UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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UCC File: 22116

FUNCTIONAL SERVICING REPORT

High Pointe East
Town of Fort Erie
February 2023

INTRODUCTION

Upper Canada Consultants has been retained to undertake and provide a Functional Servicing Report to address the servicing needs and requirements for the proposed residential development known as High Pointe East as part of the Draft Plan of Subdivision application process for the Town of Fort Erie.

The project site is located in the Town of Fort Erie as part of Lot 2 and Concession 5 and is situated north of Nathaniel Drive, east of Plato Drive, south of Bertie Street and west of Pettit Road. The site is bound by residential properties on all sides and will have roadway entrances on Pettit Road and the eastern limit of Marina Drive.

The development site is approximately 3.83 hectares and shall consist of 5 single detached dwellings, 8 semi-detached dwellings and 87 townhouse units for a total of 100 units. The site shall include associated asphalt road, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

It is anticipated that the property at #1199 Pettit Road will be developed in the near future with units fronting onto the proposed south roadway within the site. These developed lands would utilize watermain, sanitary and stormwater infrastructure discussed in this report. With this understanding, many calculations within this Functional Servicing Report and associated Stormwater Management Plan have been conducted utilizing the fully developed conditions to ensure all proposed infrastructure will have the capacity to accommodate future development.

The objectives of this study are as follows:

1. Identify domestic and fire protection water service needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

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WATER SERVICING

The following existing watermains are within proximity to the site:

- 150mm diameter PVC Municipal watermain at the east limit of Marina Drive (north side)
- 150mm diameter Cast Iron Municipal watermain on the west side of Pettit Road
- 400mm diameter PVC Regional watermain on Pettit Road

It is proposed to construct a 150mm diameter watermain within the site to provide both domestic a fire protection water supply. The proposed watermain will provide a loop between Marina Drive and Pettit Road connecting both 150mm diameter municipal watermains. The proposed single family dwellings fronting Pettit Road will have separate connections directly to the municipal 150mm diameter watermain.

The internal watermain will be constructed and detailed as part of the future detailed design with the size and location dictated by the final configuration. Fire protection will be provided to the proposed development with approximately 3 municipal fire hydrants within the subdivision. Two existing fire hydrants located fronting #1257 Pettit Road and at the south east corner of Marina Drive and Plato Drive will provide additional fire protection for buildings on this site. The spacing and location shall be identified as part future detailed design.

SANITARY SERVICING

There is an existing 200mm diameter PVC municipal sanitary sewer at the eastern limit of Marina Drive conveying flows west and a 200mm diameter PVC municipal sanitary sewer on the east side of Pettit Road conveying flows south. The Marina Drive sanitary sewer was not design to accommodate sanitary flows from the proposed development. It is proposed to connect to the existing Pettit Road sanitary sewer with a 200mm diameter sanitary sewer extended into the site. Sanitary flows from the Pettit Road sanitary sewer are conveyed south to Garrison Road and directed east to the Alliston Avenue Pumping Station before ultimately outletting to the Anger Avenue Wastewater Treatment Plant.

A sanitary analysis has been conducted for the sanitary sewer immediately downstream of the proposed development site on Pettit Road. The analysis includes the future development lands at #119 Pettit Road discharging into the proposed on-site sanitary system, shown in Figure SAN in Appendix A. As shown in the sanitary calculations, a Drainage Area of 4.56 hectares consisting of 129 residential units will discharge sanitary flows to the existing Pettit Road sanitary sewer. This will occupy approximately 28.4% of the existing capacity of the municipal 200mm diameter sanitary sewer immediately of the proposed sanitary sewer connection. It is expected that this will be an acceptable addition to the existing sanitary sewer.

As per the 2016 Regional Water and Wastewater Master Servicing Plan Update, the existing Alliston Avenue Pumping Station is current under capacity to support the existing peak wet weather flows as well as the future design wet weather flows per the growth targets in this area. The Regional Capital Program Summary within the update outlined a pump replacement would be required between 2022-2031 to increase the station capacity from 43L/s to 129L/s. The 2017 Town of Fort Erie's Wastewater Master Plan has noted these plans and states that "there appears to be sufficient wet well and system storage to prevent overflows. Some surcharging near the station is expected; HGL levels remain below the basement flooding levels." Therefore, it is expected that no adverse effects will occur due to the additional flows to the Alliston Avenue Pumping Station from the proposed development as long as the pumping station is upgraded as noted in the MSP.

STORMWATER MANAGEMENT PLAN

As part of the site development, the following is a summary of the stormwater management plan for the proposed residential development.

The criteria provided by the Town of Fort Erie and Region of Niagara for this development includes the requirement to control peak stormwater flows to existing levels up to and including the 100 year design storm event and improve stormwater quality levels to MECP Normal (70% TSS removal) Protection levels prior to discharge from the development.

To limit future stormwater flows to allowable levels, and improve stormwater quality to the required TSS removal levels, a stormwater management wet pond facility will provide the necessary controls for this development. Stormwater quality levels will be provided to a Normal Standard before outletting from the development site. A storm sewer will be constructed on Pettit Road to provide a suitable outlet for stormwater flows discharging from the proposed stormwater management facility. Stormwater flows will be directed south on Pettit Road before discharging to the existing Garrison Road (Highway 3) storm sewer and ultimately to the Kraft Drain.

As the downstream storm sewer on Garrison Road was constructed to the 2 year design storm event, the proposed stormwater management plan is to restrict stormwater flows from the proposed development during the 5 year storm event to 2 year design storm levels prior to discharging to the proposed Pettit Road storm sewer. The proposed stormwater management facility has been designed to provide quantity controls for the proposed High Pointe East development as well as the expected additional future development on the #1199 Pettit Road lands. A Stormwater Management Plan for this development has been created and can be found in Appendix B.

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CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the servicing for this site.

1. The existing 150mm diameter municipal watermain will have sufficient capacity to provide both domestic and fire protection water supply. Upgrades will be required in the near future to the Alliston Avenue SPS per the Region's MSP.

2. Stormwater quality controls are being provided to Normal Protection (70% TSS removal) levels by a stormwater wet pond facility before outletting to a proposed storm sewer on Pettit Road.

3. Stormwater quantity controls are being provided by a stormwater management wet pond facility up to the 100 year design storm event before outletting to the proposed Pettit Road storm sewer.

4. The site stormwater overland route from the road system is to the proposed stormwater management facility.

5. A storm sewer will be constructed on Pettit Road from the SWM Facility outlet to the existing storm sewer on Garrison Road to provide an adequate stormwater outlet for the site.

Based on the above and the accompanying Stormwater Management Brief, there exists adequate municipal servicing for this development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Yours very truly,

Jason Schooley, P.Eng.
February 9, 2023

LICENSED PROFESSIONAL ENGINEER
J. P. SCHOOLEY
PROVINCE OF ONTARIO

Encl.

