MEMO

TO:	1495754 Ontario Ltd.
FROM:	Aakash Bagchi, P.Eng., Saranya Jeyalakshmi
DATE:	September 4, 2024
SUBJECT:	Stormwater Management and Sanitary Servicing Study for 0 Esplanade Drive, Windsor, ON
OUR FILE:	23-7174

1.0 Introduction

Dillon Consulting Limited (Dillon) has been retained by 1495754 Ontario Inc. to complete a stormwater management (SWM) and sanitary servicing study in support of the zoning by-law amendment for the proposed residential development located at 0 Esplanade Drive, in the City of Windsor (refer to Figure 1). The total site area is approximately 0.66 ha.

Figure 1: Location Map

1.1 Background Information

The following items were referred to while conducting the current analysis:

- Windsor-Essex Region Stormwater Management Standards Manual (ERCA, 2018) [WERSMSM];
- City of Windsor Development Manual (City of Windsor, 2015);
- Little River Watershed Flood Line Mapping -Final Hydraulic Report (Dillon, 2023);
- City of Windsor Sewer and Coastal Flooding Protection Master Plan (Dillon, 2020); and
- Stormwater Management Planning and Design Manual (MECP, 2003).

Stormwater runoff from the proposed development area will drain to an existing storm sewer maintenance hole (MH-7R9843) located within the limits of the proposed development. Sanitary flow from the site will drain to the sanitary sewer maintenance hole (MH-7S1380) located along Esplanade Drive. (Figure 1). The site plan for the proposed residential development of 0 Esplanade Drive is provided in Appendix A.

1.2 SWM Design Criteria

The criteria for SWM is to control flows from the proposed development to the estimated allowable release rate for all design storm event simulations, up to and including the 100-Year return event. In addition, the maximum depth of ponding on site during the governing 100-Year return period event simulation should not exceed 0.30 m above the lowest catch basin (CB) elevation.

The Climate Change stress test (approximately 40 % more volume and intensity than the 100-Year, 4-hour event) design storm event is to be simulated to assess the proposed SWM infrastructure's resiliency to adapt to the impacts of climate change.

The following design storm events, as recommended in the WERSMSM, were used to assess the on-site storage requirements under post-development conditions:

- 5-Year, 4-hour design storm using Chicago distribution with a 15-minute time interval and a total rainfall depth of 49.5 mm;
- 2-Year, 4-hour design storm using Chicago distribution with a 15-minute time interval and a total rainfall depth of 32 mm (Water Quality Storm);
- 100-Year, 4-hour design storm using Chicago distribution with a 15-minute time interval and a total rainfall depth of 81.6 mm to determine the required 100-Year design on-site storage; and
- Climate Change stress test, approximately 40 % more volume and intensity than the 100-Year 4-hour event.

2.0 Existing Conditions

Under existing conditions, the site is vacant and covered in mostly grass. The topography of the current site is relatively flat and generally slopes towards Esplanade Drive to the south. Under existing conditions, considering current topography, some overland flow from the external parking lot area north of the existing site is expected to be routed through the proposed development area (refer to Figure 1). The site forms a part of the Little River watershed.

2.1 Soil Type

Based on the Essex Region Conservation Authority soil mapping, the soil within the site is mostly Brookston Clay which falls under the hydrologic soil group (HSG) classification of "D" soils that have high runoff potential.

2.2 Existing Conditions Hydrologic Analysis

The existing site is 0.66 ha in area, currently undeveloped and mostly covered in grass. The existing condition hydrologic analysis was performed using the PCSWMM software. The proposed residential development area was modelled as one lumped subcatchment in PCSWMM. The allowable release rate for the 0.66 ha area has been estimated as 24.6 L/s. This corresponds to the peak runoff flow from the existing undeveloped site during the 5-Year design storm event simulation. To prevent any adverse impacts on the downstream system due to the increased imperviousness level in the proposed development area, the maximum stormwater flow rate from the site is expected to be maintained at or below the allowable release rate for all events up to and including the 100-Year event. The existing condition modelling parameters and results of the analysis are presented in Table 1.

Figure 1 shows the drainage area used for the existing conditions analysis to estimate allowable release rates for the development.

Table 1: Subcatchment Parameters and Release Rate

Catchment	Area (Ha)	Percent Impervious (%)	Other Subcatchment Parameters	Design Storm Event	Release Rate (L/s)
0 Esplanade Drive	0.66	0	Flow Length = 135 m Slope = 0.5 % Impervious Depression Storage = 2.5 mm Pervious Depression Storage = 7.5 mm Manning's N Impervious = 0.013 Manning's N Pervious = 0.24 Subarea Routing = Outlet (100%) Green-Ampt Infiltration Parameters: Suction Head = 180 mm Hydraulic Conductivity = 0.5 mm/hr Initial Deficit = 0.1	5-Year, 4-hour (Chicago)	24.6

3.0 Proposed Conditions Analysis

Under proposed conditions, the 0.66 ha multistoried residential development will consist of 8 one-bedroom units and 46 two-bedroom units. Runoff from the site is to be collected through CBs in the parking lot area and conveyed through a proposed storm sewer system in the development area to the existing storm sewer node MH-7R9843. Stormwater runoff storage is provided using a combination of surface and underground storage to restrict flows to the estimated allowable release rate.

The proposed residential development area was modelled as one lumped subcatchment in PCSWMM. The modelling schematic is shown in Figure 2.

Figure 2: Proposed Development Area and the SWMM Model Schematic

The storage node (SU1) in the model represents surface storage around CB locations in the parking lot as well as sub-surface storage. The parameters used to set up the proposed conditions PCSWMM model are summarized in Table 2. The soil types are composed of Brookston Clay which has a hydrologic soil group (HSG) D classification. Green-Ampt infiltration method was used for SWMM hydrologic calculations. Dynamic wave routing method was applied for hydraulic conveyance in the model.

Table 2: Subcatchment Parameters and Release Rate

Catchment	Area (Ha)	Percent Impervious (%)	Other Subcatchment Parameters
0 Esplanade Drive	0.66	90	Flow Length = 77 m Slope = 1 % Impervious Depression Storage = 2.5 mm Pervious Depression Storage = 7.5 mm Manning's N Impervious = 0.013 Manning's N Pervious = 0.24 Subarea Routing = Outlet (100%) Green-Ampt Infiltration Parameters: Suction Head = 180 mm Hydraulic Conductivity = 0.5 mm/hr Initial Deficit = 0.1

The release rate from the site is maintained at or below the estimated allowable release rate using an orifice of size 0.1 m diameter. A flap valve is proposed along with the orifice to prevent any backwater flow from the downstream municipal sewer system.

Boundary condition restrictions were applied to the model outfall (OF1), representing the MH-7R9843 location. This is to simulate the existing tailwater conditions in the downstream municipal sewer system. The head time series for the node MH-7R9843 were provided by the City from the City-wide dynamic sewer model developed through the Sewer and Coastal Flood Protection Master Plan (SMP). The head time series are represented in Appendix B.

The PCSWMM input and output files for existing and proposed conditions models are included in Appendix C.

3.1 Stormwater Quantity Control

Based on the pre-development allowable release rate of 24.6 L/s, the required volume under 100-Year, 4-hour (Chicago distribution) design storm event has been estimated to be 404 m^3. The proposed conditions model results are summarized in Table 3.

Table 3: Proposed Conditions Model Results

Design Storm Events	Peak Flow Rate (L/s)	Storage on Site			
		Total Volume (m^3)	Parking lot Storage (m^3)	Underground Storage (m^3)	Max. depth of surface storage at CB locations (m)
Water Quality Test	14.5	105	0	105	0
5-Year, 4-hour (Chicago)	23.9	183	0	183	0
100-Year, 4-hour (Chicago)	14.5	404	221	183	0.22
Climate Change Stress Test	15.0	586	403	183	> 0.30

A combination of surface and underground storage was provided to restrict flows to the estimated allowable release rate in the residential development.

It is noted that the release from the site during the 5-Year event is estimated to be higher than the less frequent design storm events evaluated. The head time-series provided by the City for the analysis show a lower maximum Hydraulic Grade Line (HGL) (175.70 m) during the 5-Year event, compared to maximum HGL during the 100-Year event (177.97 m). The higher HGL at the outfall leads to lower release rate and more on-site storage during the larger rainfall events.

3.2 Impacts of Climate Change

During the Climate Change stress test simulation, the maximum depth of stormwater storage around CB locations is expected to be greater than 0.3 m. This is expected because the climate change event has approximately 40% more volume and intensity compared to the 100-Year 4-hour event. For events more severe than 100-Year, 4-hour event, an overland flow route will be provided from the site towards Little River.

3.3 External Drainage Area

Under existing conditions, some overland flow from the external parking lot area located north of the proposed development area (refer to Figure 1) is expected to be routed through the proposed development area. Under proposed conditions, this flow will need to be accounted in on-site storage calculations, or an alternate overland flow route to Little River will need to be provided. This will be further designed during the detailed design stage.

