0.092	0.099	0.108
0.095	0.086	0.094	0.102				0.069	0.084	0.091	0.101	0.107	
0.100	0.095	0.100	0.106				0.076	0.092	0.098	0.109	0.115	
0.105	0.103	0.106					0.083	0.099	0.104	0.117	0.122	
0.110	0.110	0.112					0.089	0.107	0.111	0.126		
0.115	0.117	0.119					0.096	0.115	0.117	0.134		
0.120	0.122						0.103	0.124	0.124			
0.125							0.109	0.133	0.130			
0.130							0.116	0.142	0.137			
0.135							0.123	0.151				
0.140							0.129	0.161				
0.145							0.136					
0.150							0.143					
intercept	0.058	0.013	0.050	0.017	0.032	0.023	0.024	0.048	0.0034	0.044	0.038	0.020
min	0.0006	0.0009	0.0003	0.0008	0.0008	0.0008	0.0010	0.0008	0.0008	0.0007	0.0009	0.0007
max	0.127	0.121	0.108	0.116	0.098	0.095	0.146	0.166	0.138	0.141	0.130	0.110

The calculated best fit catchment flow values for inlet #3, single square herringbone are included in Table B.3. They were obtained using the function parameters from Table 6. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 6.

Table B.3: Catch Basin inlet #3 (OPSD 400.020) – Single square herringbone

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)											
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010					0.0012	0.0016					0.0007	
0.015			0.0019	0.0020	0.0031	0.0030			0.0011	0.0013	0.0012	0.0017
0.020		0.0025	0.0048	0.0059	0.0049	0.0045		0.0018	0.0026	0.0033	0.0028	0.0031
0.025	0.0019	0.0047	0.0093	0.012	0.011	0.010	0.0015	0.0037	0.0056	0.0076	0.0053	0.0055
0.030	0.0038	0.0073	0.015	0.018	0.017	0.017	0.0030	0.0063	0.010	0.013	0.0088	0.0089
0.035	0.0063	0.010	0.020	0.023	0.023	0.023	0.0050	0.010	0.016	0.017	0.013	0.013
0.040	0.0094	0.016	0.025	0.029	0.029	0.029	0.0076	0.014	0.023	0.022	0.019	0.018
0.045	0.013	0.021	0.030	0.034	0.034	0.034	0.011	0.019	0.027	0.027	0.024	0.024
0.050	0.017	0.026	0.035	0.038	0.039	0.039	0.014	0.023	0.031	0.031	0.029	0.029
0.055	0.022	0.031	0.039	0.043	0.043	0.043	0.018	0.028	0.034	0.035	0.033	0.034
0.060	0.026	0.035	0.044	0.047	0.047	0.047	0.022	0.032	0.038	0.039	0.038	0.039
0.065	0.030	0.040	0.048	0.051	0.051	0.051	0.026	0.036	0.041	0.043	0.042	0.044
0.070	0.034	0.044	0.052	0.054	0.054	0.054	0.030	0.040	0.045	0.047	0.047	0.048
0.075	0.039	0.048	0.055	0.057	0.056	0.057	0.034	0.043	0.049	0.051	0.050	0.052
0.080	0.043	0.052	0.059	0.060	0.058		0.038	0.047	0.052	0.055	0.054	0.056
0.085	0.047	0.056	0.062	0.063			0.041	0.051	0.056	0.058	0.058	0.059
0.090	0.051	0.059	0.065	0.065			0.045	0.054	0.059	0.062	0.061	0.063
0.095	0.056	0.063	0.068				0.049	0.057	0.063	0.065	0.064	0.066
0.100	0.060	0.066					0.052	0.061	0.066	0.068	0.067	
0.105	0.064	0.069					0.056	0.064	0.070	0.071	0.070	
0.110	0.068	0.072					0.059	0.067	0.073	0.074		
0.115	0.073						0.063	0.070	0.077			
0.120	0.077						0.066	0.072	0.080			
0.125							0.070	0.075				
0.130							0.073	0.077				
0.135							0.077	0.080				
0.140							0.080	0.082				
0.145							0.083					
intercept	0.012	0.010	0.0068	0.0067	0.0052	0.0048	0.012	0.0086	0.024	0.0047	0.015	0.016
min	0.0009	0.0010	0.0011	0.0008	0.0008	0.0011	0.0010	0.0008	0.0008	0.0010	0.0008	0.0012
max	0.078	0.073	0.070	0.066	0.058	0.058	0.086	0.082	0.082	0.076	0.071	0.068

The calculated best fit catchment flow values for inlet #4, double square herringbone are included in Table B.4. They were obtained using the function parameters from Table 7. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 7.

Table B.4: Catch Basin inlet #4 (OPSD 400.020) – Double square herringbone

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)											
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.005												
0.010			0.0007	0.0007	0.0009	0.0014						
0.015		0.0020	0.0022	0.0041	0.0037	0.0036				0.0019	0.0014	0.0014
0.020	0.0022	0.0050	0.0066	0.0089	0.0082	0.0077	0.0010	0.0023	0.0030	0.0050	0.0042	0.0037
0.025	0.0046	0.0086	0.014	0.015	0.014	0.014	0.0025	0.0046	0.0065	0.0088	0.0079	0.0071
0.030	0.0077	0.013	0.021	0.022	0.022	0.023	0.0045	0.0076	0.011	0.013	0.013	0.012
0.035	0.012	0.018	0.028	0.031	0.031	0.034	0.0069	0.011	0.018	0.018	0.018	0.017
0.040	0.016	0.024	0.035	0.041	0.042	0.043	0.010	0.016	0.025	0.024	0.024	0.024
0.045	0.020	0.031	0.042	0.050	0.053	0.052	0.013	0.021	0.032	0.030	0.032	0.032
0.050	0.024	0.037	0.049	0.059	0.062	0.061	0.017	0.027	0.039	0.037	0.040	0.042
0.055	0.029	0.044	0.056	0.068	0.071	0.069	0.021	0.034	0.046	0.045	0.049	0.052
0.060	0.034	0.051	0.063	0.076	0.079	0.076	0.026	0.041	0.053	0.053	0.059	0.062
0.065	0.040	0.057	0.070	0.085	0.086	0.083	0.031	0.048	0.061	0.062	0.070	0.072
0.070	0.046	0.064	0.077	0.094	0.092	0.089	0.037	0.056	0.068	0.076	0.080	0.080
0.075	0.053	0.071	0.084	0.103	0.097		0.043	0.063	0.075	0.089	0.089	0.088
0.080	0.061	0.077	0.092	0.112			0.050	0.070	0.082	0.102	0.097	0.095
0.085	0.069	0.084	0.099	0.121			0.058	0.078	0.089	0.113	0.105	0.102
0.090	0.078	0.091	0.106				0.067	0.085	0.097	0.124	0.112	0.107
0.095	0.087	0.097	0.113				0.076	0.092	0.104	0.133	0.118	0.111
0.100	0.096	0.104					0.085	0.100	0.111	0.140	0.124	
0.105	0.107	0.111					0.093	0.107	0.118	0.147		
0.110	0.118	0.117					0.102	0.114	0.125	0.152		
0.115	0.129						0.111	0.122	0.132			
0.120	0.141						0.120	0.129	0.140			
0.125							0.129	0.136				
0.130							0.138	0.144				
0.135							0.146	0.151				
0.140							0.155	0.159				
intercept	0.015	0.028	0.014	0.041	0.038	0.017	0.053	0.028	0.019	0.065	0.075	0.051
min	0.0006	0.0008	0.0007	0.0006	0.0007	0.0011	0.0007	0.0011	0.0011	0.0007	0.0007	0.0007
max	0.149	0.120	0.115	0.122	0.100	0.093	0.163	0.160	0.146	0.154	0.129	0.114

The calculated best fit catchment flow values for inlet #5, single square grate with horizontal bars are included in Table B.5. They were obtained using the function parameters from Table 8. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions, where applicable, are also found in Table 8.

Table B.5: Catch Basin inlet #5 (MT-310) – Single square with horizontal bars

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)											
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010												
0.015			0.0013	0.0021	0.0005	0.0022	0.0002	0.0001		0.0013	0.0015	
0.020	0.0005	0.0022	0.0048	0.0053	0.0061	0.0064	0.0005	0.0007	0.0008	0.0043	0.0035	0.0035
0.025	0.0024	0.0047	0.012	0.010	0.011	0.011	0.0013	0.0019	0.0041	0.0072	0.0058	0.0069
0.030	0.0046	0.0080	0.017	0.016	0.017	0.015	0.0024	0.0039	0.011	0.011	0.0083	0.010
0.035	0.0069	0.012	0.023	0.023	0.022	0.019	0.0040	0.0067	0.014	0.015	0.012	0.014
0.040	0.0094	0.017	0.028	0.028	0.026	0.025	0.0061	0.011	0.018	0.020	0.017	0.017
0.045	0.012	0.022	0.033	0.033	0.031	0.031	0.0085	0.014	0.021	0.024	0.022	0.021
0.050	0.015	0.027	0.038	0.038	0.035	0.036	0.011	0.018	0.025	0.028	0.026	0.026
0.055	0.018	0.032	0.042	0.042	0.039	0.040	0.015	0.022	0.028	0.031	0.031	0.031
0.060	0.021	0.037	0.046	0.046	0.043	0.044	0.018	0.026	0.032	0.035	0.035	0.035
0.065	0.024	0.042	0.050	0.049	0.047	0.047	0.022	0.029	0.036	0.039	0.039	0.039
0.070	0.028	0.046	0.054	0.053	0.050	0.050	0.025	0.033	0.039	0.042	0.043	0.043
0.075	0.032	0.050	0.057	0.056	0.053	0.052	0.029	0.036	0.043	0.046	0.046	0.046
0.080	0.036	0.054	0.060	0.058	0.056		0.032	0.040	0.046	0.049	0.050	0.050
0.085	0.040	0.058	0.063	0.060			0.035	0.044	0.050	0.053	0.053	0.052
0.090	0.044	0.061	0.066	0.062			0.039	0.047	0.053	0.056	0.056	0.055
0.095	0.048	0.064	0.068				0.042	0.050	0.057	0.059	0.058	0.057
0.100	0.053	0.068					0.046	0.054	0.061	0.062	0.061	0.059
0.105	0.058	0.071					0.049	0.057	0.064	0.065	0.063	
0.110	0.063	0.073					0.053	0.061	0.068	0.068		
0.115	0.068						0.056	0.064	0.071			
0.120	0.073						0.060	0.067	0.075			
0.125							0.063	0.070				
0.130							0.066	0.074				
0.135							0.070	0.077				
0.140							0.073					
0.145							0.077					
0.150							0.080					
intercept		0.014	0.0094	0.023		0.018	0.012	0.0062	0.010	0.0080	0.010	0.019
min	0.0004	0.0008	0.0012	0.0007	0.0004	0.0007	0.00014	0.0001	0.00077	0.0012	0.0010	0.0010
max	0.076	0.074	0.070	0.063	0.058	0.053	0.083	0.080	0.078	0.070	0.065	0.060

The calculated best fit catchment flow values for inlet #6, high capacity inlet are included in Table B.6. They were obtained using the function parameters from Table 9. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions, where applicable, are also found in Table 9.

Table B.6: Catch Basin inlet #6 (Stepcon 5103) – High capacity inlet

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)											
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.005												
0.010						0.0015						
0.015				0.0024	0.0029	0.0036					0.001	
0.020	0.0021	0.0041	0.0057	0.0060	0.0069	0.0074		0.001	0.003	0.004	0.004	0.003
0.025	0.0046	0.0079	0.011	0.012	0.013	0.013	0.002	0.004	0.006	0.009	0.007	0.007
0.030	0.0077	0.013	0.017	0.019	0.022	0.020	0.0033	0.0077	0.011	0.014	0.012	0.011
0.035	0.011	0.018	0.025	0.029	0.033	0.032	0.0054	0.012	0.016	0.020	0.019	0.017
0.040	0.015	0.024	0.033	0.040	0.047	0.049	0.0082	0.017	0.022	0.027	0.026	0.024
0.045	0.020	0.031	0.042	0.054	0.063	0.067	0.011	0.022	0.029	0.034	0.035	0.033
0.050	0.025	0.038	0.052	0.070	0.080	0.084	0.015	0.028	0.036	0.043	0.046	0.042
0.055	0.031	0.047	0.063	0.086	0.098	0.102	0.020	0.034	0.044	0.052	0.057	0.058
0.060	0.038	0.056	0.075	0.102	0.115	0.119	0.025	0.041	0.054	0.062	0.072	0.079
0.065	0.045	0.065	0.088	0.119	0.133	0.137	0.031	0.049	0.064	0.072	0.090	0.100
0.070	0.052	0.076	0.102	0.135	0.150	0.154	0.037	0.057	0.074	0.084	0.109	0.120
0.075	0.060	0.087	0.117	0.152	0.168	0.172	0.044	0.066	0.086	0.100	0.128	0.141
0.080	0.074	0.099	0.133	0.168	0.185	0.190	0.052	0.076	0.098	0.121	0.147	0.161
0.085	0.088	0.112	0.149	0.185			0.060	0.086	0.112	0.141	0.165	0.182
0.090	0.101	0.125	0.167	0.201			0.069	0.097	0.126	0.161	0.184	0.202
0.095	0.115	0.139	0.185				0.078	0.108	0.140	0.182	0.203	0.223
0.100	0.129	0.154	0.205				0.088	0.120	0.156	0.202	0.222	0.244
0.105	0.143	0.169					0.099	0.132	0.172	0.222	0.240	
0.110	0.156	0.186					0.110	0.145	0.190	0.243	0.259	
0.115	0.170						0.122	0.159	0.208	0.263		
0.120	0.184						0.134	0.173	0.226			
0.125							0.147	0.188	0.246			
0.130							0.161	0.203				
0.135							0.175	0.219				
0.140							0.190	0.236				
0.145							0.206					
0.150							0.222					
intercept	0.060			0.069	0.065	0.025				0.090	0.067	0.047
min	0.0006	0.0013	0.0014	0.0008	0.0014	0.0010	0.0010	0.0002	0.0007	0.0008	0.0008	0.0009
max	0.191	0.196	0.209	0.202	0.200	0.192	0.227	0.249	0.261	0.269	0.262	0.262

The calculated best fit catchment flow values for inlet #7, circular open cover are included in Table B.7. They were obtained using the function parameters from Table 10. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 10.

Table B.7: Catch Basin inlet #7 (OPSD 401.010) – Circular open cover

cross-slope (%)	2.0	2.0	2.0	2.0	2.0	2.0
Grade (%)	0.5	1.0	2.5	5.0	7.5	10.0
depth (m)	Catchment (m3/s)					
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010						
0.015			0.0011	0.0018	0.0012	0.0031
0.020	0.0014	0.0024	0.0039	0.0058	0.0055	0.0055
0.025	0.0030	0.0057	0.0074	0.0099	0.0090	0.0086
0.030	0.0054	0.0090	0.012	0.014	0.012	0.012
0.035	0.0085	0.012	0.016	0.017	0.015	0.014
0.040	0.012	0.016	0.018	0.019	0.018	0.017
0.045	0.014	0.018	0.020	0.021	0.021	0.019
0.050	0.016	0.021	0.022	0.022	0.023	0.021
0.055	0.018	0.023	0.024	0.024	0.025	0.023
0.060	0.021	0.025	0.026	0.026	0.026	0.025
0.065	0.023	0.027	0.028	0.027	0.028	0.026
0.070	0.025	0.028	0.029	0.028	0.029	0.027
0.075	0.027	0.030	0.031	0.030	0.029	0.028
0.080	0.029	0.032	0.032	0.031	0.030	0.028
0.085	0.031	0.033	0.034	0.032		
0.090	0.033	0.035	0.035	0.033		
0.095	0.035	0.036	0.036			
0.100	0.036	0.037	0.037			
0.105	0.038	0.038				
0.110	0.040	0.039				
0.115	0.042	0.040				
0.120	0.043					
intercept	0.011	0.017	0.015	0.015	0.0047	0.0061
min	0.0007	0.0005	0.0009	0.0008	0.0007	0.0007
max	0.045	0.040	0.038	0.033	0.030	0.028

The calculated best fit catchment flow values for inlet #8, circular closed cover are included in Table B.8 were obtained using the function parameters from Table 11. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 11.

Table B.8: Catch Basin inlet #8 (OPSD 401.010) – Circular closed cover

cross-slope (%)	2.0	2.0
Grade (%)	0.5	2.5
depth (m)	Catchment (m3/s)	
0.000	0.000	0.000
0.015		
0.020	0.0006	0.0005
0.025	0.0009	0.0007
0.030	0.0010	0.0008
0.035	0.0011	0.0009
0.040	0.0012	0.0010
0.045	0.0012	0.0010
0.050	0.0013	0.0011
0.055	0.0014	0.0011
0.060	0.0015	0.0011
0.065	0.0015	0.0011
0.070	0.0016	0.0011
0.075	0.0017	0.0012
0.080	0.0018	0.0012
0.085	0.0018	0.0013
0.090	0.0019	0.0013
0.095	0.0020	0.0014
0.100	0.0020	0.0014
0.105	0.0021	
0.110	0.0022	
0.115	0.0023	
0.120	0.0023	
intercept	0.0009	0.0011
min	0.0005	0.0004
max	0.0024	0.0014

The calculated best fit catchment flow values for inlet #9, the S19 “FISH” round catch basin cover are included in Table B.9. They were obtained using the function parameters from Table 12. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions are also found in Table 12.

Table B.9: Catch Basin inlet #9 (DWG. No. S19) – “FISH” round catch basin cover

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
depth (m)	Catchment (m^3/s)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010			0.0004						
0.015	0.004		0.0005	0.0005	0.0028				
0.020	0.009	0.0009	0.003	0.003	0.007				0.002
0.025	0.014	0.003	0.007	0.010	0.012	0.002	0.003	0.003	0.005
0.030	0.019	0.007	0.013	0.017	0.017	0.004	0.006	0.008	0.012
0.035	0.024	0.012	0.021	0.022	0.022	0.006	0.011	0.017	0.018
0.040	0.029	0.017	0.025	0.025	0.026	0.010	0.016	0.021	0.021
0.045	0.034	0.020	0.028	0.029	0.031	0.014	0.021	0.024	0.025
0.050	0.039	0.024	0.032	0.033	0.034	0.018	0.025	0.027	0.028
0.055	0.044	0.027	0.035	0.036	0.038	0.022	0.029	0.030	0.031
0.060	0.049	0.030	0.038	0.039	0.041	0.026	0.033	0.033	0.034
0.065	0.054	0.034	0.042	0.043	0.044	0.029	0.037	0.035	0.037
0.070	0.059	0.037	0.045	0.045	0.047	0.033	0.040	0.038	0.041
0.075	0.064	0.041	0.048	0.048	0.049	0.036	0.044	0.041	0.044
0.080	0.069	0.044	0.051	0.051	0.051	0.040	0.047	0.044	0.047
0.085	0.074	0.047	0.054	0.053	0.053	0.043	0.050	0.047	0.050
0.090	0.078	0.051	0.057	0.056		0.046	0.053	0.050	0.053
0.095	0.083	0.054	0.059	0.058		0.049	0.056	0.053	0.057
0.100	0.088	0.058	0.062	0.060		0.052	0.059	0.056	0.060
0.105	0.093	0.061	0.065			0.055	0.061	0.059	0.063
0.110	0.098	0.064	0.067			0.058	0.063	0.061	0.066
0.115	0.103	0.068				0.060	0.066	0.064	
0.120	0.108	0.071				0.063	0.068	0.067	
0.125	0.113					0.065	0.070	0.070	
0.130	0.118					0.068	0.072		
0.135	0.120					0.070	0.074		
0.140	0.122					0.072	0.075		
0.145	0.124					0.074			
0.150	0.125					0.076			
0.160	0.129								
0.170	0.132								
0.180	0.136								
0.190	0.139								
0.200	0.142								
0.220	0.149								
0.240	0.156								
0.260	0.163								
0.280	0.17								
0.300	0.18								
0.320	0.18								
0.340	0.19								
intercept	0.119	0.016	0.020	0.016	0.005	0.010	0.021	0.019	0.017
min	0.0013	0.00013	0.0005	0.0004	0.00002	0.0014	0.0013	0.0011	0.0013
max	0.192	0.074	0.069	0.060	0.053	0.080	0.076	0.072	0.068

The calculated best fit catchment flow values for inlet #10, the S22 single curb inlet frame are included in Table B.10. They were obtained using the function parameters from Table 13. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions, where applicable, are also found in Table 13.