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APPENDICES

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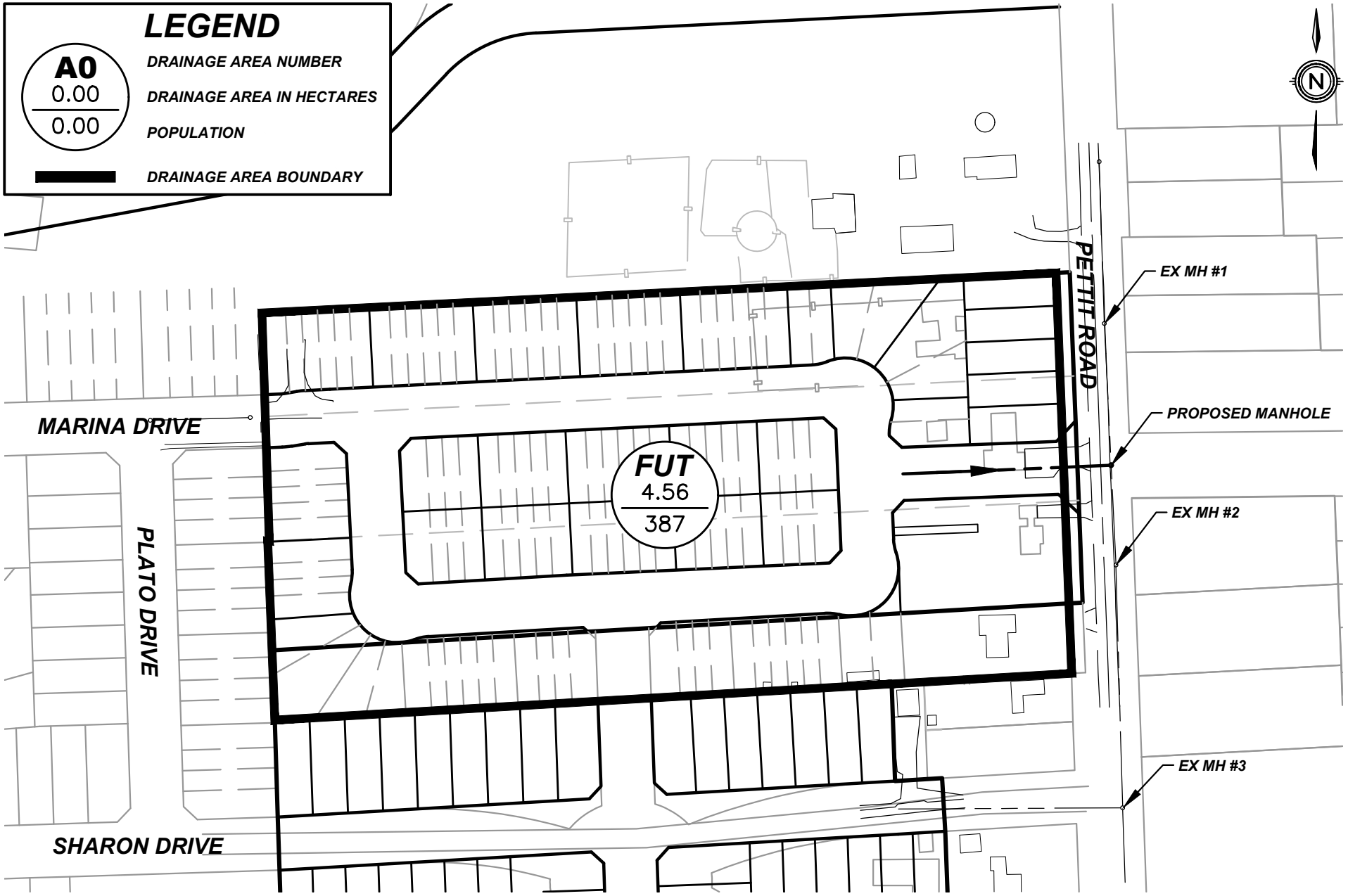
APPENDIX A

Overall Sanitary Drainage Area Plan – Figure SAN
Overall Sanitary Sewer Calculations



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HIGH POINTE EAST

TOWN OF FORT ERIE

OVERALL SANITARY DRAINAGE AREA PLAN

DATE	2023-02-09
SCALE	1:2000 m
REF No.	22116
DWG No.	FIGURE SAN

DRAWING FILE: F:\22116\Engineering\22116-HIGH PT EAST.dwg PLOTTED: Feb 09, 2023 - 4:24pm PLOTTED BY: kurt

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3-30 HANNOVER DRIVE
ST.CATHARINES, ONTARIO
L2W 1A3

DESIGN FLOWS

RESIDENTIAL: 375 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE: 0.286 L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L / s / ha)
POPULATION DENSITY: 3.0 PERSONS / UNIT

SEWER DESIGN

PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: TOWN OF FORT ERIE
PROJECT : HIGH POINTE EAST
PROJECT NO: 22116

SANITARY SEWER DESIGN SHEET

Peaking Factor= $M = 1 + \frac{14}{4 + P^{0.5}}$ Where P = design population in thousands

LOCATION			AREA		POPULATION				ACCUMULATED PEAK FLOW				DESIGN FLOW					
Location and Description	**From M.H**	**To M.H.**	**Increment (hectares)**	**Accumulated (hectares)**	**Number of Units**	**Population Density (persons/unit)**	**Population Increment**	**Total Population Served**	**Peaking Factor**	**Flow (L/s)**	**Infiltration Flow L/s**	**Total Peak Flow (L/s)**	**Pipe Diameter (mm)**	**Pipe Length (m)**	**Pipe Slope (%)**	**Full Flow Velocity (m/s)**	**Full Flow Capacity (L/s)**	**Percent Full**
HIGH POINTE EAST	PROP	PROP	4.56	4.56	129	3.0	387	387	4.03	6.77	1.30	8.07	200	90.0	0.40	0.67	21.64	37.3%
PETTIT ROAD	PROP	EX MH 2		4.56				387	4.03	6.77	1.30	8.07	200	91.0	0.69	0.88	28.42	28.4%
PETTIT ROAD	EX MH 2	EX MH 3		4.56				387	4.03	6.77	1.30	8.07	200	91.4	0.91	1.01	32.64	24.7%

**Note: 'Drainage Area' and 'Number of Units' values depict site under fully developed conditions with lots fronting onto proposed road within #1199 Pettit Road property

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APPENDIX B

High Pointe East – Stormwater Management Plan

PRELIMINARY STORMWATER MANAGEMENT PLAN

HIGH POINTE EAST

TOWN OF FORT ERIE

Prepared for:

Marina (Pettit Road) Developments Inc.

Prepared by:

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, Ontario
L2W 1A3

February 2023

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Appendix B	MIDUSS Output Files – High Pointe East Stormwater Management Facility Calculations – High Pointe East
Appendix C	MIDUSS Output Files – High Pointe Extension Stormwater Management Facility Calculations – High Pointe Extension

REFERENCES

1. Stormwater Management Planning and Design Manual
   Ontario Ministry of Environment (March 2003)

PRELIMINARY STORMWATER MANAGEMENT PLAN

HIGH POINTE EAST

TOWN OF FORT ERIE

1.0 INTRODUCTION

1.1 Study Area

The proposed residential subdivision development is located in the Town of Fort Erie as part of Lot 2 and Concession 5. As shown on the enclosed Site Location Plan (Figure 1), the subject property is situated north of Nathaniel Drive, east of Plato Drive, south of Bertie Street and west of Pettit Road. The development will have road entrances on Pettit Road and the eastern limit of Marina Drive. This Stormwater Management Plan has been written to obtain approvals as part of the Draft Plan of Subdivision process.

The approximately 3.829ha property is bound by residential properties on the north, south and west sides and Pettit Road to the east. The drainage areas contributing to this stormwater management plan consist primarily of the subject lands, though incorporate surrounding residential areas that convey stormwater flows through the development lands. The receiving body of water for the proposed stormwater flows will be the existing municipal storm sewer system on Garrison Road (Highway 3) and ultimately the Kraft Drain at the east limit of Phillips Street.

This stormwater management plan includes additional calculations and conclusions based on the expectation that the adjacent southerly property (#1199 Pettit Road) ultimately being developed and contributing stormwater flows to the proposed stormwater management system as part of this development.

1.2 Objectives

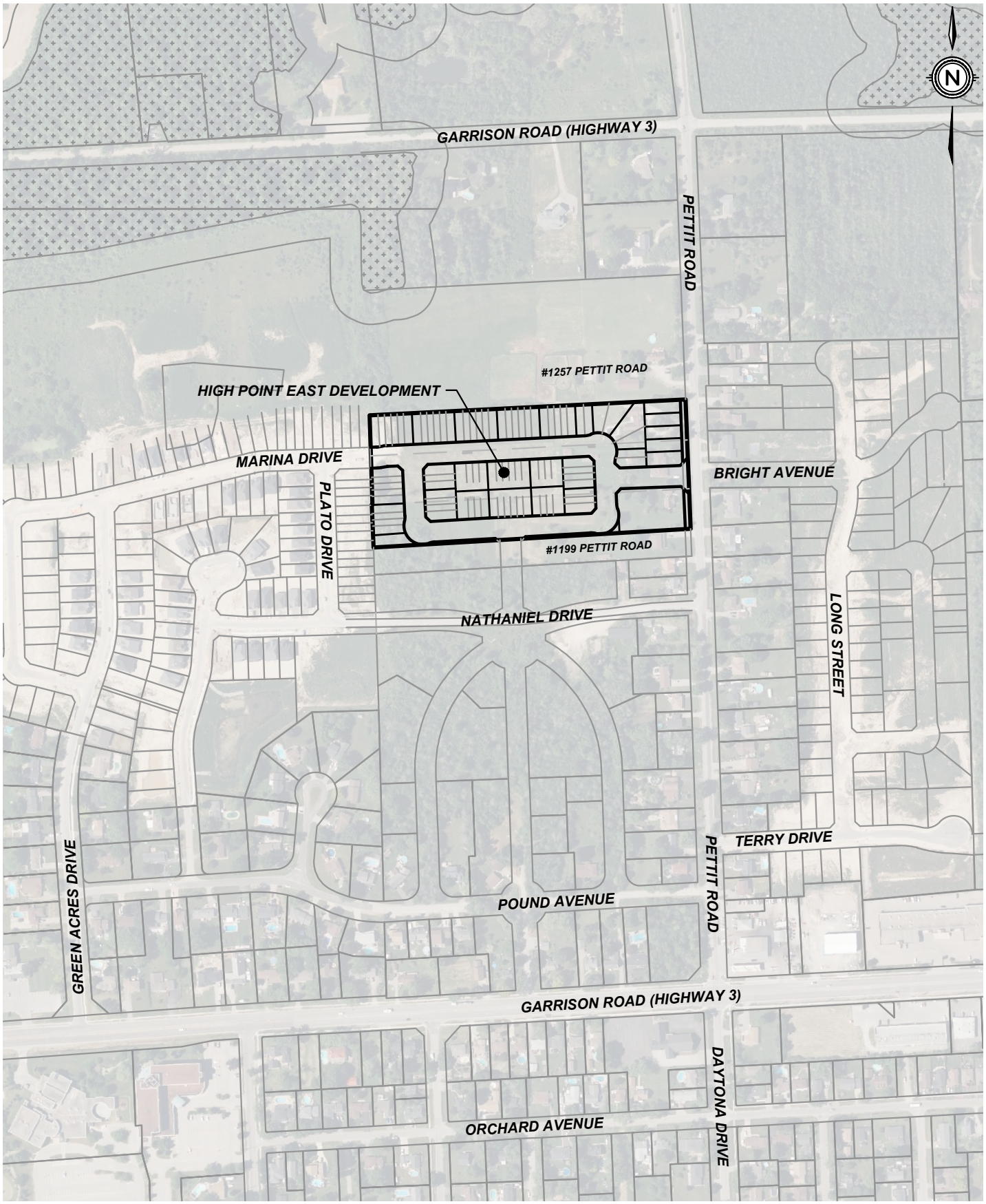
The objectives of this study are as follows:

