GEI Consultants

Functional Servicing and Stormwater Management Report

Proposed Residential Development
79 Sideroad 19

Township of Centre Wellington (Fergus), Ontario

Submitted to:
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1	September 5, 2024	Issued for Review
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1. Introduction

GEI Consultants Canada Ltd. have been retained by Wrighthaven Homes Ltd. to complete the proposed site servicing and stormwater management design for the proposed residential development involving properties 73 Sideroad 19 and 79 Sideroad 19 in the Town of Fergus in the Township of Centre Wellington, Ontario (shown on Figure 1, hereafter referred to as the "Site").

1.1. Site Information

The 1.12-hectare (ha) property is located at 79 Sideroad 19 in the Town of Fergus in the Township of Centre Wellington. The property is rectangular in shape, with approximately 57m of frontage along Sideroad 19 and a depth of approximately 190m. For the purposes of this report, Sideroad 19 is considered to have a north-south orientation. The Site is bordered by existing residential properties to the north, an existing wetland and residential properties to the east, existing residential properties to the south, and Sideroad 19 to the west.

1.2. Report Objectives

The objectives of this report are as follows:

- Document all existing reports and standards within the study area;
- Summarize the proposed development conditions and the storm, sanitary and water servicing design;
- Identify the Township of Centre Wellington (Fergus) stormwater criteria for the design of the stormwater management facilities; and,
- Detail and summarize the stormwater management design to document the existing and post-development conditions.

2. Reference Information

2.1. Reports and Standards

The proposed site servicing and stormwater management design is based on the following reports, standards, and information prepared by others:

Site Background Reports and Historical Drawings:

- **Geotechnical Investigation**, Proposed Residential Development, 79-87 Side Road 19, Township of Centre Wellington (Fergus), Ontario, Ref. No. G4670-22-12, April 2023, prepared by JLP Services Inc.
- **Reconstruction of Sideroad 19 –** Plan and Profile Sta. 3+530 to Sta. 3+710, prepared by Triton Engineering Services Limited, April 2009**.**
- **Reconstruction of Victoria Crescent –** Plan and Profile Sideroad19 to Sta. 7+150, prepared by Triton Engineering Services Limited, June 2009**.**

Reference Standards:

- **Development Manual,** Centre Wellington, dated March 2018.

2.2. Soils

Soil Conditions

The soils for the Site are classified as follows:

- The predominant soil type on the Site is a combination of sandy silt, sand and silt (JLP Services, 2023).

Groundwater Levels

The groundwater levels observed on Site are as follows:

- Five monitoring wells were installed and observed in April 2023, resulting in a range of water levels between 415.9m to 417.1m across the Site (JLP Services, 2023).

Infiltration Rates

The infiltration rates have been reviewed and developed from the Geotechnical Investigation completed by JLP Services Inc. (dated April 2023), following results:

- The predominant soils near the proposed stormwater management facility (BH5) are silt and sand. The coefficient of permeability is estimated to be in the range of 1×10^{-5} cm/s to 1×10^{-6} cm/s (JLP Services, 2023).

Refer to Appendix A for the geotechnical report prepared by JLP Services Inc.

3. Proposed Development

The proposed site development will contain the following elements:

- Twelve (12) bungalow and eight (8) two-storey dwelling units with associated yards and driveways fronting onto the proposed site access road.
- One (1) single-detached dwelling with associated yard and driveway fronting onto Sideroad 19.
- An amenity area.
- An urbanized (curb and gutter) site access road, including turnaround and parking areas. Road width is 6m, measured from edge of pavement.
- Servicing and stormwater management infrastructure, including a stormwater management facility.

3.1. Sanitary Servicing

The existing site sanitary sewer servicing is as follows:

- The existing dwelling is serviced by a sewage leaching bed located to the south of the dwelling. This existing septic system is to be removed.

The proposed site sanitary servicing is as follows:

- The extension of a new 200mm diameter sanitary sewer through the site from the existing 200mm diameter municipal sanitary sewer on Sideroad 19.
- Individual 100mm diameter sanitary service laterals to each unit. Services installed below groundwater to be furnished with clay cut-off collars or trench plugs at regular spacing.
- Waterproof wrapping applied to all proposed sewer joints where the pipe invert is greater than 0.3m below the seasonal high groundwater level.

Conceptual sanitary sewer catchment areas are shown in Figure 4 and preliminary sanitary sewer design calculations are included in Appendix B.

3.2. Water Servicing

The existing site water servicing is as follows:

- The existing dwelling is serviced by a private domestic water supply well located to the south of the dwelling. This existing well is to be used for groundwater level monitoring then decommissioned by a licensed well driller in accordance with Ontario Regulation 903.
- An existing fire hydrant is located to the west of the site, within the western boulevard along Sideroad 19 municipal right-of-way.

The proposed site water servicing is as follows:

- The extension of a new watermain through the site from the existing 200mm diameter municipal watermain on Sideroad 19.
- Individual 25mm diameter water services to each unit.
- Two new fire hydrants located along the internal site access road.

3.3. Storm Servicing

The existing site storm servicing is as follows:

- All on-site runoff, except for the front yard and driveway of the existing dwelling to remain, sheetflows in the easterly direction to the rear of the property towards the wetland. Runoff from the front yard and driveway of the existing dwelling sheetflow in a westerly direction towards the Sideroad 19 right-of-way.
- External drainage north of the Site flows through a 450mm diameter concrete pipe and ditch on-site that outlets to the wetland.

The proposed site storm servicing is as follows:

- New storm sewer and catch basins designed to capture and convey runoff to the proposed stormwater management facility, ultimately discharging from the outlet to the wetland.
- Lot swales designed to provide conveyance of runoff to the storm sewer system on-site or directly to the wetland.
- Individual 100mm storm service laterals for sump pump discharge. Services installed below groundwater to be furnished with clay cut-off collars or trench plugs at regular spacing.
- Waterproof wrapping applied to all proposed sewer joints where the pipe invert is greater than 0.3m below the seasonal high groundwater level.

Conceptual storm sewer catchment areas are shown in Figure 5 and preliminary storm sewer design calculations are included in Appendix C.

4. Stormwater Management Design

4.1. Stormwater Criteria

The stormwater management criteria established by the Township of Centre Wellington (Fergus) are as follows:

Conveyance Systems

- Storm sewers for the Site shall be designed to convey the 5-year storm event.
- Swales designed to convey the 100-year storm shall be considered significant by the Township and require an easement.
- Roof leader runoff is considered clean and shall be infiltrated where possible.
- Connections of roof leaders to laterals is prohibited.
- Foundation drains shall be directed to sump pumps and discharged to grade or a storm lateral.
- The major overland flow route shall be designed to convey the 100-year storm event. Overland Flow elevations should not come within 0.15m of the Top of Foundation grades.

Quantity Control

- The post-development condition peak flows to the wetland will be controlled to the existing condition rate for the 2-year to 100-year storm events.
- The post-development condition peak flows from the Site will be controlled to the existing condition rate for the 2-year to 100-year storm events.

Quality Control

- The Site will provide Enhanced level of protection, 80% TSS removal.

Modelling Criteria

As per the Township of Centre Wellington development standards, MIDUSS modelling is required to demonstrate the performance for the 2-year to 100-year design events. Based on the following criteria:

- The Township of Centre Wellington (Fergus) mass rainfall data was used to model the full range of design storm events
- The Chicago storm parameters and the total depth of rainfall for the 2-year up to the 100-year storm (Table 4-1)
- The Horton infiltration method was used in the MIDUSS model with the parameters summarized in Table 4-2

Table 4-1. Chicago Storm Parameters

Parameter	2 Year	5 Year	100 Year
a =	695.047	1,459.072	6,933.019
b =	6.387	13.690	34.669
c =	0.793	0.850	0.998
R =	0.375	0.375	0.375
td =	180	180	180
Rainfall depth (mm)	33.014	49.792	97.935

Table 4-2. MIDUSS Horton Parameters

Parameter	Impervious Areas	Pervious Areas
Manning's 'n'	0.013	0.300
Maximum Infiltration (mm/hr)	0.0	125.0
Minimum Infiltration (mm/hr)	0.0	5.0
Lag Constant (hr)	0.00	0.25
Depression Storage (mm)	1.5	5.0

4.2. Stormwater Design Approach

The stormwater management approach is designed to follow a "treatment train", which includes lot level, conveyance and end-of-pipe stormwater management practices, designed to filter and control runoff prior to discharging to the wetland.

Lot Level Controls

The stormwater management lot level controls designed for the Site includes the following measures:

- ***Roof Drainage to Ground Surface***
  - The lots have been designed to have split drainage with runoff conveyed to the rear yard and street. The runoff will be filtered through the grassed surfaces within and between the lots.
- ***Rear Yard Swales***
  - The rear yards of the lots have been designed to include grass swales, which will convey and filter runoff.

Conveyance Controls

The stormwater management conveyance controls designed for the Site includes the following measures:

- ***Road Storm Sewer Network***
  - The minor system (5-year storm event) will be captured within the storm sewer piping within the street right-of-way.
  - The flows will be discharged to the proposed stormwater management facility.
- ***Grassed Swales***
  - Swales in the rear yards north of the site access road will convey runoff to the proposed storm sewer network and stormwater management facility
  - Swales in the rear yards south of the site access road will convey runoff to the existing wetland.

End-of-Pipe Controls

The stormwater management end-of-pipe controls designed for the Site includes the following measures.

- ***Stormwater Management Facility***
  - 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 121.2 m^3/ha of storage volume for a contributing drainage area that is 70% impervious. 40.0 m^3/ha of the required storage volume is extended detention storage, while the remaining 81.2 m^3/ha is permanent pool storage.
  - Based on a total contributing drainage area of 0.82 hectares (Catchments 2000 and 2001), 66.6 m^3 of permanent pool storage is required. The stormwater management facility has been designed with a 0.3 m deep permanent pool, which provides 80.0 m3 of permanent pool storage and a sediment forebay which provides 38.8 m^3 of permanent pool storage, for a total permanent pool storage of 118.8 m^3.
  - Based on a total contributing drainage area of 0.82 hectares (Catchments 2000 and 2001), 32.8 m^3 of extended detention storage is required. The stormwater management facility has been designed to provide approximately 562.5 m^3 of extended detention storage.
- ***Sediment Loading and Cleanout Frequency***
  - Table 4-3 illustrates sediment loading to the sediment forebay in the stormwater management facility as well as the subsequent cleanout frequency required to maintain this system.

Table 4-3. Sediment Loading and Cleanout Frequency

Catchment Area	Percent Impervious	Annual Sediment Loading	TSS Removal	Annual TSS Reduction	Storage (1/3 volume)	Cleanout Frequency
0.82 ha	70%	2.81 m^3	80%	2.25 m^3	12.94 m^3	~ 5.5 years

4.3. Existing Conditions

For existing conditions analysis purposes, the Site was modeled as four (4) drainage catchments. The existing development condition drainage catchments are shown in Figure 2 and described below. The existing conditions MIDUSS hydrologic modeling is included in Appendix D.

Catchment 100 (3.45 hectares, 25% impervious) represents external drainage that enters the Site from the north. Runoff from Catchment 100 sheetflows overland to the wetland east of the property.

Catchment 200 (0.99 hectares, 20% impervious) represents the majority of the Site, including the existing dwellings. Runoff from Catchment 200 sheetflows overland to the wetland east of the property.

Catchment 300 (0.08 hectares, 0% impervious) represents the on-site portion of the wetland at the southeast corner of the property. Runoff from Catchment 300 sheetflows overland to the wetland east of the property.

Catchment 400 (0.05 hectares, 60% impervious) represents the northwest portion of the Site, including the front yard and driveway of the existing dwelling to remain. Runoff from Catchment 400 sheetflows overland to the Sideroad 19 right-of-way west of the property.

Table 4-4 summarizes the flow from each catchment and total flows under existing conditions.

Table 4-4. Existing Condition Flow Rates

	2-Year	5-Year	100-Year
Catchment 100	0.180 m^3/s	0.252 m^3/s	0.624 m^3/s
Catchment 200	0.044 m^3/s	0.091 m^3/s	0.335 m^3/s
Catchment 300	0.001 m^3/s	0.006 m^3/s	0.026 m^3/s
Total to Wetland	**0.215 m^3/s**	**0.334 m^3/s**	**0.888 m^3/s**
Catchment 400	0.007 m^3/s	0.009 m^3/s	0.018 m^3/s
Total to Sideroad 19	**0.007 m^3/s**	**0.009 m^3/s**	**0.018 m^3/s**
Total from the Site	**0.220 m^3/s**	**0.342 m^3/s**	**0.901 m^3/s**

4.4. Allowable Release Rates

Table 4-5 identifies the allowable release rates for post-development conditions established as the existing condition flow rates generated from the site during the 2, 5, and 100-year design storm events.

Table 4-5. Allowable Release Rates

	2-Year	5-Year	100-Year
Allowable Release Rate	0.220 m^3/s	0.342 m^3/s	0.901 m^3/s

4.5. Post-Development Conditions

For post-development analysis purposes, the Site was modeled as eight (8) drainage catchments. The post-development drainage catchments are shown in Figure 3 and described below. The post-development MIDUSS hydrologic modeling is included in Appendix D.

Catchment 1000 (3.45 hectares, 25% impervious) represents external drainage that enters the Site from the north. Runoff generated during minor storm events from Catchment 1000 is captured via an on-site storm sewer easement and conveyed to the existing wetland east of the property. Runoff which exceeds the capacity of the storm sewer during major storm events will sheetflow overland to the proposed stormwater management facility, ultimately discharging to the wetland. The facility has been designed with capacity for this external runoff.

Catchment 2000 (0.69 hectares, 80% impervious) represents the majority of the proposed road and development, including all units fronting onto the proposed site access road. Runoff generated during minor storm events from Catchment 2000 are captured via on-site storm sewers and conveyed to the proposed stormwater management facility. Runoff which exceeds the capacity of the storm sewers

during major storm events will sheetflow overland to the proposed facility, ultimately discharging to the wetland.

Catchment 2001 (0.13 hectares, 15% impervious) represents the proposed stormwater management facility at the east end of the Site and access road for the facility. Runoff from Catchment 2001 will be attenuated by the proposed stormwater management facility, ultimately discharging to the wetland.

Catchment 2002 (0.08 hectares, 0% impervious) represents the rear yards of units fronting onto the south side of the proposed site access road. Runoff from Catchment 2002 is considered clean and will be collected by a rear yard swale, ultimately discharging to the wetland.

Catchment 3000 (0.13 hectares, 0% impervious) represents the on-site portion of the wetland at the southeast corner of the property. Runoff from Catchment 3000 sheetflows overland to the wetland east of the property.

Catchment 4000 (0.05 hectares, 60% impervious) represents the northwest portion of the Site, including the front yard and driveway of the existing dwelling to remain. Runoff from Catchment 4000 sheetflows overland to the Sideroad 19 right-of-way west of the property, same as existing conditions.

Catchment 4001 (0.03 hectares, 30% impervious) represents the northeast portion of the Site, including the front yard and driveway of the proposed single-detached dwelling. Runoff from Catchment 4001 sheetflows overland to the Sideroad 19 right-of-way west of the property.

Catchment 4002 (0.01 hectares, 90% impervious) represents a very small portion of the proposed road. Runoff from Catchment 4002 sheetflows overland to the Sideroad 19 right-of-way west of the property.

4.5.1. Routing

MIDUSS was used to calculate the peak flow rate from the Site under post-development conditions. The post-development MIDUSS hydrologic modeling is included in Appendix D.
Table 4-6 identifies the storage capacity available and the capacity used for the proposed stormwater management facility under each storm condition.

Table 4-6. Proposed Stormwater Management Facility - Stage/Storage/Discharge

	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
Outlet Catch Basin Lip	0.014	336.3	416.00	--	--	--
2-Year	--	--	--	0.033	343.8	416.01
Weir	0.099	457.5	416.20	--	--	--
5-Year	--	--	--	0.159	483.0	416.24
100-Year	--	--	--	0.797	606.4	416.41
Overflow	1.331	681.3	416.50	--	--	--

Table 4-7 summarizes the flow from each catchment and total flows under post-development conditions.

Table 4-7. Post Development Flows

	2-Year	5-Year	100-Year
Catchment 1000 (controlled)	0.180 m^3/s	0.252 m^3/s	0.624 m^3/s
Catchment 2000 (controlled)	0.117 m^3/s	0.151 m^3/s	0.256 m^3/s
Catchment 2001 (controlled)	0.004 m^3/s	0.011 m^3/s	0.044 m^3/s
Catchment 2002 (uncontrolled)	0.001 m^3/s	0.005 m^3/s	0.022 m^3/s
Catchment 3000 (uncontrolled)	0.001 m^3/s	0.010 m^3/s	0.040 m^3/s
Total Flow to Wetland	**0.033 m^3/s**	**0.159 m^3/s**	**0.851 m^3/s**
Catchment 4000 (uncontrolled)	0.007 m^3/s	0.009 m^3/s	0.018 m^3/s
Catchment 4001 (uncontrolled)	0.002 m^3/s	0.004 m^3/s	0.011 m^3/s
Catchment 4002 (uncontrolled)	0.002 m^3/s	0.003 m^3/s	0.004 m^3/s
Total Flow to Sideroad 19	**0.011 m^3/s**	**0.015 m^3/s**	**0.032 m^3/s**
Total Flow from the Site	**0.034 m^3/s**	**0.168 m^3/s**	**0.869 m^3/s**

A summary of the existing and post-development peak flow rates from the Site for the 2-year to 100-year design storm events is provided in Table 4-8. Post-development peak flows rates are lower than the allowable rates for all design storm events.