Table B.10: Catch Basin inlet #10 (DWG. No. S22) – Single curb inlet frame

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
depth (m)	Catchment (m^3/s)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010					0.0006				
0.015	0.004			0.0008	0.0008				
0.020	0.007	0.0017	0.0012	0.002	0.0013	0.002	0.0013	0.0013	0.0010
0.025	0.009	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.002
0.030	0.012	0.004	0.003	0.003	0.003	0.004	0.003	0.003	0.002
0.035	0.015	0.005	0.004	0.004	0.004	0.006	0.004	0.005	0.003
0.040	0.018	0.006	0.005	0.005	0.006	0.007	0.005	0.006	0.004
0.045	0.021	0.008	0.006	0.006	0.007	0.008	0.007	0.008	0.005
0.050	0.024	0.009	0.007	0.007	0.008	0.010	0.008	0.009	0.006
0.055	0.027	0.010	0.008	0.008	0.009	0.011	0.009	0.010	0.007
0.060	0.030	0.011	0.009	0.010	0.010	0.012	0.011	0.011	0.009
0.065	0.034	0.012	0.010	0.011	0.011	0.014	0.012	0.013	0.010
0.070	0.037	0.013	0.011	0.012	0.012	0.015	0.013	0.014	0.011
0.075	0.040	0.014	0.012	0.014	0.013	0.017	0.015	0.015	0.013
0.080	0.043	0.015	0.013	0.015	0.014	0.018	0.016	0.016	0.014
0.085	0.047	0.016	0.015	0.016	0.015	0.019	0.017	0.017	0.015
0.090	0.050	0.017	0.016	0.017	0.016	0.021	0.019	0.019	0.017
0.095	0.053	0.019	0.017	0.018	0.017	0.022	0.020	0.020	0.018
0.100	0.057	0.020	0.018	0.019	0.018	0.023	0.021	0.021	0.019
0.105	0.060	0.021	0.020	0.020	0.019	0.025	0.022	0.022	0.021
0.110	0.064	0.022	0.021	0.021	0.020	0.026	0.024	0.024	0.022
0.115	0.067	0.023	0.022	0.022	0.021	0.027	0.025	0.025	0.023
0.120	0.071	0.025	0.024	0.023		0.029	0.026	0.026	0.025
0.125	0.075	0.026	0.025	0.024		0.030	0.028	0.027	0.026
0.130	0.078	0.027	0.026			0.032	0.029	0.029	
0.135	0.082	0.029	0.028			0.033	0.030	0.030	
0.140	0.086	0.030	0.029			0.034	0.032		
0.145	0.090	0.032	0.031			0.036	0.033		
0.150	0.093	0.033	0.033			0.037	0.034		
0.160	0.101	0.036	0.036			0.040	0.037		
0.170	0.109	0.040				0.043	0.040		
0.180	0.117					0.045			
0.190	0.125								
0.200	0.134								
0.220	0.151								
0.240	0.160								
0.260	0.162								
0.280	0.164								
0.300	0.166								
0.320	0.168								
0.340	0.17								
intercept	0.159	0.011		0.015	0.0009		0.004	0.006	0.006
min	0.002	0.0009	0.0006	0.0006	0.0006	0.0012	0.0010	0.0009	0.0008
max	0.170	0.040	0.038	0.024	0.021	0.047	0.041	0.030	0.027

The calculated best fit catchment flow values for inlet #11, the S22(x2) double curb inlet frame are included in Table B.11. They were obtained using the function parameters from Table 14. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions, where applicable, are also found in Table 14.

Table B.11: Catch Basin inlet #11 (DWG. No. S22) – Double curb inlet frame

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
depth (m)	Catchment (m^3/s)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.020		0.0016							
0.025		0.004							
0.030	0.018	0.006	0.003	0.003	0.002				
0.035	0.031	0.008	0.006	0.006	0.004	0.003	0.002	0.003	0.002
0.040	0.040	0.010	0.008	0.008	0.006	0.006	0.004	0.006	0.004
0.045	0.045	0.012	0.010	0.010	0.009	0.009	0.006	0.009	0.006
0.050	0.045	0.014	0.013	0.012	0.011	0.011	0.010	0.012	0.008
0.055	0.050	0.015	0.014	0.014	0.013	0.014	0.013	0.014	0.009
0.060	0.057	0.016	0.016	0.016	0.015	0.017	0.015	0.017	0.011
0.065	0.063	0.018	0.018	0.018	0.016	0.020	0.017	0.019	0.013
0.070	0.070	0.019	0.020	0.020	0.018	0.023	0.019	0.021	0.015
0.075	0.076	0.020	0.022	0.022	0.020	0.026	0.021	0.024	0.017
0.080	0.082	0.022	0.025	0.024	0.022	0.028	0.023	0.026	0.018
0.085	0.089	0.024	0.027	0.026	0.023	0.031	0.026	0.029	0.020
0.090	0.095	0.026	0.029	0.028	0.025	0.034	0.028	0.031	0.022
0.095	0.101	0.028	0.031	0.030	0.027	0.036	0.030	0.034	0.024
0.100	0.108	0.031	0.034	0.032	0.029	0.038	0.033	0.036	0.025
0.105	0.114	0.033	0.036	0.034	0.030	0.040	0.035	0.038	0.027
0.110	0.121	0.036	0.039	0.036	0.032	0.042	0.038	0.041	0.029
0.115	0.127	0.039	0.042	0.038	0.034	0.044	0.041	0.043	0.031
0.120	0.133	0.042	0.044	0.041	0.035	0.047	0.044	0.046	0.032
0.125	0.140	0.045	0.047	0.043	0.037	0.049	0.047	0.048	0.034
0.130	0.146	0.048	0.050	0.045		0.052	0.050	0.051	0.036
0.135	0.152	0.052	0.053	0.047		0.055	0.053	0.053	0.038
0.140	0.159	0.056	0.056			0.059	0.056	0.055	0.039
0.145	0.165	0.059	0.059			0.062	0.059	0.058	
0.150	0.17	0.063	0.062			0.066	0.063		
0.160	0.18	0.072	0.068			0.073	0.070		
0.170	0.20		0.075			0.082	0.077		
0.180	0.21		0.082			0.091	0.085		
0.190	0.22					0.101	0.093		
0.200	0.24								
0.220	0.26								
0.240	0.29								
0.260	0.31								
0.280	0.34								
0.300	0.36								
0.320	0.39								
0.340	0.41								
intercept	0.045	0.022	0.013	0.004	0.010	0.034	0.013	0.010	
min	0.004	0.0011	0.0015	0.0008	0.0013	0.0012	0.0013	0.0013	0.0012
max	0.42	0.076	0.083	0.048	0.039	0.107	0.093	0.059	0.040

The calculated best fit catchment flow values for inlet #12, the S28 single curb inlet frame for CBHM are included in Table B.12. They were obtained using the function parameters from Table 15. The minimum and maximum incident water depths as well as the intercept incident water depths between the two best fit functions, where applicable, are also found in Table 15.

Table B.12: Catch Basin inlet #12 (DWG. No. S28) – Single curb inlet frame for CBMH

cross-slope (%)	0.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0
Grade (%)	0.5	0.5	1.0	2.5	5.0	0.5	1.0	2.5	5.0
depth (m)	Catchment (m^3/s)								
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.015	0.006			0.0009	0.0008				
0.020	0.009	0.003	0.002	0.002	0.002	0.001	0.001	0.002	0.001
0.025	0.012	0.005	0.003	0.004	0.005	0.003	0.003	0.003	0.003
0.030	0.015	0.006	0.004	0.005	0.007	0.005	0.005	0.005	0.004
0.035	0.018	0.007	0.005	0.007	0.009	0.007	0.007	0.007	0.006
0.040	0.021	0.009	0.006	0.009	0.011	0.009	0.008	0.008	0.007
0.045	0.024	0.010	0.008	0.010	0.012	0.010	0.009	0.010	0.009
0.050	0.028	0.011	0.009	0.012	0.013	0.012	0.010	0.011	0.011
0.055	0.031	0.012	0.010	0.013	0.015	0.014	0.011	0.013	0.012
0.060	0.034	0.014	0.011	0.015	0.016	0.016	0.012	0.014	0.014
0.065	0.037	0.015	0.012	0.016	0.018	0.018	0.013	0.016	0.016
0.070	0.040	0.015	0.014	0.018	0.019	0.020	0.014	0.017	0.017
0.075	0.044	0.016	0.015	0.019	0.020	0.020	0.016	0.019	0.019
0.080	0.047	0.017	0.016	0.021	0.022	0.021	0.017	0.020	0.021
0.085	0.050	0.019	0.018	0.022	0.023	0.022	0.018	0.022	0.022
0.090	0.053	0.020	0.019	0.023	0.025	0.022	0.020	0.023	0.024
0.095	0.057	0.021	0.021	0.024	0.026	0.023	0.021	0.025	0.026
0.100	0.060	0.023	0.022	0.026	0.027	0.024	0.023	0.026	0.027
0.105	0.063	0.024	0.024	0.027	0.029	0.025	0.024	0.028	0.029
0.110	0.067	0.025	0.025	0.028	0.030	0.027	0.026	0.029	0.031
0.115	0.070	0.027	0.027	0.029		0.028	0.028	0.031	0.032
0.120	0.073	0.028	0.029	0.030		0.029	0.029	0.032	0.034
0.125	0.077	0.029	0.030	0.031		0.031	0.031	0.034	
0.130	0.080	0.030	0.032			0.032	0.033	0.035	
0.135	0.083	0.032	0.034			0.034	0.035		
0.140	0.087	0.033	0.035			0.036	0.037		
0.145	0.090	0.034	0.037			0.038	0.039		
0.150	0.093	0.036	0.039			0.040	0.041		
0.160	0.100	0.038	0.043			0.044	0.045		
0.170	0.107	0.041				0.049	0.050		
0.180	0.114	0.044				0.054			
0.190	0.121	0.046							
0.200	0.128								
0.220	0.142								
0.240	0.156								
0.260	0.171								
0.280	0.186								
0.300	0.200								
0.320	0.21								
0.340	0.21								
intercept	0.206	0.017		0.006	0.008	0.020	0.008		0.006
min	0.004	0.0018	0.0014	0.0008	0.0006	0.0014	0.0013	0.0010	0.0010
max	0.22	0.048	0.046	0.031	0.031	0.056	0.052	0.036	0.035

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

LOCATION			AREA (Ha)																FLOW						SEWER DATA									
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	LOW (min	Q/Q full
REAR YARD STORAGE PIPES																																	
	CBMH 1	CBMH 2	0.06	0.41	0.07	0.07			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	5	600	600	HDPE	0.50	25.0	434.1717	1.5356	0.2713	0.012
	CBMH 2	Ex. STM Pipe	0.03	0.42	0.04	0.10			0.00	0.00			0.00	0.00			0.00	0.00	10.27	75.78	102.78	120.48	176.12	*6	250	250	PVC	3.00	11.5	103.0008	2.0983	0.0913	0.010
To Ex. Servicing Easement, Ex. Pipe 1 - 2						0.10				0.00				0.00				0.00	10.36														
			0.03	0.20	0.02	0.02			0.00	0.00			0.00	0.00			0.00	0.00															
			0.07	0.41	0.08	0.10			0.00	0.00			0.00	0.00			0.00	0.00															
			0.06	0.42	0.07	0.17			0.00	0.00			0.00	0.00			0.00	0.00															
	CBMH 6	CBMH 5	0.05	0.42	0.06	0.22			0.00	0.00			0.00	0.00			0.00	0.00	11.35	71.98	97.56	114.34	167.09	16	600	600	HDPE	0.15	27.0	237.8056	0.8411	0.5350	0.068
	CBMH 5	CBMH 4	0.05	0.43	0.06	0.28			0.00	0.00			0.00	0.00			0.00	0.00	11.89	70.25	95.19	111.54	162.99	20	600	600	HDPE	0.15	33.0	237.8056	0.8411	0.6539	0.084
	CBMH 4	CBMH 3	0.06	0.42	0.07	0.35			0.00	0.00			0.00	0.00			0.00	0.00	12.54	68.26	92.46	108.32	158.26	24	600	600	HDPE	0.15	35.5	237.8056	0.8411	0.7035	0.102
	CBMH 3	Ex. STM Pipe	0.03	0.38	0.03	0.39			0.00	0.00			0.00	0.00			0.00	0.00	13.24	66.25	89.70	105.08	153.50	*6	250	250	PVC	3.00	15.5	103.0008	2.0983	0.1231	0.401
To Ex. Servicing Easement, Ex. Pipe 1 - 2						0.39				0.00				0.00				0.00	13.37														

*Peak flow per SWM modeling results

LICENSED PROFESSIONAL ENGINEER W. LIU 100167932 26-02-17 PROVINCE OF ONTARIO

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:	PROJECT:		
A.S.	**40 BEECHCLIFFE STREET**		
Checked:	LOCATION:		
W.L.	**City of Ottawa**		
Dwg. Reference:	File Ref:	Date:	Sheet No.
DWG. 9	24-1416	17 Feb 2026	SHEET 1 OF 1

1416_STM_Designsheet_Subm4.xlsx

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

September 30th 2025
Our File: 24-1416

CN Rail
ATTN : Ashkan Matlabi

Re: Safety Berm Design

1.0 INTRODUCTION

DSEL was retained to prepare civil servicing plans for 40 Beechcliffe, located adjacent to a rail line operated by CN Rail. As part of the design, CN requested that a safety berm be incorporated to provide separation between the proposed residential units and the rail line.

2.0 BERM SIZE AND LOCATION

Per CN's request, the berm was designed to be 2.5m high with side slopes graded to 2.5:1. It ties into the exisitng berm beside the residential untis to the west and includes a small return on the east end.

During the design process, a Hydro Ottawa easement was identified running along the length of the property line between City of Ottawa lands and the CN rail corridor. To accommodate hydro line maintenance, Hydro Ottawa requested that a 6 m wide access be maintained between the berm and CN lands. Accordingly, the berm's toe of slope is generally offset by 6 m, with the exception of a localized bump-out intended to fill a low-lying area and improve drainage.

3.0 STORM WATER CONSIDERATIONS

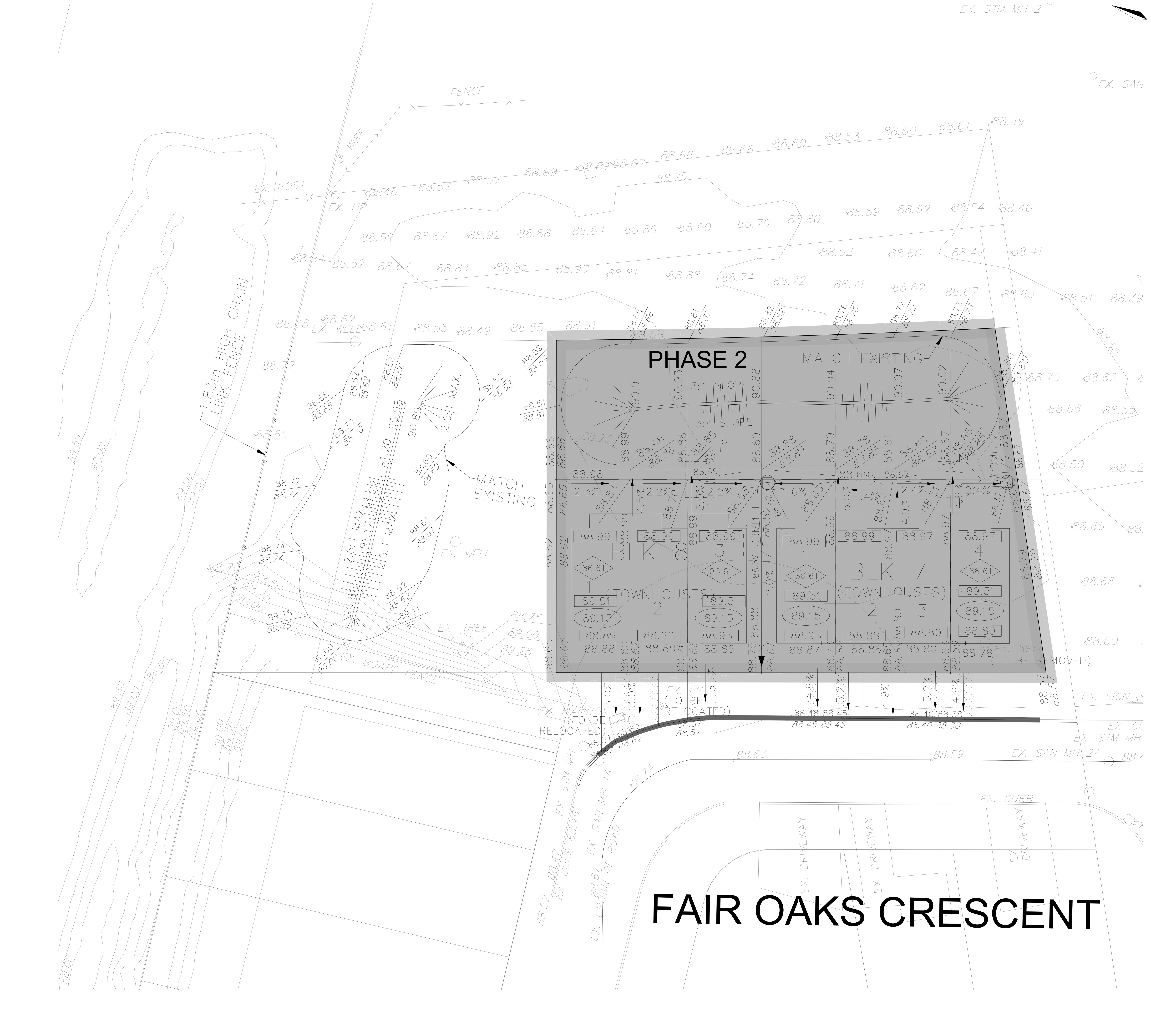
The parcel of land where the berm is proposed currently drains eastward toward Woodroffe Avenue. DSEL prepared the attached stormwater drainage plan, which demonstrates that existing drainage patterns are maintained and no additional stormwater management measures are required.

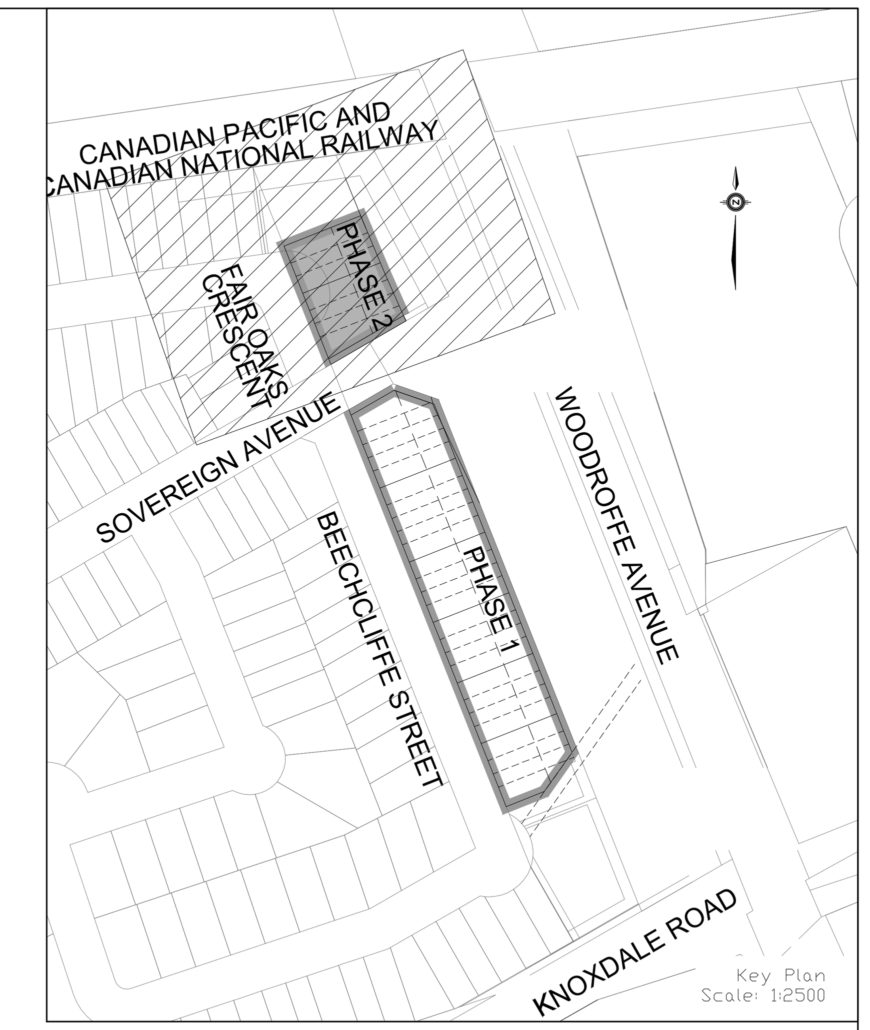
Yours truly,

David Schaeffer Engineering Ltd.

Per: Jeremy Chouinard, P.Eng.

PHASE 2 IS NOT PART OF THIS APPLICATION AND ITS APPROVAL WILL BE SUBJECT TO A SUBSEQUENT DEVELOPMENT APPLICATION.





