Preliminary Stormwater Management Report

2396584 Ontario Inc.
Teviotdale Industrial Subdivision
Town of Minto

GMBP File: 322035

June 2023

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
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TABLE OF CONTENTS

APPENDICES

PRELIMINARY STORMWATER MANAGEMENT REPORT

TEVIOTDALE INDUSTRIAL SUBDIVISION

TOWN OF MINTO

GMBP FILE: 322035

1. INTRODUCTION

This report has been prepared by GM BluePlan Engineering Limited to document the preliminary design of the stormwater management system for the proposed Teviotdale industrial subdivision, which is legally described as part of Lot 114 ConcessionD, Minto, County of Wellington, located north of the Teviotdale roundabout along Wellington Rd 109 (the 'Site').

The draft plan drawing for this development was designed by MHBC Planning Limited and the topographic survey was performed by Van Harten Surveying Inc, and further supplemented by GM BluePlan Engineering.

2. SITE INFORMATION

The proposed subdivision is located on a parcel of land approximately 8.3 hectares in size and is near the intersection of Wellington Road 109 and Wellington Road 123, with frontage on both. The site is currently used for agricultural purposes and contains field crops. The site is transected by 3 branches of the Minto Municipal Drain No. 59, namely the Main Drain, Branch 'B', and Branch 'C'. The Main Drain and Branch 'C' were last improved in 1981. The Main Drain consists of both 600mm and 530mm diameter concrete field tile, and Branch 'C' consists of 350mm diameter field tile. Branch 'B' was last improved in 2020 and consists of 450mm diameter concrete field tile. Both Branch 'B' and Branch 'C' connect to the Main Drain at the northwest corner of the site. The Main Drain has outlet into the open ditch Teviotdale Drain approximately 550m northwest of the site.

The Site is also bound by institutional zone (IN), residential zone and agricultural zone (A-1) to the north, agricultural-commercial zone (AC-21) to the east, and industrial zone (R1N and M1-41), residential zone (R1A) and hamlet commercial zone (C5) to the south. Site topography undulates in a gentle slope from east in a west and south to north direction.

At this time, the intent of the owner is to develop the existing Site into an industrial subdivision split into 12 lots, along with an associated paved street designated as Street A, a stormwater block labelled Block 13, and an open un-used space designated as Block 14. See the draft plan layout included in Appendix 'A'. Following development, stormwater runoff generated from the Site will be conveyed to an onsite stormwater management facility prior to discharging into a catchbasin connected to Municipal Drain No. 59. Overland runoff from neighbouring properties currently directed towards the Site will sheetflow into a drainage ditch running along the southern and western perimeter of the Site, which will then be routed to Drain No. 59. The existing branches of Drain No. 59 on the site will be re-routed along the road allowance or on easements and will bypass the SWM facility.

3. STORMWATER MANAGEMENT DESIGN

3.1 Stormwater Management Criteria

The stormwater management criteria for the site are as follows:

1. Post-development runoff under all storm conditions up to and including the 100-year design storm will be controlled to a rate not exceeding the capacity of the downstream receiver (Drain No. 59)
2. Normal water quality control (70% of TSS removal) is required prior to the discharge of runoff from the proposed development.

The Mount Forest Intensity-Duration-Frequency (IDF) Storm parameters used to model the 5 and 100-year design rainfall events for the site are summarized in the following Table No. 1. In addition, the 25mm Huff 2nd Quartile design storm was used to determine pond volume and drawdown for quality control purposes.

Table No. 1: IDF Parameters

Parameter	5-year	100-year
A	1012.69	1702.25
B	8.094	9.944
C	0.8196	0.8269
R	0.375	0.375

3.2 Pre-Development Outlet Rate

As noted, the Site is contained within the catchment area of Municipal Drain No. 59 and has legal outlet to the same, within the parameters as determined by the most recent drainage report. As part of the investigation, we reviewed in detail the 1981 Municipal Drain No. 59 engineer's report as well as the plan and profile drawings of the 1981 drain. Typical of drainage reports of that era, no design standard is given. It therefore is necessary to determine the design standard by back-calculating using pipe diameters, slopes, and upstream tributary areas under the most restrictive conditions. It was determined that the tributary area upstream of the 600mm Main Drain was 90.1 hectares, and that the flattest grade the pipe was laid was 0.42%. Using standard agricultural drainage design methodology, it was calculated that this pipe was designed to allow for 38mm (1 ½") of drainage per 24 hours. This equates to a maximum allowable outflow of 36 L/s for the 8.3-hectare site. Without any other changes, it will be necessary to attenuate post-development runoff from the Site to no more than the allowable outflow rate.