1. Establish specific criteria for the management of stormwater from this site.

2. Determine the impact of development on the stormwater peak flow & volume from this site.

3. Investigate alternatives for controlling the quantity and quality of stormwater from this site.

4. Establish property requirements for the Stormwater Management Facility for the Draft Plan of Subdivision.



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HIGH POINTE EAST

TOWN OF FORT ERIE

SITE LOCATION PLAN

DATE	2023-02-01
SCALE	1:5000 m
REF No.	22116
DWG No.	FIGURE 1

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1.3 Existing & Proposed Conditions

a) Existing Conditions

Historically, the site has been the location of three (3) single detached dwellings fronting Pettit Road with the western half of the properties remaining mainly vacant land. The gradient of the land is generally north to south with an overall slope of approximately 1.0-2.0%. Stormwater flows are ultimately conveyed south to the Garrison Road (Highway 3) storm sewer system and directed east to Crescent Road and south to the Kraft Drain stormwater outlet on the east side of Crescent Road at Phillips Street.

The majority of native soils within the study area have been characterized as a Chinguacousy soil that is imperfectly or poorly drained reddish-hued clay loam till. At the north limits of the site, the soil transitions to a Fonthill soil type comprised of reddish-hued coarse sandy loam and gravelly sand that is rapidly draining.

b) Proposed Conditions

It is proposed to develop the full property as no areas have been deemed undevelopable for conservation/geological issues. The residential development will consist of 5 single detached dwellings, 8 semi-detached dwellings and 87 townhouse units for a total of 100 units. The site shall be provided with full municipal services including sanitary sewers, storm sewers and watermain with asphalt pavement, concrete curbs and gutters. This stormwater management plan discusses the proposed development under fully developed conditions.

2.0 STORMWATER MANAGEMENT CRITERIA

New developments are required to provide stormwater management in accordance with provincial and municipal policies including:

- Stormwater Quality Guidelines for New Development (MECP/MNRF, May 1991)
- Stormwater Management Planning and Design Manual (MECP, March 2003)

Based on the comments and outstanding policies from various agencies (Town of Fort Erie, Regional Municipality of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of the Environment, Conservation and Parks (MECP), and others) the following site specific considerations were identified:

- The receiving watercourse, the Kraft Drain has been identified by the Ministry of Natural Resources watercourse evaluation as a **Type 3** (*Marginal*) fish habitat. Based on this fish habitat, the corresponding MECP level of protection for stormwater management quality practices on all new developments shall be *Basic,* though per local requirements, stormwater quality protection must be provided to a *Normal* standard.
- The site outlets to the downstream municipal storm sewer system and subsequent Kraft Drain which contains lands that would be negatively impacted by surcharging and increased flooding levels, and, therefore, stormwater quantity control is considered necessary to maintain the downstream peak water elevations.

Based on the above policies and site specific considerations, the following stormwater management criteria have been established for this site.

- Stormwater **quality** controls are to be provided for the internal storm system of the development according to Regional guidelines. It is proposed to provide Normal Protection (70% TSS removal) to the stormwater before outletting to the downstream municipal storm sewer system and subsequent Kraft Drain.

- Stormwater **quantity** controls are to be provided for the outlet to limit the proposed development peak flows from the 25mm, 2, 5, and 100 year storm events to allowable peak flow levels.

3.0 STORMWATER ANALYSIS

A stormwater analysis has been conducted by Upper Canada Consultants as part of the design of the High Pointe East development using the MIDUSS computer modelling program. A new stormwater analysis was conducted to represent the existing and future conditions to the downstream municipal storm sewer system.

This program was selected because it is applicable to an urban drainage area like the study area, it is relatively easy to use and modify for the proposed drainage conditions and control facilities, and it readily allows for the use of design storm hyetographs for the various return periods being investigated. Copies of the current model output files are enclosed in Appendix B.

3.1 Design Storms

Design storm hyetographs were developed using a Chicago distribution based on the Town of Fort Erie Intensity-Duration-Frequency curves. Hyetographs for the 25mm, 2, 5, and 100 year events were developed using a 4-hour Chicago distribution. Table 1 summarizes the rainfall data.

Table 1. Rainfall Data

Design Storm (Return Period)	Chicago Distribution Parameters		
	a	**b**	**c**
25mm	512.000	0.0	0.699
2 Year	628.05	6.652	0.796
5 Year	747.93	6.800	0.768
100 Year	1083.55	6.618	0.735

$$Intensity\ (mm/hr) = \frac{a}{(t_d + b)^c}$$

3.2 Existing Conditions

The existing conditions have been modelled to establish the allowable stormwater peak flows and volumes prior to development within this site. The proposed development site and surrounding area was included in the design of the Garrison Road/Crescent Road storm sewer system for the 2 year design storm event. Drainage Area's '1' & '2' in Figure 2 depict the related drainage area's and corresponding Runoff Coefficients (o.20 and 0.45 respectively) that were utilized as part of the existing storm sewer design. Drainage Area 'EX1' details the portion of the development site included in the existing design drainage areas that will be contributing flows to the proposed stormwater management facility. A weighted imperviousness calculation was conducted attributing an imperviousness of 1.5% for Drainage Area 'EX1' based on the coefficients designated for the existing sewer design.

Input parameters for the computer modelling of existing conditions are shown in Table 2. Table 3 details the stormwater peak flows and volumes generated by the various design storm events.

3.3 Proposed Conditions

The future overall drainage area for the proposed development, shown in Figure 3, was modelled to establish the stormwater peak flows and volumes once development has been completed. It is proposed to construct an internal storm sewer system to collect peak stormwater flows from the 4.21-hectare drainage area (FUT1), and discharge to a proposed storm sewer on Pettit Road.

As the Garrison Road storm sewer system was designed to accommodate peak stormwater flows up to the 2 year design storm event, the proposed stormwater management facility will restrict peak stormwater flows at the 5 year design storm event to the 2 year event. The storm sewer will convey stormwater flows from the proposed development and surrounding area to the existing municipal storm sewer system on Garrison Road (Highway 3) prior to ultimately outletting to the Kraft Drain.

Input parameters for the computer model with the proposed High Pointe East development conditions are shown in Table 2.