LEGEND

- PROPOSED ELEVATION — 103.45
- EXISTING ELEVATION — 102.73
- PROPOSED SWALE GRADE — 1.5%
- HIGH POINT — 102.16
- STREET CATCHBASIN
- CATCHBASIN MANHOLE
- TEE CATCHBASIN
- ELBOW CATCHBASIN
- HYDRANT, VALVE & VB
- VALVE & VC
- VALVE & VB
- BUILDING ENVELOPE
- TOP OF FOUNDATION (TOF) — 94.70
- FINISHED FLOOR ELEVATION (FFE) — 95.00
- UNDERSIDE OF FOOTING ELEVATION (USF) — 92.00
- FRONT/REAR ENVELOPE ELEVATION — 97.70
- WALKOUT UNITS — W.O.
- STREET LIGHT STANDARD — L.S.
- CURB TRANSITION
- OVERLAND FLOW DIRECTION
- EXTERNAL OVERLAND FLOW DIRECTION
- REAR YARD OVERLAND FLOW DIRECTION
- PHASE LIMITS
- NOISE BARRIER (1.85m HIGH UNLESS OTHERWISE NOTED)
- PROPERTY BOUNDARY
- 3:1 TERRACING MAXIMUM SLOPE — 100.20 / 99.20
- PONDING AREA WITH SPILLWAY ELEVATION — 88.47
- 250ø PVC PERFORATED PIPE (REFER TO CITY STD S29 FOR REAR YARD TRENCH AND PIPE DETAILS ONLY) (SUBDRAIN APPLIED FOR SLOPE LESS THAN 1.5%)
- EXISTING SANITARY MAINTENANCE HOLE
- EXISTING STORM MAINTENANCE HOLE
- SANITARY MAINTENANCE HOLE
- PHASE 2 (NOT PART OF THIS SUBMISSION)

NOTES:

1. ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE AUTHORITIES HAVING JURISDICTION
2. CONTRACTOR TO VERIFY THE PRECISE LOCATIONS AND INVERT ELEVATIONS OF Ex. UNDERGROUND SERVICES AND Ex. UTILITIES PRIOR TO STARTING CONSTRUCTION
3. ALL EXISTING ABOVE GROUND FEATURES, E.G. MH/CHAMBER COVERS, PEDESTALS, HYDRO AND LIGHT POLES, ETC. AFFECTED BY THE DEVELOPMENT TO BE ADJUSTED TO SUIT TO THE SATISFACTION OF PARTIES AFFECTED
4. ALL EXISTING BUILDING, SHED, POST & WIRE FENCE, CHAIN LINK FENCE, TREE, UTILITY WIRE, POLE, CULVERT AND POOL WITHIN LOTS AND BLOCKS TO BE REMOVED, UNLESS OTHERWISE NOTED
5. ALL EXISTING POST & WIRE FENCE, CULVERTS, UTILITY WIRE / POLES, TREES, SHRUBS ETC. WITHIN LOTS, BLOCKS AND ROADS TO BE REMOVED, UNLESS OTHERWISE NOTED
6. PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE
7. PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS
8. A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO INSPECT ALL SUBGRADE SURFACES FOR FOOTING AND PAVEMENT STRUCTURES PRIOR TO CONSTRUCTION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY CITY OF OTTAWA, PROJECT 40 BEECHCLIFFE STREET. SURVEY DATED JANUARY 2025. ADDITIONAL TOPOGRAPHIC INFORMATION PROVIDED BY AOV LTD. PROJECT No. 25159-25. SURVEY DATED MAY 2025 AND JUNE 2025.

LEGAL INFORMATION

REGISTERED PLAN PLAN PROVIDED BY AOV LTD., PROJECT No. 25159-25, RECEIVED ON MAY 12, 2025.

ELEVATION NOTE

ELEVATIONS SHOWN ON THIS PLAN ARE GEODETIC AND ARE REFERRED TO THE CGVD28 GEODETIC DATUM. SITE BENCH MARK ON TOP OF FH SPINDLE FRONTING CIVIC ADDRESS 33 BEECHCLIFFE STREET. ELEVATION=88.966m

No.	BY	DATE	DESCRIPTION
1	W.L.	25-09-29	CN BERM DESIGN

CITY OF OTTAWA

PROJECT No. 24-1416

HABITAT FOR HUMANITY

40 BEECHCLIFFE STREET

DSEL
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

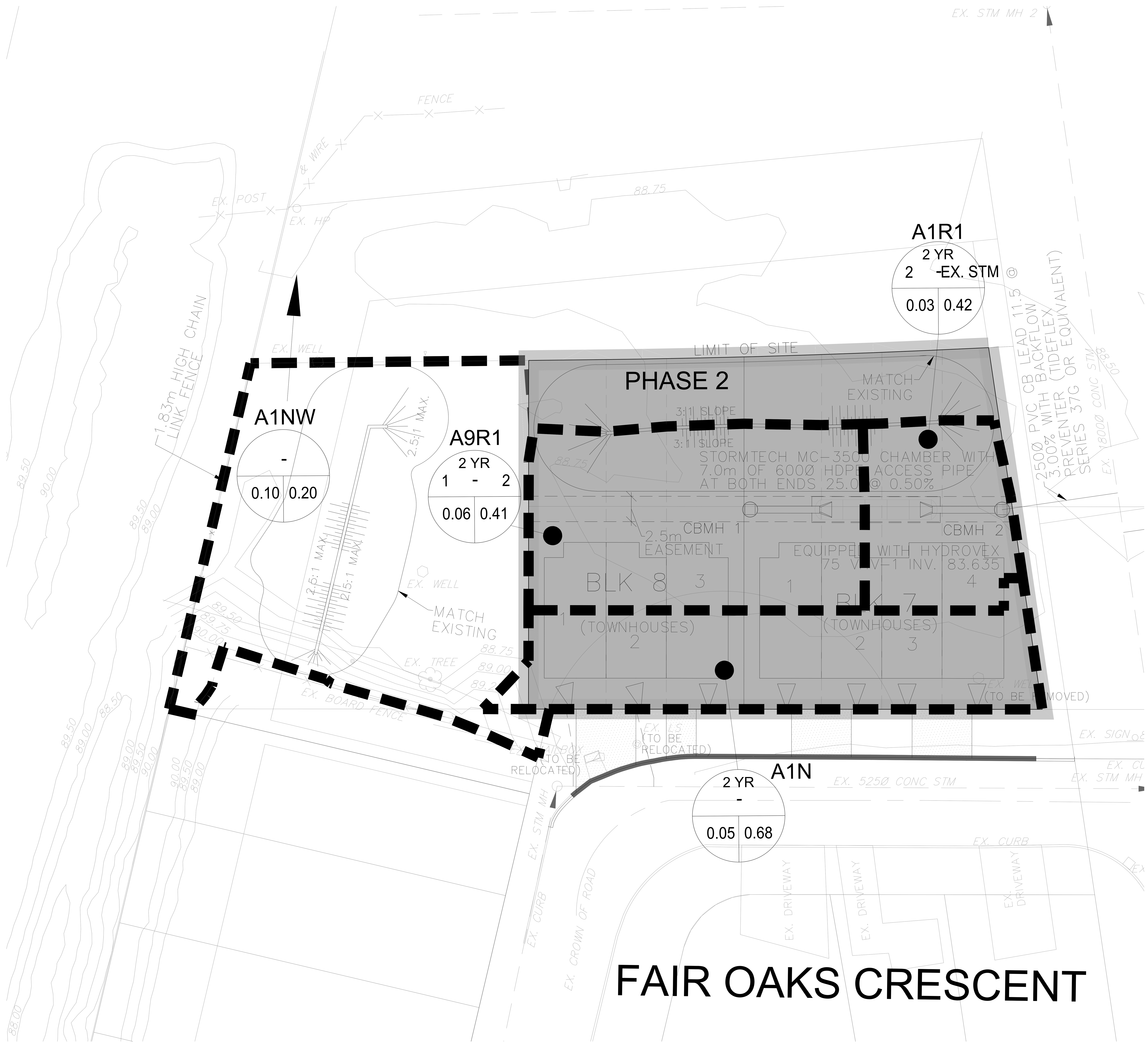
CN BERM GRADING PLAN

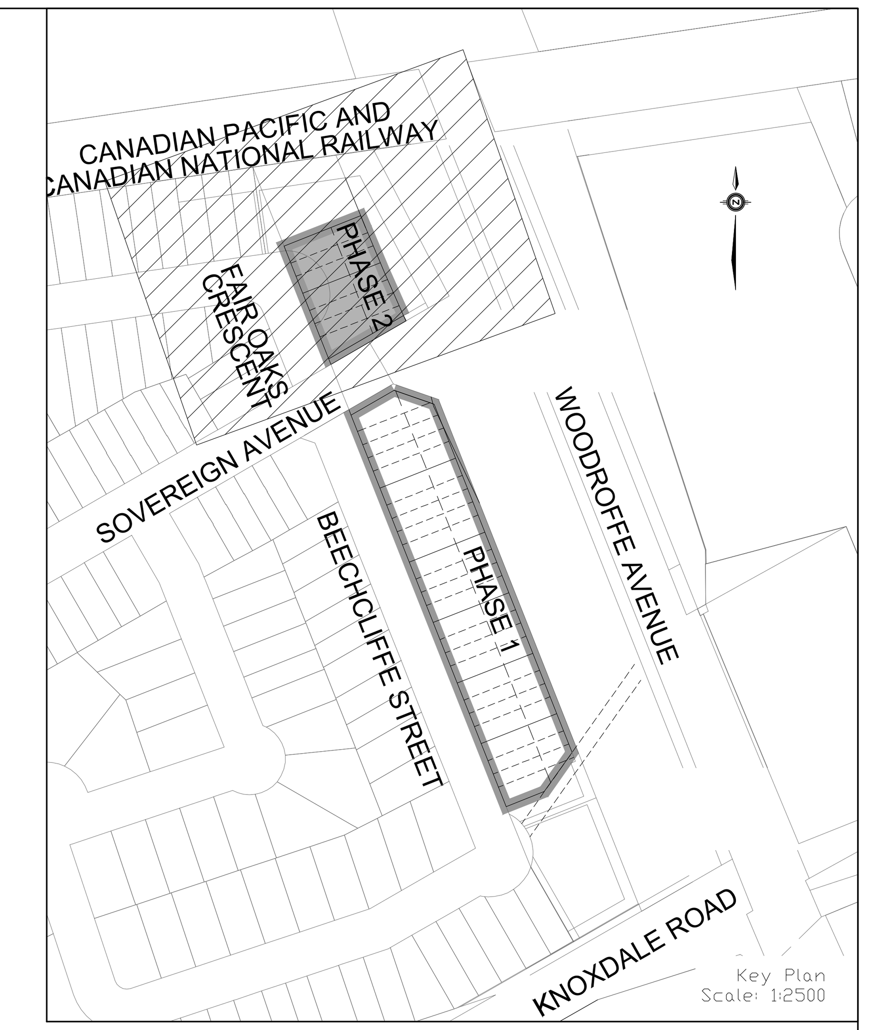
DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.
DESIGNED BY: A.S.	CHECKED BY:	1 OF 2
SCALE: 1:200	DATE: SEPTEMBER 2025	

CITY FILE No. D07-12-25-0091

CITY PLAN No. 19322

PHASE 2 IS NOT PART OF THIS APPLICATION AND ITS APPROVAL WILL BE SUBJECT TO A SUBSEQUENT DEVELOPMENT APPLICATION.





LEGEND

- STORM DRAINAGE BOUNDARY
- AREA ID (A2R1)
- STORM FREQUENCY (2Yr)
- UPSTREAM MH TO DOWNSTREAM MH (43 - 44)
- AREA IN HECTARES (0.37)
- RUNOFF COEFFICIENT (0.51)
- STREET CATCHBASIN & LEAD
- STREET CATCHBASIN WITH CLOSED LID & LEAD
- MAINTENANCE HOLE (MH202)
- CURB INLET CATCHBASIN & LEAD
- CATCHBASIN/ MAINTENANCE HOLE (CBMH201)
- INTERCONNECTED CATCH BASIN & LEADS
- CAP
- 375mmø ST
- OVERLAND FLOW DIRECTION
- EXTERNAL OVERLAND FLOW DIRECTION
- EXISTING STORM MAINTENANCE HOLE

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY CITY OF OTTAWA, PROJECT 40 BEECHCLIFFE STREET. SURVEY DATED JANUARY 2025. ADDITIONAL TOPOGRAPHIC INFORMATION PROVIDED BY AOV LTD. PROJECT No. 25159-25. SURVEY DATED MAY 2025 AND JUNE 2025.

LEGAL INFORMATION

REGISTERED PLAN PLAN PROVIDED BY AOV LTD., PROJECT No. 25159-25, RECEIVED ON MAY 12, 2025.

ELEVATION NOTE

ELEVATIONS SHOWN ON THIS PLAN ARE GEODETIC AND ARE REFERRED TO THE CGVD28 GEODETIC DATUM. SITE BENCH MARK ON TOP OF FH SPINDLE FRONTING CIVIC ADDRESS 33 BEECHCLIFFE STREET. ELEVATION=88.966m

No.	BY	DATE	DESCRIPTION
1	W.L.	25-09-29	CN BERM DESIGN

CITY OF OTTAWA

PROJECT No. 24-1416

HABITAT FOR HUMANITY

40 BEECHCLIFFE STREET

DSEL
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

CN BERM STORM DRAINAGE PLAN

DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.
DESIGNED BY: A.S.	CHECKED BY:	2 OF 2
SCALE: 1:200	DATE: SEPTEMBER 2025	

CITY PLAN No. 19322

CITY FILE No. _D07-12-25-0091

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

TECHNICAL MEMO

DATE:	February 18th, 2026	*EMAIL*
TO:	**City of Ottawa ATTN: Vincent Duquette**	
SUBJECT:	40 Beechcliffe Street Site Plan - Stormwater Management Facility (SWMF) Design and Volumetric Analysis	
OUR FILE:	24-1416	
CITY FILE:	D07-12-25-0091	
Attachments:	City email dated 2025-11-13 DSEL Drawings dated 2026-02-17: 2 Details 2A Cross-Sections 4 General Plan 5 Plan and Profile 7 Grading Plan Rational Method Calculation Sheet	

Purpose and Background

This memorandum discusses the design rationale, volumetric assessment, and operation of the proposed Stormwater Management Facility (SWMF) for the 40 Beechcliffe Street development. The design has been prepared in response to direction provided by the City via email dated November 13, 2025 (attached for reference).

Under existing conditions, the subject site provides relief storage for overland flow originating from Beechcliffe Street. The proposed development removes a portions of this storage volume through grading modifications required to support the site plan. As directed by the City, a compensatory storage strategy has been developed by DSEL to re-establish equivalent relief storage capacity within the subject lands.

Proposed System Configuration

The proposed design connects catchbasin CB 32873 to a new catch basin manhole CBMH replacing CB 32874 as seen on DSEL drawings. This interconnection will direct flows to a proposed storage pond located on City-owned lands within the Sovereign Avenue road allowance.

This configuration hydraulically links the two contributing drainage areas and conveys runoff that previously ponded at CB 32873 into the dedicated SWMF.

The proposed pond fulfills two primary hydraulic objectives. First, it replaces the relief storage volume that will be eliminated by development. Second, it attenuates additional uncontrolled runoff from the redeveloped site prior to discharge toward the Beechcliffe ROW.

Vertical Datum and Spill Elevations

A discrepancy exists between historical and current topographic datasets due to differing vertical datums. To ensure an accurate comparison between existing and proposed conditions, the spill elevations were normalized.

The City's 2024 Digital Elevation Model identifies the controlling spill elevation at 88.05m (CGG2013a). The DSEL grading design is based on the City's topographic survey referenced to CGVD28. A 0.31m offset exists between these two datums, accordingly, the equivalent spill elevation was set to 88.36m in CGVD28 to maintain consistency with the DSEL grading design.

Volumetric Analysis

A detailed volumetric analysis was undertaken to quantify the existing relief storage and to confirm that the proposed design provides an equivalent or greater volume below the normalized spill elevation. See figures below:

Figure 1 (Existing Condition): Analyzes topography on the subject property behind the curb line. Existing relief storage below the 88.05m spill elevation is approximately 980 m³. Volumes were derived using the City of Ottawa 2024 Digital Elevation Model (DEM) referenced to CGG2013a.

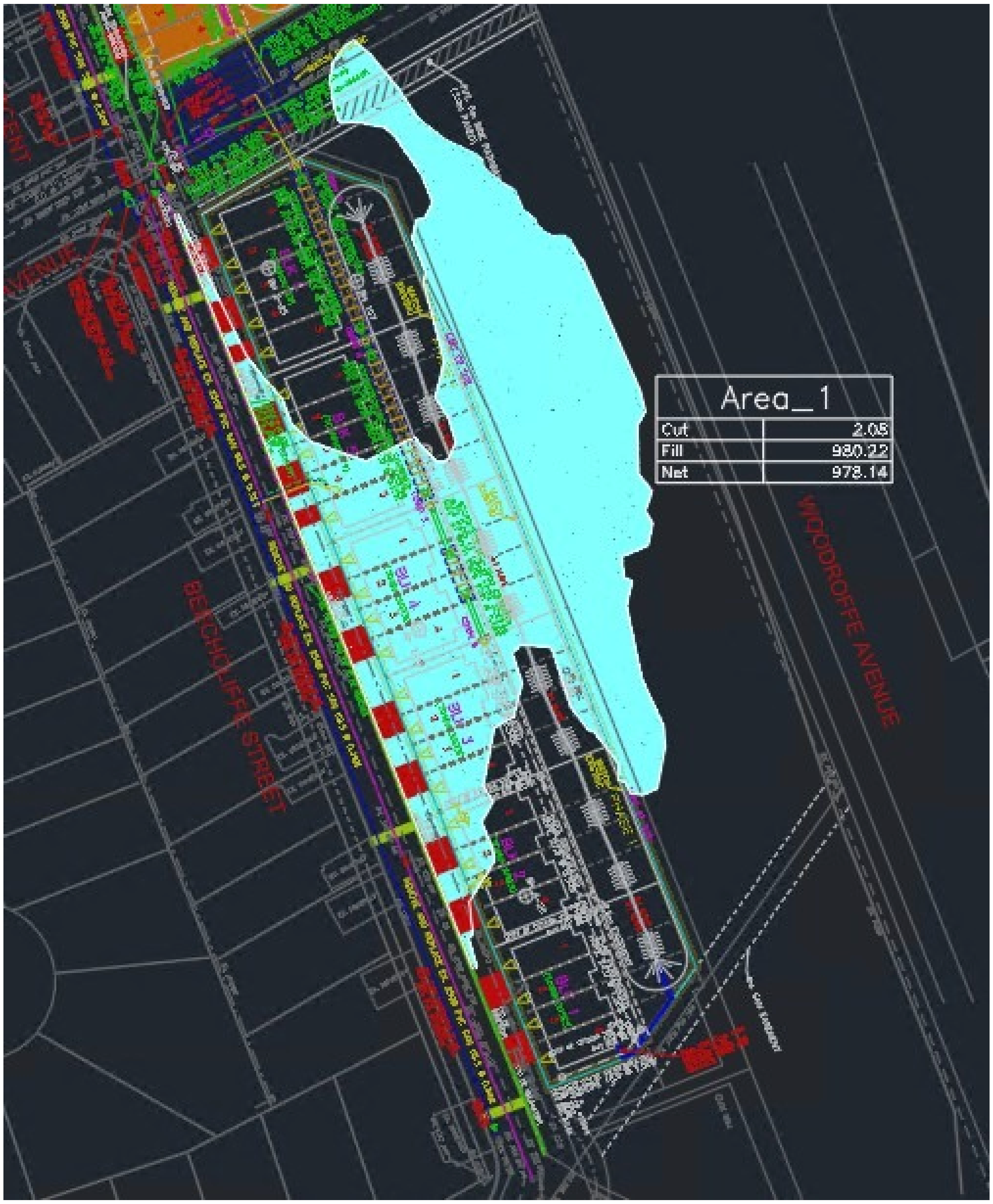


Figure 2 (Ultimate Condition): Quantifies the residual storage capacity (550 m³) maintained at the toe of the slope outside of the proposed site plan limits, which acts in conjunction with the new SWMF. Volumes were calculated using the City of Ottawa 2024 DEM referenced to CGG2013a.

Figure 3 (Proposed Design): Evaluates the DSEL design against the adjusted spill elevation, providing 140 m³ of storage. Volumes were calculated using DSEL design grades referenced to CGVD28 and spill elevation of 88.36 as discussed above.

The following table illustrates how the proposed design replaces the existing relief storage:

Storage Component	Condition	Volume (m3)
Existing Relief Storage	Pre-Development (Below 88.05 m)	**980**
Retained Volume	Post-Dev (Toe of slope behind site)	550
Front Yard Storage	Post-Dev (Proposed Grading)	140
Proposed Pond Capacity	Post-Dev (Below 88.36 m)	350
Total Post-Dev Storage	**Sum of Proposed/Retained**	**1,040**
Net Storage Surplus	**Post-Dev vs. Pre-Dev**	**+60**

Table 1 – Summary of storage volumes

Hydrologic Modeling

The Rational Method was applied to quantify the storage volume required to offset uncontrolled post-development runoff. The analysis compared pre-development and post-development conditions using standard runoff coefficients and drainage areas consistent with the approved site plan model.

The pre-development drainage area contributing toward Beechcliffe Street is 4,900 m^2, with a runoff coefficient of 0.25. The post-development impervious drainage area contributing to the system is 2,200 m^2, with a runoff coefficient of 0.89. In accordance with City criteria, the 100-year post-development flow was attenuated to the 2-year pre-development discharge rate.

As seen in the attachments, the analysis determined that 41.3 m^3 of storage is required to offset the incremental uncontrolled runoff. This requirement is fully accommodated within the 60 m^3 net storage surplus identified in the volumetric assessment.

It is further noted that the pre-development drainage area used in the calculation is based on the pre-development site plan model and is considered conservative, as it likely underrepresents the actual contributing drainage to Beechcliffe Street.