3.4 Stormwater Quality Control

Since the impervious area on the site is increasing as compared to existing conditions, measures are proposed to be undertaken to treat the quality of the stormwater runoff being discharged into the municipal storm sewers, and ultimately to Little River. Stormwater quality treatment will be provided using an oil-grit separator (OGS) positioned upstream of the existing municipal storm sewer outlet at MH-7R9843.

The 1200 mm diameter, Hydro International First Defense (FD-4HC) unit supplied by ADS, or an approved equivalent, is recommended for this application. The OGS unit is designed to meet the Ministry of Environment, Conservation and Parks (MECP) design requirements for 70% TSS removal (normal level of protection), for an upstream drainage area of 0.66 ha. Sizing details for the Water Quality Unit (WQU) recommended for the proposed development, provided by the supplier, are included in Appendix D.

3.5 Erosion and Sediment Control During Construction

Erosion and sediment control measures are to be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987) and "Construction Specification for Temporary Erosion and Sediment Control Measures" (OPSS 805).

4.0 Sanitary Servicing Under Proposed Conditions

Under the proposed conditions, the sanitary flow from the residential development will be discharged to the existing sanitary sewer (MH-7S1380) located on Esplanade Drive, in proximity of the site (refer to Figure 2). The ultimate flow under the proposed conditions was estimated based on the parameters listed in Table 4, and the flow calculation has been summarized in Table 5.

Table 4: Proposed Conditions Sanitary Flow Parameters

Parameter	Value
Residential – Population	1.5 people/one-bedroom unit; 2.5 people/two-bedroom unit[1]
Residential Sewage Flow Rate	0.0042 L/person-capita[2]
Peak Flow Factor	6 (six) [2]
Infiltration	1 L/s/ha[3]

[1] *Based on recent communication from the City of Windsor*
[2] *Based on City of Windsor Development Manual, 2015*
[3] *Based on City's Sewer and Coastal Flooding Protection Master Plan (Dillon, 2020)*

Table 5: Ultimate Sanitary Flow Calculation

Residential Sewage Flow (L/s/capita)	Ultimate Population[1]	Peak Flow Factor	Total Wastewater Flow (L/s)	Inflow and Infiltration (I&I)			Ultimate Sanitary Flow[2] (L/s)
				Site Area (ha)	Rate (L/s/ha)	Flow (L/s)	
0.0042	127	6	3.20	0.66	1.0	0.66	3.86

[1] *8 one-bedroom units and 46 two-bedroom units*
[2] *Based on Section 9.1.2-City of Windsor Development Manual, 2015*

The ultimate sanitary flow is estimated to be 3.86 L/s and will be discharged to the existing sanitary sewer (MH-7S1380).

4.1 Measures to prevent Inflow and Infiltration (I&I) into the sanitary sewer system

Placement of sanitary manhole lids/seals outside of the on-site 100-Year surface ponding extents is recommended to limit possible I&I. More details will be provided in the detailed design stage.

5.0 Flood Proofing

According to the WERSMSM design requirements, the minimum lowest building opening elevation should be the higher of the following:

- 0.30 m above the regulatory flood level for a neighboring watercourse;
- 0.30 m above the 100-Year water surface elevation (WSEL) on-site; or
- Climate Change stress test WSEL on-site.

The 100-year water level in Little River at the nearest point to the site (upstream of Tecumseh road crossing), based on pre-consultation with ERCA (refer to Appendix E) is 178.14 m. Therefore, the minimum building opening will be 178.44 m, or 0.30 m above 100-Year WSEL on-site, or Climate Change stress test WSEL on-site, whichever is greater.

The WSEL on-site for the 100-Year and Climate Change stress test design storm events will be evaluated after detailed grading design for the site is completed at a future date. No additional stormwater related requirements are necessary at this time.

6.0 Summary and Conclusions

Based on the SWM analysis completed for the proposed development site, the following conclusions were drawn.

- The maximum allowable release rate under pre-existing condition from the site is 24.6 L/s. The peak discharge from the proposed development will be restricted to this value for all events up to and including the 100-Year return period rainfall event.
- It has been demonstrated through a modelling analysis that the peak outflow from the site during all proposed conditions simulations, including the Climate Change stress test simulation, was less than the allowable release rate.
- Impact of tailwater conditions due to surcharge conditions in the downstream municipal sewer system have been accounted for in the dynamic modelling analysis.
- The flow rate under proposed development conditions has been maintained at or below the allowable release rate for all events up to and including the 100-Year return period rainfall event using an orifice of size 0.1 m diameter.
- Along with the orifice, a flap valve is recommended at the site outlet to prevent backwater flow from the downstream municipal storm sewer system. The flap valve will protect the proposed underground storage system against any high water level conditions in the Little River Drain.
- Stormwater runoff storage on site was provided using surface ponding around CB locations in the parking lot area and using an underground storage system.
- During the 100-Year, 4-hour (Chicago) proposed conditions simulation, total on-site storage estimated was approximately 404 m^3.
- Stormwater quality control will be provided on site using an OGS unit, providing 70% TSS removal. The 1200 mm diameter FD-4HC unit, supplied by ADS, or an approved equivalent, is recommended.
- Total sanitary discharge from the site is estimated to be 3.86 L/s. This includes wastewater flows generated from the residential development as well as an allowance for Inflow and Infiltration. Sanitary flows will be discharged to the existing sanitary sewer (node MH-7S1380) located on Esplanade Drive. Placement of sanitary manhole lids/seals outside of the on-site 100-year ponding extents is recommended to limit the possible I&I.

We trust that our findings provide you with the information that you require at this time. We would be pleased to meet with you to review our findings in further detail. If you have any questions in the interim, please feel free to contact the undersigned.

Sincerely,

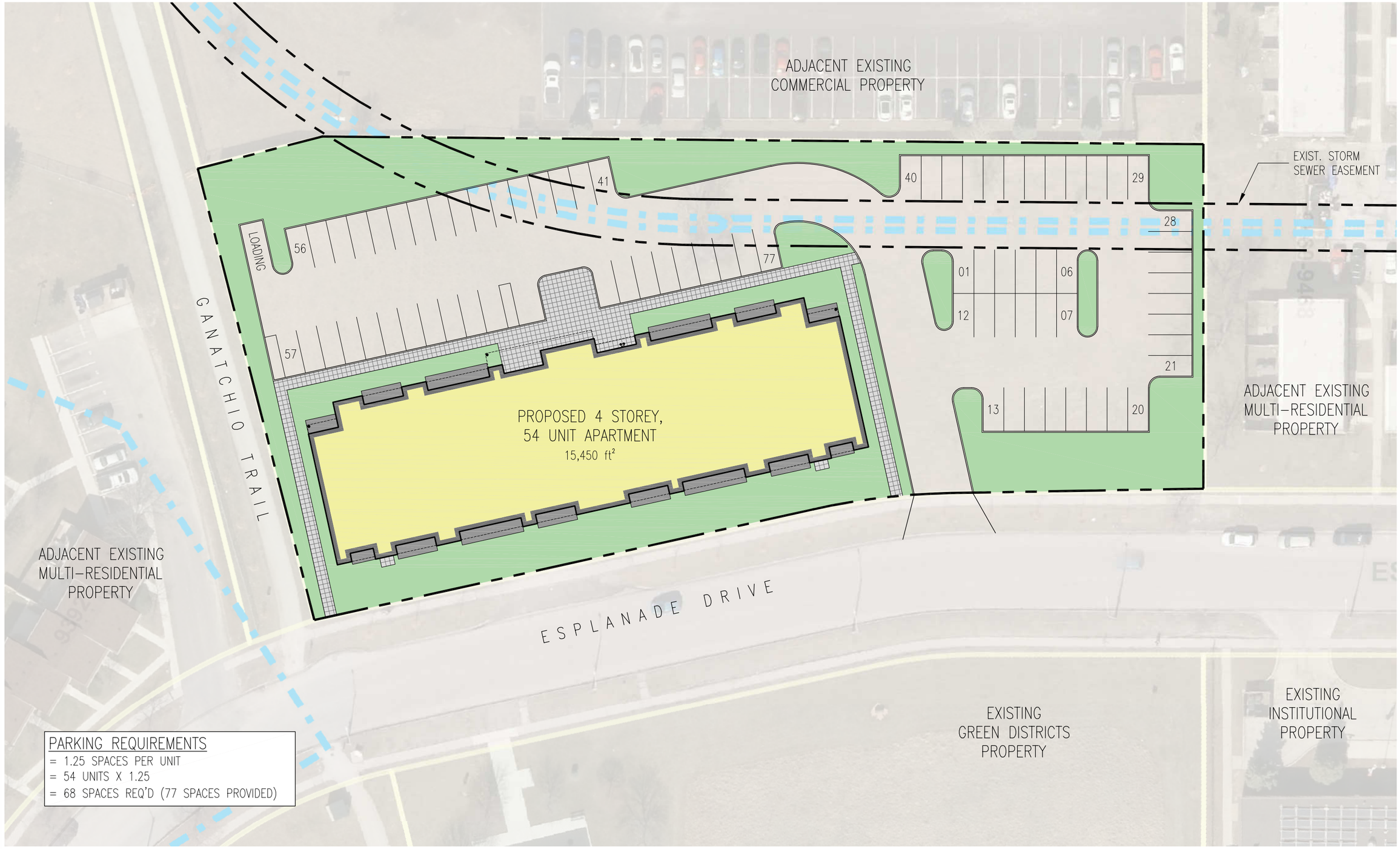
DILLON CONSULTING LIMITED

Aakash Bagchi, P.Eng.
Water Resources Engineer

Saranya Jeyalakshmi, Ph.D,
Water Resources Designer

APPENDIX A

Site Plan



PARKING REQUIREMENTS
= 1.25 SPACES PER UNIT
= 54 UNITS X 1.25
= 68 SPACES REQ'D (77 SPACES PROVIDED)

