Functional Servicing Report

River's Edge Subdivision
Town of Grand Valley
Draft Plan of Subdivision #22T-12001

GMBP File: 104104

October 2023

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA

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TOWN OF GRAND VALLEY
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1.0 INTRODUCTION

GM Blue Plan Engineering Limited has prepared this Functional Servicing Report to address the site servicing and stormwater management requirements for the site in support of the Draft Plan of Subdivision prepared by GSP Group.

The proposed development is located in the northeast end of Grand Valley, adjacent to the Grand River. **Figure 1** shows the location of the proposed development and the surrounding area. The boundaries of the development include the Grand River to the north and east, an existing wetland to the southeast, Highway No. 25 and existing residential development to the west, and Scott Street and residential lands to the south. The applicant owns additional lands on the north side of the Grand River, which are not included in the current development.

2.0 EXISTING CONDITIONS

3.1 Land Use

Under existing conditions, the northerly portion of the site is used for agricultural purposes while the southerly portion was used for aggregate extraction. The areas formerly used for aggregate extraction are no longer in production. The easterly portion of the site consists mainly of wooded areas and slope towards the Grand River.

The lands to the west and south of the site have been developed as residential lands consisting of mostly single family housing. An existing townhome condominium block is located southeast of the site. The Grand River borders the site at the westerly property boundary followed by additional wooded areas and agricultural lands further west of the Grand River.

3.2 Topography

Topography across the site varies, with grades ranging from 4% to in excess of 15% along the banks adjacent to the Grand River. There is approximately 25m of fall across the site in the northwest to southeast direction. The site elevation ranges from approximately 481m at the northwest end of the site then falls to about 455m towards the easterly and southeasterly portions of the site.

The majority of the site drains overland in the easterly direction towards the Grand River. The central portion of the site drains in the easterly direction to an existing wetland located at the southeast portion of the site ultimately discharging to the Grand River. Flows exceeding the capacity of the wetland will then sheetflow in the easterly direction to the Grand River.

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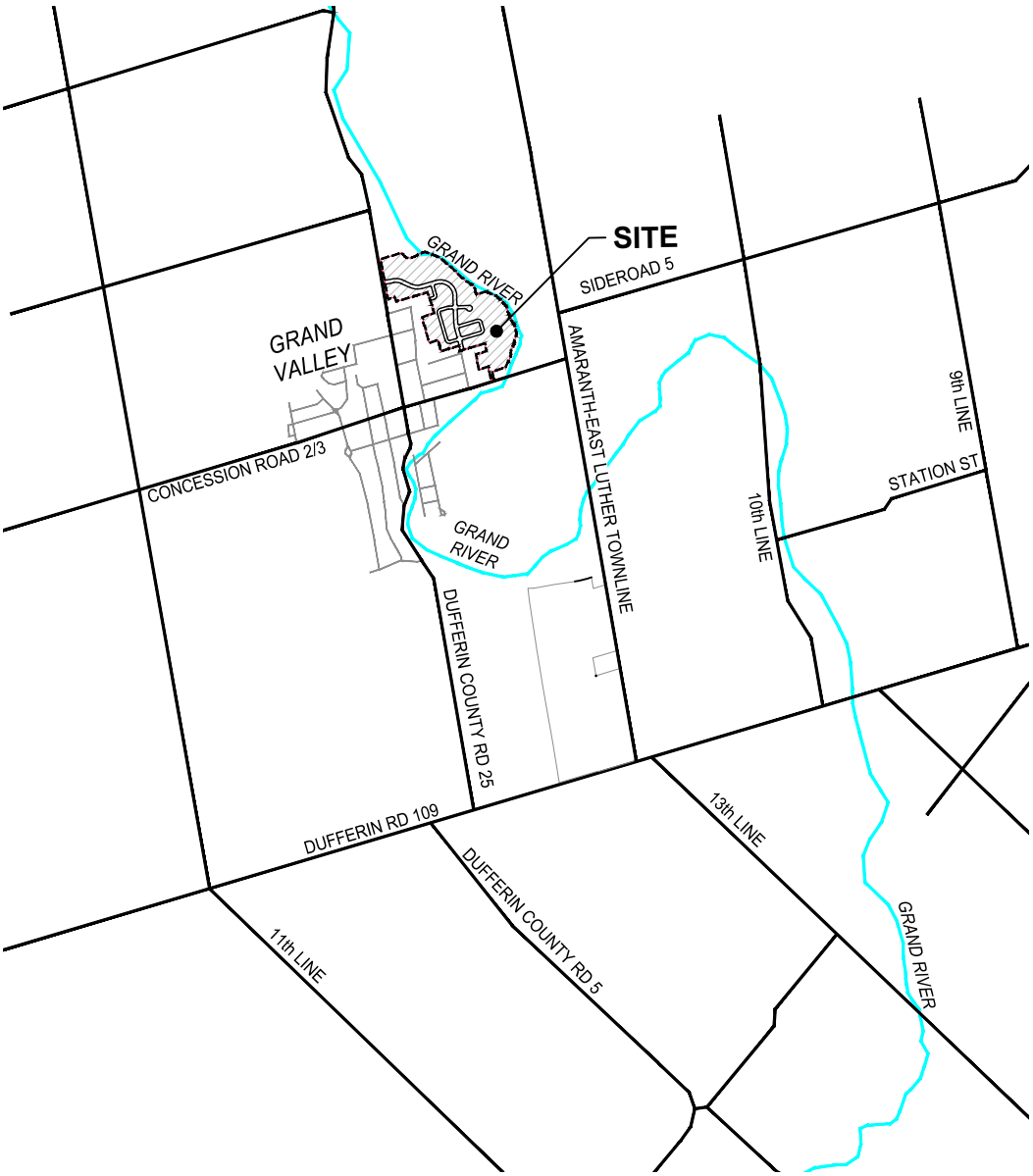
FUNCTIONAL SERVICING REPORT



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LEGEND

---------- PROPOSED SUBDIVISON

SITE LOCATION

Figure No. 1

BluePlan ENGINEERING

104104
SEPTEMBER 2023
Scale: 1:50,000 | NAD 1983 UTM Zone 17N

FILE:W:\Guelph\104-2004\104104\5 Work In Progress\Drafting\SHEETS\FIGURES\104104-SiteLocation.dwg LAYOUT:SITE LOCATION PLAN
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3.3 Soils

Peto MacCallum Ltd. completed a geotechnical investigation of the property in April 2009 followed by a slope assessment report in 2012. Based on the 2009 geotechnical investigation, there appears to be between 600 and 800mm of topsoil at the north and west portions of the site and close to 200mm thick topsoil towards the easterly portion of the site. The subsurface site soils consist of a mix of clayey silt till, sand and gravely sand deposits. The clayey silt till materials are found predominantly at the north end of the property while the sands and gravels are found towards the southerly end.

JLP Services Inc. completed a follow-up geotechnical investigation at the southerly end of the site in 2022. Based on the JLP report, the topsoil layer at the southernly end of the site ranges between 50 to 900mm at boreholes MW1, MW2 and MW3. Subsurface topsoil buried at a depth of 2.4m and 0.3m was encountered at boreholes MW3 and MW4 respectively. Deposits of loose to compacted fill have also been encountered at boreholes MW1, MW3 and MW4. The fill consists of sandy silts, some gravel, trace clay and some organics. It is recommended that the areas of buried topsoil be removed and replaced with engineered fill and the areas of loose fill be excavated, placed and compacted.

Both the Peto MacCallum and JLP geotechnical investigations recommend an impermeable liner for the proposed stormwater management facility construction due to the high permeability of the site soils at the proposed stormwater management facility location. The JLP investigation recommends a minimum 1m thick clay liner or approved equivalent synthetic liner. Furthermore it is noted that the clay liner could be constructed form some of the clayey till material on site.

Copies of the slope assessment report by Peto MacCallum (2012) and geotechnical investigations by Peto MacCallum (2009) and JLP Services Inc. (2022) are included in **Appendix A.**

3.4 Groundwater

As a component of the geotechnical investigation, Peto MacCallum Ltd. installed groundwater monitoring wells in three of the nine boreholes.

Initial readings taken from the three monitoring wells showed groundwater measurements below the bottom of the well (>5.05m below ground surface) at Borehole 3 located at the north end of the site, groundwater approximately 4.8 metres below ground surface at Borehole 4 located at the center of the site and groundwater approximately 1.1 metres below ground surface at Borehole 9 located at the southeasterly portion of the site.

JLP Services installed monitoring wells in each of the four boreholes as part of the 2022 geotechnical investigation. MW4 located at the southeast portion of the site, south of Scott Street was dry (groundwater level >3.1m below ground surface), while MW1, MW2 and MW3 located north of Scott Street showed groundwater water levels at 6m, 3m and 6m below ground surface, respectively.

Additional details regarding groundwater elevations are included in the geotechnical investigations by Peto MacCallum (2009) and JLP Services Inc. (2022) in **Appendix A.**

GM BluePlan Engineering Limited has been recording groundwater elevations to capture the seasonal high groundwater levels across the site. From 2009 to 2015, manual groundwater readings have been recorded at BH 3, 4 and 9. In 2022, dataloggers have been installed to record the groundwater elevations at BH 3, 4 and 9 as well as MW 1 to 4 and MH 101 to 103. Hydrographs showing the groundwater readings as of Fall 2023 are included in **Appendix B**.

3.0 PROPOSED DEVELOPMENT

The proposed development generally consists of single family and semi-detached lots, a townhome block, apartment block, two park blocks, open space areas, internal roadways and a stormwater management block. **Figure 2**, illustrates the proposed Draft Plan of Subdivision prepared by GSP Group.

An extension of Bielby Street from Scott Street to Highway No. 25 will form the main connection for this development. A third road connection to the existing road network will be provided by extending Luther Road from the existing cul-de-sac to the Bielby Street extension.

As illustrated on the Draft Plan of Subdivision, a pedestrian walkway connection has been provided from Crozier Street to the proposed park block.

3.1 Site Grading

The site grading for the proposed residential lots, open spaces, internal roads and stormwater management facilities is shown on the Preliminary Grading Plans. The grade and elevation of the internal streets is controlled by the elevation of the sanitary sewer outlet and existing roadway elevations at Main Street, Scott Street and Luther Road.

The proposed site grading will match the existing elevations along the west, north and southerly property limits. At the easterly portions of the site, the proposed development will match the existing elevations along the existing woodlot and Grand River Floodplain.

Internal roadways are graded with slopes ranging from 0.5% to 5%, while lots are generally graded with slopes ranging from 2% to 6% per the Town of Grand Valley Engineering Standards. 3:1 transition slopes are proposed in rear yard areas of deeper lots to accommodate the grade relief across the site. Due to the high elevation differential across the site, retaining walls are proposed in areas where transition slopes into existing ground elevations would exceed the maximum allowable grade of 3:1.

It is noted that some of the walkout lots located along the easterly site perimeter may have basements taller than the standard 2.43m (8') to provide larger elevation differential across the lots and mitigate the height and locations of 3:1 transition slopes and retaining walls.

3.2 Streets

The internal roadways will be constructed as an urban cross section complete with concrete curb and gutter. The Luther Road extension, Street A, B and C are considered local roads and will be constructed using the Town of Grand Valley standard 20m wide urban cross section, while Bielby Street is considered a collector road and will constructed using a 26m wide urban cross section.

Concrete sidewalks, with a 1.5 metre width, will be constructed per Town of Grand Valley standard cross-section.

3.3 Water Supply

The proposed development will be serviced with three watermain connections to the existing municipal watermain system. Connections will be made at the following locations; existing 200mm diameter watermain on Bielby Street at Scott Street, 150mm diameter watermain at the Luther Road Cul-de-sac and 300mm diameter watermain on Highway 25. It is anticipated that the existing 300mm diameter watermain on Highway 25 will be extended in the northerly direction from its current terminus at the existing water tower to the Highway 25 and Bielby Street intersection.

A 200mm diameter watermain will be extended through the site along Bielby Street from Scott Street to Highway 25. The remainder of the watermain sizes on internal roadways will be 150mm in diameter.

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RIVER'S EDGE SUBDIVISION
TOWN OF GRAND VALLEY

FUNCTIONAL SERVICING REPORT

DRAFT PLAN OF SUBDIVISION

Figure No. 2

104104
SEPTEMBER 2023
Scale: N.T.S. | NAD 1983 UTM Zone 17N

DRAFT PLAN OF SUBDIVISION

THOMASFIELD HOMES
RIVER'S EDGE

PART OF LOT 31, CONCESSION 3
GEOGRAPHIC TOWNSHIP OF EAST LUTHER
(VILLAGE OF GRAND VALLEY)
REGISTERED PLAN 114
ALL OF BLOCK C
TOWN OF GRAND VALLEY
COUNTY OF DUFFERIN

OWNER'S CERTIFICATE

I AUTHORIZE THE GSP GROUP INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECT, I SHOWN.

Tom Kitsiem
Atlas Glen Developments Limited

DATE

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECT, I SHOWN.

Jamros, M. Limins
Ontario Land Surveyor

DATE

ADDITIONAL INFORMATION
(UNDER SECTION 51(17) OF THE PLANNING ACT)

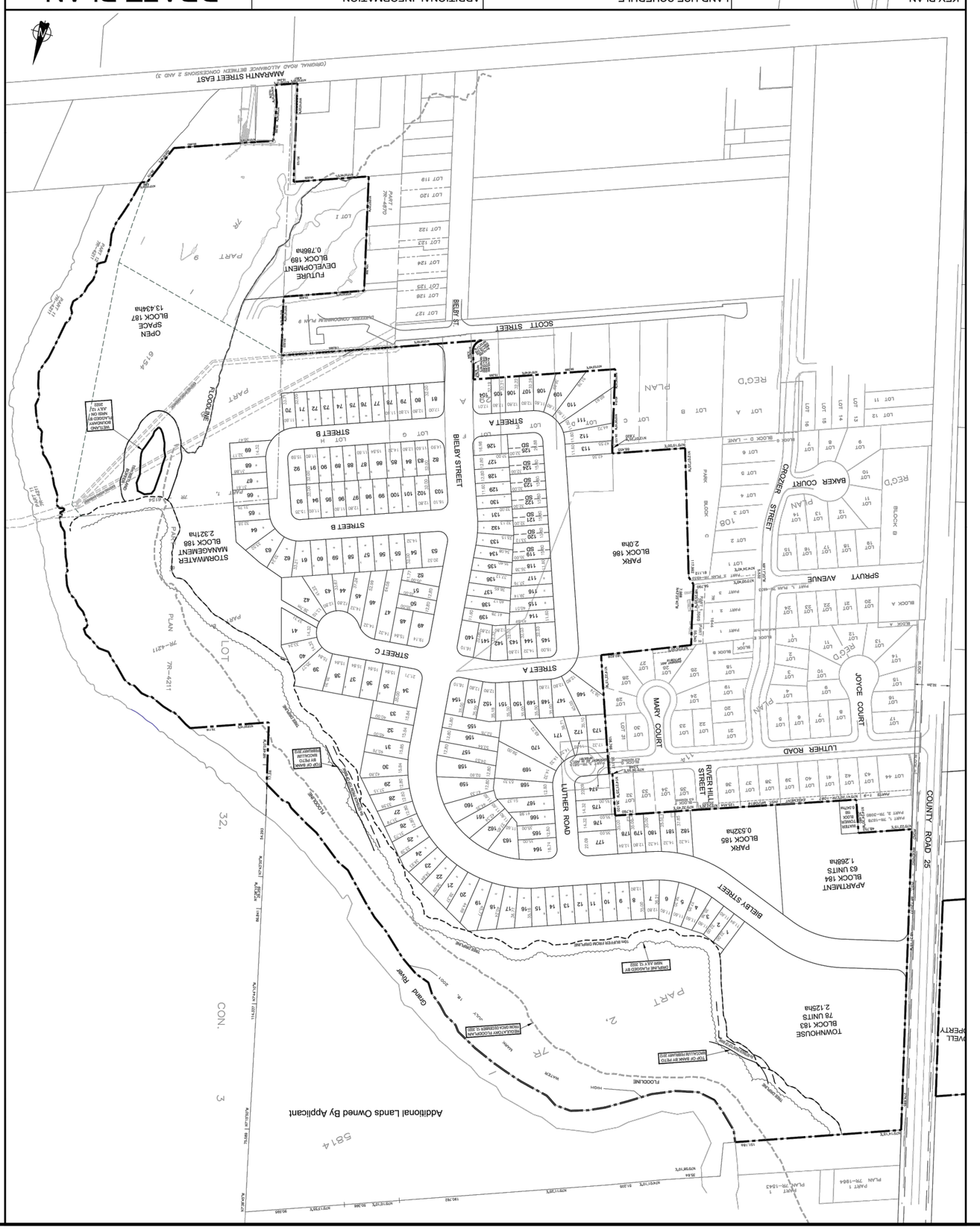
INFORMATION REQUIRED BY CLAUSES a,b,c,d,e,f,g,j and i ARE AS SHOWN ON THE DRAFT PLAN.

h) Municipal water supply
i) Silt, Clayey Silt TILL (Gravel, Clayey Silt, Sand, Unsubdivided Silt
k) All sanitary and storm sewers as required

LAND USE SCHEDULE

DESCRIPTION	LOTS /BLOCKS	UNITS	AREA (ha)
SINGLE DETACHED LOTS			9.271
11.6m	108-118, 129-139, 160-163	54	
12.8m	7-29, 42-44, 50-51, 79-81, 84, 97-107, 126-128, 140-143, 146-158, 166-168, 178-179	71	
14.32m	40-41, 45-47, 64-69, 85, 144-145, 169-172, 175-176, 180-182	34	
15.64m	30-39, 48-53, 86, 174, 177	16	
SEMI DETACHED	119-125	14	0.723
TOWNHOUSES	183	78	2.128
APARTMENT	184	63	1.268
PARK	185-186		2.542
OPEN SPACE	187		13.434
STORMWATER MANAGEMENT	188		2.321
FUTURE DEVELOPMENT	189		0.786
TO BE ADDED TO WATER TOWER	190		0.047
ROADS			4.425
TOTAL	190	330	36.568ha

KEY PLAN
N.T.S.



REVISIONS

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A 25mm diameter water service lateral will be provided for each dwelling. Fire hydrants are proposed to be placed at a minimum distance of 100m to provide fire protection, in accordance with Town Standards.

RJ Burnside and Associated Ltd. prepared a Master Servicing Plan update for the Town of Grand Valley in 2014. The Master Servicing Plan update identified water distribution system improvements required by the projected 2031 buildout. It is noted that flows from the subject property and other greenfield developments within the Town's urban boundary are included in this study along with proposed intensification to the existing developed areas. It is anticipated that the Town will grow from the 2011 population of 1,482 persons to 6,145 persons by 2031.

The following items are identified to be upgraded by the projected 2031 buildout:

- The current water tower has a capacity of 1,600m^3 and would need to be expanded by 1,732m^3 for a total volume of 3,332m^3 to meet the additional storage demands. A 0.047ha block has been allocated on the Draft Plan of Subdivision to accommodate the water tower expansion.
- Upgrades to the existing water supply system to increase the firm capacity (well supply capacity with the largest well out of service) from 1,963m^3/d to 3,792m^3/d.

The Master Servicing Plan recommends commencing the upgrades when the current needs exceed 80% of the water distribution system capacity (population reaches 2,900 people). The Class EA for the water supply and storage expansions should be initiated sooner, roughly when the population reaches 2,300 people to allow for processing time.

3.4 Sanitary Sewer

The proposed development will be serviced by a gravity sanitary sewer system connecting to the existing 200 mm diameter sanitary sewer on Bielby Street at the Scott Street intersection. Preliminary sizing indicates that a 200 mm diameter sanitary sewer will provide sufficient capacity for the River's Edge Subdivision. Each dwelling will be serviced via a proposed 125mm diameter sanitary lateral per Town of Grand Valley Standards.

As noted in the section above, RJ Burnside and Associated Ltd. prepared a Master Servicing Plan update for the Town of Grand Valley in 2014. The Master Servicing Plan update identified wastewater collection and treatment system improvements required by the projected 2031 buildout.

The following items are identified to be upgraded by the projected 2031 buildout.

- The Existing Water Pollution Control Plant (WPCP) has been designed for an average flow of 1,244m^3/d to service an average population of 2,950 persons. It is anticipated that by the 2031 buildout, the total WPCP capacity could be expanded to 2,547m^3/d to service a population of 6,050 people.
- Sewers on Emma Street, Mill Street, Ponsford Street, Amaranth Street and Leeson Street are generally identified to be increased in diameter by one pipe size. The existing sewers are noted to be over capacity by less than 8%. It is noted that the upsizing of the sanitary sewer on Emma Street is currently under construction.
- The Emma Street sanitary pumping station peak flow is estimated to be 106L/s which exceeds the current capacity of 89L/s/

The above noted upgrades would require a Scheduled EA. The Master Servicing Plan recommends assessing the capacity of the wastewater system on an annual basis and initiating the required EA processes well in advance of need just in case if there are any delays.

3.5 Storm Sewer

The storm sewer system on the internal local roads (20m right-of-way) will be sized to convey the 5-year design storm while the storm sewers on collector roads (i.e. Bielby Street – 26m right-of-way) will be sized to convey the 10-year design storm to the stormwater management facility. Major storm events will be conveyed overland through the municipal right of ways to the stormwater management facility.

The stormwater management facility will outlet to the Grand River.

A 150mm diameter storm service is proposed to be installed to each residential unit to provide gravity foundation drainage for the proposed development. Sump pumps are proposed for lots where a gravity foundation connection is not possible – the sump pump will pump the foundation drainage to the storm sewer service lateral. Lots requiring sump pumps will be identified on the preliminary grading and servicing drawings.

150mm diameter subdrains are proposed to be constructed under the curb for the full length of the roadway per Town of Grand Valley Engineering Standards.

4.0 STORMWATER MANAGEMENT CRITERIA

The studies, policies and guidelines used to develop the stormwater management plan are as follows:

1) The Stormwater Management Practices Planning and Design Manual, 1994
2) Stormwater Management Planning and Design Manual, 2003
3) The Interim Stormwater Quality Control Guidelines, 1991
4) The Stormwater Quality Best Management Practices Manual, 1991
5) The MTO Drainage Management Technical Guidelines, 1989
6) The Ontario Urban Drainage Design Guidelines, 1987

The stormwater management criteria for the River's Edge Subdivision, are as follows:

1) Post-development runoff generated from site is to be directed to the Grand River. Due to the proximity of the site to the Grand River and to limit the impact of coincidental peak flows from upstream developments, stormwater management quantity controls for the subject property are not required.
2) Provide Enhanced level of quality control (80% Total Suspended Solids (TSS) removal) from all runoff discharging from the site.
3) Major storm flows are to be routed overland to an appropriate outlet.

The method used to evaluate and design the stormwater management plan is as follows:

A three-hour duration rainfall event was used to generate the mass rainfall data required to model the 2, 5 and 100-year design storms. The Fergus Shand Dam Chicago parameters and the total depth of rainfall for each storm are shown below in **Table 1**.

Table 1: Fergus Shand Dam - Chicago Storm Parameters

	2 Year	5 Year	100 Year
a =	695.047	1459.072	6933.019
b =	6.387	13.690	34.699
c =	0.793	0.850	0.998
r =	0.380	0.380	0.380
t_d =	180.00	180.00	180.00
Rainfall depth (mm)	33.01	49.79	97.92

The Regional Storm (Hurricane Hazel) was also modelled.

The Horton infiltration method was used in the runoff calculations summarized in **Table 2**.

From the Ontario Soil Surveys, Report No. 38, Dufferin County, the soils on site are described as Huron Loam and Burford Loam. The hydrologic soil classifications for these soils are BC and AB, respectively.

The Geotechnical Investigation completed by Peto MacCallum Ltd. (2009) classified the surficial soils as consisting primarily of clayey silt tills with sand and gravel deposits. Due to the relatively poor drainage capacity of clayey silt tills, the Horton Infiltration parameters for a Type D soil have been used in the analysis of the stormwater management system. The typical maximum infiltration rate for a hydrologic Type D soil is 75 mm/hour, as per the MTO Drainage Management Manual.

Table No. 2: MIDUSS Horton Parameters

	Impervious Areas	**Pervious Areas**
Maximum Infiltration	0.0 mm/hr	75.0 mm/hr
Minimum Infiltration	0.0 mm/hr	5.0 mm/hr
Lag Constant	0.05 hr	0.25 hr
Depression Storage	1.5 mm	5.0 mm

The hydrologic model MIDUSS was used to create the runoff hydrographs and to route the flows through the storage structure.

5.0 STORMWATER MANAGEMENT PLAN

5.1 Pre-Development Conditions

For pre-development conditions analysis purposes, the site was modelled as eight (8) drainage catchments. Four (4) out of the eight (8) drainage catchments represent the subject site while the remaining four (4) represent external areas draining through the site. The pre-development condition drainage catchments are shown on **Figure 3** and described below. The existing conditions MIDUSS computer modelling is attached in **Appendix C**.

Internal Catchments:

Catchment 100 (4.92 hectares, 0% impervious) represents the north-westerly portion of the site. Runoff generated from Catchment 100 sheetflows overland in the northerly direction to the Grand River.

Catchment 101 (8.49 hectares, 0% impervious) represents the north-easterly portion of the site. Runoff generated from Catchment 101 sheetflows overland in the easterly direction to the Grand River.

Catchment 102 (8.68 hectares, 1% impervious) represents the central portion of the site. Runoff generated from Catchment 102 sheetflows overland to an existing wetland located in the southeast corner of the site then ultimately to the Grand River.

Catchment 103 (6.33 hectares, 0% impervious) represents the southern portion of the site. Runoff generated from Catchment 103 sheetflows overland to the Grand River.

External Catchments:

Catchment 104 (2.60 hectares, 55% impervious) represents the existing development on Scott Street. The storm sewer on Scott Street discharges into the site, north of Bielby Street. Runoff from Catchment 104 discharges overland through the site to the Grand River.

Catchment 105 (0.67 hectares, 55% impervious) represents rear yard areas from the existing residential lots located along the north side of Luther Road and the existing water tower site. Runoff generated from Catchment 105 sheetflows overland through the site to the Grand River.

Catchment 106 (1.09 hectares, 55% impervious) represents existing Mary Court and easterly part of Luther Road. The existing storm sewer on Luther Road conveys runoff from the eastern half of Luther Road and Mary Court and discharges to the site at the east end of Luther Road. The drainage area contributing to the storm sewer has been included in Catchment 106. Runoff generated from Catchment 106 sheetflows overland through Catchment 102 to an existing wetland located in the southeast corner of the site then ultimately to the Grand River.

Catchment 107 (3.55 hectares, 55% impervious) represents the existing drainage from the lots on Crozier Street and Baker Court. Runoff generated from Catchment 107 is being discharged overland through the site, to the Grand River.

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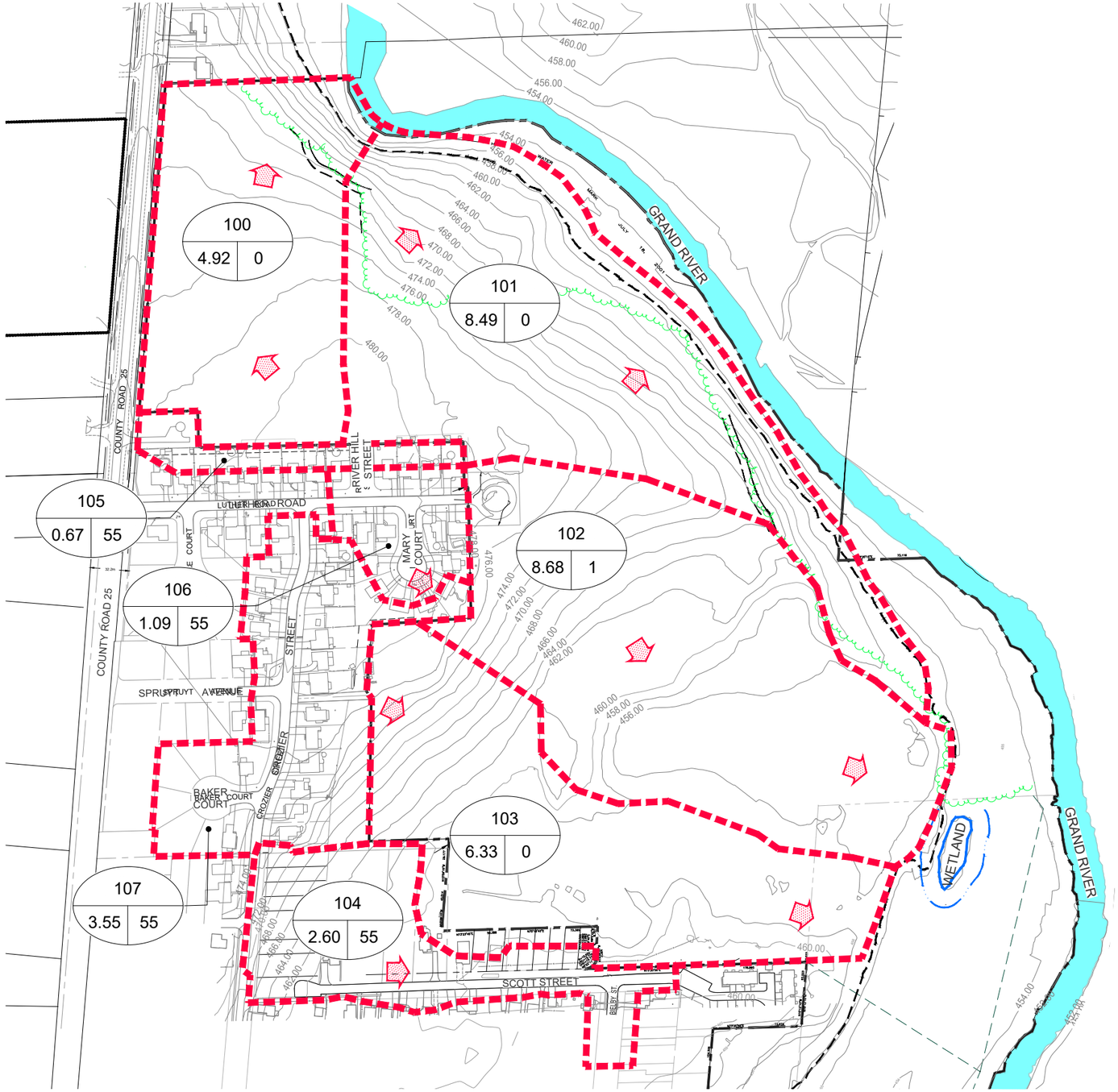
RIVER'S EDGE SUBDIVISION
TOWN OF GRAND VALLEY

FUNCTIONAL SERVICING REPORT



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LEGEND

104 — CATCHMENT NUMBER

AREA IN HECTARES — 2.86 | 55 — PERCENT IMPERVIOUS

CATCHMENT BOUNDARY

EXISTING OVERLAND FLOW ROUTE

460.00 — EXISTING GROUND CONTOURS

PRE DEVELOPMENT DRAINAGE PLAN

Figure No. 3

BluePlan ENGINEERING

104104
SEPTEMBER 2023
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Table 3 lists the flow rates discharging from each catchment under pre-development conditions.

Table 3: Pre-Development Condition Flow Rates

	2-Year	5-Year	100-Year	Regional Storm
Catchment 100	0.042	0.294	1.192	0.538
Catchment 101	0.093	0.610	2.442	0.896
Catchment 102	0.061	0.439	1.891	0.950
Catchment 103	0.059	0.404	1.633	0.686
Catchment 104	0.300	0.405	0.730	0.282
Catchment 105	0.072	0.104	0.233	0.078
Catchment 106	0.125	0.169	0.301	0.117
Catchment 107	0.397	0.544	0.948	0.371
Total Flow Rate	**0.935**	**2.172**	**8.805**	**3.839**

5.2 Post-Development Conditions

For post-development analysis purposes, the site was modelled as eleven (11) drainage catchments. The proposed stormwater management facility is designed to have three (3) inlets. Inlet 1 is located at the south portion of the facility accepting flows from Bielby Street, Inlet 2 is located midway though the facility accepting flows from Street B and Inlet 3 is located at the northerly end of the facility accepting flows from Street C. The post-development drainage catchments are shown on **Figure 4** and described below. The post-development MIDUSS computer modelling is attached in **Appendix D.**

Catchments discharging to Inlet 1 (Bielby Street):

Catchment 204 (2.09 hectares, 10% impervious) represents the proposed park block fronting Street A. Runoff generated from Catchment 204 will be directed to the proposed stormwater management facility Inlet 1.

Catchment 205 (4.32 hectares, 65% impervious) represents the southwestern portion of the proposed development. Runoff generated from Catchment 205 will be directed to the proposed stormwater management facility Inlet 1.

Catchment 301 (2.60 hectares, 55% impervious) represents the existing development on Scott Street. The storm sewer on Scott Street discharges to the proposed stormwater management facility at the Inlet 1 location.

Catchment 303 (3.55 hectares, 55% impervious) represents the existing drainage from the lots on Crozier Street and Baker Court. Runoff will be conveyed through the site to the proposed stormwater management facility Inlet 1.

Catchments discharging to Inlet 2 (Street B):

Catchment 203 (2.76 hectares, 60% impervious) represents the southeastern portion of the proposed development. Runoff generated from Catchment 203 will be directed to the proposed stormwater management facility Inlet 2.

Catchments discharging to Inlet 3 (Street C):

Catchment 201 (4.28 hectares, 90% impervious) represents the townhome and apartment blocks located at northwestern portion of the proposed development. Runoff generated from Catchment 201 will be directed to the proposed stormwater management facility Inlet 3.

Catchment 202 (4.15 hectares, 60% impervious) represents the northeast portion of the proposed development. Runoff generated from Catchment 202 will be directed to the proposed stormwater management facility Inlet 3.

Catchment 302 (0.67 hectares, 55% impervious) represents rear yard areas from the existing residential lots located along the north side of Luther Road and the existing water tower site. Runoff generated from Catchment 202 will sheetflow to the apartment block followed from which it will be directed to the proposed stormwater management facility Inlet 3 via the proposed storm sewer system and roadway network.

Catchment 304 (1.09 hectares, 55% impervious) represents existing Mary Court and parts of Luther Road. The existing storm sewer on Luther Road will be connected to the proposed storm sewer system on site. Runoff generated from Catchment 304 will be directed to the proposed stormwater management facility Inlet 3.

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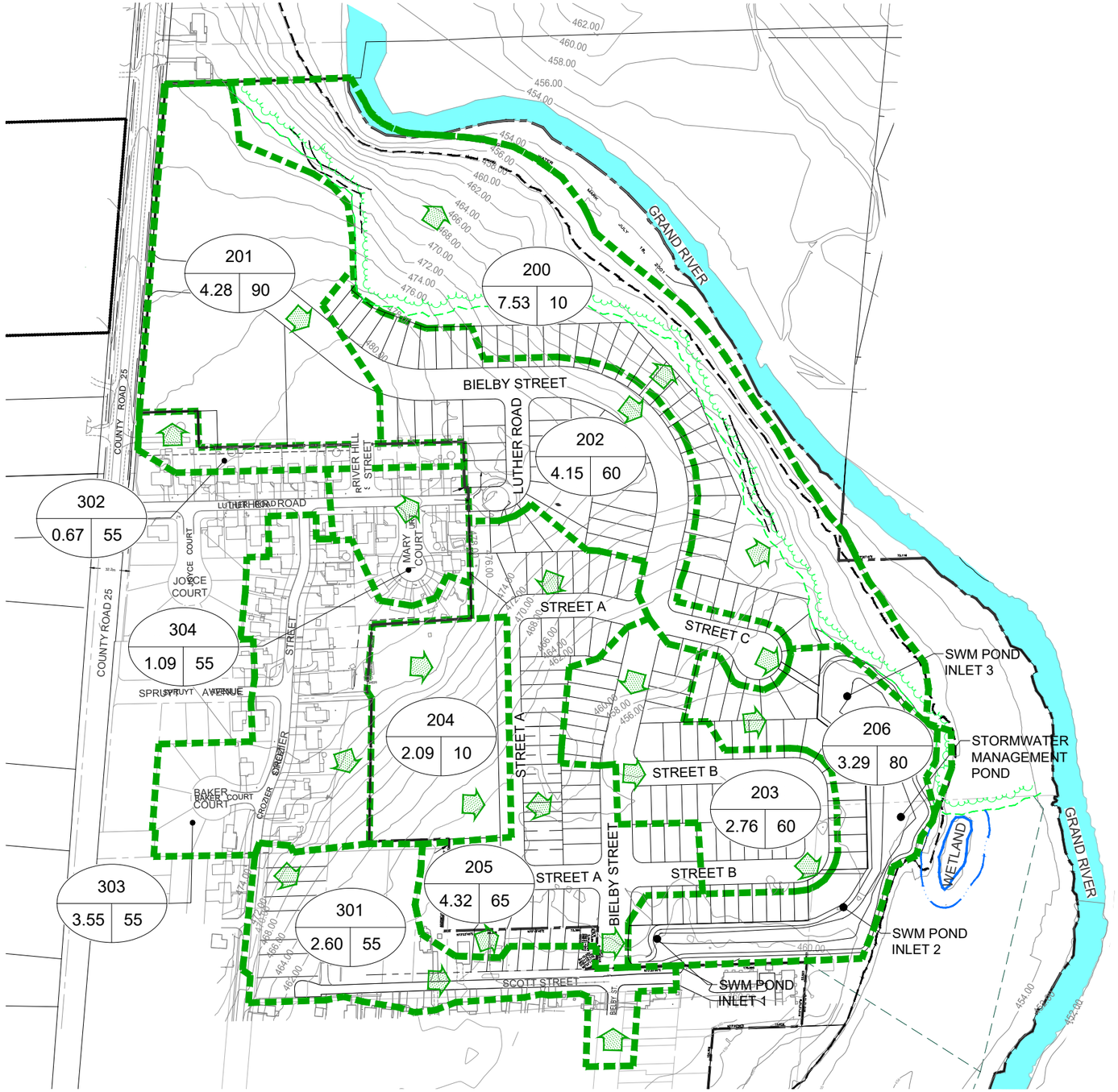

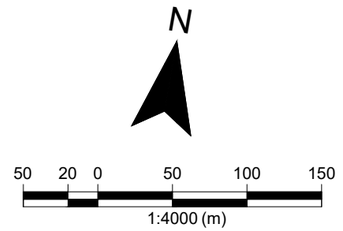

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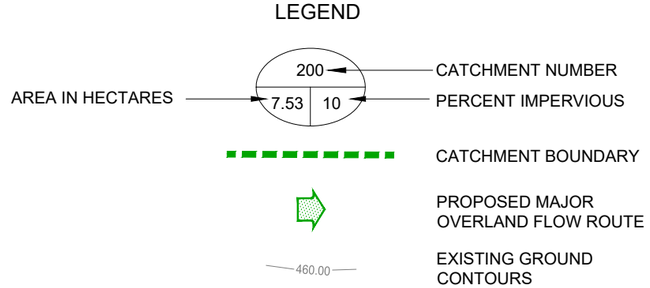

POST DEVELOPMENT DRAINAGE PLAN

Figure No. 4

BluePlan ENGINEERING

104104
SEPTEMBER 2023
Scale: 1:4000 | NAD 1983 UTM Zone 17N

Catchments discharging directly to the Grand River:

Catchment 200 (7.53 hectares, 10% impervious) represents the proposed open space block and rear yard areas of the lots fronting onto Bielby Street. Runoff generated from Catchment 200 will be sheetflow to the Grand River. Runoff generated form this catchment is considered clean water as the catchment area consists of building rooftops and vegetated areas.

Catchment 206 (3.29 hectares, 80% impervious) represents the proposed stormwater management facility and rear yard areas from Streets B and C. The proposed stormwater management facility is designed to provide the required Enhanced level of protection prior to discharging to the Grand River. The stormwater management facility will outlet to a linear dispersion trench which will spread the flows over a wide area, preventing a point source discharge, and will direct a portion of the flow to the existing wetland while directing the remaining flows to the Grand River.

Table 4 lists the post-development uncontrolled flow rates for each catchment under the 2, 5 and 100-year design storms.

Table 4: Post-Development Uncontrolled Flow Rates

	2-Year	5-Year	100-Year	Regional Storm
Catchment 200	0.162 m^3/s	0.437 m^3/s	1.746 m^3/s	0.809 m^3/s
Catchment 201	0.783 m^3/s	1.019 m^3/s	1.688 m^3/s	0.512 m^3/s
Catchment 202	0.511 m^3/s	0.695 m^3/s	1.195 m^3/s	0.447 m^3/s
Catchment 203	0.323 m^3/s	0.462 m^3/s	0.979 m^3/s	0.325 m^3/s
Catchment 204	0.043 m^3/s	0.103 m^3/s	0.433 m^3/s	0.225 m^3/s
Catchment 205	0.587 m^3/s	0.788 m^3/s	1.353 m^3/s	0.485 m^3/s
Catchment 206	0.550 m^3/s	0.732 m^3/s	1.198 m^3/s	0.389 m^3/s
Catchment 301	0.300 m^3/s	0.405 m^3/s	0.730 m^3/s	0.282 m^3/s
Catchment 302	0.072 m^3/s	0.104 m^3/s	0.233 m^3/s	0.078 m^3/s
Catchment 303	0.397 m^3/s	0.544 m^3/s	0.948 m^3/s	0.371 m^3/s
Catchment 304	0.125 m^3/s	0.169 m^3/s	0.301 m^3/s	0.117 m^3/s
Total Flow Rate	**3.852 m^3/s**	**5.256 m^3/s**	**9.788 m^3/s**	**3.853 m^3/s**

5.3 Stormwater Management Overview

In line with current practices and guidelines, the stormwater management approach for the River's Edge Subdivision is designed as a "treatment train" to remove sediments and any absorbed contaminants prior to the discharge of runoff from the development to the receiving outlets. The "treatment train" approach will include a combination of lot level, conveyance and end-of-pipe best management practices and is proposed to filter and remove sediments from stormwater runoff prior to discharging to the Grand River and existing wetland.

Due to the proximity of the Grand River, the stormwater management facility is designed to route runoff volumes that exceed the water quality volumes through the pond as quickly as possible. This will ensure the peak flows from the development are discharged and routed along the Grand River prior to peak flows from upstream lands.

Lot Level Controls

Stormwater management practices recommended for providing lot level controls on this site are as follows:

a) Roof Drainage to Ground Surface

The lots will drain to the street. The roof runoff will be filtered across the grassed surface. The runoff for any event large enough to generate flow to the swale system will be adequately filtered by the grass.

b) Rear Yard Swales

The grading of the lots will be to current Town of Grand Valley standards. Where practical, the length of the rear lot swales between catch basins will be increased to extend the contact time with the grassed surfaces.

To promote more infiltration on the lots and in the swales, it is recommended that the average depth of graded topsoil be 300 mm.

c) Foundation Drainage

Gravity connections from the foundation drainage to the storm sewer system are recommended wherever possible per Town of Grand Valley standards. Inlet restrictions will ensure that during the full range of design events, flows in the storm sewer system will not surcharge to the elevation of the foundation drains. Sump pumps are proposed for lots where a gravity foundation connection is not possible – the sump pump will pump the foundation drainage to the storm sewer lateral. Lots requiring sump pumps will be identified on the preliminary grading and servicing drawings.