Model Integration

The proposed site plan and stormwater facility were integrated into the City's community-wide PCSWMM model. This evaluation confirms that the system functions as intended under major storm conditions and establishes the 100-year Hydraulic Grade Line (HGL) within both the proposed pond and the Beechcliffe ROW.

The modeling confirms that the compensatory storage approach maintains hydraulic performance consistent with existing conditions and does not adversely impact the municipal drainage system.

Facility Design and Maintenance

The design of the SWMF adheres to the City of Ottawa Sewer Design Guidelines and is summarized below:

Internal Drainage: The pond bottom is designed with a minimum 2% longitudinal slope to ensure positive drainage toward the outlet and prevent standing water between storm events.

Inlet/Outlet Infrastructure: A ditch inlet structure is proposed to manage flow transition between the pipe network and the pond. Details of the structure are shown on DSEL drawing 2.

Grading: The facility side slopes are designed at a 4:1 ratio.

Fencing: Per the City's specific request, a post-and-rail fence will be installed along two sides of the facility to delineate the SWMF area from adjacent lands.

Operations and maintenance: Detailed procedures for the inspection and upkeep of the facility are provided under a separate Operations and Maintenance (O&M) Manual.

Conclusion and Recommendations

The proposed stormwater management design satisfies the City's requirement of replace existing relief storage removed by development while also mitigating post-development runoff. The design provides a total of 1,040 m^3 of storage below the controlling spill elevation: 550 m^3 of retained storage, 140 m^3 of front yard storage, and 350 m^3 of dedicated pond storage. This exceeds the 980 m^3 of existing relief storage by approximately 60 m^3.

Hydrologic analysis demonstrates that 41.3 m^3 of storage is required to attenuate incremental uncontrolled runoff, and this requirement is fully satisfied within the available surplus volume. PCSWMM modeling further confirms acceptable hydraulic performance under the 100-year design event.

Please contact the undersigned should additional clarification regarding datum normalization, volumetric calculations, or hydraulic modeling be required.

Prepared by,

David Schaeffer Engineering Ltd.

Per: Jeremy Chouinard, P.Eng.

Outlook

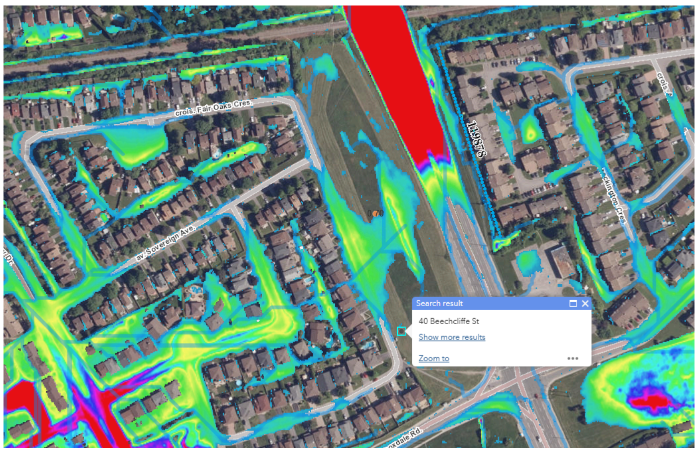
RE: 40 Beechcliffe - Site Plan D07-12-25-0091

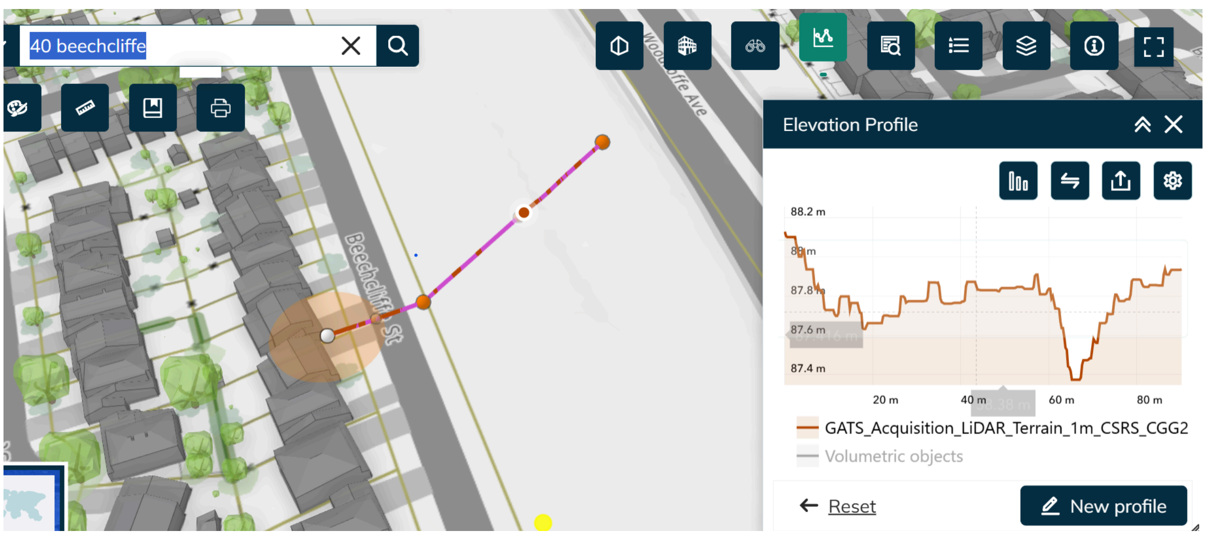
From Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Date Thu 11/13/2025 5:21 PM
To Adam Fobert <AFobert@dsel.ca>
Cc Jeremy Chouinard <JChouinard@dsel.ca>; Jhamb, Nishant <nishant.jhamb@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>; Bourke, Simone <simone.bourke@ottawa.ca>

Hi Adam,

As mentioned over the phone, this site was providing storage relief to the overland flow from Beechcliffe Street under existing conditions. See image below,. The proposed development will not only remove this existing storage but also add more flow to Beechcliffe Street. Therefore, we believe the total capture required in the ROW minor system will be much greater than what is described in the email below to ensure there is no negative impact on existing properties from the increased overland flow.

We understand the entire road will need to be excavated to replace the water main, sanitary, and add service laterals. That provides an opportunity to add road sags in the ROW, which could offset the loss in storage and the increased runoff from 40 Beechcliffe





Also, under existing conditions, the Beechcliffe overland flow would spill on the East Side (40 Beechcliffe) before it spills on the West Side. The proposed grade increase on 40 Beechcliffe will divert all of the emergency overland flow to the West Side. We need to ensure the proposed development does not increase the flow rate or volume of water that will spill on the West Side.
In summary, we would like the applicant to explore options to maximize the storage in the ROW to ensure the properties on the West Side are not negatively impacted. Due to the limitations in the Pinecrest Creek/Westboro sub-watershed study, we cannot increase the capture in the minor system.

I suggest we have a small meeting to discuss these SWM complications for this site. We are available at the following times:

- Wednesday November 19, 2025, 1130-230
- Thursday November 20, 2025, 10-1

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
City of Ottawa | Ville d'Ottawa
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Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: Duquette, Vincent
Sent: Friday, October 31, 2025 3:01 PM
To: Adam Fobert <AFobert@dsel.ca>
Cc: Erin O'Connor <eoconnor@habitatgo.ca>; JChouinard <JChouinard@dsel.ca>; William Froggatt <William.Froggatt@caivan.com>; Jhamb, Nishant <nishant.jhamb@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>; Ireland, James <james.ireland@ottawa.ca>; susan.murphy <susan.murphy@caivan.com>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi Adam,

We are currently reviewing our models internally and it does appear that sending an increased amount of flows to storm sewer and Beechcliffe ROW will have a negligeable impact on the HGL of the receiving sewers. This is most likely because of the early peaking of the flows from the subject site compared to rest of the larger drainage area. We will confirm next week if the current proposed flows are acceptable and if any ICD upsizing will be required.

Regarding the backflow preventers proposed, we have reviewed both the Tideflex Series 37G and CheckMate Ultraflex. We are ok with accepting both options. However, we request that the backflow preventer be placed downstream from the ICD to protect it. Please also ensure the backflow preventer is located within private property.

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West | 110 avenue Laurier Ouest
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: Adam Fobert <AFobert@dsel.ca>
Sent: Tuesday, October 28, 2025 4:41 PM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>; susan.murphy <susan.murphy@caivan.com>; Ireland, James <james.ireland@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>
Cc: Erin O'Connor <eoconnor@habitatgo.ca>; JChouinard <JChouinard@dsel.ca>; William Froggatt <William.Froggatt@caivan.com>; Jhamb, Nishant <nishant.jhamb@ottawa.ca>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

Hello Vincent,

Thank you for organizing the meeting today where we reviewed the City's concerns for existing flooding on Beechcliffe and the proposed backwater flow control.

As discussed, the tributary area to the existing 1800mm diameter storm sewer is roughly 112ha, whereas the subject lands measure 0.65ha; 0.6% of the drainage area. It is my opinion that the site itself will not have a meaningful impact on the HGL in the receiving sewer. There is also the matter of water being directed to the existing ROW. It was mentioned that we were doubling flow from existing. I believe that when compared to the target release rate (2yr flow C=0.25), that may be true. However, a Rational Method estimate of the runoff from the site to the existing ROW is 75.9L/s (0.49ha) during the 100-year storm. Whereas, the post-development condition will contribute 98.2L/s (0.22ha) as estimated through the Rational Method. Looking at the roof line and highpoints in the side yard swales, the post-development flow is more accurately estimated at 84.8L/s (0.19ha). 8.9L/s more than the existing condition.

I understand that the City will review the model for the community and consider an increase in rate at the CBs along Beechcliffe. I suggest that the increase can be nominal, as the development is estimated to add 8.9L/s to the existing 4 CBs on the east side of Beechcliffe. Or ~2.2L/s each.

I would like to reiterate that the development as a whole reduces the runoff from the subject lands below existing rates. Furthermore, that the site itself is too small compared to the catchment to have a meaningful impact. Lastly, engineering solutions to reduce flows from the site to meet target release rate require significant capital investment and will not have a meaningful impact on the receiving sewer.

We have considered your comments for future maintenance in regards to backflow prevention. In the proposed arrangement, the backflow preventor would be installed behind the orifice plate. Future maintenance would require unbolting the face plate for the ICD. Alternatively, we propose the attached. This valve is installed inline on the upstream sewer. There would be no need to unbolt the ICD plate. The device would be accessible inside the structure. I would add that we have used this product as well on existing private sites. Let me know if you have any questions or concerns.

Appreciate all your time and efforts.

Adam Fobert, P.Eng.

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

cell: (613) 222-9493
email: afobert@DSEL.ca

From: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Sent: October 23, 2025 2:18 PM
To: susan.murphy <susan.murphy@caivan.com>; Ireland, James <james.ireland@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>
Cc: Erin O'Connor <eoconnor@habitatgo.ca>; Adam Fobert <AFobert@dsel.ca>; Jeremy Chouinard <JChouinard@dsel.ca>; William Froggatt <William.Froggatt@caivan.com>; Jhamb, Nishant <nishant.jhamb@ottawa.ca>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

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Hi Susan,

I agree a meeting would be beneficial. Here are some time slots that work for the us.

- Tuesday October 28th. 9-12
- Wednesday October 29th. 9-10, 1-2
- Tuesday October 30th. 9-12, 230-4

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West | 110 avenue Laurier Ouest
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: Susan Murphy <susan.murphy@caivan.com>
Sent: Thursday, October 23, 2025 1:51 PM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>; Ireland, James <james.ireland@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>
Cc: Erin O'Connor <eoconnor@habitatgo.ca>; Adam Fobert <afobert@dsel.ca>; JChouinard <JChouinard@dsel.ca>; William Froggatt <William.Froggatt@caivan.com>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

Good Afternoon,

We have had a chance to review the comments pertaining to stormwater management. We would appreciate having a meeting with yourselves and the staff providing the stormwater management comments. Prior to formally replying, we feel it would be beneficial to discuss the comments and the design to confirm next steps.

It would be appreciated if you could provide some suggested meeting dates and times.

Thank you,

Sue

SUSAN MURPHY
President, Land Development
3713 Borrisokane Road
Ottawa, ON K2J 4J4
C: 613-355-6706

CAIVAN

From: William Froggatt <William.Froggatt@caivan.com>
Sent: Wednesday, October 22, 2025 3:49 PM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Cc: Susan Murphy <susan.murphy@caivan.com>; Erin O'Connor <eoconnor@habitatgo.ca>; Ireland, James <james.ireland@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>
Subject: Re: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi Vincent,

Thank you for providing! I will speak with our engineers and let you know if we have any further questions.

Thank you,

William Froggatt

Project Coordinator, Land Development

3713 Borrisokane Road

Ottawa, ON K2J 4J4

C: 343-961-8717

From: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Sent: Wednesday, October 22, 2025 2:52 PM
To: William Froggatt <William.Froggatt@caivan.com>
Cc: Susan Murphy <susan.murphy@caivan.com>; Erin O'Connor <eoconnor@habitatgo.ca>; Ireland, James <james.ireland@ottawa.ca>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi William,

Thank you for your patience awaiting my comments. See attached my third review comments. The only comments left are related to SWM. Feel free to reach out if you have any questions about these comments.

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
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110 Laurier Avenue West | 110 avenue Laurier Ouest
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: William Froggatt <William.Froggatt@caivan.com>
Sent: Thursday, October 16, 2025 9:11 AM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>; Ireland, James <james.ireland@ottawa.ca>
Cc: susan.murphy <susan.murphy@caivan.com>; Erin O'Connor <eoconnor@habitatgo.ca>
Subject: Re: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi Vincent,

Yes, we would now like to include the north parcel in the scope of our application (blocks 7-8). Once we receive your final comments, we will resubmit the full package making clear reference to all 8 blocks in the site.

We spoke with our lawyer yesterday who informed us that new lots within 150m of a rail corridor must be subject to site plan control.

James, could you confirm that a full re-circulation will not be required since our package had already included these blocks in the design?

Thank you,

William Froggatt
Project Coordinator, Land Development
3713 Borrisokane Road
Ottawa, ON K2J 4J4
C: 343-961-8717

From: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Sent: Wednesday, October 15, 2025 10:49 PM
To: William Froggatt <William.Froggatt@caivan.com>
Cc: Ireland, James <james.ireland@ottawa.ca>; Susan Murphy <susan.murphy@caivan.com>; Erin O'Connor <eoconnor@habitatgo.ca>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi William,

Unfortunately, I've been swamped since my return and won't be able to get you the review comments this week. I will aim for early next week.

On a separate note, I have a question regarding the scope of the SPC application. At our last meeting there was some discussion about formally including the north phase in scope of the application. Has there been a decision on that matter?

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
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110 Laurier Avenue West | 110 avenue Laurier Ouest
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: William Froggatt <William.Froggatt@caivan.com>
Sent: Tuesday, October 14, 2025 12:38 PM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>

Cc: Ireland, James <james.ireland@ottawa.ca>; susan.murphy <susan.murphy@caivan.com>; Erin O'Connor <eoconnor@habitatgo.ca>
Subject: Re: 40 Beechcliffe - Site Plan D07-12-25-0091

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Hi Vincent,

Following up on the engineering review for our latest submission in Beechcliffe. When can we expect it to be complete?

Thank you,

William Froggatt
Project Coordinator, Land Development
3713 Borrisokane Road
Ottawa, ON K2J 4J4
C: 343-961-8717

From: William Froggatt <William.Froggatt@caivan.com>
Sent: Wednesday, September 24, 2025 4:43 PM
To: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Cc: Erin O'Connor <eoconnor@habitatgo.ca>; Susan Murphy <susan.murphy@caivan.com>; Dickinson, Mary <mary.dickinson@ottawa.ca>; Hodgins, Cameron <cameron.hodgins@ottawa.ca>; Ireland, James <james.ireland@ottawa.ca>
Subject: Re: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi Vincent,

Thank you for letting us know. I hope all is still well considering this is an unexpected leave.

Thanks,

William Froggatt
Project Coordinator, Land Development
3713 Borrisokane Road
Ottawa, ON K2J 4J4
C: 343-961-8717
CAIVAN

From: Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Sent: Wednesday, September 24, 2025 3:56 PM
To: William Froggatt <William.Froggatt@caivan.com>

Cc: Erin O'Connor <eoconnor@habitatgo.ca>; Susan Murphy <susan.murphy@caivan.com>; Dickinson, Mary <mary.dickinson@ottawa.ca>; Hodgins, Cameron <cameron.hodgins@ottawa.ca>; Ireland, James <james.ireland@ottawa.ca>
Subject: RE: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi William,

Resubmission has been received. Unfortunately, I will be away all of next week and returning on October 7th. This unexpected absence means I won't be able to review your resubmission until I'm back. Thank you for your understanding in advance.

Best Regards,

Vincent Duquette, P.Eng
Project Manager, Infrastructure Approvals | Gestionnaire de projet, Projets d'infrastructure
Development Review – All Ward | Direction de l'examen des projets d'aménagement - Tous les quartiers
Planning, Development and Building Services Department (PDBS)| Direction générale des services de la planification, de l'aménagement et du bâtiment (DGSPAB)
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West | 110 avenue Laurier Ouest
Ottawa, ON K1P 1J1
613.580.2424 ext./poste 14048, vincent.duquette@ottawa.ca

From: William Froggatt <William.Froggatt@caivan.com>
Sent: Monday, September 22, 2025 4:37 PM
To: Ireland, James <james.ireland@ottawa.ca>; Duquette, Vincent <Vincent.Duquette@ottawa.ca>
Cc: Erin O'Connor <eoconnor@habitatgo.ca>; susan.murphy <susan.murphy@caivan.com>; Dickinson, Mary <mary.dickinson@ottawa.ca>; Hodgins, Cameron <cameron.hodgins@ottawa.ca>
Subject: 40 Beechcliffe - Site Plan D07-12-25-0091

Hi James and Vincent,

As a response to the Formal Circulation Comments on August 21st, please see following link to our resubmission as well as the attached comment response table. The updated reports include the following:

- Revised Engineering Submission
- Geotechnical Grading Plan Review
- Geotechnical Comment Response Memo
- Updated Survey Plan, Site Plan, and Landscape Plan
  - Only changes made to title block and sheet format.