SITE PLAN

SCALE : 1" = 40'–0"

0 10 20 40 60 120 FEET

date: 2023-09-09
comm. no.: 2023-088
dwg. no.: A1.0

title: SITE PLAN
drawn by: JT
checked by: JBK

project:
RESIDENTIAL DEVELOPMENT
WINDSOR, ON

client:
RAFIH GROUP DEVELOPMENTS

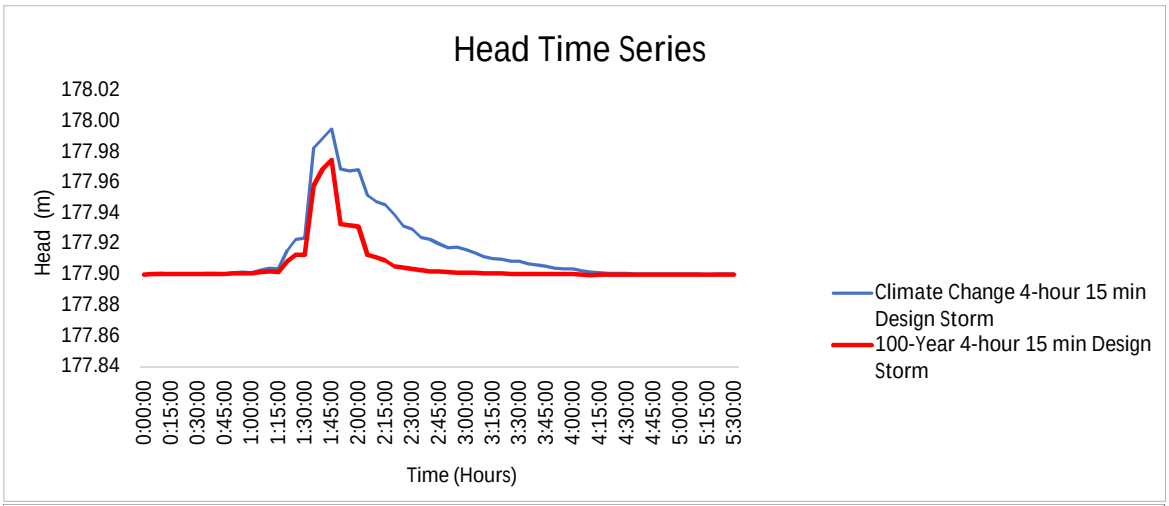
1670 mercer street
windsor ontario canada n8x 3p7
ph 519.254.3430 fax 519.254.3642
email - info@ada-architect.ca www.ada-architect.ca

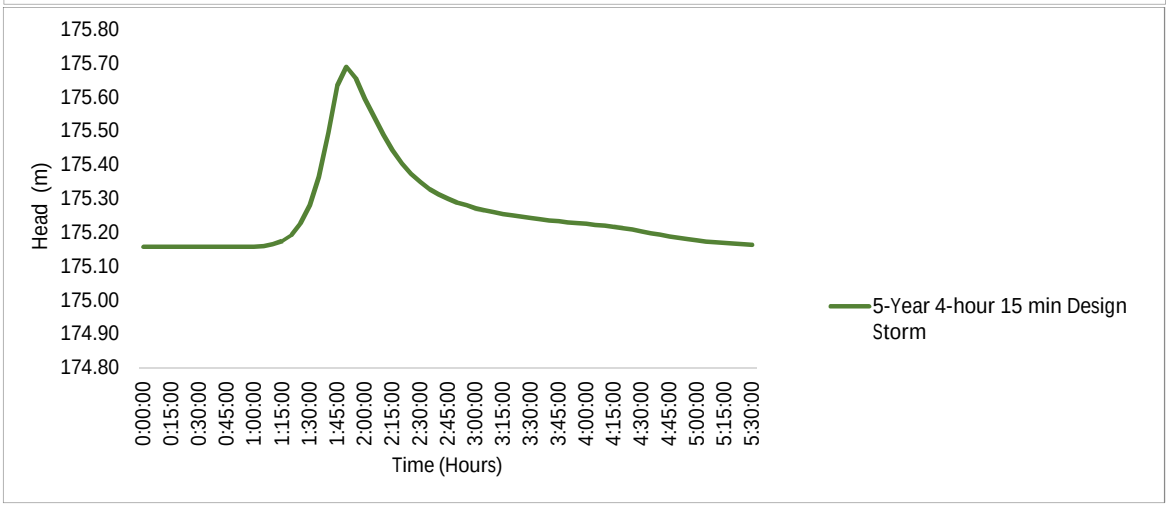
architectural design associates inc. architect

APPENDIX B

Head Time Series from the City of Windsor

Head Time Series from the City of Windsor





APPENDIX C

SWMM Input-Output Files

Existing 5-Year Input Files

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;;Project Title/Notes

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;;Option             Value
FLOW_UNITS           CMS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           4/29/2024
START_TIME           00:00:00
REPORT_START_DATE    4/29/2024
REPORT_START_TIME    00:00:00
END_DATE             4/30/2024
END_TIME             00:00:00
SWEEP_START          1/1
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         5
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              8

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT         0.0
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
Raingage         INTENSITY 0:15     1.0      TIMESERIES 5Year4hour15min

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
S1               Raingage         OF1              0.66     0        48.889   0.5      0

[SUBAREAS]
```

```
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
S1               0.013      0.24       2.5        7.5        0          OUTLET

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
S1               180        0.5        0.1        0          0          GREEN_AMPT

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
OF1              0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
100year4hour15min            0:00       3.95
100year4hour15min            0:15       4.87
100year4hour15min            0:30       6.36
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100year4hour15min            1:00       16.45
100year4hour15min            1:15       46.45
100year4hour15min            1:30       143.67
100year4hour15min            1:45       32.45
100year4hour15min            2:00       17.25
100year4hour15min            2:15       11.53
100year4hour15min            2:30       8.62
100year4hour15min            2:45       6.87
100year4hour15min            3:00       5.71
100year4hour15min            3:15       4.89
100year4hour15min            3:30       4.28
100year4hour15min            3:45       3.81
100year4hour15min            4:00       0

5Year4hour15min             0:00       2.58
5Year4hour15min             0:15       3.13
5Year4hour15min             0:30       4.02
5Year4hour15min             0:45       5.66
5Year4hour15min             1:00       9.76
5Year4hour15min             1:15       26.72
5Year4hour15min             1:30       88.4
5Year4hour15min             1:45       18.73
5Year4hour15min             2:00       10.21
5Year4hour15min             2:15       6.99
5Year4hour15min             2:30       5.33
5Year4hour15min             2:45       4.31
5Year4hour15min             3:00       3.64
5Year4hour15min             3:15       3.15
5Year4hour15min             3:30       2.78
5Year4hour15min             3:45       2.49
5Year4hour15min             4:00       0

[REPORT]
;;Reporting Options
INPUT      YES
CONTROLS   NO
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```
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS       341299.87365     4686121.25085    341460.28335     4686224.14815
UNITS            Meters

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
OF1              341433.506         4686209.471

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[POLYGONS]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
S1               341322.26          4686188.935
S1               341340.95          4686192.156
S1               341385.988         4686199.087
S1               341431.872         4686206.661
S1               341445.869         4686208.166
S1               341447.582         4686199.491
S1               341449.205         4686192.561
S1               341451.691         4686171.599
S1               341452.992         4686162.957
S1               341406.432         4686154.901
S1               341332.802         4686125.928
S1               341307.165         4686182.984
S1               341322.26          4686188.935

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[PROFILES]
;;Name           Links
;;-------------- ----------
```

Existing 5-Year Output

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)
------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 1
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                 Data       Recording
Name                 Data Source                 Type       Interval
----------------------------------------------------------------------
Raingage             5Year4hour15min             INTENSITY   15 min.


********************
Subcatchment Summary
********************
Name                         Area     Width   %Imperv    %Slope Rain Gage           Outlet
-------------------------------------------------------------------------------------------------------
S1                           0.66     48.89      0.00    0.5000 Raingage            OF1


************
Node Summary
************
                                    Invert      Max.    Ponded    External
Name                 Type            Elev.     Depth      Area    Inflow
----------------------------------------------------------------------------
OF1                  OUTFALL           0.00      0.00       0.0


****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Surcharge Method ......... EXTRAN
Starting Date ............ 04/29/2024 00:00:00
Ending Date .............. 04/30/2024 00:00:00
```

Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00

Runoff Quantity Continuity	Volume hectare-m	Depth mm
Total Precipitation	0.033	49.475
Evaporation Loss	0.000	0.000
Infiltration Loss	0.015	23.269
Surface Runoff	0.017	26.251
Final Storage	0.000	0.000
Continuity Error (%)	-0.091	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.017	0.173
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.017	0.173
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	49.48	0.00	0.00	23.27	0.00	26.25	26.25	0.17	0.02	0.531

Analysis begun on: Wed May 1 08:54:07 2024
Analysis ended on: Wed May 1 08:54:08 2024
Total elapsed time: 00:00:01

Proposed Input Files

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;;Project Title/Notes

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;;Option             Value
FLOW_UNITS           CMS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO

START_DATE           04/29/2024
START_TIME           00:00:00
REPORT_START_DATE    04/29/2024
REPORT_START_TIME    00:00:00
END_DATE             04/30/2024
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         0.5
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              8

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;;Data Source    Parameters
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DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
Raingage         INTENSITY 0:15     1.0      TIMESERIES 100year4hour15min

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
S1               Raingage         SU1              0.66     90       85.714   1        0

[SUBAREAS]
```

```
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
S1               0.013      0.24       2.5        7.5        0          OUTLET

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
S1               180        0.5        0.1        0          0          GREEN_AMPT

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
J1               175.6      3.5        0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
OF1              175.1      TIMESERIES 100yearTW        YES

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            SurDepth Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- -------- -------- -------- --------
SU1              175.9    3.2        0          TABULAR    Parkinglot                   0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
OR1_1            SU1              J1               10         0.013      175.9      175.6      0          0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
OR1_2            J1               OF1              SIDE         175.6      0.65       YES      0

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
OR1_1            CIRCULAR     0.3              0          0          0          1
OR1_2            CIRCULAR     0.078            0          0          0

[LOSSES]
;;Link           Kentry     Kexit      Kavg       Flap Gate  Seepage
;;-------------- ---------- ---------- ---------- ---------- ----------
OR1_1            0.5        0.5        0          NO         0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
Parkinglot       Storage    0          122
Parkinglot                  1.49       122
Parkinglot                  1.5        0.7
Parkinglot                  2.9        0.7
Parkinglot                  3.2        2681

parkingonly      Storage    0          0.7
parkingonly                 2.9        0.7
parkingonly                 3.2        2681
```

```
[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
100year4hour15min            0:00       3.95
100year4hour15min            0:15       4.87
100year4hour15min            0:30       6.36
100year4hour15min            0:45       9.19
100year4hour15min            1:00       16.45
100year4hour15min            1:15       46.45
100year4hour15min            1:30       143.67
100year4hour15min            1:45       32.45
100year4hour15min            2:00       17.25
100year4hour15min            2:15       11.53
100year4hour15min            2:30       8.62
100year4hour15min            2:45       6.87
100year4hour15min            3:00       5.71
100year4hour15min            3:15       4.89
100year4hour15min            3:30       4.28
100year4hour15min            3:45       3.81
100year4hour15min            4:00       0

100yearTW                    0:00:00    177.900009
100yearTW                    0:05:00    177.900299
100yearTW                    0:10:00    177.900497
100yearTW                    0:15:00    177.900375
100yearTW                    0:20:00    177.900269
100yearTW                    0:25:00    177.900284
100yearTW                    0:30:00    177.900299
100yearTW                    0:35:00    177.900421
100yearTW                    0:40:00    177.900452
100yearTW                    0:45:00    177.900360
100yearTW                    0:50:00    177.900696
100yearTW                    0:55:00    177.900879
100yearTW                    1:00:00    177.900696
100yearTW                    1:05:00    177.901749
100yearTW                    1:10:00    177.902328
100yearTW                    1:15:00    177.901932
100yearTW                    1:20:00    177.908966
100yearTW                    1:25:00    177.913147
100yearTW                    1:30:00    177.912811
100yearTW                    1:35:00    177.958206
100yearTW                    1:40:00    177.968964
100yearTW                    1:45:00    177.974808
100yearTW                    1:50:00    177.933060
100yearTW                    1:55:00    177.932068
100yearTW                    2:00:00    177.931396
100yearTW                    2:05:00    177.913055
100yearTW                    2:10:00    177.911118
100yearTW                    2:15:00    177.909088
100yearTW                    2:20:00    177.905502
100yearTW                    2:25:00    177.904617
100yearTW                    2:30:00    177.903885
100yearTW                    2:35:00    177.902771
100yearTW                    2:40:00    177.902191
100yearTW                    2:45:00    177.902130
100yearTW                    2:50:00    177.901672
100yearTW                    2:55:00    177.901382
```

100yearTW	3:00:00	177.901337
100yearTW	3:05:00	177.901108
100yearTW	3:10:00	177.900925
100yearTW	3:15:00	177.900909
100yearTW	3:20:00	177.900757
100yearTW	3:25:00	177.900635
100yearTW	3:30:00	177.900635
100yearTW	3:35:00	177.900543
100yearTW	3:40:00	177.900467
100yearTW	3:45:00	177.900467
100yearTW	3:50:00	177.900391
100yearTW	3:55:00	177.900345
100yearTW	4:00:00	177.900345
100yearTW	4:05:00	177.899887
100yearTW	4:10:00	177.899750
100yearTW	4:15:00	177.899918
100yearTW	4:20:00	177.900177
100yearTW	4:25:00	177.900040
100yearTW	4:30:00	177.899872
100yearTW	4:35:00	177.899963
100yearTW	4:40:00	177.900085
100yearTW	4:45:00	177.900101
100yearTW	4:50:00	177.899979
100yearTW	4:55:00	177.899948
100yearTW	5:00:00	177.900024
100yearTW	5:05:00	177.900116
100yearTW	5:10:00	177.900024
100yearTW	5:15:00	177.899963
100yearTW	5:20:00	177.900009
100yearTW	5:25:00	177.900070
100yearTW	5:30:00	177.900040
5Year4hour15min	0:00	2.58
5Year4hour15min	0:15	3.13
5Year4hour15min	0:30	4.02
5Year4hour15min	0:45	5.66
5Year4hour15min	1:00	9.76
5Year4hour15min	1:15	26.72
5Year4hour15min	1:30	88.4
5Year4hour15min	1:45	18.73
5Year4hour15min	2:00	10.21
5Year4hour15min	2:15	6.99
5Year4hour15min	2:30	5.33
5Year4hour15min	2:45	4.31
5Year4hour15min	3:00	3.64
5Year4hour15min	3:15	3.15
5Year4hour15min	3:30	2.78
5Year4hour15min	3:45	2.49
5Year4hour15min	4:00	0
5yearTW	0:00:00	175.16
5yearTW	0:05:00	175.16
5yearTW	0:10:00	175.16
5yearTW	0:15:00	175.16
5yearTW	0:20:00	175.16
5yearTW	0:25:00	175.16
5yearTW	0:30:00	175.16

5yearTW	0:35:00	175.16
5yearTW	0:40:00	175.16
5yearTW	0:45:00	175.16
5yearTW	0:50:00	175.16
5yearTW	0:55:00	175.16
5yearTW	1:00:00	175.16
5yearTW	1:05:00	175.16
5yearTW	1:10:00	175.17
5yearTW	1:15:00	175.18
5yearTW	1:20:00	175.19
5yearTW	1:25:00	175.23
5yearTW	1:30:00	175.28
5yearTW	1:35:00	175.37
5yearTW	1:40:00	175.50
5yearTW	1:45:00	175.64
5yearTW	1:50:00	175.69
5yearTW	1:55:00	175.66
5yearTW	2:00:00	175.60
5yearTW	2:05:00	175.54
5yearTW	2:10:00	175.49
5yearTW	2:15:00	175.44
5yearTW	2:20:00	175.41
5yearTW	2:25:00	175.38
5yearTW	2:30:00	175.35
5yearTW	2:35:00	175.33
5yearTW	2:40:00	175.31
5yearTW	2:45:00	175.30
5yearTW	2:50:00	175.29
5yearTW	2:55:00	175.28
5yearTW	3:00:00	175.27
5yearTW	3:05:00	175.27
5yearTW	3:10:00	175.26
5yearTW	3:15:00	175.26
5yearTW	3:20:00	175.25
5yearTW	3:25:00	175.25
5yearTW	3:30:00	175.24
5yearTW	3:35:00	175.24
5yearTW	3:40:00	175.24
5yearTW	3:45:00	175.23
5yearTW	3:50:00	175.23
5yearTW	3:55:00	175.23
5yearTW	4:00:00	175.23
5yearTW	4:05:00	175.22
5yearTW	4:10:00	175.22
5yearTW	4:15:00	175.22
5yearTW	4:20:00	175.21
5yearTW	4:25:00	175.21
5yearTW	4:30:00	175.21
5yearTW	4:35:00	175.20
5yearTW	4:40:00	175.19
5yearTW	4:45:00	175.19
5yearTW	4:50:00	175.19
5yearTW	4:55:00	175.18
5yearTW	5:00:00	175.18
5yearTW	5:05:00	175.18
5yearTW	5:10:00	175.17
5yearTW	5:15:00	175.17

5yearTW	5:20:00	175.17
5yearTW	5:25:00	175.17
5yearTW	5:30:00	175.17
ClimateChangeTW	0:00:00	177.90
ClimateChangeTW	0:05:00	177.90
ClimateChangeTW	0:10:00	177.90
ClimateChangeTW	0:15:00	177.90
ClimateChangeTW	0:20:00	177.90
ClimateChangeTW	0:25:00	177.90
ClimateChangeTW	0:30:00	177.90
ClimateChangeTW	0:35:00	177.90
ClimateChangeTW	0:40:00	177.90
ClimateChangeTW	0:45:00	177.90
ClimateChangeTW	0:50:00	177.90
ClimateChangeTW	0:55:00	177.90
ClimateChangeTW	1:00:00	177.90
ClimateChangeTW	1:05:00	177.90
ClimateChangeTW	1:10:00	177.90
ClimateChangeTW	1:15:00	177.90
ClimateChangeTW	1:20:00	177.92
ClimateChangeTW	1:25:00	177.92
ClimateChangeTW	1:30:00	177.92
ClimateChangeTW	1:35:00	177.98
ClimateChangeTW	1:40:00	177.99
ClimateChangeTW	1:45:00	178.00
ClimateChangeTW	1:50:00	177.97
ClimateChangeTW	1:55:00	177.97
ClimateChangeTW	2:00:00	177.97
ClimateChangeTW	2:05:00	177.95
ClimateChangeTW	2:10:00	177.95
ClimateChangeTW	2:15:00	177.95
ClimateChangeTW	2:20:00	177.94
ClimateChangeTW	2:25:00	177.93
ClimateChangeTW	2:30:00	177.93
ClimateChangeTW	2:35:00	177.92
ClimateChangeTW	2:40:00	177.92
ClimateChangeTW	2:45:00	177.92
ClimateChangeTW	2:50:00	177.92
ClimateChangeTW	2:55:00	177.92
ClimateChangeTW	3:00:00	177.92
ClimateChangeTW	3:05:00	177.91
ClimateChangeTW	3:10:00	177.91
ClimateChangeTW	3:15:00	177.91
ClimateChangeTW	3:20:00	177.91
ClimateChangeTW	3:25:00	177.91
ClimateChangeTW	3:30:00	177.91
ClimateChangeTW	3:35:00	177.91
ClimateChangeTW	3:40:00	177.91
ClimateChangeTW	3:45:00	177.91
ClimateChangeTW	3:50:00	177.90
ClimateChangeTW	3:55:00	177.90
ClimateChangeTW	4:00:00	177.90
ClimateChangeTW	4:05:00	177.90
ClimateChangeTW	4:10:00	177.90
ClimateChangeTW	4:15:00	177.90
ClimateChangeTW	4:20:00	177.90