Conveyance Controls

Conveyance controls will be achieved through municipal maintenance of the storm sewer system. The regular cleanout of the manholes, catch basins and oil/grit structures will remove the heavier sediments deposited from the runoff during storm events.

Oil/grit separators have been designed and sized to pre-treat the runoff from the proposed development prior to discharging to the stormwater management facility. Oil/grit separators will be installed within the proposed development at each of the three pond inlets (Inlet 1 – Bielby Street, Inlet 2 – Street B and Inlet 3 – Street C). The pre-treatment of stormwater runoff will remove larger particles and reduce the frequency with which the facility requires remediation due to sediment build-up.

End of Pipe Facilities

The end-of-pipe component consists of the proposed stormwater management facility located near the south-easterly edge of the property adjacent to the Grand River. The stormwater management facility will outlet to a linear dispersion trench which will spread the flows over a wide area preventing a point source discharge and will direct a portion of the flow to the existing wetland while directing the remaining flows to the Grand River. The proposed stormwater management facility has been designed as wetland type facility complete with three forebays and a 0.3m deep permanent pool to provide the required water quality controls. The proposed outlet structure is designed to provide extended detention of the required water quality storage volumes as per the Ministry of Environment 2003 Stormwater Management Planning and Design Manual.

5.4 Proposed Stormwater Management Facility

Water Quality

The proposed stormwater management facility has been designed to function as a wetland. From Table 3.2, Stormwater Management Planning and Design Manual, 2003, in order to provide Enhanced water quality treatment, a wetland facility requires 115 m³/ha of storage volume for a contributing drainage area that is 65% impervious. 40 m³/ha of the required storage volume is extended detention volume, while the remaining 75 m³/ha is permanent pool.

The quality control drainage area was sized based on the development areas provided in the Draft Plan of Subdivision. The table below summarizes the development areas which contribute flows to the proposed stormwater management facility.

Table 5: Development Areas Contributing Flow to the Stormwater Management Facility

Land Use	Area (ha)	% Impervious
Single Detached Lots	9.271	60.0%
Semi Detached	0.373	70.0%
Townhomes	2.125	90.0%
Apartment	1.268	90.0%
Park	2.532	10.0%
Stormwater Management	2.321	50.0%
To be added to Water Tower	0.047	50.0%
Roads	4.425	80.0%
Total	**22.362**	**62.0%**

Please note that Open Space Block 187 and Future Development Block 189 are not included in the above calculation as the open space area drains directly to the Grand River and the future development block is located downstream of the stormwater management facility and is assumed to have it's own stormwater management system at the time of development.

Based on a contributing site area of 22.362 hectares and a requirement for 75m³/ha of permanent pool storage volume to achieve Enhanced treatment, the required permanent pool storage is 1,677m³.

The external drainage areas that discharge to the site such as existing developments on Luther Road, Mary Court, Baker Court, Crozier Street and Scott Street are not included in the water quality calculations for the proposed stormwater management facility and will be conveyed through the facility to the Grand River.

The proposed stormwater management facility has been designed with a 0.3 metre deep permanent pool, which provides 1,788m³ of permanent pool volume. Additional permanent pool volume of 962m³ will be provided in the three (3) sediment forebays created at each pond inlet for a total permanent pool volume of 2,750m³.

Oil/grit separators located upstream of the pond inlets have been sized to pre-treat runoff prior to entering the proposed stormwater management facility. A Stormceptor EF08 will pre-treat runoff prior to reaching Inlet 1, providing 64% Total Suspended Solid removal. For Inlet 2, a Stormceptor EF04 will pre-treat runoff providing 61% Total Suspended Solid reduction. AT Inlet 3, a Stormceptor EF08 is proposed to pre-treat runoff providing 60% Total Suspended Solid reduction. The pre-treatment of the stormwater runoff from the development will reduce the frequency in which the stormwater management facility needs to be remediated due to sediment buildup. Pre-treatment will remove larger sediments before they are deposited within the stormwater management facility. Oil/grit separator sizing is included in **Appendix E**.

Extended Detention

Extended detention volume is calculated based on the runoff volume generated by the 4-hour 25mm design storm event. The outlet structure has been designed to provide a 24.7-hour detention of the required extended detention volume, which corresponds to a release rate of 0.060m³/s.

From the design of the stormwater management pond, a storage volume of 3,749m³ corresponds to a ponding depth of approximately 0.50 metres. The outlet structure has been designed with a 215mm diameter orifice, which will control the extended detention volume for the 24.7 hour detention time.

Pond Routing

Table 6 compares the routing results through the stormwater management facility with the available stage/storage/ discharge capacities.

Table 6: Stormwater Management Facility – Stage/Storage/Discharge Comparison

Control	Available Capacity			Actual Capacity Used			
	Peak Flow m³/s	Storage Volume m³	Storage Elevation m	Peak Flow m³/s	Storage Volume m³	Storage Elevation m	Drawdown Time hr.
Bottom of Pond	0	0	456.00	--	--	--	--
25 mm Storm	--	--	--	0.060	3,749	456.50	24.7
DICB Lip	0.060	3,760	456.50	--	--	--	--
2 Year Storm	--	--	--	0.264	4,552	456.59	25.1
5 Year Storm	--	--	--	1.235	6,160	456.77	25.5
Weir (3 weirs)	2.490	8,552	457.00	--	--	--	--
Regional Storm	--	--	--	2.808	8,684	457.01	26.0
100 Year Storm	--	--	--	5.771	9,570	457.09	25.8
Top of Pond	31.960	13,276	457.40	--	--	--	--
Overflow	44.189	14,711	457.50	--	--	--	--

The pond outlet will comprise of three (3) ditch inlet structures per OPSD 702.050, each connected to a 600mm diameter outlet pipe at a slope of 0.50%, outleting to a linear dispersion trench located at the east side of the pond block at an elevation of 455.36m, above the river's 100-year storm flooding elevation of 455.13m. The linear dispersion trench will spread the flows over a wide area, preventing a point source discharge. Additional details for the linear dispersion trench are provided in **Section 5.6.**

Three (3) major overland flow weirs are proposed at an elevation of 457.00m, above the Grand River Regional flooding elevation of 456.84m. The intent of the three weirs is to provide an unrestricted outlet for the major flow events so that the peak flows from the development are discharged and routed along the Grand River prior to peak flows from upstream lands.

The flooding elevations for the Grand River have been provided by the Grand River Conservation Authority (GRCA) in Canadian Geodetic Vertical Datum 1928 (CGVD28) format.

Sediment Forebay Design

The proposed stormwater management facility has been designed with three (3) sediment forebays at the main pipe inlet locations. The sediment forebays are 1.0 m deep and have been designed per the Ministry of Environment Stormwater Management Planning and Design Manual guidelines. The full sediment forebay sizing information has been included in **Appendix D**.

Table No. 7 summarizes the required and provided parameters within the sediment forebay design.

Table No. 7: Sediment Forebay Design Details

		Forebay at Inlet 1	Forebay at Inlet 2	Forebay at Inlet 3
Required	**Dispersion Length (m)**	28.9	7.4	31.8
	Settling Length (m)	24.9	25.1	23
	Flow Velocity (m/s)	0.15	0.15	0.15
	Length to Width Ratio	2:1	2:1	2:1
	Settling Velocity (m/s)	0.0003	0.0003	0.0003
Provided	**Forebay Length (m)**	34	33	38.5
	Flow Velocity (m/s)	0.15	0.04	0.12
	Length to Width Ratio	3.1:1	3.1:1	2.7:1

Therefore, the sediment forebays have been designed to provide the required dispersion and flow lengths.

Sediment Loading and Cleanout Frequency

Table No. 8 illustrates sediment loading to the oil/grit separator systems and sediment forebays as well as the subsequent cleanout frequency required to maintain these systems. The oil/grit separator structures are designed to filter out large sediments before reaching the stormwater management facility. The oil/grit separators are proposed to be flushed out and cleaned on a yearly basis.

Table No. 8: Sediment Loading and Cleanout Frequency – Sediment Forebays

System Component	Treatment Train Component	Catchment Area	Imp. (%)	Annual Sediment Loading	TSS Removal	Annual TSS Reduction	Storage Volume	Cleanout Frequency
Forebay at Pond Inlet 1	OGS (Stormceptor EFO8)	9.96 ha	50%	15.9m^3 (based on 1.6m^3/ha)	64%	10.1 m^3	8.8 m^3	~ 10 months
	Forebay				80%	4.6 m^3	91 m^3 (1/3 of forebay)	~ 10 years
	Forebay (Scott St Pipe Outlet)	2.60 ha	55%	4.9m^3 (based on 1.9m^3/ha)	80%	4.0 m^3		
						Total Inlet 1 = 8.6m^3		
Forebay at Pond Inlet 2	OGS (Stormceptor EFO4)	2.76 ha	60%	6.1m^3 (based on 2.2m^3/ha)	61%	3.7 m^3	1.2 m^3	~4 months
	Forebay				80%	1.9 m^3	82 m^3 (1/3 of forebay)	~ 43 years
Forebay at Pond Inlet 3	OGS (Stormceptor EFO8)	10.19 ha	72%	31.6m^3 (based on 3.1m^3/ha)	60%	19.0 m^3	8.8 m^3	~6 months
	Forebay				80%	10.1 m^3	148 m^3 (1/3 of forebay)	~ 14 years

Sediment loadings obtained from Table 6.3 of the MOE Stormwater Management Planning and Design Manual, 2003 and prorated based on catchment percent impervious.

The above noted Stormceptor storage volumes are manufacturer specified minimums. As part of the detail design stage, the Stormceptor sump can be increased to provide additional volume to accommodate the annual TSS reduction volume and require a cleanout frequency of one (1) year.

5.6 Stormwater Management Facility Outlet / Linear Dispersion Trench

The stormwater management facility outlet pipes will discharge to the proposed linear dispersion trench located at the east side of the pond between the existing woodlot and wetland.

The 15m long, 8m wide, 0.5m deep linear dispersion trench will spread the flows over a wide area, preventing a point source discharge and will be constructed flat to allow the trench to fill-up gradually then spill evenly over the sides. The flows spilling from the south side of the linear dispersion trench will be directed to the existing wetland by the natural topography while the remaining flows will follow the existing topography in the easterly direction to the Grand River.

Table 9 compares the routing results through the linear dispersion trench with the available stage/storage/ discharge capacities.

Table 9: Linear Dispersion Trench – Stage/Storage/Discharge Comparison

Control	Available Capacity			Actual Capacity Used		
	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m
Bottom of Trench	0	0	454.86	--	--	--
Top of Trench / Weir	0	20	455.36	--	--	--
25 mm Storm	--	--	--	0.060	20	455.36
2 Year Storm	--	--	--	0.264	20	455.38
5 Year Storm	--	--	--	1.235	20	455.43
Regional Storm	--	--	--	2.458	21	455.48
100 Year Storm	--	--	--	3.056	21	455.50

The linear dispersion trench will act in a similar fashion to a weir. The north, south and east portions of the trench will all spill at the same elevation causing the flows to follow the natural topography to the existing wetland and Grand River.

Table 10 interpolates the flow distribution from the linear dispersion trench to the existing wetland and Grand River which is used in the MIDUSS Model. It is assumed that the linear dispersion trench is acting as a weir with three (3) sides, north, east and south. The north and east sides of the linear dispersion trench will outlet to the Grand River via the existing topography along the bank of the river while flows exiting the south side of the trench will follow the natural topography and will outlet to the existing wetland.

The total flow length along the three sides of the linear dispersion trench is 38m (15m north portion + 8m east portion + 15m south portion). Flows directed to the wetland are split on a 39.5% split from the total flow exiting the linear dispersion trench (15m / 38m).

Table 10: Flow Diversion to the Grand River and Existing Wetland

Design Storm	Level (m)	Flow (m^3/s)	Existing Wetland (m^3/s)	Grand River (m^3/s)
2-Year	455.38	0.264	0.104	**0.160**
5-Year	455.43	1.235	0.488	**0.747**
100-Year	455.50	3.056	1.207	**1.849**
Regional	455.48	2.458	0.971	**1.487**

The MIDUSS model was used to divert the flows to the Grand River and existing wetland based on the flow rates in Table 10 above. Table 11 below compares the pre and post development flow rates and volumes to the existing wetland.

Table 11: Comparison of Pre and Post-Development Flows and Volumes to the Existing Wetland

	2 Year		5 Year		100 Year		Regional Storm	
	Flow Rate (m^3/s)	Volume (m^3)	Flow Rate (m^3/s)	Volume (m^3)	Flow Rate (m^3/s)	Volume (m^3)	Flow Rate (m^3/s)	Volume (m^3)
Pre-Development	0.147	428	0.497	1,869	2.116	6,413	1.056	14,804
Post-Development	0.104	2,289	0.488	4,097	1.207	8,163	0.971	24,098

Therefore, during post-development conditions, the flow rates to the existing wetland are generally in close proximity to existing flows with the exception of the 100-year design storm event where the flow rate is almost reduced in half. The runoff volumes to the existing wetland are generally higher in post-development conditions.

5.7 Comparison to Pre-Development Flows

Table 12 summarizes the comparison of pre and post-development flows from the entire development.

Table 12: Comparison of Pre and Post-Development Flows

	2 Year	5 Year	100 Year	Regional Storm
	Flow Rate (m^3/s)	Flow Rate (m^3/s)	Flow Rate (m^3/s)	Flow Rate (m^3/s)
Pre-Development	0.935	2.172	8.805	3.839
Post-Development	0.305	1.616	10.573	6.075

The post-development peak flow rates are generally lower than the pre-development peak flow rates from the site under the minor storm events. For the major storm events, the post development peak flow rates exceed the pre-development peak flow rates as both the 100-year design storm event and Regional storm event will flow over the weir structures in the stormwater management facility.

The intent is to route flows to the Grand River as quickly as possible as discussed in the sections above in order to ensure that the peak flows from the development are discharged and routed along the Grand River prior to peak flows from upstream lands. However, the stormwater management facility does provide some natural attenuation under the minor storm events as the quality storm extended detention drawdown time requirement of 24 hours limits the ability to quickly discharge minor storm events.

6.0 SEDIMENT AND EROSION CONTROL PLAN

Primary sediment control will be achieved with the installation of Type 2 sediment fence around the property boundary. The silt fence will eliminate the opportunity for water borne sediments to be transported from the site.

Temporary rock check dams will be installed in rear and side yard swales after the initial grading has been completed to slow the flow rates and promote the settlement of water borne sediments before they reach the silt fences and ponds.

Upon completion of the grading, any area not subject to active construction within 30 days will be topsoiled and seeded as per OPSS 572.

The stormwater management facility will be graded and shaped at the start of any construction or pre-grading activity. A silt fence will be placed around the outlet structures to restrict the movement of sediment.

Once catch basins have been installed, the grates will be wrapped in filter cloth. This will be maintained until all building and landscaping has been completed.

Inspection and maintenance of all silt fencing and the sediment pond will start after installation is complete. These features will be inspected on a weekly basis 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.

Monthly reports on the condition of the sediment and erosion control measures will be submitted to the Town of Grand Valley and the Grand River Conservation Authority.

Once construction has been substantially completed, the silt fence will be removed from within the pond, any accumulated sediment will be removed and the landscaping and planting of the ponds will be completed.

After construction of the complete development, erosion will not occur and sediment transport will be minimal. The stormwater management facility will provide all sediment removal.

7.0 CONCLUSIONS

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

1. Gravity sanitary sewer for the River's Edge Subdivision will be provided by connecting to the existing municipal sanitary sewer on Bielby Street. It is noted that some improvements could be required downstream of the subject lands to support the ultimate Town buildout as discussed in Section 4.4 of this report.

2. Water servicing will be provided by connection to the existing municipal watermains on Bielby Street, Luther Road and proposed watermain extension on Highway 25. It is noted that some improvements could be required to the Town's water storage and supply system as discussed in Section 4.3 of this report.

3. Storm sewers will be sized at the detail design stage to convey the 5-year design storm event to the proposed stormwater management facility. It is noted that storm sewers on collector roads, i.e. Bielby Street will be required to convey the 10-year design storm event as per Town of Grand Valley Engineering Standards. Major overland flows will be directed towards the municipal right of ways to the proposed stormwater management facility.

4. The proposed stormwater management facility is designed to function as a wetland with 0.3m deep permanent pool and forebays to provide an Enhanced level of quality control (80% Total Suspended Solid removal).

5. Stormwater quality pre-treatment will be provided by oil/grit separators located upstream of the stormwater management facility.

6. Due to proximity to the Grand River, quantity control targets are not required for the proposed stormwater management facility. However, the facility does provide natural attenuation of runoff prior to outleting to the Grand River.

7. The proposed development will continue to discharge flows to the existing wetland located at the south easterly portion of the site. Under post-development conditions, the flow rates to the existing wetland are generally reduced while the runoff volumes are generally increased from pre-development conditions.

8. Flows discharged from the proposed stormwater management facility will be routed through a linear dispersion trench to spread the flows over a wide area, avoiding a point source discharge.

9. The stormwater management systems meet the current Provincial and Municipal guidelines.

10. The principles of "Stormwater Management Practices", the Ministry of Environment Stormwater Management Planning and Design Manual 2003 have been used in the design of the stormwater management system.

All of which is respectfully submitted.

GM Blue Plan Engineering LIMITED
Per:

Angela Kroetsch, P.Eng.
SZ/
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APPENDIX A

Geotechnical Investigation, Peto MacCallum Ltd., 2009
Geotechnical Slope Assessment, Peto MacCallum Ltd., 2012
Geotechnical Investigation, JLP Services Inc., 2022

Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
FIFE ROAD SUBDIVISION
FIFE ROAD
GRAND VALLEY, ONTARIO

for

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PML Ref.: 09KF021
Report: 1
June 3, 2009

Peto MacCallum Ltd.
CONSULTING ENGINEERS

June 3, 2009

PML Ref.: 09KF021
Report: 1

Ms. Sarah Austin, P.Eng.
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Dear Ms. Austin

Geotechnical Investigation
Fife Road Subdivision
Fife Road
Grand Valley, Ontario

Peto MacCallum Ltd. (PML) is pleased to report the findings of the geotechnical investigation recently completed for the above noted site. Authorization was received from Mr. Paul McLennan, P. Eng of Gamsby and Mannerow Limited, in a signed Engineering Services Agreement (ESA), dated April 1, 2009.

The project involves a planned 115 lot residential subdivision, located near the existing Fife Road Subdivision, in Grand Valley, Ontario. The development will include storm water management facilities at the northwest and southeast corners of the site. Once the design is finalized, PML should be retained to check that the recommendations in this report remain applicable.

The purpose of the geotechnical investigation was to explore the subsurface soil and groundwater conditions at the site. Based on the findings, geotechnical design and construction recommendations were to be provided. Specific considerations to be addressed included:

- Site preparation, including stripping, cut and fill grading, and requirements for placement of engineered fill
- Foundations, including bearing capacity and settlement estimates
- Excavating conditions, including safe side slopes, and groundwater control requirements

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- Bedding and backfilling, including reusability of site materials
- Structural pavement designs
- Hydraulic conductivity estimates for storm water management retention ponds

An environmental assessment of the site was not included within the terms of reference for this assignment.

Investigation Procedure

The field work for the investigation was carried out on April 16 and 17, 2009, and consisted of nine conventional sampled boreholes at locations shown on the appended Borehole Location Plan, Drawing 1. The boreholes were advanced to depths of between 2.30 and 14.00 m below grade. Boreholes 3, 4 and 9 included 50 mm observation well installations for follow-up groundwater level monitoring.

The boreholes were advanced using a Dietrich-50, track mounted drillrig equipped with continuous flight solid stem and hollow stem augers, supplied and operated by a specialist drilling contractor.

Representative samples of the overburden were recovered at regular intervals throughout the depths explored. Standard penetration tests were carried out during sampling operations using conventional split spoon equipment. Groundwater observations were made in the boreholes and observation wells during and upon completion drilling.

The field work was supervised throughout by a member of our engineering staff who directed the drilling and sampling operation, prepared stratigraphic logs, monitored groundwater conditions, and processed the recovered samples.

The borehole locations and ground surface elevations were surveyed by Gamsby and Mannerow Limited, and provided on a site grading plan.

All samples secured in the field were returned to our laboratory for detailed visual examination to confirm field soil classifications. The laboratory testing program included moisture content determinations on all recovered samples together with three particle size distribution analysis carried out on soil samples encountered in the area of the storm water management pond.

It should be noted that decommissioning of the monitoring wells as required under O.Reg 903 was not included within PML's terms of reference for this assignment and future decommissioning will be required.

Summarized Site and Subsurface Conditions

The site consisted primarily of vacant land, with agricultural land comprising the northern portion of the site. A former gravel pit was located near the southern portion of the site, but was no longer in operation. The site is hilly with a total relief of approximately 25 m from a plateau near Fife Road to the low point, above a slope to the Grand River near the southern portion of the site. From the grading plan, it appears that many lots will contain units with walkout basements.

Reference is made to the appended Log of Borehole sheets for details of the drilling work including soil descriptions, inferred stratigraphy, standard penetration N values, groundwater observations during and upon completion of drilling, and natural moisture content determination test results.

In general, the subsurface stratigraphy contacted at the site comprised surficial topsoil overlying mixed till, sand and gravelly sand deposits.

The boreholes typically encountered between 600 and 800 mm of surficial topsoil. No topsoil was penetrated in Borehole 8 and in Boreholes 6 and 9, 200 and 100 mm of topsoil were encountered respectively. The surficial topsoil was typically about plastic limit (APL) and was typically described as firm to hard clayey silt with rootlets and occasional cobbles. Surficial boulders were also present around Boreholes 6, 7 and 9.

Mixed deposits of tills, sand and gravelly sand were underlying the surficial topsoil.

Clayey silt till was contacted immediately below the surficial topsoil in Boreholes 1 through 7 and was described as firm to stiff with standard penetration N values between 7 and 77 for 150 mm of penetration. Occasional to numerous cobbles and boulders were contacted in the till layer. Isolated seams of sand and gravelly sand were contained within the till deposit at various depths, which exhibited groundwater seepage in Boreholes 1, 3 and 4. The upper till layer extended to between 3.05 and 6.30 m below grade in Boreholes 1 through 7; extending to the borehole termination depth in Boreholes 2, 3 and 7. In Borehole 5, the clayey silt till was overlying a silt till layer and a second layer of clayey silt to a depth of 9.45 m below grade. Deeper till deposits were also encountered in Boreholes 1, 4 and 9; typically consisting of hard brown or grey clayey silt.

Reference is made to Figure 1, attached, for a particle size distribution chart for the clayey silt till encountered in Borehole 3.

Various sand and gravel, gravelly sand and sand deposits were encountered in Boreholes 1, 4, 5, 6, 8 and 9. These layers were described as saturated in Boreholes 1, 4, 5 and 9. Borehole 8 was terminated in a sand layer at a depth of 2.30 m below grade, due to auger refusal on boulders.

Particle size distribution charts for the medium sand, and the sand and gravel deposits encountered in Borehole 9 are presented in Figures 2 and 3 respectively.

Groundwater observations carried out during and upon completion of drilling and in observation wells installed in Boreholes 3, 4 and 9 are summarized on the appended Log of Borehole Sheets.

Groundwater seepage was encountered in Boreholes 1 and 4 in sand seams confined in the till deposits at 1.5 m below grade in both boreholes. The seepage in these boreholes was likely attributable to perched water conditions. The groundwater table was penetrated in Boreholes 1, 3, 4 and 9. Groundwater was encountered at various depths in the boreholes, between elevation 453.80 and 477.85 (metric, geodetic).

Initial water level readings were taken in the observations wells installed in Boreholes 4 and 9 and were at elevation 472.20 and 454.23 respectively. The observation well installed at Borehole 3 was dry at the time of the initial reading.

It should be noted that groundwater levels, particularly perched groundwater levels, can vary significantly in response to seasonal weather conditions and weather events.

Discussion and Recommendations

The project involves a planned 115 lot residential subdivision located near the existing Fife Road Subdivision. The development will include storm water management ponds at the northwest and southeast corners of the site. The storm water management ponds are expected to be detention type facilities. It is understood that the proposed development will generally involve site grading, servicing, road construction and building construction.

Site Grading

The site is hilly with a total relief of approximately 25 m across the site. The site plateaus north of the existing Fife Road at an elevation of approximately 481.0 (metric, geodetic) and gradually falls off to the north, to an elevation of about 469.0 at the top of a steep embankment slope to the Grand River. From the plateau, the site grade falls steeply to an elevation of about 455.0 toward the east and southeast of the site; the grades through this portion of the site are variable, and are hillier than to the north or northwest. A former gravel pit was located near the southeast portion of the site. The Grand River is situated along the eastern portion of the site, running from northwest to southeast.

The site grading plan shows that significant cuts and fills will be required prior to construction. Grade cuts will be necessary to the east and north of the existing Fife Road (around Boreholes 1, 4 and 5). The grade cuts will typically be between 1.0 and 2.0 m with as much as 4.0 m east of Borehole 4, and east of Borehole 1. The northern portion of the site (Boreholes 2 and 3) will typically require around 0.5 to 1.5 m of fill and as much as 2.0 to 3.0 m near the top of the slope to the Grand River. The south and southeastern portion of the site will also require fill (Boreholes 6 through 9). The area around Borehole 6 and 7 typically require less than 1.0 m of fill, however between 3.0 and 5.0 m of fill is needed around Borehole 8. Approximately 5.0 m of fill is typically expected for the area around Borehole 9, with a range between 2.0 and 7.0 m.

Removal of all surficial topsoil will be required prior to the grading operations. Surficial topsoil thicknesses across the site typically ranged between 100 and 800 mm. No topsoil was present at Borehole 8, and topsoil was sporadic around Borehole 9. In calculating the approximate quantity of topsoil to be stripped, we recommend that the topsoil thickness shown on the individual borehole logs be increased by 50 mm to account for variations and some stripping of the mineral soil below.

Engineered fill material used to raise grades should comprise approved inorganic material placed in maximum 300 mm thick lifts and compacted to at least 98% standard Proctor maximum dry density (SPMDD) below footings, and 95% SPMDD below floors and pavements. Further, generic recommendations for fill subgrade preparation and engineered fill construction are provided in Appendix A.

It is anticipated that excess materials generated from grade cuts will primarily comprise clayey silt, and silt materials which are highly susceptible to moisture content variations and not well suited for engineered fill construction. Compaction difficulties due to elevated moisture levels are expected. It is anticipated that the site material will not be suitable for compaction to 98% SPMDD. Select portions of the material may be used where compaction to 95% SPMDD is specified providing excessively wet soils are discarded (i.e material described as WTPL or wet / saturated on the borehole logs).

Settlement of on site soils due to the surcharge of additional properly compacted site grading fills is not expected to be of concern.

Building Construction

Based on the investigation findings, the native inorganic soils are suitable to support the proposed buildings on conventional footings. For preliminary design purposes, footings founded at least 0.50 m into the native deposits may be designed using the recommended values for factored resistance at ultimate limit state (ULS) and serviceability limit state (SLS) of 225 and 150 kPa, respectively.

Where grades are raised, the footings may be supported on engineered structural fill, placed in accordance with the generic recommendations for engineered fill construction provided in Appendix A. For engineered fill supporting footing loads, compaction to a minimum 98% of the materials SPMDD, should be specified, as per recommendations outlined in the preceding 'Site Grading' section of this report and in Appendix A.

Footings supported on the structural fill may then be designed using the recommended values for factored resistance at ULS and SLS of 225 and 150 kPa, respectively.

Full time inspection of the structural fill placement by PML personnel is recommended to approve fill materials and to verify that the specified compaction levels are being achieved.

Total settlements of footings founded on the approved engineered fill or native overburden deposits, designed as outlined above are not expected to exceed 25 mm, with differential settlements between footings being no more than 50% of this value.

All exterior footings should be provided with a minimum 1.2 m of earth cover or the thermal insulation equivalent to provide adequate insulation against potential frost damage. A 25 mm thick layer of polystyrene insulation is thermally equivalent to 600 mm of soil cover.

Prior to concrete placement, all founding surfaces should be examined by PML personnel to verify the competency of the founding surfaces.

It is anticipated that the floor slabs for the proposed structures will be founded on approved structural fill or on the competent overburden deposits and conventional slab-on-grade construction is feasible. We recommend a minimum 150 mm cushion of well compacted Granular A be provided directly beneath the slab to provide uniform support. For conventional slabs, a polyethylene vapour barrier should be installed directly beneath the slab if moisture sensitive floor finishes are planned.

Following removal of any loose organic material and deleterious fill, the exposed floor slab subgrade must be proofrolled with a heavy compactor to achieve 98% SPMDD. Any additional soft areas encountered in the proofrolling process should be subexcavated and backfilled with approved granular material, compacted to 98% SPMDD.

Foundation drainage measures should be taken for units with basements. For discussion purposes, it is assumed that foundations for the proposed buildings will extend to depths of up to 2.0 m below final lot grades. Perforated drainage pipe should be laid around the outside edge of the footings, and connected to a frost free sump system. It is recommended that the drainage pipes be surrounded with a granular filter protected with filter fabric, or alternatively wrapped with filter cloth and surrounded by concrete sand.

A "free draining" granular material or an equivalent, approved drainage board product must be provided for the basement walls, in accordance with the Ontario Building Code. The onsite silty soils are not suitable for use as basement wall backfill unless a drainage board product is provided. The gravelly sand and sand and gravel materials encountered in several locations would be suitable for basement wall backfill. Backfilling should not take place until the ground floor has been constructed, in order to provide lateral support for the wall.

Excavation and Backfilling

Excavation for footings and service trenches will extend through a combination of surficial topsoil, clayey silt till and cohesionless soils. Seepage into the footing excavations should be expected due to perched groundwater within cohesionless soil layers, although this should be manageable by conventional sump pumping.

These soils are classified as Type 3 materials as defined in the Occupational Health and Safety Act (OHSA). Subject to inspection and providing adequate groundwater control is achieved, excavations within Type 3 soils that are to be entered by workers should be inclined from the base of the excavation at one horizontal to one vertical (1H:1V) or flatter.

No bearing problems are anticipated for pipes founded in the native mineral soils encountered at the site. On stable subgrade, a minimum 150 mm thick bedding course of Granular A material compacted to 95% SPMDD is recommended beneath the pipes. The Granular A material should extend around the pipe to at least 300 mm above the pipe obvert or as set out by Ontario Provincial Standards (OPS), or the local authority. Material that is too wet for compaction to a minimum of 95% SPMDD should be allocated for use in landscaped/non settlement sensitive locations, and compacted to at least 90% SPMDD.

Foundation backfill and backfill below pavements, floor slabs (interior backfill) and other settlement sensitive features, should be similarly compacted to 95% SPMDD. It should be noted that the clayey silt till and silt till site materials are frost susceptible and should not be used at locations where frost heave movement could have adverse effects such as at exterior doors and the like. In addition, it should be noted that the clayey silt till material will tend to retain a voided structure when placed as fill. It will be particularly important to ensure that sufficient compaction is applied to breakdown all lumps/clods within the fill matrix to achieve a non-voided condition. Significant post-construction settlement could otherwise result. It is anticipated that suitable site material may not be available in sufficient quantities for use as interior foundation backfill, particularly during wet weather construction periods. Imported sand and gravel will likely be required for this purpose.

For walk-out style houses, exterior grades should be maintained at least 150 mm below the finished lower floor slab level and sloped to promote drainage away from the building.

Pavement Design

Based on the proposed pavement usage, frost susceptibility, and strength of the expected subgrade soils, the following pavement component thicknesses are considered suitable for local residential and minor collector traffic categories.

PAVEMENT COMPONENT	THICKNESS (mm)
HL 3 Surface Course	40
HL 4 Binder Course	40
Granular A Base	150
Granular B Subbase	350

The flexible pavement designs provided above consider that construction will be carried out during the drier time of the year and the subgrade is stable, as determined by proofrolling inspected by PML personnel. If the subgrade is wet and unstable, additional granular subbase will be required.

The pavement materials should conform to current OPS specifications. The Granular A base and Granular B subbase courses should be placed in thin lifts and compacted to a minimum of 100% SPMDD, and asphaltic concrete should be placed and compacted to between 92% and 96.5% of the material's maximum relative density (MRD). Reference is made to OPS Specification 310, revised April 2008.

During construction, testing should be conducted to confirm the gradation and compactibility characteristics of the granular base and subbase materials and the mix design properties of the asphaltic concrete.

Proofrolling procedures and the placement and compaction of all the fill and granular materials and asphaltic concrete for the pavement construction and backfilling at the site should be inspected on a continuous basis by PML technicians.

Since relatively impermeable clayey silt till material will be present at shallow depth beneath the pavement structure in several areas, pavement subdrains should be provided to prevent water accumulation on the pavement subgrade surface. The subgrade should be graded so that water is directed to the catch basin structures or to the pavement edge. Subdrains should be discharged in to the catch basins. The subdrains may consist of 3 m long stubs of filter wrapped, 100 mm diameter perforated plastic pipe, set within the subbase layer at the subgrade surface. At the pavement edge, suitable pavement drainage should be provided by means of subdrains or side ditches.

Storm Water Management

Two storm water management (SWM) ponds are depicted on the Gamsby and Mannerow Limited site grading plan. The ponds are located at Block 165, near the northwest corner (Borehole 3) and Block 166, near the southeast corner (Borehole 9) of the site. It is understood that the SWM ponds will be detention ponds.

Minor grade cuts and fills (typically less than 2.0 m) are planned for the Block 165 SWM pond. The site material in the area of this pond consists primarily of clayey silt till material of very low permeability; typically less than $1x10^{-6}$ cm/sec. Therefore, a detention pond in this area is considered feasible. Reference is made to Figure 1 attached, for a typical particle size distribution chart of the clayey silt till.

Large cut and fill operations will be required (up to 3.5 m) for the Block 166 SWM pond. Based on the information from Borehole 9 and the grading plan, the subgrade soil for this pond will likely be variable. In the cut areas, the subgrade soil will likely comprise sand and gravel materials of high permeability; typically greater than $5.0x10^{-3}$ cm/sec. This material would not be considered suitable for a detention pond. It is therefore recommended that a minimum 1.0 m thick clay liner is constructed for the Block 166 SWM pond.

The liner may be constructed from excess clayey silt till material generated from cuts during site grading (near Boreholes 1, 4 and 5, and from the Block 165 SWM pond). The liner should be compacted to minimum 95% SPMDD during construction. In addition, it should be noted that the clayey silt till material will tend to retain a voided structure when placed as fill. It will be particularly important to ensure that sufficient compaction is applied to breakdown all lumps/clods within the fill matrix to achieve a non-voided condition. Significant post-construction settlement and leakage could otherwise result.

Both SWM ponds should be inspected by PML personnel during construction to verify the presence of clayey silt subgrade materials for the Block 165 SWM pond, and to inspect construction of the clay liner for the Block 166 SWM pond.

We trust this report has been completed within our terms of reference, and is sufficient for your immediate requirements. If you have any questions or require further information, please do not hesitate to contact our office.

Sincerely

Peto MacCallum Ltd.

Ken Hanes, BASc
Project Supervisor

Marian S. Molodecki, P.Eng.
Senior Consultant
Geotechnical and Geoenvironmental Services

KH:sh

Enclosures:
Figures 1-3 – Particle Size Distribution Analysis
List of Abbreviations
Log of Borehole 1 to 9
Drawing 1 - Borehole Location Plan
Appendix A - Engineered Fill

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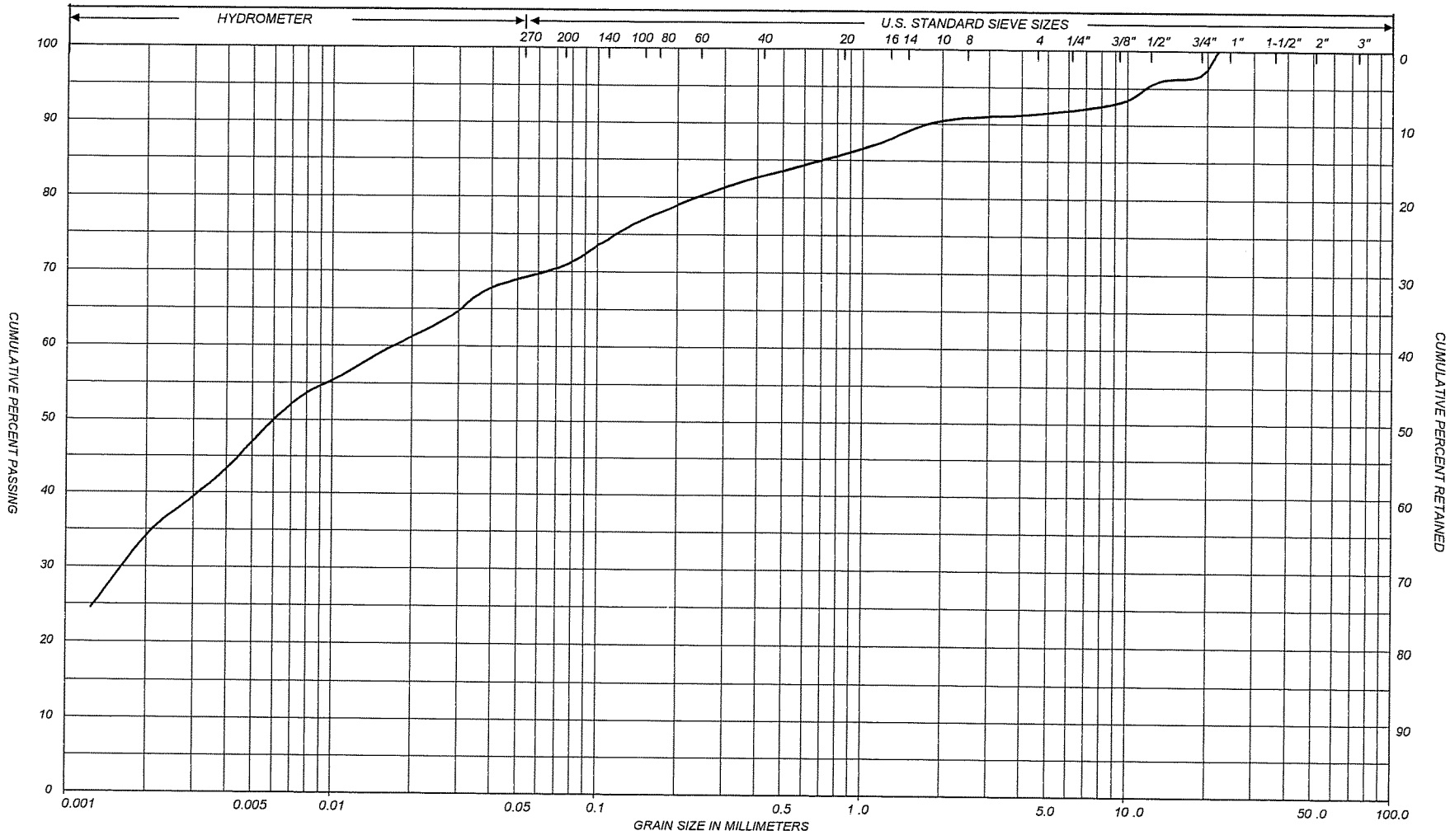
PML REF. 09KF021
FIGURE NO. 1

PARTICLE SIZE DISTRIBUTION CHART



SILT & CLAY				FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
				SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT			VERY FINE	FINE	MEDIUM	COARSE	GRAVEL		U.S. BUREAU
				SAND						

REMARKS Borehole 3, Sample SS2 and SS3, Depth 0.60 to 2.00 m

CLAYEY SILT TILL, TRACE GRAVEL, TRACE SAND

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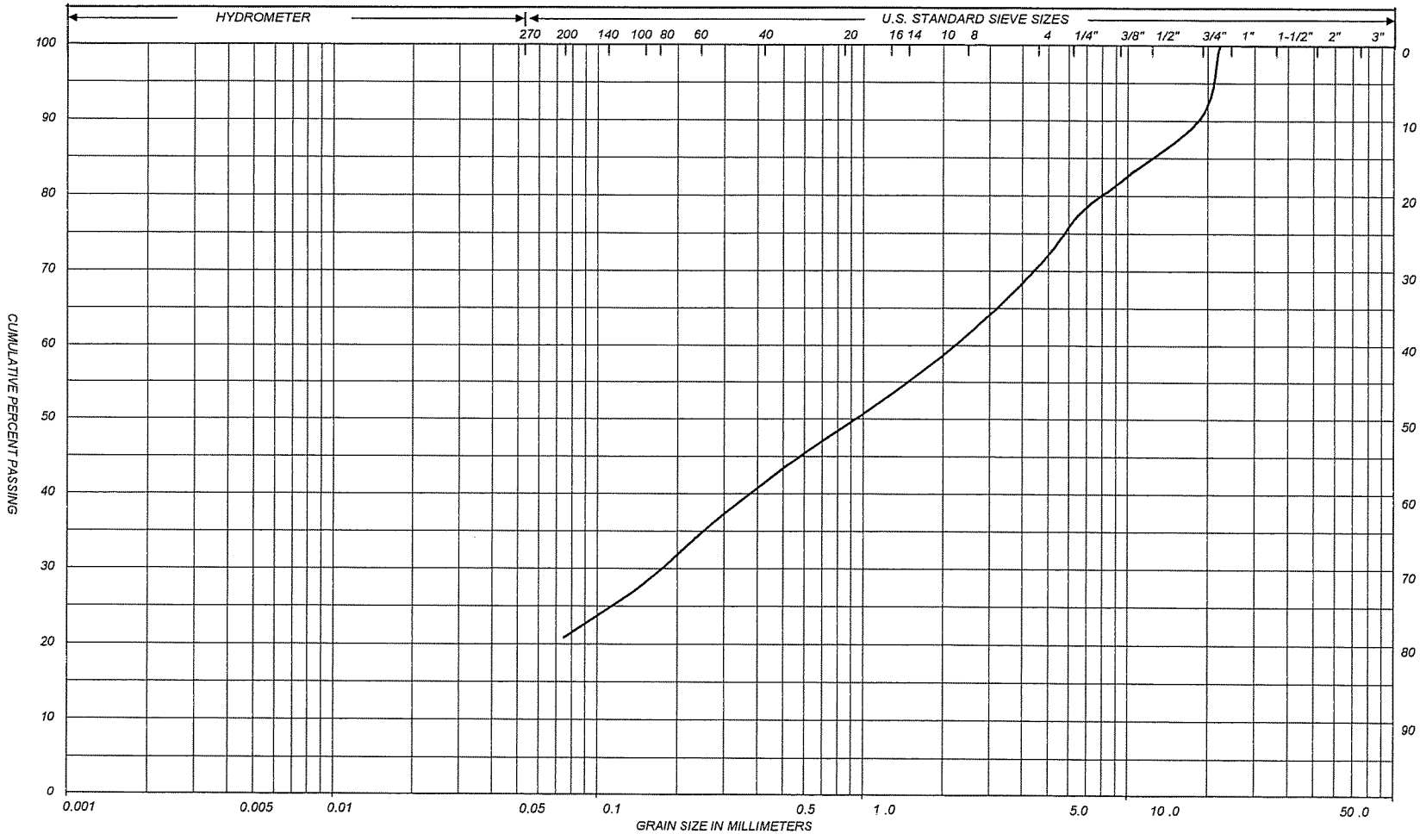
PML REF. 09KF021
FIGURE NO. 2

PARTICLE SIZE DISTRIBUTION CHART



SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		VERY FINE	FINE	MEDIUM	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS Borehole 9, Sample SS2, Depth 0.10 to 1.50 m

MEDIUM SAND, SOME GRAVEL, SOME SILT

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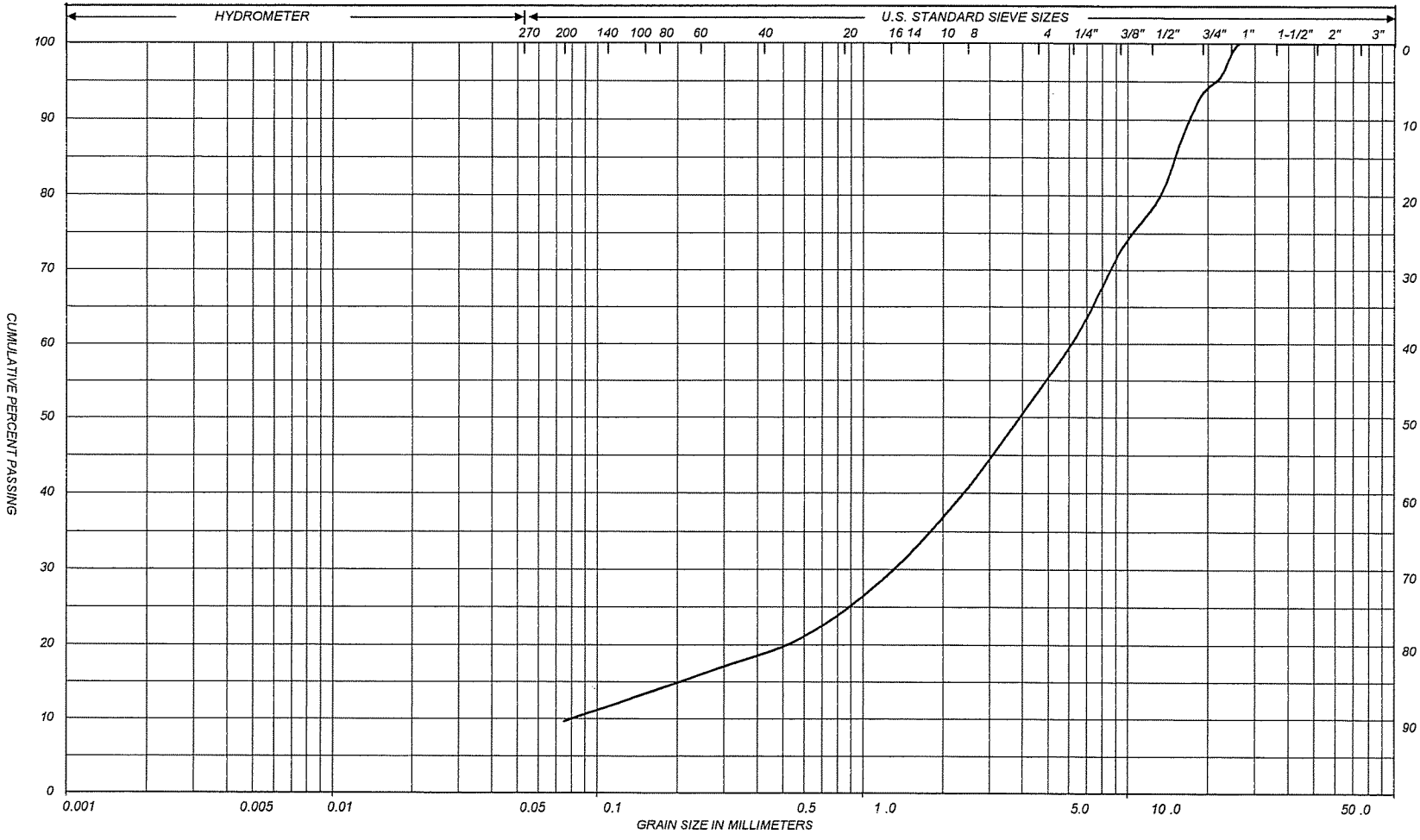
PML REF. 09KF021
FIGURE NO. 3

PARTICLE SIZE DISTRIBUTION CHART



SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL		COBBLES	UNIFIED
			SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT		VERY FINE	FINE	MEDIUM	COARSE	GRAVEL			U.S. BUREAU
			SAND							

REMARKS Borehole 9, Sample SS3, Depth 1.50 to 2.75 m

SAND AND GRAVEL, TRACE SILT

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample		

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE NO. 1

PROJECT FIFE ROAD SUBDIVISION — **OUR PROJECT NO.** 09KF021

LOCATION Fife Road, Grand Valley, Ontario — **BORING DATE** 2009 04 16 — **ENGINEER** M. Molodecki

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Hanes

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 479.35						
0.60	TOPSOIL: Dark brown clayey silt, trace gravel, occasional cobbles, rootlets, APL/WTPL		479	1	AS		
1.50	CLAYEY SILT TILL: Firm to stiff brown clayey silt, trace to some gravel, occasional cobbles, WTPL		478	2	SS	7	
1.5	numerous saturated gravelly sand seams			3	SS	16	Sampler wet from 1.5 m.
2.30	becoming hard, DTPL		477	4	SS	66	
3.05	GRAVELLY SAND: Very dense brown gravelly sand, saturated		476	5	SS	50 for 100 mm	
3.0							
4.55			475				
4.5	CLAYEY SILT TILL: Hard grey clayey silt, trace gravel, DTPL			6	SS	50 for 50 mm	
5.05	BOREHOLE TERMINATED AT 5.05 m						Upon completion of drilling, borehole wet caved at 1.05 m.