250922 - 40 Beechcliffe - 3rd Submission

Thank you,

William Froggatt
Project Coordinator, Land Development
3713 Borrisokane Road
Ottawa, ON K2J 4J4
C: 343-961-8717

CAIVAN

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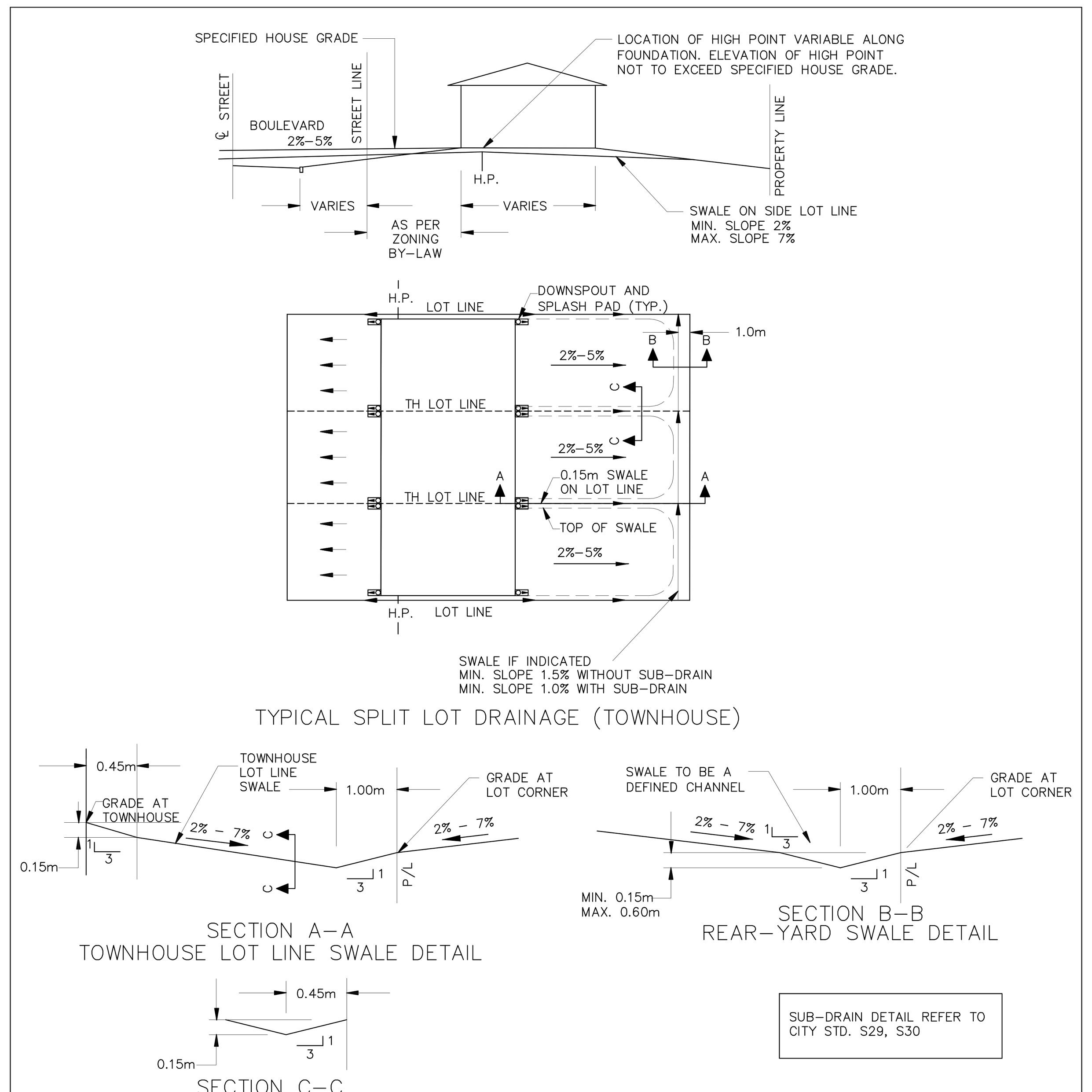
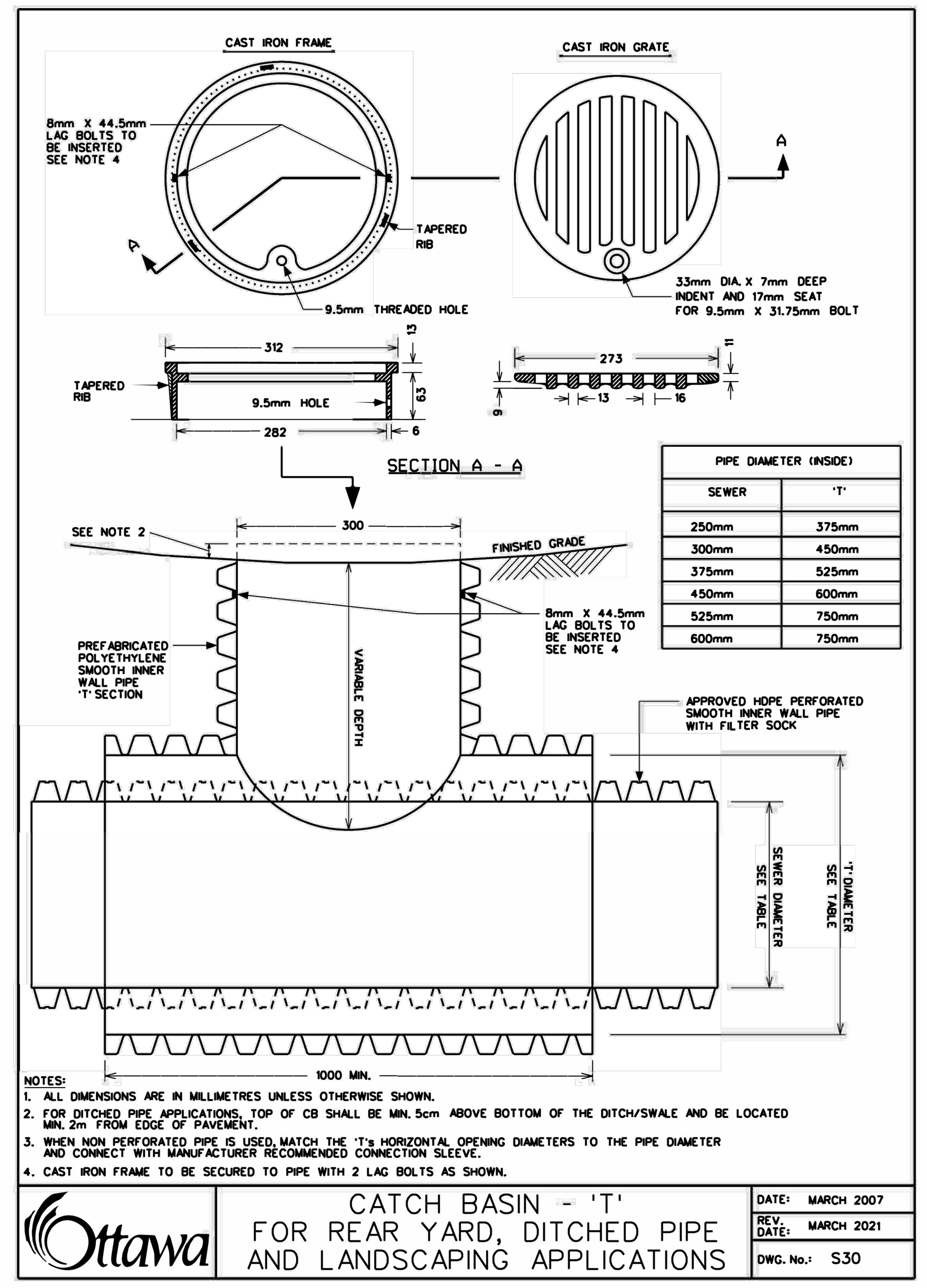


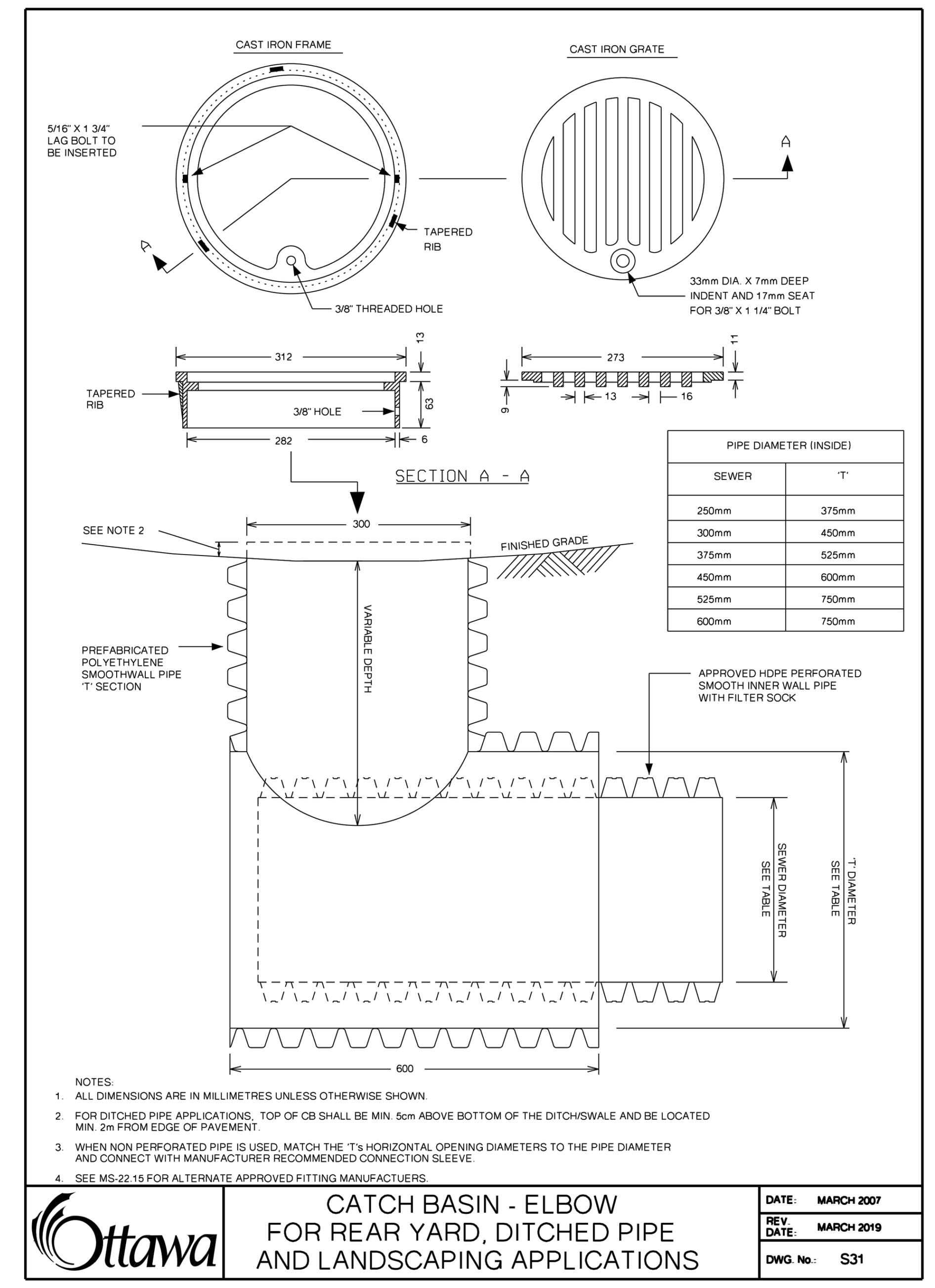
NOTES:

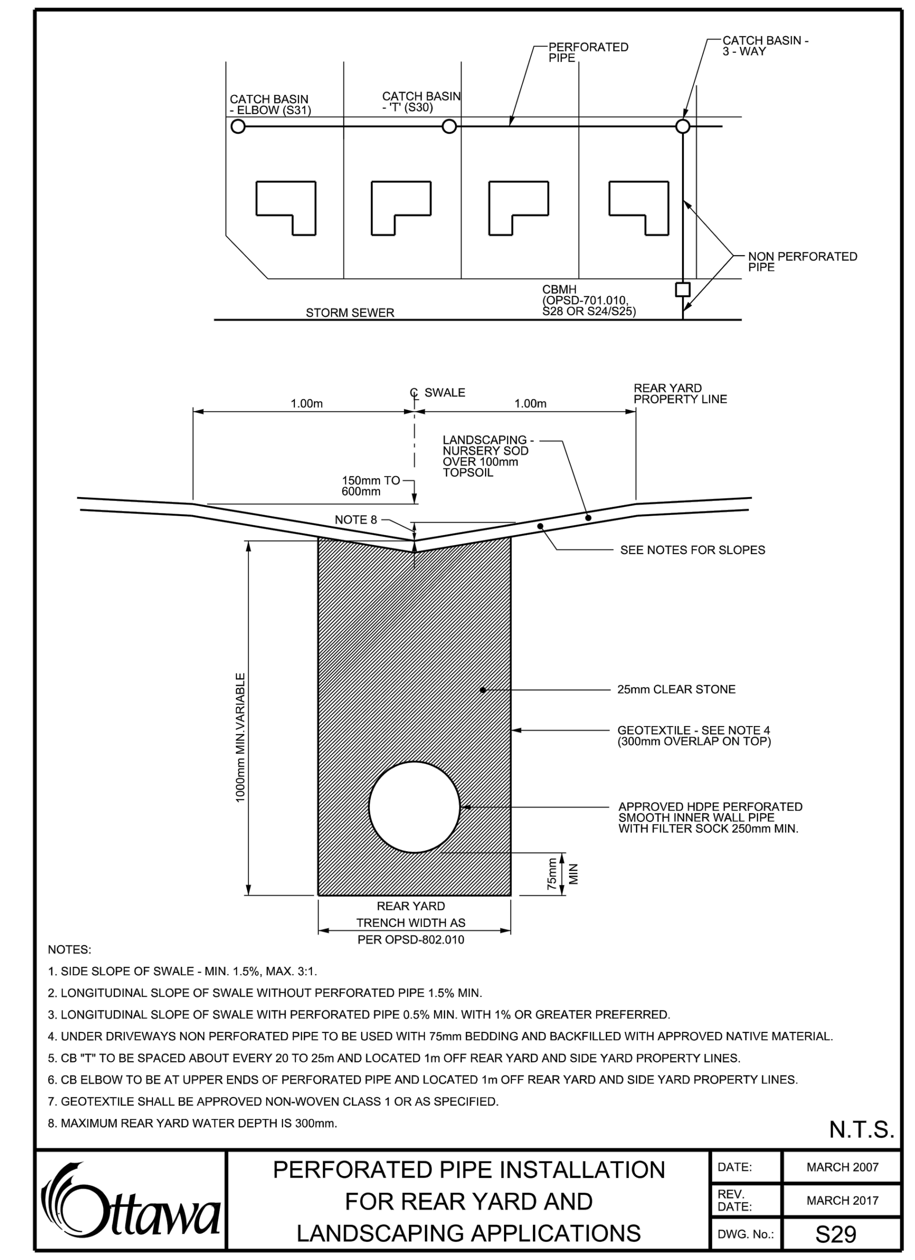
1) IF ATTACHED GARAGE CONSTRUCTED THEN REAR YARD SLOPE MAY COMMENCE AT REAR GARAGE WALL.
2) SLOPE FROM SPECIFIED HOUSE GRADE TO REAR LOT SWALE TO BE 2% MIN. AND 7% MAX. GRADING OVER 7% SHALL BE TERRACED AT 3:1 MAX.
3) IF A PROTECTIVE APRON IS REQUIRED AROUND THE FOUNDATION GRADING SHOULD BE KEPT 0.15m BELOW SPECIFIED HOUSE GRADE. ALL GRADING TO REMAIN 2% MIN.
4) SEE DRAWING FOR DETAILED LOT DIMENSIONS.
5) DRIVEWAY GRADE TO BE 2–6% (MAX.)
6) DOWNSPOUTS TO DISCHARGE ONTO GROUND VIA SPLASH PAD. REFER TO ARCHITECTURAL DWG. FOR ACTUAL LOCATIONS. FOR SPLASH PAD, SEE DETAIL ON THIS DWG.

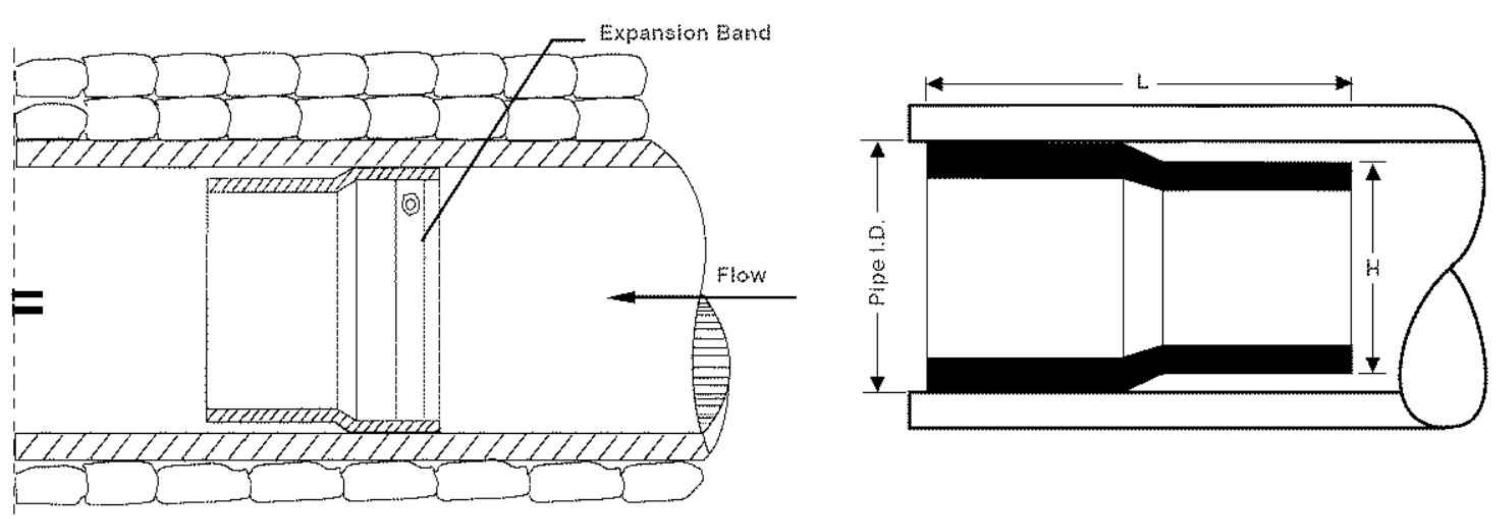
TYPICAL GRADE CONTROL REQUIREMENTS

N.T.S.



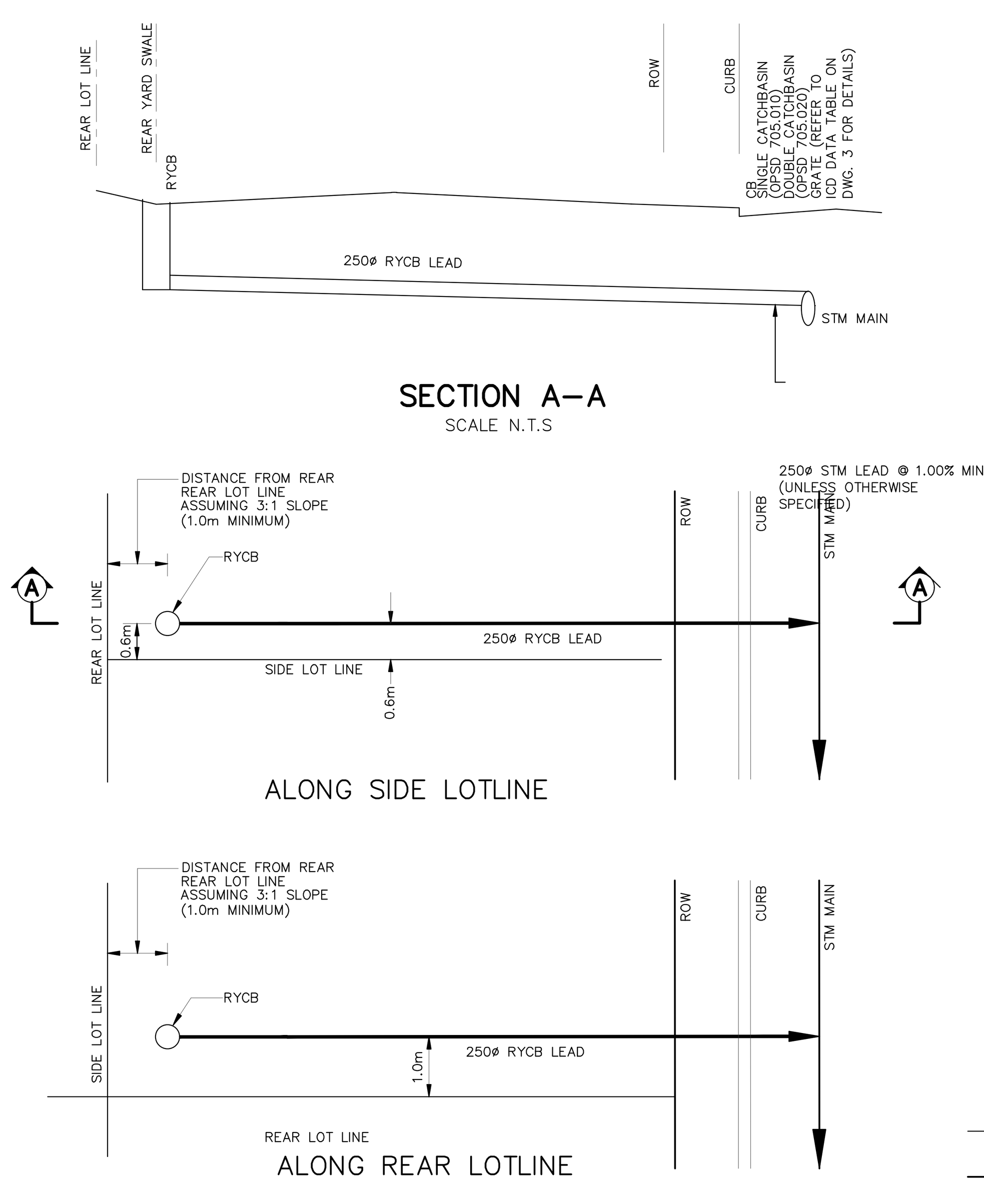






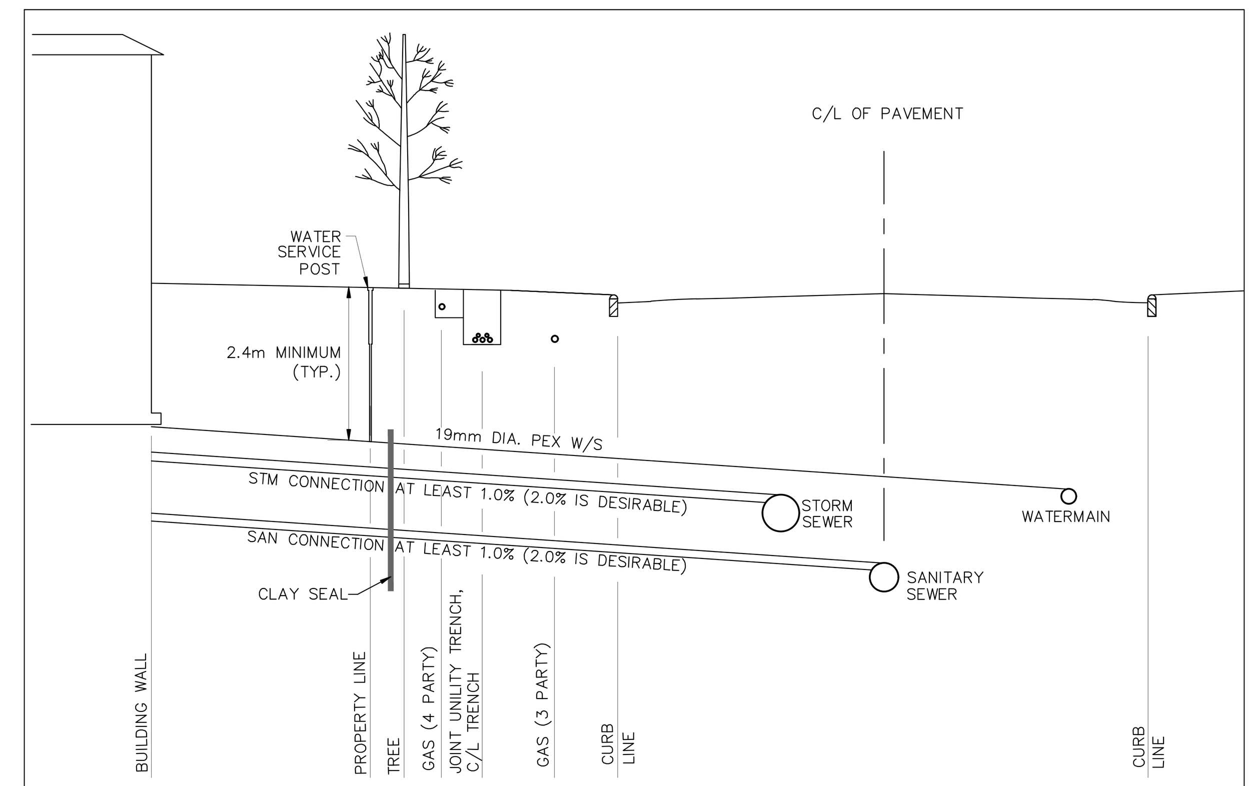
BACKFLOW PREVENTOR
TIDEFLEX SERIES 37G OR EQUIVALENT

SCALE: N.T.S.