```
ClimateChangeTW            4:25:00    177.90
ClimateChangeTW            4:30:00    177.90
ClimateChangeTW            4:35:00    177.90
ClimateChangeTW            4:40:00    177.90
ClimateChangeTW            4:45:00    177.90
ClimateChangeTW            4:50:00    177.90
ClimateChangeTW            4:55:00    177.90
ClimateChangeTW            5:00:00    177.90
ClimateChangeTW            5:05:00    177.90
ClimateChangeTW            5:10:00    177.90
ClimateChangeTW            5:15:00    177.90
ClimateChangeTW            5:20:00    177.90
ClimateChangeTW            5:25:00    177.90
ClimateChangeTW            5:30:00    177.90

[REPORT]
;;Reporting Options
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS       341299.87365     4686121.25085    341460.28335     4686224.14815
UNITS            Meters

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
J1               341410.734         4686194.004
OF1              341433.506         4686209.471
SU1              341379.002         4686172.379

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[POLYGONS]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
S1               341322.26          4686188.935
S1               341340.95          4686192.156
S1               341385.988         4686199.087
S1               341431.872         4686206.661
S1               341445.869         4686208.166
S1               341447.582         4686199.491
S1               341449.205         4686192.561
S1               341451.691         4686171.599
S1               341452.992         4686162.957
S1               341406.432         4686154.901
S1               341332.802         4686125.928
S1               341307.165         4686182.984
S1               341322.26          4686188.935

;;Storage Node   X-Coord            Y-Coord
```

```
;;-------------- ------------------ ------------------

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[PROFILES]
;;Name           Links
;;-------------- ----------
```

Proposed Conditions 5-Year 4-hour Output Files

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)
------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 1
Number of nodes ........... 3
Number of links ........... 2
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                  Data       Recording
Name                 Data Source                  Type       Interval
----------------------------------------------------------------------
Raingage             5Year4hour15min              INTENSITY   15 min.


********************
Subcatchment Summary
********************
Name                         Area     Width   %Imperv    %Slope Rain Gage           Outlet
-----------------------------------------------------------------------------------------------------
S1                           0.66     85.71     90.00    1.0000 Raingage            SU1


************
Node Summary
************
                                    Invert      Max.    Ponded    External
Name                 Type            Elev.     Depth      Area    Inflow
------------------------------------------------------------------------
J1                   JUNCTION       175.60      3.50       0.0
OF1                  OUTFALL        175.10      0.00       0.0
SU1                  STORAGE        175.90      3.20       0.0


************
Link Summary
************
Name             From Node        To Node          Type             Length    %Slope Roughness
-------------------------------------------------------------------------------------------
OR1_1            SU1              J1               CONDUIT            10.0    3.0014    0.0130
OR1_2            J1               OF1              ORIFICE


*********************
Cross Section Summary
*********************
                                  Full     Full     Hyd.     Max.   No. of     Full
```

Conduit	Shape	Depth	Area	Rad.	Width	Barrels	Flow
OR1_1	CIRCULAR	0.30	0.07	0.07	0.30	1	0.17

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... HORTON
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 04/29/2024 00:00:00
Ending Date 04/30/2024 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step ..... 0.50 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.033	49.475
Evaporation Loss	0.000	0.000
Infiltration Loss	0.001	1.751
Surface Runoff	0.030	45.790
Final Storage	0.001	2.252
Continuity Error (%)	-0.642	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.030	0.302
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.030	0.302
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000

Final Stored Volume 0.000   0.000
Continuity Error (%) 0.000

****
Time-Step Critical Elements
****
None

****
Highest Flow Instability Indexes
****
All links are stable.

****
Most Frequent Nonconverging Nodes
****
Convergence obtained at all time steps.

****
Routing Time Step Summary
****
Minimum Time Step   :   0.50 sec
Average Time Step   :   0.50 sec
Maximum Time Step   :   0.50 sec
% of Time in Steady State   :   0.00
Average Iterations per Step :   2.00
% of Steps Not Converging   :   0.00
Time Step Frequencies   :
    0.500 - 0.500 sec   :   100.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	49.48	0.00	0.00	1.75	42.54	3.25	45.79	0.30	0.16	0.926

****
Node Depth Summary
****

	Average	Maximum	Maximum	Time of Max	Reported

Node	Type	Depth Meters	Depth Meters	HGL Meters	Occurrence days	hr:min	Max Depth Meters
J1	JUNCTION	0.29	3.09	178.69	0	02:07	3.09
OF1	OUTFALL	0.09	0.59	175.69	0	01:50	0.59
SU1	STORAGE	0.21	2.80	178.70	0	02:07	2.80

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.000	0.024	0	02:07	0	0.302	-0.002
OF1	OUTFALL	0.000	0.024	0	02:07	0	0.302	0.000
SU1	STORAGE	0.160	0.160	0	01:45	0.302	0.302	-0.000

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
J1	JUNCTION	5.90	2.790	0.410

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m³	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m³	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CMS
SU1	0.024	4.1	0.0	0.0	0.183	31.3	0	02:07	0.024

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	41.09	0.009	0.024	0.302
System	41.09	0.009	0.024	0.302

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
OR1_1	CONDUIT	0.024	0	02:07	0.40	0.14	1.00
OR1_2	ORIFICE	0.024	0	02:07			1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
OR1_1	1.00	0.03	0.00	0.00	0.71	0.26	0.00	0.00	0.72	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
OR1_1	4.52	4.52	5.90	0.01	0.01

Analysis begun on: Wed May 8 12:22:18 2024
Analysis ended on: Wed May 8 12:22:18 2024
Total elapsed time: < 1 sec

Proposed Conditions 100-Year 4-hour Output Files

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)
------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 1
Number of nodes ........... 3
Number of links ........... 2
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                  Data       Recording
Name                 Data Source                  Type       Interval
----------------------------------------------------------------------
Raingage             100year4hour15min            INTENSITY   15 min.