Table 4-8. Peak Flow Comparison

	2-Year	5-Year	100-Year
Allowable Release Rate	0.220 m^3/s	0.342 m^3/s	0.901 m^3/s
Post-Development Flow	0.034 m^3/s	0.168 m^3/s	0.869 m^3/s

4.5.2. Drainage Conveyance

The following is a description of the post-development drainage conveyance within the Site:

- ***External Drainage Conveyance:***
  - The external drainage from north of the Site will be conveyed through a 450mm diameter storm pipe within a 3.0m wide easement located along the north and east limits of the Site, discharging to the existing wetland. Once this storm sewer reaches capacity, drainage will be conveyed via a swale to the on-site storm sewer network to the proposed stormwater management facility, ultimately discharging to the existing wetland. Once this swale reaches capacity, drainage will sheetflow overland to the proposed stormwater management facility, ultimately discharging to the existing wetland.

- ***Roadway Drainage Conveyance:***
  - Conveyance will be through a combination of catch basins and storm sewer piping sized to the 5-year design storm event, to the proposed stormwater management facility to outlet at the existing wetland. Runoff which exceeds the 5-year design storm event will sheetflow overland, either to the Sideroad 19 right-of-way or to the stormwater management facility.

- ***Rear Yard Conveyance:***
  - Runoff from the rear yards north of the site access road will be conveyed by the storm sewer network described above.
  - Runoff from the rear yards south of the site access road will be conveyed by a swale that discharges directly to the existing wetland.

5. Water Budget

5.1. Existing Conditions

The average annual precipitation for the area in which the Site is location is estimated to be about 945.9 mm. This amount is based on precipitation data recorded at the Fergus Shand Dam meteorological station for the period from 1981 to 2010.

It has been estimated that the potential annual evapotranspiration for this area is 586.3 mm for pervious surfaces. Therefore, 359.6 mm remains available for infiltration and runoff. For impervious surfaces within the development, the annual evapotranspiration is estimated to be 183 mm, resulting in approximately 762.9 mm available for runoff and infiltration.

Under existing conditions, the Site is approximately 20% impervious overall. The existing annual average runoff volume towards the wetland is 2,278 m^3 and the existing annual average runoff volume towards the Sideroad 19 right-of-way is 261 m^3. The existing annual recharge volume for the site is 2,787 m^3. Tables 5-1, 5-2 and 5-3 illustrate the monthly water balance under existing conditions.

5.2. Post-Development Conditions

Under post-development conditions, the Site is approximately 52% impervious overall.
The increase in impervious area results in increased runoff and decreased recharge. Following the development of the Site, the average annual recharge volume will be 1,379 m^3, the average annual runoff volume towards the wetland will be 4,798 m^3, and the average annual runoff volume towards the Sideroad 19 right-of-way will be 426 m^3. Tables 5-4, 5-5 and 5-6 illustrate the monthly water balance under post-development conditions.

To mitigate the change in groundwater recharge anticipated under post-development conditions, a comprehensive review of the site layout and groundwater conditions was completed to investigate the feasibility of low-impact development features such as infiltration galleries and bioswales to enhance infiltration on the Site. Based on provincial and municipal design guidelines, a minimum vertical separation of 1.0m is required between groundwater level and the underside of infiltration systems. Furthermore, a minimum horizontal separation of 5.0m is required between building foundations and infiltration systems.

Groundwater elevations are shown in Figure 7 contained in the Hydrogeological Study Report completed by GEI Consultants Canada Ltd. Finished ground elevations are shown in the conceptual grading plan submitted with this report. Both groundwater and ground elevations decrease across the Site in the easterly direction, from Sideroad 19 to the wetland. However, ground elevations decrease in greater magnitude, resulting in decreased vertical separation between groundwater and ground towards the eastern end of the Site. At the end of the proposed swale along the southern edge of the Site and the start of the wetland, groundwater is at ground level. As a result of the 1.0m separation requirement, infiltration facilities are not feasible in the eastern half of the Site.

Looking at the western half of the Site, there is more separation between groundwater and ground elevations. However, there is only one location where infiltration systems can be placed 5.0m away from building foundations, which is the front yard of the proposed single-detached dwelling. However, an infiltration system at this location would conflict with water and sanitary services for the dwelling. Furthermore, this infiltration system would not be significant as it would capture runoff from a relatively small area.

Based on the information presented above, infiltration systems are not feasible on the Site. Furthermore, as detailed in the Hydrogeological Study Report by GEI Consultants Canada Ltd., it is expected that the decrease in recharge will not have a significant impact on overall municipal groundwater resources.

Table 5-1. Existing Conditions Water Balance Inputs

	Contributing Area (ha)	Percent Impervious (%)	Soil Type	Vegetation Type	Root Zone Depth (m)	Soil Moisture Retention Capacity (mm)	Runoff Factor	Evapotranspiration Factor for Impervious Surfaces
To Wetland	1.07	19	Fine sand	Shallow-rooted crops	0.50	50	0.45	0.34
To Right-of-Way	0.05	60	Fine sand	Shallow-rooted crops	0.50	50	0.85	0.34

Table 5-2. Existing Conditions Monthly Water Balance (To Wetland)

Month	Daily Average Temp. (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factor	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accumulative Potential Water Loss (mm)	Storage (mm)	ΔS (mm)	Actual Evapotrans-piration (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Runoff Volume (m^3)	Recharge Volume (m^3)
Jan	-7.4	0.00	0.0	24.3	0.0	67.9	67.9		186.5	0.0	0.0	0.0	12.7	0.0	12.7	5.7	62	74
Feb	-6.3	0.00	0.0	24.6	0.0	55.9	55.9		242.4	0.0	0.0	0.0	6.3	0.0	6.3	2.9	31	37
Mar	-1.9	0.00	0.0	30.6	0.0	59.6	59.6		302.0	0.0	0.0	0.0	3.2	0.0	3.2	1.4	15	18
Apr	5.7	1.22	0.9	33.6	30.2	74.1	43.9		50.0	0.0	26.5	47.6	23.8	25.2	49.0	22.2	238	286
May	12.2	3.86	2.0	37.8	75.6	86.9	11.3		50.0	0.0	66.4	20.5	22.2	226.8	249.0	113.0	1,209	1455
Jun	17.5	6.66	2.9	38.4	111.4	83.8	-27.6	-27.6	28.0	-22.0	92.9	12.9	17.6	0.0	17.6	8.0	85	103
Jul	20.0	8.16	3.4	38.7	131.6	89.2	-42.4	-69.9	11.0	-17.0	93.2	13.0	15.3	0.0	15.3	6.9	74	89
Aug	19	7.55	3.2	36.0	115.2	96.6	-18.6	-88.5	8.0	-3.0	87.4	12.2	13.7	0.0	13.7	6.2	67	80
Sep	14.9	5.22	2.5	31.2	78.0	93.1	15.1		23.1	15.1	68.5	9.5	11.6	0.0	11.6	5.3	57	68
Oct	8.3	2.15	1.3	28.5	37.1	77.2	40.2		50.0	26.9	32.5	17.8	14.7	0.0	14.7	6.7	71	86
Nov	2.1	0.27	0.3	24.3	7.3	93.0	85.7		50.0	0.0	6.4	86.6	50.7	0.0	50.7	23.0	246	296
Dec	-3.9	0.00	0.0	23.1	0.0	68.6	68.6		118.6	0.0	0.0	0.0	25.3	0.0	25.3	11.5	123	148
Total		**35.09**			**586.3**	**945.9**	**359.6**				**473.8**	**220.1**	**217.0**	**252.0**	**469.0**	**212.9**	**2,278.1**	**2,739.9**

Table 5-3. Existing Conditions Monthly Water Balance (To Right-of-Way)

Month	Daily Average Temp. (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factor	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accumulative Potential Water Loss (mm)	Storage (mm)	ΔS (mm)	Actual Evapotrans-piration (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Runoff Volume (m^3)	Recharge Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		186.5	0.0	0.0	0.0	15.0	0.0	15.0	12.7	6	1
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		242.4	0.0	0.0	0.0	7.5	0.0	7.5	6.4	3	1
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		302.0	0.0	0.0	0.0	3.8	0.0	3.8	3.2	2	0
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		50.0	0.0	18.2	55.9	27.9	25.2	53.1	45.1	23	4
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		50.0	0.0	45.6	41.3	34.6	226.8	261.4	221.7	111	20
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	28.0	-22.0	63.8	42.0	38.3	0.0	38.3	32.5	16	3
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	11.0	-17.0	64.1	42.1	40.2	0.0	40.2	34.1	17	3
Aug	19	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	8.0	-3.0	60.1	39.5	39.8	0.0	39.8	33.8	17	3
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		23.1	15.1	47.1	30.9	35.4	0.0	35.4	30.0	15	3
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		50.0	26.9	22.4	27.9	31.7	0.0	31.7	26.9	13	2
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		50.0	0.0	4.4	88.6	60.1	0.0	60.1	51.0	25	5
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		118.6	0.0	0.0	0.0	30.1	0.0	30.1	25.5	13	2
Total		**35.1**			**586.3**	**945.9**	**359.6**				**325.7**	**368.2**	**364.4**	**252.0**	**616.4**	**522.7**	**261.4**	**46.8**

Table 5-4. Post-Development Conditions Water Balance Inputs

	Contributing Area (ha)	Percent Impervious (%)	Soil Type	Vegetation Type	Root Zone Depth (m)	Soil Moisture Retention Capacity (mm)	Runoff Factor	Evapotranspiration Factor for Impervious Surfaces
To Wetland	1.07	52	Fine sand	Shallow-rooted crops	0.50	50	0.79	0.34
To Right-of-Way	0.09	53	Fine sand	Shallow-rooted crops	0.50	50	0.80	0.34

Table 5-5. Post-Development Conditions Monthly Water Balance (To Wetland)

Month	Daily Average Temp. (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factor	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accumulative Potential Water Loss (mm)	Storage (mm)	ΔS (mm)	Actual Evapotrans-piration (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Runoff Volume (m^3)	Recharge Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		186.5	0.0	0.0	0.0	14.6	0.0	14.6	11.5	119	32
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		242.4	0.0	0.0	0.0	7.3	0.0	7.3	5.8	59	16
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		302.0	0.0	0.0	0.0	3.6	0.0	3.6	2.9	30	8
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		50.0	0.0	19.8	54.3	27.2	25.2	52.4	41.4	426	113
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		50.0	0.0	49.4	37.5	32.3	226.8	259.1	204.8	2,110	559
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	28.0	-22.0	69.2	36.6	34.5	0.0	34.5	27.3	281	74
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	11.0	-17.0	69.4	36.8	35.6	0.0	35.6	28.2	290	77
Aug	19	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	8.0	-3.0	65.1	34.5	35.1	0.0	35.1	27.7	285	76
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		23.1	15.1	51.0	27.0	31.0	0.0	31.0	24.5	253	67
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		50.0	26.9	24.2	26.1	28.6	0.0	28.6	22.6	232	62
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		50.0	0.0	4.8	88.2	58.4	0.0	58.4	46.2	475	126
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		118.6	0.0	0.0	0.0	29.2	0.0	29.2	23.1	238	63
Total		**35.1**			**586.3**	**945.9**	**359.6**				**352.9**	**341.0**	**337.3**	**252.0**	**589.3**	**465.9**	**4,798.3**	**1,271.9**

Table 5-6. Post-Development Conditions Monthly Water Balance (To Right-of-Way)

Month	Daily Average Temp. (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factor	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accumulative Potential Water Loss (mm)	Storage (mm)	ΔS (mm)	Actual Evapotrans-piration (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Runoff Volume (m^3)	Recharge Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		186.5	0.0	0.0	0.0	14.7	0.0	14.7	11.7	11	3
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		242.4	0.0	0.0	0.0	7.3	0.0	7.3	5.9	5	1
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		302.0	0.0	0.0	0.0	3.7	0.0	3.7	2.9	3	1
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		50.0	0.0	19.6	54.5	27.3	25.2	52.5	41.9	38	9
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		50.0	0.0	48.9	38.0	32.6	226.8	259.4	207.4	187	47
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	28.0	-22.0	68.5	37.3	35.0	0.0	35.0	27.9	25	6
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	11.0	-17.0	68.8	37.4	36.2	0.0	36.2	28.9	26	7
Aug	19	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	8.0	-3.0	64.5	35.1	35.7	0.0	35.7	28.5	26	6
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		23.1	15.1	50.5	27.5	31.6	0.0	31.6	25.2	23	6
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		50.0	26.9	24.0	26.3	28.9	0.0	28.9	23.1	21	5
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		50.0	0.0	4.7	88.3	58.6	0.0	58.6	46.8	42	11
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		118.6	0.0	0.0	0.0	29.3	0.0	29.3	23.4	21	5
Total		**35.1**			**586.3**	**945.9**	**359.6**				**349.5**	**344.4**	**340.7**	**252.0**	**592.7**	**473.8**	**426.4**	**107.0**

6. Erosion and Sediment Control Plan

Silt fence will be installed along the property boundary in all locations where runoff will discharge from the Site to adjacent lands. The silt fence will serve to minimize the opportunity for water borne sediments to be washed on to the adjacent properties.

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

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

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.

Once construction and landscaping have been substantially completed, the silt fence will be removed, any accumulated sediment will be removed, and the landscaping will be completed.

7. Maintenance Plan

To ensure that the stormwater management system continues to function as designed and constructed, we recommend that the following inspections and maintenance activities be completed on an annual basis:

1. Maintenance of storm sewers typically consists of cleaning out leaves, debris and accumulated sediment caught in sumps in catch basins and manholes and inspection and cleanout of inlets and outlets annually or as needed.
2. The stormwater management facility should be inspected on an annual basis and include the following considerations:
    a. Is the pond level higher than normal permanent pool elevation > 48 hours after a storm? If yes, the outlet structure may be obstructed – check and remove anything obstructing flow out of the pond.
    b. Is the pond level lower than the normal permanent pool elevation (catch basin top of grate)? If yes, the inlet structure may be obstructed, check and remove anything obstructing the inlet structure or storm sewers upstream.
    c. Is the vegetation around the stormwater management facility unhealthy or dying? If yes, re-establishment of the upland vegetation is required.
    d. Is the pond all open water (no bulrushes or vegetation in the water)? Are there areas around the pond with easy access to open water where there should be vegetation? If yes, re-establishment of the wetland vegetation is required.
    e. Is there an oily sheen on the water near the inlet or outlet? Is the water frothy? Is there an unusual colouring to the water? If yes, this indicates the occurrence of an oil spill, cleanup spill to avoid transfer to the municipal drain.
    f. Check the sediment depth in the forebay. Is it higher than a third of the depth of the forebay (originally 1.15 metres from bottom of forebay to catch basin top of grate elevation)? If yes, the forebay and potentially the permanent pool must be cleaned of sediment.

8. Site Lighting

The approximate location of the site lighting (poles and fixtures) has been indicated on the preliminary drawings.

The detailed site lighting / photometric plan will be provided at a later stage. The site lighting will be designed to ensure zero light trespass over the property line and compliance with Township standards.

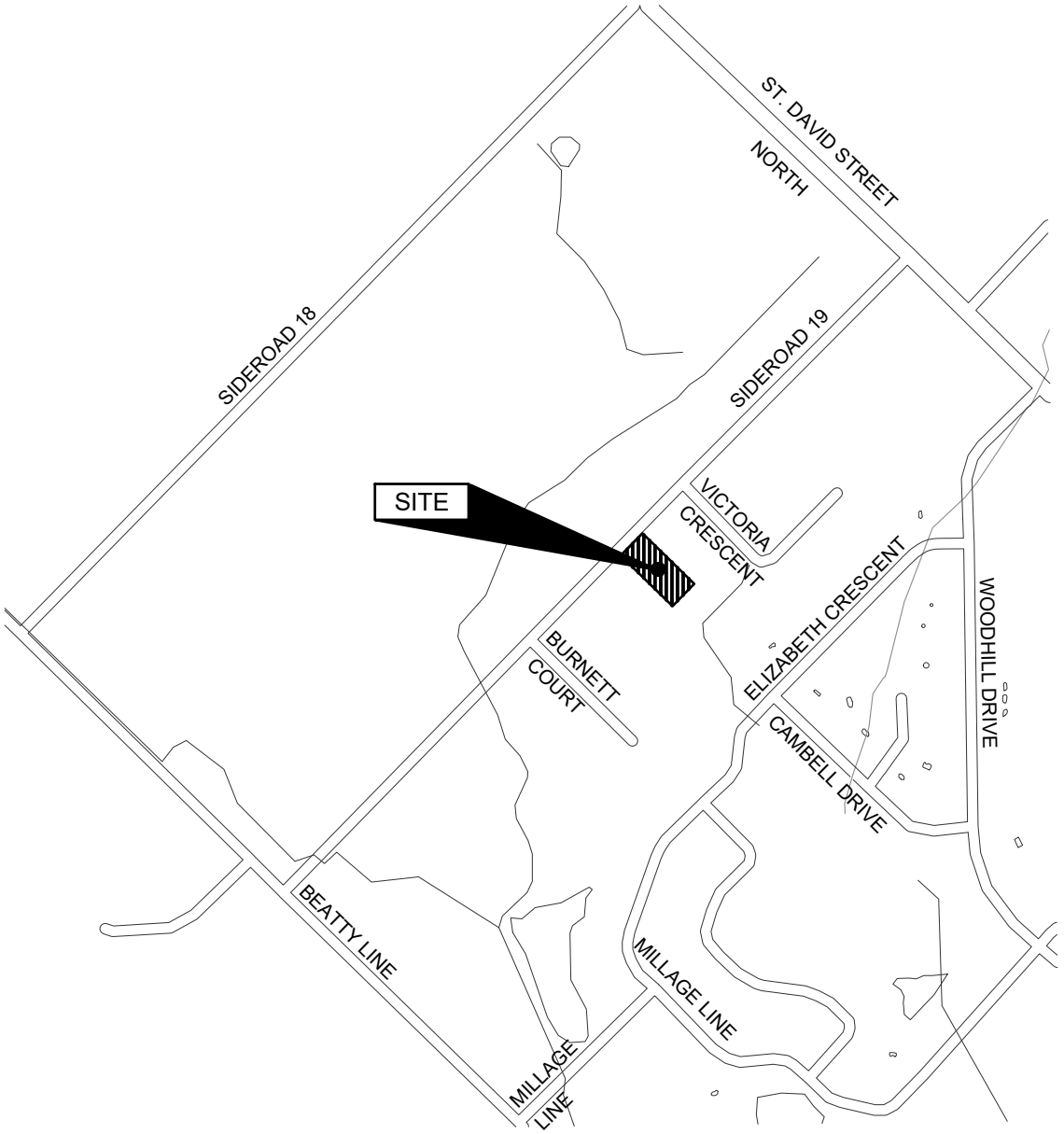
9. Conclusions

In summary, the 79 Sideroad 19 Functional Servicing and Stormwater Management Report includes the following:

- The report background documented all existing reports and standards relevant to the 79 Sideroad 19 development.
- The Township of Centre Wellington (Fergus) criteria were provided and followed for the proposed design.
- The water and sanitary servicing designs have been prepared for the proposed development:
    - A new sanitary sewer will be connected to the existing sanitary municipal sewer on Sideroad 19.
    - A new watermain and two fire hydrants will be connected to the existing municipal watermain on Sideroad 19.
- The storm servicing and stormwater management designs have been prepared for the proposed development:
    - A storm sewer network has been designed to provide conveyance of runoff to the proposed stormwater management facility, ultimately discharging to the existing wetland.
    - Local swales have been designed to convey runoff within the rear yards to the storm sewer network, ultimately discharging to the existing wetland.
    - The stormwater management facility has been designed to provide Enhanced water quality treatment, including the required permanent pool storage and extended detention storage volumes.