SHEAR STRENGTH C_u ▲ — 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M — 20 40 60 80

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % — 10 20 30

NOTES

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LOG OF BOREHOLE NO. 2

PROJECT FIFE ROAD SUBDIVISION — **OUR PROJECT NO.** 09KF021
LOCATION Fife Road, Grand Valley, Ontario — **BORING DATE** 2009 04 17 — **ENGINEER** M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Hanes

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 476.11						
	TOPSOIL: Firm dark brown clayey silt, trace gravel, occasional cobbles, rootlets, APL			1	SS	7	
0.85							
	CLAYEY SILT TILL: Stiff clayey silt, trace gravel, occasional cobbles and boulders, APL		475	2	SS	9	
1.50	becoming very stiff			3	SS	22	
2.30	becoming hard, DTPL		474	4	SS	50 for 75 mm	
3.0			473	5	SS	50 for 100 mm	
			472				
4.5				6	SS	50 for 75 mm	
5.05	BOREHOLE TERMINATED AT 5.05 m						Upon completion of drilling, borehole open with no free water

SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10 20 30)

NOTES

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LOG OF BOREHOLE NO. 3

PROJECT FIFE ROAD SUBDIVISION
OUR PROJECT NO. 09KF021
LOCATION Fife Road, Grand Valley, Ontario
BORING DATE 2009 04 17
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN K. Hanes

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES
	GROUND ELEVATION 471.02					
	TOPSOIL: Firm to stiff dark brown clayey silt, trace gravel, occasional cobbles, rootlets, APL			1	SS	8
0.60			470			
	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, trace gravel, occasional cobbles and boulders, APL/DTPL			2	SS	22
1.50						
1.5				3	SS	30
	occasional wet medium sand seams		469			
2.30	no sand seams			4	SS	28
3.0			468	5	SS	32
4.05	becoming stiff, grey, APL		467			
4.5				6	SS	13
5.05	BOREHOLE TERMINATED AT 5.05 m		466			

SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUND WATER OBSERVATIONS AND REMARKS

1.1 m Stick up with J Plug and Steel Casing
Concrete
50 mm PVC Standpipe
Bentonite Seal
Filter Sand

Water Level Reading:
04/17/2009: No water

NOTES

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LOG OF BOREHOLE NO. 4

PROJECT FIFE ROAD SUBDIVISION — **OUR PROJECT NO.** 09KF021
LOCATION Fife Road, Grand Valley, Ontario — **BORING DATE** 2009 04 17 — **ENGINEER** M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Hanes

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES
	GROUND ELEVATION 477.00				
0.60	TOPSOIL: Stiff dark brown clayey silt, trace sand, trace gravel, occasional cobbles, rootlets, APL	476	1	SS	10
1.50	CLAYEY SILT TILL: Very stiff brown clayey silt, trace gravel, numerous cobbles, occasional boulders, APL becoming hard with occasional saturated medium sand seams	475	2	SS	16
3.05		474	3	SS	40
	becoming DTPL, no sand seams	473	4	SS	44
		472	5	SS	50 for 100 mm
6.30		471	6	SS	50 for 100 mm
7.00	GRAVELLY SAND: Brown gravelly sand, numerous cobbles, occasional boulders, saturated	470	7	AS	
	CLAYEY SILT TILL: Brownish grey clayey silt, trace gravel, occasional cobbles and boulders, APL	469	8	AS	
9.50		468			
	SAND: Grey sand, some gravel, saturated	467			
		466			
		465			
		464			
14.00		463			
	BOREHOLE TERMINATED AT 14.00 m				

SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUND WATER OBSERVATIONS AND REMARKS

- 1.0 m Stick up with J Plug and Steel Casing
- Concrete
- Groundwater seepage at 1.5 m
- 50 mm PVC standpipe
- Bentonite Seal
- Groundwater seepage at 6.3 m.
- Groundwater below 9.5 m.
- Filter Sand
- Slotted Screen

Water Level Reading:
04/17/2009: 4.8 m

NOTES

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LOG OF BOREHOLE NO. 5

PROJECT FIFE ROAD SUBDIVISION — **OUR PROJECT NO.** 09KF021
LOCATION Fife Road, Grand Valley, Ontario — **BORING DATE** 2009 04 17 — **ENGINEER** M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** K. Hanes

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 471.33						
	TOPSOIL: Firm dark brown clayey silt, occasional cobbles, rootlets, APL		471	1	SS	7	
0.60	CLAYEY SILT TILL: Firm to stiff clayey silt, trace gravel, occasional cobbles and boulders, APL		470	2	SS	10	
1.5			469	3	SS	6	
3.05	becoming hard, DTPL		468	4	SS	77	
4.55	SILT TILL: Very dense brown silt, trace fine sand, trace gravel, occasional cobbles and boulders, damp		467	5	SS	50 for 150 mm	
6.10	some fine sand, some gravel		466	6	SS	50 for 150 mm	
7.5			465	7	SS	52	
8.60	CLAYEY SILT: Hard clayey silt, trace gravel, DTPL		464	8	SS	62	
9.45	SAND: Very dense light brown fine sand, trace silt, damp		463	9	SS	50 for 150 mm	
10.10	becoming wet/saturated		462				
10.5			461				
11.15	BOREHOLE TERMINATED AT 11.15 m						Upon completion of drilling, borehole open with groundwater seepage below 10.1 m

SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10 20 30)

NOTES

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

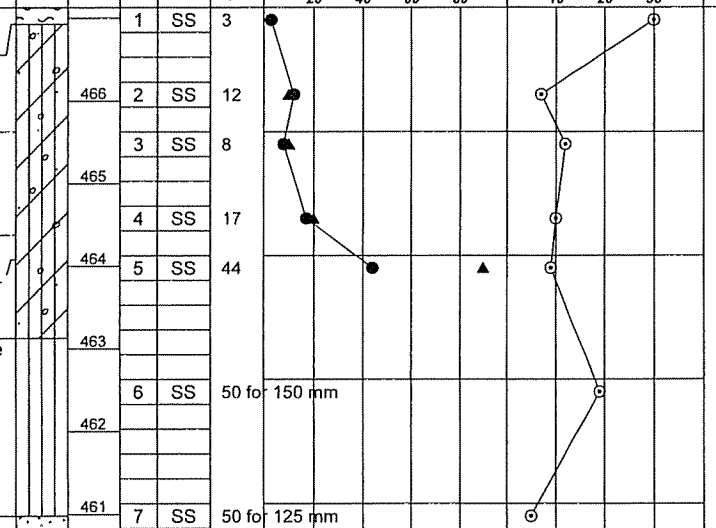
LOG OF BOREHOLE NO. 6

PROJECT FIFE ROAD SUBDIVISION — OUR PROJECT NO. 09KF021
LOCATION Fife Road, Grand Valley, Ontario — BORING DATE 2009 04 16 — ENGINEER M Molodecki
BORING METHOD Continuous Flight Solid Stem Augers — TECHNICIAN K. Hanes

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 467.13					
0.20	TOPSOIL: Soft dark brown clayey silt, trace gravel, high organics, APL		1	SS	3	
	CLAYEY SILT TILL: Stiff clayey silt, trace gravel, numerous cobbles, occasional boulders, APL/WTPL	466	2	SS	12	
1.50	becoming APL with occasional dry brown sand seams	465	3	SS	8	
2.75	becoming very stiff with occasional wet gravelly sand seams	464	4	SS	17	
3.05	becoming hard, DTPL		5	SS	44	
4.00	SILT: Very dense brown silt, trace fine sand, moist to wet	463				
		462	6	SS	50 for 150 mm	
6.15	SAND: Very dense light brown fine sand, moist	461	7	SS	50 for 125 mm	
6.55	BOREHOLE TERMINATED AT 6.55 m					Upon completion of drilling, borehole open with no free water.

SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10 20 30)



NOTES

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 9

PROJECT FIFE ROAD SUBDIVISION — **OUR PROJECT NO.** 09KF021
LOCATION Fife Road, Grand Valley, Ontario — **BORING DATE** 2009 04 16 — **ENGINEER** M. Molodecki
BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** K. Hanes

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES
	GROUND ELEVATION 455.33					
0.10	SILT TOPSOIL: Dark brown silt, trace gravel, occasional cobbles and boulders, moist		455	1	SS	50*
1.50	SAND: Dark brown medium sand, some gravel, some silt, numerous cobbles, occasional boulders, damp		454	2	SS	50*
1.5				3	SS	50*
2.75	SAND AND GRAVEL: Brown sand and gravel, trace silt, numerous cobbles and boulders, saturated		453			
3.0	CLAYEY SILT TILL: Hard brown clayey silt, trace gravel, occasional cobbles and boulders, APL		452	4	SS	37
4.00	becoming grey, DTPL		451			
4.5				5	SS	50 for 125 mm
5.05	BOREHOLE TERMINATED AT 5.05 m					

SHEAR STRENGTH C_u ▲ (50, 100, 150, 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20, 40, 60, 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10, 20, 30)

GROUND WATER OBSERVATIONS AND REMARKS

1.0 m Stick up with J Plug and Steel Casing
Concrete
Bentonite Seal
50 mm PVC Standpipe
Filter Sand
Slotted Screen

Water Level Reading:
04/16/2009: 1.1 m

NOTES

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APPENDIX A

ENGINEERED FILL

ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

2. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

3. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.

4. Subsurface Preparation

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

5. Suitable Fill Materials

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

6. Test Section

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

7. Inspection and Testing

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.

8. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

9. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compactability prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

10. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.

Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

11. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.

BH 3
EL. 471.01

BH 2
EL. 476.11

BH 1
EL. 479.35

BH 4
EL. 477.00

BH 5
EL. 471.33

BH 6
EL. 467.13

BH 7
EL. 467.22

BH 8
EL. 460.47

BH 9
EL. 455.33

BIELBY STREET

STREET A

KINGS HIGHWAY No. 25

MAIN STREET

FIFE ROAD

RIVER HILL STREET

MARY COURT

JOYCE COURT

CROZIER STREET

SPRUYT AVENUE

BAKER COURT

SCOTT STREET

BIELBY ST.

Pipeline

Grand River

SCALE

0 m 50 m 100 m 150 m 200 m 250 m

NOTES:

1. THE INFERRED STRATIGRAPHY REFERRED TO IN THIS REPORT IS BASED ON DATA FROM THESE BOREHOLES, SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY AT OTHER POINTS BETWEEN THE BORINGS MAY VARY FROM THAT SHOWN.
2. THIS DRAWING WAS REPRODUCED FROM A PLAN PROVIDED BY CLIENT.

GAMSBY AND MANNEROW LIMITED

FIFE ROAD SUBDIVISION
GRAND VALLEY
ONTARIO

BOREHOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN:	DATE	SCALE	JOB NO.	DRAWING NO.
KH	JUNE 2009	AS SHOWN	09KF021	1
CHECKED: MSM				
APPROVED: MSM				

Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL SLOPE ASSESSMENT
FIFE ROAD SUBDIVISION
GRAND VALLEY, ONTARIO

for

GAMSBY AND MANNEROW LIMITED

PETO MacCALLUM LTD.
16 FRANKLIN STREET SOUTH
KITCHENER, ONTARIO
N2C 1R4
PHONE: (519) 893-7500
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Distribution:
4 cc: Gamsby and Mannerow Limited
1 cc: PML Kitchener
1 cc: PML Toronto

PML Ref.: 09KF021A
Report: 1
February 9, 2012

Peto MacCallum Ltd.
CONSULTING ENGINEERS

February 9, 2012

PML Ref.: 09KF021A
Report: 1

Mr. Grant Campbell, BASc, EIT
Gamsby and Mannerow Limited
650 Woodlawn Road West
Block C, Unit 2
Guelph, Ontario
N1K 1B8

Dear Mr. Campbell

Geotechnical Slope Hazard Assessment
Fife Road Subdivision
Grand Valley, Ontario

We are pleased to present our report on the geotechnical site assessment recently carried out at the above referenced site. This work was authorized by Mr. Grant Campbell in an email received January 18, 2012.

The project involves a planned 115 lot residential subdivision extending to the north and east of the existing Fife Road Subdivision in Grand Valley, Ontario. Peto MacCallum Ltd. has completed a prior geotechnical investigation for the development, with the findings presented in our Geotechnical Investigation, PML Ref.: 09KF021, Report 1, dated June 3, 2009.

The lot layout has now been completed. The purpose of the slope hazard assessment was to determine the safe set-back distance for lots backing onto the west bank of the Grand River, in accordance with Grand Valley Conservation Authority (GRCA) published policy document titled "Policies for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation" dated November 30, 2007, made under O.Reg. 150/06 of the Conservation Authorities Act.

16 Franklin Street South, Kitchener, Ontario N2C 1R4
Tel: (519) 893-7500 Fax: (519) 893-0654
E-mail: kitchener@petomaccallum.com
BARRIE, BRAMPTON, HAMILTON, KITCHENER, TORONTO

Methodology

The scope of work for this assignment included the following:

- A review of lot plans and site topography as shown on Gamsby and Mannerow 'Preliminary Grading Plan, Drawings A and B', for Fife Subdivision, dated June, 2009;
- A review of the geotechnical report including Borehole 3 and 6 specifically, where there was some potential that the safe building setback could encroach close to or into the proximal lots as identified from the topographic contours;
- A site visit completed on January 21, 2012, to conduct a visual slope assessment at the two potential hazard locations; and
- A review of the local geology and historical aerial photography and topographic mapping over a 41 year time period, as tabulated below:

TABLE I
AERIAL PHOTOGRAPHS, TOPOGRAPHIC MAPS, GEOLOGIC MAPS

1. Aerial Photographs		
TIME PERIOD	**SCALE**	**SOURCE**
2000	1:10,000	GRCA Website
2010	1:10,000	GRCA Website
2. Geologic Maps		
1971	1:50,000	Ontario Division of Mines, Preliminary Map P. 848, 'Quaternary Geology of the Orangeville Area' published 1973.
3. Topographic Maps		
1976	1:50,000	Department of Energy, Mine and Resources, Surveys and Mapping Branch, National Topographic System Map Index 40 P/16 'Orangeville' Edition 3
1980	1:50,000	Energy, Mine and Resources Canada, Surveys and Mapping Branch, National Topographic System Map Index 40 P/16 'Orangeville' Edition 4

Findings and Observations

Site Description and Topography

The overall subdivision development, including the lot layout and site topography at 0.5 m contour intervals, is shown on the appended Hazard Limits drawing. PML has identified two locations adjacent to the west bank of the Grand River, where the slope hazard limit line could potentially encroach into or close to the proximal building lots. The site reconnaissance and detailed research for this assignment was focused on these two areas. Both locations feature riverbank slopes with local inclinations approaching two horizontal to one vertical (2H:1V), as based on the topographic contours and site observations.

The cross sectional geometry was calculated at the steepest section of each area as illustrated on the appended drawing.

At Area 1, located near Borehole 3, the average slope inclination is 2.3H:1V. The slope height from toe to crest is about 15 to 15.5 m. The toe of the slope at the river's edge exhibits evidence of slow, ongoing toe erosion as evidenced by a 0.5 to 1.0 m high cut standing at a near vertical inclination. The eroded face at the toe consists of silt till-like material with a dense mat of exposed tree roots. The slope itself is densely wooded with mixed hardwoods and stands of cedar. Numerous cedar of up 200 mm diameter were inclined at about 45° within the bottom 1 m of the tree trunk, gradually curving to a near vertical posture at a height of about 0.5 to 1.0 m above grade. The tree trunk curvature is indicative of ongoing solifluction movement of the slope surface.

Area 2 in the vicinity of Borehole 6 exhibits a 13 m high riverbank slope with an average toe to crest inclination of 3.9H:1V, and with a maximum inclination of 2.4H:1V near the top 4 m of the slope face. The toe of slope at the water's edge exhibited similar erosional features as Area 1, with an eroded face of up to 1.5 m in height. The overall slope face was fully wooded with cedar tree vegetation, with no overt evidence of solifluction movement.

There were no signs found of slope failure, active erosional gullies, springs or seepage in either area examined.

Subsurface Conditions

The soil stratigraphy in Borehole 3 (Area 1) comprises very stiff to hard clayey silt till to a depth of 4.05 m, underlain by stiff clayey silt till to the borehole termination depth of 5.05 m.

Borehole 6 near Area 2, disclosed stiff to hard clayey silt till to a depth of 4.00 m, underlain by very dense silt to a depth of 6.15 m, underlain by dense sand to the borehole termination at a depth of 6.55 m.

Groundwater was not contacted within the depth explored at either borehole.

The remaining boreholes within the subdivision disclosed similar high strength soils to a lowest explored elevation of 450.28.

The site geology shown on Ontario Division of Mines, Preliminary Map P. 848, 'Quaternary Geology of the Orangeville Area', indicates that the riverbank at both locations is comprised of silt till of the Georgian Bay Lobe.

A copy of each log for Boreholes 3 and 6 is appended for ease of reference.

Discussions and Recommendations

The angle of internal friction of the predominant clayey silt till deposit is estimated to be between 35 and 38°. The factor of safety against deep seated failure of the slope is estimated at 1.6 to 1.8.

The long term regression of these slopes will be dictated by solifluction movement being mobilized by ongoing erosion at the toe.

The riverbank slope at both locations is classified as a confined system with active toe erosion. The regulated development limit for this setting is established based on a toe erosion allowance, a stable slope angle, plus a 15 m allowance beyond the Erosion Hazard Limit. This is illustrated in the sketch below, excerpted from the GRCA policy document.

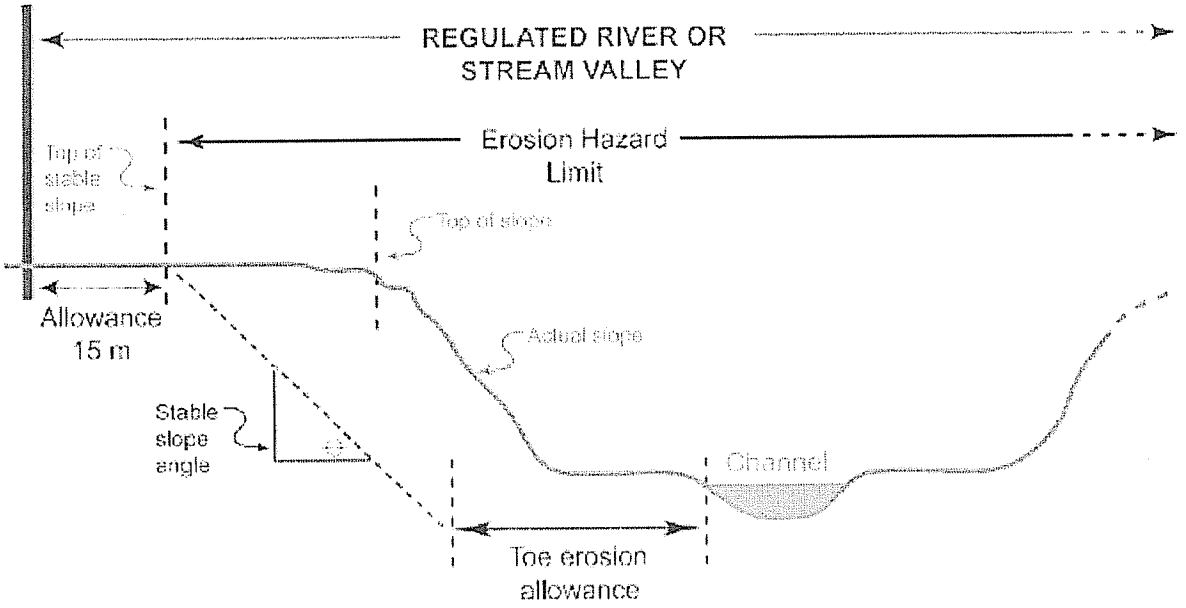


Figure 6. Riverine Erosion Hazard – Regulated Area for Apparent Oversteepened Valleys with Active Toe Erosion

Area 1 is located on the outside of a local meander loop, positioned about 70 m from the project path of a straight river alignment. Assuming that 70 m of movement has occurred over a 10,000 year time period since the recession of the Wisconsinan glaciation, an average erosion rate of 0.7 m per 100 years is inferred. The typical toe erosion allowance in dense, silt till subsoil setting is in the order of 1 m per 100 years. Although there was no erosion evident on the mapping and aerial photography researched, a Toe Erosion Allowance of 2 m per 100 years is estimated based on the observed scour at the toe and evidence of solifluction movement. The stable slope angle is conservatively estimated at 2.3H:1V, equivalent to the current average inclination at the steepest cross section in Area 1. For purposes of graphing the Hazard Limit line, the eroded toe of slope was taken as Elevation 454.0. The Hazard Limit thus established is illustrated on Drawing 1, appended.

Where a geotechnical study has been completed, Section 8.2.3 of the GRCA policy generally permits building construction to within the Erosion Hazard Allowance, providing the lots are set back a minimum of 6 m from the Hazard Limit. The permissible property line limit thus established for the lots is also illustrated on Drawing 1. Beyond the two areas studied in detail, the lot limit may be taken as 6 m from the crest of the slope, which is generally defined by the existing tree line.

It is noted that a storm water management pond will be located near the crest of the slope in Area 1. In accordance with Section 8.1.20 of the GRCA policy document, this will be permissible providing it is a dug pond and it does not encroach within the Hazard Limit. However, a portion of the perimeter fill berm along the north side of the pond encroaches beyond the Hazard Limit, which contravenes GRCA policy with regard to fill placement on slopes. The pond layout and grading plans will need to be revised accordingly.

Significant storm runoff discharged over the slope in unprotected channels will result in erosional problems. We therefore recommend that any storm discharge over the slope should generally be in controlled channels.

Along the crest of the existing slope, the existing ground surface should be maintained, as is, and vegetation cover should be maintained. During construction, fill and/or construction materials should be kept away from this area. As well, material should not be dumped over the crest of the slopes.

In addition, erosion control measures should be observed for the entire slope. Typically this would require maintenance of a healthy vegetation cover.

We trust this report has been completed within our terms of reference, and is sufficient for your immediate requirements. If you have any questions or require further information, please do not hesitate to contact our office.

Sincerely

Peto MacCallum Ltd.

Marian S. Molodecki, P.Eng.
Senior Consultant,
Geotechnical and Geoenvironmental Services

Gerry Mitchell, MEng, P.Eng.
Director
Branch Manager

MSM:sh

Enclosures:
List of Abbreviations
Log of Boreholes 3 and 6 from 09KF021
Drawing 1 – Hazard Limits

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. - Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)
Very Soft	0 - 2	0 - 12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	> 30	> 200

DENSENESS	N (blows/0.3 m)
Very Loose	0 - 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	> 50

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon
WS	Washed Sample
SB	Scraper Bucket Sample
AS	Auger Sample
CS	Chunk Sample
ST	Slotted Tube Sample
PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually
TW	Thinwall Open
TP	Thinwall Piston
OS	Oesterberg Sample
FS	Foil Sample
RC	Rock Core
USS	Undisturbed Shear Strength
RSS	Remoulded Shear Strength

SOIL TESTS

Qu	Unconfined Compression
Q	Undrained Triaxial
Qcu	Consolidated Undrained Triaxial
Qd	Drained Triaxial
LV	Laboratory Vane
FV	Field Vane
C	Consolidation

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

PROJECT FIFE ROAD SUBDIVISION
LOCATION Fife Road, Grand Valley, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2009 04 17
OUR PROJECT NO. 09KF021
ENGINEER M Molodecki
TECHNICIAN K Hanes

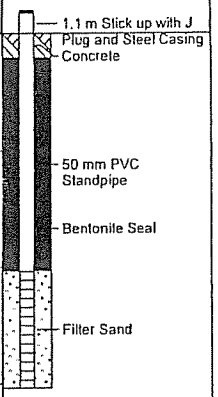
GROUND ELEVATION 471.02

DEPTH In METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES
	TOPSOIL: Firm to stiff dark brown		1	SS	8
0.60	clayey silt, trace gravel, occasional cobbles, rootlets, APL	470	2	SS	22
1.50	CLAYEY SILT TILL: Very stiff to hard brown clayey silt, trace gravel, occasional cobbles and boulders, APL/DTPL	469	3	SS	30
2.30	occasional wet medium sand seams				
	no sand seams	468	4	SS	28
			5	SS	32
4.05	becoming stiff, grey, APL	467			
			6	SS	13
5.05	BOREHOLE TERMINATED AT 5.05 m	466			

SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUND WATER OBSERVATIONS AND REMARKS



Water Level Reading:
04/17/2009: No water

NOTES

CHECKED BY

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 6

PROJECT FIFE ROAD SUBDIVISION
LOCATION Fife Road, Grand Valley, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2009 04 16
OUR PROJECT NO. 09KF021
ENGINEER M Molodecki
TECHNICIAN K. Hanes

DEPTH In METRES	DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 467.13						
0.20	TOPSOIL: Soft dark brown clayey silt, trace gravel, high organics, APL			1	SS	3	
	CLAYEY SILT TILL: Stiff clayey silt, trace gravel, numerous cobbles, occasional boulders, APL/WTPL		466	2	SS	12	
1.50	becoming APL with occasional dry brown sand seams		465	3	SS	8	
2.75	becoming very stiff with occasional wet gravelly sand seams		464	4	SS	17	
3.05	becoming hard, DTPL			5	SS	44	
4.00	SILT: Very dense brown silt, trace fine sand, moist to wet		463	6	SS	50 for 150 mm	
6.15	SAND: Very dense light brown fine sand, moist		462	7	SS	50 for 125 mm	Upon completion of drilling, borehole open with no free water
6.55	BOREHOLE TERMINATED AT 6.55 m		461				

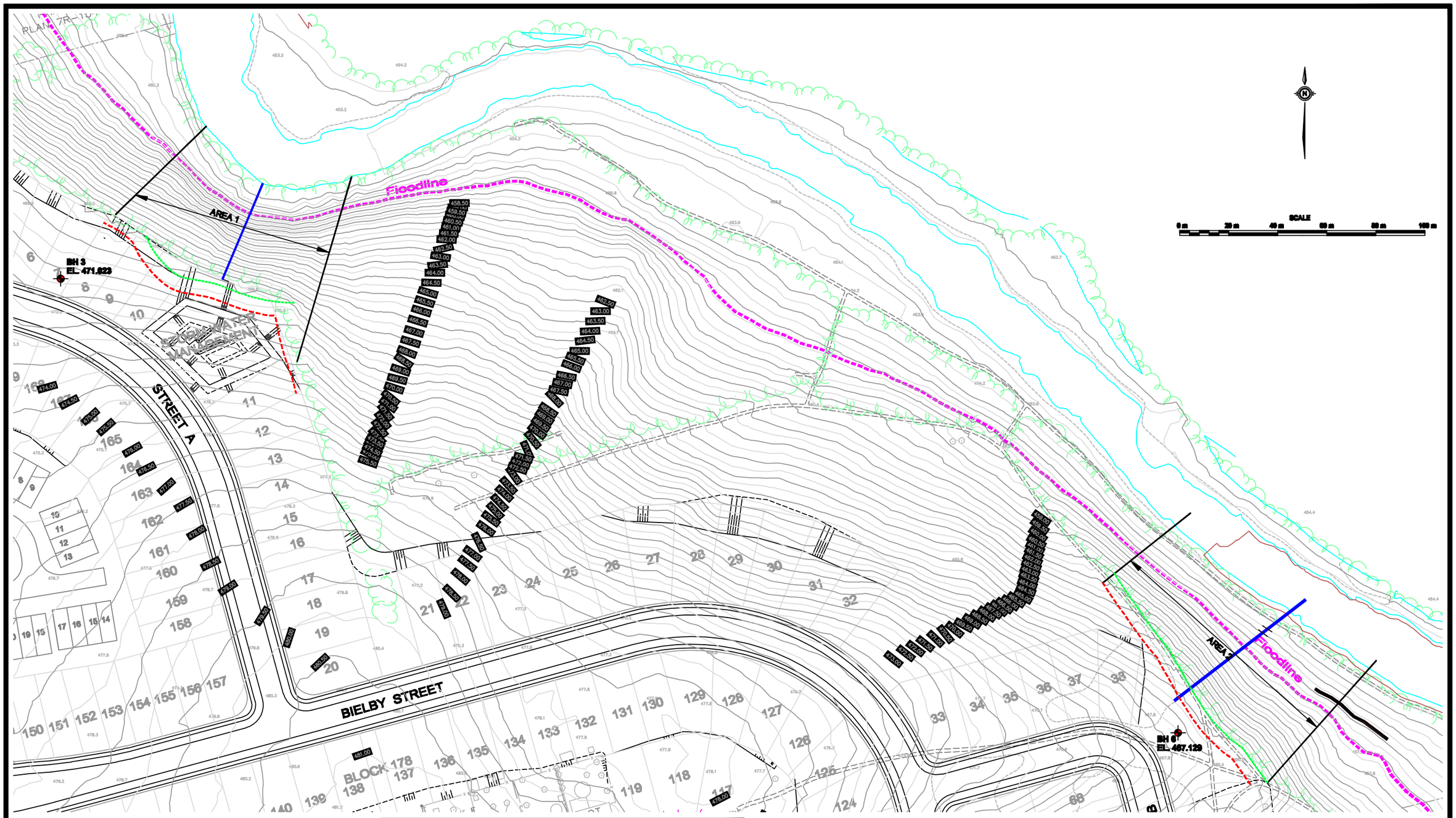
SHEAR STRENGTH C_u ▲ (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20 40 60 80)

LIQUID LIMIT ____ W_L
PLASTIC LIMIT ____ W_P
WATER CONTENT ____ W
W_P — W — W_L
WATER CONTENT % (10 20 30)

NOTES

CHECKED BY

LOG OF BOREHOLE 09KF021 LOGS GPJ PETOMAC GDT 2009 05 25



REFERENCE:

BOREHOLE LOCATION PLAN REPRODUCED FROM DRAWING SUPPLIED BY CLIENT.

NOTE:

THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

LEGEND:

- BOREHOLE FROM PREVIOUS INVESTIGATION (PML REF NO. 09KF021, REPORT 1)
- ANALYSED PROFILE
- HAZARD LIMIT
- PROPERTY LINE LIMITS FOR LOTS
- TREE LINE

GAMSBY AND MANNEROW LIMITED

GEOTECHNICAL SLOPE HAZARD ASSESSMENT
FIFE ROAD SUBDIVISION
GRAND VALLEY, ONTARIO

HAZARD LIMITS

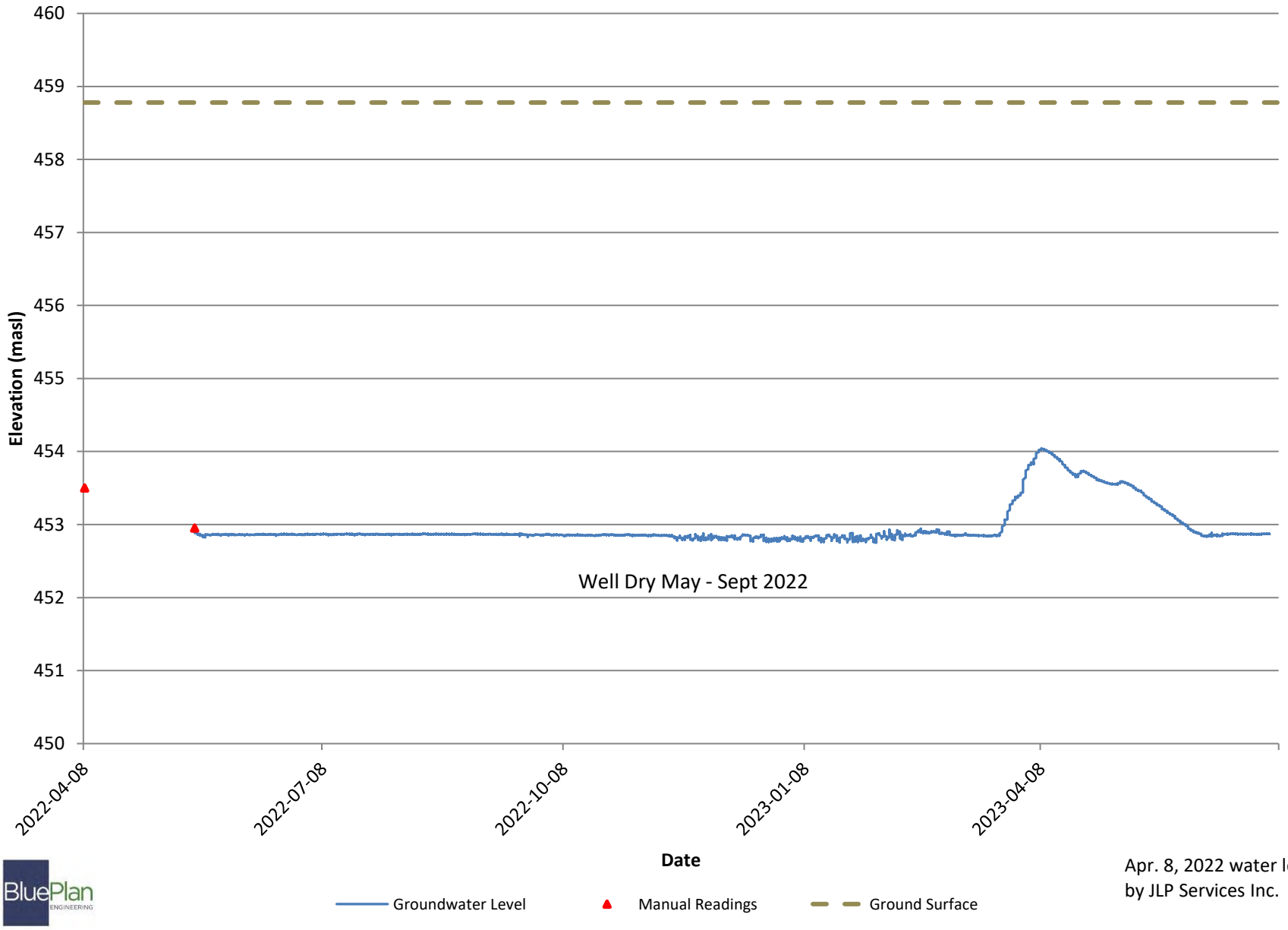
PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	M. MOLODECKI	FEBRUARY 2012	1:1500	09KF021A	1
APPROVED	M. MOLODECKI				

APPENDIX B

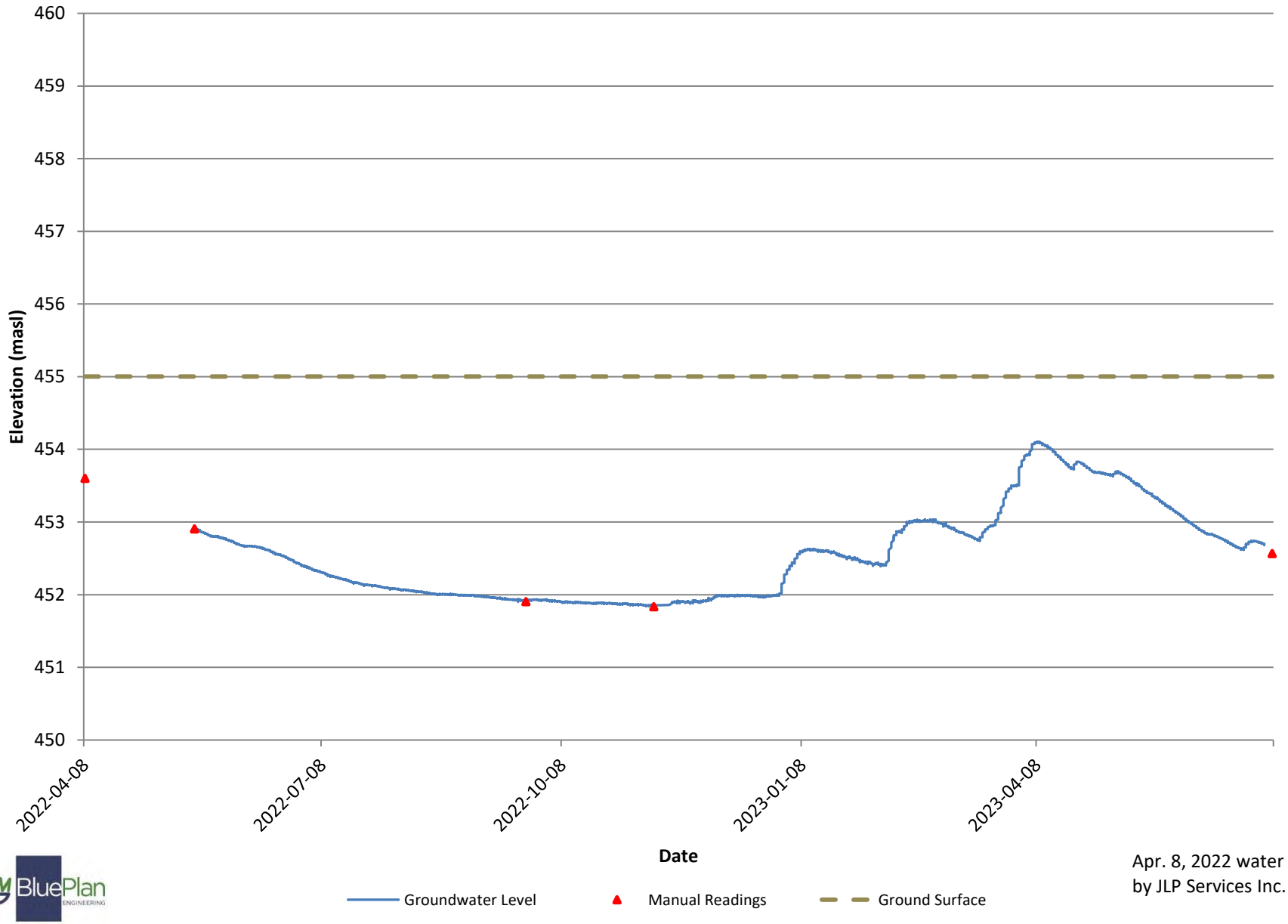
Groundwater Measurements by GM BluePlan Engineering Limited

MW1



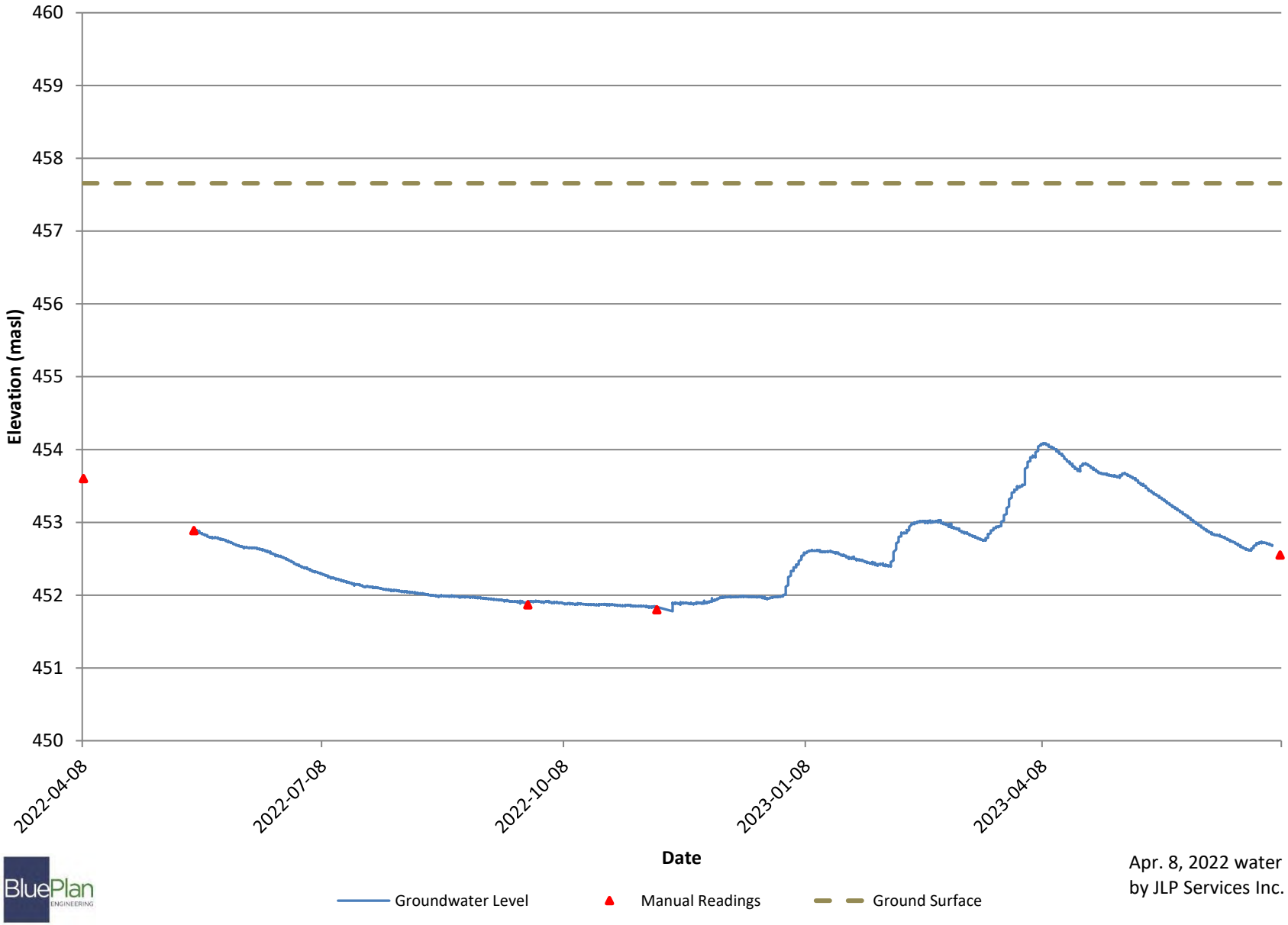
Apr. 8, 2022 water level
by JLP Services Inc.