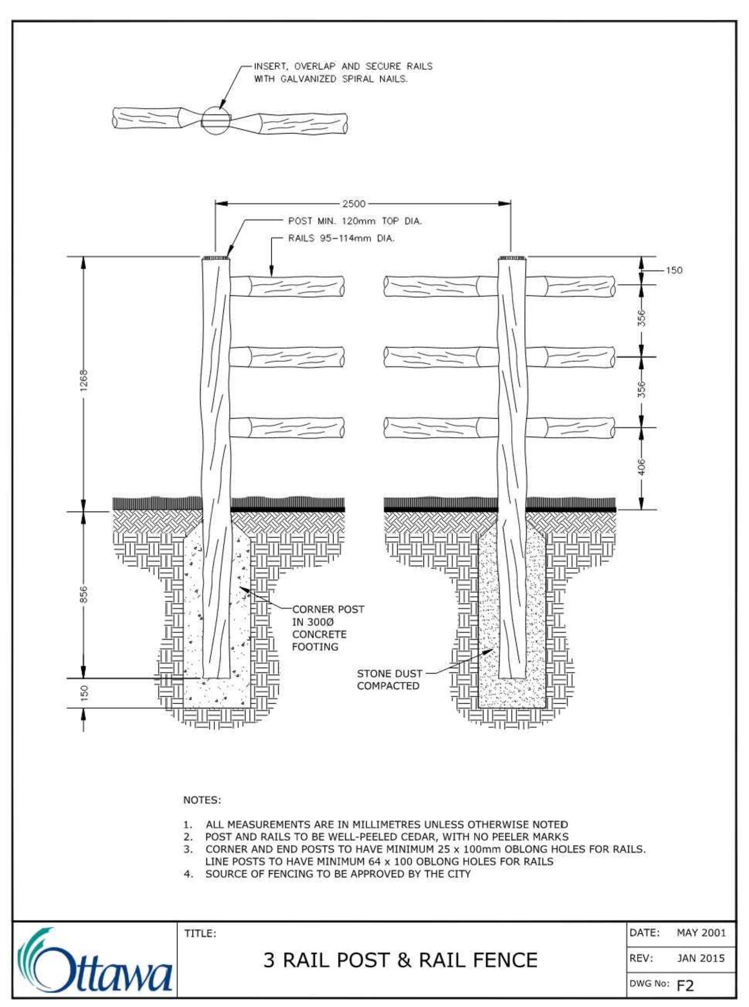
RYCB DETAIL (TYPICAL)
(SINGLE)

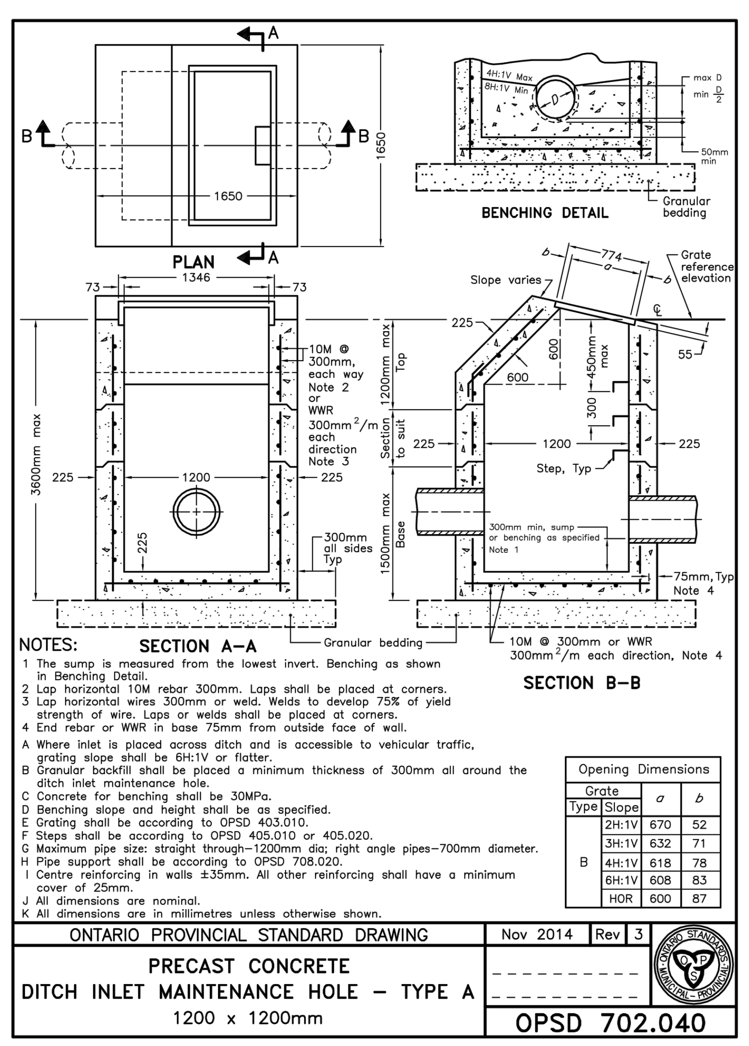
N.T.S.

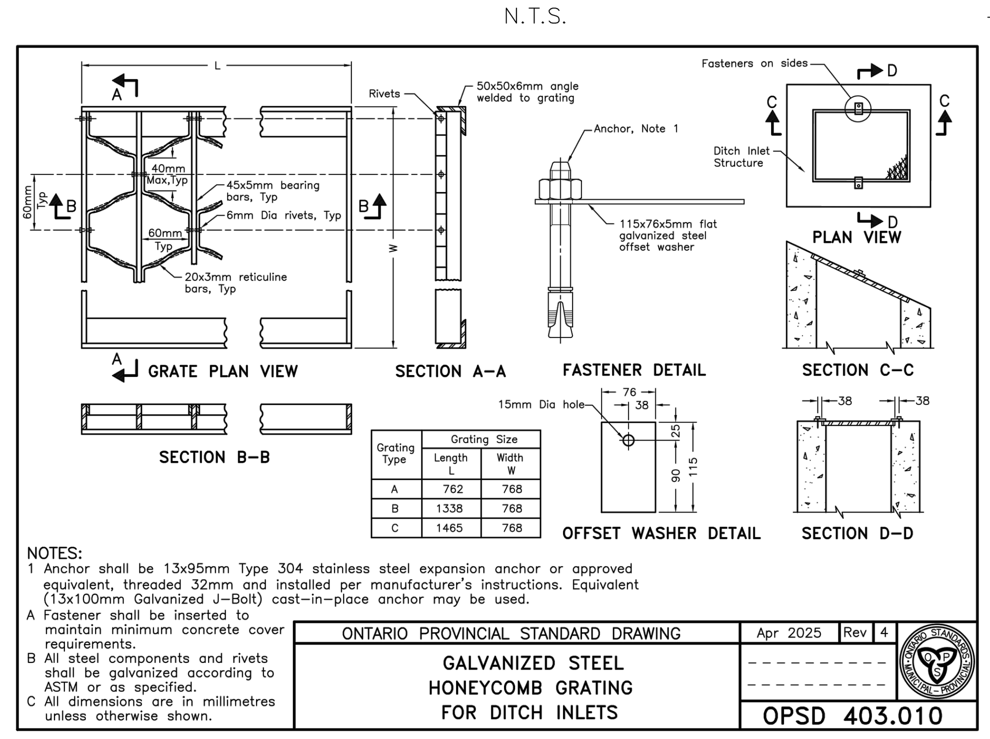


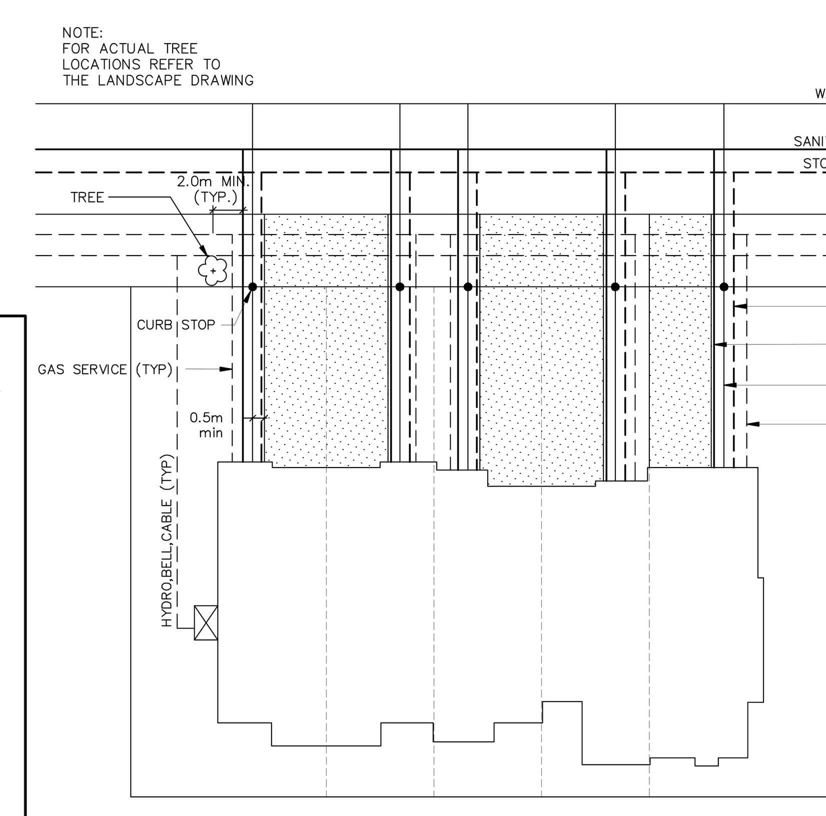
TYPICAL SERVICE CONNECTIONS CROSS SECTION

N.T.S.









DRIVEWAY AND CONNECTIONS TABLE				
LOT	UNIT WIDTH (m)	DRIVEWAY WIDTH (m)	DRIVEWAY MIN. OFFSET FROM LOTLINE (m)	CONNECTION
INTERNAL UNIT	6.40	4.0	0	0.5m FROM DRIVEWAY
END UNIT	8.20	4.0	0	0.5m FROM DRIVEWAY
CORNER UNIT	9.00	4.0	0	0.5m FROM DRIVEWAY

TYPICAL SERVICE CONNECTION (TOWNHOUSE)

N.T.S.

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY CITY OF OTTAWA, PROJECT 40 BEECHCLIFFE STREET. SURVEY DATED JANUARY 2025. ADDITIONAL TOPOGRAPHIC INFORMATION PROVIDED BY AOV LTD. PROJECT No. 25159–25. SURVEY DATED MAY 2025 AND JUNE 2025.

LEGAL INFORMATION

REGISTERED PLAN PLAN PROVIDED BY AOV LTD., PROJECT No. 25159–25, RECEIVED ON MAY 12, 2025.

ELEVATION NOTE

ELEVATIONS SHOWN ON THIS PLAN ARE GEODETIC AND ARE REFERRED TO THE CGVD28 GEODETIC DATUM. SITE BENCH MARK ON TOP OF FH SPINDLE FRONTING CIVIC ADDRESS 33 BEECHCLIFFE STREET. ELEVATION=88.966m

No.	BY	DATE	DESCRIPTION
5	W.L.	26–02–17	4th SUBMISSION
4	W.L.	25–09–15	3rd SUBMISSION
3	W.L.	25–08–01	2nd SUBMISSION
2	W.L.	25–07–15	ISSUED FOR TENDER
1	W.L.	25–06–20	1st SUBMISSION

CITY OF OTTAWA

PROJECT No. 24–1416

LICENSED PROFESSIONAL ENGINEER
W. LIU
100167932
26-02-17
PROVINCE OF ONTARIO

HABITAT FOR HUMANITY

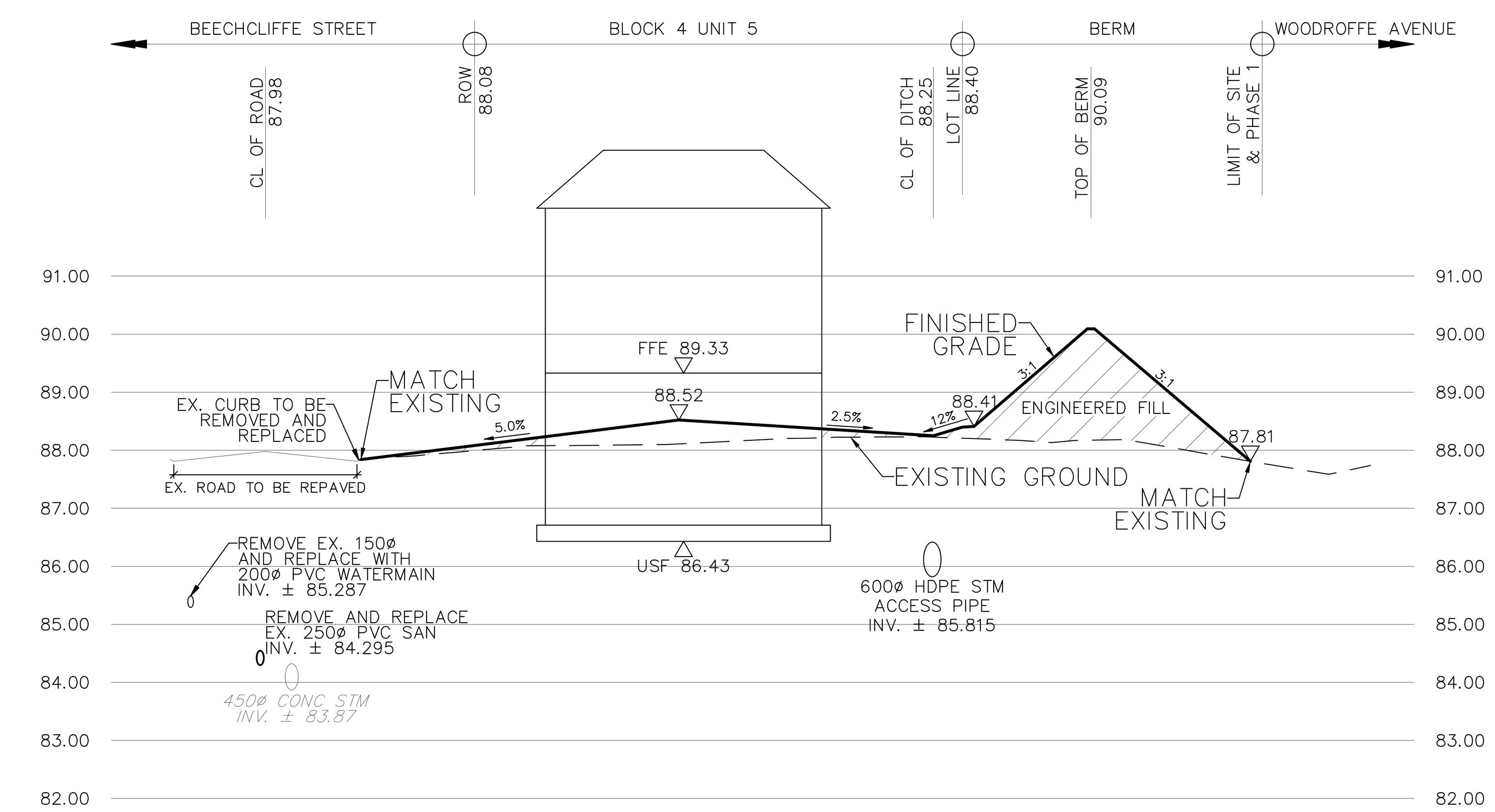
40 BEECHCLIFFE STREET

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DETAILS

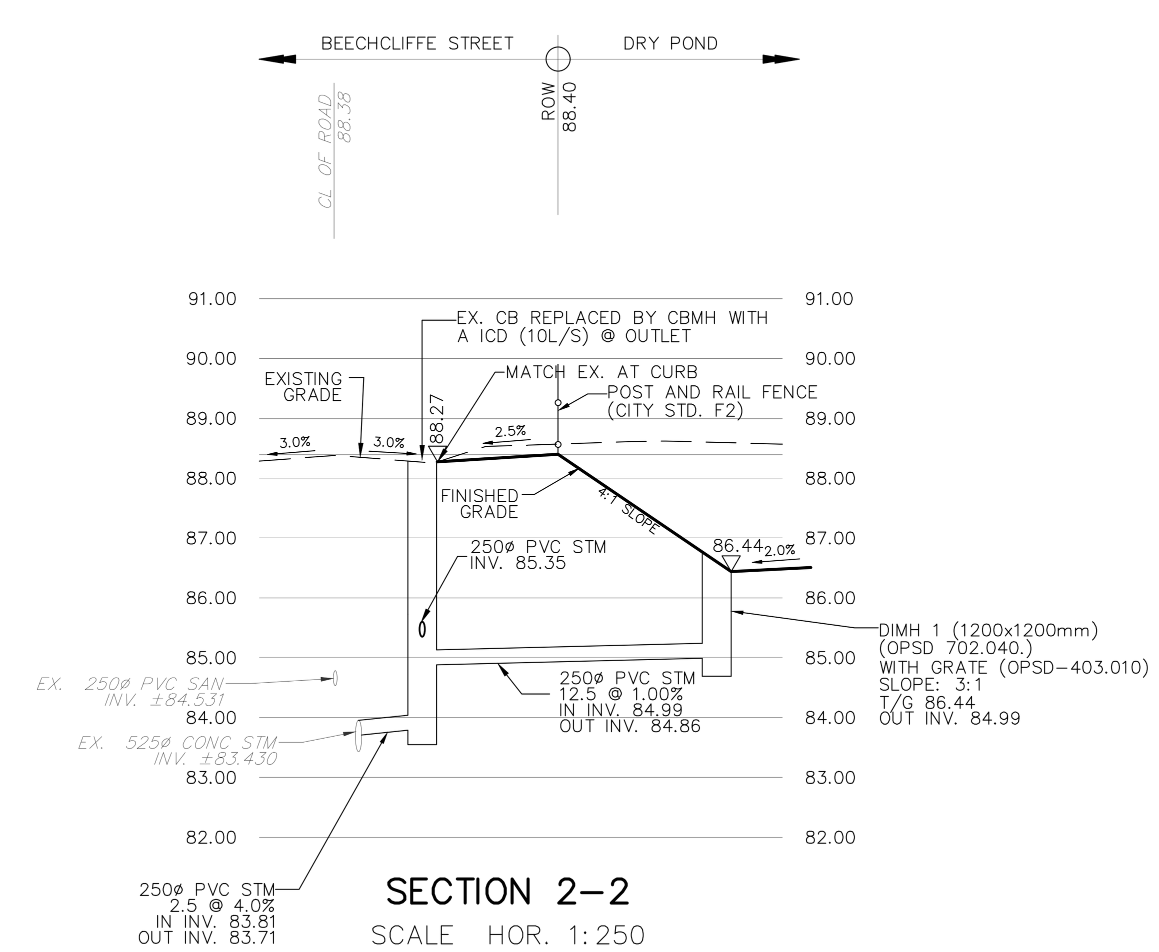
DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.	
DESIGNED BY: A.S.	CHECKED BY:	2 OF 12	
SCALE: 1:500	DATE: JUNE 2025		