Based on the above works, we trust that this is the information required at this time to support approval of the proposed residential development.

Figures



079 SIDEROAD 19 RESIDENTIAL DEVELOPMENT
TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

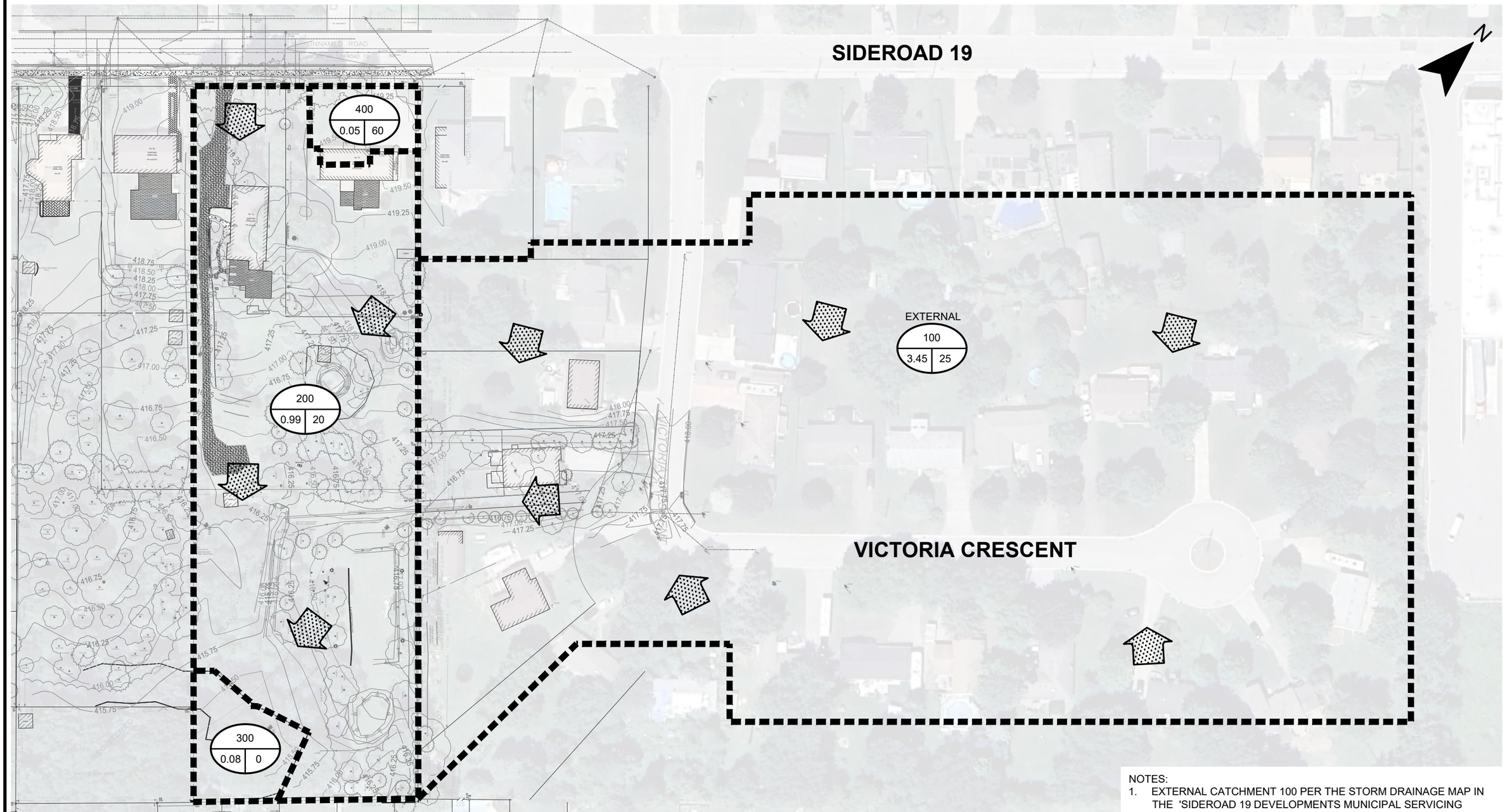
WRIGHTHAVEN HOMES LTD.

GEI Consultants

LOCATION PLAN

Project 2401073 | AUGUST 2024 | Figure No. 1

---- \\geiconsultants.com\data\Data_Storage\Working\WRIGHTHAVEN HOMES\2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Drafting\Figures\122025_SITE LOCATION.dwg - 6/13/2024



NOTES:
1. EXTERNAL CATCHMENT 100 PER THE STORM DRAINAGE MAP IN THE 'SIDEROAD 19 DEVELOPMENTS MUNICIPAL SERVICING ASSESSMENT' MEMORANDUM PREPARED BY TRITON ENGINEERING SERVICES LIMITED, DATED 2021-09-29 (FILE # A6766A)

LEGEND

201 / 0.110 | 80
- CATCHMENT NUMBER
- % IMPERVIOUS
- CATCHMENT AREA IN HECTARES

CATCHMENT BOUNDARY

MAJOR OVERLAND FLOW

15 0 10 20 40
1:1000 (m)

079 SIDEROAD 19 RESIDENTIAL DEVELOPMENT
TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

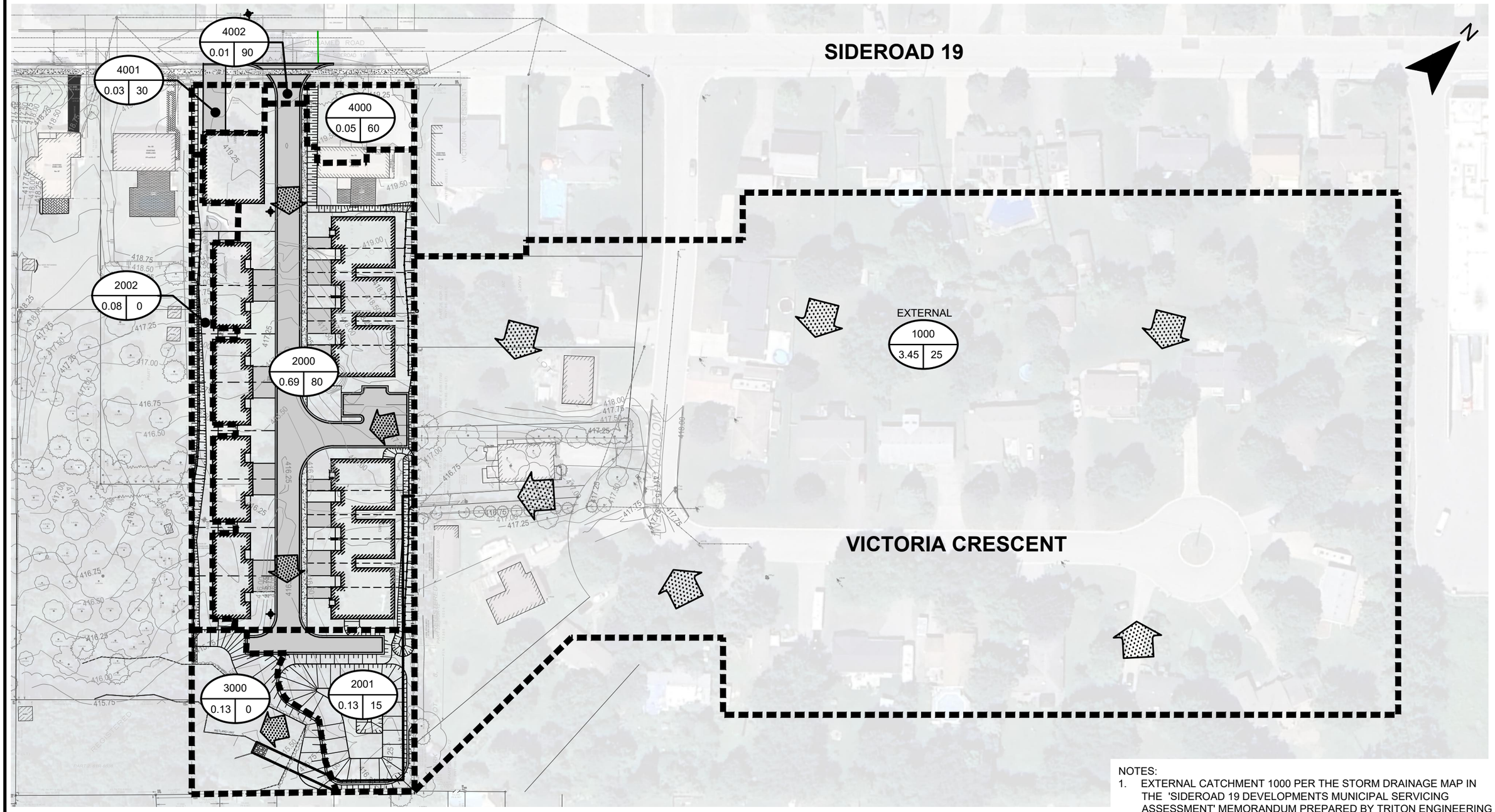
WRIGHTHAVEN HOMES LTD.

GEI Consultants

EXISTING CONDITIONS
DRAINAGE AREAS

Project 2401073 | AUGUST 2024 | FIGURE No. 2

LAMBIER, BRADLEY \\geiconsultants.com\data\Data_Storage\Working\WRIGHTHAVEN HOMES\2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Drafting\Figures\122025 SWM Figures.dwg - 8/21/2024



NOTES:
1. EXTERNAL CATCHMENT 1000 PER THE STORM DRAINAGE MAP IN THE 'SIDEROAD 19 DEVELOPMENTS MUNICIPAL SERVICING ASSESSMENT' MEMORANDUM PREPARED BY TRITON ENGINEERING SERVICES LIMITED, DATED 2021-09-29 (FILE # A6766A)

LEGEND

201 — CATCHMENT NUMBER
0.110 | 80 — % IMPERVIOUS
CATCHMENT AREA IN HECTARES

CATCHMENT BOUNDARY

MAJOR OVERLAND FLOW

15 0 10 20 40
1:1000 (m)

079 SIDEROAD 19 RESIDENTIAL DEVELOPMENT
TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

WRIGHTHAVEN HOMES LTD.

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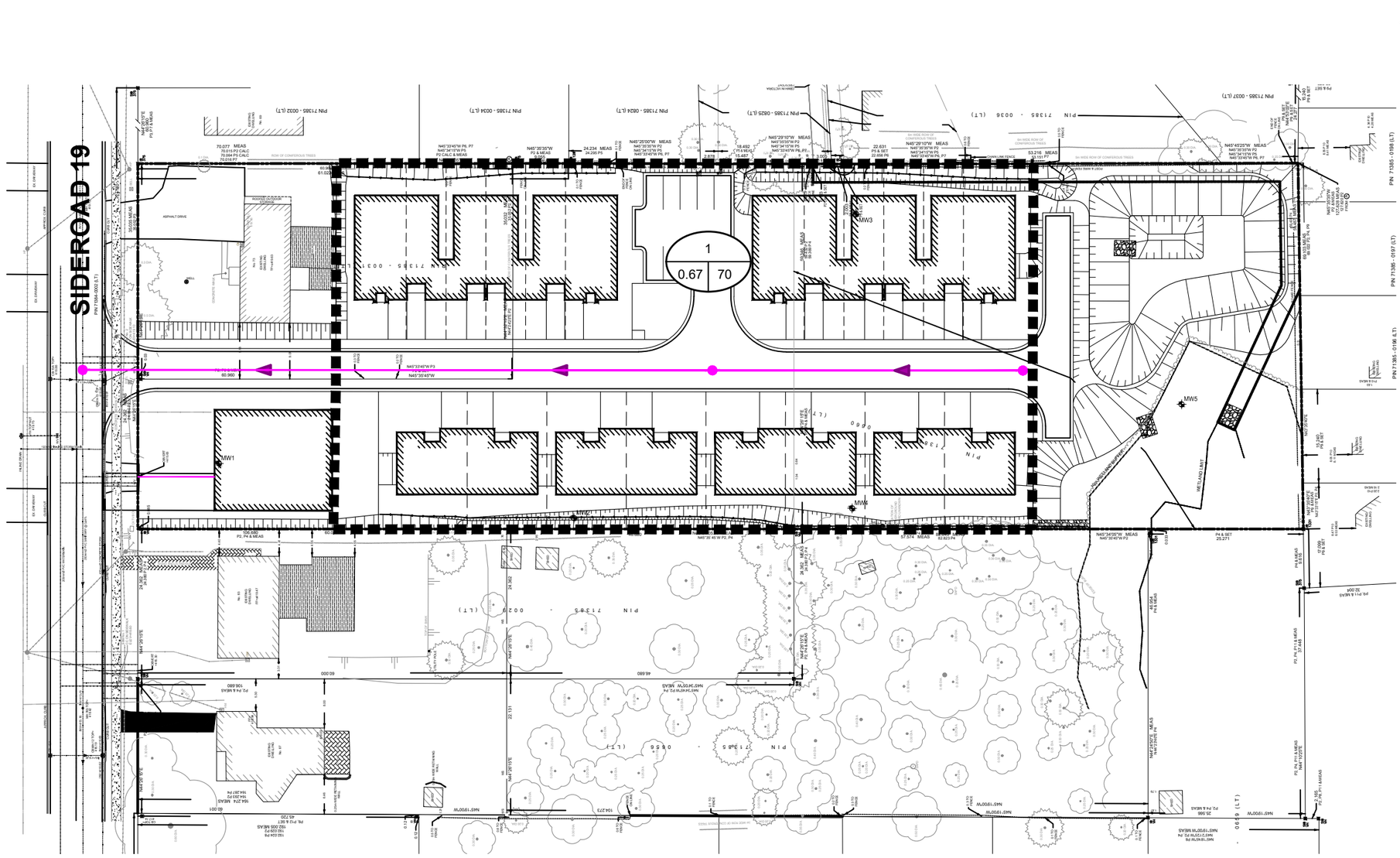
POST-DEVELOPMENT DRAINAGE AREAS