MW2



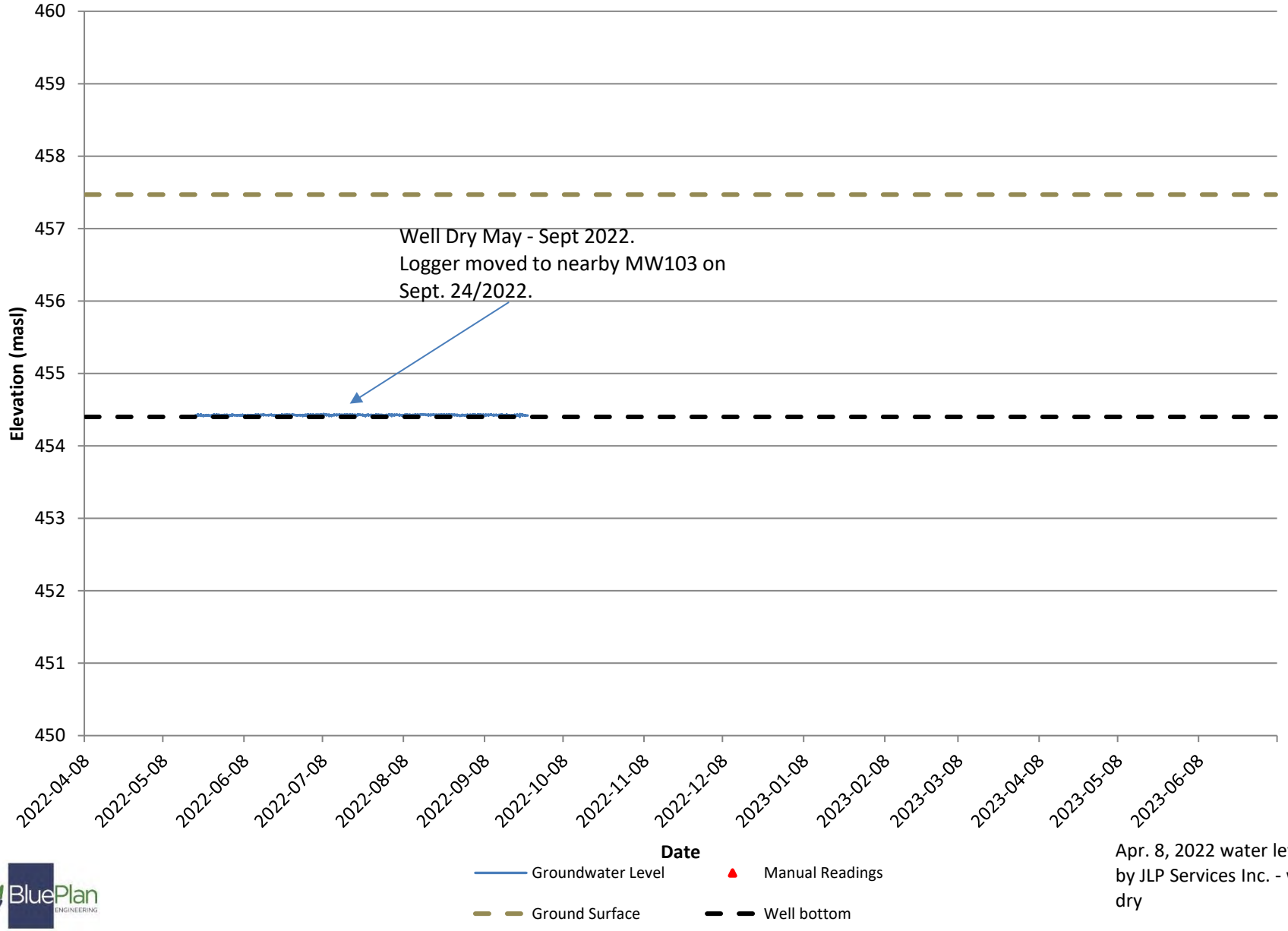
Apr. 8, 2022 water level by JLP Services Inc.

MW3

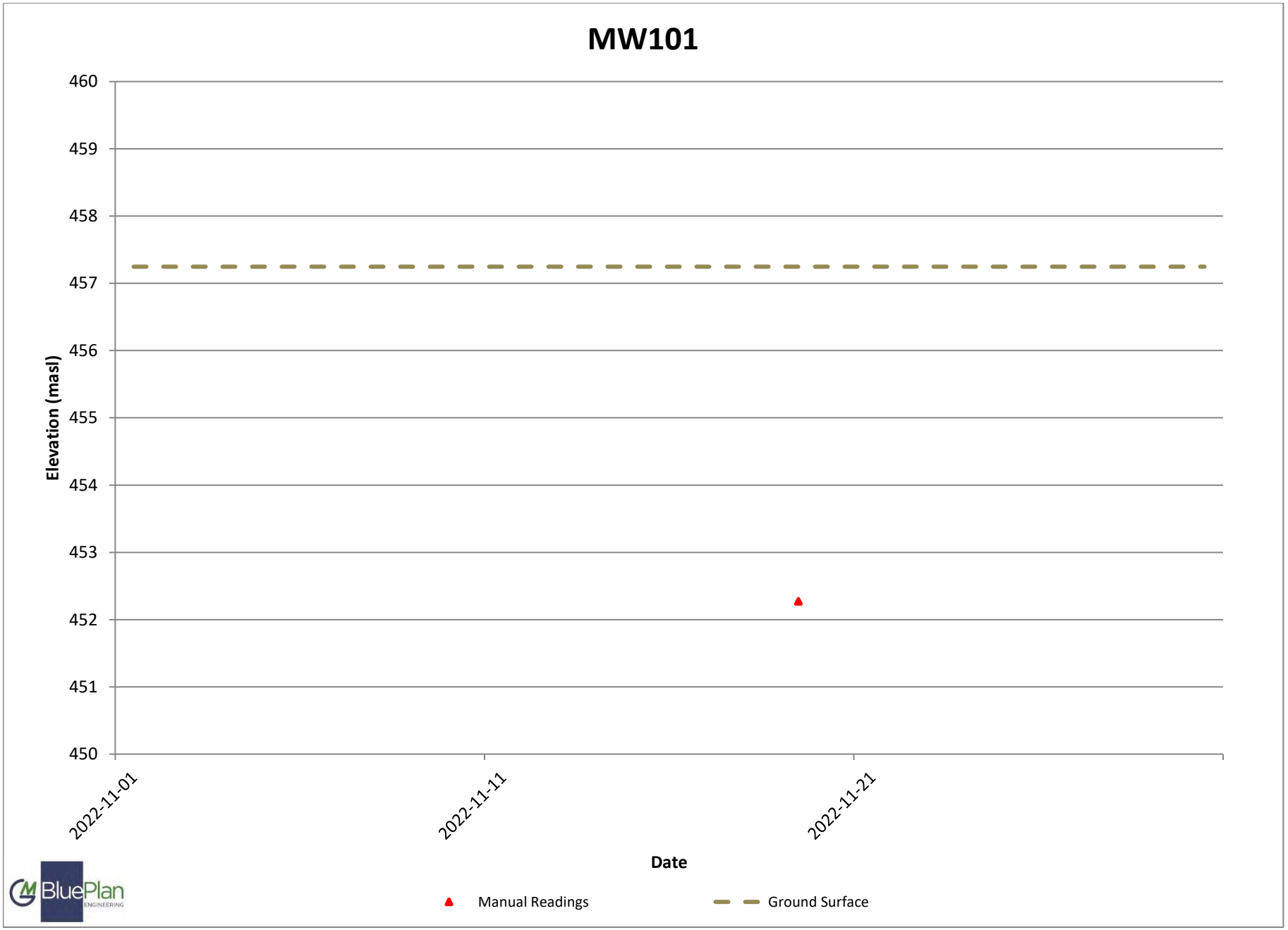


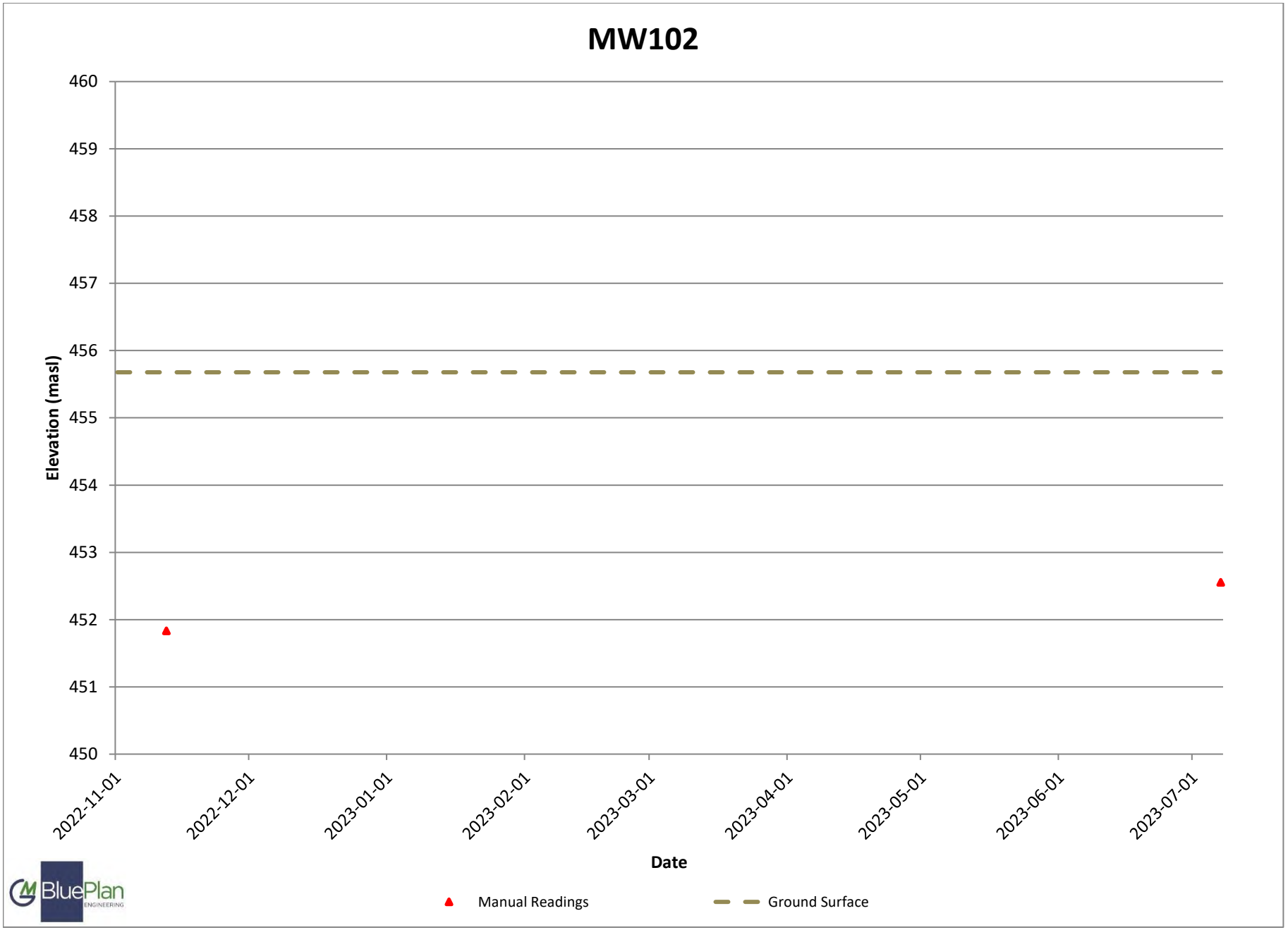
Apr. 8, 2022 water level
by JLP Services Inc.

MW4

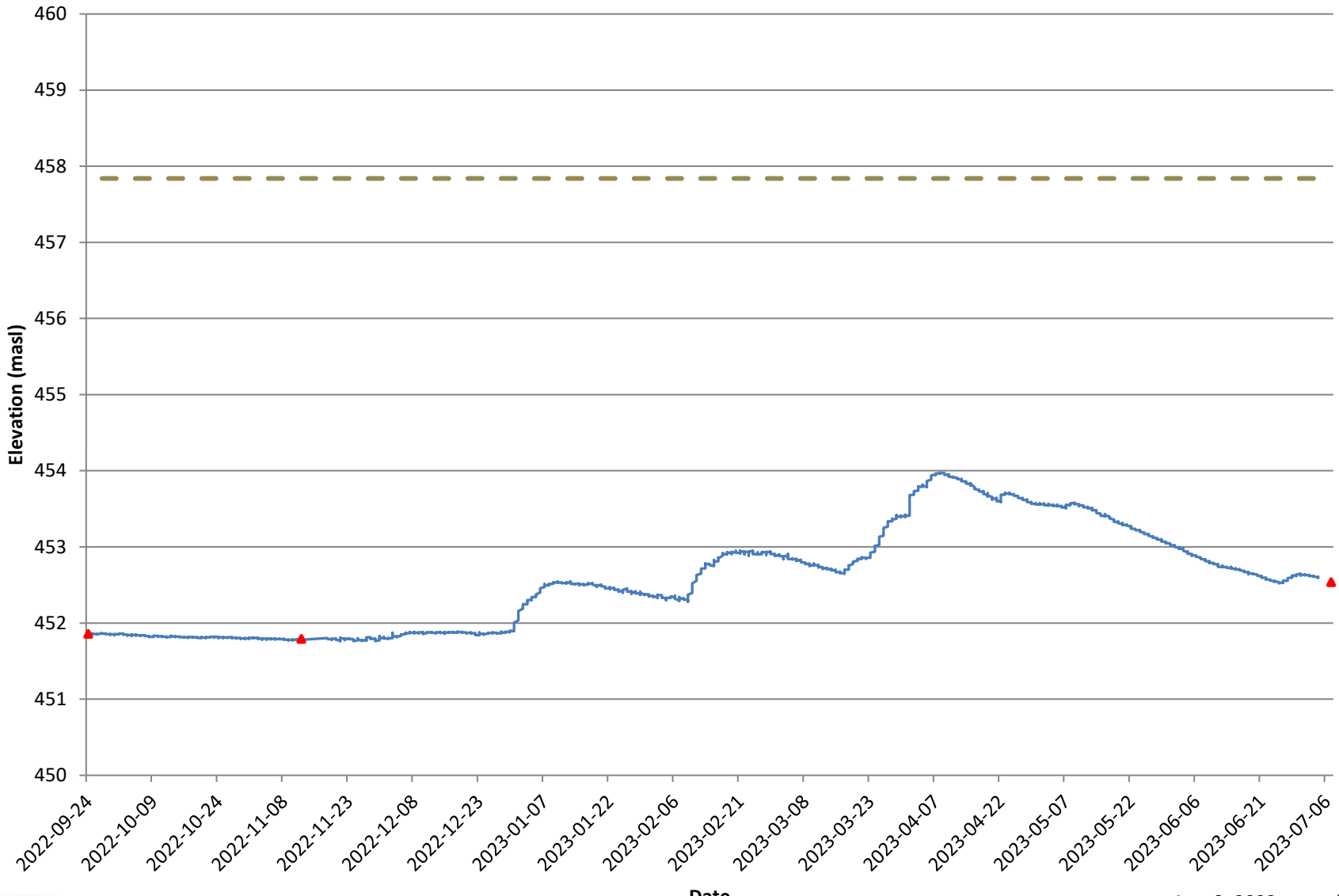


Apr. 8, 2022 water level by JLP Services Inc. - well dry


MW101
460
459
458
457
456
455
454
453
452
451
450
Elevation (masl)
2022-11-01
2022-11-11
2022-11-21
Date
BluePlan
ENGINEERING
Manual Readings
Ground Surface

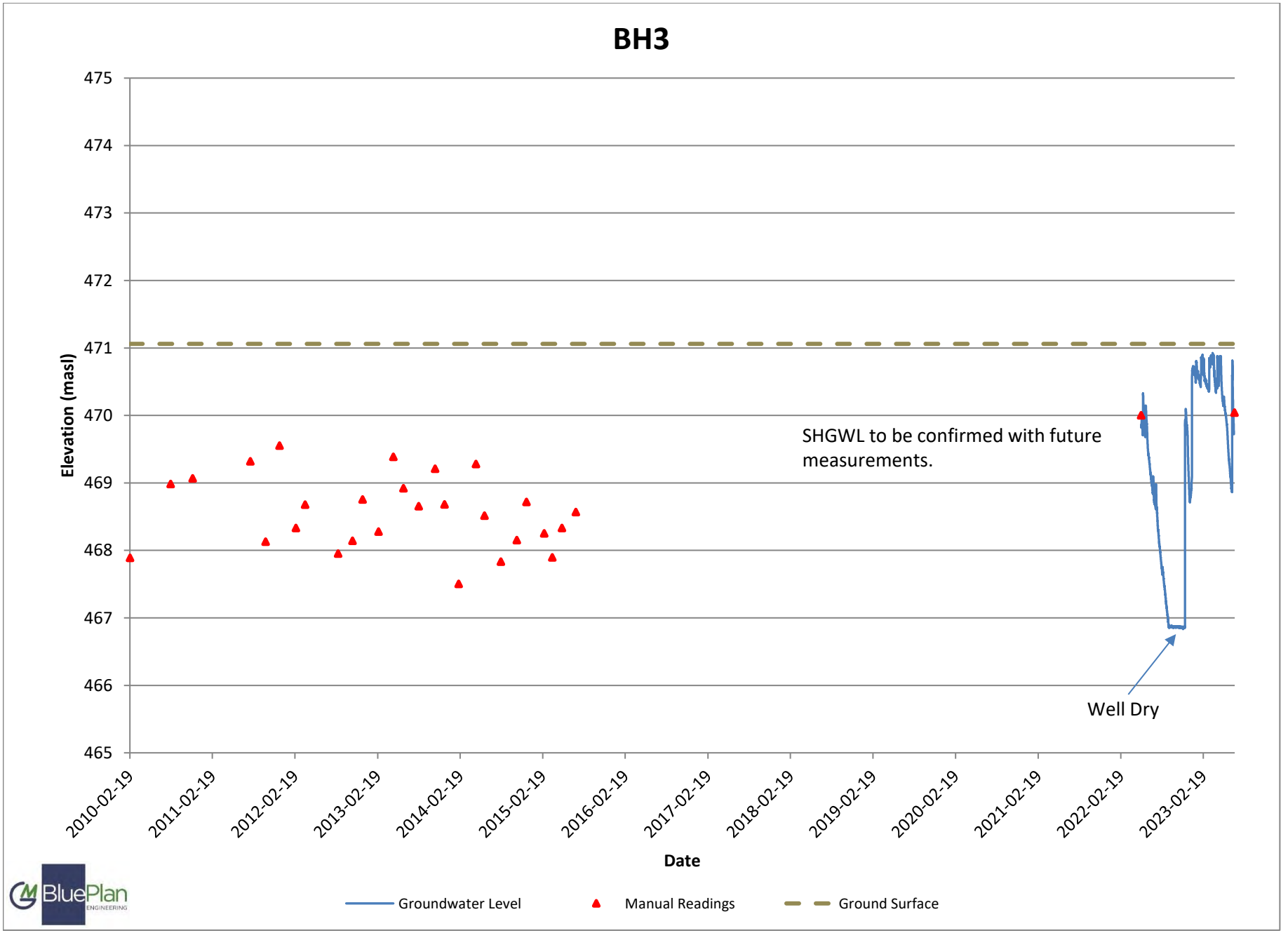

MW102
460
459
458
457
456
455
454
453
452
451
450
Elevation (masl)
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
Date
BluePlan ENGINEERING
Manual Readings
Ground Surface

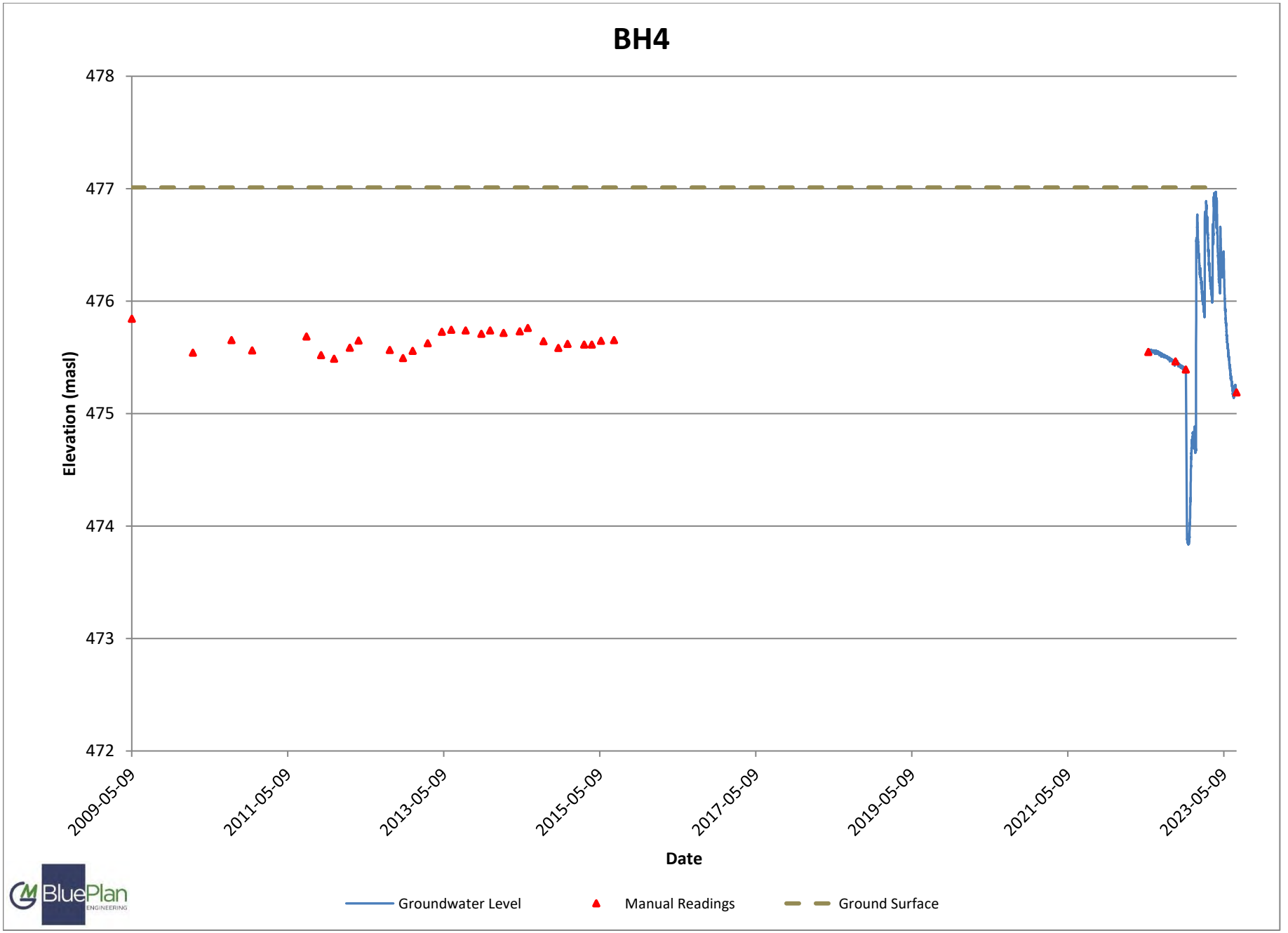
MW103

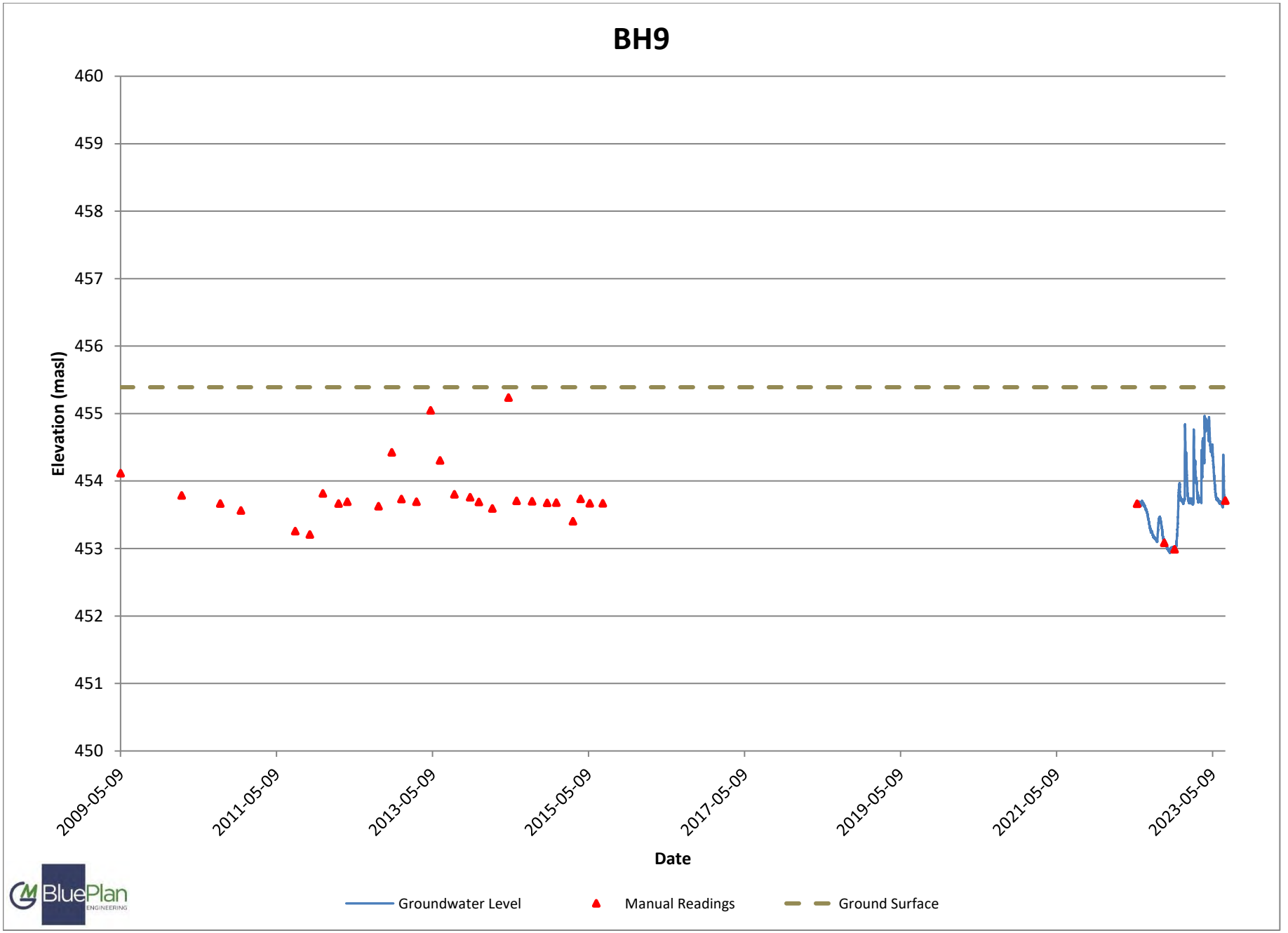


BluePlan ENGINEERING

Apr. 8, 2022 water level
by JLP Services Inc.


BH3
475
474
473
472
471
470
469
468
467
466
465
Elevation (masl)
2010-02-19
2011-02-19
2012-02-19
2013-02-19
2014-02-19
2015-02-19
2016-02-19
2017-02-19
2018-02-19
2019-02-19
2020-02-19
2021-02-19
2022-02-19
2023-02-19
Date
SHGWL to be confirmed with future measurements.
Well Dry
BluePlan ENGINEERING
Groundwater Level
Manual Readings
Ground Surface


BH4
478
477
476
475
474
473
472
Elevation (masl)
2009-05-09
2011-05-09
2013-05-09
2015-05-09
2017-05-09
2019-05-09
2021-05-09
2023-05-09
Date
BluePlan
ENGINEERING
Groundwater Level
Manual Readings
Ground Surface


BH9
460
459
458
457
456
455
454
453
452
451
450
Elevation (masl)
2009-05-09
2011-05-09
2013-05-09
2015-05-09
2017-05-09
2019-05-09
2021-05-09
2023-05-09
Date
BluePlan
ENGINEERING
Groundwater Level
Manual Readings
Ground Surface

APPENDIX C

Pre-Development Conditions
Stormwater Management Analysis

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                104-104 existing 002 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/21/2023 at 1:49:38 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.050   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            93.293    mm/hr"
"             Total depth                  33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 105"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.072     0.000     0.000     0.000 c.m/sec"
```

```
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  22.062     2.281      3.430      minutes"
"             Time to Centroid       96.472     86.938     87.492     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        99.54      121.66     221.19     c.m"
"             Rainfall losses        30.676     2.000      14.904     mm"
"             Runoff depth           2.338      31.014     18.110     mm"
"             Runoff volume          7.05       114.29     121.33     c.m"
"             Runoff coefficient     0.071      0.939      0.549      "
"             Maximum flow           0.004      0.072      0.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.072     0.072     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"        0.000   % Impervious"
"        4.920   Total Area"
"      175.000   Flow length"
"        8.000   Overland Slope"
"        4.920   Pervious Area"
"      175.000   Pervious length"
"        8.000   Pervious slope"
"        0.000   Impervious Area"
"      175.000   Impervious length"
"        8.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.042     0.072     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           4.920      0.000      4.920      hectare"
"             Time of concentration  41.936     4.335      41.935     minutes"
"             Time to Centroid       114.284    89.957     114.283    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        1624.29    0.00       1624.29    c.m"
"             Rainfall losses        30.670     1.796      30.669     mm"
"             Runoff depth           2.344      31.218     2.344      mm"
"             Runoff volume          115.35     0.00       115.35     c.m"
"             Runoff coefficient     0.071      0.000      0.071      "
```

```
"             Maximum flow           0.042      0.000      0.042      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.042     0.076     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Catchment 101"
"        0.000   % Impervious"
"        8.490   Total Area"
"      130.000   Flow length"
"       10.000   Overland Slope"
"        8.490   Pervious Area"
"      130.000   Pervious length"
"       10.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"       10.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.093     0.076     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           8.490      0.000      8.490      hectare"
"             Time of concentration  32.814     3.392      32.813     minutes"
"             Time to Centroid       106.157    88.635     106.157    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        2802.88    0.00       2802.89    c.m"
"             Rainfall losses        30.669     2.144      30.669     mm"
"             Runoff depth           2.345      30.870     2.345      mm"
"             Runoff volume          199.06     0.00       199.06     c.m"
"             Runoff coefficient     0.071      0.000      0.071      "
"             Maximum flow           0.093      0.000      0.093      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.093     0.144     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.093     0.144     0.144     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Grand River"
"             Maximum flow                  0.144    c.m/sec"
"             Hydrograph volume           435.741    c.m"
"                    0.093     0.144     0.144     0.144"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.093     0.000     0.144     0.144"
" 33          CATCHMENT 106"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          106   Catchment 106"
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.125     0.000     0.144     0.144 c.m/sec"
"             Catchment 106          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  48.108     4.973      7.458      minutes"
"             Time to Centroid       119.816    90.843     92.512     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        161.93     197.92     359.85     c.m"
"             Rainfall losses        30.669     1.629      14.697     mm"
"             Runoff depth           2.345      31.385     18.317     mm"
"             Runoff volume          11.50      188.15     199.65     c.m"
"             Runoff coefficient     0.071      0.951      0.555      "
"             Maximum flow           0.004      0.124      0.125      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.125     0.125     0.144     0.144"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
```

```
"            2   Horton equation"
"          102   Catchment 102"
"        1.000   % Impervious"
"        8.680   Total Area"
"      220.000   Flow length"
"        6.000   Overland Slope"
"        8.593   Pervious Area"
"      220.000   Pervious length"
"        6.000   Pervious slope"
"        0.087   Impervious Area"
"      220.000   Impervious length"
"        6.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.061     0.125     0.144     0.144 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           8.593      0.087      8.680      hectare"
"             Time of concentration  52.444     5.422      46.855     minutes"
"             Time to Centroid       123.693    91.446     119.860    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        2836.96    28.66      2865.61    c.m"
"             Rainfall losses        30.669     1.692      30.379     mm"
"             Runoff depth           2.345      31.322     2.635      mm"
"             Runoff volume          201.54     27.19      228.73     c.m"
"             Runoff coefficient     0.071      0.949      0.080      "
"             Maximum flow           0.059      0.018      0.061      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.061     0.147     0.144     0.144"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.061     0.147     0.147     0.144"
" 40          HYDROGRAPH   Combine    2000"
"            6   Combine "
"         2000   Node #"
"                Wetland"
"             Maximum flow                 0.147    c.m/sec"
"             Hydrograph volume          428.383    c.m"
"                     0.061     0.147     0.147     0.147"
" 40          HYDROGRAPH   Confluence    2000"
"            7   Confluence "
"         2000   Node #"
```

```
"               Wetland"
"             Maximum flow                  0.147    c.m/sec"
"             Hydrograph volume           428.383    c.m"
"                     0.061     0.147     0.147     0.000"
" 33          CATCHMENT 107"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           107   Catchment 107"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                     0.397     0.147     0.147     0.000 c.m/sec"
"             Catchment 107          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  55.598     5.748      8.629      minutes"
"             Time to Centroid       126.518    91.941     93.939     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        527.40     644.60     1172.00    c.m"
"             Rainfall losses        30.669     1.730      14.753     mm"
"             Runoff depth           2.345      31.284     18.261     mm"
"             Runoff volume          37.47      610.81     648.28     c.m"
"             Runoff coefficient     0.071      0.948      0.553      "
"             Maximum flow           0.011      0.397      0.397      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.397     0.544     0.147     0.000"
" 33          CATCHMENT 103"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           103   Catchment 103"
"         0.000   % Impervious"
```

```
"        6.330   Total Area"
"      160.000   Flow length"
"        9.000   Overland Slope"
"        6.330   Pervious Area"
"      160.000   Pervious length"
"        9.000   Pervious slope"
"        0.000   Impervious Area"
"      160.000   Impervious length"
"        9.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.059     0.544     0.147     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           6.330      0.000      6.330      hectare"
"             Time of concentration  38.361     3.966      38.360     minutes"
"             Time to Centroid       111.070    89.459     111.070    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        2089.78    0.00       2089.78    c.m"
"             Rainfall losses        30.671     1.977      30.671     mm"
"             Runoff depth           2.343      31.037     2.343      mm"
"             Runoff volume          148.30     0.00       148.30     c.m"
"             Runoff coefficient     0.071      0.000      0.071      "
"             Maximum flow           0.059      0.000      0.059      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.059     0.550     0.147     0.000"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.300     0.550     0.147     0.000 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  44.057     4.555      6.834      minutes"
"             Time to Centroid       116.160    90.239     91.735     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        386.26     472.10     858.36     c.m"
"             Rainfall losses        30.671     1.703      14.738     mm"
"             Runoff depth           2.343      31.311     18.276     mm"
"             Runoff volume          27.41      447.75     475.16     c.m"
"             Runoff coefficient     0.071      0.948      0.554      "
"             Maximum flow           0.009      0.299      0.300      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.300     0.850     0.147     0.000"
" 64          SHOW TABLE"
"            2   Flow hydrograph"
"            4   Inflow Hydrograph"
"             Maximum flow                  0.850    c.m/sec"
"             Hydrograph volume          1700.128    c.m"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.300     0.850     0.850     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"          1000   Node #"
"                 Grand River"
"             Maximum flow                  0.935    c.m/sec"
"             Hydrograph volume          2135.870    c.m"
"                     0.300     0.850     0.850     0.935"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"          1000   Node #"
"                 Grand River"
"             Maximum flow                  0.935    c.m/sec"
"             Hydrograph volume          2135.870    c.m"
"                     0.300     0.935     0.850     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                     4.437    hectare"
```

```
"             Total % impervious                        12.214"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                104-104 existing 005 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/21/2023 at 1:50:18 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.586    mm/hr"
"             Total depth                 49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 105"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.104     0.000     0.000     0.000 c.m/sec"
```

```
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  14.420     2.108      4.886      minutes"
"             Time to Centroid       100.204    85.724     88.991     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        150.12     183.48     333.60     c.m"
"             Rainfall losses        32.852     2.224      16.007     mm"
"             Runoff depth           16.939     47.568     33.785     mm"
"             Runoff volume          51.07      175.29     226.36     c.m"
"             Runoff coefficient     0.340      0.955      0.679      "
"             Maximum flow           0.028      0.095      0.104      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.104     0.104     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"        0.000   % Impervious"
"        4.920   Total Area"
"      175.000   Flow length"
"        8.000   Overland Slope"
"        4.920   Pervious Area"
"      175.000   Pervious length"
"        8.000   Pervious slope"
"        0.000   Impervious Area"
"      175.000   Impervious length"
"        8.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.294     0.104     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           4.920      0.000      4.920      hectare"
"             Time of concentration  27.409     4.007      27.409     minutes"
"             Time to Centroid       115.162    88.415     115.162    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        2449.75    0.00       2449.75    c.m"
"             Rainfall losses        32.839     2.133      32.839     mm"
"             Runoff depth           16.953     47.659     16.953     mm"
"             Runoff volume          834.06     0.00       834.07     c.m"
"             Runoff coefficient     0.340      0.000      0.340      "
```