3.3 Post-Development Drainage Area

As a rural un-serviced subdivision, maximum post-development imperiousness will be slightly less than what would be expected of a similar urban development due to the presence of septic systems and water wells. An urban industrial subdivision would typically be 75% impervious, however this report assumes a maximum imperviousness for this Site under post-development conditions of 70%. This should allow for the maximum development potential of the site.

The Site was modelled using the hydrologic software PCSWMM and with the 5-year and 100-year return period design storms. The following table No. 2 outlines the unattenuated post-development runoff from the Site.

Table No. 2: Post-Development Unattenuated Runoff (L/s)

Catchment	5-year	100-year
Site	1,420	2,470

3.4 Post-Development Outlet Rate

As noted in section 3.2 the maximum allowable outlet rate for the Site is 36 L/s. This rate is quite low and will require a stormwater storage facility of unreasonably large size, reducing the available land for development purposes. Consequently, it is proposed to improve the existing Main Drain of Drain No. 59 downstream of the Site to the Teviotdale Drain. The improvement will consist of replacing the existing 600mm and 530mm diameter

drain tiles with an 825mm diameter drain tile, starting at the north property line of the Site and extending to the outlet into the Teviotdale Drain. This replacement will be done under a separate report following the process and requirements of the *Drainage Act*. It is assumed that the Teviotdale Drain has sufficient capacity to allow for an increased outlet rate from the Site, and as an open ditch system this is considered a reasonable assumption.

The improved Main Drain will support an increase in permissible outlet rate from the Site. The proposed 825mm diameter drain tile, laid at a minimum grade of 0.9%, will provide full flow capacity of 1.36 m^3/s. In comparison, the existing 600mm diameter tile at a minimum grade of 0.42% has a pipe-full capacity of 0.40 m^3/s. It is assumed the capacity of the existing pipe is already utilized by external lands, therefore only the additional capacity provided by the 825mm tile, 0.96 m^3/s, will be considered available for outlet purposes. The stormwater facility will be designed to attenuate all runoff from the Site under full development conditions to no more than 0.96 m^3/s.

3.4.1 Routing

It is proposed to construct a hybrid wet pond type stormwater management facility on lands set aside for this purpose between Lot 9 and Lot 12 labelled as Block 13 on the Draft Plan. The facility will have approximate top dimensions of 85m in length by 35m in width. The facility will include sufficient active storage to contain runoff up to and including 100-year design storms, as well as a permanent pool for quality control. Outlet from the pond will be controlled by a 110mm diameter orifice for quality control, and a ditch inlet catch basin with a 600mm diameter outlet pipe laid at 0.5% grade for peak flow attenuation for all design storms up to and including the 100-year storm. The pond will also include an overflow weir in case the outlet becomes blocked, or in the event of the Regional storm (Hazel). The pond is proposed to be 1.6m deep in total, with a calculated bank-full active storage capacity of 2,847 m3 at 1.25m depth, and a 0.35m deep permanent pool with a volume of approximately 540 m3.

Runoff from the Site will be conveyed to the SWM facility via a combination of roadside ditches and rear and side-yard swales. The outlet structure will be connected to the improved portion of Municipal Drain No. 59 at a proposed catch basin structure to be installed on the Site property line at the northwest corner of Block 13. The stage/storage/discharge for the proposed SWM facility is given in the following Table:

Table No. 3: SWM Facility Stage/Storage/Discharge

	Peak Inflow m^3/s	Elevation m	Active Storage Depth m	Active Storage Volume m^3	Peak Outflow m^3/s
Permanent Pool Bottom	-	414.50	-	-	-
110mm Orifice	-	414.85	0.00	-	-
25mm Quality Storm	0.65	415.38	0.54	1,018	0.02
CB Lip	-	415.40	0.55	1,047	-
5-Year	1.51	415.46	0.61	1,169	0.62
100-Year	2.64	415.81	0.96	2,042	0.98
Weir	-	415.85	1.00	2,142	-
Top of Pond	-	417.10	1.25	2,847	-

The proposed SWM facility will control post-development runoff to not exceed the capacity of the downstream receiver under all storm conditions up to and including the 100-year design storm, with a minor non-significant exceedance under the 100-year design storm condition. Modelling results are included in Appendix 'B'.