Project 2401073 | AUGUST 2024 | FIGURE No. 3



LEGEND

200
0.75 | 25

CATCHMENT NUMBER
POPULATION
CATCHMENT AREA IN HECTARES

CATCHMENT BOUNDARY

079 SIDEROAD 19 RESIDENTIAL DEVELOPMENT
TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

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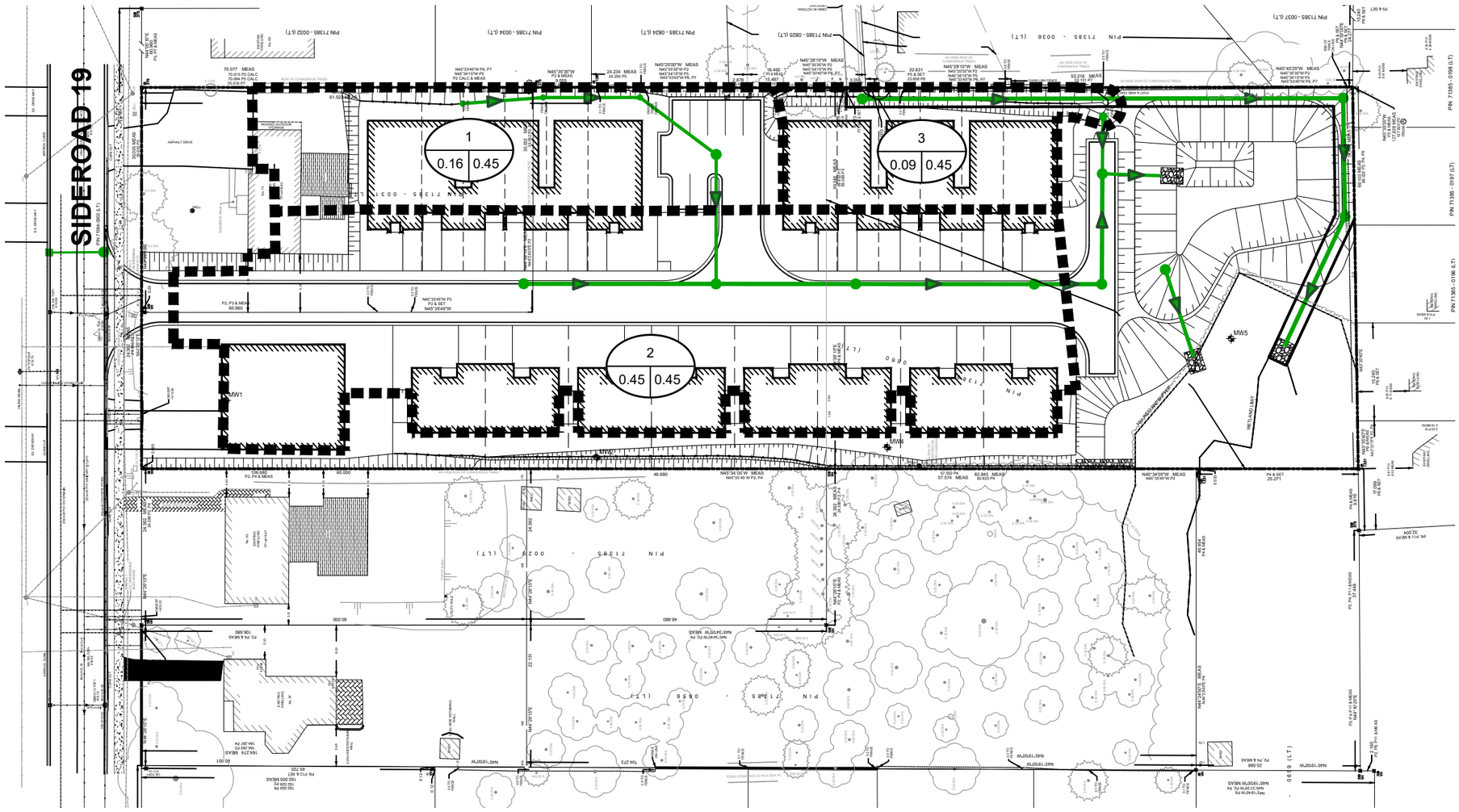
CONCEPTUAL SANITARY SEWER CATCHMENT AREAS

Project 2401073 | AUGUST 2024 | FIGURE No. 4

LAMBIER, BRADLEY \\geiconsultants.com\data\Data_Storage\Working\WRIGHTHAVEN HOMES\2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Drafting\Figures\122025_SANITARY CATCHMENT FIG.dwg - 8/21/2024



10 5 0 10 20 30

1:750 (m)

LEGEND

200
0.75 | 0.45

- CATCHMENT NUMBER
- RUN-OFF CO-EFFICENT
- CATCHMENT AREA IN HECTARES
- CATCHMENT BOUNDARY

079 SIDEROAD 19 RESIDENTIAL DEVELOPMENT
TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

WRIGHTHAVEN HOMES LTD.

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CONCEPTUAL STORM SEWER CATCHMENT AREAS

Project 2401073 | AUGUST 2024 | FIGURE No. 5

Appendix A Geotechnical Investigation, JLP Services Inc., April 18, 2023

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Geotechnical Investigation

Proposed Residential Development
79-87 Side Road 19
Township of Centre Wellington (Fergus), Ontario

Client:
WrightHaven Homes Limited
925 Gartshore Street, Units 1 & 2
Fergus, Ontario N1M 2W7

Attention: Steven Wright, President
Adam Wright, Project Manager

Type of Document:
Geotechnical Report

Project Number:
G4670-22-12

JLP Services Inc.
Geotechnical and Environmental Consultants
405 York Road
Guelph, ON
N1E 3H3

Date Submitted:
April 18, 2023

Cc: GM BluePlan Engineering Ltd.

Table of Contents

Enclosures

List of Appendices

1. Introduction

JLP Services Inc. (JLP) was retained by WrightHaven Homes Limited to carry out a geotechnical investigation for the proposed residential development located at 79-87 Side Road 19 in the Township of Centre Wellington (Fergus), Ontario.

Although final details concerning the proposed residential development are unavailable at the time of this report, it is understood, from the conceptual plan, that the proposed development consists of twenty (20) townhomes with basement and associated municipal site services, access road and storm water management facility.

The purpose of this investigation was to reveal the subsurface soil and groundwater conditions at the site and to determine the relevant soil properties for preliminary recommendations for the design and construction of building foundations, floor slab-on-grade, municipal site services, paved access road, and storm water management facility.

The conclusions and recommendations given in this report are based on the assumption that the design concept mentioned above will proceed into construction. If changes are made in the design phase and/or during construction, JLP must be retained to review these changes. The outcome of this review may lead to modifications to our recommendations or may require additional field and/or laboratory analyses to determine if the proposed changes are acceptable from a geotechnical standpoint.

2. Site Description

The site is located on southeast side of Side Road 19, about 120m northeast of Burnett Court, in Fergus, Ontario. The site is an open space behind existing residential dwellings on 79 Side Road 19 and is about 1.1 hectares in size. It is surrounded by existing residential dwellings and properties on all sides.

The ground surface is gently sloping with the higher grounds at the north side of the property. The difference in ground surface elevations is about 3.35m between the highest and the lowest borehole locations.

3. Field Work

The fieldwork was carried out over the period of January 30 to 31, 2023 and consisted of five (5) boreholes at the approximate locations shown on the Borehole Location Plan, Enclosure 1.

Prior to the commencement of drilling and sampling operations at the site, the borehole locations were cleared of underground utilities by Ontario One Call contractors and by a private utility locator.

The boreholes were advanced to the sampling depths by means of a track-mounted, power auger machine, equipped with solid and hollow stem augers and split spoon samplers for soil sampling. Standard Penetration tests were carried out at frequent intervals of depth and the results are shown on the Borehole Logs as N-values. The subsurface soils were visually examined, logged and sampled at the borehole locations.

Ground water conditions were observed in the open boreholes during the drilling and sampling operations. Monitoring wells were installed in all five (5) boreholes for subsequent groundwater monitoring to be conducted by GM BluePlan Engineering Limited (GMBP).

JLP engineering staff supervised and directed the fieldwork. The layout of borehole locations and the survey of ground surface elevations was carried out in the field by GMBP. The ground surface elevations at the borehole locations are listed in Table 1 below.

Table 1: Borehole Location and Ground Surface Elevations

Borehole	Ground Surface Elevation (m±)
MW1	419.211
MW2	417.100
MW3	416.939
MW4	416.302
MW5	415.859

4. Subsurface Conditions

Full details of the soil conditions encountered in each borehole are given on the Borehole Logs, Enclosures 2 to 6, inclusive and the following notes are intended to summarize this data.

A deposit of **Fill**, about 125mm thick, was encountered locally at the surface of Boreholes 2 and 4. The fill generally consisted of brown sand and gravel, some silt.

Based on visual and tactile examination of the soil samples, the fill is considered to be in a generally loose state of compactness and in moist condition.

A deposit of **topsoil**, about 100 to 650mm thick, was encountered at the surface of Boreholes 1, 3 and 5 and below the fill layer in Boreholes 2 and 4 extending to about 0.1 to 0.8 metres below grade. The topsoil consisted of sandy silt, some organics, and was black in colour. The natural moisture content was found to range between 20 and 34%.

It should be noted that the thickness of topsoil may vary significantly between borehole locations and should not be relied upon to estimate the quantity of topsoil for removal.

A deposit of **silt** was encountered below the topsoil in all the boreholes to depth of about 1.0 to 2.3 metres below grade. This material was brown to grey in colour and consisted of silt, some sand. In Boreholes 1, 2, 3, the silt contained occasional coarse sand inclusions. In Borehole 1, the silt contained trace organic inclusions. In Boreholes 4 and 5, the silt contained scattered organic seams and wood or plant fibres in upper portion. Standard Penetration tests in the silt gave N-values ranging between 5 and 14 blows/300mm, with typical values between 7 and 11 blows/300mm. The natural moisture content was found to range from 8 to 33%, with typical values between 18 and 22%. The relatively high natural moisture content test results in Boreholes 1, 4 and 5 may be attributed to the presence of organics in the deposit.

A typical grain size distribution curve for the silt can be found on Enclosure 7. The grain size analysis results indicate 1% of gravel, 17% of sand, 73% of silt and 9% of clay size particles by weight. The liquid limit (LL), plastic limit (PL) and plasticity index (PI) of the sample of silt is 21.4%, 17.7% and 3.8%, respectively.

Based on the test results and visual and tactile examination of the soil samples, the silt is considered to be in a loose to dense state of compactness and in moist to wet condition.

A deposit of **sand** was encountered below the silt in all the boreholes extending to depths of about 3.5 and 7.6 metres below grade in Boreholes 1, 3, 4 and 5 and to the termination depth of Borehole 2 at about 5.2 metres below grade. The sand was brown to grey in colour and consisted of trace silt. In Borehole 1, scattered silty seams were observed at about 5.0 metres below grade. Standard Penetration tests in this deposit gave N-values ranging from 6 to 53 blows/300mm, with typical values between 8 and 18 blows/300mm. The natural moisture content was found to range from 12 to 32%, with typical values between 19 and 24%.

A typical grain size distribution curve for the sand can be found on Enclosure 8. The grain size analysis results indicate 0% of gravel, 92% of sand, 7% of silt and 1% of clay size particles by weight.

Based on the test results and visual and tactile examination of the soil samples, the sand is considered to be in a generally loose to compact state of compactness and in moist to wet condition.

A discontinuous deposit of **sandy silt till** was encountered below the sand in Boreholes 1, 3, 4 and 5 and extending to the termination depths of the boreholes at about 3.7 to 8.2 metres below grade. The sandy silt till was grey in colour and contained trace clay and occasional gravel inclusions. Standard Penetration tests in the sandy silt till gave N-values ranging between 12 and 84 blows/300mm, with typical values between 30 and 53 blows/300mm. The natural moisture content of this material was found to range from 10 to 18%.

A typical grain size distribution curve for the sandy silt till can be found on Enclosure 9. The grain size analysis results indicate 1% of gravel, 21% of sand, 77% of silt and 1% of clay size particles by weight. The liquid limit (LL), plastic limit (PL) and plasticity index (PI) of the sample of sandy silt till are 17.2 %, 13.7% and 3.5 %, respectively.

Based on the test results and visual and tactile examination of the soil samples, the sandy silt till is considered to be in a generally compact to very dense state of compactness and in moist to wet condition.

5.0 Groundwater Conditions

No free water was encountered in any of the boreholes on completion of the fieldwork.

A monitoring well was installed in each of the five (5) boreholes, sealed with bentonite between 0.25 below ground surface and 0.6 metres above top of well screen for groundwater level monitoring. Free water surface levels were measured by personnel from GMBP at depths and elevations noted in Table 2 below.

Table 2: Observed Groundwater Levels

Location	Ground Elevation (m)	March 14, 2023		April 5, 2023	
		Depth Below Existing Grade (m±)	Water Level Elevation (m±)	Depth Below Existing Grade (m±)	Water Level Elevation (m±)
MW 1	419.211	N/R	N/R	2.141	417.070
MW 2	417.100	N/R	N/R	0.120	416.980
MW 3	416.939	1.208	415.731	0.606	416.333
MW 4	416.302	0.679	415.623	0.198	416.104
MW 5	415.859	0.667	415.192	0.295	415.564

*N/R denotes “not recorded” due to well not accessible on the date of reading water levels

An examination of the soil samples indicated that the materials were generally moist to wet.

It is noted that no sub-artesian water pressure was encountered in any of the boreholes.

Based on the foregoing measurements and the moisture content profiles of the soil samples, the localized groundwater table at the site is considered to be located at about 0.5 to 1.0 metre below grade, Elevations 416.2m to 415.1m. The groundwater is believed to be originated within the sand deposit above the less permeable sandy silt till.

Seasonal fluctuation of the groundwater level should be anticipated.

6.0 Discussion and Recommendations

6.1 General

The boreholes generally encountered a surficial deposit of topsoil, followed by a deposit of silt, underlain by a deposit of sand, followed by a deposit of sandy silt till. The groundwater level at the site appears to be stabilized at about 0.1 to 2.1 metres below existing grade, Elevations 417.1 to 415.6m.

Although final details concerning the proposed development are unavailable at the time of this report, it is understood, from the conceptual plan, that the proposed development consists of twenty (20) townhomes with basement and associated municipal site services, access road and storm water management facility. Based on the foregoing, the following discussion is therefore considered preliminary. It should be reviewed when more details are available.

6.2 Site Grading

It is assumed some re-grading will be required at the site depending on the final design grades of the proposed residential development.

Following clearing and grubbing as required, the surficial topsoil may be removed and stockpiled for re-use and/or off-site disposal. The design site grades may be achieved by cut and fill operations. All cut and fill to support the proposed building lots, site services and pavement areas should be carried out following the procedure for “engineered fill” construction.

The procedure for “engineered fill” construction would consist of the following:

1. All vegetation, surficial topsoil, fill and any deleterious materials should be removed from the proposed building lots, site services and pavement areas. Any organic, excessively wet or otherwise deleterious materials should not be used as “engineered fill” material.

2. Existing groundwater monitoring wells and/or potable water wells, if any, should be properly decommissioned in accordance with the Ontario Water Resources Act, R.R.O. 1990, Ontario (O.Reg.) 903 – amended to O.Reg. 128/03.
3. The exposed subgrade should be proof-rolled with a heavy-duty equipment, such as a loaded dump truck, and examined by geotechnical personnel from JLP. Any loose or soft areas encountered during the proof-rolling process should be further sub-excavated and replaced with approved on-site or imported soil materials compacted to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD).
4. Low areas can then be brought up to the design pre-grade level with approved on-site or imported soil materials placed in maximum 200mm thick lifts and compacted to a minimum of 98% of the SPMDD.
5. Moisture conditioning should be applied to the approved on-site and/or imported soil materials for effective compaction. Some of the on-site soil materials may require air drying before they can be properly compacted.
6. The "engineered fill" under all structures to be supported should extend to at least 1.0 metre laterally beyond the edge of their perimeter at the founding level and at least a distance equal to the depths of the fill pad, at the level of the approved subgrade.
7. Temporary fill slopes should be no steeper than 1 vertical to 2 horizontal and should be protected from surface erosion.
8. All imported fill materials should be assessed by JLP prior to transport to the site in accordance with the "On-Site and Excess Soil Management Regulation", O.Reg. 406/19 and supporting amendments.
9. All imported fill materials should be free from organics, cobbles/boulders and debris and should be tested geotechnically by JLP prior to transport to the site.
10. All topsoil and unsuitable material removal, subgrade preparation, fill placement and compaction should be monitored on a full-time basis by geotechnical staff from JLP to approve materials and to verify that the specified degree of compaction have been achieved.

6.3 Site Services

The inverts of the proposed site services are not available at the time of this report. However, it is expected that the storm sewer and watermain inverts will be located at depths ranging

between 2.0 and 4.0 metres below the finished grades. All sewers and watermains should be protected from frost actions by at least 1.4m of soil cover or equivalent thermal insulation.

Reference to the Borehole Logs indicates that the subgrade for site services will generally consist of native sand in loose to compact state, sandy silt till in compact to very dense state or "engineered fill" constructed during site grading. The subgrade will generally provide adequate support for the pipes and allow the use of OPSD 802.010 and/or OPSD 802.031 Class 'B' bedding using OPSS.MUNI 1010 Granular 'A' material.

Clear crushed stone should not be used as bedding as fine-grained particles may migrate into the voids of the clear stone and cause undesirable settlements. Where the exposed subgrade is less competent than the materials identified in the Borehole Logs, the bedding thickness may have to be increased.

If the trench excavation is above the observed groundwater level, the sides of the open cut excavation should either be cut back at a side slope of 1 vertical to 1 horizontal or supported with trench box or temporary shoring system.

If the trench excavation is below the observed groundwater level, construction dewatering by means of pumping from sump within the excavation or by pumping from well-points may be required to lower the groundwater level to at least 600 mm below the bottom of the trench to facilitate construction. The sides of the open cut excavation should either be cut back at a side slope of 1 vertical to 2 horizontal or supported with trench box or temporary shoring system.

The excavated materials will be generally suitable for re-use as trench backfill provided that they are free of topsoil, organic material and cobbles/boulders. If the on-site materials become wet, they should be air dried prior to re-use as trench backfill. The trench backfill should be placed in maximum 300mm thick layers and uniformly compacted to at least 95% of its Standard Proctor Maximum Dry Density (SPMDD).

The backfill around maintenance holes, catchbasins, valve chambers, thrust blocks and/or service connections should consist of free-draining granular material, such as the OPSS Granular 'B' Type I or Type II Modified material and compacted to a minimum of 95% of its SPMDD.

To minimize potential problems and wetting of the subgrade material, backfilling operations should follow closely after excavations, so that only a minimal length of trench is exposed at a time. Should construction be carried out in the winter season, particular attention should be given to make sure no frozen material is used for backfill.

Cobbles and/or boulders may be present in the native sandy silt till deposit, and some difficulty or delays may be anticipated during excavation at depth. Cobbles and/or boulders with nominal diameter larger than 150mm should not be re-used as trench backfill.

6.4 Storm Water Management Facility

Grain size distribution curves were prepared for representative samples of the subsoils obtained at the boreholes. These grain size distribution analyses were performed following applicable ASTM laboratory procedures and are found on Enclosures 7 to 9, inclusive.

The grain size distribution curves were compared to the family of curves presented in the Supplementary Standard SB-6 of the 2012 Building Code Compendium. According to the Unified Soils Classification System and taking into consideration the specific physical nature of the soils, the samples in question are considered to have the properties noted in the following Table 3.