```
"             Maximum flow           0.294      0.000      0.294      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.294     0.334     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Catchment 101"
"        0.000   % Impervious"
"        8.490   Total Area"
"      130.000   Flow length"
"       10.000   Overland Slope"
"        8.490   Pervious Area"
"      130.000   Pervious length"
"       10.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"       10.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.610     0.334     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           8.490      0.000      8.490      hectare"
"             Time of concentration  21.447     3.135      21.447     minutes"
"             Time to Centroid       108.288    87.231     108.288    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        4227.31    0.00       4227.31    c.m"
"             Rainfall losses        32.850     2.512      32.850     mm"
"             Runoff depth           16.942     47.279     16.942     mm"
"             Runoff volume          1438.37    0.00       1438.38    c.m"
"             Runoff coefficient     0.340      0.000      0.340      "
"             Maximum flow           0.610      0.000      0.610      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.610     0.943     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.610     0.943     0.943     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Grand River"
"             Maximum flow                  0.943    c.m/sec"
"             Hydrograph volume          2498.804    c.m"
"                     0.610     0.943     0.943     0.943"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                     0.610     0.000     0.943     0.943"
" 33          CATCHMENT 106"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           106   Catchment 106"
"        55.000   % Impervious"
"         1.090   Total Area"
"       110.000   Flow length"
"         2.000   Overland Slope"
"         0.491   Pervious Area"
"       110.000   Pervious length"
"         2.000   Pervious slope"
"         0.600   Impervious Area"
"       110.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                     0.169     0.000     0.943     0.943 c.m/sec"
"              Catchment 106          Pervious   Impervious Total Area "
"              Surface Area           0.491      0.600      1.090      hectare"
"              Time of concentration  31.443     4.597      10.620     minutes"
"              Time to Centroid       119.805    89.191     96.060     minutes"
"              Rainfall depth         49.792     49.792     49.792     mm"
"              Rainfall volume        244.23     298.50     542.73     c.m"
"              Rainfall losses        32.853     1.876      15.816     mm"
"              Runoff depth           16.939     47.916     33.976     mm"
"              Runoff volume          83.09      287.25     370.34     c.m"
"              Runoff coefficient     0.340      0.962      0.682      "
"              Maximum flow           0.027      0.165      0.169      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.169     0.169     0.943     0.943"
" 33          CATCHMENT 102"
"             1   Triangular SCS"
"             1   Equal length"
```

```
"            2   Horton equation"
"          102   Catchment 102"
"        1.000   % Impervious"
"        8.680   Total Area"
"      220.000   Flow length"
"        6.000   Overland Slope"
"        8.593   Pervious Area"
"      220.000   Pervious length"
"        6.000   Pervious slope"
"        0.087   Impervious Area"
"      220.000   Impervious length"
"        6.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.439     0.169     0.943     0.943 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           8.593      0.087      8.680      hectare"
"             Time of concentration  34.277     5.011      33.463     minutes"
"             Time to Centroid       123.076    89.738     122.149    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        4278.70    43.22      4321.92    c.m"
"             Rainfall losses        32.841     1.787      32.531     mm"
"             Runoff depth           16.950     48.005     17.261     mm"
"             Runoff volume          1456.58    41.67      1498.25    c.m"
"             Runoff coefficient     0.340      0.964      0.347      "
"             Maximum flow           0.434      0.024      0.439      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.439     0.497     0.943     0.943"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.439     0.497     0.497     0.943"
" 40          HYDROGRAPH   Combine    2000"
"            6   Combine "
"         2000   Node #"
"                Wetland"
"             Maximum flow                 0.497    c.m/sec"
"             Hydrograph volume         1868.590    c.m"
"                     0.439     0.497     0.497     0.497"
" 40          HYDROGRAPH   Confluence    2000"
"            7   Confluence "
"         2000   Node #"
```

```
"               Wetland"
"             Maximum flow                  0.497    c.m/sec"
"             Hydrograph volume          1868.590    c.m"
"                     0.439     0.497     0.497     0.000"
" 33          CATCHMENT 107"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           107   Catchment 107"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                     0.544     0.497     0.497     0.000 c.m/sec"
"             Catchment 107          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  36.338     5.313      12.264     minutes"
"             Time to Centroid       125.451    90.132     98.045     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        795.42     972.18     1767.60    c.m"
"             Rainfall losses        32.839     1.757      15.744     mm"
"             Runoff depth           16.953     48.035     34.048     mm"
"             Runoff volume          270.82     937.88     1208.71    c.m"
"             Runoff coefficient     0.340      0.965      0.684      "
"             Maximum flow           0.078      0.534      0.544      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.544     0.796     0.497     0.000"
" 33          CATCHMENT 103"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           103   Catchment 103"
"         0.000   % Impervious"
```

```
"        6.330   Total Area"
"      160.000   Flow length"
"        9.000   Overland Slope"
"        6.330   Pervious Area"
"      160.000   Pervious length"
"        9.000   Pervious slope"
"        0.000   Impervious Area"
"      160.000   Impervious length"
"        9.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.404     0.796     0.497     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           6.330      0.000      6.330      hectare"
"             Time of concentration  25.072     3.666      25.072     minutes"
"             Time to Centroid       112.469    87.991     112.469    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        3151.81    0.00       3151.81    c.m"
"             Rainfall losses        32.853     2.512      32.853     mm"
"             Runoff depth           16.939     47.280     16.939     mm"
"             Runoff volume          1072.25    0.00       1072.25    c.m"
"             Runoff coefficient     0.340      0.000      0.340      "
"             Maximum flow           0.404      0.000      0.404      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.404     1.092     0.497     0.000"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.405     1.092     0.497     0.000 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  28.795     4.210      9.735      minutes"
"             Time to Centroid       116.746    88.669     94.978     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        582.56     712.02     1294.58    c.m"
"             Rainfall losses        32.859     1.996      15.884     mm"
"             Runoff depth           16.933     47.796     33.908     mm"
"             Runoff volume          198.12     683.48     881.60     c.m"
"             Runoff coefficient     0.340      0.960      0.681      "
"             Maximum flow           0.068      0.395      0.405      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.405     1.276     0.497     0.000"
" 64          SHOW TABLE"
"            2   Flow hydrograph"
"            4   Inflow Hydrograph"
"             Maximum flow                  1.276    c.m/sec"
"             Hydrograph volume          5031.145    c.m"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.405     1.276     1.276     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Grand River"
"             Maximum flow                  2.172    c.m/sec"
"             Hydrograph volume          7529.947    c.m"
"                     0.405     1.276     1.276     2.172"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Grand River"
"             Maximum flow                  2.172    c.m/sec"
"             Hydrograph volume          7529.947    c.m"
"                     0.405     2.172     1.276     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                     4.437    hectare"
```

```
"             Total % impervious                        12.214"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                104-104 existing 100 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/21/2023 at 1:50:53 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.020   Coefficient A"
"       34.699   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          168.777    mm/hr"
"             Total depth                 97.921    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 105"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.233     0.000     0.000     0.000 c.m/sec"
```

```
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  10.076     1.799      4.711      minutes"
"             Time to Centroid       97.792     84.352     89.081     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        295.23     360.84     656.07     c.m"
"             Rainfall losses        34.803     2.791      17.197     mm"
"             Runoff depth           63.119     95.130     80.725     mm"
"             Runoff volume          190.30     350.55     540.86     c.m"
"             Runoff coefficient     0.645      0.971      0.824      "
"             Maximum flow           0.099      0.153      0.233      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.233     0.233     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"        0.000   % Impervious"
"        4.920   Total Area"
"      175.000   Flow length"
"        8.000   Overland Slope"
"        4.920   Pervious Area"
"      175.000   Pervious length"
"        8.000   Pervious slope"
"        0.000   Impervious Area"
"      175.000   Impervious length"
"        8.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.192     0.233     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           4.920      0.000      4.920      hectare"
"             Time of concentration  19.152     3.420      19.152     minutes"
"             Time to Centroid       108.129    86.591     108.129    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        4817.72    0.00       4817.73    c.m"
"             Rainfall losses        34.540     3.750      34.540     mm"
"             Runoff depth           63.381     94.172     63.381     mm"
"             Runoff volume          3118.34    0.00       3118.35    c.m"
"             Runoff coefficient     0.647      0.000      0.647      "
```

```
"             Maximum flow           1.192      0.000      1.192      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.192     1.364     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Catchment 101"
"        0.000   % Impervious"
"        8.490   Total Area"
"      130.000   Flow length"
"       10.000   Overland Slope"
"        8.490   Pervious Area"
"      130.000   Pervious length"
"       10.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"       10.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    2.442     1.364     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           8.490      0.000      8.490      hectare"
"             Time of concentration  14.986     2.676      14.986     minutes"
"             Time to Centroid       103.392    85.567     103.392    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        8313.51    0.01       8313.52    c.m"
"             Rainfall losses        34.574     3.577      34.574     mm"
"             Runoff depth           63.347     94.344     63.347     mm"
"             Runoff volume          5378.16    0.01       5378.17    c.m"
"             Runoff coefficient     0.647      0.000      0.647      "
"             Maximum flow           2.442      0.000      2.442      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.442     3.805     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    2.442     3.805     3.805     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Grand River"
"             Maximum flow                  3.805    c.m/sec"
"             Hydrograph volume          9037.379    c.m"
"                     2.442     3.805     3.805     3.805"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     2.442     0.000     3.805     3.805"
" 33          CATCHMENT 106"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          106   Catchment 106"
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.301     0.000     3.805     3.805 c.m/sec"
"             Catchment 106          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  21.971     3.923      10.297     minutes"
"             Time to Centroid       111.333    87.214     95.731     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        480.30     587.04     1067.34    c.m"
"             Rainfall losses        34.507     2.882      17.113     mm"
"             Runoff depth           63.414     95.039     80.808     mm"
"             Runoff volume          311.04     569.76     880.81     c.m"
"             Runoff coefficient     0.648      0.971      0.825      "
"             Maximum flow           0.114      0.260      0.301      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.301     0.301     3.805     3.805"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
```

```
"            2   Horton equation"
"          102   Catchment 102"
"        1.000   % Impervious"
"        8.680   Total Area"
"      220.000   Flow length"
"        6.000   Overland Slope"
"        8.593   Pervious Area"
"      220.000   Pervious length"
"        6.000   Pervious slope"
"        0.087   Impervious Area"
"      220.000   Impervious length"
"        6.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.891     0.301     3.805     3.805 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           8.593      0.087      8.680      hectare"
"             Time of concentration  23.951     4.277      23.656     minutes"
"             Time to Centroid       113.589    87.628     113.200    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        8414.58    85.00      8499.57    c.m"
"             Rainfall losses        34.508     2.400      34.187     mm"
"             Runoff depth           63.413     95.522     63.734     mm"
"             Runoff volume          5449.21    82.91      5532.12    c.m"
"             Runoff coefficient     0.648      0.975      0.651      "
"             Maximum flow           1.874      0.038      1.891      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.891     2.116     3.805     3.805"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.891     2.116     2.116     3.805"
" 40          HYDROGRAPH   Combine    2000"
"            6   Combine "
"         2000   Node #"
"                Wetland"
"             Maximum flow                 2.116    c.m/sec"
"             Hydrograph volume         6412.921    c.m"
"                     1.891     2.116     2.116     2.116"
" 40          HYDROGRAPH   Confluence    2000"
"            7   Confluence "
"         2000   Node #"
```

```
"               Wetland"
"             Maximum flow                  2.116    c.m/sec"
"             Hydrograph volume          6412.922    c.m"
"                     1.891     2.116     2.116     0.000"
" 33          CATCHMENT 107"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           107   Catchment 107"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                     0.948     2.116     2.116     0.000 c.m/sec"
"             Catchment 107          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  25.391     4.534      11.868     minutes"
"             Time to Centroid       115.220    87.952     97.540     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1564.29    1911.91    3476.21    c.m"
"             Rainfall losses        34.527     2.269      16.785     mm"
"             Runoff depth           63.395     95.653     81.137     mm"
"             Runoff volume          1012.73    1867.62    2880.35    c.m"
"             Runoff coefficient     0.647      0.977      0.829      "
"             Maximum flow           0.333      0.843      0.948      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.948     2.824     2.116     0.000"
" 33          CATCHMENT 103"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           103   Catchment 103"
"         0.000   % Impervious"
```

```
"        6.330   Total Area"
"      160.000   Flow length"
"        9.000   Overland Slope"
"        6.330   Pervious Area"
"      160.000   Pervious length"
"        9.000   Pervious slope"
"        0.000   Impervious Area"
"      160.000   Impervious length"
"        9.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.633     2.824     2.116     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           6.330      0.000      6.330      hectare"
"             Time of concentration  17.519     3.129      17.519     minutes"
"             Time to Centroid       106.265    86.212     106.265    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        6198.41    0.01       6198.42    c.m"
"             Rainfall losses        34.499     3.700      34.499     mm"
"             Runoff depth           63.423     94.221     63.423     mm"
"             Runoff volume          4014.64    0.01       4014.65    c.m"
"             Runoff coefficient     0.648      0.000      0.648      "
"             Maximum flow           1.633      0.000      1.633      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.633     4.411     2.116     0.000"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.730     4.411     2.116     0.000 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  20.121     3.593      9.455      minutes"
"             Time to Centroid       109.215    86.819     94.762     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1145.68    1400.27    2545.95    c.m"
"             Rainfall losses        34.520     3.529      17.475     mm"
"             Runoff depth           63.401     94.392     80.446     mm"
"             Runoff volume          741.80     1349.81    2091.61    c.m"
"             Runoff coefficient     0.647      0.964      0.822      "
"             Maximum flow           0.277      0.616      0.730      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.730     4.999     2.116     0.000"
" 64          SHOW TABLE"
"            2   Flow hydrograph"
"            4   Inflow Hydrograph"
"             Maximum flow                  4.999    c.m/sec"
"             Hydrograph volume         15399.529    c.m"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.730     4.999     4.999     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Grand River"
"             Maximum flow                  8.805    c.m/sec"
"             Hydrograph volume         24436.910    c.m"
"                     0.730     4.999     4.999     8.805"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Grand River"
"             Maximum flow                  8.805    c.m/sec"
"             Hydrograph volume         24436.910    c.m"
"                     0.730     8.805     4.999     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                     4.437    hectare"
```

```
"             Total % impervious                        12.214"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                     104-104 existing Reg.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/21/2023 at 1:51:38 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 105"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.078     0.000     0.000     0.000 c.m/sec"
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  16.093     2.860      7.181      minutes"
"             Time to Centroid       2720.207   2251.465   2404.533   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        859.28     1050.22    1909.50    c.m"
"             Rainfall losses        139.563    39.596     84.581     mm"
"             Runoff depth           145.437    245.404    200.419    mm"
"             Runoff volume          438.49     904.31     1342.81    c.m"
"             Runoff coefficient     0.510      0.861      0.703      "
"             Maximum flow           0.031      0.047      0.078      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.078     0.078     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"        0.000   % Impervious"
"        4.920   Total Area"
"      175.000   Flow length"
"        8.000   Overland Slope"
"        4.920   Pervious Area"
"      175.000   Pervious length"
"        8.000   Pervious slope"
"        0.000   Impervious Area"
"      175.000   Impervious length"
"        8.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.538     0.078     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           4.920      0.000      4.920      hectare"
"             Time of concentration  30.590     5.436      30.590     minutes"
"             Time to Centroid       2736.207   2231.294   2736.206   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1.4022     0.0000     1.4022     ha-m"
"             Rainfall losses        139.351    31.050     139.351    mm"
"             Runoff depth           145.649    253.950    145.649    mm"
"             Runoff volume          7165.91    0.01       7165.92    c.m"
"             Runoff coefficient     0.511      0.000      0.511      "
"             Maximum flow           0.538      0.000      0.538      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.538     0.601     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Catchment 101"
"        0.000   % Impervious"
"        8.490   Total Area"
"      130.000   Flow length"
"       10.000   Overland Slope"
"        8.490   Pervious Area"
"      130.000   Pervious length"
"       10.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"       10.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.896     0.601     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           8.490      0.000      8.490      hectare"
"             Time of concentration  23.936     4.253      23.936     minutes"
"             Time to Centroid       2730.043   2232.872   2730.043   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        2.4196     0.0000     2.4196     ha-m"
"             Rainfall losses        139.107    35.924     139.107    mm"
"             Runoff depth           145.893    249.076    145.893    mm"
"             Runoff volume          1.2386     0.0000     1.2386     ha-m"
"             Runoff coefficient     0.512      0.000      0.512      "
"             Maximum flow           0.896      0.000      0.896      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.896     1.497     0.000     0.000"
```

```
" 40          HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.896     1.497     1.497     0.000"
" 40          HYDROGRAPH   Combine    1000"
"             6   Combine "
"          1000   Node #"
"                 Grand River"
"              Maximum flow                  1.497    c.m/sec"
"              Hydrograph volume         20895.053    c.m"
"                      0.896     1.497     1.497     1.497"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                      0.896     0.000     1.497     1.497"
" 33          CATCHMENT 106"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           106   Catchment 106"
"        55.000   % Impervious"
"         1.090   Total Area"
"       110.000   Flow length"
"         2.000   Overland Slope"
"         0.491   Pervious Area"
"       110.000   Pervious length"
"         2.000   Pervious slope"
"         0.600   Impervious Area"
"       110.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.117     0.000     1.497     1.497 c.m/sec"
"              Catchment 106          Pervious   Impervious Total Area "
"              Surface Area           0.491      0.600      1.090      hectare"
"              Time of concentration  35.092     6.236      15.325     minutes"
"              Time to Centroid       2739.025   2235.505   2394.105   minutes"
"              Rainfall depth         285.000    285.000    285.000    mm"
"              Rainfall volume        1397.93    1708.57    3106.50    c.m"
"              Rainfall losses        140.362    27.637     78.363     mm"
"              Runoff depth           144.638    257.363    206.637    mm"
"              Runoff volume          709.45     1542.89    2252.34    c.m"
"              Runoff coefficient     0.508      0.903      0.725      "
"              Maximum flow           0.054      0.076      0.117      c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.117     0.117     1.497     1.497"
" 33          CATCHMENT 102"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           102   Catchment 102"
"         1.000   % Impervious"
"         8.680   Total Area"
"       220.000   Flow length"
"         6.000   Overland Slope"
"         8.593   Pervious Area"
"       220.000   Pervious length"
"         6.000   Pervious slope"
"         0.087   Impervious Area"
"       220.000   Impervious length"
"         6.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.950     0.117     1.497     1.497 c.m/sec"
"              Catchment 102          Pervious   Impervious Total Area "
"              Surface Area           8.593      0.087      8.680      hectare"
"              Time of concentration  38.255     6.798      37.689     minutes"
"              Time to Centroid       2741.159   2241.450   2732.164   minutes"
"              Rainfall depth         285.000    285.000    285.000    mm"
"              Rainfall volume        2.4491     0.0247     2.4738     ha-m"
"              Rainfall losses        141.565    24.677     140.396    mm"
"              Runoff depth           143.435    260.323    144.604    mm"
"              Runoff volume          1.2326     0.0226     1.2552     ha-m"
"              Runoff coefficient     0.503      0.913      0.507      "
"              Maximum flow           0.943      0.011      0.950      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.950     1.056     1.497     1.497"
" 40          HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.950     1.056     1.056     1.497"
" 40          HYDROGRAPH   Combine    2000"
"             6   Combine "
"          2000   Node #"
"                 Wetland"
```

```
"             Maximum flow                  1.056    c.m/sec"
"             Hydrograph volume         14803.967    c.m"
"                     0.950     1.056     1.056     1.056"
" 40          HYDROGRAPH   Confluence    2000"
"            7   Confluence "
"         2000   Node #"
"                Wetland"
"             Maximum flow                  1.056    c.m/sec"
"             Hydrograph volume         14803.966    c.m"
"                     0.950     1.056     1.056     0.000"
" 33          CATCHMENT 107"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          107   Catchment 107"
"       55.000   % Impervious"
"        3.550   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.597   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        1.952   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.371     1.056     1.056     0.000 c.m/sec"
"             Catchment 107          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  40.556     7.207      17.519     minutes"
"             Time to Centroid       2744.076   2245.793   2399.878   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.4553     0.5565     1.0117     ha-m"
"             Rainfall losses        141.525    22.773     76.211     mm"
"             Runoff depth           143.475    262.227    208.789    mm"
"             Runoff volume          2292.02    5119.98    7412.00    c.m"
"             Runoff coefficient     0.503      0.920      0.733      "
"             Maximum flow           0.175      0.247      0.371      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.371     1.405     1.056     0.000"
```

```
" 33          CATCHMENT 103"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           103   Catchment 103"
"         0.000   % Impervious"
"         6.330   Total Area"
"       160.000   Flow length"
"         9.000   Overland Slope"
"         6.330   Pervious Area"
"       160.000   Pervious length"
"         9.000   Pervious slope"
"         0.000   Impervious Area"
"       160.000   Impervious length"
"         9.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.686     1.405     1.056     0.000 c.m/sec"
"              Catchment 103          Pervious   Impervious Total Area "
"              Surface Area           6.330      0.000      6.330      hectare"
"              Time of concentration  27.982     4.972      27.982     minutes"
"              Time to Centroid       2734.145   2231.264   2734.144   minutes"
"              Rainfall depth         285.000    285.000    285.000    mm"
"              Rainfall volume        1.8040     0.0000     1.8041     ha-m"
"              Rainfall losses        138.998    32.769     138.998    mm"
"              Runoff depth           146.002    252.231    146.002    mm"
"              Runoff volume          9241.89    0.02       9241.91    c.m"
"              Runoff coefficient     0.512      0.000      0.512      "
"              Maximum flow           0.686      0.000      0.686      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.686     2.091     1.056     0.000"
" 33          CATCHMENT 104"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           104   Scott Street External"
"        55.000   % Impervious"
"         2.600   Total Area"
"        95.000   Flow length"
"         2.000   Overland Slope"
"         1.170   Pervious Area"
```

```
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.282     2.091     1.056     0.000 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  32.137     5.711      14.115     minutes"
"             Time to Centroid       2737.280   2232.538   2393.050   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3334.50    4075.50    7410.00    c.m"
"             Rainfall losses        139.558    29.801     79.192     mm"
"             Runoff depth           145.442    255.199    205.808    mm"
"             Runoff volume          1701.67    3649.34    5351.01    c.m"
"             Runoff coefficient     0.510      0.895      0.722      "
"             Maximum flow           0.128      0.181      0.282      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.282     2.343     1.056     0.000"
" 64          SHOW TABLE"
"            2   Flow hydrograph"
"            4   Inflow Hydrograph"
"             Maximum flow                  2.343    c.m/sec"
"             Hydrograph volume         36808.887    c.m"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.282     2.343     2.343     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"          1000   Node #"
"                 Grand River"
"             Maximum flow                  3.839    c.m/sec"
"             Hydrograph volume         57703.930    c.m"
"                     0.282     2.343     2.343     3.839"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"          1000   Node #"
"                 Grand River"
"             Maximum flow                  3.839    c.m/sec"
```

```
"             Hydrograph volume         57703.930    c.m"
"                     0.282     3.839     2.343     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                     4.437    hectare"
"             Total % impervious                       12.214"
" 19          EXIT"
```

APPENDIX D

Post-Development Conditions Stormwater Management Analysis

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Proposed Stormwater Management Pond

Active Storage Volume Calculations
Wetland SWM Facility

Elevation (m)	Depth (m)	Pond Surface Area (m^2)	Perm. Pool (P.P) Volume (m^3)	Accum. P.P. Volume (m^3)	Pond Active Volume (m^3)	Accum. Active Volume (m^3)	
455.70	0.00	4,716.0	0.0	0.0			P.P. Bottom
455.80	0.10	5,931.0	532.4	532.4			
455.90	0.20	6,277.0	610.4	1,142.7			
456.00	**0.00**	**6,626.0**	**645.2**	**1,787.9**	**0.0**	**0.0**	**P.P. Top/Bottom of Storage**
456.10	0.10	6,979.0			680.3	680.3	
456.20	0.20	7,335.0			715.7	1,395.9	
456.30	0.30	7,696.0			751.6	2,147.5	
456.40	0.40	8,063.0			787.9	2,935.4	
456.48	0.48	8,361.0			657.0	3,592.4	
456.50	0.50	8,436.0			168.0	3,760.4	DICB Lip
456.60	0.60	8,904.0			867.0	4,627.4	
456.70	0.70	9,344.0			912.4	5,539.8	
456.80	0.80	9,798.0			957.1	6,496.9	
456.90	0.90	10,270.0			1,003.4	7,500.3	
457.00	1.00	10,756.0			1,051.3	8,551.6	Weir Control
457.10	1.10	11,253.0			1,100.5	9,652.0	
457.20	1.20	11,769.0			1,151.1	10,803.1	
457.30	1.30	12,298.0			1,203.4	12,006.5	
457.40	1.40	13,083.0			1,269.0	13,275.5	Top of Pond
457.50	1.50	15,629.0			1,435.6	14,711.1	Overflow

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Proposed Stormwater Management Pond

Knockout			**600 mm Diameter Orifice**		
INV	456.00	m	INV	455.48	m
Q =	0.114	m^3/s	Q =	0.986	m^3/s
Cd =	0.600		Cd =	0.600	
H =	1.3925	m	H =	1.72	m
2g =	19.620		2g =	19.620	
A =	0.036	m^2	A =	0.283	m^2
D =	0.215	m	D =	0.600	m

3-600mm dia. pipes @ 0.50% will discharge flows from the stormwater management pond. Orifice flows will be multiplied by 3.

1200 mm x 1200 mm Ditch Inlet Outlet Structure Weir Flow OPSD 702.050

Elev	d1	h	H	2g	L	Qfront	Qback	Qsides	Qtotal	Q for 3 Structures
m	m	m	m		m	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
456.50	0.50	0.50	0.00	19.62	1.20	0.000	0.000	0.000	0.000	0.000
456.60	0.60	0.50	0.10	19.62	1.20	0.054	0.000	0.018	0.072	0.217
456.70	0.70	0.50	0.20	19.62	1.20	0.157	0.000	0.072	0.230	0.689
456.80	0.80	0.50	0.30	19.62	1.20	0.297	0.000	0.174	0.470	1.411
456.90	0.90	0.50	0.40	19.62	1.20	0.467	0.053	0.367	0.834	2.501
457.00	1.00	0.50	0.50	19.62	1.20	0.664	0.153	0.639	1.304	3.911

These are the flows over the DICB Lip - once flows are equal to or exceed orifice flow, the SSD table switches to orifice flow.

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Proposed Stormwater Management Pond

Overflow Weir No. 1

Elev	d1	h	H	2g	L	Q
m	m	m	m		m	m^3/s
457.00	1.00	1.00	0.00	19.62	47.50	0.00
457.10	1.10	1.00	0.10	19.62	47.50	2.09
457.20	1.20	1.00	0.20	19.62	47.50	6.02
457.30	1.30	1.00	0.30	19.62	47.50	11.25
457.40	1.40	1.00	0.40	19.62	47.50	17.60
457.50	1.50	1.00	0.50	19.62	47.50	24.95

Overflow Weir No. 2

Elev	d1	h	H	2g	L	Q
m	m	m	m		m	m^3/s
457.00	1.00	1.00	0.00	19.62	19.00	0.00
457.10	1.10	1.00	0.10	19.62	19.00	0.83
457.20	1.20	1.00	0.20	19.62	19.00	2.41
457.30	1.30	1.00	0.30	19.62	19.00	4.50
457.40	1.40	1.00	0.40	19.62	19.00	7.04
457.50	1.50	1.00	0.50	19.62	19.00	9.98

Overflow Weir No. 3

Elev	d1	h	H	2g	L	Q
m	m	m	m		m	m^3/s
457.00	1.00	1.00	0.00	19.62	12.00	0.00
457.10	1.10	1.00	0.10	19.62	12.00	0.53
457.20	1.20	1.00	0.20	19.62	12.00	1.52
457.30	1.30	1.00	0.30	19.62	12.00	2.84
457.40	1.40	1.00	0.40	19.62	12.00	4.45
457.50	1.50	1.00	0.50	19.62	12.00	6.30

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Proposed Stormwater Management Pond

Stage-Storage-Discharge Table

Elevation (m)	Stage (m)	Storage (m^3)	Knockout Control 210mm (m^3/s)	1200 x 1200 Ditch Inlet 3-Total (m^3/s)	600mm Orifice Control 3-Total (m^3/s)	600mm Pipe Discharge 3-Total (m^3/s)	Overflow Weir No. 1 (m^3/s)	Overflow Weir No. 2 (m^3/s)	Overflow Weir No. 3 (m^3/s)	Actual Discharge (m^3/s)	
456.00	0.00	0.0	0.000		0.000	0.000	0.000	0.000	0.000	0.000	Bottom of Storage
456.10	0.10	680.3	0.015		0.000	0.000	0.000	0.000	0.000	0.015	
456.20	0.20	1,395.9	0.029		0.000	0.000	0.000	0.000	0.000	0.029	
456.30	0.30	2,147.5	0.042		0.000	0.000	0.000	0.000	0.000	0.042	
456.40	0.40	2,935.4	0.052		0.000	0.000	0.000	0.000	0.000	0.052	
456.48	0.48	3,592.4	0.059		0.000	0.000	0.000	0.000	0.000	0.059	
456.50	0.50	3,760.4	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.060	DICB Lip
456.60	0.60	4,627.4	0.068	0.217	2.041	2.978	0.000	0.000	0.000	0.284	
456.70	0.70	5,539.8	0.074	0.689	2.162	3.201	0.000	0.000	0.000	0.763	
456.80	0.80	6,496.9	0.080	1.411	2.277	3.410	0.000	0.000	0.000	1.491	
456.90	0.90	7,500.3	0.086	2.501	2.386	3.607	0.000	0.000	0.000	2.386	
457.00	1.00	8,551.6	0.091	3.911	2.490	3.793	0.000	0.000	0.000	2.490	Weir
457.10	1.10	9,652.0	0.096		2.590	3.971	2.085	0.834	0.527	6.036	
457.20	1.20	10,803.1	0.101		2.686	4.141	6.018	2.407	1.520	12.632	
457.30	1.30	12,006.5	0.105		2.779	4.304	11.254	4.502	2.843	21.379	
457.40	1.40	13,275.5	0.110		2.869	4.461	17.603	7.041	4.447	31.960	Top of Pond
457.50	1.50	14,711.1	0.114		2.957	4.613	24.949	9.980	6.303	44.189	Overflow

Notes:

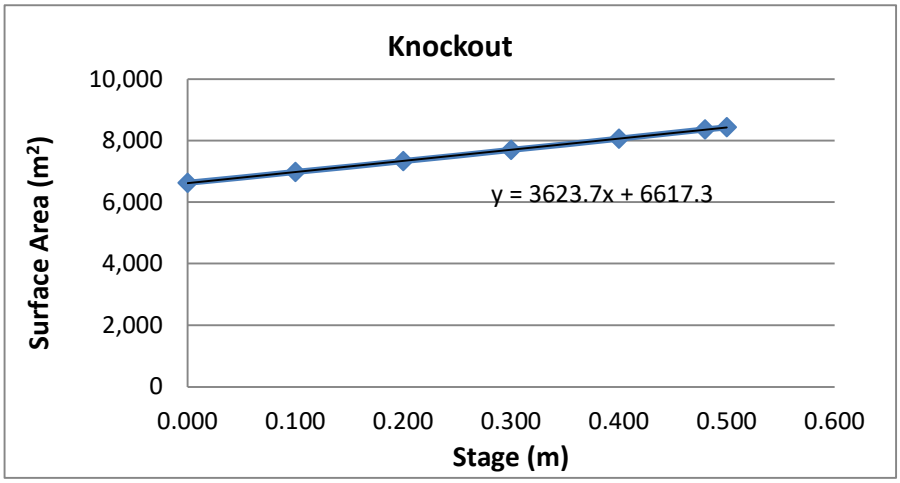
1. The minimum of ditch inlet + knockout, orifice control and pipe discharge flow rate is used in the actual discharge calculation

Interpolate weir flows away from Linear Dispersion Trench

Design Storm	Level (m)	Flow	Weir No. 1 Flow (m^3/s)	Weir No. 2 Flow (m^3/s)	Total Weir Flow 1 and 2 (m^3/s)	Remaining Flow to Linear Dispersion Trench (m^3/s)
100-Year	457.093	5.771	1.939	0.776	2.715	**3.056**
Regional	457.012	2.808	0.250	0.100	0.350	**2.458**

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Stormwater Management Pond Drawdown Calculations

Elevation (m)	Stage (m)	Surface area (m^2)	
456.00	0.000	6,626	Knockout Invert
456.10	0.100	6,979	
456.20	0.200	7,335	
456.30	0.300	7,696	
456.40	0.400	8,063	
456.48	0.480	8,361	
456.50	0.500	8,436	DICB Lip
456.60	0.600	8,904	
456.70	0.700	9,344	
456.80	0.800	9,798	
456.90	0.900	10,270	
457.00	1.000	10,756	Weir Control
457.10	1.100	11,253	
457.20	1.200	11,769	
457.30	1.300	12,298	
457.40	1.400	13,083	Top of Pond
457.50	1.500	15,629	Overflow

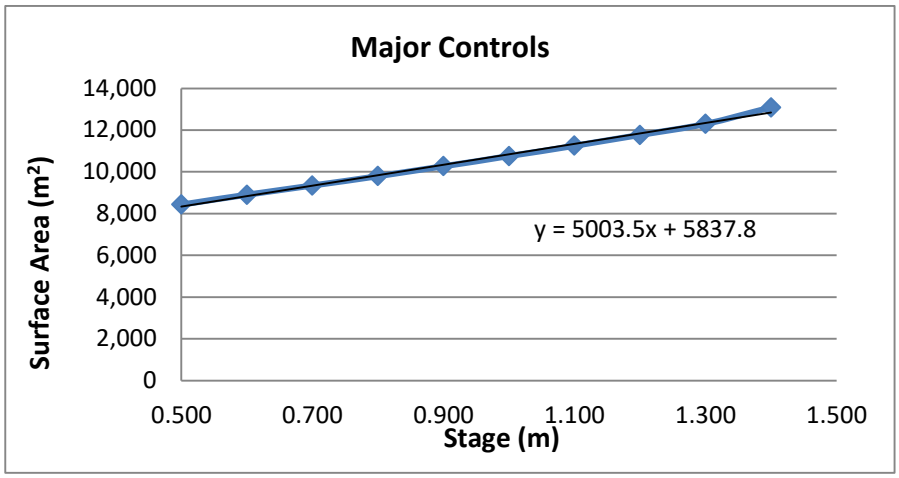


River's Edge Subdivision

Town of Grand Valley

File No. 104-104

Stormwater Management Pond Drawdown Calculations



$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o}$$

Eq. 4.11 (MOE, 2003)

Knockout			Major Controls		
Given: d =	0.215	m	Given: d =	0.600	m x 3
A_o =	0.036	m	A_o =	0.848	m
C_2 =	3624		C_2 =	5004	
C_3 =	6617		C_3 =	5838	

Storm	Ponding Elevation (m)	Knockout h (m)	Knockout Drawdown (hr)	Major Controls h (m)	Major Controls Drawdown (hr)	Total Drawdown (hr)
25mm	456.50	0.39	24.7	0.00	0.0	24.7
2-Year	456.59	0.39	24.7	0.09	0.4	25.1
5-Year	456.77	0.39	24.7	0.26	0.8	25.5
100-Year	457.09	0.39	24.7	0.59	1.3	26.0
Regional	457.01	0.39	24.7	0.51	1.1	25.8

River's Edge Subdivision
Town of Grand Valley
File No. 104-104

Stormwater Management Facility
Forebay at Inlet 1 Sizing

Forebay Length =	34.0	m	(Dist)
Forebay Top Width =	11.0	m	
Active Forebay Depth =	1.0	m	(d)
Active Forebay Bottom Width =	5.0	m	
Approximate Permanent Forebay Pool Volume =	272	m^3	
Length Width Ratio =	3.1	:1	(r)
25 mm Storm Peak Flowrate =	0.060	m^3/s	(Q25mm)
5 Year Storm Inflow Rate =	1.806	m^3/s	(Q5)
Desired Forebay Velocity =	0.500	m/s	(Vf)
Desired Settling Velocity (recommended) =	0.0003	m/s	(Vs)

Settling Length

Dist = ((r x Q25mm)/Vs)^.5 =	24.9	m	25mm

Forebay length (34 m) exceeds the settling length (24.9 m).

Dispersion Length

Dist = (8 x Q5)/(d x Vf) =	28.9	m	5 Year

Forebay length (34 m) exceeds dispersion length (28.9 m).

Flow Velocity in Forebay

Cross-sectional Area =	8	m^2	
Cross-sectional Area (With Permanent Pool) =	11.75	m^2	A
Q5 =	1.806	m^3/s	
Velocity = Q5/A =	0.15	m/s	5 Year

The average flow velocity through the forebay meets the allowable velocity of 0.15 m/s.

River's Edge Subdivision
Town of Grand Valley
File No. 104-104

Stormwater Management Facility
Forebay at Inlet 2 Sizing

Forebay Length =	33.0	m	(Dist)
Forebay Top Width =	10.5	m	
Active Forebay Depth =	1.0	m	(d)
Active Forebay Bottom Width =	4.5	m	
Approximate Permanent Forebay Pool Volume =	247.5	m^3	
Length Width Ratio =	3.1	:1	(r)
25 mm Storm Peak Flowrate =	0.060	m^3/s	(Q25mm)
5 Year Storm Inflow Rate =	0.462	m^3/s	(Q5)
Desired Forebay Velocity =	0.500	m/s	(Vf)
Desired Settling Velocity (recommended) =	0.0003	m/s	(Vs)

Settling Length

Dist = ((r x Q25mm)/Vs)^.5 =	25.1	m	25mm

Forebay length (33 m) exceeds the settling length (25.1 m).

Dispersion Length

Dist = (8 x Q5)/(d x Vf) =	7.4	m	5 Year

Forebay length (33 m) exceeds dispersion length (7.4 m).

Flow Velocity in Forebay

Cross-sectional Area =	7.5	m^2	
Cross-sectional Area (With Permanent Pool) =	11.1	m^2	A
Q5 =	0.462	m^3/s	
Velocity = Q5/A =	0.04	m/s	5 Year

The average flow velocity through the forebay meets the allowable velocity of 0.15 m/s.

River's Edge Subdivision
Town of Grand Valley
File No. 104-104

Stormwater Management Facility
Forebay at Inlet 3 Sizing

Forebay Length =	38.5	m	(Dist)
Forebay Top Width =	14.5	m	
Active Forebay Depth =	1.0	m	(d)
Active Forebay Bottom Width =	8.5	m	
Approximate Permanent Forebay Pool Volume =	442.75	m^3	
Length Width Ratio =	2.7	:1	(r)
25 mm Storm Peak Flowrate =	0.060	m^3/s	(Q25mm)
5 Year Storm Inflow Rate =	1.988	m^3/s	(Q5)
Desired Forebay Velocity =	0.500	m/s	(Vf)
Desired Settling Velocity (recommended) =	0.0003	m/s	(Vs)

Settling Length

Dist = ((r x Q25mm)/Vs)^.5 =	23.0	m	25mm

Forebay length (38.5 m) exceeds the settling length (23 m).

Dispersion Length

Dist = (8 x Q5)/(d x Vf) =	31.8	m	5 Year

Forebay length (38.5 m) exceeds dispersion length (31.8 m).

Flow Velocity in Forebay

Cross-sectional Area =	11.5	m^2	
Cross-sectional Area (With Permanent Pool) =	16.3	m^2	A
Q5 =	1.988	m^3/s	
Velocity = Q5/A =	0.12	m/s	5 Year

The average flow velocity through the forebay meets the allowable velocity of 0.15 m/s.

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Equalizing Pipe Calculation

Flow at Pond Inlets 1, 2 and 3

	Regional Storm (m^3/s)	100 Year Storm (m^3/s)	5 Year Storm (m^3/s)	2 Year Storm (m^3/s)	25mm Storm (m^3/s)
Inlet 1	1.310	3.244	1.806	1.328	1.185
Inlet 2	0.325	0.979	0.462	0.323	0.334
Total 1 and 2	**1.635**	**4.223**	**2.268**	**1.651**	**1.519**
Inlet 3	1.153	3.416	1.988	1.490	1.375

	Ponding Elevation (m)
Regional Storm	457.01
100 Year Storm	457.09
5 Year Storm	456.77
2 Year Storm	456.59
25 mm Storm	456.5

1. Assume that the equalizing pipes act as an orifice, equalizing the flow between the two portions of the pond. The equalizing pipes must convey the greater of Inlet 1+2 flows or Inlet 3 flows.

2. Assume 3-900 mm diameter equalizing pipes installed in parallel at the bottom of permanent pool elevation.

Orifice Regional Storm

INV	455.70	m		
			Q for 3 pipes (m^3/s)	**Greather than (m^3/s)**
Q =	1.568	m^3/s		
Cd =	0.600		**4.704**	**1.635**
H =	0.86	m		
2g =	19.620			
A =	0.636	m^2		
D =	0.900	m		

Orifice 100 Year Storm

INV	455.70	m		
			Q for 3 pipes (m^3/s)	**Greather than (m^3/s)**
Q =	1.639	m^3/s		
Cd =	0.600		**4.918**	**4.223**
H =	0.94	m		
2g =	19.620			
A =	0.636	m^2		
D =	0.900	m		

River's Edge Subdivision
Town of Grand Valley
File No. 104-104
Equalizing Pipe Calculation

Orifice 5 Year Storm

INV	455.70	m		
			Q for 3 pipes	**Greather than**
Q =	1.331	m^3/s	**(m^3/s)**	**(m^3/s)**
Cd =	0.600		**3.994**	**2.268**
H =	0.62	m		
2g =	19.620			
A =	0.636	m^2		
D =	0.900	m		

Orifice 2 Year Storm

INV	455.70	m		
			Q for 3 pipes	**Greather than**
Q =	1.122	m^3/s	**(m^3/s)**	**(m^3/s)**
Cd =	0.600		**3.365**	**1.651**
H =	0.44	m		
2g =	19.620			
A =	0.636	m^2		
D =	0.900	m		

Orifice 25mm Storm

INV	455.70	m		
			Q for 3 pipes	**Greather than**
Q =	1.000	m^3/s	**(m^3/s)**	**(m^3/s)**
Cd =	0.600		**3.001**	**1.519**
H =	0.35	m		
2g =	19.620			
A =	0.636	m^2		
D =	0.900	m		

River's Edge Subdivision
Town of Grand Valley
File No: 104-104
Linear Dispersion Trench

Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area (m^2)	Increase Stone Volume (m^3)	Increase Storage Volume (m^3)	Accum. Storage Volume (m^3)	
454.86	0.00	120.00	0.00	0.00	0.00	Bottom of Stone
454.96	0.10	120.00	12.00	4.00	4.00	
455.06	0.20	120.00	12.00	4.00	8.00	
455.16	0.30	120.00	12.00	4.00	12.00	
455.26	0.40	120.00	12.00	4.00	16.00	
455.36	0.50	120.00	12.00	4.00	20.00	Top of Stone/Weir
455.46	0.60	0.00	0.00	0.50	20.50	
455.56	0.70	0.00	0.00	0.50	21.00	
455.66	0.80	0.00	0.00	0.50	21.50	

Overflow Weir

Elev m	d1 m	h m	H m	2g m/s^2	L m	Q m^3/s
455.36	0.50	0.50	0.00	19.62	38.00	0.00
455.46	0.60	0.50	0.10	19.62	38.00	1.70
455.56	0.70	0.50	0.20	19.62	38.00	4.98
455.66	0.80	0.50	0.30	19.62	38.00	9.39

BOTTOM

L(dw) = 15.00 m
W(dw) = 8.00 m
D(dw) = 0.50 m

A(c) = 120.0 m^2

K = 1.00E-05 cm/s

SIDES

L(dw) = 15.00 m
D(dw) = 0.50 m

A(c) = 15.0 sq m (both sides)

River's Edge Subdivision
Town of Grand Valley
File No: 104-104
Linear Dispersion Trench

Stage/Storage/Discharge Table

Stage (m)	Storage (m^3)	Infiltration Discharge (m^3/s)	Overflow Weir Discharge (m^3/s)	Total Discharge (m^3/s)	
454.860	0.00	0.00000	0.00	0.000	Bottom of Stone
454.960	4.00	0.00001	0.00	0.000	
455.060	8.00	0.00001	0.00	0.000	
455.160	12.00	0.00001	0.00	0.000	
455.260	16.00	0.00001	0.00	0.000	
455.360	20.00	0.00001	0.00	0.000	Top of Stone/Weir
455.460	20.50	0.00001	1.70	1.702	
455.560	21.00	0.00001	4.98	4.979	
455.660	21.50	0.00001	9.39	9.395	

Interpolate for Flow to Wetland and Grand River

Design Storm	Linear Dispersion Trench Flow (m^3/s)	Wetland Flow (m^3/s)	Grand River Flow (m^3/s)
25mm	0.060	0.024	**0.036**
2-Year	0.264	0.104	**0.160**
5-Year	1.235	0.488	**0.747**
100-Year	3.056	1.207	**1.849**
Regional	2.458	0.971	**1.487**

Notes:
1. Assumes that linear dispersion trench is flat and overflow is acting like a weir with three (3) sides (north, south and east)

2. Assumes that south side of linear dispersion trench discharges to the existing wetland. Wetland flow split is (15m / 38m = 39.5%)

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"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:      104-104 post  002 year-Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/21/2023 at 1:57:01 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.047   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            93.292    mm/hr"
"             Total depth                  33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.072     0.000     0.000     0.000 c.m/sec"
```