4. QUALITY CONTROL

Quality control will be provided to the "normal" level which is defined as the long-term removal of 70% of total suspended solids as per the MECP Stormwater Management Manual. The total site area is 8.3 hectares however a portion of the site is occupied by Block 13 which is the stormwater facility itself. Block 13 does not require control measures and is excluded from this calculation, resulting in a site area for quality control purposes of 7.74 hectares. As per table 3.2 of the MECP manual, a hybrid wet pond serving a 7.74-hectare site with a total imperviousness of 70% requires an interpolated storage volume of 105 m^3/hectare. Of this, 40 m^3/hectare is to be provided as extended detention volume with the remaining 65 m^3/hectare included in the permanent pool.

In total, 813 m^3 of quality control storage will be required of which a minimum of 503 m^3 will be in the permanent pool and the remainder in active storage. The facility will be designed with a permanent pool 0.35 m deep. The volume of the permanent pool was calculated to be approximately 543 m^3 which meets the requirement for quality control storage.

Outlet control from active storage for the quality storm is provided by a 110mm diameter orifice. Pond drawdown was checked against the 25mm quality control storm to ensure minimum detention time using the 4.11 equation in the MECP manual. Drawdown time was calculated to be approximately 25.5 hours, satisfying the optimal minimum drawdown time of 24 hours.

5. SEDIMENT AND EROSION CONTROL

A silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. The silt fence will serve to minimize the opportunity for waterborne sediments to be washed on to the adjacent surfaces.

Inspection and maintenance of all silt fencing will start after installation is complete. The fence will be inspected on a weekly basis during active construction or after a rainfall event of 13 mm or greater. Maintenance will be carried out, within 48 hours, on any part of the facility found to need repair.

Once construction and landscaping has been substantially completed, the silt fence will be removed, any accumulated sediment will be removed, and the landscaping will be completed. After construction of the complete development, erosion and sediment transport will be minimal.

6. CONCLUSIONS

In summary, the features of the design for the proposed development are as follows:

1. The existing 600mm and 530mm diameter Main Drain of the Municipal Drain No. 59 will be replaced downstream of the Site with an 825mm diameter drain tile to provide for improved outlet capacity for the Site.
2. The Site will include a hybrid wet pond type SWM facility with a permanent pool and active storage volume sufficient to contain the runoff from all design storms under full post-development conditions.
3. The post-development peak runoff rate under all storm conditions including 100-year design storms will not exceed the capacity of the downstream receiver (825 mm drain tile), with a minor non-significant exceedance under 100-year design storm conditions.
4. Quality control will be provided by the permanent pool and extended detention to the "normal" level of 70% long-term suspended solids removal, as per the MECP Stormwater Management Planning and Design Manual.
5. Prior to construction, a silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. This will minimize the transport of sediment off-site during the construction period.

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED
Per:

Matt Ash, C.E.T.

Brian Fritz, P.Eng

APPENDIX A:
DRAFT PLAN DRAWING

DRAFT PLAN OF SUBDIVISION

Legal Description

PART OF LOT 114
CONCESSION D
TOWN OF MINTO
COUNTY OF WELLINGTON

Owner's Certificate

I HEREBY AUTHORIZE MACNAUGHTON HERMSEN BRITTON CLARKSON PLANNING LIMITED TO SUBMIT THIS PLAN FOR APPROVAL.

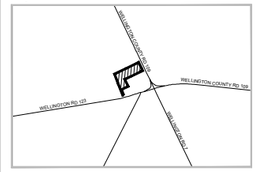
DATE:_____ _____
DOUG TAYLOR, OWNER
FRONTIERS DESIGN BUILD INC.

Surveyor's Certificate

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE:_____ _____
JOHN S. SCOTT, OLS
VAN HARTEN SURVEYING INC.