Table 3: Soil Permeability and T-time Estimation

Sample Number	Material					Unified Soils Classification Group	Estimated Co-efficient of Permeability (k) (cm/sec)	Estimated T-time (min/cm)
	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)			
BH1 SS5	Sand, trace silt	0	92	7	1	(SP)	10^{-2} - 10^{-3}	10
BH3 SS2	Silt, some sand	1	21	77	1	(ML)	10^{-5} - 10^{-6}	50
BH5 SS3	Silt, some silt	1	17	73	9	(ML)	10^{-5} - 10^{-6}	50

If a storm water management pond is to be constructed for the proposed subdivision, a low permeability liner may be required to maintain a permanent wet pond. The low permeability liner may be constructed with a minimum 1m thick layer of clayey soils conforming to OPSS.MUNI 1205 requirements. Alternatively, a geosynthetic clay liner, such as Bentofix CNSL, or a synthetic liner, such as Nilex Geomembrane PVC 40 mil or similar products, may be used.

If a geosynthetic or synthetic liner is used, a minimum 300mm thick marker layer should be placed above the liner as an indicator/protective soil cover. The liner should be installed as per manufacturer's guidelines and up to a minimum of 0.6m above the design flood level in the pond. An underdrainage system will be required to relieve the hydrostatic uplift against the liner as the bottom of pond is likely lower than the highest observed groundwater level in the vicinity of the pond.

6.5 Pavement Design and Construction

It is envisaged that the subgrade for local roads and collectors will consist of native silt, sand, compacted "engineered fill" and/or compacted trench backfill. All organics or deleterious materials encountered should be stripped from the proposed road pavement areas. The exposed subgrade should be re-compacted from the surface to at least 98% of its standard Proctor maximum dry density (SPMDD) prior to construction of the road pavement. Any loose areas which are detected should be sub-excavated and backfilled with approved imported granular fill. All granular fill materials should be placed in 150 to 200mm thick lifts and compacted to 100% of the SPMDD.

Considering the probable traffic requirements, subgrade conditions and a functional design life of about 25 years, the pavement structure designs listed in Table 4 are recommended:

Table 4: Recommended Pavement Structures

Pavement Components	Local Road (mm)	Collector Road (mm)
Asphaltic Concrete – HL3	40	40
Asphaltic Concrete – HL4	50	60
Granular 'A' Base Course	150	150
Granular 'B' Type I or Type II Modified Subbase Course	450	600

The granular base and sub-base materials should meet Ontario Provincial Standard Specification OPSS.MUNI.1010 and Township of Centre Wellington requirements and should be compacted to 100% of the Standard Proctor Maximum Dry Density (SPMDD) as per OPSS.MUNI.501 requirements. The asphaltic concrete should conform to OPSS.MUNI.1150 and should be compacted to a minimum of 92.0% of the Maximum Relative Density (MRD) as per OPSS.MUNI.310 requirements.

Frequent inspections by geotechnical personnel from JLP Services Inc. should be carried out during construction to verify the compaction of the subgrade, base courses and asphaltic concrete by in-situ density testing using nuclear gauges.

6.6 Building Foundations

The proposed buildings to be constructed at the site are assumed to be primarily townhome residential dwellings with basements. Due to the relatively high groundwater level observed at the site, it may be prudent to raise the overall site grades to ensure the basement level will be higher than the observed groundwater level at the site or to eliminate the basement level in the design of the proposed buildings.

The proposed buildings can be supported on spread footings founded a minimum of 0.3m into the native undisturbed silt or sand in compact state of compactness or into the properly

constructed "engineered fill" and designed to a geotechnical reaction of 100 kPa at Serviceability Limit States (S.L.S.) and a factored geotechnical resistance of 150 kPa at Ultimate Limit States (U.L.S.).

All exterior footings or footings in unheated areas should be located at least 1.4 metres below finished grade or provided with equivalent thermal insulation for adequate frost protection.

Elevation differences between adjacent footings should not be more than a half of the horizontal distance between them.

It is estimated that the total and differential settlements of spread footings designed to these bearing pressures will be less than 25mm and 20mm respectively, which are normally considered acceptable for the proposed structure.

It is recommended that all foundation excavations be inspected by geotechnical personnel from JLP to ensure the founding soils are similar to those identified in the boreholes or are competent "engineered fill" and that they are capable of supporting the design bearing pressures.

Based on the 2012 Building Code Compendium, the classification of soils for seismic design should be based on the average properties of the top 30 metres of the soil profile. The maximum depth of boreholes was 8.2 metres below existing grade and were terminated in very dense sandy silt till. Assuming this deposit extend to depth, the soils at the site may be classified as Site Class 'D' under the site classification for seismic site response of 2012 Building Code Compendium.

6.7 Basement Walls

The basement walls of the proposed buildings may be designed to resist lateral earth pressures and the magnitude of which can be determined from the equation below:

$$p = K(\gamma d + q)$$

where; p = lateral earth pressure, kN/m^2

K	=	active earth pressure coefficient, K = Ka = 0.33, if retaining structure is permitted to move, otherwise, K = Ko = 0.50
γ	=	bulk unit weight of backfill, use 20 kN/m^3
d	=	depth below finished grade, metres
q	=	adjacent surcharge acting close to the wall, kN/m^2

The above equation assumes that there is no hydrostatic pressure build up against the basement walls. As such, the basement walls should be dampproofed and protected with a synthetic vertical drainage layer. A perimeter subdrain system should be installed at footing level outside the building envelope to facilitate drainage. The perimeter subdrain system should consist of 150mm diameter perforated pipe surrounded with a minimum of 300mm of 19mm clear stone all wrapped with a filter fabric, such as Texel 100C or other products with equivalent apparent opening size (AOS).

Water collected in the perimeter drainage system should be directed to the local storm drainage system either by gravity or by a permanent sump pump. Surface runoff around the proposed buildings should be directed away from the building.

Alternatively, the basement walls and floors can be sealed tight using waterproofing systems and designed to resist full hydrostatic pressures.

6.8 Floor Slabs

All topsoil and any deleterious materials encountered should be stripped from the proposed building areas. Any loose material encountered should be sub-excavated and replaced with approved fill. The exposed subgrade should be re-compacted from the surface to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD).

Backfill around the footings and basement walls should be compacted to a minimum of 98% of the SPMDD. The backfill may consist of approved on-site soils or imported granular materials, such as OPSS Granular 'B' Type I (natural sand, some gravel). All fills should be placed in 150 to 200mm thick lifts and compacted to a minimum of 98% of the SPMDD.

A layer of free-draining material, such as OPSS.MUNI 1004 19mm Clear Stone, at least 150mm thick and nominally compacted, or Granular 'A' complying with OPSS Form 1010 Specifications and compacted to 100% Standard Proctor maximum dry density should be placed under the floor slabs to provide a uniform bearing surface and act as a moisture barrier.

Ideally, the basement floors should be located at least 0.6 metres above the highest observed groundwater level, otherwise sub-floor drainage systems together with continual pumping from the drainage systems will be required. It is recommended that a sub-floor drainage system be provided for all townhome dwellings with a basement level due to the relatively high groundwater level observed at the site.

Around the perimeter of the proposed buildings, the ground surface should be sloped on a positive grade away from the structure to promote surface water run-off and reduce groundwater infiltration adjacent to the foundations.

Frequent field review and testing by geotechnical personnel from JLP should be carried out during construction to verify the competency of the subgrade and compaction of granular base and/or backfill by in-situ density testing using nuclear gauges.

6.9 Excavation and Groundwater Control

Excavation to reach the footing founding levels will extend to about 0.9 to 1.2 metres below design pre-grades. Excavations must be carried out in accordance with the current Occupation Health and Safety Act (OHSA) and local regulations.

Assuming the proposed buildings will be raised above the highest groundwater level observed, the side slopes of shallow excavation should be cut back to 1 vertical to 1 horizontal as the native silt, sand and/or "engineered fill" using native soils as fill are considered to be Type 3 soils within the meaning of the OHSA.

Minor seepage from groundwater in the native soil deposits or "engineered fill" should be anticipated during construction. However, it should be possible to control and remove seepage

water from these sources or surface water from precipitation by pumping on as and where required basis.

If the proposed buildings are to be constructed below the observed groundwater levels, localized dewatering will be required to drawdown the groundwater level to at least 0.6m below the lowest excavation depth to facilitate construction. Without effective dewatering, excavation to reach the subgrade for footings and/or site services in the silt and sand deposits will be unmanageable. Construction dewatering may consist of vacuum well points and should be designed and installed by a specialist dewatering contractor.

7.0 Statement of Limitation

The Statement of Limitation including the Terms and Conditions of this report is presented on Appendix 'A' is an integral part of this report.

8.0 Closure

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Sincerely,

JLP Services Inc.

Alexander Lee, M.Sc. (Eng.), P.Eng.
Senior Geotechnical Engineer

J. Board, B.A.
General Manager

Enclosures

Notes:
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BORING NUMBER MW1

JLP
Geotechnical & Environmental Consultants

CLIENT Wrighthaven Homes Limited
PROJECT NAME Residential Subdivision
PROJECT NUMBER G4670-22-12
PROJECT LOCATION 79 Sideroad 19, Fergus, Ontario
DATE STARTED 23-1-30 **COMPLETED** 23-1-30
GROUND ELEVATION 419.211 m **HOLE SIZE** 200mm
DRILLING CONTRACTOR Pontil Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY AK/PB **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 2.14 m / Elev 417.07 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY %	HEADSPACE VAPOUR	ANALYSIS	SPT N VALUE / PL MC LL / FINES CONTENT (%)	WELL CONSTRUCTION
419			**TOPSOIL** 250mm sandy silt, some organics; black, moist (organic odour, no staining)	0.3	SS 1	6-2-3-3 (5)	54		Metals, ORPs		
418	1		**SILT** some sand, scattered coarse sand inclusions, trace organics inclusions in upper portion; brown, moist, loose to dense (no odour, no staining)	1.8	SS 2	5-19-18-14 (37)	75				
417	2		**SAND** sand, trace to some silt; brown, moist to wet, compact to loose (no odour, no staining)		SS 3	4-13-14-15 (27)	71				
416	3				SS 4	7-9-12-8 (21)	71		PHC, BTEX		
415	4				SS 5	2-5-7-6 (12)	75				
414	5		occasional silty seams		SS 6	4-4-5-4 (9)	79				
413	6				SS 7	2-6-6-10 (12)	100				
412	7				SS 8	4-7-5-6 (12)	83				
411	8		**SANDY SILT TILL** sandy silt, trace clay, occasional gravel inclusions; grey, moist, very dense (no odour, no staining)	7.6 / 8.2	SS 9	20-40-44 (84)	100				

End of Borehole at 8.23 mbgs

Water Level Readings:

Date	Depth (m)	Elevation (m)
Mar 14, 2023	N/R	N/R
Apr 05, 2023	2.14	417.07

BORING NUMBER MW2

JLP
Geotechnical & Environmental Consultants

CLIENT Wrighthaven Homes Limited
PROJECT NAME Residential Subdivision
PROJECT NUMBER G4670-22-12
PROJECT LOCATION 79 Sideroad 19, Fergus, Ontario
DATE STARTED 23-1-30 **COMPLETED** 23-1-30
GROUND ELEVATION 417.1 m **HOLE SIZE** 200mm
DRILLING CONTRACTOR Pontil Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY AK/PB **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 0.12 m / Elev 416.98 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY %	HEADSPACE VAPOUR	ANALYSIS	SPT N VALUE / PL MC LL / FINES CONTENT (%)	WELL CONSTRUCTION
417			**FILL** 125mm sand and gravel, some silt; brown, moist (no odour, no staining)	0.1	SS 1	8-4-4-6 (8)	75		Metals, ORPs		
416	1		**TOPSOIL** 650mm sandy silt, some organics; black, moist (organic odour, no staining)	0.8	SS 2	2-6-5-5 (11)	75				
415	2		**SILT** some sand, occasional coarse sand inclusions; brown, moist, compact (no odour, no staining)	1.5	SS 3	3-4-4-4 (8)	50		PHC, BTEX		
414	3		**SAND** sand, trace silt; brown, wet, loose to compact (no odour, no staining)		SS 4	2-10-19-14 (29)	71				
413	4				SS 5	5-11-15-9 (26)	67				
412	5			5.2	SS 6	3-4-4-12 (8)	58				

End of Borehole at 5.18 mbgs

Water Level Readings:

Date	Depth (m)	Elevation (m)
Mar 14, 2023	N/R	N/R
Apr 05, 2023	0.12	416.98

BORING NUMBER MW3

JLP
Geotechnical & Environmental Consultants

CLIENT Wrighthaven Homes Limited
PROJECT NAME Residential Subdivision
PROJECT NUMBER G4670-22-12
PROJECT LOCATION 79 Sideroad 19, Fergus, Ontario
DATE STARTED 23-1-31 **COMPLETED** 23-1-31
GROUND ELEVATION 416.939 m **HOLE SIZE** 200mm
DRILLING CONTRACTOR Pontil Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY AK/PB **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 0.61 m / Elev 416.33 m

ELEV. (m)	DEPTH (m)	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY %	HEADSPACE VAPOUR	ANALYSIS
		TOPSOIL 250mm sandy silt, some organics; dark brown, moist (organic odour, no staining)	0.3	SS 1	3-3-3-4 (6)	79		Metals, ORPs
416	1	**SILT** some sand, occasional coarse sand inclusions; brown, wet, compact (no odour, no staining) becoming grey and saturated at 1.52 mbgs	1.7	SS 2	2-3-8-5 (11)	58		
415	2	**SAND** sand, trace silt; grey, wet, compact to loose (no odour, no staining)		SS 3	3-6-8-7 (14)	71		PHC, BTEX
				SS 4	6-6-6-7 (12)	67		
414	3			SS 5	4-6-4-5 (10)	75		
413	4			SS 6	3-2-4-5 (6)	63		
412	5	**SANDY SILT TILL** sandy silt, trace clay, occasional gravel inclusions; grey, wet, compact (no odour, no staining)	4.9 / 5.2	SS 7	2-3-9-18 (12)	71		

End of Borehole at 5.18 mbgs

▲SPT N VALUE▲ 20 40 60 80
PL MC LL 20 40 60 80
☐FINES CONTENT (%)☐ 20 40 60 80

WELL CONSTRUCTION

Water Level Readings:

Date	Depth (m)	Elevation (m)
Mar 14, 2023	1.21	415.73
Apr 05, 2023	0.61	416.33

BORING NUMBER MW4

JLP
Geotechnical & Environmental Consultants

CLIENT Wrighthaven Homes Limited
PROJECT NAME Residential Subdivision
PROJECT NUMBER G4670-22-12
PROJECT LOCATION 79 Sideroad 19, Fergus, Ontario
DATE STARTED 23-1-30 **COMPLETED** 23-1-30
GROUND ELEVATION 416.302 m **HOLE SIZE** 200mm
DRILLING CONTRACTOR Pontil Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY AK/PB **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 0.20 m / Elev 416.10 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY %	HEADSPACE VAPOUR	ANALYSIS	SPT N VALUE / PL MC LL / FINES CONTENT (%)	WELL CONSTRUCTION
416			**FILL** 125mm sand and gravel, some silt; brown, moist (no odour, no staining)	0.1	SS 1	3-3-5-3 (8)	29				
	1		**TOPSOIL** 500mm sandy silt, some organics; black, moist (organic odour, no staining)	0.6 1.0	SS 2	1-3-5-5 (8)	46				
415			**SILT** some sand, scattered organic seams and wood fibres in upper portion; grey, wet, loose (no odour, no staining)		SS 3	2-2-3-3 (5)	71				
	2				SS 4	3-7-11-7 (18)	50				
414											
	3		**SAND** sand, trace silt; grey, wet, loose to compact (no odour, no staining)	3.5	SS 5	15-15-15-13 (30)	100				
413			**SANDY SILT TILL** sandy silt, occasional gravel inclusions; grey, wet, compact (no odour, no staining)	3.7							
			End of Borehole at 3.66 mbgs								

Water Level Readings:

Date	Depth (m)	Elevation (m)
Mar 14, 2023	0.68	415.62
Apr 05, 2023	0.20	416.10

BORING NUMBER MW5

JLP
Geotechnical & Environmental Consultants

CLIENT Wrighthaven Homes Limited
PROJECT NAME Residential Subdivision
PROJECT NUMBER G4670-22-12
PROJECT LOCATION 79 Sideroad 19, Fergus, Ontario
DATE STARTED 23-1-31 **COMPLETED** 23-1-31
GROUND ELEVATION 415.859 m **HOLE SIZE** 200mm
DRILLING CONTRACTOR Pontil Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem
AT TIME OF DRILLING ---
LOGGED BY AK/PB **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 0.30 m / Elev 415.56 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY %	HEADSPACE VAPOUR	ANALYSIS	WELL CONSTRUCTION
			TOPSOIL 100mm sandy silt, some organics; black (organic odour, no staining)	0.1	SS 1	3-3-4-4 (7)	42			
415	1		**SILT** some sand, scattered organic seams and plant fibres in upper portion; brown, wet, loose (no odour, no staining)		SS 2	2-2-3-5 (5)	63			
414	2		**SAND** sand, trace silt; brown, mottled grey, wet, loose to very loose (no odour, no staining) becoming grey at 2.3 mbgs	1.8	SS 3	4-6-4-5 (10)	67			
413	3				SS 4	5-6-3-3 (9)	58			
					SS 5	1-1-2-6 (3)	71			
412	4		**SANDY SILT TILL** sandy silt, trace clay, occasional gravel inclusions; grey, wet, very dense (no odour, no staining)	4.0 4.4	SS 6	11-17-36-37 (53)	67			