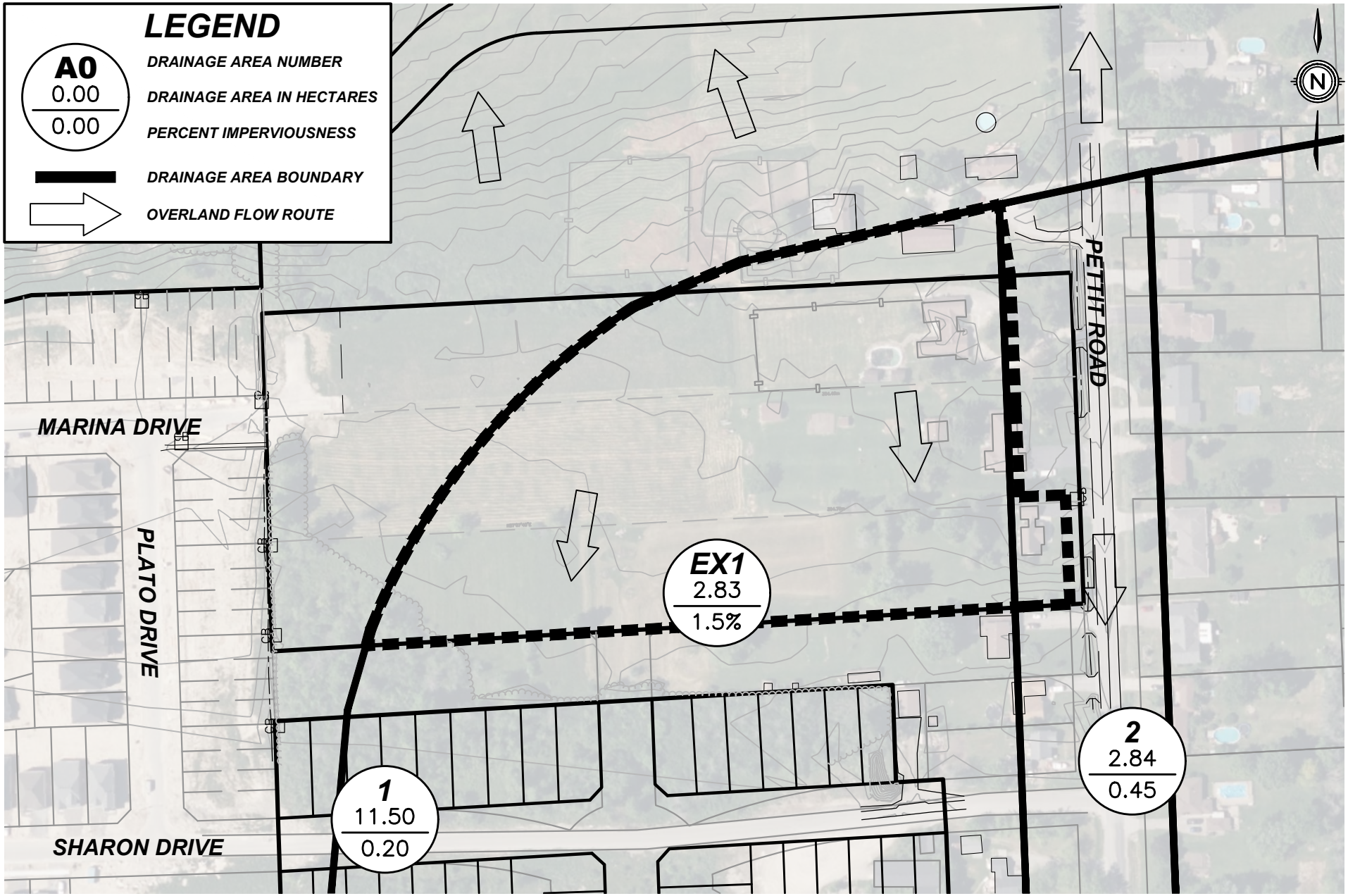
Table 2. Hydrologic Parameters

Area No.	Area (ha)	Length (m)	Slope (%)	SCS CN	Percent Impervious
Existing Conditions					
EX1	2.83	80	2.0	77	1.5
Future Conditions					
FUT1	4.21	200	1.0	77	70.0

The results of the modelling are shown in Table 3, where the peak flows and runoff volumes were calculated for the 25mm, 2, 5, and 100 year design storm events. The future peak flows and volumes in Table 3 are represent fully developed conditions without stormwater quantity controls.

Table 3. Peak Flow and Volume for Future Development Conditions						
Design Storm	**Peak Flow (m^3/s)**			**Volume (m^3)**		
	Existing	**Future***	**Change**	**Existing**	**Future***	**Change**
25mm	0.011	0.266	+2,318%	99	635	+536
2 Year	**0.022**	0.343	+1,459%	169	844	+675
5 Year	0.053	**0.468**	+783%	338	1,261	+923
100 Year	0.201	0.768	+282%	924	2,433	+1,509

As seen above in Table 3, stormwater quantity controls are considered necessary for the proposed development since the peak flows and volumes outletting from the proposed development area increase substantially as a result of the proposed development. The existing and future stormwater drainage areas shown on Figures 2 and 3 were used to assess the stormwater management plan for this study.



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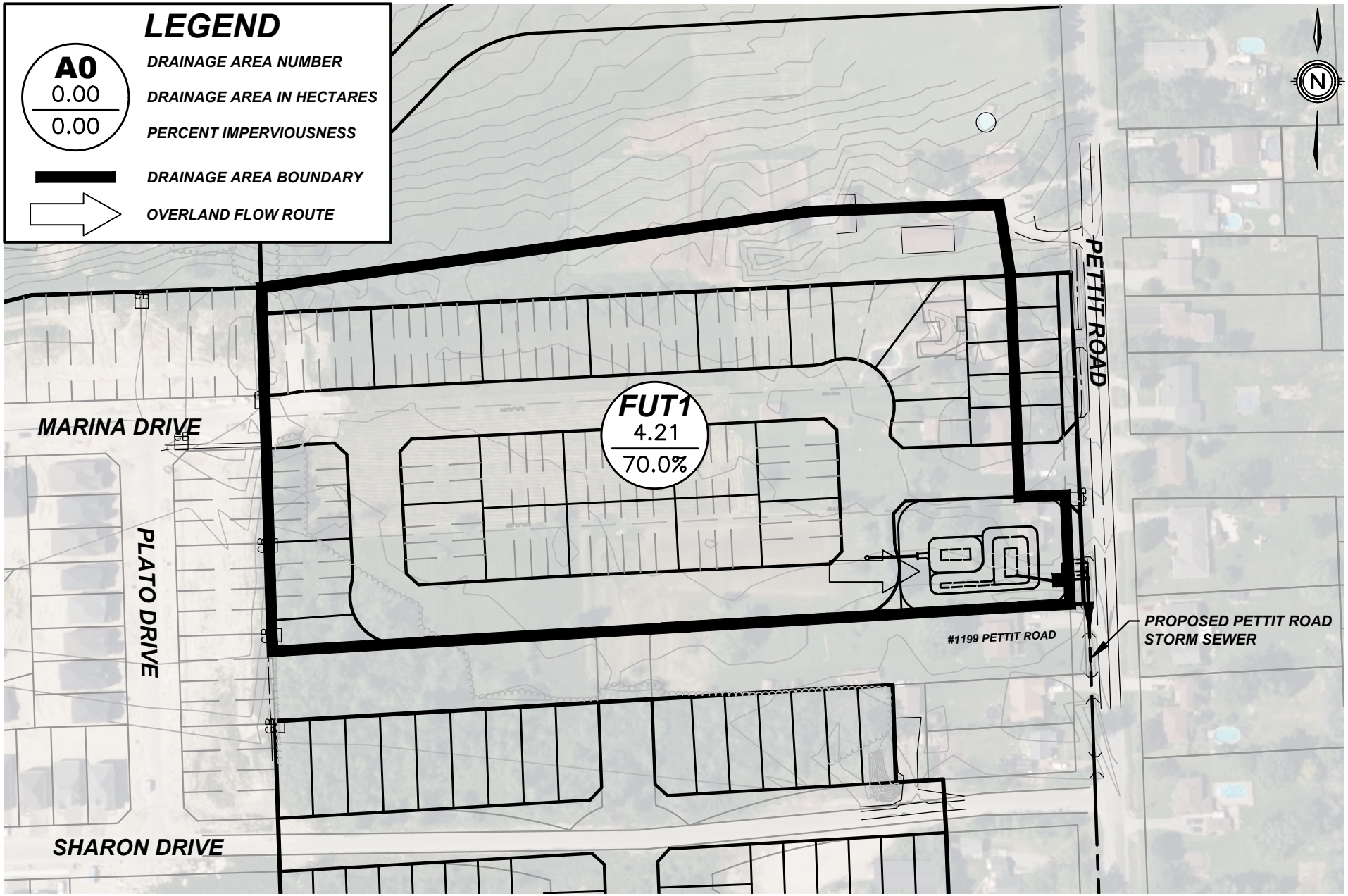
HIGH POINTE EAST

TOWN OF FORT ERIE

EXISTING OVERALL DRAINAGE AREA PLAN

DATE	2023-02-01
SCALE	1:2000 m
REF No.	22116
DWG No.	FIGURE 2

DRAWING FILE: F:\22116\Engineering\22116-HIGH PT EAST.dwg PLOTTED: Feb 01, 2023 - 2:16pm PLOTTED BY: kurt