Key Plan



Subject Lands

north

SCALE: NTS

Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990, c.P.13 as Amended

A. AS SHOWN	B. AS SHOWN	C. AS SHOWN
D. RESIDENTIAL, PARK, STORMWATER MANAGEMENT, OPEN SPACE, WALKWAY/ TRAIL		
E. AS SHOWN	F. AS SHOWN	G. AS SHOWN
H. MUNICIPAL WATER SUPPLY	I. LOAM/ CLAY LOAM	J. AS SHOWN
K. ALL SERVICES AS REQUIRED	L. AS SHOWN	

Area Schedule

	LOTS/BLOCKS	UNITS	AREA (ha.)	AREA (ac.)
RURAL INDUSTRIAL	1-12	12	6.38	15.77
STORM WATER MANAGEMENT	13		0.30	0.74
OPEN SPACE	14		0.36	0.89
0.3m RESERVE	15		0.001	0.00
ROADS			1.58	3.90
TOTAL	**15**	**12**	**8.26**	**20.41**

Notes

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN
2. CONCEPT PLAN PREPARED BY FRONTIERS DESIGN BUILD INC.

Revision No.	Date	Issued / Revision	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200-540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9 | P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

Approval Stamp	**Date** November 28, 2022
	File No. 22343A
	Plan Scale 1: 1,000 (Arch D)
	Drawn By LC
Project TEVIOTDALE	**Checked By** PC
Applicant 2396584 ONTARIO INC.	**Other** north
File Name DRAFT PLAN OF SUBDIVISION	**Dwg No.** 1 of 1

K:\22343A - TEVIOTDALE, WELLINGTON\DP\DP_28NOVEMBER2022.DWG

APPENDIX B:
PCSWMM MODELLING RESULTS

SWMM MODEL INPUTS

```
[OPTIONS]
;;Option             Value
FLOW_UNITS           CMS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO

START_DATE           10/25/2022
START_TIME           00:00:00
REPORT_START_DATE    10/25/2022
REPORT_START_TIME    00:00:00
END_DATE             10/26/2022
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         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              4

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

```
[RAINGAGES]
;;Name                                    Format    Interval SCF      Source
;;--------------                          --------- -------- -------- ----------
Huff_(0-10_sq._mi.)_Second_quartile_25mm  INTENSITY 0:05     1.0      TIMESERIES Huff_(0-
10_sq._mi.)_Second_quartile_25mm
MtForest_100Yr                           INTENSITY 0:10     1.0      TIMESERIES MtForest_100Yr
MtForest_5Yr                             INTENSITY 0:10     1.0      TIMESERIES MtForest_5Yr

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
;Development site
Site             MtForest_5Yr     NewPond          8.25     70       1100     2        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
Site             0.015      0.25       1.5        5          25         PERVIOUS   100

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
Site             75         12.5       4          7          0

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
;Catch basin on Main Drain connection
Drain59CB        414.48     2.48       0          0          500

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
;Drain elevation at outlet
TeviotdaleDrain  409.8      FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            SurDepth Fevap    Psi
Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- -------- --------
;SWM pond for Site
NewPond          414.85   1.25       0          TABULAR    NewPond                      0        0
```

```
[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
;Improved section of Drain No. 59
MainDrain59      Drain59CB        TeviotdaleDrain  499.806    0.013      0          0          0          0
;Pipe from pond to Drain CB
OutletPipe       NewPond          Drain59CB        20         0.013      0          0.27       0          0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
;Low flow orifice
Orifice          NewPond          Drain59CB        SIDE         0          0.62       NO       0

[WEIRS]
;;Name           From Node        To Node          Type         CrestHt    Qcoeff     Gated    EndCon   EndCoeff
Surcharge  RoadWidth  RoadSurf   Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- -------- ----------
;Overflow weir
Overflow         NewPond          Drain59CB        TRAPEZOIDAL  1          1.82       NO       0        0

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
MainDrain59      CIRCULAR     0.825            0          0          0          1
OutletPipe       CIRCULAR     0.6              0          0          0          1
Orifice          CIRCULAR     0.11             0          0          0
Overflow         TRAPEZOIDAL  0.25             3          5          5

[LOSSES]
;;Link           Kentry     Kexit      Kavg       Flap Gate  Seepage
;;-------------- ---------- ---------- ---------- ---------- ----------

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
NewPond          Storage    0          1650.29
NewPond                     0.05       1679
NewPond                     0.15       1776
NewPond                     0.25       1875
NewPond                     0.35       1976
NewPond                     0.45       2079
NewPond                     0.55       2184
NewPond                     0.65       2291
NewPond                     0.75       2400
```

```
NewPond                    0.85       2511
NewPond                    0.95       2624
NewPond                    1.05       2739
NewPond                    1.15       2856
NewPond                    1.25       2975