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"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  22.063     2.281      3.430      minutes"
"             Time to Centroid       96.472     86.938     87.492     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        99.54      121.66     221.19     c.m"
"             Rainfall losses        30.676     2.000      14.904     mm"
"             Runoff depth           2.338      31.014     18.110     mm"
"             Runoff volume          7.05       114.28     121.33     c.m"
"             Runoff coefficient     0.071      0.939      0.549      "
"             Maximum flow           0.004      0.072      0.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.072     0.072     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.783     0.072     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  68.866     7.119      7.629      minutes"
"             Time to Centroid       138.361    93.923     94.289     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        141.30     1271.69    1412.99    c.m"
"             Rainfall losses        30.669     1.681      4.580      mm"
"             Runoff depth           2.345      31.333     28.434     mm"
"             Runoff volume          10.04      1206.95    1216.98    c.m"
"             Runoff coefficient     0.071      0.949      0.861      "
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"             Maximum flow           0.002      0.782      0.783      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.783     0.855     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.125     0.855     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  48.109     4.973      7.458      minutes"
"             Time to Centroid       119.817    90.843     92.512     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        161.93     197.92     359.85     c.m"
"             Rainfall losses        30.669     1.629      14.697     mm"
"             Runoff depth           2.345      31.385     18.317     mm"
"             Runoff volume          11.50      188.15     199.65     c.m"
"             Runoff coefficient     0.071      0.951      0.555      "
"             Maximum flow           0.004      0.124      0.125      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.125     0.979     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

```
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.511     0.979     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  53.181     5.498      7.765      minutes"
"             Time to Centroid       124.334    91.560     93.119     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        548.03     822.04     1370.07    c.m"
"             Rainfall losses        30.670     1.714      13.296     mm"
"             Runoff depth           2.344      31.300     19.718     mm"
"             Runoff volume          38.92      779.36     818.28     c.m"
"             Runoff coefficient     0.071      0.948      0.597      "
"             Maximum flow           0.011      0.510      0.511      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.511     1.490     0.000     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.323     1.490     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  22.063     2.281      3.227      minutes"
"             Time to Centroid       96.472     86.938     87.394     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        364.47     546.71     911.18     c.m"
"             Rainfall losses        30.676     2.000      13.471     mm"
"             Runoff depth           2.338      31.014     19.543     mm"
"             Runoff volume          25.81      513.58     539.40     c.m"
"             Runoff coefficient     0.071      0.939      0.592      "
"             Maximum flow           0.016      0.322      0.323      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.323     1.813     0.000     0.000"
" 33          CATCHMENT 303"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          303   External"
"       55.000   % Impervious"
"        3.550   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.597   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        1.952   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.397     1.813     0.000     0.000 c.m/sec"
```

```
"             Catchment 303          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  55.599     5.748      8.629      minutes"
"             Time to Centroid       126.518    91.941     93.939     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        527.40     644.59     1171.99    c.m"
"             Rainfall losses        30.669     1.730      14.752     mm"
"             Runoff depth           2.345      31.284     18.261     mm"
"             Runoff volume          37.47      610.81     648.28     c.m"
"             Runoff coefficient     0.071      0.948      0.553      "
"             Maximum flow           0.011      0.397      0.397      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.397     2.210     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Park"
"       10.000   % Impervious"
"        2.090   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.881   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.043     2.210     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  55.599     5.748      25.832     minutes"
"             Time to Centroid       126.518    91.941     105.871    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        620.99     69.00      689.99     c.m"
"             Rainfall losses        30.669     1.730      27.775     mm"
"             Runoff depth           2.345      31.284     5.239      mm"
"             Runoff volume          44.12      65.38      109.50     c.m"
"             Runoff coefficient     0.071      0.948      0.159      "
```

```
"             Maximum flow           0.013      0.042      0.043      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.043     2.254     0.000     0.000"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.300     2.254     0.000     0.000 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  44.058     4.555      6.834      minutes"
"             Time to Centroid       116.161    90.239     91.735     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        386.26     472.10     858.36     c.m"
"             Rainfall losses        30.671     1.703      14.738     mm"
"             Runoff depth           2.343      31.311     18.275     mm"
"             Runoff volume          27.41      447.75     475.16     c.m"
"             Runoff coefficient     0.071      0.948      0.554      "
"             Maximum flow           0.009      0.299      0.300      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.300     2.554     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
```

```
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.587     2.554     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  45.435     4.697      6.274      minutes"
"             Time to Centroid       117.422    90.442     91.487     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        499.17     927.03     1426.20    c.m"
"             Rainfall losses        30.669     1.666      11.817     mm"
"             Runoff depth           2.345      31.347     21.197     mm"
"             Runoff volume          35.46      880.24     915.69     c.m"
"             Runoff coefficient     0.071      0.950      0.642      "
"             Maximum flow           0.012      0.586      0.587      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.587     3.141     0.000     0.000"
" 33          CATCHMENT 206"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.550     3.141     0.000     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  45.435     4.697      5.445      minutes"
"             Time to Centroid       117.422    90.442     90.937     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        217.23     868.92     1086.15    c.m"
"             Rainfall losses        30.669     1.666      7.467      mm"
"             Runoff depth           2.345      31.347     25.547     mm"
"             Runoff volume          15.43      825.06     840.49     c.m"
"             Runoff coefficient     0.071      0.950      0.774      "
"             Maximum flow           0.005      0.549      0.550      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.550     3.691     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.162     3.691     0.000     0.000 c.m/sec"
```

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"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  45.435     4.697      21.089     minutes"
"             Time to Centroid       117.422    90.442     101.298    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        2237.35    248.59     2485.94    c.m"
"             Rainfall losses        30.669     1.666      27.769     mm"
"             Runoff depth           2.345      31.347     5.245      mm"
"             Runoff volume          158.93     236.05     394.97     c.m"
"             Runoff coefficient     0.071      0.950      0.159      "
"             Maximum flow           0.053      0.157      0.162      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.162     3.852     0.000     0.000"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    36.330    hectare"
"             Total Impervious area                   18.751    hectare"
"             Total % impervious                      51.612"
" 19          EXIT"
```

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"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:      104-104 post  005 year-Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/21/2023 at 1:57:33 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.586    mm/hr"
"             Total depth                 49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.104     0.000     0.000     0.000 c.m/sec"
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"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  14.420     2.108      4.886      minutes"
"             Time to Centroid       100.204    85.724     88.991     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        150.12     183.48     333.60     c.m"
"             Rainfall losses        32.852     2.224      16.007     mm"
"             Runoff depth           16.939     47.568     33.785     mm"
"             Runoff volume          51.07      175.29     226.36     c.m"
"             Runoff coefficient     0.340      0.955      0.679      "
"             Maximum flow           0.028      0.095      0.104      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.104     0.104     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.019     0.104     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  45.009     6.580      8.036      minutes"
"             Time to Centroid       135.435    91.865     93.515     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        213.11     1917.98    2131.08    c.m"
"             Rainfall losses        32.839     1.944      5.034      mm"
"             Runoff depth           16.953     47.847     44.758     mm"
"             Runoff volume          72.56      1843.08    1915.64    c.m"
"             Runoff coefficient     0.340      0.961      0.899      "
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"             Maximum flow           0.018      1.018      1.019      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.019     1.124     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.169     1.124     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  31.443     4.597      10.620     minutes"
"             Time to Centroid       119.805    89.191     96.060     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        244.23     298.50     542.73     c.m"
"             Rainfall losses        32.853     1.876      15.816     mm"
"             Runoff depth           16.939     47.916     33.976     mm"
"             Runoff volume          83.09      287.25     370.34     c.m"
"             Runoff coefficient     0.340      0.962      0.682      "
"             Maximum flow           0.027      0.165      0.169      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.169     1.293     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

```
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.695     1.293     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  34.758     5.082      10.733     minutes"
"             Time to Centroid       123.626    89.815     96.253     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        826.54     1239.81    2066.36    c.m"
"             Rainfall losses        32.847     1.767      14.199     mm"
"             Runoff depth           16.945     48.025     35.593     mm"
"             Runoff volume          281.29     1195.82    1477.11    c.m"
"             Runoff coefficient     0.340      0.965      0.715      "
"             Maximum flow           0.083      0.684      0.695      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.695     1.988     0.000     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.462     1.988     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  14.420     2.108      4.470      minutes"
"             Time to Centroid       100.204    85.724     88.502     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        549.70     824.55     1374.25    c.m"
"             Rainfall losses        32.852     2.224      14.475     mm"
"             Runoff depth           16.939     47.568     35.316     mm"
"             Runoff volume          187.01     787.72     974.73     c.m"
"             Runoff coefficient     0.340      0.955      0.709      "
"             Maximum flow           0.103      0.429      0.462      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.462     2.450     0.000     0.000"
" 33          CATCHMENT 303"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          303   External"
"       55.000   % Impervious"
"        3.550   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.597   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        1.952   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.544     2.450     0.000     0.000 c.m/sec"
```

```
"             Catchment 303          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  36.338     5.313      12.264     minutes"
"             Time to Centroid       125.451    90.132     98.045     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        795.42     972.18     1767.60    c.m"
"             Rainfall losses        32.839     1.757      15.744     mm"
"             Runoff depth           16.953     48.035     34.048     mm"
"             Runoff volume          270.82     937.88     1208.71    c.m"
"             Runoff coefficient     0.340      0.965      0.684      "
"             Maximum flow           0.078      0.534      0.544      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.544     2.993     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Park"
"       10.000   % Impervious"
"        2.090   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.881   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.103     2.993     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  36.338     5.313      28.909     minutes"
"             Time to Centroid       125.451    90.132     116.994    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        936.58     104.06     1040.65    c.m"
"             Rainfall losses        32.839     1.757      29.731     mm"
"             Runoff depth           16.953     48.035     20.061     mm"
"             Runoff volume          318.89     100.39     419.28     c.m"
"             Runoff coefficient     0.340      0.965      0.403      "
```

```
"             Maximum flow           0.092      0.057      0.103      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.103     3.062     0.000     0.000"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.405     3.062     0.000     0.000 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  28.795     4.210      9.735      minutes"
"             Time to Centroid       116.746    88.669     94.978     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        582.56     712.02     1294.58    c.m"
"             Rainfall losses        32.859     1.996      15.884     mm"
"             Runoff depth           16.933     47.796     33.908     mm"
"             Runoff volume          198.12     683.48     881.60     c.m"
"             Runoff coefficient     0.340      0.960      0.681      "
"             Maximum flow           0.068      0.395      0.405      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.405     3.467     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
```

```
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.788     3.467     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  29.695     4.341      8.402      minutes"
"             Time to Centroid       117.798    88.850     93.486     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        752.85     1398.15    2151.00    c.m"
"             Rainfall losses        32.840     1.920      12.742     mm"
"             Runoff depth           16.952     47.871     37.050     mm"
"             Runoff volume          256.32     1344.23    1600.55    c.m"
"             Runoff coefficient     0.340      0.961      0.744      "
"             Maximum flow           0.086      0.775      0.788      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.788     4.256     0.000     0.000"
" 33          CATCHMENT 206"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.732     4.256     0.000     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  29.695     4.341      6.403      minutes"
"             Time to Centroid       117.798    88.850     91.205     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        327.63     1310.52    1638.15    c.m"
"             Rainfall losses        32.840     1.920      8.104      mm"
"             Runoff depth           16.952     47.871     41.688     mm"
"             Runoff volume          111.55     1259.97    1371.52    c.m"
"             Runoff coefficient     0.340      0.961      0.837      "
"             Maximum flow           0.038      0.726      0.732      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.732     4.988     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.437     4.988     0.000     0.000 c.m/sec"
```

```
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  29.695     4.341      23.640     minutes"
"             Time to Centroid       117.798    88.850     110.884    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        3374.38    374.93     3749.31    c.m"
"             Rainfall losses        32.840     1.920      29.748     mm"
"             Runoff depth           16.952     47.871     20.044     mm"
"             Runoff volume          1148.85    360.47     1509.32    c.m"
"             Runoff coefficient     0.340      0.961      0.403      "
"             Maximum flow           0.387      0.208      0.437      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.437     5.256     0.000     0.000"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    36.330    hectare"
"             Total Impervious area                   18.751    hectare"
"             Total % impervious                      51.612"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:      104-104 post  100 year-Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/21/2023 at 1:58:24 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.020   Coefficient A"
"       34.699   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          168.777    mm/hr"
"             Total depth                 97.921    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.233     0.000     0.000     0.000 c.m/sec"
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"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  10.076     1.799      4.711      minutes"
"             Time to Centroid       97.792     84.352     89.081     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        295.23     360.84     656.07     c.m"
"             Rainfall losses        34.803     2.791      17.197     mm"
"             Runoff depth           63.119     95.130     80.725     mm"
"             Runoff volume          190.30     350.55     540.86     c.m"
"             Runoff coefficient     0.645      0.971      0.824      "
"             Maximum flow           0.099      0.153      0.233      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.233     0.233     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.688     0.233     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  31.450     5.616      7.390      minutes"
"             Time to Centroid       122.128    89.288     91.543     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        419.10     3771.93    4191.03    c.m"
"             Rainfall losses        34.482     2.307      5.524      mm"
"             Runoff depth           63.439     95.615     92.397     mm"
"             Runoff volume          271.52     3683.07    3954.59    c.m"
"             Runoff coefficient     0.648      0.976      0.944      "
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"             Maximum flow           0.079      1.669      1.688      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.688     1.920     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.301     1.920     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  21.971     3.923      10.297     minutes"
"             Time to Centroid       111.333    87.214     95.731     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        480.30     587.04     1067.34    c.m"
"             Rainfall losses        34.507     2.882      17.113     mm"
"             Runoff depth           63.414     95.039     80.808     mm"
"             Runoff volume          311.04     569.76     880.81     c.m"
"             Runoff coefficient     0.648      0.971      0.825      "
"             Maximum flow           0.114      0.260      0.301      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.301     2.221     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

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"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.195     2.221     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  24.287     4.337      10.458     minutes"
"             Time to Centroid       113.975    87.701     95.762     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1625.49    2438.24    4063.73    c.m"
"             Rainfall losses        34.488     2.372      15.219     mm"
"             Runoff depth           63.434     95.549     82.703     mm"
"             Runoff volume          1053.00    2379.17    3432.17    c.m"
"             Runoff coefficient     0.648      0.976      0.845      "
"             Maximum flow           0.358      1.078      1.195      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.195     3.416     0.000     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.979     3.416     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  10.076     1.799      4.338      minutes"
"             Time to Centroid       97.792     84.352     88.474     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1081.05    1621.58    2702.63    c.m"
"             Rainfall losses        34.803     2.791      15.596     mm"
"             Runoff depth           63.119     95.130     82.325     mm"
"             Runoff volume          696.83     1575.35    2272.18    c.m"
"             Runoff coefficient     0.645      0.971      0.841      "
"             Maximum flow           0.363      0.689      0.979      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.979     4.396     0.000     0.000"
" 33          CATCHMENT 303"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          303   External"
"       55.000   % Impervious"
"        3.550   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.597   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        1.952   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.948     4.396     0.000     0.000 c.m/sec"
```

```
"             Catchment 303          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  25.391     4.534      11.868     minutes"
"             Time to Centroid       115.220    87.952     97.540     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1564.29    1911.91    3476.21    c.m"
"             Rainfall losses        34.527     2.269      16.785     mm"
"             Runoff depth           63.395     95.653     81.137     mm"
"             Runoff volume          1012.73    1867.62    2880.35    c.m"
"             Runoff coefficient     0.647      0.977      0.829      "
"             Maximum flow           0.333      0.843      0.948      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.948     5.343     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Park"
"       10.000   % Impervious"
"        2.090   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.881   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.433     5.343     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  25.391     4.534      22.397     minutes"
"             Time to Centroid       115.220    87.952     111.305    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1841.90    204.66     2046.56    c.m"
"             Rainfall losses        34.527     2.269      31.301     mm"
"             Runoff depth           63.395     95.653     66.620     mm"
"             Runoff volume          1192.45    199.91     1392.37    c.m"
"             Runoff coefficient     0.647      0.977      0.680      "
```

```
"             Maximum flow           0.393      0.090      0.433      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.433     5.557     0.000     0.000"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.730     5.557     0.000     0.000 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  20.121     3.593      9.455      minutes"
"             Time to Centroid       109.215    86.819     94.762     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1145.68    1400.27    2545.95    c.m"
"             Rainfall losses        34.520     3.529      17.475     mm"
"             Runoff depth           63.401     94.392     80.446     mm"
"             Runoff volume          741.80     1349.81    2091.61    c.m"
"             Runoff coefficient     0.647      0.964      0.822      "
"             Maximum flow           0.277      0.616      0.730      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.730     6.286     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
```

```
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.353     6.286     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  20.749     3.705      8.225      minutes"
"             Time to Centroid       109.932    86.956     93.049     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1480.57    2749.63    4230.20    c.m"
"             Rainfall losses        34.536     3.348      14.264     mm"
"             Runoff depth           63.385     94.574     83.658     mm"
"             Runoff volume          958.39     2655.63    3614.02    c.m"
"             Runoff coefficient     0.647      0.966      0.854      "
"             Maximum flow           0.359      1.213      1.353      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.353     7.639     0.000     0.000"
" 33          CATCHMENT 206"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.198     7.639     0.000     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  20.749     3.705      6.151      minutes"
"             Time to Centroid       109.932    86.956     90.254     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        644.32     2577.29    3221.61    c.m"
"             Rainfall losses        34.536     3.348      9.585      mm"
"             Runoff depth           63.385     94.574     88.336     mm"
"             Runoff volume          417.08     2489.18    2906.26    c.m"
"             Runoff coefficient     0.647      0.966      0.902      "
"             Maximum flow           0.156      1.137      1.198      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.198     8.837     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.746     8.837     0.000     0.000 c.m/sec"
```

```
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  20.749     3.705      18.326     minutes"
"             Time to Centroid       109.932    86.956     106.665    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        6636.13    737.35     7373.48    c.m"
"             Rainfall losses        34.536     3.348      31.417     mm"
"             Runoff depth           63.385     94.574     66.504     mm"
"             Runoff volume          4295.63    712.14     5007.77    c.m"
"             Runoff coefficient     0.647      0.966      0.679      "
"             Maximum flow           1.608      0.325      1.746      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  1.746     9.788     0.000     0.000"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    36.330    hectare"
"             Total Impervious area                   18.751    hectare"
"             Total % impervious                      51.612"
" 19          EXIT"
```

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"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:             C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:            104-104 post  Reg-Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/21/2023 at 1:59:03 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"P
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.078     0.000     0.000     0.000 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  16.093     2.860      7.181      minutes"
"             Time to Centroid       2720.207   2251.465   2404.533   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        859.28     1050.22    1909.50    c.m"
"             Rainfall losses        139.563    39.596     84.581     mm"
"             Runoff depth           145.437    245.404    200.419    mm"
"             Runoff volume          438.49     904.31     1342.81    c.m"
"             Runoff coefficient     0.510      0.861      0.703      "
"             Maximum flow           0.031      0.047      0.078      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.078     0.078     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.512     0.078     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  50.233     8.926      11.288     minutes"
"             Time to Centroid       2757.880   2264.252   2292.474   minutes"
```

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"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.1220     1.0978     1.2198     ha-m"
"             Rainfall losses        138.714    16.956     29.132     mm"
"             Runoff depth           146.286    268.044    255.868    mm"
"             Runoff volume          0.0626     1.0325     1.0951     ha-m"
"             Runoff coefficient     0.513      0.941      0.898      "
"             Maximum flow           0.046      0.484      0.512      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.512     0.590     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.117     0.590     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  35.092     6.236      15.325     minutes"
"             Time to Centroid       2739.025   2235.505   2394.105   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1397.93    1708.57    3106.50    c.m"
"             Rainfall losses        140.362    27.637     78.363     mm"
"             Runoff depth           144.638    257.363    206.637    mm"
"             Runoff volume          709.45     1542.89    2252.34    c.m"
"             Runoff coefficient     0.508      0.903      0.725      "
"             Maximum flow           0.054      0.076      0.117      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.117     0.707     0.000     0.000"
```

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" 33          CATCHMENT 202"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           202   Internal to Pond Inet 3"
"        60.000   % Impervious"
"         4.150   Total Area"
"       130.000   Flow length"
"         4.000   Overland Slope"
"         1.660   Pervious Area"
"       130.000   Pervious length"
"         2.000   Pervious slope"
"         2.490   Impervious Area"
"       130.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.447     0.707     0.000     0.000 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           1.660      2.490      4.150      hectare"
"              Time of concentration  38.792     6.893      15.449     minutes"
"              Time to Centroid       2741.816   2242.481   2376.420   minutes"
"              Rainfall depth         285.000    285.000    285.000    mm"
"              Rainfall volume        0.4731     0.7096     1.1828     ha-m"
"              Rainfall losses        141.611    24.215     71.174     mm"
"              Runoff depth           143.389    260.785    213.826    mm"
"              Runoff volume          2380.25    6493.54    8873.79    c.m"
"              Runoff coefficient     0.503      0.915      0.750      "
"              Maximum flow           0.182      0.315      0.447      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.447     1.153     0.000     0.000"
" 33          CATCHMENT 203"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           203   Internal to Pond Inet 2"
"        60.000   % Impervious"
"         2.760   Total Area"
"        30.000   Flow length"
"         4.000   Overland Slope"
"         1.104   Pervious Area"
```

```
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.325     1.153     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  16.093     2.860      6.608      minutes"
"             Time to Centroid       2720.207   2251.465   2384.215   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3146.40    4719.60    7866.00    c.m"
"             Rainfall losses        139.563    39.596     79.583     mm"
"             Runoff depth           145.437    245.404    205.417    mm"
"             Runoff volume          1605.63    4063.89    5669.52    c.m"
"             Runoff coefficient     0.510      0.861      0.721      "
"             Maximum flow           0.115      0.211      0.325      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.325     1.479     0.000     0.000"
" 33          CATCHMENT 303"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          303   External"
"       55.000   % Impervious"
"        3.550   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.597   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        1.952   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.371     1.479     0.000     0.000 c.m/sec"
"             Catchment 303          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  40.556     7.207      17.519     minutes"
"             Time to Centroid       2744.076   2245.793   2399.878   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.4553     0.5565     1.0117     ha-m"
"             Rainfall losses        141.525    22.773     76.211     mm"
"             Runoff depth           143.475    262.227    208.789    mm"
"             Runoff volume          2292.02    5119.98    7412.00    c.m"
"             Runoff coefficient     0.503      0.920      0.733      "
"             Maximum flow           0.175      0.247      0.371      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.371     1.850     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Park"
"       10.000   % Impervious"
"        2.090   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.881   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.225     1.850     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  40.556     7.207      34.926     minutes"
"             Time to Centroid       2744.076   2245.793   2659.968   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        5360.85    595.65     5956.50    c.m"
"             Rainfall losses        141.525    22.773     129.649    mm"
"             Runoff depth           143.475    262.227    155.351    mm"
"             Runoff volume          2698.77    548.05     3246.83    c.m"
"             Runoff coefficient     0.503      0.920      0.545      "
"             Maximum flow           0.206      0.026      0.225      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.225     2.022     0.000     0.000"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.282     2.022     0.000     0.000 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  32.137     5.711      14.115     minutes"
"             Time to Centroid       2737.280   2232.538   2393.050   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3334.50    4075.50    7410.00    c.m"
"             Rainfall losses        139.558    29.801     79.192     mm"
"             Runoff depth           145.442    255.199    205.808    mm"
"             Runoff volume          1701.67    3649.34    5351.01    c.m"
"             Runoff coefficient     0.510      0.895      0.722      "
"             Maximum flow           0.128      0.181      0.282      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.282     2.304     0.000     0.000"
```

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" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.485     2.304     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  33.142     5.889      12.266     minutes"
"             Time to Centroid       2737.930   2233.505   2351.531   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.4309     0.8003     1.2312     ha-m"
"             Rainfall losses        139.790    29.018     67.788     mm"
"             Runoff depth           145.210    255.982    217.212    mm"
"             Runoff volume          2195.58    7187.97    9383.55    c.m"
"             Runoff coefficient     0.510      0.898      0.762      "
"             Maximum flow           0.166      0.355      0.485      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.485     2.789     0.000     0.000"
" 33          CATCHMENT 206"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
```

```
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.389     2.789     0.000     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  33.142     5.889      9.274      minutes"
"             Time to Centroid       2737.929   2233.505   2296.156   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1875.30    7501.20    9376.50    c.m"
"             Rainfall losses        139.790    29.018     51.172     mm"
"             Runoff depth           145.210    255.982    233.828    mm"
"             Runoff volume          955.48     6737.44    7692.93    c.m"
"             Runoff coefficient     0.510      0.898      0.820      "
"             Maximum flow           0.072      0.333      0.389      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.389     3.178     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.809     3.178     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  33.142     5.889      28.678     minutes"
"             Time to Centroid       2737.929   2233.505   2655.311   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1.9314     0.2146     2.1461     ha-m"
"             Rainfall losses        139.790    29.018     128.713    mm"
"             Runoff depth           145.210    255.982    156.287    mm"
"             Runoff volume          0.9841     0.1928     1.1768     ha-m"
"             Runoff coefficient     0.510      0.898      0.548      "
"             Maximum flow           0.744      0.095      0.809      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.809     3.853     0.000     0.000"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    36.330    hectare"
"             Total Impervious area                   18.751    hectare"
"             Total % impervious                      51.612"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                                      25mm.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               2/22/2023 at 10:32:47 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1581.200   Coefficient A"
"       13.000   Constant B"
"        1.000   Exponent C"
"        0.400   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            84.723    mm/hr"
"             Total depth                  24.999    mm"
"            8   00025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.074     0.000     0.000     0.000 c.m/sec"
```

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"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration      ---    2.370      2.370      minutes"
"             Time to Centroid       0.000      110.927    110.927    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        75.37      92.12      167.49     c.m"
"             Rainfall losses        24.999     1.866      12.276     mm"
"             Runoff depth           0.000      23.134     12.724     mm"
"             Runoff volume          0.00       85.25      85.25      c.m"
"             Runoff coefficient     0.000      0.925      0.509      "
"             Maximum flow           0.000      0.074      0.074      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.074     0.074     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.742     0.074     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration      ---    7.399      7.399      minutes"
"             Time to Centroid       0.000      117.918    117.918    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        107.00     962.97     1069.97    c.m"
"             Rainfall losses        24.999     1.678      4.010      mm"
"             Runoff depth           0.000      23.321     20.989     mm"
"             Runoff volume          0.00       898.33     898.33     c.m"
"             Runoff coefficient     0.000      0.933      0.840      "
```

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"             Maximum flow           0.000      0.742      0.742      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.742     0.797     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.112     0.797     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration      ---    5.169      5.169      minutes"
"             Time to Centroid       0.000      114.879    114.879    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        122.62     149.87     272.49     c.m"
"             Rainfall losses        24.999     1.698      12.183     mm"
"             Runoff depth           0.000      23.302     12.816     mm"
"             Runoff volume          0.00       139.69     139.69     c.m"
"             Runoff coefficient     0.000      0.932      0.513      "
"             Maximum flow           0.000      0.112      0.112      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.112     0.909     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

```
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.467     0.909     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration      ---    5.714      5.714      minutes"
"             Time to Centroid       0.000      115.659    115.659    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        414.99     622.48     1037.47    c.m"
"             Rainfall losses        24.999     1.646      10.987     mm"
"             Runoff depth           0.000      23.353     14.012     mm"
"             Runoff volume          0.00       581.50     581.50     c.m"
"             Runoff coefficient     0.000      0.934      0.560      "
"             Maximum flow           0.000      0.467      0.467      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.467     1.375     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.467     1.375     1.375     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  1.375    c.m/sec"
"             Hydrograph volume          1704.772    c.m"
"                     0.467     1.375     1.375     1.375"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.467     0.000     1.375     1.375"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
```

```
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.334     0.000     1.375     1.375 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration      ---    2.370      2.370      minutes"
"             Time to Centroid       0.000      110.927    110.927    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        275.99     413.99     689.98     c.m"
"             Rainfall losses        24.999     1.866      11.119     mm"
"             Runoff depth           0.000      23.134     13.880     mm"
"             Runoff volume          0.00       383.09     383.09     c.m"
"             Runoff coefficient     0.000      0.925      0.555      "
"             Maximum flow           0.000      0.334      0.334      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.334     0.334     1.375     1.375"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.334     0.334     0.334     1.375"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Pond Inlet 2"
"             Maximum flow                 0.334    c.m/sec"
"             Hydrograph volume          383.093    c.m"
"                    0.334     0.334     0.334     0.334"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.334     0.000     0.334     0.334"
```

```
" 33          CATCHMENT 303"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           303   External"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.366     0.000     0.334     0.334 c.m/sec"
"              Catchment 303          Pervious   Impervious Total Area "
"              Surface Area           1.597      1.952      3.550      hectare"
"              Time of concentration      ---    5.974      5.974      minutes"
"              Time to Centroid       0.000      116.025    116.025    minutes"
"              Rainfall depth         24.999     24.999     24.999     mm"
"              Rainfall volume        399.36     488.11     887.47     c.m"
"              Rainfall losses        24.999     1.621      12.141     mm"
"              Runoff depth           0.000      23.379     12.858     mm"
"              Runoff volume          0.00       456.47     456.47     c.m"
"              Runoff coefficient     0.000      0.935      0.514      "
"              Maximum flow           0.000      0.366      0.366      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.366     0.366     0.334     0.334"
" 33          CATCHMENT 204"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           204   Park"
"        10.000   % Impervious"
"         2.090   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.881   Pervious Area"
```

```
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.039     0.366     0.334     0.334 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration      ---    5.974      5.974      minutes"
"             Time to Centroid       0.000      116.025    116.025    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        470.24     52.25      522.48     c.m"
"             Rainfall losses        24.999     1.621      22.661     mm"
"             Runoff depth           0.000      23.379     2.338      mm"
"             Runoff volume          0.00       48.86      48.86      c.m"
"             Runoff coefficient     0.000      0.935      0.094      "
"             Maximum flow           0.000      0.039      0.039      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.039     0.405     0.334     0.334"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.262     0.405     0.334     0.334 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration      ---    4.734      4.734      minutes"
"             Time to Centroid       0.000      114.243    114.243    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        292.49     357.49     649.98     c.m"
"             Rainfall losses        24.999     1.677      12.172     mm"
"             Runoff depth           0.000      23.322     12.827     mm"
"             Runoff volume          0.00       333.50     333.50     c.m"
"             Runoff coefficient     0.000      0.933      0.513      "
"             Maximum flow           0.000      0.262      0.262      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.262     0.667     0.334     0.334"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.518     0.667     0.334     0.334 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration      ---    4.882      4.882      minutes"
"             Time to Centroid       0.000      114.456    114.456    minutes"
```

```
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        377.99     701.98     1079.97    c.m"
"             Rainfall losses        24.999     1.695      9.851      mm"
"             Runoff depth           0.000      23.304     15.148     mm"
"             Runoff volume          0.00       654.38     654.38     c.m"
"             Runoff coefficient     0.000      0.932      0.606      "
"             Maximum flow           0.000      0.518      0.518      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.518     1.185     0.334     0.334"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.518     1.185     1.185     0.334"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                  1.185    c.m/sec"
"             Hydrograph volume          1493.211    c.m"
"                    0.518     1.185     1.185     1.185"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                  1.185    c.m/sec"
"             Hydrograph volume          1493.211    c.m"
"                    0.518     1.185     1.185     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.518     1.185     1.185     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Pond"
"             Maximum flow                  1.185    c.m/sec"
"             Hydrograph volume          1493.211    c.m"
"                    0.518     1.185     1.185     1.185"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  1.375    c.m/sec"
"             Hydrograph volume          1704.772    c.m"
"                    0.518     1.375     1.185     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.518     1.375     1.375     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Pond"
"            Maximum flow                  2.561    c.m/sec"
"            Hydrograph volume          3197.983    c.m"
"                    0.518     1.375     1.375     2.561"
" 40         HYDROGRAPH   Confluence    2"
"           7   Confluence "
"           2   Node #"
"               Pond Inlet 2"
"            Maximum flow                  0.334    c.m/sec"
"            Hydrograph volume           383.093    c.m"
"                    0.518     0.334     1.375     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.518     0.334     0.334     0.000"
" 40         HYDROGRAPH   Combine    1000"
"           6   Combine "
"        1000   Node #"
"               Pond"
"            Maximum flow                  2.808    c.m/sec"
"            Hydrograph volume          3581.077    c.m"
"                    0.518     0.334     0.334     2.808"
" 40         HYDROGRAPH   Confluence    1000"
"           7   Confluence "
"        1000   Node #"
"               Pond"
"            Maximum flow                  2.808    c.m/sec"
"            Hydrograph volume          3581.077    c.m"
"                    0.518     2.808     0.334     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.518     2.808     2.808     0.000"
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                    0.518     2.808     2.808     0.000"
" 33         CATCHMENT 206"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.486     2.808     2.808     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration      ---    4.882      4.882      minutes"
"             Time to Centroid       0.000      114.456    114.456    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        164.49     657.98     822.47     c.m"
"             Rainfall losses        24.999     1.695      6.356      mm"
"             Runoff depth           0.000      23.304     18.643     mm"
"             Runoff volume          0.00       613.37     613.37     c.m"
"             Runoff coefficient     0.000      0.932      0.746      "
"             Maximum flow           0.000      0.486      0.486      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.486     3.294     2.808     0.000"
" 54          POND DESIGN"
"        3.294   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"       4194.4   Hydrograph volume    c.m"
"          17.   Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.100   0.01500   680.300"
"                456.200   0.02900  1395.900"
"                456.300   0.04200  2147.500"
"                456.400   0.05200  2935.400"
"                456.480   0.05900  3592.400"
"                456.500   0.06000  3760.400"
"                456.600    0.2840  4627.400"
"                456.700    0.7630  5539.800"
"                456.800     1.491  6496.900"
"                456.900     2.386  7500.300"
"                457.000     2.490  8551.600"
"                457.100     6.036  9652.000"
"                457.200    12.632  10803.10"
"                457.300    21.379  12006.50"
"                457.400    31.960  13275.50"
```

```
"               457.500    44.189  14711.10"
"             Peak outflow                  0.060    c.m/sec"
"             Maximum level               456.499    metre"
"             Maximum storage            3748.784    c.m"
"             Centroidal lag               15.759   hours"
"                  0.486     3.294     0.060     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.486     0.060     0.060     0.000"
" 54          POND DESIGN"
"        0.060   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"       4141.6   Hydrograph volume    c.m"
"           9.   Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"               454.860     0.000     0.000"
"               454.960  1.20E-05     4.000"
"               455.060  1.20E-05     8.000"
"               455.160  1.20E-05    12.000"
"               455.260  1.20E-05    16.000"
"               455.360  1.20E-05    20.000"
"               455.460     1.702    20.500"
"               455.560     4.979    21.000"
"               455.660     9.395    21.500"
"             Peak outflow                  0.060    c.m/sec"
"             Maximum level               455.363    metre"
"             Maximum storage              20.018    c.m"
"             Centroidal lag               16.043   hours"
"                  0.486     0.060     0.060     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.486     0.060     0.060     0.000"
" 56          DIVERSION"
"         3000   Node number"
"        0.000   Overflow threshold"
"        0.399   Computed diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.024    c.m/sec"
"             Volume of diverted flow    1625.398    c.m"
"             DIV03000.00025hyd"
"             Major flow at 3000"
"                     0.486     0.060     0.036     0.000 c.m/sec"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Diverted to existing wetland on site"
" 40          HYDROGRAPH   Combine    4000"
```

```
"            6   Combine "
"         4000   Node #"
"                Site"
"              Maximum flow                  0.036    c.m/sec"
"              Hydrograph volume          2497.057    c.m"
"                       0.486     0.060     0.036     0.036"
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                       0.486     0.000     0.036     0.036"
" 33           CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                       0.139     0.000     0.036     0.036 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration      ---    4.882      4.882      minutes"
"             Time to Centroid       0.000      114.456    114.456    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        1694.20    188.24     1882.44    c.m"
"             Rainfall losses        24.999     1.695      22.669     mm"
"             Runoff depth           0.000      23.304     2.330      mm"
"             Runoff volume          0.00       175.48     175.48     c.m"
"             Runoff coefficient     0.000      0.932      0.093      "
"             Maximum flow           0.000      0.139      0.139      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                       0.139     0.139     0.036     0.036"
" 40           HYDROGRAPH Copy to Outflow"
```

```
"            8   Copy to Outflow"
"                     0.139     0.139     0.139     0.036"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  0.139    c.m/sec"
"             Hydrograph volume          2672.536    c.m"
"                     0.139     0.139     0.139     0.139"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.139     0.000     0.139     0.139"
" 47          FILEI_O Read/Open DIV03000.00025hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV03000.00025hyd"
"             Major flow at 3000"
"             Total volume               1625.398    c.m"
"             Maximum flow                  0.024    c.m/sec"
"                  0.024     0.000     0.139     0.139 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.024     0.024     0.139     0.139"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.024     0.024     0.024     0.139"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  0.139    c.m/sec"
"             Hydrograph volume          4297.937    c.m"
"                     0.024     0.024     0.024     0.139"
" 40          HYDROGRAPH   Confluence    4000"
"            7   Confluence "
"         4000   Node #"
"                Site"
"             Maximum flow                  0.139    c.m/sec"
"             Hydrograph volume          4297.937    c.m"
"                     0.024     0.139     0.024     0.000"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Total flow to Grand River"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                    18.751    hectare"
"             Total % impervious                       51.612"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                    104-104 post  002 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               2/22/2023 at 10:44:38 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.050   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            93.293    mm/hr"
"             Total depth                  33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.072     0.000     0.000     0.000 c.m/sec"
```

```
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  22.062     2.281      3.430      minutes"
"             Time to Centroid       96.472     86.938     87.492     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        99.54      121.66     221.19     c.m"
"             Rainfall losses        30.676     2.000      14.904     mm"
"             Runoff depth           2.338      31.014     18.110     mm"
"             Runoff volume          7.05       114.29     121.33     c.m"
"             Runoff coefficient     0.071      0.939      0.549      "
"             Maximum flow           0.004      0.072      0.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.072     0.072     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.783     0.072     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  68.865     7.119      7.629      minutes"
"             Time to Centroid       138.360    93.923     94.289     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        141.30     1271.70    1413.00    c.m"
"             Rainfall losses        30.669     1.681      4.580      mm"
"             Runoff depth           2.345      31.333     28.434     mm"
"             Runoff volume          10.04      1206.95    1216.99    c.m"
"             Runoff coefficient     0.071      0.949      0.861      "
```

```
"             Maximum flow           0.002      0.782      0.783      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.783     0.855     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.125     0.855     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  48.108     4.973      7.458      minutes"
"             Time to Centroid       119.816    90.843     92.512     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        161.93     197.92     359.85     c.m"
"             Rainfall losses        30.669     1.629      14.697     mm"
"             Runoff depth           2.345      31.385     18.317     mm"
"             Runoff volume          11.50      188.15     199.65     c.m"
"             Runoff coefficient     0.071      0.951      0.555      "
"             Maximum flow           0.004      0.124      0.125      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.125     0.979     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

```
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.511     0.979     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  53.180     5.498      7.765      minutes"
"             Time to Centroid       124.334    91.560     93.119     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        548.03     822.05     1370.08    c.m"
"             Rainfall losses        30.670     1.714      13.296     mm"
"             Runoff depth           2.344      31.300     19.718     mm"
"             Runoff volume          38.92      779.37     818.28     c.m"
"             Runoff coefficient     0.071      0.948      0.597      "
"             Maximum flow           0.011      0.510      0.511      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.511     1.490     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.511     1.490     1.490     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  1.490    c.m/sec"
"             Hydrograph volume          2356.259    c.m"
"                     0.511     1.490     1.490     1.490"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.511     0.000     1.490     1.490"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
```

```
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.323     0.000     1.490     1.490 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  22.062     2.281      3.227      minutes"
"             Time to Centroid       96.472     86.938     87.394     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        364.47     546.71     911.19     c.m"
"             Rainfall losses        30.676     2.000      13.471     mm"
"             Runoff depth           2.338      31.014     19.543     mm"
"             Runoff volume          25.81      513.59     539.40     c.m"
"             Runoff coefficient     0.071      0.939      0.592      "
"             Maximum flow           0.016      0.322      0.323      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.323     0.323     1.490     1.490"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.323     0.323     0.323     1.490"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Pond Inlet 2"
"             Maximum flow                 0.323    c.m/sec"
"             Hydrograph volume          539.399    c.m"
"                     0.323     0.323     0.323     0.323"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.323     0.000     0.323     0.323"
```

```
" 33          CATCHMENT 303"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           303   External"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.397     0.000     0.323     0.323 c.m/sec"
"              Catchment 303          Pervious   Impervious Total Area "
"              Surface Area           1.597      1.952      3.550      hectare"
"              Time of concentration  55.598     5.748      8.629      minutes"
"              Time to Centroid       126.518    91.941     93.939     minutes"
"              Rainfall depth         33.014     33.014     33.014     mm"
"              Rainfall volume        527.40     644.60     1172.00    c.m"
"              Rainfall losses        30.669     1.730      14.753     mm"
"              Runoff depth           2.345      31.284     18.261     mm"
"              Runoff volume          37.47      610.81     648.28     c.m"
"              Runoff coefficient     0.071      0.948      0.553      "
"              Maximum flow           0.011      0.397      0.397      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.397     0.397     0.323     0.323"
" 33          CATCHMENT 204"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           204   Park"
"        10.000   % Impervious"
"         2.090   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.881   Pervious Area"
```