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80

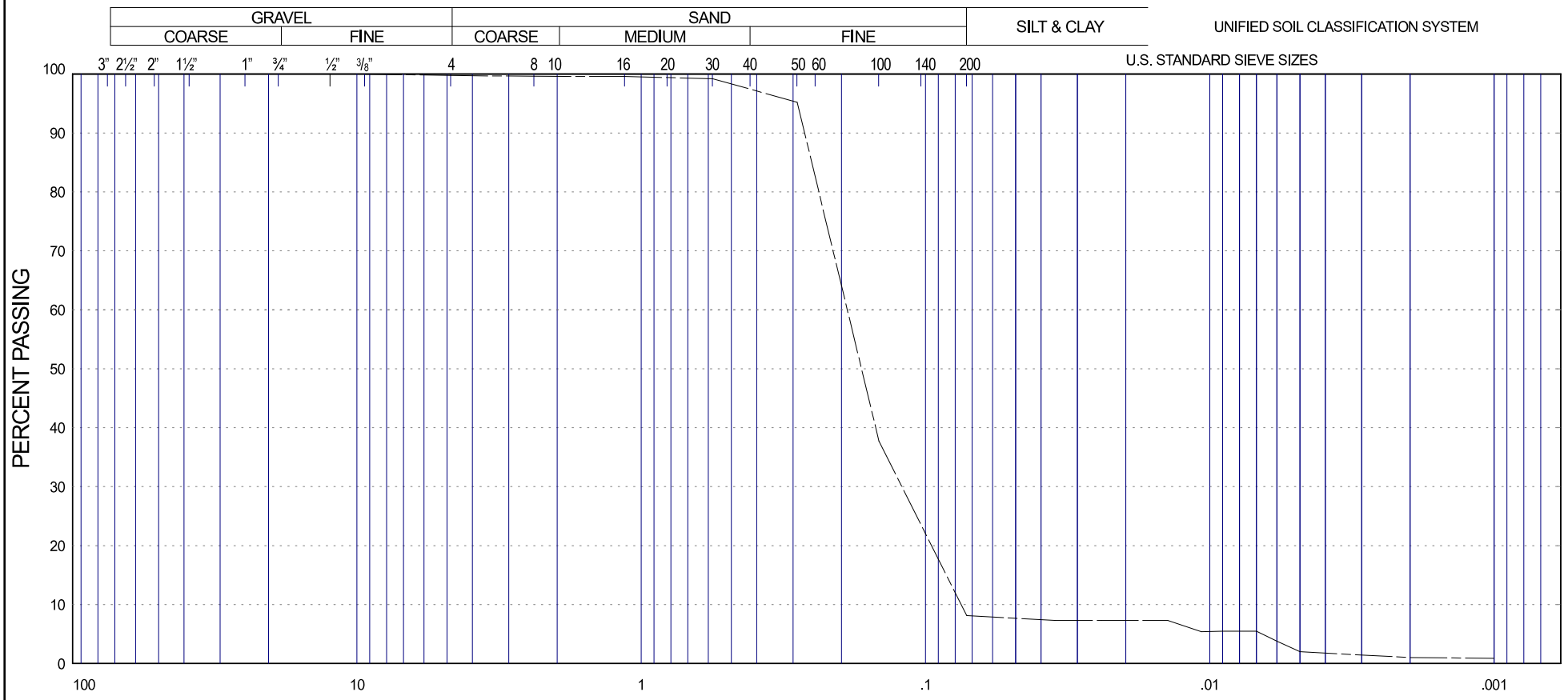
End of Borehole at 4.42 mbgs

Water Level Readings:

Date	Depth (m)	Elevation (m)
Mar 14, 2023	0.67	415.19
Apr 05, 2023	0.29	415.56

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4670-22-12



PROJECT: Residential Subdivision

LOCATION: 79 - 87 Sideroad ,Fergus, ON

BOREHOLE N°: 1

SAMPLE N°: 5

DEPTH: 3.0- 3.6 m±

ELEVATION: 416.3 - 415.7 m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SAND, trace silt

PLASTIC PROPERTIES

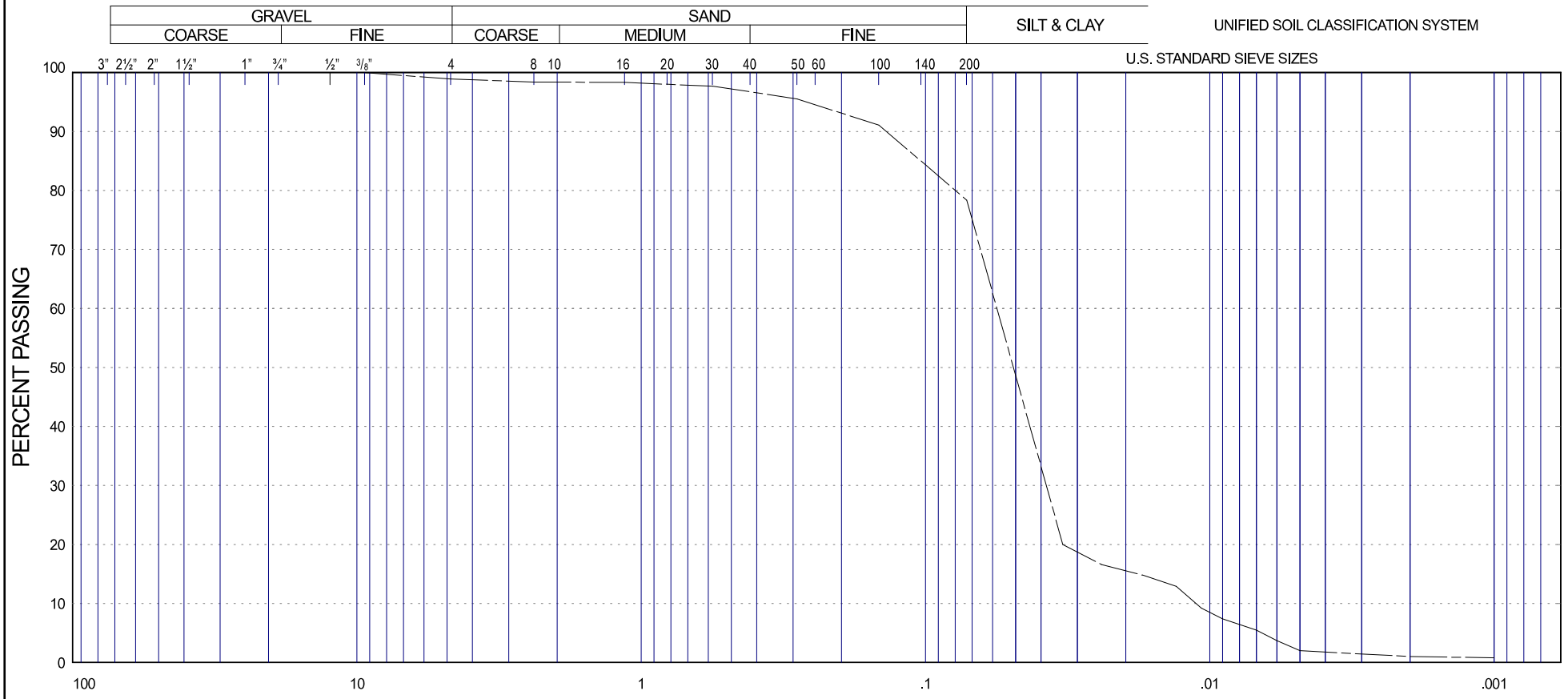
LIQUID LIMIT	% = -
PLASTIC LIMIT	% = -
PLASTICITY INDEX	% = -
MOISTURE CONTENT	% = 25.3

ENCLOSURE N° 7

JLP SERVICES INC.

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4670-22-12



PROJECT: Residential Subdivision

LOCATION: 79 - 87 Sideroad , (Fergus), ON

BOREHOLE N°: 3

SAMPLE N°: 2

DEPTH: 0.8 - 1.4 m±

ELEVATION: 416.4 - 415.8 m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SANDY SILT (ML)

PLASTIC PROPERTIES

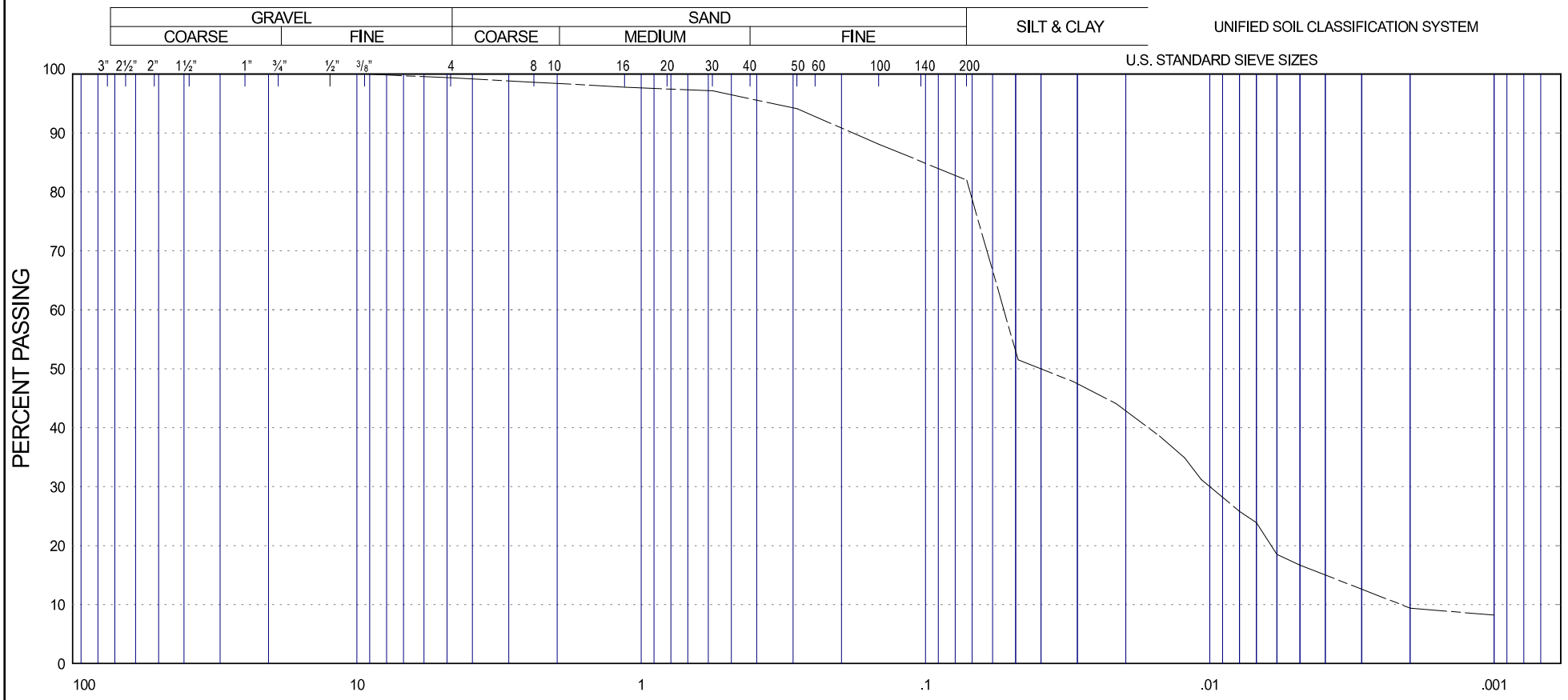
LIQUID LIMIT	% = 17.2
PLASTIC LIMIT	% = 13.7
PLASTICITY INDEX	% = 3.5
MOISTURE CONTENT	% = 17.5

ENCLOSURE N° 8

JLP SERVICES INC.

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4670-22-12



PROJECT: Residential Subdivision

LOCATION: 79 - 87 Sideroad, Fergus, ON

BOREHOLE N°: 5

SAMPLE N°: 3

DEPTH: 1.5 - 2.1 m±

ELEVATION: 414.3 - 413.7 m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SILT, some sand, trace clay (ML)

PLASTIC PROPERTIES

LIQUID LIMIT	% = 21.4
PLASTIC LIMIT	% = 17.7
PLASTICITY INDEX	% = 3.8
MOISTURE CONTENT	% = 16.40

ENCLOSURE N° 9

JLP SERVICES INC.

Appendix A – Limitations and Use of Report

REPORT TERMS AND CONDITIONS

NOTICE: THE FOLLOWING PROVISIONS SET FORTH IMPORTANT QUALIFICATIONS AND LIMITATIONS ON THE FINDINGS AND RECOMMENDATIONS IN THE REPORT AS WELL AS THE USE OF, AND RELIANCE ON, THE REPORT.

1. **DEFINITIONS**. The following capitalized terms have the following meanings:

(a) "**Additional Investigations**" means investigations that JLP has indicated to the Client should be undertaken to take into account any Out-of-Scope Requirements, but that are not otherwise specifically within the scope of investigations conducted for the purpose of the Report.

(b) "**Applicable Laws**" means and includes without limitation all applicable provincial laws, regulations, guidelines, policies, standards, protocols, and objectives administered by the Ministry of the Environment and Climate Change or any other duly-constituted governmental authority, all as in force as of the date of the Report.

(c) "**Client**" means the Client as referred to in the Report.

(d) "**Client Information**" means the information, representations, and instructions provided by the Client, the Client's representatives, and/or others and upon which the Report is based, in whole or in part.

(e) "**Findings**" means the evaluations and conclusions set forth in the Report.

(f) "**JLP**" means JLP Services Inc.

(g) "**Out-of-Scope Requirements**" means special concerns or requirements of the Client in respect of the subject matter of the Report.

(h) "**Recommendations**" mean the findings and recommendations referred to in the Report, taking into account any Out-of-Scope Requirements that were disclosed to JLP prior to the date of the Report.

(i) "**Report**" means the report to which these Terms and Conditions are attached and form part.

(j) "**Report Documents**" means the underlying documents, records, data, and files, in any medium whatsoever, generated in connection with the preparation of the Report, including without limitation, the instructions and objectives communicated to JLP by the Client, communications between JLP and the Client, and other reports, proposals, or documents prepared by JLP for the Client in connection with the Site.

(k) "**Site**" means the site in respect of which the Report was prepared.

(l) "**Site Conditions**" means Site conditions known as a result of, or reasonably imputed by, the investigations that were undertaken as of the date of the Report.

2. **BASIS OF REPORT**. The Report is based on the Site Conditions. Any changes to the Site Conditions after the date of the Report that could or will affect the Site Conditions may or will have a corresponding effect on the Recommendations. The Report does not take into account any (a) Additional Investigations that were not undertaken, or (b) Out-of-Scope Requirements that were not communicated prior to completion of the investigations that were been undertaken as of the date of the Report. Where recommended field services are referred to, they are the minimum services necessary to determine compliance of construction with Applicable Laws,

generally accepted industry-standard practices, and the Recommendations.

3. **RELIANCE & USE**. The Report has been prepared only for the Site and the related design, development, building, or building assessment objectives identified by the Client. The Findings and Recommendations are based on the Site Conditions and the Client Information. In preparing the Report, JLP has relied upon the Client Information and disclaims any responsibility for any inaccuracy, misstatement, omission, unintentional misrepresentation, or other deficiency contained in the Report as a result of such reliance. Unless specifically stated otherwise, the applicability and reliability of the Findings and the Recommendations expressed in the Report are only valid to the extent that (a) there has been no material change to or variation from any of the Client Information, (b) the Client Information contains no untrue statement of a material fact, or (c) the Client Information omits no statement of a material fact necessary in order to make the Client Information not misleading.

   The Report and the Findings and Recommendations are for the sole benefit of the Client. No other party may use or rely upon the Report in whole or in part without the prior written consent of JLP, which may be arbitrarily withheld or conditioned.

   RELIANCE UPON THE REPORT OR ANY OF THE DETERMINATIONS MADE HEREIN BY A THIRD PARTY WITHOUT JLP'S CONSENT IS PROHIBITED AND JLP MAKES NO REPRESENTATION, GUARANTEE, OR WARRANTY IN FAVOUR OF ANY THIRD PARTY WITH RESPECT TO THE REPORT WHATSOEVER. JLP FULLY DISCLAIMS, AND WILL HAVE NO LIABILITY FOR, ANY LOSS, DAMAGES, OR EXPENSES WHICH ANY THIRD PARTY MAY INCUR OR SUFFER AS A RESULT OF THE USE OF OR RELIANCE ON THIE REPORT WHERE JLP HAS NOT EXPRESSLY AUTHORIZED SAME. ANY THIRD PARTY WHO RELIES ON THE REPORT TO ANY EXTENT DOES SO AT SUCH PARTY'S OWN RISK AND COMPLETELY WAIVES ANY AND ALL CLAIMS AGAINST JLP IN CONNECTION WITH THE REPORT, REGARDLESS OF THE THEORY OF LAW (WHETHER IN CONTRACT, TORT, OR ANY THEORY OF LAW COMING INTO EXISTENCE HEREAFTER).

4. **STANDARD OF CARE**. The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances. No other warranty, expressed or implied, is made or intended in the Report. It is intended that the Findings and Recommendations are meant to assist in reducing the Client's risk associated with environmental impairment at the Site. The Report should not be considered risk mitigation.

5. **ENTIRE REPORT**. The Report also includes the Report Documents. In order to properly understand the Findings and Recommendations, reference must be made to the Report in its entirety. JLP is not responsible for use by any party of a part of the Report only.

6. **GOVERNING FORMAT**. Notwithstanding that JLP may have submitted an electronic version of the Report or any document forming part of the Report, only the signed and sealed physical copy of the Report shall be deemed to be the original and in the event of any dispute or discrepancy, the physical copy shall govern. JLP makes no representation about the compatibility of its electronic or digital file format with the Client's current or future software and/or hardware systems. The documents described herein are JLP's instruments of professional service and shall not be altered without the written consent of JLP.

7. **GENERAL LIMITATIONS**.

   (a) Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

   (b) The Report contains no opinion or determination as to any matters governed by laws other than the laws of the Province of Ontario and the federal laws of Canada applicable therein as of the date hereof.