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;Huff_(0-10_sq._mi.)_Second_quartile_25mm design storm, total rainfall = 25 mm, rain interval = 5 minutes, rain units =
mm/hr.
;MtForest_100Yr, Chicago design storm, a = 1702.25, b = 9.944, c = 0.8269, Duration = 240 minutes, r = 0.375, rain
units = mm/hr.
;MtForest_5Yr, Chicago design storm, a = 1012.69, b = 8.094, c = 0.8196, Duration = 240 minutes, r = 0.375, rain units
= mm/hr.
```

POST-DEVELOPMENT 25mm QUALITY STORM OUTPUT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
---------------------------------------------------------------

*************
Element Count
*************
Number of rain gages ...... 3
Number of subcatchments ... 1
Number of nodes ........... 3
Number of links ........... 4
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************
                                                  Data       Recording
Name                 Data Source                  Type       Interval
------------------------------------------------------------------------
Huff_(0-10_sq._mi.)_Second_quartile_25mm Huff_(0-10_sq._mi.)_Second_quartile_25mm INTENSITY    5 min.
MtForest_100Yr       MtForest_100Yr               INTENSITY   10 min.
MtForest_5Yr         MtForest_5Yr                 INTENSITY   10 min.


********************
Subcatchment Summary
********************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
------------------------------------------------------------------------------------------------
Site                        8.25   1100.00     70.00    2.0000 Huff_(0-10_sq._mi.)_Second_quartile_25mm NewPond

************
Node Summary
************
                                      Invert      Max.    Ponded    External
Name                 Type              Elev.     Depth      Area    Inflow
------------------------------------------------------------------------
Drain59CB            JUNCTION         414.48      2.48     500.0
TeviotdaleDrain      OUTFALL          409.80      0.82       0.0
NewPond              STORAGE          414.85      1.25       0.0
```

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
MainDrain59	Drain59CB	TeviotdaleDrain	CONDUIT	499.8	0.9364	0.0130
OutletPipe	NewPond	Drain59CB	CONDUIT	20.0	0.5000	0.0130
Orifice	NewPond	Drain59CB	ORIFICE			
Overflow	NewPond	Drain59CB	WEIR			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
MainDrain59	CIRCULAR	0.82	0.53	0.21	0.82	1	1.39
OutletPipe	CIRCULAR	0.60	0.28	0.15	0.60	1	0.43

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
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 10/25/2022 00:00:00
Ending Date 10/26/2022 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 ........ 5.00 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 ......         0.206        25.000
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.095        11.520
Surface Runoff ...........         0.107        13.024
Final Storage ............         0.007         0.788
Continuity Error (%) .....        -1.326

**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.107         1.074
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.095         0.949
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 ......         0.013         0.127
Continuity Error (%) .....        -0.154

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

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

****
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
Site	25.00	0.00	0.00	11.52	16.85	13.02	13.02	1.07	0.69	0.521

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
Drain59CB	JUNCTION	0.05	0.07	414.55	0 01:24	0.07
TeviotdaleDrain	OUTFALL	0.05	0.07	409.87	0 01:24	0.07
NewPond	STORAGE	0.26	0.54	415.39	0 01:20	0.54

****
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
Drain59CB	JUNCTION	0.000	0.018	0 01:20	0	0.95	0.141
TeviotdaleDrain	OUTFALL	0.000	0.018	0 01:24	0	0.949	0.000
NewPond	STORAGE	0.690	0.690	0 00:35	1.07	1.07	0.032

****
Node Surcharge Summary
****
No nodes were surcharged.

****
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
NewPond	0.473	17	0	0	1.018	36	0 01:20	0.018

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
TeviotdaleDrain	98.31	0.011	0.018	0.949
System	98.31	0.011	0.018	0.949

****
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
MainDrain59	CONDUIT	0.018	0 01:24	0.91	0.01	0.08
OutletPipe	CONDUIT	0.000	0 00:00	0.00	0.00	0.45
Orifice	ORIFICE	0.018	0 01:20			1.00
Overflow	WEIR	0.000	0 00:00			0.00

****
Conduit Surcharge Summary
****
No conduits were surcharged.

Analysis begun on: Thu Jun 22 13:34:57 2023
Analysis ended on: Thu Jun 22 13:34:57 2023
Total elapsed time: < 1 sec

POST-DEVELOPMENT 5-YEAR OUTPUT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