********************
Subcatchment Summary
********************
Name                         Area     Width   %Imperv    %Slope Rain Gage           Outlet
------------------------------------------------------------------------------------------------
S1                           0.66     85.71     90.00    1.0000 Raingage            SU1


************
Node Summary
************
                                    Invert      Max.    Ponded    External
Name                 Type            Elev.     Depth      Area    Inflow
------------------------------------------------------------------------
J1                   JUNCTION       175.60      3.50       0.0
OF1                  OUTFALL        175.10      0.00       0.0
SU1                  STORAGE        175.90      3.20       0.0


************
Link Summary
************
Name             From Node        To Node          Type             Length    %Slope Roughness
-------------------------------------------------------------------------------------------
OR1_1            SU1              J1               CONDUIT            10.0    3.0014    0.0130
OR1_2            J1               OF1              ORIFICE


*********************
Cross Section Summary
*********************
                                     Full     Full     Hyd.     Max.   No. of     Full
```

Conduit	Shape	Depth	Area	Rad.	Width	Barrels	Flow
OR1_1	CIRCULAR	0.30	0.07	0.07	0.30	1	0.17

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... HORTON
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 04/29/2024 00:00:00
Ending Date 04/30/2024 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step ..... 0.50 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.054	81.587
Evaporation Loss	0.000	0.000
Infiltration Loss	0.001	1.801
Surface Runoff	0.051	78.015
Final Storage	0.001	2.252
Continuity Error (%)	-0.589	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.051	0.515
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.033	0.331
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000

Final Stored Volume 0.018   0.183
Continuity Error (%) 0.181

****
Time-Step Critical Elements
****
None

****
Highest Flow Instability Indexes
****
All links are stable.

****
Most Frequent Nonconverging Nodes
****
Convergence obtained at all time steps.

****
Routing Time Step Summary
****
Minimum Time Step   :   0.50 sec
Average Time Step   :   0.50 sec
Maximum Time Step   :   0.50 sec
% of Time in Steady State   :   0.00
Average Iterations per Step :   2.02
% of Steps Not Converging   :   0.01
Time Step Frequencies   :
    0.500 - 0.500 sec   :   100.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	81.59	0.00	0.00	1.80	71.59	6.42	78.01	0.51	0.26	0.956

****
Node Depth Summary
****

	Average	Maximum	Maximum	Time of Max	Reported

Node	Type	Depth Meters	Depth Meters	HGL Meters	Occurrence days	hr:min	Max Depth Meters
J1	JUNCTION	2.45	3.42	179.02	0	02:49	3.42
OF1	OUTFALL	2.80	2.87	177.97	0	01:45	2.87
SU1	STORAGE	2.16	3.12	179.02	0	02:49	3.12

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.000	0.014	0	02:55	0	0.331	0.073
OF1	OUTFALL	0.000	0.014	0	02:55	0	0.331	0.000
SU1	STORAGE	0.262	0.262	0	01:45	0.515	0.515	0.272

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
J1	JUNCTION	23.20	3.118	0.082

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m³	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m³	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CMS
SU1	0.209	35.7	0.0	0.0	0.404	69.0	0	02:49	0.014

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	30.67	0.012	0.014	0.331
System	30.67	0.012	0.014	0.331

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
OR1_1	CONDUIT	0.014	0	02:55	0.29	0.09	1.00
OR1_2	ORIFICE	0.014	0	02:55			1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
OR1_1	1.00	0.02	0.00	0.00	0.97	0.00	0.00	0.00	0.01	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
OR1_1	22.71	22.71	23.20	0.01	0.01

Analysis begun on: Wed May 8 12:28:08 2024
Analysis ended on: Wed May 8 12:28:08 2024
Total elapsed time: < 1 sec

WQT Output Files

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)
------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 1
Number of nodes ........... 3
Number of links ........... 2
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                 Data       Recording
Name                 Data Source                 Type       Interval
----------------------------------------------------------------------
Raingage             WQT                         INTENSITY   15 min.


********************
Subcatchment Summary
********************
Name                         Area     Width   %Imperv    %Slope Rain Gage           Outlet
-------------------------------------------------------------------------------------------------
S1                           0.66     85.71     90.00    1.0000 Raingage            SU1


************
Node Summary
************
                                    Invert      Max.    Ponded    External
Name                 Type            Elev.     Depth      Area    Inflow
------------------------------------------------------------------------
J1                   JUNCTION       175.60      3.50       0.0
OF1                  OUTFALL        175.10      0.00       0.0
SU1                  STORAGE        175.90      3.20       0.0


************
Link Summary
************
Name             From Node        To Node          Type             Length    %Slope Roughness
-----------------------------------------------------------------------------------------------
OR1_1            SU1              J1               CONDUIT            10.0    3.0014    0.0130
OR1_2            J1               OF1              ORIFICE


*********************
Cross Section Summary
*********************
                                     Full     Full     Hyd.     Max.   No. of     Full
```

Conduit	Shape	Depth	Area	Rad.	Width	Barrels	Flow
OR1_1	CIRCULAR	0.30	0.07	0.07	0.30	1	0.17

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... HORTON
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 04/29/2024 00:00:00
Ending Date 04/30/2024 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step ..... 0.50 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.021	31.995
Evaporation Loss	0.000	0.000
Infiltration Loss	0.001	1.694
Surface Runoff	0.019	28.256
Final Storage	0.001	2.252
Continuity Error (%)	-0.648	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.019	0.186
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.019	0.186
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000

Final Stored Volume 0.000   0.000
Continuity Error (%) 0.000

****
Time-Step Critical Elements
****
None

****
Highest Flow Instability Indexes
****
All links are stable.

****
Most Frequent Nonconverging Nodes
****
Convergence obtained at all time steps.

****
Routing Time Step Summary
****
Minimum Time Step   :   0.50 sec
Average Time Step   :   0.50 sec
Maximum Time Step   :   0.50 sec
% of Time in Steady State   :   0.00
Average Iterations per Step :   2.00
% of Steps Not Converging   :   0.00
Time Step Frequencies   :
    0.500 - 0.500 sec   :   100.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %
    0.500 - 0.500 sec   :   0.00 %

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	31.99	0.00	0.00	1.69	26.72	1.53	28.26	0.19	0.10	0.883

****
Node Depth Summary
****

	Average	Maximum	Maximum	Time of Max	Reported

Node	Type	Depth Meters	Depth Meters	HGL Meters	Occurrence days	hr:min	Max Depth Meters
J1	JUNCTION	0.14	1.16	176.76	0	02:09	1.16
OF1	OUTFALL	0.00	0.00	175.10	0	00:00	0.00
SU1	STORAGE	0.09	0.86	176.76	0	02:09	0.86

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.000	0.015	0	02:09	0	0.186	-0.001
OF1	OUTFALL	0.000	0.015	0	02:09	0	0.186	0.000
SU1	STORAGE	0.102	0.102	0	01:45	0.186	0.186	-0.001

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
J1	JUNCTION	4.26	0.860	2.340

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m³	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m³	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CMS
SU1	0.011	1.9	0.0	0.0	0.105	18.0	0	02:09	0.015

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	35.60	0.006	0.015	0.186
System	35.60	0.006	0.015	0.186

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
OR1_1	CONDUIT	0.015	0	02:09	0.41	0.09	1.00
OR1_2	ORIFICE	0.015	0	02:09			1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
OR1_1	1.00	0.04	0.00	0.00	0.68	0.28	0.00	0.00	0.78	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
OR1_1	2.96	2.96	4.26	0.01	0.01

Analysis begun on: Wed May 8 12:39:30 2024
Analysis ended on: Wed May 8 12:39:30 2024
Total elapsed time: < 1 sec

Climate Change Stress Test Output Files

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)
------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 1
Number of nodes ........... 3
Number of links ........... 2
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                 Data       Recording
Name                 Data Source                 Type       Interval
----------------------------------------------------------------------
Raingage             ClimateChange               INTENSITY   15 min.


********************
Subcatchment Summary
********************
Name                         Area     Width   %Imperv    %Slope Rain Gage           Outlet
-------------------------------------------------------------------------------------------------
S1                           0.66     85.71     90.00    1.0000 Raingage            SU1


************
Node Summary
************
                                    Invert      Max.    Ponded    External
Name                 Type            Elev.     Depth      Area    Inflow
------------------------------------------------------------------------
J1                   JUNCTION       175.60      3.50       0.0
OF1                  OUTFALL        175.10      0.00       0.0
SU1                  STORAGE        175.90      3.20       0.0


************
Link Summary
************
Name             From Node        To Node          Type             Length    %Slope Roughness
-----------------------------------------------------------------------------------------------
OR1_1            SU1              J1               CONDUIT            10.0    3.0014    0.0130
OR1_2            J1               OF1              ORIFICE