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HIGH POINTE EAST

TOWN OF FORT ERIE

PROPOSED OVERALL DRAINAGE AREA PLAN

DATE	2023–02–01
SCALE	1:2000 m
REF No.	22116
DWG No.	FIGURE 3

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4.0 STORMWATER MANAGEMENT ALTERNATIVES

4.1 Screening of Stormwater Management Alternatives

A variety of stormwater management alternatives are available to control the quality of stormwater, most of which are described in the Stormwater Management Planning and Design Manual (MECP, March 2003). Alternatives for the proposed and ultimate developments were considered in the following broad categories: lot level, vegetative, infiltration, and end-of-pipe controls. General comments on each category are provided below. Individual alternatives for the proposed development are listed in Table 4 with comments on their effectiveness and applicability to the proposed outlet.

a) Lot Level Controls

Lot level controls are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

b) Vegetative Alternatives

Vegetative stormwater management practices are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

c) Infiltration Alternatives

Where soils are suitable, infiltration techniques can be very effective in providing quantity and quality control. However, the very small amount of surface area on this site dedicated to permeable surfaces such as greenspace and landscaping make this an impractical option. Therefore, infiltration techniques will not be considered for this development.

d) End-of-Pipe Alternatives

Surface storage techniques can be very effective in providing quality and quantity control. Dry facilities are effective practices for stormwater erosion and flood control for large drainage areas.

Wet facilities are effective practices for stormwater erosion, quality and quantity control for large drainage areas.

Table 4. Evaluation of Stormwater Management Practices

High Pointe East	Criteria for Implementation of Stormwater Management Practices (SWMP)					Technical Effectiveness (10 high)	Recommend Implementation Yes / No	Comments
	Topography	**Soils**	**Bedrock**	**Groundwater**	**Area**			
Site Conditions	***Variable 1 to 3%***	***Clay Loam <12mm/hr***	***At Considerable Depth***	***At Considerable Depth***	***± 5.0ha***			
Lot Level Controls								
Lot Grading	<5%	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Leaders to Surface	nlc	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Ldrs.to Soakaway Pits	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	6	No	Unsuitable site conditions
Sump Pump Fdtn. Drains	nlc	nlc	nlc	nlc	nlc	2	No	Unsuitable site conditions
Vegetative								
Grassed Swales	< 5 %	nlc	nlc	nlc	nlc	7	Yes	Quality/quantity benefits
Filter Strips(Veg. Buffer)	< 10 %	nlc	nlc	>.5m Below Bottom	< 2 ha	5	No	Unsuitable site conditions
Infiltration								
Infiltration Basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 5 ha	2	No	Unsuitable site conditions
Infiltration Trench	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 2 ha	4	No	Unsuitable site conditions
Rear Yard Infiltration	< 2.0 %	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	7	No	Unsuitable site conditions
Perforated Pipes	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	4	No	Unsuitable site conditions
Pervious Catch basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	3	No	Unsuitable site conditions
Sand Filters	nlc	nlc	nlc	>.5m Below Bottom	< 5 ha	5	No	High maintenance/poor aesthetics
Surface Storage								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	7	No	No quality control
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	9	Yes	Very effective quality control
Wetlands	nlc	nlc	nlc	nlc	> 5 ha	10	No	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	<2 ha	3	No	Limited benefit/area too large

Reference: Stormwater Management Practices Planning and Design Manual - 1994
nlc - No Limiting Criteria

4.2 Selection of Stormwater Management Alternatives

Stormwater management alternatives were screened based on technical effectiveness, physical suitability for this site, and their ability to meet the stormwater management criteria established for proposed and future development areas. The following stormwater management alternatives are recommended for implementation on the proposed development:

- **Lot grading** to be kept as flat as practical in order to slow down stormwater and encourage infiltration.
- **Roof leaders to be discharged to the ground surface** in order to slow down stormwater and encourage infiltration.
- **Grassed swales** to be used to collect rear lot drainage. Grassed swales tend to filter sediments and slow down the rate of stormwater.
- A **wet pond facility** to be constructed to provide stormwater quality enhancement for frequent storms.

5.0 STORMWATER MANAGEMENT PLAN

A MIDUSS model was created to assess existing, future and ultimate development peak flows and stormwater volumes generated by the proposed subdivision. The purpose of this report is to outline the proposed stormwater management plan for the proposed High Pointe East development.

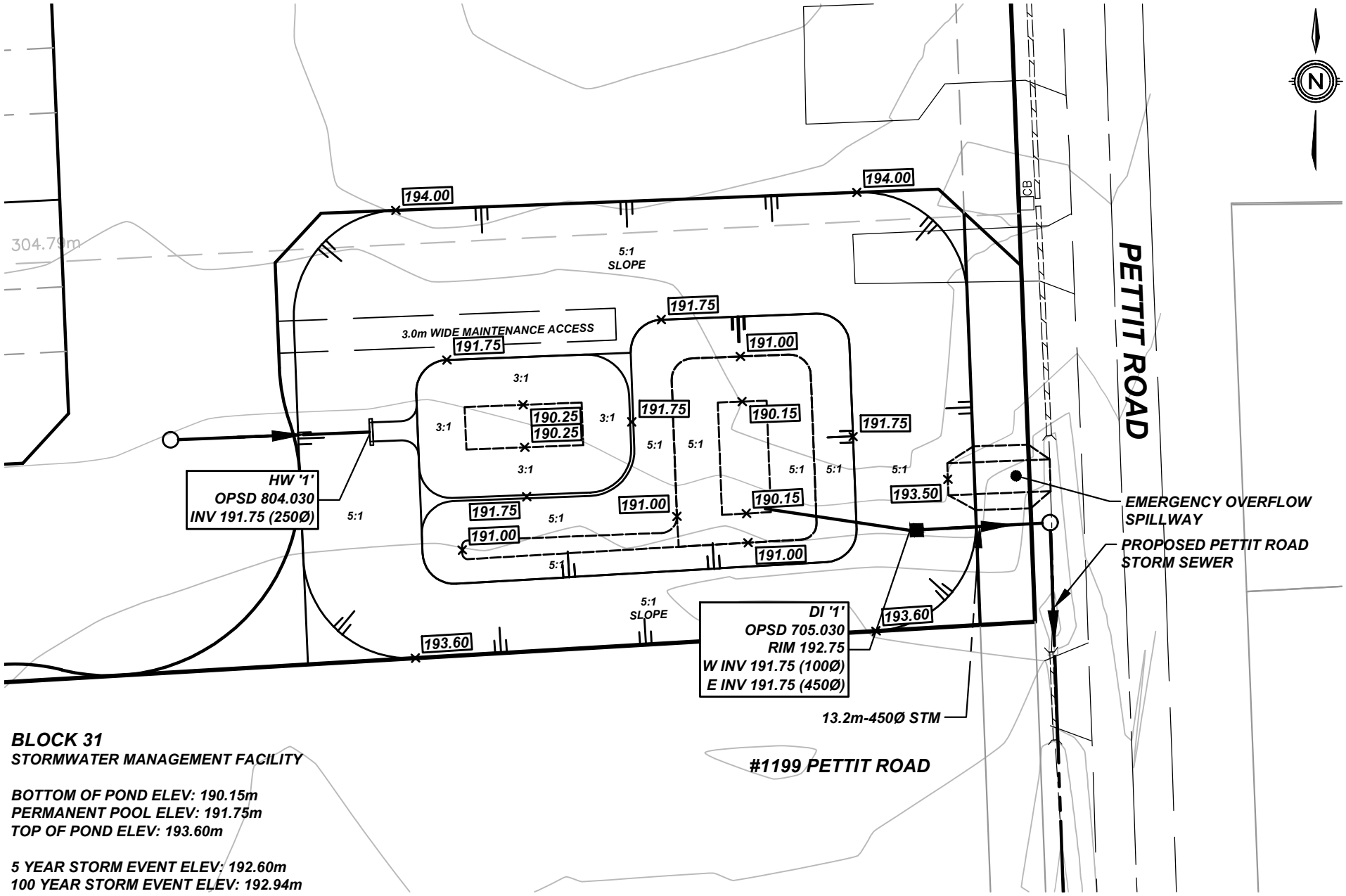
As stated previously, the pond has been modelled to provide the necessary quantity and quality controls under the proposed *High Pointe East* development plan (Section 5.1) as well as the expected fully developed conditions with the additional development of the adjacent southerly property at #1199 Pettit Road. To differentiate the two scenarios, the extended development stormwater management plan will be discussed as '*High Point Extension'*(Section 5.2).