*********************
Subcatchment Summary
*********************
Name                        Area     Width    %Imperv    %Slope Rain Gage            Outlet
-----------------------------------------------------------------------------------------------
Site                        8.25   1100.00     70.00    2.0000 MtForest_5Yr         NewPond

**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.364        44.148
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.146        17.666
Surface Runoff ...........         0.216        26.188
Final Storage ............         0.007         0.788
Continuity Error (%) .....        -1.119

**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.216         2.159
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.200         1.997
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 ......         0.016         0.164
Continuity Error (%) .....        -0.125


**************************
Time-Step Critical Elements
**************************
Link OutletPipe (3.59%)
```

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

****
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
Site	44.15	0.00	0.00	17.67	30.31	26.19	26.19	2.16	1.51	0.593

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
Drain59CB	JUNCTION	0.06	0.38	414.86	0 01:56	0.38
TeviotdaleDrain	OUTFALL	0.06	0.38	410.18	0 01:56	0.38
NewPond	STORAGE	0.29	0.61	415.46	0 01:55	0.61

****
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
Drain59CB	JUNCTION	0.000	0.615	0 01:55	0	2	0.381
TeviotdaleDrain	OUTFALL	0.000	0.615	0 01:56	0	2	0.000
NewPond	STORAGE	1.512	1.512	0 01:45	2.16	2.16	-0.273

****
Node Surcharge Summary
****
No nodes were surcharged.

****
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
NewPond	0.531	19	0	0	1.170	41	0 01:55	0.615

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
TeviotdaleDrain	93.81	0.030	0.615	1.997
System	93.81	0.030	0.615	1.997

****
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
MainDrain59	CONDUIT	0.615	0 01:56	2.52	0.44	0.47
OutletPipe	CONDUIT	0.596	0 01:55	2.19	1.37	0.92
Orifice	ORIFICE	0.019	0 01:55			1.00
Overflow	WEIR	0.000	0 00:00			0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
OutletPipe	0.01	0.10	0.01	0.34	0.01

Analysis begun on: Thu Jun 22 13:39:18 2023
Analysis ended on: Thu Jun 22 13:39:18 2023
Total elapsed time: < 1 sec

POST-DEVELOPMENT 100-YEAR OUTPUT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

*******************
Subcatchment Summary
*******************
Name                         Area     Width    %Imperv    %Slope Rain Gage            Outlet
-----------------------------------------------------------------------------------------------
Site                         8.25   1100.00     70.00    2.0000 MtForest_100Yr       NewPond

*************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
*************************     ---------       -------
Total Precipitation ......         0.584        70.844
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.161        19.551
Surface Runoff ...........         0.422        51.133
Final Storage ............         0.007         0.788
Continuity Error (%) .....        -0.886


*************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
*************************     ---------      ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.421         4.213
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.404         4.038
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         0.178
Continuity Error (%) .....        -0.067


***************************
Time-Step Critical Elements
***************************
Link OutletPipe (7.99%)
```

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

****
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
Site	70.84	0.00	0.00	19.55	49.05	51.13	51.13	4.22	2.64	0.722

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
Drain59CB	JUNCTION	0.08	0.51	414.99	0 01:56	0.51
TeviotdaleDrain	OUTFALL	0.08	0.51	410.31	0 01:56	0.51
NewPond	STORAGE	0.33	0.96	415.81	0 01:55	0.96

****
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
Drain59CB	JUNCTION	0.000	0.975	0 01:51	0	4.05	0.201
TeviotdaleDrain	OUTFALL	0.000	0.973	0 01:56	0	4.04	0.000
NewPond	STORAGE	2.639	2.639	0 01:40	4.21	4.21	-0.146

****
Node Surcharge Summary
****
No nodes were surcharged.

****
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
NewPond	0.615	22	0	0	2.042	72	0 01:55	0.975

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
TeviotdaleDrain	94.52	0.078	0.973	4.038
System	94.52	0.078	0.973	4.038

****
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
MainDrain59	CONDUIT	0.973	0 01:56	2.81	0.70	0.62
OutletPipe	CONDUIT	0.952	0 01:51	3.38	2.19	1.00
Orifice	ORIFICE	0.024	0 01:54			1.00
Overflow	WEIR	0.000	0 00:00			0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
OutletPipe	0.11	0.86	0.11	0.94	0.11

Analysis begun on: Thu Jun 22 13:44:16 2023
Analysis ended on: Thu Jun 22 13:44:16 2023
Total elapsed time: < 1 sec