*********************
Cross Section Summary
*********************
                                     Full     Full     Hyd.     Max.   No. of     Full
```

Conduit	Shape	Depth	Area	Rad.	Width	Barrels	Flow
OR1_1	CIRCULAR	0.30	0.07	0.07	0.30	1	0.17

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... HORTON
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 04/29/2024 00:00:00
Ending Date 04/30/2024 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step ..... 0.10 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.075	114.223
Evaporation Loss	0.000	0.000
Infiltration Loss	0.001	1.829
Surface Runoff	0.073	110.783
Final Storage	0.001	2.252
Continuity Error (%)	-0.562	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.073	0.731
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.055	0.547
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000

Final Stored Volume 0.018   0.183
Continuity Error (%) 0.079

****
Time-Step Critical Elements
****
None

****
Highest Flow Instability Indexes
****
Link OR1_2 (4)

****
Most Frequent Nonconverging Nodes
****
Convergence obtained at all time steps.

****
Routing Time Step Summary
****
Minimum Time Step   :   0.10 sec
Average Time Step   :   0.10 sec
Maximum Time Step   :   0.10 sec
% of Time in Steady State   :   0.00
Average Iterations per Step :   2.19
% of Steps Not Converging   :   1.05
Time Step Frequencies   :
    0.100 - 0.100 sec   :   100.00 %
    0.100 - 0.100 sec   :   0.00 %
    0.100 - 0.100 sec   :   0.00 %
    0.100 - 0.100 sec   :   0.00 %
    0.100 - 0.100 sec   :   0.00 %

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	114.22	0.00	0.00	1.83	101.12	9.67	110.78	0.73	0.37	0.970

****
Node Depth Summary
****

	Average	Maximum	Maximum	Time of Max	Reported

Node	Type	Depth Meters	Depth Meters	HGL Meters	Occurrence days hr:min	Max Depth Meters
J1	JUNCTION	2.69	6.50	182.10	0 02:28	6.48
OF1	OUTFALL	2.80	2.90	178.00	0 01:40	2.90
SU1	STORAGE	2.40	6.20	182.10	0 02:28	6.20

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.000	0.028	0 02:32	0	0.547	-0.023
OF1	OUTFALL	0.000	0.028	0 02:32	0	0.547	0.000
SU1	STORAGE	0.368	0.368	0 01:45	0.731	0.731	0.194

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
J1	JUNCTION	23.36	6.200	0.000
SU1	STORAGE	22.87	5.900	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CMS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 ltr	Maximum Ponded Depth Meters
J1	0.01	0.000	0 02:28	0.000	3.000
SU1	0.06	0.012	0 02:28	0.000	3.000

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m³	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m³	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SU1	0.274	46.8	0.0	0.0	0.586	100.0	0 02:28	0.028

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	45.46	0.014	0.028	0.547
System	45.46	0.014	0.028	0.547

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
OR1_1	CONDUIT	0.028	0 02:32	0.40	0.17	1.00
OR1_2	ORIFICE	0.028	0 02:32			1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
OR1_1	1.00	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
OR1_1	22.87	22.87	23.36	0.01	0.01