   (c) During any future development of the Site, conditions not observed during JLP's investigations may become apparent. If this occurs, JLP should be contacted to assess the situation and whether there is a need for additional testing.

Appendix B Preliminary Sanitary Sewer Design Sheet

q = average daily per capita flow (350 L/cap.d)
I = unit of peak extraneous flow (0.15 L/ha/s)
A = Tributary area in gross hectares
M = Peaking factor
Q(p) = peak population flow (L/s)
Q(i) = peak extraneous flow (L/s)
Q(d) = peak design flow

PRELIMINARY SANITARY SEWER DESIGN

TOWN OF CENTRE WELLINGTON (FERGUS)

079 Side Road 19 - Residential Development

$M = 1 + \frac{14}{4 + (P)^{1/2}}$ where P is population in 1000's

$Q(p) = \frac{PqM}{86.4}$ (L/s)

Q(i) = IA

Q(d) = Q(p) + Q(i) (L/s)

August 14, 2024

Designed By: BL | Checked By:

Location		Individual Population	Cumulative Population	Individual Area (ha)	Cumulative Area	Peaking Factor (M)	Pop. Flow Q(p) (L/s)	Peak Extraneous Flow Q(i) (L/s)	Peak Design Flow Q(d) (m3/s)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Actual velocity at Q(d)
From	To														
Catchment 1	Side Road 19 Ex. Sanitary	70	70	0.67	0.67	4.283	1.21	0.101	0.0013	200	0.013	0.50	0.023	0.738	0.384

Appendix C Preliminary Storm Sewer Design Sheet

PRELIMINARY STORM SEWER DESIGN

5 Year Design

TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

079 Side Road 19 - Residential Development

Fergus Shand Dam IDF Curves
A = 1459.072
B = 13.69
C= 0.85
Intensity = $A / (t + B)^C$

Q = CiA (m^3/s)

August 15, 2024

Designed By: BL

Checked By:

Location								Proposed Sewer						
Catchment Area	Area (ha)	Runoff Coefficient	A x C	Cumulative A x C	Time of Conc. (min.)	Intensity (mm/hr)	Flow (m^3/s)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min.)
1	0.16	0.45	0.07	0.07	10.00	99.01	0.020	63.0	300	0.013	0.50	0.07	0.97	1.09
2	0.45	0.45	0.20	0.27	11.09	95.31	0.073	75.0	375	0.013	0.50	0.12	1.12	1.11
3	0.09	0.45	0.04	0.04	10.00	99.01	0.011	9.0	300	0.013	0.50	0.07	0.97	0.16
N/A	0.00	0.45	0.00	0.32	12.20	91.82	0.080	9.0	375	0.013	0.50	0.12	1.12	0.13

Appendix D MIDUSS Hydrologic Modelling

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
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Calcs\2024-04-11 SWM Pond"
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"                Company                                                       "
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"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.050   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.375   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            99.625    mm/hr"
"             Total depth                  33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   EXTERNAL"
"       25.000   % Impervious"
"        3.450   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        2.588   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        0.863   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.180     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           2.588      0.863      3.450      hectare"
"             Time of concentration  72.493     5.835      11.857     minutes"
"             Time to Centroid       128.681    91.788     95.121     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        854.24     284.75     1138.98    c.m"
"             Rainfall losses        31.976     1.664      24.398     mm"
"             Runoff depth           1.038      31.350     8.616      mm"
"             Runoff volume          26.85      270.39     297.25     c.m"
"             Runoff coefficient     0.031      0.950      0.261      "
"             Maximum flow           0.007      0.179      0.180      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.180     0.180     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   SITE"
"       20.000   % Impervious"
"        0.990   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.792   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.198   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.044     0.180     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.792      0.198      0.990      hectare"
"             Time of concentration  21.640     1.742      4.086      minutes"
"             Time to Centroid       91.393     85.614     86.295     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        261.47     65.37      326.84     c.m"
"             Rainfall losses        31.977     1.962      25.974     mm"
"             Runoff depth           1.037      31.052     7.040      mm"
```

```
"             Runoff volume          8.21       61.48      69.69      c.m"
"             Runoff coefficient     0.031      0.941      0.213      "
"             Maximum flow           0.006      0.044      0.044      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.044     0.215     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   SITE WETLAND"
"        0.000   % Impervious"
"        0.080   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.001     0.215     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  24.740     1.991      24.740     minutes"
"             Time to Centroid       93.722     86.074     93.722     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        26.41      0.00       26.41      c.m"
"             Rainfall losses        31.977     1.935      31.977     mm"
"             Runoff depth           1.037      31.079     1.037      mm"
"             Runoff volume          0.83       0.00       0.83       c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.001      0.000      0.001      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.001     0.215     0.000     0.000"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          400   SITE FRONT"
"       60.000   % Impervious"
"        0.050   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.020   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.007     0.215     0.000     0.000 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.020      0.030      0.050      hectare"
"             Time of concentration  14.277     1.149      1.439      minutes"
"             Time to Centroid       86.060     84.800     84.828     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        6.60       9.90       16.51      c.m"
"             Rainfall losses        31.976     2.325      14.185     mm"
"             Runoff depth           1.038      30.689     18.829     mm"
"             Runoff volume          0.21       9.21       9.41       c.m"
"             Runoff coefficient     0.031      0.930      0.570      "
"             Maximum flow           0.000      0.007      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.220     0.000     0.000"
" 38          START/RE-START TOTALS 400"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.570    hectare"
"             Total Impervious area                     1.091    hectare"
"             Total % impervious                       23.862"
" 19          EXIT"
```

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"                MIDUSS created                          Sunday, February 07, 2010"
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"                Licensee name:                                             gmbp"
"                Company                                                       "
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" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.375   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           119.775    mm/hr"
"             Total depth                  49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   EXTERNAL"
"       25.000   % Impervious"
"        3.450   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        2.588   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        0.863   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.252     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           2.588      0.863      3.450      hectare"
"             Time of concentration  42.120     5.421      20.225     minutes"
"             Time to Centroid       115.206    89.951     100.139    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        1288.36    429.45     1717.81    c.m"
"             Rainfall losses        38.982     1.829      29.694     mm"
"             Runoff depth           10.810     47.963     20.098     mm"
"             Runoff volume          279.70     413.68     693.38     c.m"
"             Runoff coefficient     0.217      0.963      0.404      "
"             Maximum flow           0.093      0.238      0.252      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.252     0.252     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   SITE"
"       20.000   % Impervious"
"        0.990   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.792   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.198   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.091     0.252     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.792      0.198      0.990      hectare"
"             Time of concentration  12.573     1.618      6.819      minutes"
"             Time to Centroid       88.068     84.552     86.221     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        394.35     98.59      492.94     c.m"
"             Rainfall losses        39.035     2.185      31.665     mm"
"             Runoff depth           10.757     47.607     18.127     mm"
```

```
"             Runoff volume          85.19      94.26      179.45     c.m"
"             Runoff coefficient     0.216      0.956      0.364      "
"             Maximum flow           0.063      0.056      0.091      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.091     0.331     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   SITE WETLAND"
"        0.000   % Impervious"
"        0.080   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.006     0.331     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  14.375     1.850      14.375     minutes"
"             Time to Centroid       89.770     84.851     89.770     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        39.83      0.00       39.83      c.m"
"             Rainfall losses        38.999     2.189      38.999     mm"
"             Runoff depth           10.793     47.602     10.793     mm"
"             Runoff volume          8.63       0.00       8.63       c.m"
"             Runoff coefficient     0.217      0.000      0.217      "
"             Maximum flow           0.006      0.000      0.006      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.006     0.334     0.000     0.000"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          400   SITE FRONT"
"       60.000   % Impervious"
"        0.050   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.020   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.009     0.334     0.000     0.000 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.020      0.030      0.050      hectare"
"             Time of concentration  8.295      1.068      2.029      minutes"
"             Time to Centroid       84.311     83.761     83.834     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        9.96       14.94      24.90      c.m"
"             Rainfall losses        38.990     2.855      17.309     mm"
"             Runoff depth           10.802     46.936     32.483     mm"
"             Runoff volume          2.16       14.08      16.24      c.m"
"             Runoff coefficient     0.217      0.943      0.652      "
"             Maximum flow           0.002      0.009      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.009     0.342     0.000     0.000"
" 38          START/RE-START TOTALS 400"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.570    hectare"
"             Total Impervious area                     1.091    hectare"
"             Total % impervious                       23.862"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                     B:\Working\WRIGHTHAVEN HOMES\"
"                2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Design
Calcs\2024-06-06 SWM Pond"
"                Output filename:                         122025 Pre 100yr.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:                6/21/2024 at 9:33:27 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.019   Coefficient A"
"       34.669   Constant B"
"        0.998   Exponent C"
"        0.375   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           174.792    mm/hr"
"             Total depth                  97.935    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   EXTERNAL"
"       25.000   % Impervious"
"        3.450   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        2.588   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        0.863   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.624     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           2.588      0.863      3.450      hectare"
"             Time of concentration  26.519     4.660      18.100     minutes"
"             Time to Centroid       108.723    87.693     100.623    minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        2534.07    844.69     3378.76    c.m"
"             Rainfall losses        47.001     2.217      35.805     mm"
"             Runoff depth           50.934     95.718     62.130     mm"
"             Runoff volume          1317.91    825.57     2143.47    c.m"
"             Runoff coefficient     0.520      0.977      0.634      "
"             Maximum flow           0.468      0.372      0.624      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.624     0.624     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   SITE"
"       20.000   % Impervious"
"        0.990   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.792   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.198   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.335     0.624     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.792      0.198      0.990      hectare"
"             Time of concentration  7.916      1.391      5.838      minutes"
"             Time to Centroid       88.951     83.432     87.193     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        775.65     193.91     969.56     c.m"
"             Rainfall losses        47.138     2.969      38.305     mm"
"             Runoff depth           50.796     94.966     59.630     mm"
```

```
"             Runoff volume          402.31     188.03     590.34     c.m"
"             Runoff coefficient     0.519      0.970      0.609      "
"             Maximum flow           0.259      0.087      0.335      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.335     0.863     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   SITE WETLAND"
"        0.000   % Impervious"
"        0.080   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.025     0.863     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  9.050      1.590      9.050      minutes"
"             Time to Centroid       90.079     83.653     90.079     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        78.35      0.00       78.35      c.m"
"             Rainfall losses        47.259     2.758      47.259     mm"
"             Runoff depth           50.676     95.177     50.676     mm"
"             Runoff volume          40.54      0.00       40.54      c.m"
"             Runoff coefficient     0.517      0.000      0.517      "
"             Maximum flow           0.025      0.000      0.025      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.025     0.888     0.000     0.000"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          400   SITE FRONT"
"       60.000   % Impervious"
"        0.050   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.020   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.018     0.888     0.000     0.000 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.020      0.030      0.050      hectare"
"             Time of concentration  5.223      0.918      2.065      minutes"
"             Time to Centroid       86.094     82.955     83.791     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        19.59      29.38      48.97      c.m"
"             Rainfall losses        47.395     5.151      22.049     mm"
"             Runoff depth           50.540     92.784     75.886     mm"
"             Runoff volume          10.11      27.84      37.94      c.m"
"             Runoff coefficient     0.516      0.947      0.775      "
"             Maximum flow           0.007      0.013      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.018     0.901     0.000     0.000"
" 38          START/RE-START TOTALS 400"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     4.570    hectare"
"             Total Impervious area                    1.091    hectare"
"             Total % impervious                      23.862"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                     B:\Working\WRIGHTHAVEN HOMES\"
"                2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Design
Calcs\2024-08-20 SWM Pond"
"                Output filename:                          122025 Post 2yr.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:               8/21/2024 at 9:21:58 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.050   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.375   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            99.625    mm/hr"
"             Total depth                  33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   EXTERNAL"
"        25.000   % Impervious"
"        3.450   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        2.588   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        0.863   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.180     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           2.588      0.863      3.450      hectare"
"             Time of concentration  72.493     5.835      11.857     minutes"
"             Time to Centroid       128.681    91.788     95.121     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        854.24     284.75     1138.98    c.m"
"             Rainfall losses        31.976     1.664      24.398     mm"
"             Runoff depth           1.038      31.350     8.616      mm"
"             Runoff volume          26.85      270.39     297.25     c.m"
"             Runoff coefficient     0.031      0.950      0.261      "
"             Maximum flow           0.007      0.179      0.180      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.180     0.180     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   SITE"
"       80.000   % Impervious"
"        0.690   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.138   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.552   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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     0.180     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           0.138      0.552      0.690      hectare"
"             Time of concentration  27.600     2.222      2.432      minutes"
"             Time to Centroid       95.779     86.449     86.527     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        45.56      182.24     227.80     c.m"
"             Rainfall losses        31.976     1.987      7.985      mm"
"             Runoff depth           1.038      31.027     25.029     mm"
```

```
"             Runoff volume          1.43       171.27     172.70     c.m"
"             Runoff coefficient     0.031      0.940      0.758      "
"             Maximum flow           0.001      0.117      0.117      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.117     0.281     0.000     0.000"
" 33          CATCHMENT 2001"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2001   SITE SWM"
"       15.000   % Impervious"
"        0.130   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.110   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.019   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.004     0.281     0.000     0.000 c.m/sec"
"             Catchment 2001         Pervious   Impervious Total Area "
"             Surface Area           0.110      0.019      0.130      hectare"
"             Time of concentration  21.640     1.742      4.908      minutes"
"             Time to Centroid       91.393     85.614     86.533     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        36.48      6.44       42.92      c.m"
"             Rainfall losses        31.977     1.962      27.475     mm"
"             Runoff depth           1.037      31.052     5.539      mm"
"             Runoff volume          1.15       6.06       7.20       c.m"
"             Runoff coefficient     0.031      0.941      0.168      "
"             Maximum flow           0.001      0.004      0.004      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.004     0.285     0.000     0.000"
" 54          POND DESIGN"
"        0.285   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"        477.2   Hydrograph volume    c.m"
```

```
"          21.   Number of stages"
"       0.000   Minimum water level    metre"
"       3.000   Maximum water level    metre"
"       0.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"               415.500     0.000     0.000"
"               415.550  1.01E-05   135.600"
"               415.600   0.00500   153.400"
"               415.650   0.00700   172.200"
"               415.700   0.00800   192.200"
"               415.750   0.00900   213.200"
"               415.800   0.01000   235.500"
"               415.850   0.01100   258.800"
"               415.900   0.01200   283.400"
"               415.950   0.01300   309.200"
"               416.000   0.01400   336.300"
"               416.050   0.08500   364.600"
"               416.100   0.09000   394.200"
"               416.150   0.09500   425.200"
"               416.200   0.09900   457.500"
"               416.250    0.1800   491.100"
"               416.300    0.3290   526.200"
"               416.350    0.5240   562.700"
"               416.400    0.7580   600.700"
"               416.450     1.028   640.100"
"               416.500     1.331   681.300"
"             Peak outflow                  0.033    c.m/sec"
"             Maximum level               416.013    metre"
"             Maximum storage             343.824    c.m"
"             Centroidal lag                4.368   hours"
"                  0.004     0.285     0.033     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"           5   Next link "
"                    0.004     0.033     0.033     0.000"
" 33          CATCHMENT 2002"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"        2002   SITE REAR"
"       0.000   % Impervious"
"       0.080   Total Area"
"      40.000   Flow length"
"       2.000   Overland Slope"
"       0.080   Pervious Area"
"      40.000   Pervious length"
"       2.000   Pervious slope"
"       0.000   Impervious Area"
"      40.000   Impervious length"
"       2.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.000     0.033     0.033     0.000 c.m/sec"
"             Catchment 2002          Pervious   Impervious Total Area "
"             Surface Area            0.080      0.000      0.080      hectare"
"             Time of concentration   32.800     2.640      32.800     minutes"
"             Time to Centroid        99.630     87.071     99.629     minutes"
"             Rainfall depth          33.014     33.014     33.014     mm"
"             Rainfall volume         26.41      0.00       26.41      c.m"
"             Rainfall losses         31.976     2.026      31.976     mm"
"             Runoff depth            1.038      30.988     1.038      mm"
"             Runoff volume           0.83       0.00       0.83       c.m"
"             Runoff coefficient      0.031      0.000      0.031      "
"             Maximum flow            0.000      0.000      0.000      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.000     0.033     0.033     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   SITE WETLAND"
"        0.000   % Impervious"
"        0.130   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
```

```
"                    0.001     0.033     0.033     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  24.740     1.991      24.740     minutes"
"             Time to Centroid       93.722     86.074     93.722     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        42.92      0.00       42.92      c.m"
"             Rainfall losses        31.977     1.935      31.977     mm"
"             Runoff depth           1.037      31.079     1.037      mm"
"             Runoff volume          1.35       0.00       1.35       c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.001      0.000      0.001      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.001     0.033     0.033     0.000"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   SITE REMAIN"
"       60.000   % Impervious"
"        0.050   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.020   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.007     0.033     0.033     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.020      0.030      0.050      hectare"
"             Time of concentration  14.277     1.149      1.439      minutes"
"             Time to Centroid       86.060     84.800     84.828     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        6.60       9.90       16.51      c.m"
"             Rainfall losses        31.976     2.325      14.185     mm"
"             Runoff depth           1.038      30.689     18.829     mm"
"             Runoff volume          0.21       9.21       9.41       c.m"
```

```
"             Runoff coefficient     0.031      0.930      0.570      "
"             Maximum flow           0.000      0.007      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.033     0.033     0.000"
" 33          CATCHMENT 4001"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4001   SITE SINGLE"
"       30.000   % Impervious"
"        0.030   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.021   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.009   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.002     0.033     0.033     0.000 c.m/sec"
"             Catchment 4001         Pervious   Impervious Total Area "
"             Surface Area           0.021      0.009      0.030      hectare"
"             Time of concentration  14.277     1.149      2.110      minutes"
"             Time to Centroid       86.060     84.800     84.892     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        6.93       2.97       9.90       c.m"
"             Rainfall losses        31.976     2.325      23.081     mm"
"             Runoff depth           1.038      30.689     9.933      mm"
"             Runoff volume          0.22       2.76       2.98       c.m"
"             Runoff coefficient     0.031      0.930      0.301      "
"             Maximum flow           0.000      0.002      0.002      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.002     0.034     0.033     0.000"
" 33          CATCHMENT 4002"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4002   SITE ENTRANCE"
```

```
"       90.000   % Impervious"
"        0.010   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.001   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.009   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.002     0.034     0.033     0.000 c.m/sec"
"             Catchment 4002         Pervious   Impervious Total Area "
"             Surface Area           0.001      0.009      0.010      hectare"
"             Time of concentration  9.419      0.758      0.791      minutes"
"             Time to Centroid       82.317     84.479     84.471     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        0.33       2.97       3.30       c.m"
"             Rainfall losses        31.986     3.083      5.974      mm"
"             Runoff depth           1.028      29.931     27.040     mm"
"             Runoff volume          0.01       2.69       2.70       c.m"
"             Runoff coefficient     0.031      0.907      0.819      "
"             Maximum flow           0.000      0.002      0.002      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.002     0.034     0.033     0.000"
" 38          START/RE-START TOTALS 4002"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.570    hectare"
"             Total Impervious area                     1.482    hectare"
"             Total % impervious                       32.429"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                        B:\Working\WRIGHTHAVEN HOMES\"
"                2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Design
Calcs\2024-08-20 SWM Pond"
"                Output filename:                             122025 Post 5yr.out"
"                Licensee name:                                             gmbp"
"                Company                                                       "
"                Date & Time last used:                  8/21/2024 at 9:47:39 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.375   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           119.775    mm/hr"
"             Total depth                  49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   EXTERNAL"
"       25.000   % Impervious"
"        3.450   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        2.588   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        0.863   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.252     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           2.588      0.863      3.450      hectare"
"             Time of concentration  42.120     5.421      20.225     minutes"
"             Time to Centroid       115.206    89.951     100.139    minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        1288.36    429.45     1717.81    c.m"
"             Rainfall losses        38.982     1.829      29.694     mm"
"             Runoff depth           10.810     47.963     20.098     mm"
"             Runoff volume          279.70     413.68     693.38     c.m"
"             Runoff coefficient     0.217      0.963      0.404      "
"             Maximum flow           0.093      0.238      0.252      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.252     0.252     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   SITE"
"       80.000   % Impervious"
"        0.690   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.138   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.552   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.151     0.252     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           0.138      0.552      0.690      hectare"
"             Time of concentration  16.036     2.064      2.813      minutes"
"             Time to Centroid       91.266     85.228     85.552     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        68.71      274.85     343.56     c.m"
"             Rainfall losses        39.023     2.256      9.609      mm"
"             Runoff depth           10.768     47.536     40.182     mm"
```