```
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.043     0.397     0.323     0.323 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  55.598     5.748      25.832     minutes"
"             Time to Centroid       126.517    91.941     105.871    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        620.99     69.00      689.99     c.m"
"             Rainfall losses        30.669     1.730      27.775     mm"
"             Runoff depth           2.345      31.284     5.239      mm"
"             Runoff volume          44.12      65.38      109.50     c.m"
"             Runoff coefficient     0.071      0.948      0.159      "
"             Maximum flow           0.013      0.042      0.043      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.043     0.441     0.323     0.323"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.300     0.441     0.323     0.323 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  44.057     4.555      6.834      minutes"
"             Time to Centroid       116.160    90.239     91.735     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        386.26     472.10     858.36     c.m"
"             Rainfall losses        30.671     1.703      14.738     mm"
"             Runoff depth           2.343      31.311     18.276     mm"
"             Runoff volume          27.41      447.75     475.16     c.m"
"             Runoff coefficient     0.071      0.948      0.554      "
"             Maximum flow           0.009      0.299      0.300      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.300     0.741     0.323     0.323"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.587     0.741     0.323     0.323 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  45.434     4.697      6.274      minutes"
"             Time to Centroid       117.422    90.442     91.487     minutes"
```

```
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        499.17     927.03     1426.20    c.m"
"             Rainfall losses        30.669     1.666      11.817     mm"
"             Runoff depth           2.345      31.348     21.197     mm"
"             Runoff volume          35.46      880.24     915.70     c.m"
"             Runoff coefficient     0.071      0.950      0.642      "
"             Maximum flow           0.012      0.586      0.587      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.587     1.328     0.323     0.323"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.587     1.328     1.328     0.323"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                 1.328    c.m/sec"
"             Hydrograph volume          2148.645    c.m"
"                    0.587     1.328     1.328     1.328"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                 1.328    c.m/sec"
"             Hydrograph volume          2148.645    c.m"
"                    0.587     1.328     1.328     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.587     1.328     1.328     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Pond"
"             Maximum flow                 1.328    c.m/sec"
"             Hydrograph volume          2148.645    c.m"
"                    0.587     1.328     1.328     1.328"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                 1.490    c.m/sec"
"             Hydrograph volume          2356.259    c.m"
"                    0.587     1.490     1.328     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.587     1.490     1.490     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Pond"
"            Maximum flow                  2.818    c.m/sec"
"            Hydrograph volume          4504.905    c.m"
"                    0.587     1.490     1.490     2.818"
" 40         HYDROGRAPH   Confluence    2"
"           7   Confluence "
"           2   Node #"
"               Pond Inlet 2"
"            Maximum flow                  0.323    c.m/sec"
"            Hydrograph volume           539.399    c.m"
"                    0.587     0.323     1.490     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.587     0.323     0.323     0.000"
" 40         HYDROGRAPH   Combine    1000"
"           6   Combine "
"        1000   Node #"
"               Pond"
"            Maximum flow                  3.141    c.m/sec"
"            Hydrograph volume          5044.305    c.m"
"                    0.587     0.323     0.323     3.141"
" 40         HYDROGRAPH   Confluence    1000"
"           7   Confluence "
"        1000   Node #"
"               Pond"
"            Maximum flow                  3.141    c.m/sec"
"            Hydrograph volume          5044.305    c.m"
"                    0.587     3.141     0.323     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.587     3.141     3.141     0.000"
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                    0.587     3.141     3.141     0.000"
" 33         CATCHMENT 206"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.550     3.141     3.141     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  45.434     4.697      5.445      minutes"
"             Time to Centroid       117.422    90.442     90.937     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        217.23     868.93     1086.16    c.m"
"             Rainfall losses        30.669     1.666      7.467      mm"
"             Runoff depth           2.345      31.348     25.547     mm"
"             Runoff volume          15.43      825.07     840.50     c.m"
"             Runoff coefficient     0.071      0.950      0.774      "
"             Maximum flow           0.005      0.549      0.550      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.550     3.691     3.141     0.000"
" 54          POND DESIGN"
"        3.691   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"       5884.8   Hydrograph volume    c.m"
"          17.   Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.100   0.01500   680.300"
"                456.200   0.02900  1395.900"
"                456.300   0.04200  2147.500"
"                456.400   0.05200  2935.400"
"                456.480   0.05900  3592.400"
"                456.500   0.06000  3760.400"
"                456.600    0.2840  4627.400"
"                456.700    0.7630  5539.800"
"                456.800     1.491  6496.900"
"                456.900     2.386  7500.300"
"                457.000     2.490  8551.600"
"                457.100     6.036  9652.000"
"                457.200    12.632  10803.10"
"                457.300    21.379  12006.50"
"                457.400    31.960  13275.50"
```

```
"               457.500    44.189  14711.10"
"             Peak outflow                  0.264    c.m/sec"
"             Maximum level               456.591    metre"
"             Maximum storage            4551.645    c.m"
"             Centroidal lag               12.538   hours"
"                  0.550     3.691     0.264     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                   0.550     0.264     0.264     0.000"
" 54          POND DESIGN"
"        0.264   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"       5827.4   Hydrograph volume    c.m"
"           9.   Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"               454.860     0.000     0.000"
"               454.960  1.20E-05     4.000"
"               455.060  1.20E-05     8.000"
"               455.160  1.20E-05    12.000"
"               455.260  1.20E-05    16.000"
"               455.360  1.20E-05    20.000"
"               455.460     1.702    20.500"
"               455.560     4.979    21.000"
"               455.660     9.395    21.500"
"             Peak outflow                  0.264    c.m/sec"
"             Maximum level               455.376    metre"
"             Maximum storage              20.078    c.m"
"             Centroidal lag               12.813   hours"
"                  0.550     0.264     0.264     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                   0.550     0.264     0.264     0.000"
" 56          DIVERSION"
"         3000   Node number"
"        0.000   Overflow threshold"
"        0.394   Computed diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.104    c.m/sec"
"             Volume of diverted flow    2288.765    c.m"
"             DIV03000.002hyd"
"             Major flow at 3000"
"                   0.550     0.264     0.160     0.000 c.m/sec"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Diverted to existing wetland on site"
" 40          HYDROGRAPH   Combine    4000"
```

```
"            6   Combine "
"         4000   Node #"
"                Site"
"              Maximum flow                  0.160    c.m/sec"
"              Hydrograph volume          3513.095    c.m"
"                       0.550     0.264     0.160     0.160"
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                       0.550     0.000     0.160     0.160"
" 33           CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                       0.162     0.000     0.160     0.160 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  45.434     4.697      21.089     minutes"
"             Time to Centroid       117.422    90.442     101.298    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        2237.36    248.60     2485.95    c.m"
"             Rainfall losses        30.669     1.666      27.769     mm"
"             Runoff depth           2.345      31.348     5.245      mm"
"             Runoff volume          158.93     236.05     394.98     c.m"
"             Runoff coefficient     0.071      0.950      0.159      "
"             Maximum flow           0.053      0.157      0.162      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                       0.162     0.162     0.160     0.160"
" 40           HYDROGRAPH Copy to Outflow"
```

```
"            8   Copy to Outflow"
"                     0.162     0.162     0.162     0.160"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  0.205    c.m/sec"
"             Hydrograph volume          3908.075    c.m"
"                     0.162     0.162     0.162     0.205"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.162     0.000     0.162     0.205"
" 47          FILEI_O Read/Open DIV03000.002hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV03000.002hyd"
"             Major flow at 3000"
"             Total volume               2288.765    c.m"
"             Maximum flow                  0.104    c.m/sec"
"                  0.104     0.000     0.162     0.205 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.104     0.104     0.162     0.205"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.104     0.104     0.104     0.205"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  0.305    c.m/sec"
"             Hydrograph volume          6196.842    c.m"
"                     0.104     0.104     0.104     0.305"
" 40          HYDROGRAPH   Confluence    4000"
"            7   Confluence "
"         4000   Node #"
"                Site"
"             Maximum flow                  0.305    c.m/sec"
"             Hydrograph volume          6196.842    c.m"
"                     0.104     0.305     0.104     0.000"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Total flow to Grand River"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    36.330    hectare"
"             Total Impervious area                   18.751    hectare"
"             Total % impervious                      51.612"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                    104-104 post  005 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/22/2023 at 10:50:36 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           113.586    mm/hr"
"             Total depth                  49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.104     0.000     0.000     0.000 c.m/sec"
```

```
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  14.420     2.108      4.886      minutes"
"             Time to Centroid       100.204    85.724     88.991     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        150.12     183.48     333.60     c.m"
"             Rainfall losses        32.852     2.224      16.007     mm"
"             Runoff depth           16.939     47.568     33.785     mm"
"             Runoff volume          51.07      175.29     226.36     c.m"
"             Runoff coefficient     0.340      0.955      0.679      "
"             Maximum flow           0.028      0.095      0.104      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.104     0.104     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.019     0.104     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  45.009     6.580      8.036      minutes"
"             Time to Centroid       135.435    91.865     93.515     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        213.11     1917.98    2131.08    c.m"
"             Rainfall losses        32.839     1.944      5.034      mm"
"             Runoff depth           16.953     47.847     44.758     mm"
"             Runoff volume          72.56      1843.08    1915.64    c.m"
"             Runoff coefficient     0.340      0.961      0.899      "
```

```
"             Maximum flow           0.018      1.018      1.019      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.019     1.124     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.169     1.124     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  31.443     4.597      10.620     minutes"
"             Time to Centroid       119.805    89.191     96.060     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        244.23     298.50     542.73     c.m"
"             Rainfall losses        32.853     1.876      15.816     mm"
"             Runoff depth           16.939     47.916     33.976     mm"
"             Runoff volume          83.09      287.25     370.34     c.m"
"             Runoff coefficient     0.340      0.962      0.682      "
"             Maximum flow           0.027      0.165      0.169      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.169     1.293     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

```
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.695     1.293     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  34.758     5.082      10.733     minutes"
"             Time to Centroid       123.626    89.815     96.253     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        826.54     1239.81    2066.36    c.m"
"             Rainfall losses        32.847     1.767      14.199     mm"
"             Runoff depth           16.945     48.025     35.593     mm"
"             Runoff volume          281.29     1195.82    1477.11    c.m"
"             Runoff coefficient     0.340      0.965      0.715      "
"             Maximum flow           0.083      0.684      0.695      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.695     1.988     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.695     1.988     1.988     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  1.988    c.m/sec"
"             Hydrograph volume          3989.447    c.m"
"                     0.695     1.988     1.988     1.988"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.695     0.000     1.988     1.988"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
```

```
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.462     0.000     1.988     1.988 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  14.420     2.108      4.470      minutes"
"             Time to Centroid       100.204    85.724     88.502     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        549.70     824.55     1374.25    c.m"
"             Rainfall losses        32.852     2.224      14.475     mm"
"             Runoff depth           16.939     47.568     35.316     mm"
"             Runoff volume          187.01     787.72     974.73     c.m"
"             Runoff coefficient     0.340      0.955      0.709      "
"             Maximum flow           0.103      0.429      0.462      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.462     0.462     1.988     1.988"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.462     0.462     0.462     1.988"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Pond Inlet 2"
"             Maximum flow                 0.462    c.m/sec"
"             Hydrograph volume          974.732    c.m"
"                    0.462     0.462     0.462     0.462"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.462     0.000     0.462     0.462"
```

```
" 33          CATCHMENT 303"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           303   External"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.544     0.000     0.462     0.462 c.m/sec"
"              Catchment 303          Pervious   Impervious Total Area "
"              Surface Area           1.597      1.952      3.550      hectare"
"              Time of concentration  36.338     5.313      12.264     minutes"
"              Time to Centroid       125.451    90.132     98.045     minutes"
"              Rainfall depth         49.792     49.792     49.792     mm"
"              Rainfall volume        795.42     972.18     1767.60    c.m"
"              Rainfall losses        32.839     1.757      15.744     mm"
"              Runoff depth           16.953     48.035     34.048     mm"
"              Runoff volume          270.82     937.88     1208.71    c.m"
"              Runoff coefficient     0.340      0.965      0.684      "
"              Maximum flow           0.078      0.534      0.544      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.544     0.544     0.462     0.462"
" 33          CATCHMENT 204"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           204   Park"
"        10.000   % Impervious"
"         2.090   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.881   Pervious Area"
```

```
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.103     0.544     0.462     0.462 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  36.338     5.313      28.909     minutes"
"             Time to Centroid       125.451    90.132     116.994    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        936.58     104.06     1040.65    c.m"
"             Rainfall losses        32.839     1.757      29.731     mm"
"             Runoff depth           16.953     48.035     20.061     mm"
"             Runoff volume          318.89     100.39     419.28     c.m"
"             Runoff coefficient     0.340      0.965      0.403      "
"             Maximum flow           0.092      0.057      0.103      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.103     0.613     0.462     0.462"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
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"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.405     0.613     0.462     0.462 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  28.795     4.210      9.735      minutes"
"             Time to Centroid       116.746    88.669     94.978     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        582.56     712.02     1294.58    c.m"
"             Rainfall losses        32.859     1.996      15.884     mm"
"             Runoff depth           16.933     47.796     33.908     mm"
"             Runoff volume          198.12     683.48     881.60     c.m"
"             Runoff coefficient     0.340      0.960      0.681      "
"             Maximum flow           0.068      0.395      0.405      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.405     1.018     0.462     0.462"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.788     1.018     0.462     0.462 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  29.695     4.341      8.402      minutes"
"             Time to Centroid       117.798    88.850     93.486     minutes"
```

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"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        752.85     1398.15    2151.00    c.m"
"             Rainfall losses        32.840     1.920      12.742     mm"
"             Runoff depth           16.952     47.871     37.050     mm"
"             Runoff volume          256.32     1344.23    1600.55    c.m"
"             Runoff coefficient     0.340      0.961      0.744      "
"             Maximum flow           0.086      0.775      0.788      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.788     1.806     0.462     0.462"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.788     1.806     1.806     0.462"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                 1.806    c.m/sec"
"             Hydrograph volume         4110.126    c.m"
"                    0.788     1.806     1.806     1.806"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                 1.806    c.m/sec"
"             Hydrograph volume         4110.127    c.m"
"                    0.788     1.806     1.806     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.788     1.806     1.806     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Pond"
"             Maximum flow                 1.806    c.m/sec"
"             Hydrograph volume         4110.127    c.m"
"                    0.788     1.806     1.806     1.806"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                 1.988    c.m/sec"
"             Hydrograph volume         3989.446    c.m"
"                    0.788     1.988     1.806     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.788     1.988     1.988     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Pond"
"            Maximum flow                  3.794    c.m/sec"
"            Hydrograph volume          8099.575    c.m"
"                    0.788     1.988     1.988     3.794"
" 40         HYDROGRAPH   Confluence    2"
"           7   Confluence "
"           2   Node #"
"               Pond Inlet 2"
"            Maximum flow                  0.462    c.m/sec"
"            Hydrograph volume           974.732    c.m"
"                    0.788     0.462     1.988     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.788     0.462     0.462     0.000"
" 40         HYDROGRAPH   Combine    1000"
"           6   Combine "
"        1000   Node #"
"               Pond"
"            Maximum flow                  4.256    c.m/sec"
"            Hydrograph volume          9074.310    c.m"
"                    0.788     0.462     0.462     4.256"
" 40         HYDROGRAPH   Confluence    1000"
"           7   Confluence "
"        1000   Node #"
"               Pond"
"            Maximum flow                  4.256    c.m/sec"
"            Hydrograph volume          9074.310    c.m"
"                    0.788     4.256     0.462     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    0.788     4.256     4.256     0.000"
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                    0.788     4.256     4.256     0.000"
" 33         CATCHMENT 206"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

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"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.732     4.256     4.256     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  29.695     4.341      6.403      minutes"
"             Time to Centroid       117.798    88.850     91.205     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        327.63     1310.52    1638.15    c.m"
"             Rainfall losses        32.840     1.920      8.104      mm"
"             Runoff depth           16.952     47.871     41.688     mm"
"             Runoff volume          111.55     1259.97    1371.52    c.m"
"             Runoff coefficient     0.340      0.961      0.837      "
"             Maximum flow           0.038      0.726      0.732      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.732     4.988     4.256     0.000"
" 54          POND DESIGN"
"        4.988   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"      10445.8   Hydrograph volume    c.m"
"         17.   Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.100   0.01500   680.300"
"                456.200   0.02900  1395.900"
"                456.300   0.04200  2147.500"
"                456.400   0.05200  2935.400"
"                456.480   0.05900  3592.400"
"                456.500   0.06000  3760.400"
"                456.600    0.2840  4627.400"
"                456.700    0.7630  5539.800"
"                456.800     1.491  6496.900"
"                456.900     2.386  7500.300"
"                457.000     2.490  8551.600"
"                457.100     6.036  9652.000"
"                457.200    12.632  10803.10"
"                457.300    21.379  12006.50"
"                457.400    31.960  13275.50"
```

```
"               457.500    44.189  14711.10"
"             Peak outflow                  1.235    c.m/sec"
"             Maximum level               456.765    metre"
"             Maximum storage            6159.941    c.m"
"             Centroidal lag                8.236   hours"
"                  0.732     4.988     1.235     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.732     1.235     1.235     0.000"
" 54          POND DESIGN"
"         1.235   Current peak flow    c.m/sec"
"         0.206   Target outflow    c.m/sec"
"       10392.8   Hydrograph volume    c.m"
"            9.   Number of stages"
"       456.800   Minimum water level    metre"
"       458.000   Maximum water level    metre"
"       456.800   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 454.860     0.000     0.000"
"                 454.960  1.20E-05     4.000"
"                 455.060  1.20E-05     8.000"
"                 455.160  1.20E-05    12.000"
"                 455.260  1.20E-05    16.000"
"                 455.360  1.20E-05    20.000"
"                 455.460     1.702    20.500"
"                 455.560     4.979    21.000"
"                 455.660     9.395    21.500"
"             Peak outflow                  1.235    c.m/sec"
"             Maximum level               455.433    metre"
"             Maximum storage              20.363    c.m"
"             Centroidal lag                8.348   hours"
"                  0.732     1.235     1.235     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.732     1.235     1.235     0.000"
" 56          DIVERSION"
"          3000   Node number"
"         0.000   Overflow threshold"
"         0.395   Computed diverted fraction"
"             0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.488    c.m/sec"
"             Volume of diverted flow    4097.439    c.m"
"             DIV03000.005hyd"
"             Major flow at 3000"
"                     0.732     1.235     0.747     0.000 c.m/sec"
" 81          ADD COMMENT================================================="
"           1  Lines of comment"
"             Diverted to existing wetland on site"
" 40          HYDROGRAPH   Combine    4000"
```

```
"            6   Combine "
"         4000   Node #"
"                Site"
"              Maximum flow                  0.747    c.m/sec"
"              Hydrograph volume          6276.480    c.m"
"                       0.732     1.235     0.747     0.747"
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                       0.732     0.000     0.747     0.747"
" 33           CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                       0.437     0.000     0.747     0.747 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  29.695     4.341      23.640     minutes"
"             Time to Centroid       117.798    88.850     110.884    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        3374.38    374.93     3749.31    c.m"
"             Rainfall losses        32.840     1.920      29.748     mm"
"             Runoff depth           16.952     47.871     20.044     mm"
"             Runoff volume          1148.85    360.47     1509.32    c.m"
"             Runoff coefficient     0.340      0.961      0.403      "
"             Maximum flow           0.387      0.208      0.437      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                       0.437     0.437     0.747     0.747"
" 40           HYDROGRAPH Copy to Outflow"
```

```
"            8   Copy to Outflow"
"                     0.437     0.437     0.437     0.747"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  1.136    c.m/sec"
"             Hydrograph volume          7785.801    c.m"
"                     0.437     0.437     0.437     1.136"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.437     0.000     0.437     1.136"
" 47          FILEI_O Read/Open DIV03000.005hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV03000.005hyd"
"             Major flow at 3000"
"             Total volume               4097.439    c.m"
"             Maximum flow                  0.488    c.m/sec"
"                  0.488     0.000     0.437     1.136 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.488     0.488     0.437     1.136"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.488     0.488     0.488     1.136"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  1.616    c.m/sec"
"             Hydrograph volume         11883.240    c.m"
"                     0.488     0.488     0.488     1.616"
" 40          HYDROGRAPH   Confluence    4000"
"            7   Confluence "
"         4000   Node #"
"                Site"
"             Maximum flow                  1.616    c.m/sec"
"             Hydrograph volume         11883.240    c.m"
"                     0.488     1.616     0.488     0.000"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Total flow to Grand River"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                    18.751    hectare"
"             Total % impervious                       51.612"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                   104-104 post  100 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               2/22/2023 at 11:06:09 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.020   Coefficient A"
"       34.699   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          168.777    mm/hr"
"             Total depth                 97.921    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.233     0.000     0.000     0.000 c.m/sec"
```

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"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  10.076     1.799      4.711      minutes"
"             Time to Centroid       97.792     84.352     89.081     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        295.23     360.84     656.07     c.m"
"             Rainfall losses        34.803     2.791      17.197     mm"
"             Runoff depth           63.119     95.130     80.725     mm"
"             Runoff volume          190.30     350.55     540.86     c.m"
"             Runoff coefficient     0.645      0.971      0.824      "
"             Maximum flow           0.099      0.153      0.233      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.233     0.233     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.688     0.233     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  31.450     5.616      7.390      minutes"
"             Time to Centroid       122.128    89.288     91.543     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        419.10     3771.93    4191.03    c.m"
"             Rainfall losses        34.482     2.307      5.524      mm"
"             Runoff depth           63.439     95.615     92.397     mm"
"             Runoff volume          271.52     3683.07    3954.59    c.m"
"             Runoff coefficient     0.648      0.976      0.944      "
```

```
"             Maximum flow           0.079      1.669      1.688      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.688     1.920     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.301     1.920     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  21.971     3.923      10.297     minutes"
"             Time to Centroid       111.333    87.214     95.731     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        480.30     587.04     1067.34    c.m"
"             Rainfall losses        34.507     2.882      17.113     mm"
"             Runoff depth           63.414     95.039     80.808     mm"
"             Runoff volume          311.04     569.76     880.81     c.m"
"             Runoff coefficient     0.648      0.971      0.825      "
"             Maximum flow           0.114      0.260      0.301      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.301     2.221     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
```

```
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.195     2.221     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  24.287     4.337      10.458     minutes"
"             Time to Centroid       113.975    87.701     95.762     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1625.49    2438.24    4063.73    c.m"
"             Rainfall losses        34.488     2.372      15.219     mm"
"             Runoff depth           63.434     95.549     82.703     mm"
"             Runoff volume          1053.00    2379.17    3432.17    c.m"
"             Runoff coefficient     0.648      0.976      0.845      "
"             Maximum flow           0.358      1.078      1.195      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.195     3.416     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.195     3.416     3.416     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  3.416    c.m/sec"
"             Hydrograph volume          8808.417    c.m"
"                     1.195     3.416     3.416     3.416"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.195     0.000     3.416     3.416"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
```

```
"            2   Horton equation"
"          203   Internal to Pond Inet 2"
"       60.000   % Impervious"
"        2.760   Total Area"
"       30.000   Flow length"
"        4.000   Overland Slope"
"        1.104   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        1.656   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.979     0.000     3.416     3.416 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           1.104      1.656      2.760      hectare"
"             Time of concentration  10.076     1.799      4.338      minutes"
"             Time to Centroid       97.792     84.352     88.474     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1081.05    1621.58    2702.63    c.m"
"             Rainfall losses        34.803     2.791      15.596     mm"
"             Runoff depth           63.119     95.130     82.325     mm"
"             Runoff volume          696.83     1575.35    2272.18    c.m"
"             Runoff coefficient     0.645      0.971      0.841      "
"             Maximum flow           0.363      0.689      0.979      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.979     0.979     3.416     3.416"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.979     0.979     0.979     3.416"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Pond Inlet 2"
"             Maximum flow                 0.979    c.m/sec"
"             Hydrograph volume         2272.181    c.m"
"                    0.979     0.979     0.979     0.979"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.979     0.000     0.979     0.979"
```

```
" 33          CATCHMENT 303"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           303   External"
"        55.000   % Impervious"
"         3.550   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.597   Pervious Area"
"       140.000   Pervious length"
"         2.000   Pervious slope"
"         1.952   Impervious Area"
"       140.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.948     0.000     0.979     0.979 c.m/sec"
"              Catchment 303          Pervious   Impervious Total Area "
"              Surface Area           1.597      1.952      3.550      hectare"
"              Time of concentration  25.391     4.534      11.868     minutes"
"              Time to Centroid       115.220    87.952     97.540     minutes"
"              Rainfall depth         97.921     97.921     97.921     mm"
"              Rainfall volume        1564.29    1911.91    3476.21    c.m"
"              Rainfall losses        34.527     2.269      16.785     mm"
"              Runoff depth           63.395     95.653     81.137     mm"
"              Runoff volume          1012.73    1867.62    2880.35    c.m"
"              Runoff coefficient     0.647      0.977      0.829      "
"              Maximum flow           0.333      0.843      0.948      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.948     0.948     0.979     0.979"
" 33          CATCHMENT 204"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           204   Park"
"        10.000   % Impervious"
"         2.090   Total Area"
"       140.000   Flow length"
"         2.000   Overland Slope"
"         1.881   Pervious Area"
```

```
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.433     0.948     0.979     0.979 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  25.391     4.534      22.397     minutes"
"             Time to Centroid       115.220    87.952     111.305    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1841.90    204.66     2046.56    c.m"
"             Rainfall losses        34.527     2.269      31.301     mm"
"             Runoff depth           63.395     95.653     66.620     mm"
"             Runoff volume          1192.45    199.91     1392.37    c.m"
"             Runoff coefficient     0.647      0.977      0.680      "
"             Maximum flow           0.393      0.090      0.433      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.433     1.178     0.979     0.979"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.730     1.178     0.979     0.979 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  20.121     3.593      9.455      minutes"
"             Time to Centroid       109.215    86.819     94.762     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1145.68    1400.27    2545.95    c.m"
"             Rainfall losses        34.520     3.529      17.475     mm"
"             Runoff depth           63.401     94.392     80.446     mm"
"             Runoff volume          741.80     1349.81    2091.61    c.m"
"             Runoff coefficient     0.647      0.964      0.822      "
"             Maximum flow           0.277      0.616      0.730      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.730     1.891     0.979     0.979"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.353     1.891     0.979     0.979 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  20.749     3.705      8.225      minutes"
"             Time to Centroid       109.932    86.956     93.049     minutes"
```

```
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        1480.57    2749.63    4230.20    c.m"
"             Rainfall losses        34.536     3.348      14.264     mm"
"             Runoff depth           63.385     94.574     83.658     mm"
"             Runoff volume          958.39     2655.63    3614.02    c.m"
"             Runoff coefficient     0.647      0.966      0.854      "
"             Maximum flow           0.359      1.213      1.353      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.353     3.244     0.979     0.979"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.353     3.244     3.244     0.979"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                  3.244    c.m/sec"
"             Hydrograph volume          9978.332    c.m"
"                    1.353     3.244     3.244     3.244"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                  3.244    c.m/sec"
"             Hydrograph volume          9978.331    c.m"
"                    1.353     3.244     3.244     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.353     3.244     3.244     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Pond"
"             Maximum flow                  3.244    c.m/sec"
"             Hydrograph volume          9978.331    c.m"
"                    1.353     3.244     3.244     3.244"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  3.416    c.m/sec"
"             Hydrograph volume          8808.417    c.m"
"                    1.353     3.416     3.244     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.353     3.416     3.416     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
```

```
"               Pond"
"            Maximum flow                  6.660    c.m/sec"
"            Hydrograph volume         18786.760    c.m"
"                    1.353     3.416     3.416     6.660"
" 40         HYDROGRAPH   Confluence    2"
"           7   Confluence "
"           2   Node #"
"               Pond Inlet 2"
"            Maximum flow                  0.979    c.m/sec"
"            Hydrograph volume          2272.181    c.m"
"                    1.353     0.979     3.416     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    1.353     0.979     0.979     0.000"
" 40         HYDROGRAPH   Combine    1000"
"           6   Combine "
"        1000   Node #"
"               Pond"
"            Maximum flow                  7.639    c.m/sec"
"            Hydrograph volume         21058.924    c.m"
"                    1.353     0.979     0.979     7.639"
" 40         HYDROGRAPH   Confluence    1000"
"           7   Confluence "
"        1000   Node #"
"               Pond"
"            Maximum flow                  7.639    c.m/sec"
"            Hydrograph volume         21058.926    c.m"
"                    1.353     7.639     0.979     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                    1.353     7.639     7.639     0.000"
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                    1.353     7.639     7.639     0.000"
" 33         CATCHMENT 206"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         206   Pond"
"       80.000   % Impervious"
"        3.290   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        0.658   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.198     7.639     7.639     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  20.749     3.705      6.151      minutes"
"             Time to Centroid       109.932    86.956     90.254     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        644.32     2577.29    3221.61    c.m"
"             Rainfall losses        34.536     3.348      9.585      mm"
"             Runoff depth           63.385     94.574     88.336     mm"
"             Runoff volume          417.08     2489.18    2906.26    c.m"
"             Runoff coefficient     0.647      0.966      0.902      "
"             Maximum flow           0.156      1.137      1.198      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.198     8.837     7.639     0.000"
" 54          POND DESIGN"
"        8.837   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"      23965.2   Hydrograph volume    c.m"
"         17.    Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.100   0.01500   680.300"
"                456.200   0.02900  1395.900"
"                456.300   0.04200  2147.500"
"                456.400   0.05200  2935.400"
"                456.480   0.05900  3592.400"
"                456.500   0.06000  3760.400"
"                456.600    0.2840  4627.400"
"                456.700    0.7630  5539.800"
"                456.800     1.491  6496.900"
"                456.900     2.386  7500.300"
"                457.000     2.490  8551.600"
"                457.100     6.036  9652.000"
"                457.200    12.632  10803.10"
"                457.300    21.379  12006.50"
"                457.400    31.960  13275.50"
```

```
"               457.500    44.189  14711.10"
"             Peak outflow                  5.771    c.m/sec"
"             Maximum level               457.093    metre"
"             Maximum storage            9569.881    c.m"
"             Centroidal lag                4.769   hours"
"                  1.198     8.837     5.771     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                  1.198     5.771     5.771     0.000"
" 56          DIVERSION"
"         2000   Node number"
"        3.056   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         2.715    c.m/sec"
"             Volume of diverted flow    3134.302    c.m"
"             DIV02000.100hyd"
"             Divert Weir 1 and 2 away from Dispersion Trench"
"                  1.198     5.771     3.056     0.000 c.m/sec"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Divert Flow from Weirs 1 and 2 away from Dispersion Trench"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  3.056    c.m/sec"
"             Hydrograph volume         20685.248    c.m"
"                  1.198     5.771     3.056     3.056"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                  1.198     3.056     3.056     3.056"
" 54          POND DESIGN"
"        3.056   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"      20685.2   Hydrograph volume    c.m"
"           9.   Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"               454.860     0.000     0.000"
"               454.960  1.20E-05     4.000"
"               455.060  1.20E-05     8.000"
"               455.160  1.20E-05    12.000"
"               455.260  1.20E-05    16.000"
"               455.360  1.20E-05    20.000"
"               455.460     1.702    20.500"
"               455.560     4.979    21.000"
```

```
"               455.660     9.395    21.500"
"             Peak outflow                  3.056    c.m/sec"
"             Maximum level               455.501    metre"
"             Maximum storage              20.707    c.m"
"             Centroidal lag                5.258   hours"
"                  1.198     3.056     3.056     3.056 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                  1.198     3.056     3.056     3.056"
" 56          DIVERSION"
"         3000   Node number"
"        0.000   Overflow threshold"
"        0.395   Computed diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         1.207    c.m/sec"
"             Volume of diverted flow    8163.324    c.m"
"             DIV03000.100hyd"
"             Major flow at 3000"
"                  1.198     3.056     1.849     3.056 c.m/sec"
" 81          ADD COMMENT================================================="
"          1  Lines of comment"
"             Diverted to existing wetland on site"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  4.905    c.m/sec"
"             Hydrograph volume         33190.559    c.m"
"                  1.198     3.056     1.849     4.905"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                  1.198     0.000     1.849     4.905"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"       10.000   % Impervious"
"        7.530   Total Area"
"      100.000   Flow length"
"        5.000   Overland Slope"
"        6.777   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
```

```
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    1.746     0.000     1.849     4.905 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  20.749     3.705      18.326     minutes"
"             Time to Centroid       109.932    86.956     106.665    minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        6636.13    737.35     7373.48    c.m"
"             Rainfall losses        34.536     3.348      31.417     mm"
"             Runoff depth           63.385     94.574     66.504     mm"
"             Runoff volume          4295.63    712.14     5007.77    c.m"
"             Runoff coefficient     0.647      0.966      0.679      "
"             Maximum flow           1.608      0.325      1.746      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.746     1.746     1.849     4.905"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.746     1.746     1.746     4.905"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"             Maximum flow                  6.651    c.m/sec"
"             Hydrograph volume         38198.348    c.m"
"                    1.746     1.746     1.746     6.651"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    1.746     0.000     1.746     6.651"
" 47          FILEI_O Read/Open DIV03000.100hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV03000.100hyd"
"             Major flow at 3000"
"             Total volume               8163.322    c.m"
"             Maximum flow                  1.207    c.m/sec"
"                  1.207     0.000     1.746     6.651 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.207     1.207     1.746     6.651"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.207     1.207     1.207     6.651"
```

```
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"              Maximum flow                  7.858    c.m/sec"
"              Hydrograph volume         46361.719    c.m"
"                      1.207     1.207     1.207     7.858"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                      1.207     0.000     1.207     7.858"
" 47          FILEI_O Read/Open DIV02000.100hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV02000.100hyd"
"             Divert Weir 1 and 2 away from Dispersion Trench"
"             Total volume               3134.302    c.m"
"             Maximum flow                  2.715    c.m/sec"
"                  2.715     0.000     1.207     7.858 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                      2.715     2.715     1.207     7.858"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                      2.715     2.715     2.715     7.858"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"              Maximum flow                 10.574    c.m/sec"
"              Hydrograph volume         49496.012    c.m"
"                      2.715     2.715     2.715    10.574"
" 40          HYDROGRAPH   Confluence    4000"
"            7   Confluence "
"          4000   Node #"
"                 Site"
"              Maximum flow                 10.573    c.m/sec"
"              Hydrograph volume         49496.012    c.m"
"                      2.715    10.573     2.715     0.000"
" 81          ADD COMMENT================================================="
"           1  Lines of comment"
"              Total flow to Grand River"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     36.330    hectare"
"             Total Impervious area                    18.751    hectare"
"             Total % impervious                       51.612"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\104104"
"                Output filename:                        104-104 post  Reg.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:               2/22/2023 at 11:46:29 AM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          302   External lands and water tower"
"       55.000   % Impervious"
"        0.670   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.302   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.368   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.078     0.000     0.000     0.000 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.302      0.368      0.670      hectare"
"             Time of concentration  16.093     2.860      7.181      minutes"
"             Time to Centroid       2720.207   2251.465   2404.533   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        859.28     1050.22    1909.50    c.m"
"             Rainfall losses        139.563    39.596     84.581     mm"
"             Runoff depth           145.437    245.404    200.419    mm"
"             Runoff volume          438.49     904.31     1342.81    c.m"
"             Runoff coefficient     0.510      0.861      0.703      "
"             Maximum flow           0.031      0.047      0.078      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.078     0.078     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Townhome and Apartment Blocks"
"       90.000   % Impervious"
"        4.280   Total Area"
"      200.000   Flow length"
"        4.000   Overland Slope"
"        0.428   Pervious Area"
"      200.000   Pervious length"
"        2.000   Pervious slope"
"        3.852   Impervious Area"
"      200.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.512     0.078     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.428      3.852      4.280      hectare"
"             Time of concentration  50.233     8.926      11.288     minutes"
"             Time to Centroid       2757.880   2264.252   2292.474   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.1220     1.0978     1.2198     ha-m"
"             Rainfall losses        138.714    16.956     29.132     mm"
"             Runoff depth           146.286    268.044    255.868    mm"
"             Runoff volume          0.0626     1.0325     1.0951     ha-m"
"             Runoff coefficient     0.513      0.941      0.898      "
"             Maximum flow           0.046      0.484      0.512      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.512     0.590     0.000     0.000"
" 33          CATCHMENT 304"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          304   External - Luther Rd."
"       55.000   % Impervious"
"        1.090   Total Area"
"      110.000   Flow length"
"        2.000   Overland Slope"
"        0.491   Pervious Area"
"      110.000   Pervious length"
"        2.000   Pervious slope"
"        0.600   Impervious Area"
"      110.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.117     0.590     0.000     0.000 c.m/sec"
"             Catchment 304          Pervious   Impervious Total Area "
"             Surface Area           0.491      0.600      1.090      hectare"
"             Time of concentration  35.092     6.236      15.325     minutes"
"             Time to Centroid       2739.025   2235.505   2394.105   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1397.93    1708.57    3106.50    c.m"
"             Rainfall losses        140.362    27.637     78.363     mm"
"             Runoff depth           144.638    257.363    206.637    mm"
"             Runoff volume          709.45     1542.89    2252.34    c.m"
"             Runoff coefficient     0.508      0.903      0.725      "
"             Maximum flow           0.054      0.076      0.117      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.117     0.707     0.000     0.000"
```

```
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Internal to Pond Inet 3"
"       60.000   % Impervious"
"        4.150   Total Area"
"      130.000   Flow length"
"        4.000   Overland Slope"
"        1.660   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        2.490   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.447     0.707     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.660      2.490      4.150      hectare"
"             Time of concentration  38.792     6.893      15.449     minutes"
"             Time to Centroid       2741.816   2242.481   2376.420   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.4731     0.7096     1.1828     ha-m"
"             Rainfall losses        141.611    24.215     71.174     mm"
"             Runoff depth           143.389    260.785    213.826    mm"
"             Runoff volume          2380.25    6493.54    8873.79    c.m"
"             Runoff coefficient     0.503      0.915      0.750      "
"             Maximum flow           0.182      0.315      0.447      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.447     1.153     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.447     1.153     1.153     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  1.153    c.m/sec"
"             Hydrograph volume         23420.094    c.m"
"                     0.447     1.153     1.153     1.153"
```

```
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                      0.447     0.000     1.153     1.153"
" 33          CATCHMENT 203"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           203   Internal to Pond Inet 2"
"        60.000   % Impervious"
"         2.760   Total Area"
"        30.000   Flow length"
"         4.000   Overland Slope"
"         1.104   Pervious Area"
"        30.000   Pervious length"
"         2.000   Pervious slope"
"         1.656   Impervious Area"
"        30.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"         5.000   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.325     0.000     1.153     1.153 c.m/sec"
"              Catchment 203          Pervious   Impervious Total Area "
"              Surface Area           1.104      1.656      2.760      hectare"
"              Time of concentration  16.093     2.860      6.608      minutes"
"              Time to Centroid       2720.207   2251.465   2384.215   minutes"
"              Rainfall depth         285.000    285.000    285.000    mm"
"              Rainfall volume        3146.40    4719.60    7866.00    c.m"
"              Rainfall losses        139.563    39.596     79.583     mm"
"              Runoff depth           145.437    245.404    205.417    mm"
"              Runoff volume          1605.63    4063.89    5669.52    c.m"
"              Runoff coefficient     0.510      0.861      0.721      "
"              Maximum flow           0.115      0.211      0.325      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.325     0.325     1.153     1.153"
" 40          HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.325     0.325     0.325     1.153"
" 40          HYDROGRAPH   Combine    2"
"             6   Combine "
"             2   Node #"
"                 Pond Inlet 2"
```

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"             Maximum flow                  0.325    c.m/sec"
"             Hydrograph volume          5669.517    c.m"
"                    0.325     0.325     0.325     0.325"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.325     0.000     0.325     0.325"
" 33          CATCHMENT 303"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          303   External"
"       55.000   % Impervious"
"        3.550   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.597   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        1.952   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.371     0.000     0.325     0.325 c.m/sec"
"             Catchment 303          Pervious   Impervious Total Area "
"             Surface Area           1.597      1.952      3.550      hectare"
"             Time of concentration  40.556     7.207      17.519     minutes"
"             Time to Centroid       2744.076   2245.793   2399.878   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.4553     0.5565     1.0117     ha-m"
"             Rainfall losses        141.525    22.773     76.211     mm"
"             Runoff depth           143.475    262.227    208.789    mm"
"             Runoff volume          2292.02    5119.98    7412.00    c.m"
"             Runoff coefficient     0.503      0.920      0.733      "
"             Maximum flow           0.175      0.247      0.371      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.371     0.371     0.325     0.325"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          204   Park"
"       10.000   % Impervious"
"        2.090   Total Area"
"      140.000   Flow length"
"        2.000   Overland Slope"
"        1.881   Pervious Area"
"      140.000   Pervious length"
"        2.000   Pervious slope"
"        0.209   Impervious Area"
"      140.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.225     0.371     0.325     0.325 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           1.881      0.209      2.090      hectare"
"             Time of concentration  40.556     7.207      34.926     minutes"
"             Time to Centroid       2744.076   2245.793   2659.968   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        5360.85    595.65     5956.50    c.m"
"             Rainfall losses        141.525    22.773     129.649    mm"
"             Runoff depth           143.475    262.227    155.351    mm"
"             Runoff volume          2698.77    548.05     3246.83    c.m"
"             Runoff coefficient     0.503      0.920      0.545      "
"             Maximum flow           0.206      0.026      0.225      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.225     0.574     0.325     0.325"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          301   Scott Street External"
"       55.000   % Impervious"
"        2.600   Total Area"
"       95.000   Flow length"
"        2.000   Overland Slope"
"        1.170   Pervious Area"
"       95.000   Pervious length"
"        2.000   Pervious slope"
"        1.430   Impervious Area"
"       95.000   Impervious length"
```

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"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.282     0.574     0.325     0.325 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           1.170      1.430      2.600      hectare"
"             Time of concentration  32.137     5.711      14.115     minutes"
"             Time to Centroid       2737.280   2232.538   2393.050   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3334.50    4075.50    7410.00    c.m"
"             Rainfall losses        139.558    29.801     79.192     mm"
"             Runoff depth           145.442    255.199    205.808    mm"
"             Runoff volume          1701.67    3649.34    5351.01    c.m"
"             Runoff coefficient     0.510      0.895      0.722      "
"             Maximum flow           0.128      0.181      0.282      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.282     0.826     0.325     0.325"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Internal to Pond Inet 1"
"       65.000   % Impervious"
"        4.320   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"        1.512   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.808   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
```

```
"        1.500   Impervious Depression storage"
"                     0.485     0.826     0.325     0.325 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           1.512      2.808      4.320      hectare"
"             Time of concentration  33.142     5.889      12.266     minutes"
"             Time to Centroid       2737.930   2233.505   2351.531   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.4309     0.8003     1.2312     ha-m"
"             Rainfall losses        139.790    29.018     67.788     mm"
"             Runoff depth           145.210    255.982    217.212    mm"
"             Runoff volume          2195.58    7187.97    9383.55    c.m"
"             Runoff coefficient     0.510      0.898      0.762      "
"             Maximum flow           0.166      0.355      0.485      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.485     1.310     0.325     0.325"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.485     1.310     1.310     0.325"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                  1.310    c.m/sec"
"             Hydrograph volume         25393.383    c.m"
"                     0.485     1.310     1.310     1.310"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Pond Inlet 1"
"             Maximum flow                  1.310    c.m/sec"
"             Hydrograph volume         25393.383    c.m"
"                     0.485     1.310     1.310     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.485     1.310     1.310     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Pond"
"             Maximum flow                  1.310    c.m/sec"
"             Hydrograph volume         25393.383    c.m"
"                     0.485     1.310     1.310     1.310"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                Pond Inlet 3"
"             Maximum flow                  1.153    c.m/sec"
"             Hydrograph volume         23420.096    c.m"
"                     0.485     1.153     1.310     0.000"
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" 40          HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.485     1.153     1.153     0.000"
" 40          HYDROGRAPH   Combine    1000"
"             6   Combine "
"          1000   Node #"
"                 Pond"
"              Maximum flow                  2.463    c.m/sec"
"              Hydrograph volume         48813.477    c.m"
"                      0.485     1.153     1.153     2.463"
" 40          HYDROGRAPH   Confluence    2"
"             7   Confluence "
"             2   Node #"
"                 Pond Inlet 2"
"              Maximum flow                  0.325    c.m/sec"
"              Hydrograph volume          5669.517    c.m"
"                      0.485     0.325     1.153     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.485     0.325     0.325     0.000"
" 40          HYDROGRAPH   Combine    1000"
"             6   Combine "
"          1000   Node #"
"                 Pond"
"              Maximum flow                  2.789    c.m/sec"
"              Hydrograph volume         54482.996    c.m"
"                      0.485     0.325     0.325     2.789"
" 40          HYDROGRAPH   Confluence    1000"
"             7   Confluence "
"          1000   Node #"
"                 Pond"
"              Maximum flow                  2.789    c.m/sec"
"              Hydrograph volume         54482.996    c.m"
"                      0.485     2.789     0.325     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.485     2.789     2.789     0.000"
" 40          HYDROGRAPH Next link "
"             5   Next link "
"                      0.485     2.789     2.789     0.000"
" 33          CATCHMENT 206"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           206   Pond"
"        80.000   % Impervious"
"         3.290   Total Area"
"       100.000   Flow length"
"         4.000   Overland Slope"
"         0.658   Pervious Area"
```