CITY FILE No._D07-12-25-0091_____ CITY PLAN No. 19322_____



SECTION 1–1

SCALE HOR. 1:250
VER. 1:100



SECTION 2–2

SCALE HOR. 1:250
VER. 1:100

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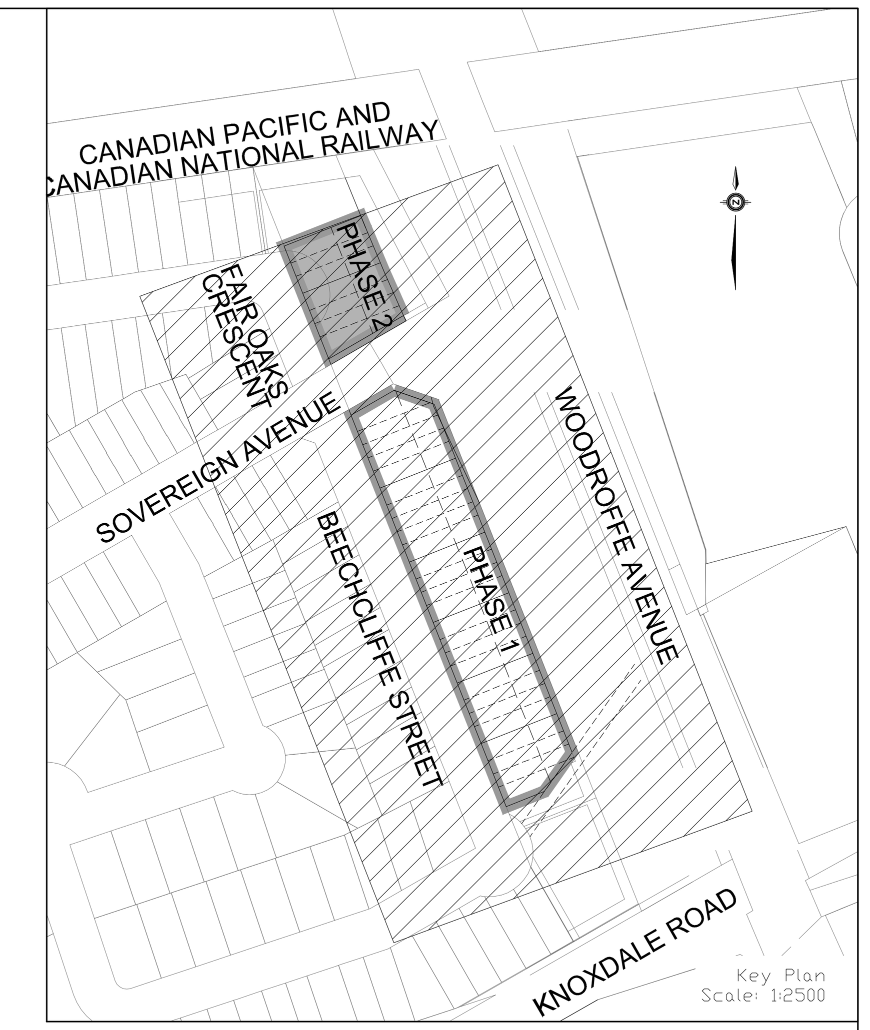
CROSS SECTIONS

DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.
DESIGNED BY: A.S.	CHECKED BY:	2A OF 12
SCALE: AS SHOWN	DATE: JUNE 2025	

CITY FILE No. _D07-12-25-0091_____ CITY PLAN No. 19322_____

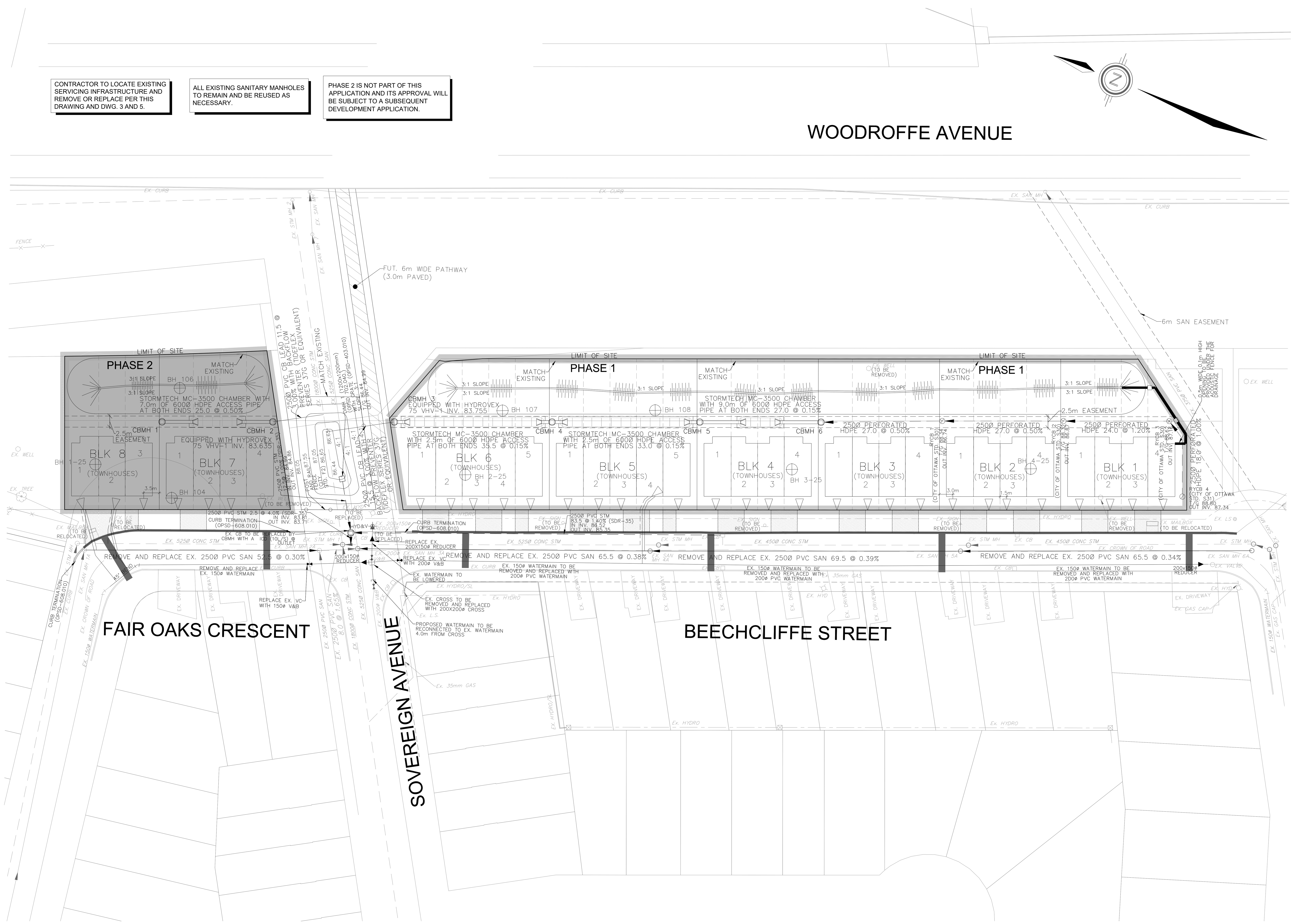
UNIT NUMBER	8 (1)	8 (2)	8 (3)	7 (1)	7 (2)	7 (3)	7 (4)	6 (1)	6 (2)	6 (3)	6 (4)	6 (5)	5 (1)	5 (2)	5 (3)	5 (4)	5 (5)	4 (1)	4 (2)	4 (3)	4 (4)	3 (1)	3 (2)	3 (3)	3 (4)	2 (1)	2 (2)	2 (3)	2 (4)	1 (1)	1 (2)	1 (3)	1 (4)
SAN Lateral Invert at SAN Main	84.86	84.84	84.82	84.80	84.78	84.76	84.74	84.19	84.21	84.23	84.26	84.28	84.31	84.33	84.35	84.36	84.39	84.42	84.44	84.47	84.50	84.53	84.56	84.58	84.60	84.63	84.65	84.67	84.70	84.73	84.75	84.77	84.79
USF	86.61	86.61	86.61	86.61	86.61	86.61	86.61	86.39	86.39	86.39	86.39	86.39	86.43	86.43	86.43	86.43	86.43	86.47	86.47	86.47	86.47	86.50	86.50	86.50	86.50	86.53	86.53	86.53	86.53	86.53	86.53	86.53	86.53
Invert of Lateral at Foundation	86.33	86.33	86.33	86.33	86.33	86.33	86.33	86.11	86.11	86.11	86.11	86.11	86.15	86.15	86.15	86.15	86.15	86.19	86.19	86.19	86.19	86.22	86.22	86.22	86.22	86.25	86.25	86.25	86.25	86.25	86.25	86.25	86.25
Obvert of STM Main Intersecting SAN Lateral	85.15	84.91	84.76	84.48	84.24	84.07	83.82	84.03	84.07	84.10	84.14	84.17	84.22	84.25	84.28	84.31	84.28	84.35	84.40	84.44	84.50	84.57	84.62	84.66	84.72	84.77	84.92	84.93	84.97	85.01	85.04	85.06	85.09
SAN Lateral Invert Intersecting STM Main	85.84	85.84	85.84	85.84	85.84	85.84	85.83	85.62	85.62	85.62	85.62	85.62	85.66	85.66	85.66	85.65	85.66	85.70	85.70	85.70	85.70	85.73	85.73	85.73	85.73	85.75	85.76	85.76	85.76	85.76	85.76	85.76	85.76



CONTRACTOR TO LOCATE EXISTING SERVICING INFRASTRUCTURE AND REMOVE OR REPLACE PER THIS DRAWING AND DWG. 3 AND 5.

ALL EXISTING SANITARY MANHOLES TO REMAIN AND BE REUSED AS NECESSARY.

PHASE 2 IS NOT PART OF THIS APPLICATION AND ITS APPROVAL WILL BE SUBJECT TO A SUBSEQUENT DEVELOPMENT APPLICATION.



LEGEND

- CROSS
- 45° BEND
- LATERAL
- HYDRANT, VALVE & VB
- TEE
- VALVE & VC
- VALVE & VB
- 22.5° BEND
- 11.25° BEND
- REDUCER
- CAP
- STREET CATCHBASIN & LEAD
- STREET CATCHBASIN WITH CLOSED LID & LEAD
- STORM MAINTENANCE HOLE
- CURB INLET CATCH-BASIN & LEAD
- CATCHBASIN/ MAINTENANCE HOLE
- INTERCONNECTED CATCH BASIN & LEADS
- CAP
- TEE CATCHBASIN
- PERFORATED PIPE
- ELBOW CATCHBASIN
- SANITARY MAINTENANCE HOLE (WATERTIGHT LID PER OPSD 401.030)
- SANITARY MAINTENANCE HOLE
- CAP
- RETAINING WALL (SEE NOTES ON DWG. 1 AND STRUCTURAL DWG'S FOR DETAIL)
- WATER BOX
- SINGLE SERVICE LOCATION (ST, SAN & WM)
- HYDRO SWITCHGEAR
- HYDRO TRANSFORMER
- STREET LIGHT STANDARD
- DITCH AND CULVERT
- CONCRETE SIDEWALK (PER CITY OF OTTAWA STD SC1.4)
- BARRIER CURB, BARRIER CURB WITH GUTTER & DEPRESSED CURB (PER CITY OF OTTAWA STD SC1.1, SC1.2, SC1.3)
- NOISE BARRIER (1.85m HIGH UNLESS OTHERWISE NOTED)
- PHASING LIMITS
- PROPERTY BOUNDARY
- OVERLAND FLOW DIRECTION
- EXTERNAL OVERLAND FLOW DIRECTION
- EMERGENCY OVERLAND FLOW DIRECTION
- TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA STD. SC6, SC7, SC7.1, SC7.2, SC7.3)
- CLAY SEAL (REFER TO GENERAL NOTES. No. 18. ON DWG. No. 1, AND GEOTECHNICAL CONSULTANT'S SPECIFICATIONS)
- EXISTING SANITARY MAINTENANCE HOLE
- EXISTING STORM MAINTENANCE HOLE
- SPEED HUMP PER CITY STD. R19
- BIKE RACK
- EARTHBIN (DWG. 3 FOR DETAILS)
- PHASE 2 (NOT PART OF THIS SUBMISSION)

NOTES:

1. ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE AUTHORITIES HAVING JURISDICTION
2. CONTRACTOR TO VERIFY THE PRECISE LOCATIONS AND INVERT ELEVATIONS OF Ex. UNDERGROUND SERVICES AND Ex. UTILITIES PRIOR TO STARTING CONSTRUCTION
3. ALL EXISTING ABOVE GROUND FEATURES, E.G. MH/CHAMBER COVERS, PEDESTALS, HYDRO AND LIGHT POLES, ETC. AFFECTED BY THE DEVELOPMENT TO BE ADJUSTED TO SUIT TO THE SATISFACTION OF PARTIES AFFECTED
4. ALL EXISTING BUILDING, SHED, POST & WIRE FENCE, CHAIN LINK FENCE, TREE, UTILITY WIRE, POLE, CULVERT AND POOL WITHIN LOTS AND BLOCKS TO BE REMOVED, UNLESS OTHERWISE NOTED
5. ALL EXISTING POST & WIRE FENCE, CULVERTS, UTILITY WIRE / POLES, TREES, SHRUBS ETC. WITHIN LOTS, BLOCKS AND ROADS TO BE REMOVED, UNLESS OTHERWISE NOTED
6. PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE
7. PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS
8. ANY DISTURBED MATERIAL ENCOUNTERED BELOW THE SUBGRADE LEVEL WITHIN A BUILDING FOOTPRINT TO BE SUB-EXCAVATED AND BACKFILLED WITH COMPACTED ENGINEERED FILL AS PER GEOTECHNICAL ENGINEERS RECOMMENDATION.
9. FOR WATERMAIN CROSSING BELOW AND ABOVE SEWERS, REFER TO CITY STD. W25 AND W25.2, RESPECTIVELY, WHERE APPLICABLE
10. ALL WATERMAIN CONNECTIONS AND DECOMMISSIONING OF EXISTING WATERMAINS TO BE COMPLETED BY CITY FORCES. TRENCH BACKFILL/REINSTATEMENT TO BE COMPLETED BY THE CONTRACTOR TO THE SATISFACTION OF THE CITY OF OTTAWA
11. FOR WATERMAIN STUBS, 2.4m MIN. COVER TO BE PROVIDED
12. THE COVER OF EX. MH, CB, CHAMBER AND OTHER ABOVEGROUND FEATURES TO BE ADJUSTED TO SUIT THE NEW FINISHED GRADE, WHERE APPLICABLE
13. INSULATION REQUIRED FOR WATERMAIN / WATER SERVICE WHERE THE SEPARATION BETWEEN WATERMAIN / WATER SERVICE AND OTHER SERVICES AND STRUCTURES IS LESS THAN 1.2m AND THE COVER IS LESS THAN 2.4m. REFER TO CITY STD. W23 FOR DETAIL.
14. FOR SERVICE INSTALLATION AT SEWER CROSSING, REFER TO CITY STD. W38 FOR DETAIL

TOPOGRAPHIC INFORMATION

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2	W.L.	25-07-15	ISSUED FOR TENDER
1	W.L.	25-06-20	1st SUBMISSION

CITY OF OTTAWA

PROJECT No. 24-1416

W. LIU
100167932
26-02-17
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

HABITAT FOR HUMANITY

40 BEECHCLIFFE STREET

DSEL
120 Iber Road, Unit 103
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GENERAL PLAN

DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.
DESIGNED BY: A.S.	CHECKED BY:	4 OF 12
SCALE: 1:500	DATE: JUNE 2025	

CITY FILE No. D07-12-25-0091

CITY PLAN No. 19322

PAVEMENT DESIGN

40mm HL-3 OR SUPERPAVE 12.5 ASPHALTIC CONCRETE
50mm HL-8 OR SUPERPAVE 19.0 ASPHALTIC CONCRETE
150mm OPSS GRANULAR A CRUSHED STONE
400mm OPSS GRANULAR B TYPE II

NOTES:

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2. CONTRACTOR TO VERIFY THE PRECISE LOCATIONS AND INVERT ELEVATIONS OF Ex. UNDERGROUND SERVICES AND Ex. UTILITIES PRIOR TO STARTING CONSTRUCTION
3. ALL EXISTING TREES, SHRUBS ETC. WITHIN LOTS, BLOCKS AND ROADS TO BE REMOVED, UNLESS OTHERWISE NOTED
4. PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS
5. FOR WATERMAIN STUBS, 2.4m MIN. COVER TO BE PROVIDED
6. ANY DISTURBED MATERIAL ENCOUNTERED BELOW THE SUBGRADE LEVEL WITHIN A BUILDING FOOTPRINT TO BE SUB-EXCAVATED AND BACKFILLED WITH COMPACTED ENGINEERED FILL AS PER GEOTECHNICAL ENGINEERS RECOMMENDATION

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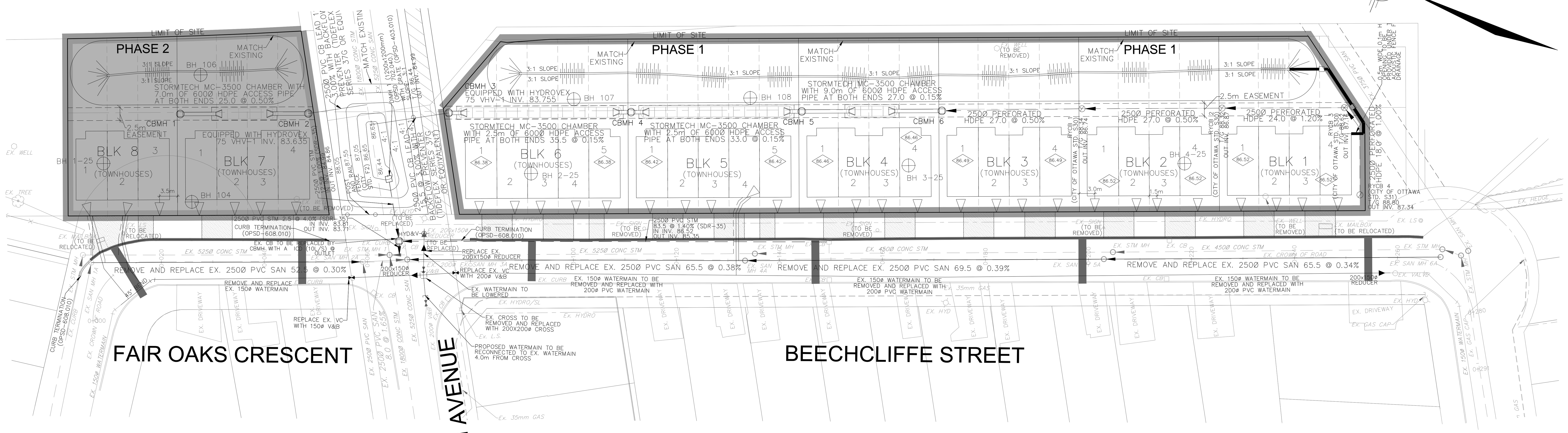