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"             Runoff volume          14.86      262.40     277.26     c.m"
"             Runoff coefficient     0.216      0.955      0.807      "
"             Maximum flow           0.010      0.150      0.151      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.151     0.392     0.000     0.000"
" 33          CATCHMENT 2001"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2001   SITE SWM"
"       15.000   % Impervious"
"        0.130   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.110   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.019   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.011     0.392     0.000     0.000 c.m/sec"
"             Catchment 2001         Pervious   Impervious Total Area "
"             Surface Area           0.110      0.019      0.130      hectare"
"             Time of concentration  12.573     1.618      7.769      minutes"
"             Time to Centroid       88.069     84.552     86.526     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        55.02      9.71       64.73      c.m"
"             Rainfall losses        39.035     2.185      33.507     mm"
"             Runoff depth           10.757     47.607     16.284     mm"
"             Runoff volume          11.89      9.28       21.17      c.m"
"             Runoff coefficient     0.216      0.956      0.327      "
"             Maximum flow           0.009      0.006      0.011      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.011     0.401     0.000     0.000"
" 54          POND DESIGN"
"        0.401   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"        991.8   Hydrograph volume    c.m"
```

```
"          21.   Number of stages"
"       0.000   Minimum water level    metre"
"       3.000   Maximum water level    metre"
"       0.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"               415.500     0.000     0.000"
"               415.550  1.01E-05   135.600"
"               415.600   0.00500   153.400"
"               415.650   0.00700   172.200"
"               415.700   0.00800   192.200"
"               415.750   0.00900   213.200"
"               415.800   0.01000   235.500"
"               415.850   0.01100   258.800"
"               415.900   0.01200   283.400"
"               415.950   0.01300   309.200"
"               416.000   0.01400   336.300"
"               416.050   0.08500   364.600"
"               416.100   0.09000   394.200"
"               416.150   0.09500   425.200"
"               416.200   0.09900   457.500"
"               416.250    0.1800   491.100"
"               416.300    0.3290   526.200"
"               416.350    0.5240   562.700"
"               416.400    0.7580   600.700"
"               416.450     1.028   640.100"
"               416.500     1.331   681.300"
"             Peak outflow                  0.159    c.m/sec"
"             Maximum level              416.238    metre"
"             Maximum storage            483.003    c.m"
"             Centroidal lag               3.003   hours"
"                  0.011     0.401     0.159     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.011     0.159     0.159     0.000"
" 33          CATCHMENT 2002"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2002   SITE REAR"
"       0.000   % Impervious"
"       0.080   Total Area"
"      40.000   Flow length"
"       2.000   Overland Slope"
"       0.080   Pervious Area"
"      40.000   Pervious length"
"       2.000   Pervious slope"
"       0.000   Impervious Area"
"      40.000   Impervious length"
"       2.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.005     0.159     0.159     0.000 c.m/sec"
"             Catchment 2002          Pervious   Impervious Total Area "
"             Surface Area            0.080      0.000      0.080      hectare"
"             Time of concentration   19.058     2.453      19.058     minutes"
"             Time to Centroid        94.013     85.795     94.013     minutes"
"             Rainfall depth          49.792     49.792     49.792     mm"
"             Rainfall volume         39.83      0.00       39.83      c.m"
"             Rainfall losses         39.007     2.406      39.007     mm"
"             Runoff depth            10.785     47.386     10.785     mm"
"             Runoff volume           8.63       0.00       8.63       c.m"
"             Runoff coefficient      0.217      0.000      0.217      "
"             Maximum flow            0.005      0.000      0.005      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.005     0.162     0.159     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   SITE WETLAND"
"        0.000   % Impervious"
"        0.130   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
```

```
"                    0.010     0.162     0.159     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  14.375     1.850      14.375     minutes"
"             Time to Centroid       89.770     84.851     89.770     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        64.73      0.00       64.73      c.m"
"             Rainfall losses        38.999     2.189      38.999     mm"
"             Runoff depth           10.793     47.602     10.793     mm"
"             Runoff volume          14.03      0.00       14.03      c.m"
"             Runoff coefficient     0.217      0.000      0.217      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.010     0.165     0.159     0.000"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   SITE REMAIN"
"       60.000   % Impervious"
"        0.050   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.020   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.009     0.165     0.159     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.020      0.030      0.050      hectare"
"             Time of concentration  8.295      1.068      2.029      minutes"
"             Time to Centroid       84.311     83.761     83.834     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        9.96       14.94      24.90      c.m"
"             Rainfall losses        38.990     2.855      17.309     mm"
"             Runoff depth           10.802     46.936     32.483     mm"
"             Runoff volume          2.16       14.08      16.24      c.m"
```

```
"             Runoff coefficient     0.217      0.943      0.652      "
"             Maximum flow           0.002      0.009      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.009     0.167     0.159     0.000"
" 33          CATCHMENT 4001"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4001   SITE SINGLE"
"       30.000   % Impervious"
"        0.030   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.021   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.009   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.004     0.167     0.159     0.000 c.m/sec"
"             Catchment 4001         Pervious   Impervious Total Area "
"             Surface Area           0.021      0.009      0.030      hectare"
"             Time of concentration  8.295      1.068      3.593      minutes"
"             Time to Centroid       84.311     83.761     83.953     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        10.46      4.48       14.94      c.m"
"             Rainfall losses        38.990     2.855      28.149     mm"
"             Runoff depth           10.802     46.936     21.642     mm"
"             Runoff volume          2.27       4.22       6.49       c.m"
"             Runoff coefficient     0.217      0.943      0.435      "
"             Maximum flow           0.002      0.003      0.004      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.004     0.167     0.159     0.000"
" 33          CATCHMENT 4002"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4002   SITE ENTRANCE"
```

```
"       90.000   % Impervious"
"        0.010   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.001   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.009   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.003     0.167     0.159     0.000 c.m/sec"
"             Catchment 4002         Pervious   Impervious Total Area "
"             Surface Area           0.001      0.009      0.010      hectare"
"             Time of concentration  5.473      0.704      0.826      minutes"
"             Time to Centroid       81.634     83.719     83.666     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        0.50       4.48       4.98       c.m"
"             Rainfall losses        39.045     4.334      7.805      mm"
"             Runoff depth           10.747     45.457     41.986     mm"
"             Runoff volume          0.11       4.09       4.20       c.m"
"             Runoff coefficient     0.216      0.913      0.843      "
"             Maximum flow           0.000      0.003      0.003      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.003     0.168     0.159     0.000"
" 38          START/RE-START TOTALS 4002"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.570    hectare"
"             Total Impervious area                     1.482    hectare"
"             Total % impervious                       32.429"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                       B:\Working\WRIGHTHAVEN HOMES\"
"                2401073 - 122025 079 Sideroad 19 Fergus\5 Work in Progress\Design
Calcs\2024-08-20 SWM Pond"
"                Output filename:                          122025 Post 100yr.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 8/20/2024 at 4:13:00 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.019   Coefficient A"
"       34.669   Constant B"
"        0.998   Exponent C"
"        0.375   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           174.792    mm/hr"
"             Total depth                  97.935    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   EXTERNAL"
"       25.000   % Impervious"
"        3.450   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        2.588   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        0.863   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.624     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           2.588      0.863      3.450      hectare"
"             Time of concentration  26.519     4.660      18.100     minutes"
"             Time to Centroid       108.723    87.693     100.623    minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        2534.07    844.69     3378.76    c.m"
"             Rainfall losses        47.001     2.217      35.805     mm"
"             Runoff depth           50.934     95.718     62.130     mm"
"             Runoff volume          1317.91    825.57     2143.47    c.m"
"             Runoff coefficient     0.520      0.977      0.634      "
"             Maximum flow           0.468      0.372      0.624      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.624     0.624     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   SITE"
"       80.000   % Impervious"
"        0.690   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.138   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        0.552   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.256     0.624     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           0.138      0.552      0.690      hectare"
"             Time of concentration  10.096     1.774      2.752      minutes"
"             Time to Centroid       91.213     83.851     84.716     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        135.15     540.60     675.75     c.m"
"             Rainfall losses        47.269     2.793      11.688     mm"
"             Runoff depth           50.666     95.142     86.247     mm"
```

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"             Runoff volume          69.92      525.18     595.10     c.m"
"             Runoff coefficient     0.517      0.971      0.881      "
"             Maximum flow           0.041      0.239      0.256      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.256     0.777     0.000     0.000"
" 33          CATCHMENT 2001"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2001   SITE SWM"
"       15.000   % Impervious"
"        0.130   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.110   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.019   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.044     0.777     0.000     0.000 c.m/sec"
"             Catchment 2001         Pervious   Impervious Total Area "
"             Surface Area           0.110      0.019      0.130      hectare"
"             Time of concentration  7.916      1.391      6.297      minutes"
"             Time to Centroid       88.951     83.432     87.582     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        108.22     19.10      127.32     c.m"
"             Rainfall losses        47.138     2.969      40.513     mm"
"             Runoff depth           50.797     94.966     57.422     mm"
"             Runoff volume          56.13      18.52      74.65      c.m"
"             Runoff coefficient     0.519      0.970      0.586      "
"             Maximum flow           0.036      0.009      0.044      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.044     0.821     0.000     0.000"
" 54          POND DESIGN"
"        0.821   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"       2813.2   Hydrograph volume    c.m"
```

```
"          21.   Number of stages"
"       0.000   Minimum water level    metre"
"       3.000   Maximum water level    metre"
"       0.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"               415.500     0.000     0.000"
"               415.550  1.01E-05   135.600"
"               415.600   0.00500   153.400"
"               415.650   0.00700   172.200"
"               415.700   0.00800   192.200"
"               415.750   0.00900   213.200"
"               415.800   0.01000   235.500"
"               415.850   0.01100   258.800"
"               415.900   0.01200   283.400"
"               415.950   0.01300   309.200"
"               416.000   0.01400   336.300"
"               416.050   0.08500   364.600"
"               416.100   0.09000   394.200"
"               416.150   0.09500   425.200"
"               416.200   0.09900   457.500"
"               416.250    0.1800   491.100"
"               416.300    0.3290   526.200"
"               416.350    0.5240   562.700"
"               416.400    0.7580   600.700"
"               416.450     1.028   640.100"
"               416.500     1.331   681.300"
"             Peak outflow                  0.797    c.m/sec"
"             Maximum level               416.407    metre"
"             Maximum storage             606.390    c.m"
"             Centroidal lag                2.189   hours"
"                  0.044     0.821     0.797     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.044     0.797     0.797     0.000"
" 33          CATCHMENT 2002"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2002   SITE REAR"
"       0.000   % Impervious"
"       0.080   Total Area"
"      40.000   Flow length"
"       2.000   Overland Slope"
"       0.080   Pervious Area"
"      40.000   Pervious length"
"       2.000   Pervious slope"
"       0.000   Impervious Area"
"      40.000   Impervious length"
"       2.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.022     0.797     0.797     0.000 c.m/sec"
"             Catchment 2002          Pervious   Impervious Total Area "
"             Surface Area            0.080      0.000      0.080      hectare"
"             Time of concentration   11.999     2.109      11.999     minutes"
"             Time to Centroid        93.262     84.338     93.262     minutes"
"             Rainfall depth          97.935     97.935     97.935     mm"
"             Rainfall volume         78.35      0.00       78.35      c.m"
"             Rainfall losses         47.135     3.112      47.135     mm"
"             Runoff depth            50.800     94.823     50.800     mm"
"             Runoff volume           40.64      0.00       40.64      c.m"
"             Runoff coefficient      0.519      0.000      0.519      "
"             Maximum flow            0.022      0.000      0.022      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.022     0.818     0.797     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   SITE WETLAND"
"        0.000   % Impervious"
"        0.130   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
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"                    0.040     0.818     0.797     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  9.050      1.590      9.050      minutes"
"             Time to Centroid       90.079     83.653     90.079     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        127.32     0.00       127.32     c.m"
"             Rainfall losses        47.259     2.758      47.259     mm"
"             Runoff depth           50.676     95.177     50.676     mm"
"             Runoff volume          65.88      0.00       65.88      c.m"
"             Runoff coefficient     0.517      0.000      0.517      "
"             Maximum flow           0.040      0.000      0.040      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.040     0.851     0.797     0.000"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   SITE REMAIN"
"       60.000   % Impervious"
"        0.050   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.020   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.018     0.851     0.797     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.020      0.030      0.050      hectare"
"             Time of concentration  5.223      0.918      2.065      minutes"
"             Time to Centroid       86.094     82.955     83.791     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        19.59      29.38      48.97      c.m"
"             Rainfall losses        47.395     5.151      22.049     mm"
"             Runoff depth           50.540     92.784     75.886     mm"
"             Runoff volume          10.11      27.84      37.94      c.m"
```

```
"             Runoff coefficient     0.516      0.947      0.775      "
"             Maximum flow           0.007      0.013      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.018     0.861     0.797     0.000"
" 33          CATCHMENT 4001"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4001   SITE SINGLE"
"       30.000   % Impervious"
"        0.030   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.021   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.009   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                     0.011     0.861     0.797     0.000 c.m/sec"
"             Catchment 4001         Pervious   Impervious Total Area "
"             Surface Area           0.021      0.009      0.030      hectare"
"             Time of concentration  5.223      0.918      3.327      minutes"
"             Time to Centroid       86.094     82.955     84.712     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        20.57      8.81       29.38      c.m"
"             Rainfall losses        47.395     5.151      34.722     mm"
"             Runoff depth           50.540     92.784     63.213     mm"
"             Runoff volume          10.61      8.35       18.96      c.m"
"             Runoff coefficient     0.516      0.947      0.645      "
"             Maximum flow           0.008      0.004      0.011      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.011     0.867     0.797     0.000"
" 33          CATCHMENT 4002"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4002   SITE ENTRANCE"
```

```
"       90.000   % Impervious"
"        0.010   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.001   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.009   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   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"
"                    0.004     0.867     0.797     0.000 c.m/sec"
"             Catchment 4002         Pervious   Impervious Total Area "
"             Surface Area           0.001      0.009      0.010      hectare"
"             Time of concentration  3.446      0.606      0.773      minutes"
"             Time to Centroid       84.155     82.875     82.950     minutes"
"             Rainfall depth         97.935     97.935     97.935     mm"
"             Rainfall volume        0.98       8.81       9.79       c.m"
"             Rainfall losses        48.287     9.708      13.566     mm"
"             Runoff depth           49.647     88.227     84.369     mm"
"             Runoff volume          0.50       7.94       8.44       c.m"
"             Runoff coefficient     0.507      0.901      0.861      "
"             Maximum flow           0.000      0.004      0.004      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.004     0.869     0.797     0.000"
" 38          START/RE-START TOTALS 4002"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.570    hectare"
"             Total Impervious area                     1.482    hectare"
"             Total % impervious                       32.429"
" 19          EXIT"
```