The stormwater management facility was sized according to MECP Guidelines (MECP, March 2003) as follows:

5.1 Proposed Stormwater Management Facility (High Pointe East)

5.1.1 Stormwater Quality

The stormwater drainage outlet for the proposed development is to a proposed storm sewer on Pettit Road and subsequent existing municipal storm sewer on Garrison Road. Based on regional and local stormwater quality requirements, the corresponding MECP level of protection for stormwater management quality practices on all new developments shall be *Normal* (70% TSS removal). Based on Table 3.2 of SWMP & Design Manual, the water quality storage requirement is approximately 130m^3/ha for *Normal* protection for developments with 70% impervious areas. The drainage area requiring stormwater quality improvement draining to the proposed facility is 4.21 hectares. The storage volumes required for this proposed facility are shown in Table 5.



BLOCK 31
STORMWATER MANAGEMENT FACILITY

BOTTOM OF POND ELEV: 190.15m
PERMANENT POOL ELEV: 191.75m
TOP OF POND ELEV: 193.60m

5 YEAR STORM EVENT ELEV: 192.60m
100 YEAR STORM EVENT ELEV: 192.94m

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

HIGH POINTE EAST

TOWN OF FORT ERIE

STORMWATER MANAGEMENT FACILITY

DATE	2023–02–01
SCALE	1:500 m
REF No.	22116
DWG No.	FIGURE 4

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Table 5. Stormwater Quality Volume Calculations	
Total Water Quality Volume = 4.21 ha x 130 m^3/ha = 547.3 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 4.21 ha x 90 m^3/ha = 378.9 m^3	**Extended Detention Volume** = 4.21 ha x 40 m^3/ha = 168.4 m^3

5.1.2 Stormwater Quantity Control

As shown in the previous Table 3, stormwater management quantity controls are required to reduce the peak flows from the development area to existing conditions up to and including the 100 year design storm event. The stormwater peak flows from the proposed development shall be reduced to existing levels by providing stormwater quantity storage. It is proposed to construct a control structure outlet to reduce the peak stormwater flows outletting from the proposed facility.

5.1.3 Stormwater Management Facility Configuration

As seen on the Proposed Stormwater Management Facility detail (Figure 4), the layout of the stormwater management facility is providing a single storm sewer outlet to a proposed storm sewer on Pettit Road. The storm sewer will convey stormwater flows south to the existing storm sewer on Garrison Road and ultimately the Kraft Drain.

It is proposed to construct a three-stage outlet for the stormwater management facility. The first stage of control consists of a reverse slope pipe acting as a 100mm diameter orifice to provide the required quality controls. The second stage of control consists of a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. An emergency spillway will provide an outlet for flows exceeding the capacity of the ditch inlet catch basin and outlet pipe.

As per the preliminary design, the proposed effective bottom elevation of the facility is 190.15m, and the permanent pool water level is 191.75m for a water depth of 1.6 metres. The configuration of the facility provides 452m^3 of permanent pool volume, which is more than the required 378.9m^3 to provide the necessary quality controls. The proposed top of pond is at an elevation of 193.60m which provides a total active volume of 2,879.4m^3.

Based on the configuration of the proposed facility, it was determined that a 100mm diameter quality orifice shall provide 30.2 hours of detention (24hrs is the minimum required duration of detention). The rim elevation for the proposed ditch inlet chamber is 192.75m and will provide an extended detention volume of 1,254m^3, which is more than the required 168m^3.

The outflow pipe from the stormwater management facility is to be 450mm in diameter and will convey the stormwater flows from the ditch inlet to the proposed Pettit Road storm sewer. A stage-storage-discharge relationship was determined for the facility and is included in Appendix A for reference purposes.

Overland flows from the development area shall be directed to the proposed stormwater management facility.

Table 6 summarizes the peak inflows and outflows for the stormwater management facility along with corresponding pond elevations. Based on the MIDUSS model, Table 6 shows the maximum wet pond elevation of 192.94m, and an active storage volume of 1,603m^3 for the 100-year design storm event for the proposed High Pointe East development. This will leave a free board of 0.66m to the top of the facility.

Table 6. Stormwater Management Wet Pond Facility Characteristics

Design Storm (Return Period)	Peak Flows (m^3/s)		Maximum Elevation	Maximum Volume (m^3)
	Inflow	Outflow		
25mm	0.266	0.011	192.19	512
2 Year	0.343	0.014	192.34	682
5 Year	0.468	0.019	192.60	1,028
100 Year	0.768	0.112	192.94	1,603

An emergency overflow spillway will be constructed at an elevation of 193.50m for extreme storm events greater than the 100 year design storm event. The spillway will discharge stormwater flows to the Pettit Road roadside ditch, where flows will be directed southerly towards Garrison Road.

Table 7 details the difference in peak stormwater flows for existing and future conditions with the constructed and operational stormwater management facility. The table outlines that the proposed facility will restrict stormwater flows during the 5 year event to below levels experienced during the 2 year event under existing conditions.

Table 7. Impacts of Wet Pond Facility on Peak Flows

Design Storm	Peak Flow (m^3/s)		
	Existing	Future with SWM	Change*
25mm	0.011	0.011	-
2 Year	**0.022**	0.014	-36.4%
5 Year	0.053	**0.019**	-64.2%
100 Year	0.201	0.112	-44.3%

Note: *indicates the percent change between existing conditions and future conditions with stormwater management controls in place.

The proposed facility has a single storm sewer inlet, therefore, the sediment forebay was designed to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility and to localize maintenance activities. Calculations for the forebay sizing follow MECP Guidelines and are shown in Table 8 for the storm sewer outlet.

Table 8. Stormwater Management Facility Forebay Sizing

a) Forebay Settling Length (MOECC SWMP&D, Equation 4.5)

$$Settling\ Length = \sqrt{\frac{r * Q_p}{V_s}}$$

r =	2.8	:1	(Length:Width Ratio)
Q_p =	0.012	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **10.49 m**

b) Dispersion Length (MOECC SWMP&D, Equation 4.6)

$$Dispersion\ Length = \frac{8 * Q}{D * V_f}$$

Q =	0.468	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.50	m	(Depth of Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **4.99 m**

c) Minimum Forebay Deep Zone Bottom Width (MOECC SWMP&D, Equation 4.7)

$$Width = \frac{Dispersion\ Length}{8}$$

Minimum Forebay Length from Equations 3.3 and 3.4

10.49 m (minimum required length)

Width = **1.31 m** (minimum required width)

d) Average Velocity of Flow

$$Average\ Velocity = \frac{Q}{A}$$

Q =	0.266	m^3/s	(Quality Design Inflow)
A =	12.75	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	4.00	m	(Proposed Bottom Width)
S =	3	:1	(Side slopes - minimum)

Average Velocity = **0.02 m/s**

Is this Acceptable? **Yes** (Maximum velocity of flow = 0.15 m/s)

e) Cleanout Frequency

Is this Acceptable? **Yes**	L =	11.0	m (Proposed Bottom Length)
	ASL =	2.8	m^3/ha (Annual Sediment Loading)
	A =	4.14	ha (Drainage Area)
	FRC =	70	% (Facility Removal Efficiency)
	FV =	228.0	m^3 (Forebay Volume)

Cleanout Frequency = **13.8 years**

Is this Acceptable? **Yes** (10 year minimum cleanout frequency)

5.2 Proposed Stormwater Management Facility (High Pointe Extension)

As stated earlier in this report, it is expected that the property at municipal address #1199 Pettit Road, immediately south of the proposed development, will ultimately be developed (High Pointe Extension). It is expected that stormwater flows from the developed property will outlet into the proposed storm sewers on this site and discharge into the proposed stormwater management facility. As such, the proposed stormwater management facility has been sized to accommodate flows under the fully developed conditions consisting of the High Pointe East development and adjacent #1199 Pettit Road property.

The existing and proposed stormwater conditions of the development site utilized in the modelling of the fully developed scenario can be seen on Figures 4 & 5. The total area of the site now included in the existing drainage area for the Garrison Road/Crescent Avenue storm sewer has increased to 3.54 hectares as outlined by Drainage Area EX2 on Figure 4. Figure 5 outlines a drainage area of 5.00 hectares (FUT2) conveying stormwater flows to the proposed stormwater management facility under fully developed conditions.