```
Analysis begun on:  Thu May  9 10:35:04 2024
Analysis ended on:  Thu May  9 10:35:05 2024
Total elapsed time: 00:00:01
```

APPENDIX D

Water Quality Unit

ADS OGS Sizing Summary

Project Name:	0 Esplanade Dr.
Consulting Engineer:	Dillon Consulting
Location:	Windsor, ON
Sizing Completed By:	C. Neath

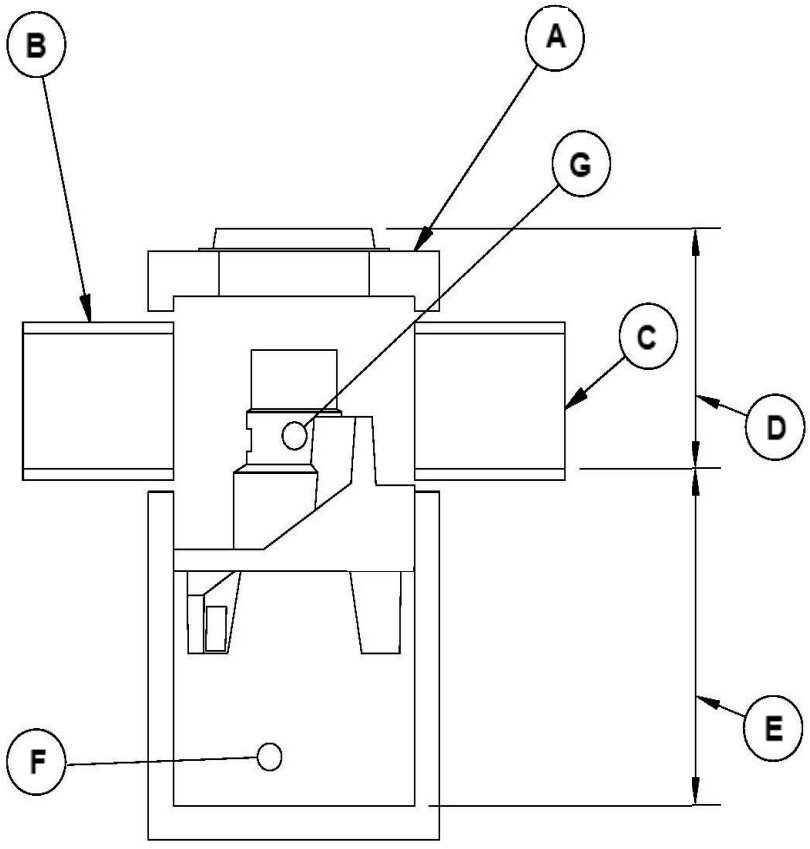
Email: cody.neath@adspipe.com

Treatment Requirements		
Treatment Goal:	Normal (MOE)	
Selected Parameters:	70% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.66 ha
% Impervious:	90%
Rational C:	0.84
Rainfall Station:	Windsor, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
Model	**TSS Removal**	**Volume Treated**
FD-4HC	76.0%	>90%
FD-5HC	84.0%	>90%
FD-6HC	86.0%	>90%
FD-8HC	91.0%	>90%
FD-10HC	94.0%	>90%

FD-4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name:	0 Esplanade Dr.
Consulting Engineer:	Dillon Consulting
Location:	Windsor, ON

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[(1)]	Rational Equation Flowrate	Surface Loading Rate	Fraction of Rainfall[(1)]	FD-4HC Removal Efficiency	Weighted Net-Annual Removal Efficiency
mm/hr	L/s	L/min/m^2	%	%	%
3.00	4.6	245	13.2%	90%	11.9%
4.00	6.2	327	9.6%	88%	8.4%
5.00	7.7	408	7.5%	86%	6.5%
6.00	9.2	490	6.0%	85%	5.1%
7.00	10.8	572	4.8%	83%	4.0%
8.00	12.3	654	4.1%	82%	3.4%
9.00	13.9	735	3.6%	81%	2.9%
10.00	15.4	817	3.2%	81%	2.6%
11.00	16.9	899	2.8%	80%	2.2%
12.00	18.5	980	2.5%	79%	2.0%
15.00	23.1	1225	6.6%	78%	5.1%
20.00	30.8	1634	8.3%	76%	6.3%
25.00	38.5	2042	5.8%	74%	4.3%
30.00	46.2	2451	4.6%	73%	3.3%
35.00	53.9	2859	3.8%	72%	2.7%
40.00	61.6	3268	2.9%	71%	2.1%
45.00	69.3	3676	2.4%	70%	1.7%
50.00	77.0	4085	1.8%	69%	1.2%
65.00	100.1	5310	6.6%	0%	0.0%
Total Net Annual Removal Efficiency:					75.7%
Total Runoff Volume Treated:					>90%

Notes:

(1) Based on Windsor/Essex Region Stormwater Manual 2018, Table 3.4.1.5

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

APPENDIX E

ERCA FLOOD MAPPING & PRE-CONSULTATION

North Sheet Number 31

West Sheet Number 36

East Sheet Number 38

South Sheet Number 43

BASE MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019
*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR – DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO
2019 IMAGERY - THE DIGITAL MAP LAYERS HAVE BEEN USED WITH THE EXPRESS PERMISSION OF THE CORPORATION OF THE COUNTY OF ESSEX SUPPLEMENTED WITH ESRI BASEMAP IMAGERY

DILLON CONSULTING

BASE MAP CREATED BY: LMM

BASE MAP CHECKED BY: ARTC

FLOOD RISK MAP DRAWING INFORMATION:
DATA PROCESSING NOTES 2021-03-29

FLOOD RISK PEO INITALS: RTL

FLOOD RISK PEO SIGNATURE:

LICENSED PROFESSIONAL ENGINEER
R.T. LANGLOIS
100163823
MAY 1, 2023
PROVINCE OF ONTARIO

PROJECT: 19-9817

STATUS: FINAL

PROCESS DATE: 2023-04-25

LEGEND

PROJECT DATA
- STUDY AREA
- MAJOR STRUCTURE
- PROJECT MUNICIPAL DRAIN

FLOOD BASE DATA
- MAJOR ELEVATION CONTOUR (10 M)
- MINOR ELEVATION CONTOUR (0.5 M)

FLOOD HAZARD DATA
- 1:100 YEAR GOVERNING IN-DRAIN FLOOD LEVEL (MASL)
- 1:100 YEAR FLOOD FRINGE LEVEL (MASL)
- 1:100 YEAR FLOOD FRINGE EXTENTS
- 1:100 YEAR FLOODWAY EXTENTS
- BREAKLINE REPRESENTATIVE OF 1:100 YEAR IN-DRAIN FLOOD LEVEL CHANGE FROM QSS MODEL TO DYNAMIC MODEL RESULTS.

BASE DATA
- MAJOR ROAD
- LOCAL ROAD
- TRAIL
- WATERCOURSE
- BUILDING FOOTPRINT

N
W E
S

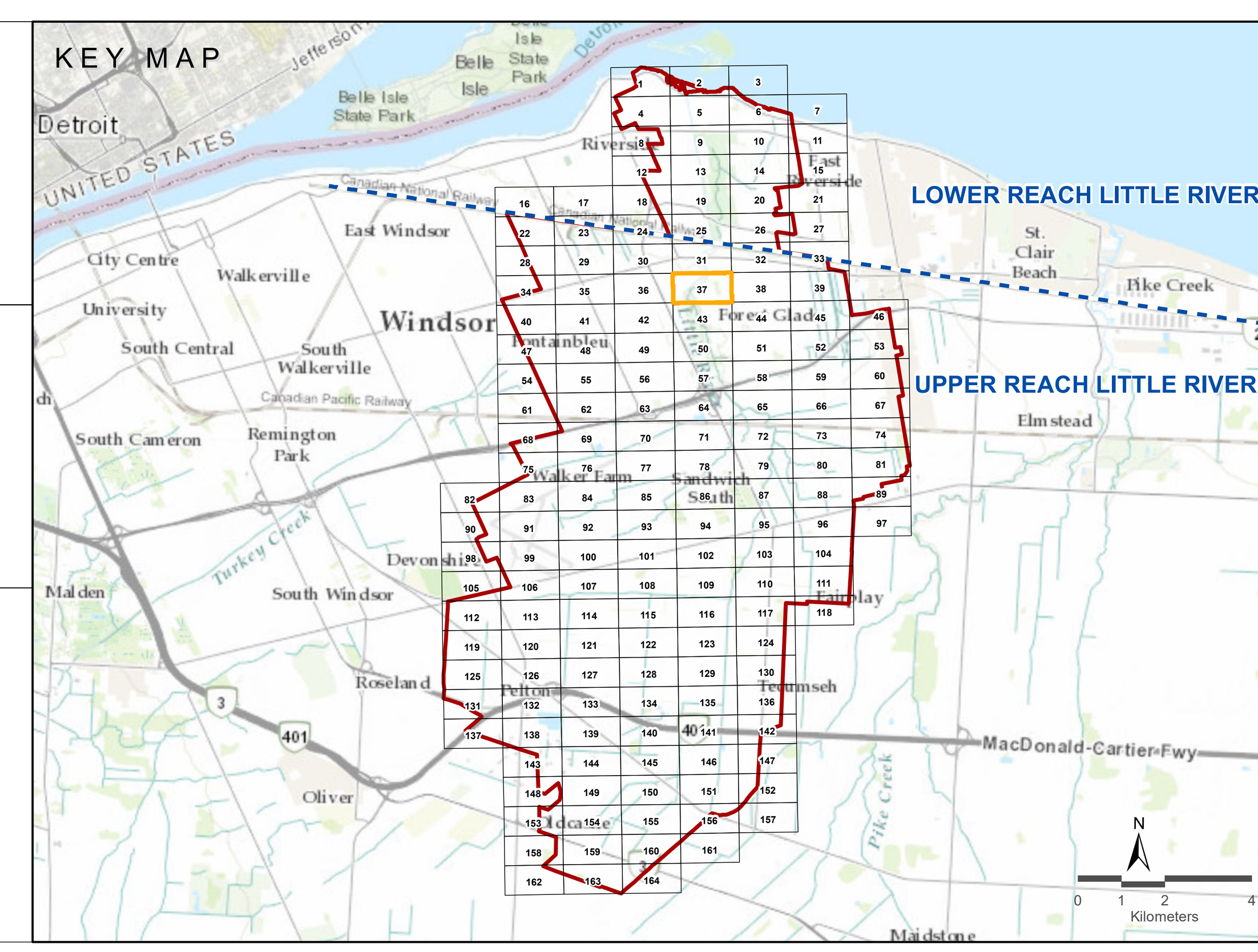
DATUM: NAD 1983 CSRS UTM Zone 17N

Contour Interval 10m

Interpolated Contour Interval 0.5m

SCALE 1:1,000

0 15 30 60 Metres



THE CITY OF WINDSOR ONTARIO, CANADA

LITTLE RIVER WATERSHED FLOOD PLAIN MAPPING

SHEET 37 OF 164

Essex Region Conservation Authority
sustaining the place for life

FLOOD PLAIN MAPPING LOWER REACHES

NOTES:
MASL - Meters Above Sea Level

Flood Proofing along Little River Between Stations 00000+00 to 02594+33 Governed by: ERCA Engineering Flood Standards

Flood Proofing along Little River Between Stations 02594+33 to 03628+27 Governed by: 1:100 Year In-Drain Dynamic Hydraulic Model

Flood Proofing along Little River Between Stations 03628+27 to 14013+25 Governed by: 1:100 Year In-Drain Quasi-Steady State Hydraulic Model

Flood Proofing In All Other Drains Governed by: 1:100 Year In-Drain Quasi-Steady State Hydraulic Model

Jeyalakshmi, Saranya <sjeyalakshmi@dillon.ca>

Fwd: FW: SWM/Floodproofing requirements for 0 Esplanade Drive, Windsor

1 message

Bagchi, Aakash <abagchi@dillon.ca> Tue, Sep 3, 2024 at 10:11 AM
To: Saranya Jeyalakshmi <sjeyalakshmi@dillon.ca>

Please see the floodproofing elevation from ERCA for 0 Esplanade below. It needs to be updated in the SWM Report.

Aakash Bagchi
Associate
Dillon Consulting Limited
3200 Deziel Drive Suite 608
Windsor, Ontario, N8W 5K8
T - 519.948.5000 ext. 3235
ABagchi@dillon.ca
www.dillon.ca

WE'RE MOVING! - On October 1, 2024 our office will be relocating to 1 Riverside Drive West, Windsor ON, N9A 5K3
Upcoming Vacation: September 5-6; September 30-October 4 (dates inclusive)

---------- Forwarded message ---------
From: **Tian Martin** <TMartin@erca.org>
Date: Wed, Aug 28, 2024 at 1:34 PM
Subject: FW: SWM/Floodproofing requirements for 0 Esplanade Drive, Windsor
To: Bagchi, Aakash <abagchi@dillon.ca>
Cc: Amy Farkas <afarkas@dillon.ca>

Apologies, please see the correction below.

From: Tian Martin
Sent: Wednesday, August 28, 2024 12:19 PM
To: Bagchi, Aakash <abagchi@dillon.ca>
Cc: Amy Farkas <afarkas@dillon.ca>
Subject: RE: SWM/Floodproofing requirements for 0 Esplanade Drive, Windsor

Hi Aakash,

Based on the Little River Flood Hazard Map 37 attached, the nearest 1:100 year water level in the Little River is 178.14m CGVD28:78, therefore the minimum building opening elevation will be ~~178.48~~ 178.44m CGVD28:78, or 0.30m above the 1:100 year WSEL on-site, or the Stress Test WSEL on-site.

Based on the information provided, the anticipated outlet being the city storm sewer and the design being in accordance with the regional SWM guidelines, ERCA does not foresee any further stormwater related

requirements at this time.

Thanks,

TIAN MARTIN, P.Eng.

Water Resources Engineer, Watershed Management Services

Essex Region Conservation Authority

360 Fairview Avenue West, Suite 311 Ÿ Essex, Ontario Ÿ N8M 1Y6

P. 519-776-5209 x 304 Ÿ F. 519-776-8688

tmartin@erca.org www.essexregionconservation.ca

From: Bagchi, Aakash <abagchi@dillon.ca>
Sent: Tuesday, August 27, 2024 4:11 PM
To: Tian Martin <TMartin@erca.org>
Cc: Amy Farkas <afarkas@dillon.ca>
Subject: SWM/Floodproofing requirements for 0 Esplanade Drive, Windsor

Good Afternoon Tian,

Dillon is assisting with a proposed development in Windsor, located at 0 Esplanade Drive. A map showing the location is attached for reference. The City of Windsor has requested consultation with ERCA regarding floodproofing and other design requirements that may affect the SWM design.

Can you please confirm the floodproofing requirements for this development?

Based on our knowledge of the watershed, the following will apply:

- The 100-year water level in Little River at the nearest point to the site (upstream of Tecumseh road crossing) in the Little River Watershed Flood Line Mapping - Final Hydraulic Report (Dillon, 2023) is 178.08 m.
- Therefore, the minimum building opening will be 178.38 m, or 0.30 m above 100-Year WSEL on-site, or Climate Change stress test WSEL on-site, whichever is greater.

Can you also confirm if there are any other design requirements related to stormwater management that we should take into account for this site?

The proposed stormwater outlet for this site will be a storm trunk sewer that passes through the site in a municipal easement, eventually draining to Little River. The preliminary SWM design requires underground as well as surface storage to meet the requirements of the regional SWM guidelines.

Thank you,

Aakash

Aakash Bagchi
Associate
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2 attachments

ERCA Mapping_0 Esplanade.pdf
1489K

FloodHazard_LittleRiver_GridIndex_L_1067mm_x_762mm_37.pdf
8964K