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"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.632   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.389     2.789     2.789     0.000 c.m/sec"
"             Catchment 206          Pervious   Impervious Total Area "
"             Surface Area           0.658      2.632      3.290      hectare"
"             Time of concentration  33.142     5.889      9.274      minutes"
"             Time to Centroid       2737.929   2233.505   2296.156   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1875.30    7501.20    9376.50    c.m"
"             Rainfall losses        139.790    29.018     51.172     mm"
"             Runoff depth           145.210    255.982    233.828    mm"
"             Runoff volume          955.48     6737.44    7692.93    c.m"
"             Runoff coefficient     0.510      0.898      0.820      "
"             Maximum flow           0.072      0.333      0.389      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.389     3.178     2.789     0.000"
" 54          POND DESIGN"
"        3.178   Current peak flow    c.m/sec"
"        0.206   Target outflow    c.m/sec"
"      62175.9   Hydrograph volume    c.m"
"         17.    Number of stages"
"      456.800   Minimum water level    metre"
"      458.000   Maximum water level    metre"
"      456.800   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.100   0.01500   680.300"
"                456.200   0.02900  1395.900"
"                456.300   0.04200  2147.500"
"                456.400   0.05200  2935.400"
"                456.480   0.05900  3592.400"
"                456.500   0.06000  3760.400"
"                456.600    0.2840  4627.400"
"                456.700    0.7630  5539.800"
"                456.800     1.491  6496.900"
```

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"               456.900     2.386  7500.300"
"               457.000     2.490  8551.600"
"               457.100     6.036  9652.000"
"               457.200    12.632  10803.10"
"               457.300    21.379  12006.50"
"               457.400    31.960  13275.50"
"               457.500    44.189  14711.10"
"             Peak outflow                  2.808    c.m/sec"
"             Maximum level               457.012    metre"
"             Maximum storage            8684.418    c.m"
"             Centroidal lag               43.065   hours"
"                  0.389     3.178     2.808     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.389     2.808     2.808     0.000"
" 56          DIVERSION"
"          2000   Node number"
"         2.458   Overflow threshold"
"         1.000   Required diverted fraction"
"             0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.350    c.m/sec"
"             Volume of diverted flow    1259.027    c.m"
"             DIV02000.9999hyd"
"             Divert Weir 1 and 2 away from Dispersion Trench"
"                     0.389     2.808     2.458     0.000 c.m/sec"
" 81          ADD COMMENT================================================="
"           1  Lines of comment"
"             Divert Flow from Weirs 1 and 2 away from Dispersion Trench"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"             Maximum flow                  2.458    c.m/sec"
"             Hydrograph volume         61031.441    c.m"
"                     0.389     2.808     2.458     2.458"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.389     2.458     2.458     2.458"
" 54          POND DESIGN"
"         2.458   Current peak flow    c.m/sec"
"         0.206   Target outflow    c.m/sec"
"       61031.4   Hydrograph volume    c.m"
"            9.   Number of stages"
"       456.800   Minimum water level    metre"
"       458.000   Maximum water level    metre"
"       456.800   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 454.860     0.000     0.000"
"                 454.960  1.20E-05     4.000"
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"               455.060  1.20E-05     8.000"
"               455.160  1.20E-05    12.000"
"               455.260  1.20E-05    16.000"
"               455.360  1.20E-05    20.000"
"               455.460     1.702    20.500"
"               455.560     4.979    21.000"
"               455.660     9.395    21.500"
"             Peak outflow                  2.458    c.m/sec"
"             Maximum level              455.483    metre"
"             Maximum storage             20.615    c.m"
"             Centroidal lag              43.075   hours"
"                  0.389     2.458     2.458     2.458 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.389     2.458     2.458     2.458"
" 56          DIVERSION"
"          3000   Node number"
"         0.000   Overflow threshold"
"         0.395   Computed diverted fraction"
"             0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.971    c.m/sec"
"             Volume of diverted flow   24097.531    c.m"
"             DIV03000.9999hyd"
"             Major flow at 3000"
"                     0.389     2.458     1.487     2.458 c.m/sec"
" 81          ADD COMMENT================================================="
"           1  Lines of comment"
"              Diverted to existing wetland on site"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"             Maximum flow                  3.945    c.m/sec"
"             Hydrograph volume         97949.086    c.m"
"                     0.389     2.458     1.487     3.945"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.389     0.000     1.487     3.945"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Rear yard and Open Space to Grand River"
"        10.000   % Impervious"
"         7.530   Total Area"
"       100.000   Flow length"
"         5.000   Overland Slope"
"         6.777   Pervious Area"
"       100.000   Pervious length"
"         2.000   Pervious slope"
```

```
"        0.753   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"        5.000   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.809     0.000     1.487     3.945 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           6.777      0.753      7.530      hectare"
"             Time of concentration  33.142     5.889      28.678     minutes"
"             Time to Centroid       2737.929   2233.505   2655.311   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1.9314     0.2146     2.1461     ha-m"
"             Rainfall losses        139.790    29.018     128.713    mm"
"             Runoff depth           145.210    255.982    156.287    mm"
"             Runoff volume          0.9841     0.1928     1.1768     ha-m"
"             Runoff coefficient     0.510      0.898      0.548      "
"             Maximum flow           0.744      0.095      0.809      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.809     0.809     1.487     3.945"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.809     0.809     0.809     3.945"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"         4000   Node #"
"                Site"
"             Maximum flow                  4.754    c.m/sec"
"             Hydrograph volume        109717.539    c.m"
"                     0.809     0.809     0.809     4.754"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.809     0.000     0.809     4.754"
" 47          FILEI_O Read/Open DIV03000.9999hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV03000.9999hyd"
"             Major flow at 3000"
"             Total volume              24097.531    c.m"
"             Maximum flow                  0.971    c.m/sec"
"                  0.971     0.000     0.809     4.754 c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.971     0.971     0.809     4.754"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.971     0.971     0.971     4.754"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"             Maximum flow                  5.725    c.m/sec"
"             Hydrograph volume        133815.031    c.m"
"                     0.971     0.971     0.971     5.725"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.971     0.000     0.971     5.725"
" 47          FILEI_O Read/Open DIV02000.9999hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV02000.9999hyd"
"             Divert Weir 1 and 2 away from Dispersion Trench"
"             Total volume               1259.027    c.m"
"             Maximum flow                  0.350    c.m/sec"
"                  0.350     0.000     0.971     5.725 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.350     0.350     0.971     5.725"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.350     0.350     0.350     5.725"
" 40          HYDROGRAPH   Combine    4000"
"            6   Combine "
"          4000   Node #"
"                 Site"
"             Maximum flow                  6.075    c.m/sec"
"             Hydrograph volume        135074.063    c.m"
"                     0.350     0.350     0.350     6.075"
" 40          HYDROGRAPH   Confluence    4000"
"            7   Confluence "
"          4000   Node #"
"                 Site"
"             Maximum flow                  6.075    c.m/sec"
"             Hydrograph volume        135074.063    c.m"
"                     0.350     6.075     0.350     0.000"
" 81          ADD COMMENT================================================="
"           1  Lines of comment"
"             Total flow to Grand River"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
```

```
"             Total Catchment area                    36.330    hectare"
"             Total Impervious area                   18.751    hectare"
"             Total % impervious                      51.612"
" 19          EXIT"
```

APPENDIX E

Oil/Grit Separator Sizing

River's Edge Subdivision
Town of Grand Valley
File No. 104-104

Oil/Grit Separator Drainage Area

Inlet 1

Catchment		**Area (ha)**	**%Imp**
	204	2.09	10%
	205	4.32	65%
	303	3.55	55%
	Total	**9.96**	**50%**

Inlet 2

Catchment		**Area (ha)**	**%Imp**
	203	2.76	60%
	Total	**2.76**	**60%**

Inlet 3

Catchment		**Area (ha)**	**%Imp**
	201	4.28	90%
	202	4.15	60%
	302	0.67	55%
	304	1.09	55%
	Total	**10.19**	**72%**

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

02/22/2023

Province:	Ontario
City:	Grand Valley
Nearest Rainfall Station:	TORONTO INTL AP
Climate Station Id:	6158731
Years of Rainfall Data:	20

Project Name:	River's Edge Subdivision
Project Number:	104104
Designer Name:	Sergio Zaga
Designer Company:	GM BluePlan Engineering Limited
Designer Email:	sergio.zaga@gmblueplan.ca
Designer Phone:	519-824-8150
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Site Name:	Inlet 1
Drainage Area (ha):	9.96
% Imperviousness:	50.00

Runoff Coefficient 'c': 0.60

Particle Size Distribution:	Fine
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	185.84
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	36
EFO6	52
EFO8	64
EFO10	73
EFO12	78

Recommended Stormceptor EFO Model: EFO8

Estimated Net Annual Sediment (TSS) Load Reduction (%): 64

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	8.31	498.0	106.0	96	8.2	8.2
1	20.6	29.1	16.61	997.0	212.0	83	17.0	25.2
2	16.8	45.9	33.23	1994.0	424.0	73	12.3	37.5
3	10.8	56.7	49.84	2990.0	636.0	64	6.9	44.4
4	8.5	65.2	66.45	3987.0	848.0	63	5.3	49.7
5	6.4	71.6	83.07	4984.0	1060.0	60	3.9	53.5
6	5.5	77.0	99.68	5981.0	1273.0	55	3.0	56.6
7	3.9	81.0	116.29	6978.0	1485.0	49	2.0	58.5
8	2.9	83.9	132.91	7974.0	1697.0	43	1.3	59.8
9	2.7	86.5	149.52	8971.0	1909.0	39	1.0	60.8
10	2.2	88.7	166.13	9968.0	2121.0	35	0.8	61.6
11	1.0	89.7	182.75	10965.0	2333.0	31	0.3	61.9
12	1.7	91.3	199.36	11962.0	2545.0	29	0.5	62.3
13	1.4	92.8	215.97	12958.0	2757.0	27	0.4	62.7
14	1.0	93.7	232.59	13955.0	2969.0	25	0.2	63.0
15	0.3	94.0	249.20	14952.0	3181.0	24	0.1	63.0
16	0.8	94.8	265.81	15949.0	3393.0	22	0.2	63.2
17	0.8	95.7	282.43	16946.0	3605.0	20	0.2	63.4
18	0.2	95.8	299.04	17942.0	3818.0	19	0.0	63.4
19	1.5	97.3	315.65	18939.0	4030.0	18	0.3	63.7
20	0.2	97.5	332.27	19936.0	4242.0	17	0.0	63.7
21	0.6	98.2	348.88	20933.0	4454.0	17	0.1	63.8
22	0.0	98.2	365.49	21930.0	4666.0	16	0.0	63.8
23	0.2	98.4	382.11	22926.0	4878.0	15	0.0	63.9
24	0.2	98.6	398.72	23923.0	5090.0	15	0.0	63.9
25	0.2	98.9	415.33	24920.0	5302.0	14	0.0	63.9
30	1.1	100.0	498.40	29904.0	6363.0	12	0.1	64.1
35	0.0	100.0	581.46	34888.0	7423.0	10	0.0	64.1
40	0.0	100.0	664.53	39872.0	8483.0	9	0.0	64.1
45	0.0	100.0	747.60	44856.0	9544.0	8	0.0	64.1
Estimated Net Annual Sediment (TSS) Load Reduction =								**64 %**

Climate Station ID: 6158731 *Years of Rainfall Data*: 20

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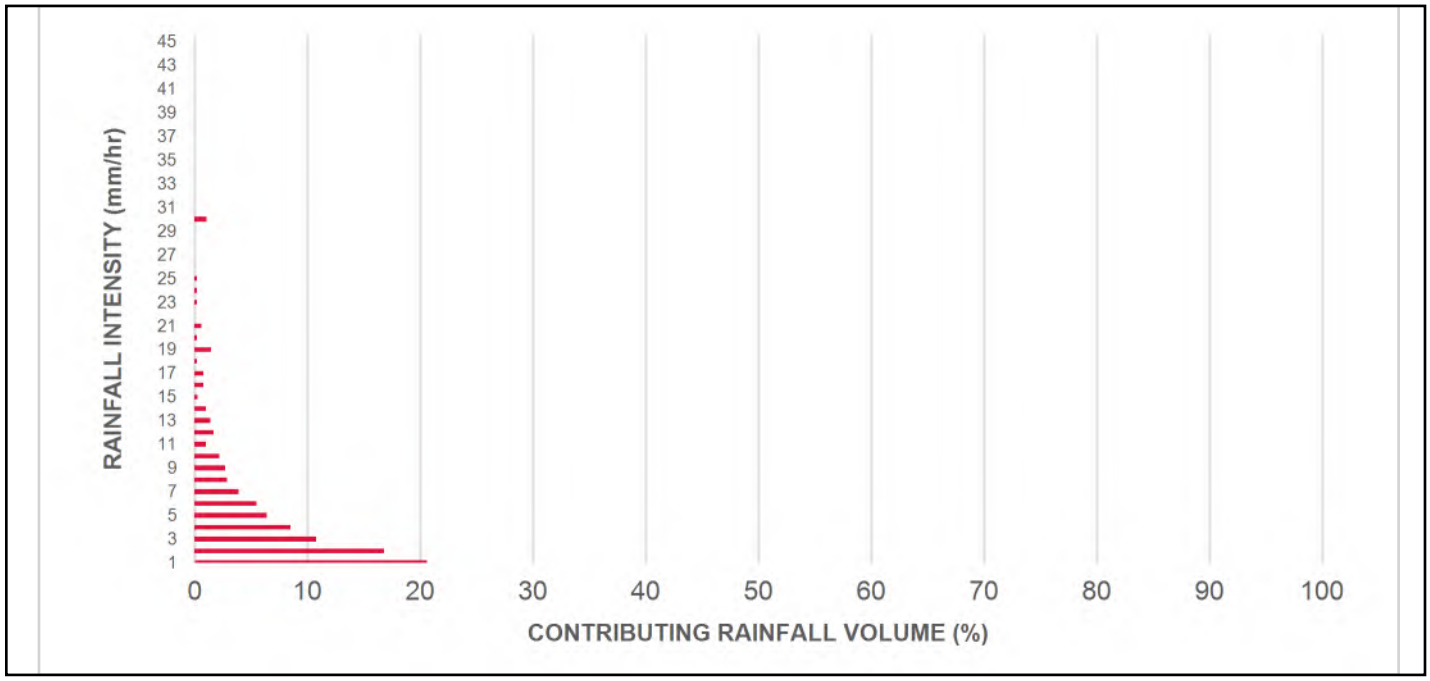
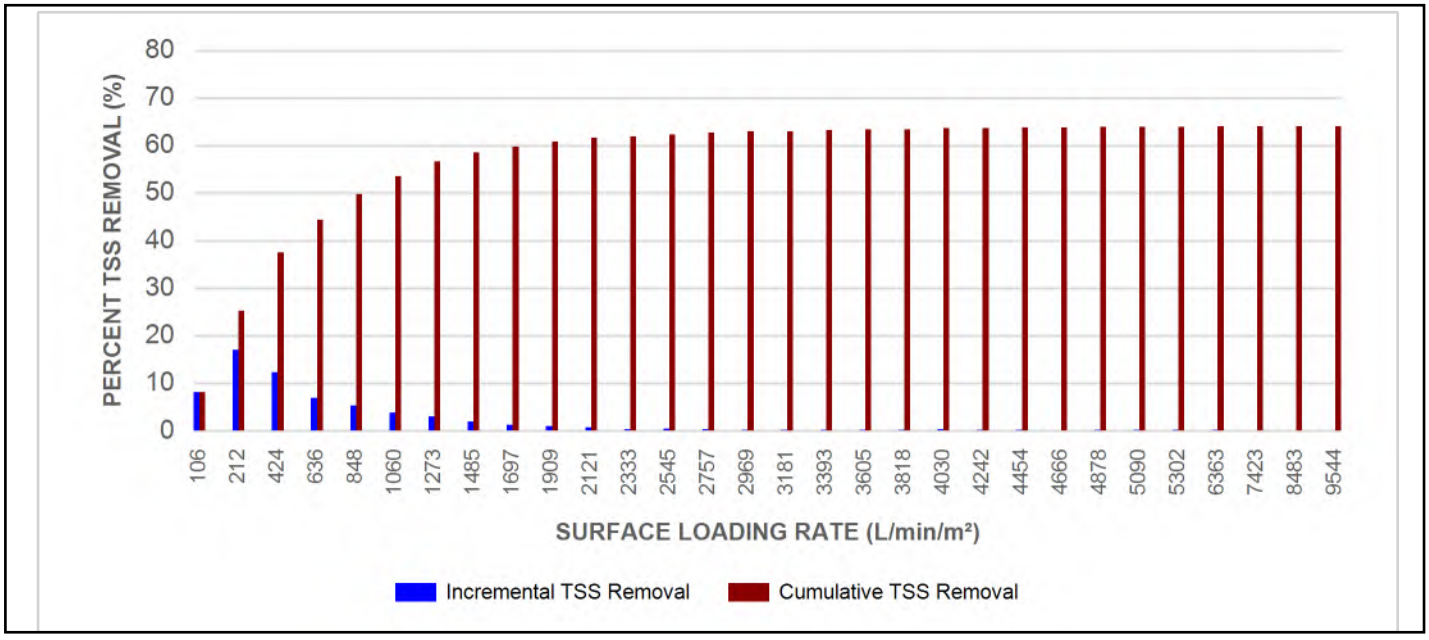
RAINFALL DATA FROM TORONTO INTL AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

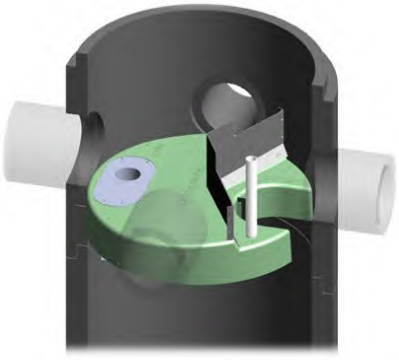
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

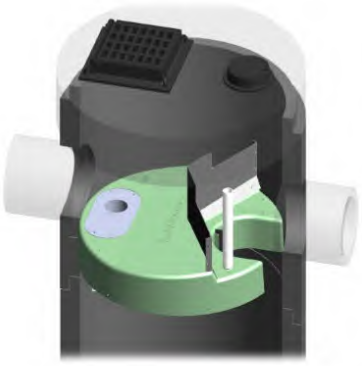
DESIGN FLEXIBILITY

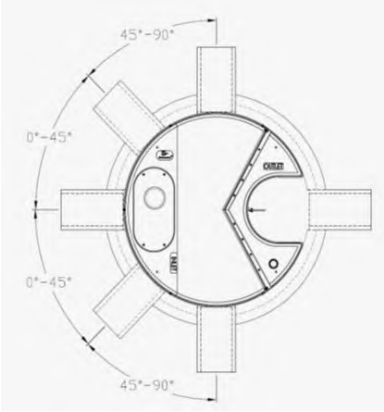
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit** S**eparators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

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Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/15/2022

Province:	Ontario
City:	Grand Valley
Nearest Rainfall Station:	TORONTO INTL AP
Climate Station Id:	6158731
Years of Rainfall Data:	20

Site Name:	Inlet 2
Drainage Area (ha):	2.76
% Imperviousness:	60.00

Runoff Coefficient 'c': 0.66

Particle Size Distribution:	Fine
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	56.65
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	River's Edge Subdivision
Project Number:	104104
Designer Name:	Sergio Zaga
Designer Company:	GM BluePlan Engineering Limited
Designer Email:	sergio.zaga@gmblueplan.ca
Designer Phone:	519-824-8150
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	61
EFO6	75
EFO8	84
EFO10	89
EFO12	93

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 61

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

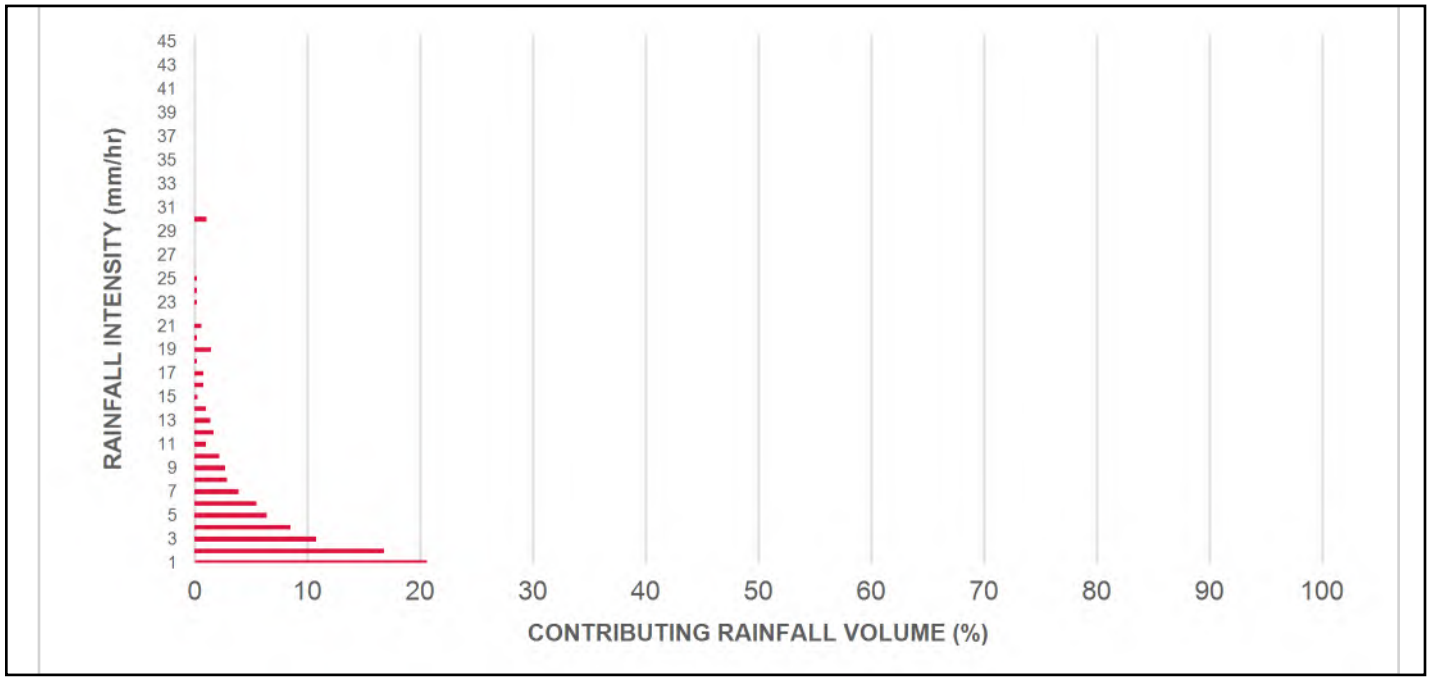
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

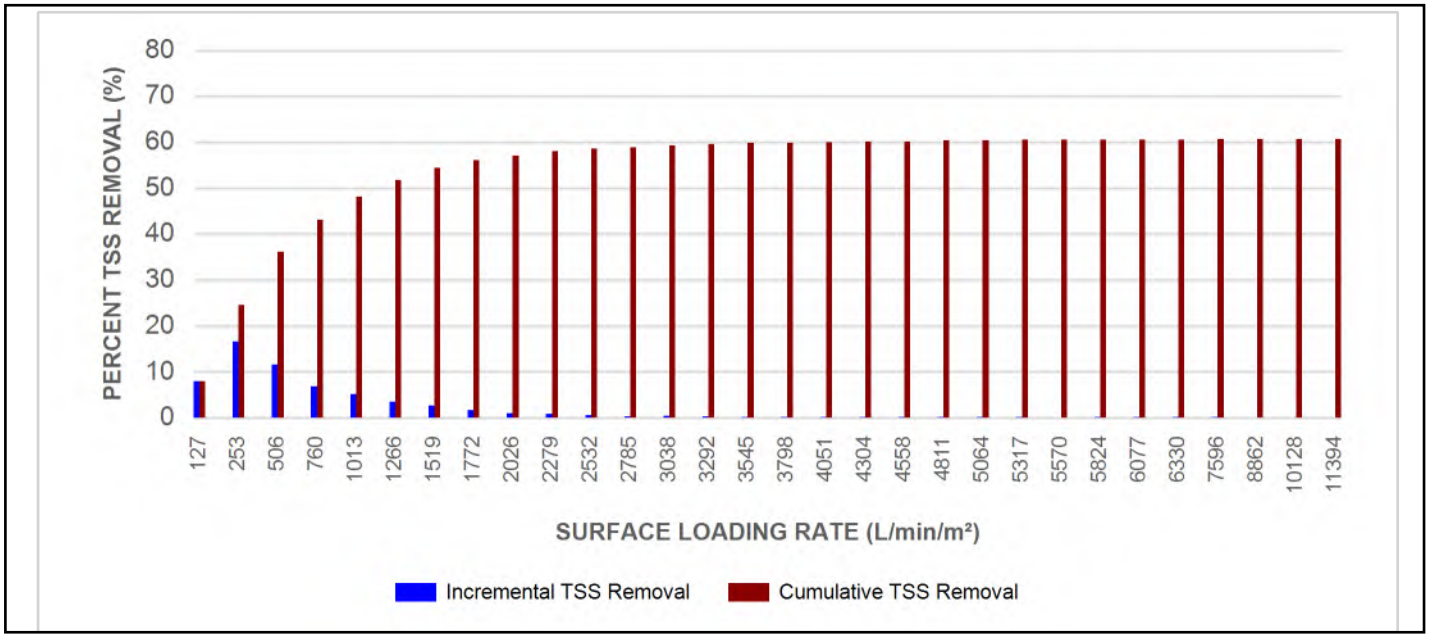
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	2.53	152.0	127.0	93	8.0	8.0
1	20.6	29.1	5.06	304.0	253.0	81	16.7	24.6
2	16.8	45.9	10.13	608.0	506.0	69	11.6	36.2
3	10.8	56.7	15.19	912.0	760.0	63	6.8	43.1
4	8.5	65.2	20.26	1215.0	1013.0	61	5.2	48.2
5	6.4	71.6	25.32	1519.0	1266.0	56	3.6	51.8
6	5.5	77.0	30.38	1823.0	1519.0	48	2.6	54.4
7	3.9	81.0	35.45	2127.0	1772.0	41	1.6	56.1
8	2.9	83.9	40.51	2431.0	2026.0	36	1.0	57.1
9	2.7	86.5	45.58	2735.0	2279.0	32	0.9	58.0
10	2.2	88.7	50.64	3038.0	2532.0	29	0.6	58.6
11	1.0	89.7	55.70	3342.0	2785.0	27	0.3	58.9
12	1.7	91.3	60.77	3646.0	3038.0	24	0.4	59.3
13	1.4	92.8	65.83	3950.0	3292.0	23	0.3	59.6
14	1.0	93.7	70.90	4254.0	3545.0	21	0.2	59.8
15	0.3	94.0	75.96	4558.0	3798.0	20	0.1	59.9
16	0.8	94.8	81.02	4861.0	4051.0	18	0.1	60.0
17	0.8	95.7	86.09	5165.0	4304.0	17	0.1	60.1
18	0.2	95.8	91.15	5469.0	4558.0	16	0.0	60.2
19	1.5	97.3	96.22	5773.0	4811.0	15	0.2	60.4
20	0.2	97.5	101.28	6077.0	5064.0	15	0.0	60.4
21	0.6	98.2	106.35	6381.0	5317.0	14	0.1	60.5
22	0.0	98.2	111.41	6685.0	5570.0	13	0.0	60.5
23	0.2	98.4	116.47	6988.0	5824.0	13	0.0	60.5
24	0.2	98.6	121.54	7292.0	6077.0	12	0.0	60.6
25	0.2	98.9	126.60	7596.0	6330.0	12	0.0	60.6
30	1.1	100.0	151.92	9115.0	7596.0	10	0.1	60.7
35	0.0	100.0	177.24	10635.0	8862.0	8	0.0	60.7
40	0.0	100.0	202.56	12154.0	10128.0	7	0.0	60.7
45	0.0	100.0	227.88	13673.0	11394.0	7	0.0	60.7
Estimated Net Annual Sediment (TSS) Load Reduction =								**61 %**

Climate Station ID: 6158731 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO INTL AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

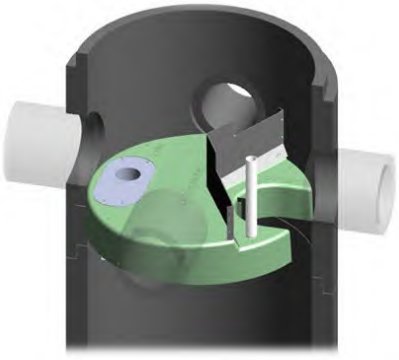
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

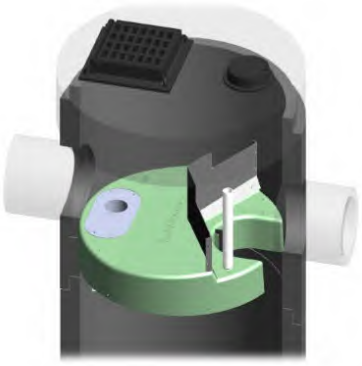
DESIGN FLEXIBILITY

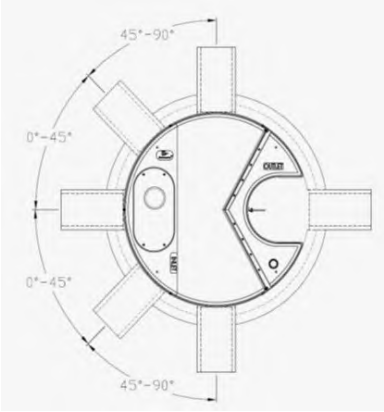
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit** S**eparators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/15/2022

Province:	Ontario
City:	Grand Valley
Nearest Rainfall Station:	TORONTO INTL AP
Climate Station Id:	6158731
Years of Rainfall Data:	20

Site Name:	Inlet 3

Drainage Area (ha):	10.19
% Imperviousness:	72.00

Runoff Coefficient 'c': 0.73

Particle Size Distribution:	Fine
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	182.50
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	River's Edge Subdivision
Project Number:	104104
Designer Name:	Sergio Zaga
Designer Company:	GM BluePlan Engineering Limited
Designer Email:	sergio.zaga@gmblueplan.ca
Designer Phone:	519-824-8150
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	32
EFO6	48
EFO8	60
EFO10	68
EFO12	75

Recommended Stormceptor EFO Model: EFO8

Estimated Net Annual Sediment (TSS) Load Reduction (%): 60

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

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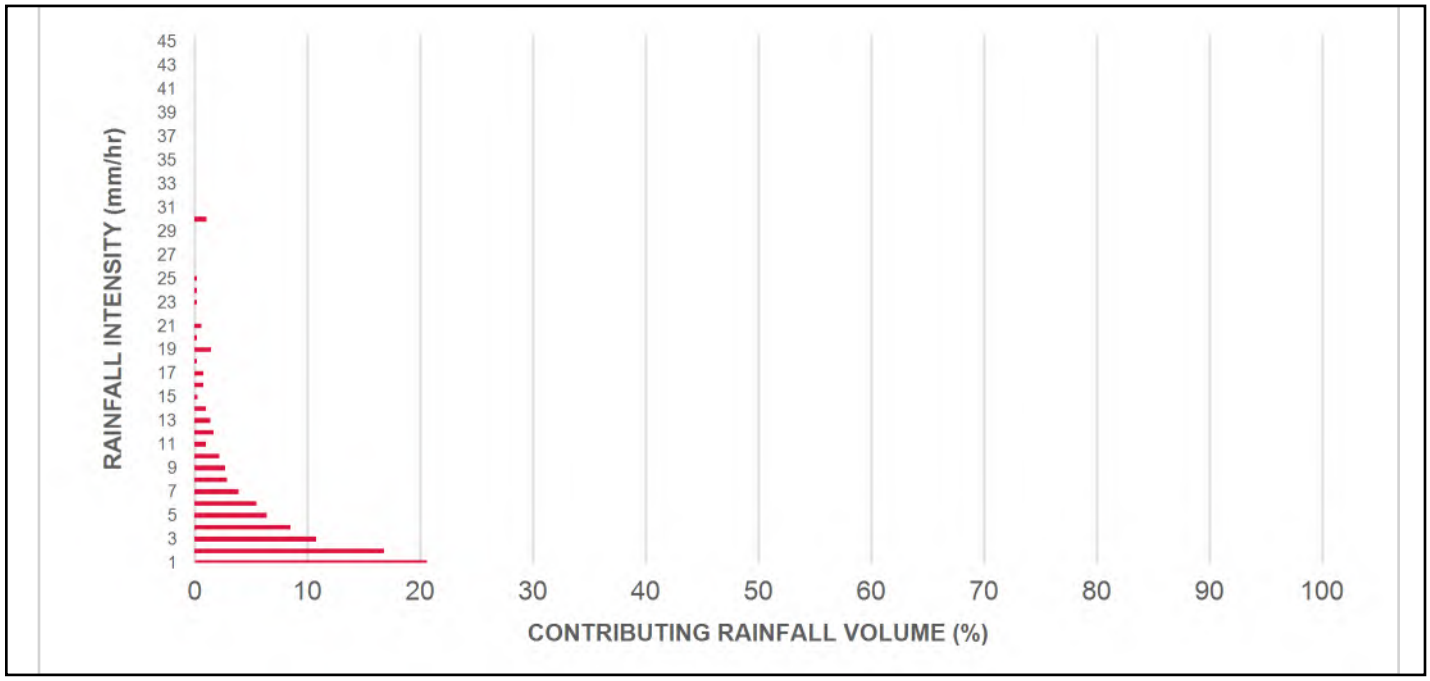
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

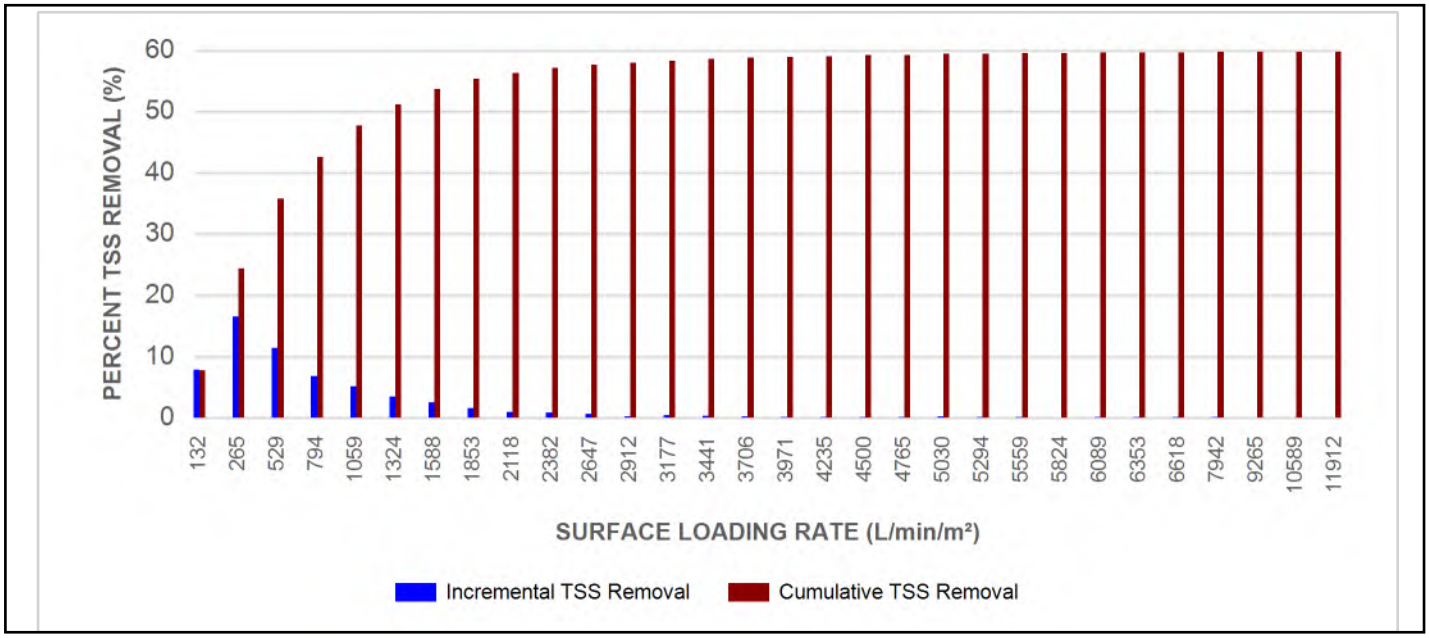
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	10.37	622.0	132.0	92	7.8	7.8
1	20.6	29.1	20.74	1244.0	265.0	80	16.6	24.4
2	16.8	45.9	41.47	2488.0	529.0	68	11.4	35.8
3	10.8	56.7	62.21	3733.0	794.0	63	6.8	42.6
4	8.5	65.2	82.94	4977.0	1059.0	60	5.1	47.7
5	6.4	71.6	103.68	6221.0	1324.0	54	3.5	51.2
6	5.5	77.0	124.42	7465.0	1588.0	46	2.5	53.7
7	3.9	81.0	145.15	8709.0	1853.0	40	1.6	55.3
8	2.9	83.9	165.89	9953.0	2118.0	35	1.0	56.3
9	2.7	86.5	186.63	11198.0	2382.0	31	0.8	57.1
10	2.2	88.7	207.36	12442.0	2647.0	28	0.6	57.7
11	1.0	89.7	228.10	13686.0	2912.0	25	0.2	58.0
12	1.7	91.3	248.83	14930.0	3177.0	24	0.4	58.3
13	1.4	92.8	269.57	16174.0	3441.0	22	0.3	58.6
14	1.0	93.7	290.31	17418.0	3706.0	20	0.2	58.8
15	0.3	94.0	311.04	18663.0	3971.0	19	0.1	58.9
16	0.8	94.8	331.78	19907.0	4235.0	17	0.1	59.0
17	0.8	95.7	352.52	21151.0	4500.0	16	0.1	59.2
18	0.2	95.8	373.25	22395.0	4765.0	16	0.0	59.2
19	1.5	97.3	393.99	23639.0	5030.0	15	0.2	59.4
20	0.2	97.5	414.72	24883.0	5294.0	14	0.0	59.4
21	0.6	98.2	435.46	26128.0	5559.0	13	0.1	59.5
22	0.0	98.2	456.20	27372.0	5824.0	13	0.0	59.5
23	0.2	98.4	476.93	28616.0	6089.0	12	0.0	59.6
24	0.2	98.6	497.67	29860.0	6353.0	12	0.0	59.6
25	0.2	98.9	518.41	31104.0	6618.0	11	0.0	59.6
30	1.1	100.0	622.09	37325.0	7942.0	9	0.1	59.7
35	0.0	100.0	725.77	43546.0	9265.0	8	0.0	59.7
40	0.0	100.0	829.45	49767.0	10589.0	7	0.0	59.7
45	0.0	100.0	933.13	55988.0	11912.0	7	0.0	59.7
Estimated Net Annual Sediment (TSS) Load Reduction =								**60 %**

Climate Station ID: 6158731 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO INTL AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

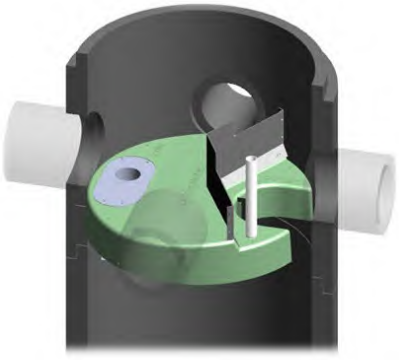
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

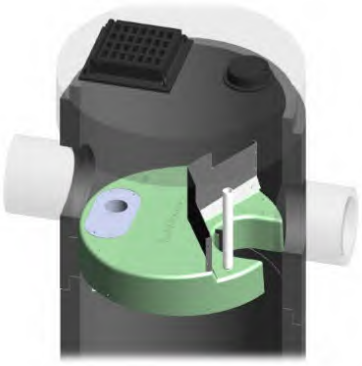
DESIGN FLEXIBILITY

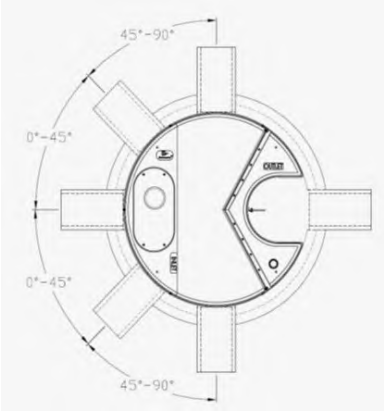
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit** S**eparators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.