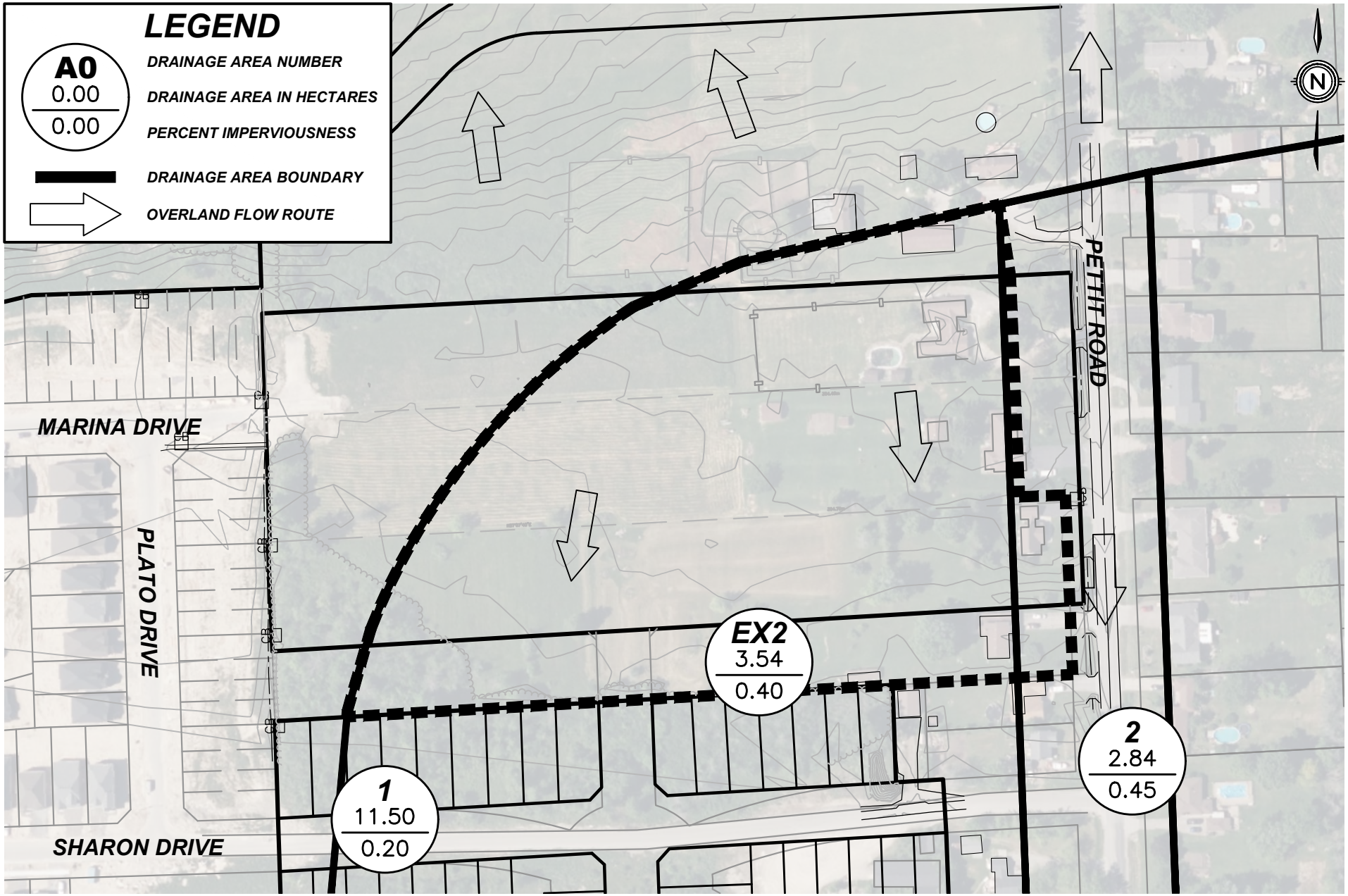
Input parameters for the computer model with the proposed development under fully developed conditions are shown in Table 9. The MIDUS modelling and Stormwater Management Facility Calculation Sheet can be found in Appendix C.

Table 9. Hydrologic Parameters (High Pointe Extension)

Area No.	Area (ha)	Length (m)	Slope (%)	SCS CN	Percent Impervious
Existing Conditions					
EX2	3.54	80	2.0	77	1.7
Future Conditions					
FUT2	5.00	200	1.0	77	70.0

5.2.1 Stormwater Quality

The proposed stormwater management facility has been designed to provide stormwater quality controls to a *Normal* (70% TSS removal) Standard under the fully developed conditions with High Pointe Extension, prior to discharging to the proposed Pettit Road storm sewer. Based on Table 3.2 of SWMP & Design Manual, the water quality storage requirement is approximately 130m^3/ha for *Normal* protection for developments with 70% impervious areas. The drainage area requiring stormwater quality improvement draining to the proposed facility is 5.00 hectares. The storage volumes required for this proposed facility are shown in Table 10.



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HIGH POINTE EAST

TOWN OF FORT ERIE

EXISTING OVERALL DRAINAGE AREA PLAN
HIGH POINTE EXTENSION

DATE	2023-02-01
SCALE	1:2000 m
REF No.	22116
DWG No.	FIGURE 5

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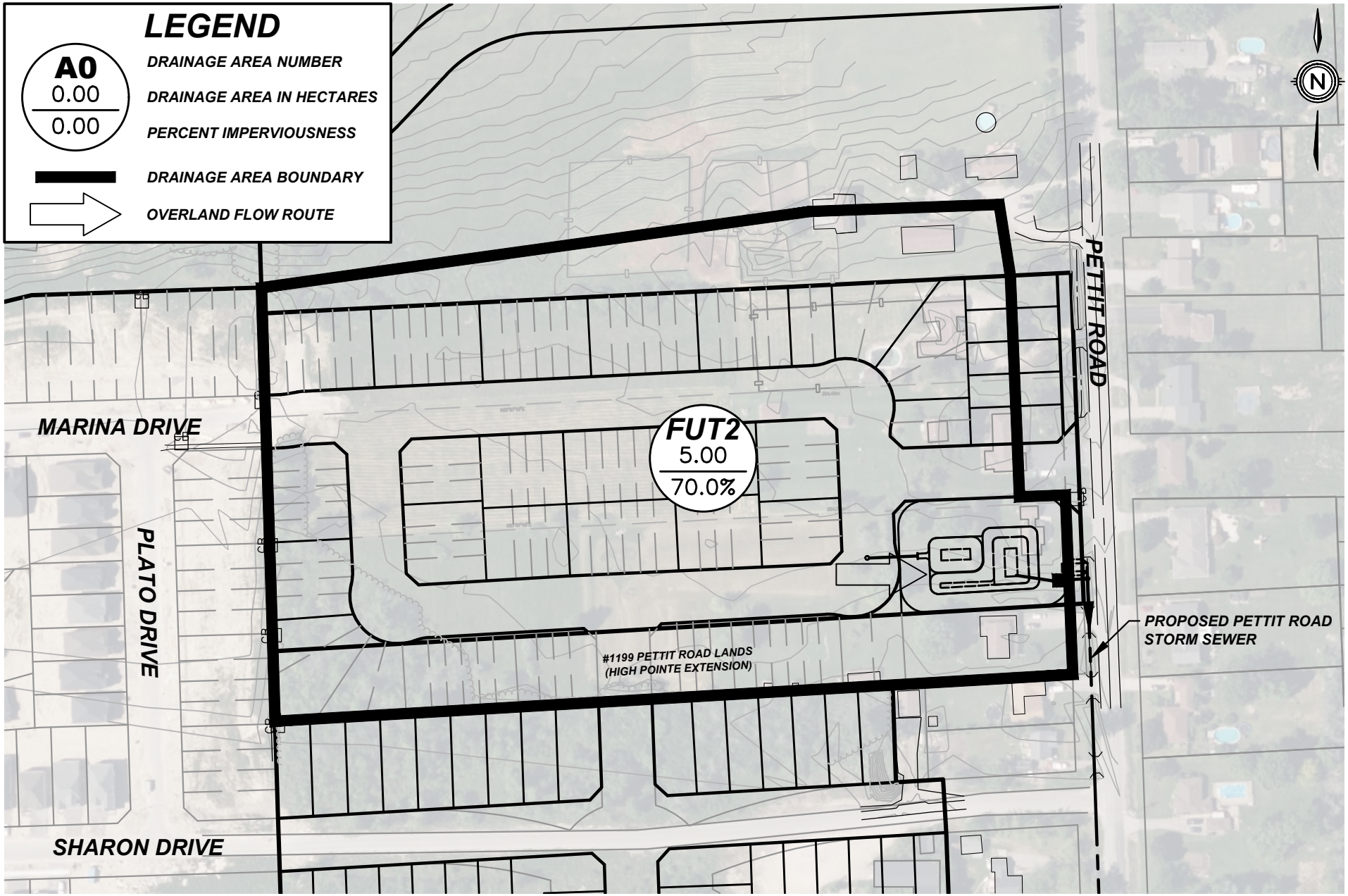

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ENGINEERS / PLANNERS

HIGH POINTE EAST

TOWN OF FORT ERIE

PROPOSED OVERALL DRAINAGE AREA PLAN
HIGH POINTE EXTENSION

DATE	2023–02–01
SCALE	1:2000 m
REF No.	22116
DWG No.	FIGURE 6

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Table 10. Stormwater Quality Volmue Characteristics High Pointe Extension	
Total Water Quality Volume = 5.00 ha x 130 m^3/ha = 650 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 5.00 ha x 90 m^3/ha = 450.0 m^3	**Extended Detention Volume** = 5.00 ha x 40 m^3/ha = 200.0 m^3

As shown in the Stage Storage Discharge Calculation Sheet for the proposed stormwater management facility in Appendix C, the facility will have a permanent pool volume of 452m^3 in addition to the sediment forebay. An extended detention volume of 1,253.7m^3 will be provided up to the Ditch Inlet elevation, 1.0m above the permanent pool.