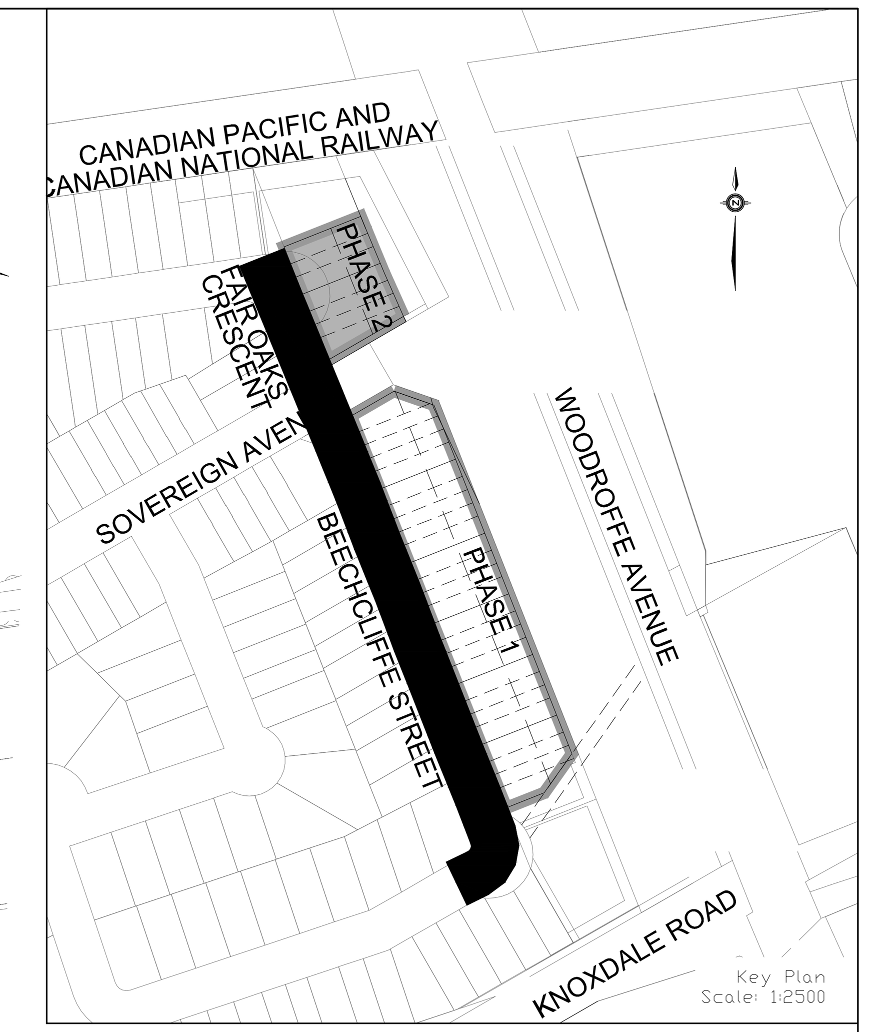

LEGEND

CROSS
45° BEND
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HYDRANT, VALVE & VB
TEE
VALVE & VC
VALVE & VB
22.5° BEND
11.25° BEND
REDUCER
CAP
SANITARY MAINTENANCE HOLE
CAP
STREET CATCHBASIN & LEAD
STREET CATCHBASIN WITH CLOSED LID & LEAD
STORM MAINTENANCE HOLE
CURB INLET CATCHBASIN & LEAD
CATCHBASIN/ MAINTENANCE HOLE
INTERCONNECTED CATCH BASIN & LEADS
CAP
STREET LIGHT STANDARD
CURB & DEPRESSED CURB
PHASING LIMITS
PROPERTY BOUNDARY
BOREHOLE (BH)
TEST PIT (TP)
AUGER HOLE (AH)
MONITORING WELL LOCATION
CONCEPTUAL WELL LOCATION
AS PER GEOTECHNICAL REPORT
UNDERSIDE OF FOOTING ELEVATION
OVERLAND FLOW DIRECTION
EXTERNAL OVERLAND FLOW DIRECTION
EMERGENCY OVERLAND FLOW DIRECTION
WATER BOX
SINGLE SERVICE LOCATION (ST, SAN & WM)
TEE CATCHBASIN
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ELBOW CATCHBASIN
NOISE BARRIER (1.85m HIGH UNLESS OTHERWISE NOTED)
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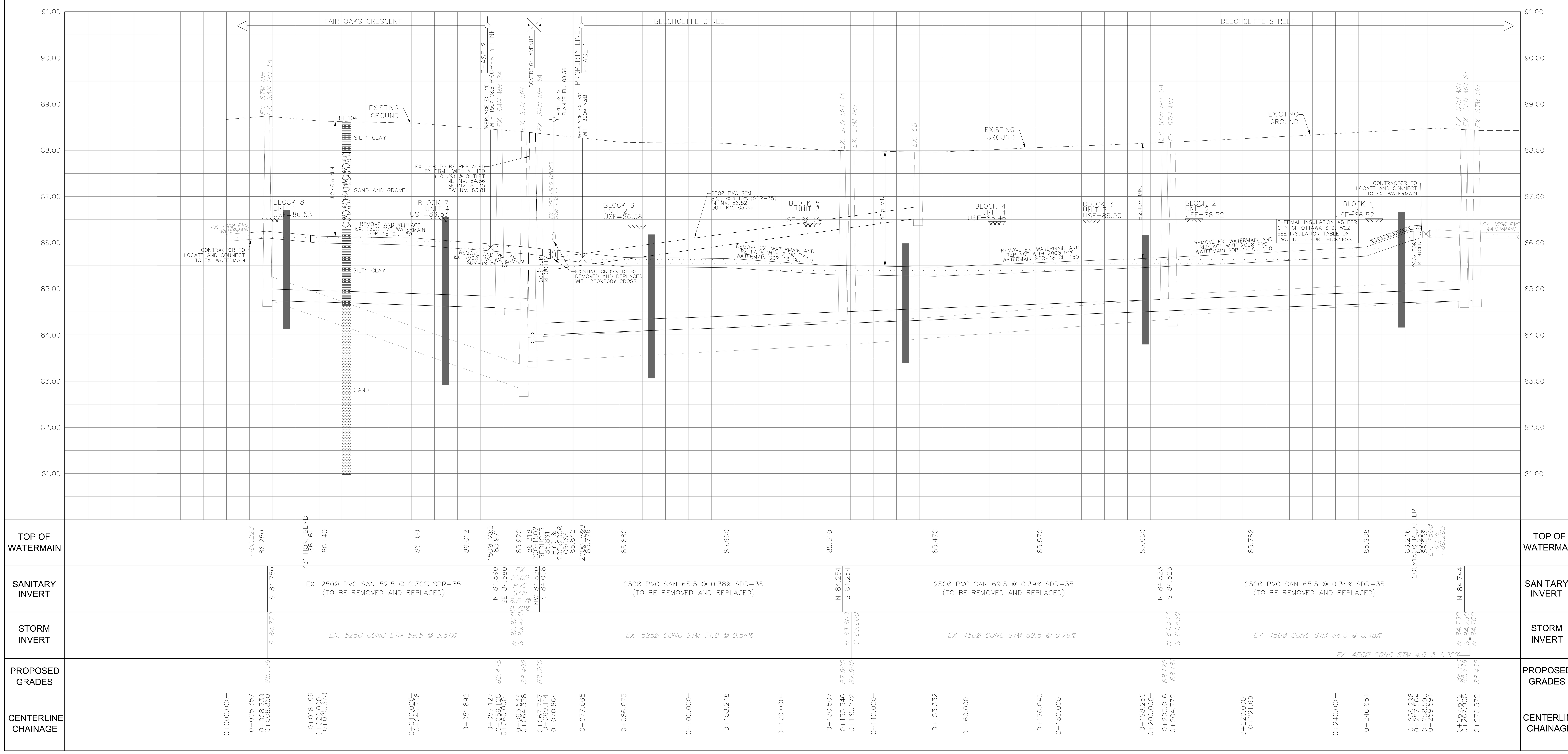

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CITY OF OTTAWA

PROJECT No. 24-1416

LICENSED PROFESSIONAL ENGINEER
W. LIU
100167932
26-02-17
PROVINCE OF ONTARIO

HABITAT FOR HUMANITY

40 BEECHCLIFFE STREET

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Tel. (613) 836-0856
Fax. (613) 836-7183
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BEECHCLIFFE ST & FAIR OAKS CRES

STA. 0+000.000 TO STA. 0+291.090

DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.
DESIGNED BY: A.S.	CHECKED BY:	5 OF 12
SCALE: H=1:500/V=1:50	DATE: JUNE 2025	

CITY FILE No. _D07-12-25-0091_____ CITY PLAN No. 19322_____

2156m² OF ROAD PAVEMENT TO BE REMOVED AND REPLACED PER DWG. 3.

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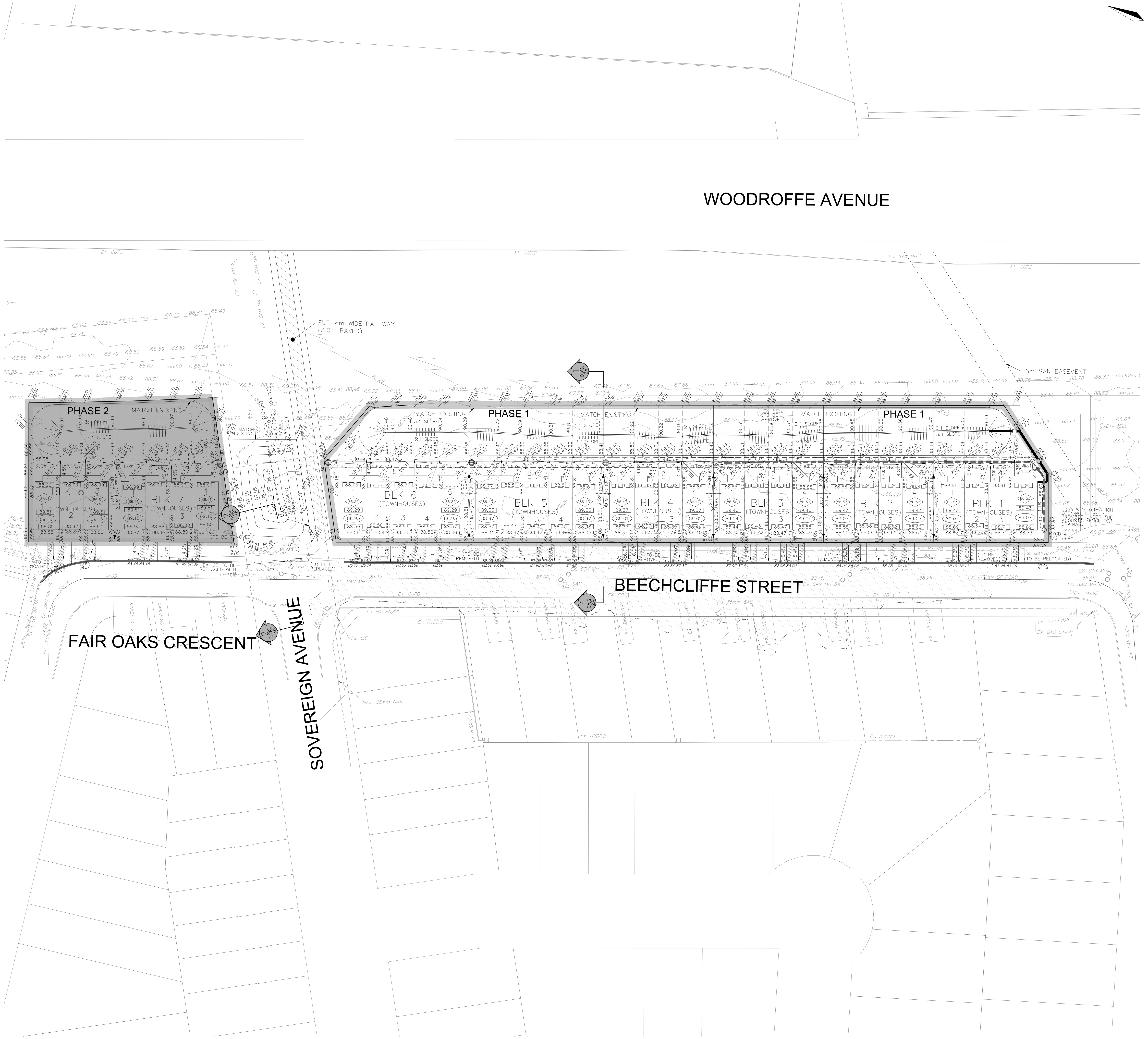

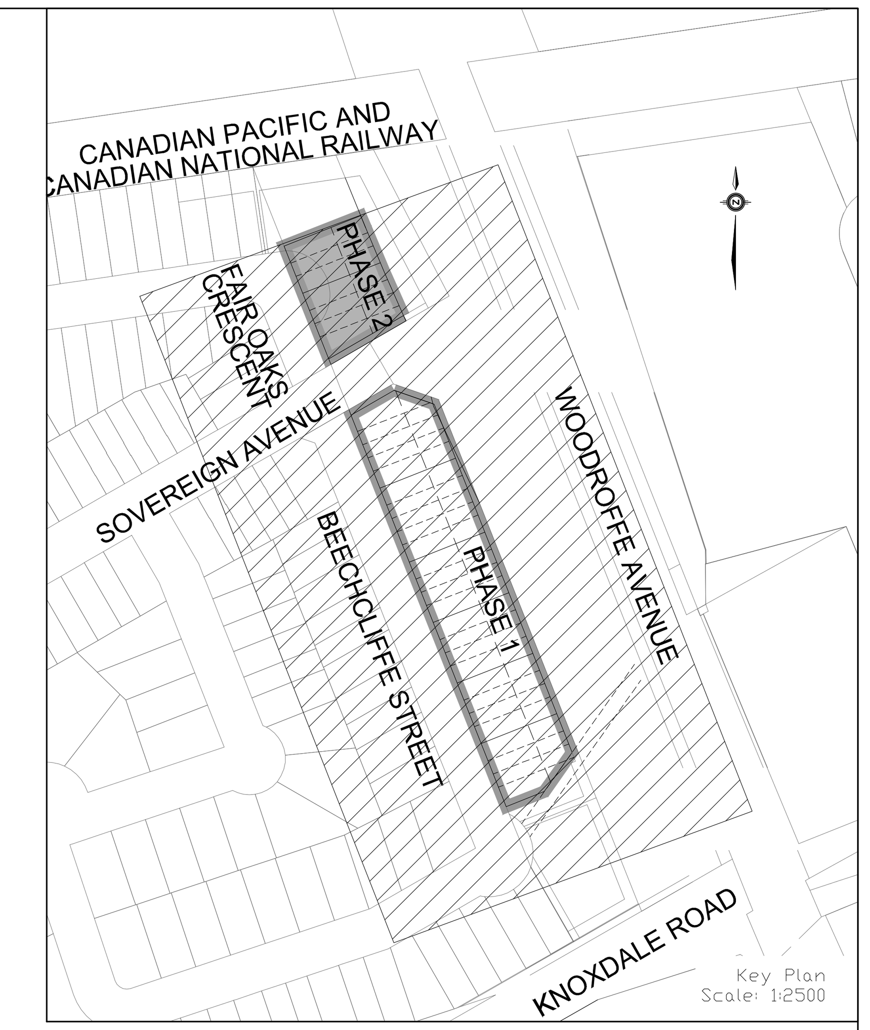

LEGEND

- PROPOSED ELEVATION — 103.45
- EXISTING ELEVATION — 102.73
- PROPOSED SWALE GRADE — 1.5%
- HIGH POINT — 102.16
- STREET CATCHBASIN
- CATCHBASIN MANHOLE
- TEE CATCHBASIN
- ELBOW CATCHBASIN
- HYDRANT, VALVE & VB
- VALVE & VC
- VALVE & VB
- BUILDING ENVELOPE
- TOP OF FOUNDATION (TOF) — 94.70
- FINISHED FLOOR ELEVATION (FFE) — 95.00
- UNDERSIDE OF FOOTING ELEVATION (USF) — 92.00
- FRONT/REAR ENVELOPE ELEVATION — 97.70
- WALKOUT UNITS — W.O.
- STREET LIGHT STANDARD — L.S.
- CURB TRANSITION
- OVERLAND FLOW DIRECTION
- EXTERNAL OVERLAND FLOW DIRECTION
- REAR YARD OVERLAND FLOW DIRECTION
- PHASE LIMITS
- NOISE BARRIER (1.85m HIGH UNLESS OTHERWISE NOTED)
- PROPERTY BOUNDARY
- 3:1 TERRACING MAXIMUM SLOPE — 100.20 / 99.20
- PONDING AREA WITH SPILLWAY ELEVATION — 88.47
- 250ø PVC PERFORATED PIPE (REFER TO CITY STD S29 FOR REAR YARD TRENCH AND PIPE DETAILS ONLY) (SUBDRAIN APPLIED FOR SLOPE LESS THAN 1.5%)
- EXISTING SANITARY MAINTENANCE HOLE
- EXISTING STORM MAINTENANCE HOLE
- SANITARY MAINTENANCE HOLE
- PHASE 2 (NOT PART OF THIS SUBMISSION)

NOTES:

1. ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE AUTHORITIES HAVING JURISDICTION
2. CONTRACTOR TO VERIFY THE PRECISE LOCATIONS AND INVERT ELEVATIONS OF Ex. UNDERGROUND SERVICES AND Ex. UTILITIES PRIOR TO STARTING CONSTRUCTION
3. ALL EXISTING ABOVE GROUND FEATURES, E.G. MH/CHAMBER COVERS, PEDESTALS, HYDRO AND LIGHT POLES, ETC. AFFECTED BY THE DEVELOPMENT TO BE ADJUSTED TO SUIT TO THE SATISFACTION OF PARTIES AFFECTED
4. ALL EXISTING BUILDING, SHED, POST & WIRE FENCE, CHAIN LINK FENCE, TREE, UTILITY WIRE, POLE, CULVERT AND POOL WITHIN LOTS AND BLOCKS TO BE REMOVED, UNLESS OTHERWISE NOTED
5. ALL EXISTING POST & WIRE FENCE, CULVERTS, UTILITY WIRE / POLES, TREES, SHRUBS ETC. WITHIN LOTS, BLOCKS AND ROADS TO BE REMOVED, UNLESS OTHERWISE NOTED
6. PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE
7. PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS
8. A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO INSPECT ALL SUBGRADE SURFACES FOR FOOTING AND PAVEMENT STRUCTURES PRIOR TO CONSTRUCTION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY CITY OF OTTAWA, PROJECT 40 BEECHCLIFFE STREET. SURVEY DATED JANUARY 2025. ADDITIONAL TOPOGRAPHIC INFORMATION PROVIDED BY AOV LTD. PROJECT No. 25159-25. SURVEY DATED MAY 2025 AND JUNE 2025.

LEGAL INFORMATION

REGISTERED PLAN PLAN PROVIDED BY AOV LTD., PROJECT No. 25159-25, RECEIVED ON MAY 12, 2025.

ELEVATION NOTE

ELEVATIONS SHOWN ON THIS PLAN ARE GEODETIC AND ARE REFERRED TO THE CGVD28 GEODETIC DATUM. SITE BENCH MARK ON TOP OF FH SPINDLE FRONTING CIVIC ADDRESS 33 BEECHCLIFFE STREET. ELEVATION=88.966m

No.	BY	DATE	DESCRIPTION
5	W.L.	26-02-17	4th SUBMISSION
4	W.L.	25-09-15	3rd SUBMISSION
3	W.L.	25-08-01	2nd SUBMISSION
2	W.L.	25-07-15	ISSUED FOR TENDER
1	W.L.	25-06-20	1st SUBMISSION

Ottawa — CITY OF OTTAWA

PROJECT No. 24-1416

LICENSED PROFESSIONAL ENGINEER
W. LIU
100167932
26-02-17
PROVINCE OF ONTARIO

HABITAT FOR HUMANITY

40 BEECHCLIFFE STREET

DSEL

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

GRADING PLAN

DRAWN BY: A.S.	CHECKED BY: W.L.	SHEET NO.	
DESIGNED BY: A.S.	CHECKED BY:	7 of 12	
SCALE: 1:500	DATE: JUNE 2025		

CITY FILE No. D07-12-25-0091

CITY PLAN No. 19322

Stormwater - Proposed Development
City of Ottawa Sewer Design Guidelines, 2012

DSEL

Target Flow Rate

Area	0.78	ha
C	0.25	Rational Method runoff coefficient
t_c	10.0	min

	2-year	
i	76.5	mm/hr
Q	41.4	L/s

Estimated Post Development Peak Flow from Unattenuated Areas

Total Area	0.00	ha
C	0.00	Rational Method runoff coefficient

	5-year					**100-year**				
t_c (min)	**i (mm/hr)**	**Q_{actual} (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual}* (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10.0	104.2	0.0	0.0	0.0	0.0	178.6	0.0	0.0	0.0	0.0

Note:
C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

Estimated Post Development Peak Flow from Attenuated Areas

Total Area	0.22	ha
C	0.89	Rational Method runoff coefficient

	5-year					**100-year**				
t_c (min)	**i (mm/hr)**	**Q_{actual} (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual} (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10	104.2	56.5	21.5	35.0	21.0	178.6	109.1	41.4	67.7	40.6
15	83.6	45.3	21.5	23.8	21.4	142.9	87.3	41.4	45.9	41.3
20	70.3	38.1	21.5	16.6	19.9	120.0	73.3	41.4	31.9	38.2
25	60.9	33.0	21.6	11.5	17.2	103.8	63.5	41.4	22.0	33.0
30	53.9	29.2	21.6	7.7	13.8	91.9	56.1	41.4	14.7	26.5
35	48.5	26.3	21.6	4.7	9.9	82.6	50.5	41.4	9.0	18.9
40	44.2	24.0	21.6	2.3	5.6	75.1	45.9	41.4	4.5	10.7
45	40.6	22.0	21.6	0.4	1.1	69.1	42.2	41.4	0.8	2.0
50	37.7	20.4	20.4	0.0	0.0	64.0	39.1	39.1	0.0	0.0
55	35.1	19.0	19.0	0.0	0.0	59.6	36.4	36.4	0.0	0.0
60	32.9	17.9	17.9	0.0	0.0	55.9	34.2	34.2	0.0	0.0
65	31.0	16.8	16.8	0.0	0.0	52.6	32.2	32.2	0.0	0.0
70	29.4	15.9	15.9	0.0	0.0	49.8	30.4	30.4	0.0	0.0
75	27.9	15.1	15.1	0.0	0.0	47.3	28.9	28.9	0.0	0.0
80	26.6	14.4	14.4	0.0	0.0	45.0	27.5	27.5	0.0	0.0
85	25.4	13.8	13.8	0.0	0.0	43.0	26.2	26.2	0.0	0.0
90	24.3	13.2	13.2	0.0	0.0	41.1	25.1	25.1	0.0	0.0
95	23.3	12.6	12.6	0.0	0.0	39.4	24.1	24.1	0.0	0.0
100	22.4	12.2	12.2	0.0	0.0	37.9	23.2	23.2	0.0	0.0
105	21.6	11.7	11.7	0.0	0.0	36.5	22.3	22.3	0.0	0.0
110	20.8	11.3	11.3	0.0	0.0	35.2	21.5	21.5	0.0	0.0

Note:
C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

5-year $Q_{attenuated}$	**21.51**	**L/s**	**100-year $Q_{attenuated}$**	**41.45**	**L/s**
5-year Max. Storage Required	**21.4**	**m^3**	**100-year Max. Storage Required**	**41.3**	**m^3**

Summary of Release Rates and Storage Volumes

Control Area	**5-Year Release Rate (L/s)**	**5-Year Storage (m^3)**	**100-Year Release Rate (L/s)**	**100-Year Storage (m^3)**
Unattenuated Areas	0.00	0.0	0.00	0.0
Attenutated Areas	21.51	21.4	41.45	41.3
Total	**21.5**	**21.43**	**41.45**	**41.3**