5.2.2 Stormwater Quantity Controls

It will be required that the proposed stormwater management facility provide quantity controls to allowable levels up to and including the 100 year design storm event. In addition, the facility is required to restrict future peak 5 year design flows to existing 2 year design conditions. Under the fully developed conditions of High Pointe East as well as High Pointe Extension (the adjacent southerly #1199 Pettit Road property), the proposed facility will continue to utilize the proposed forebay and outlet structures to provide the necessary quantity controls.

Table 11 below outlines peak stormwater flows experienced by the pond with the increased development area along with the corresponding volumes and elevations within the facility during the modelled storm events.

Table 11. Stormwater Management Wet Pond Facility Characteristics High Pointe Extension				
Design Storm (Return Period)	**Peak Flows (m^3/s)**		**Maximum Elevation**	**Maximum Volume (m^3)**
	Inflow	**Outflow**		
25mm	0.316	0.013	192.27	608
2 Year	0.408	0.017	192.44	809
5 Year	0.556	0.021	192.74	1,237
100 Year	0.912	0.115	193.02	1,772

Therefore, with the additional flows from the High Pointe Extension development entering the stormwater management facility, flows will reach a maximum elevation of 193.02m during the 100 year design storm event leaving a free board of approximately 0.6m.

The forebay has been sized to accommodate the additional flows due the increased drainage area as part of the High Pointe Extension. Calculations for the forebay sizing follow MECP Guidelines and are shown in Table 12 on the next page for the storm sewer outlet.

Table 12. Stormwater Management Facility Forebay Sizing
High Pointe Extension Calculations

a) Forebay Settling Length (MOECC SWMP&D, Equation 4.5)

$$Settling\ Length = \sqrt{\frac{r * Q_p}{V_s}}$$

r =	2.8	:1	(Length:Width Ratio)
Q_p =	0.013	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **10.92** **m**

b) Dispersion Length (MOECC SWMP&D, Equation 4.6)

$$Dispersion\ Length = \frac{8 * Q}{D * V_f}$$

Q =	0.556	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.50	m	(Depth of Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **5.93** **m**

c) Minimum Forebay Deep Zone Bottom Width (MOECC SWMP&D, Equation 4.7)

$$Width = \frac{Dispersion\ Length}{8}$$

Minimum Forebay Length from Equations 3.3 and 3.4

10.92 m (minimum required length)

Width = **1.36** **m** (minimum required width)

d) Average Velocity of Flow

$$Average\ Velocity = \frac{Q}{A}$$

Q =	0.316	m^3/s	(Quality Design Inflow)
A =	12.75	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	4.00	m	(Proposed Bottom Width)
S =	3	:1	(Side slopes - minimum)

Average Velocity = **0.02** **m/s**

Is this Acceptable? **Yes** (Maximum velocity of flow = 0.15 m/s)

e) Cleanout Frequency

Is this Acceptable? **Yes**	L =	11.0	m (Proposed Bottom Length)
	ASL =	2.8	m^3/ha (Annual Sediment Loading)
	A =	5.0	ha (Drainage Area)
	FRC =	70	% (Facility Removal Efficiency)
	FV =	228.0	m^3 (Forebay Volume)

Cleanout Frequency = **11.3** **years**

Is this Acceptable? **Yes** (10 year minimum cleanout frequency)

Table 13 details the difference in peak stormwater flows for existing (allowable) and future conditions with the proposed stormwater management facility. The table outlines that the proposed facility will restrict stormwater flows during the 5 year event to below levels experienced during the 2 year event under existing conditions.

Table 13. Impacts of Wet Pond Facility on Peak Flows
High Pointe Extension

Design Storm	Peak Flow (m^3/s)		
	Existing	**Future with SWM**	**Change***
25mm	0.013	0.013	-
2 Year	**0.028**	0.017	-39.3%
5 Year	0.067	**0.021**	-68.7%
100 Year	0.251	0.115	-54.2%

Note: *indicates the percent change between existing conditions and future conditions with stormwater management controls in place.

Therefore, the proposed stormwater management facility will be able to adequately provide all necessary quantity and quality controls for the proposed High Pointe East development as well as the additional development expected immediately south on the #1199 Pettit Road property (High Pointe Extension).

5.3 Proposed Pettit Road Storm Sewer

As there is no suitable stormwater outlet for the proposed High Pointe East development, it is proposed to construct a storm sewer on Pettit Road to from the existing storm sewer on Garrison Road to the stormwater outlet as part of the proposed stormwater management facility. The storm sewer will be sized to accommodate flows from upstream and downstream areas included in the initial Garrison Road storm sewer design drainage areas for the 2 year design storm event.

Due to the existing infrastructure within the Pettit Road road allowance, the storm sewer will be required to be constructed on the west portion of Pettit Road between the municipal 150mm diameter watermain and the Regional 400mm diameter watermain. Using information gathered through adjacent completed developments and plans provided by the Town it is estimated that a minimum clearance of 8.0m is currently provided between the watermains without other significant infrastructure, leaving suitable space for the proposed storm sewer.

The cost of the proposed Pettit Road storm sewer is expected to be financed by the Town's Development Charges, though some cost sharing may occur due to upstream drainage areas.

6.0 SEDIMENT AND EROSION CONTROL

Sediment and erosion controls are required during all construction phases of this development to limit the transport of sediment into the adjacent Locally Significant Wetland as well as the Eagle Marsh Drain.

The following additional erosion and sediment controls will also be implemented during construction:

- Install silt control fencing along the limits of construction of the development to collect sediment in overland flows before discharging to downstream systems. The silt control fence installed along east end of site will be installed along the wetland buffer to act as the limit of construction.

- Re-vegetate disturbed areas as soon as possible after grading works have been completed.

- Lot grading and siltation controls plans will be provided with sediment and erosion control measures to the appropriate agencies for approval during the final design stage.

7.0 STORMWATER MANAGEMENT FACILITY MAINTENANCE

7.1 Wetpond Facility

Maintenance is a necessary and important aspect of urban stormwater quality and quantity measures such as constructed wetlands. Many pollutants (ie. nutrients, metals, bacteria, etc.) bind to sediment and therefore removal of sediment on a scheduled basis is required.

The wet pond for this development is subject to frequent wetting and deposition of sediments as a result of frequent low intensity storm events. The purpose of the wet pond is to improve post development sediment and contaminant loadings by detaining the 'first flush' flow for a 24 hour period. For the initial operation period of the stormwater management facility, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the home construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the effectiveness of sediment and erosion control techniques employed.

Inspections of the wet pond will indicate whether or not maintenance is required. Inspections should be made after every significant storm during the first two years of operation or until all development is completed to ensure the wet pond is functioning properly. This may translate into an average of six inspections per year. Once all building activity is finalized, inspections shall be performed annually. The following points should be addressed during inspections of the facility.

a) Standing water above the inlet storm sewer invert a day or more after a storm may indicate a blockage in the reverse slope pipe or orifice. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.

b) The vegetation around the wet pond should be inspected to ensure its function and aesthetics. Visual inspections will indicate whether replacement of plantings are required. A decline in vegetation habitat may indicate that other aspects of the constructed wet pond are operating improperly, such as the detention times may be inadequate or excessive.

c) The accumulation of sediment and debris at the wet pond inlet sediment forebay or around the high water line of the wet pond should be inspected. This will indicate the need for sediment removal or debris clean up.

d) The wet pond has been created by excavating a detention area. The integrity of the embankments should be periodically checked to ensure that it remains watertight and the side slopes have not sloughed.

Grass cutting is a maintenance activity that is done solely for aesthetic purposes. It is recommended that grass cutting be eliminated. It should be noted that municipal by-laws may require regular grass maintenance for weed control.

Trash removal is an integral part of maintenance and an annual cleanup, usually in the spring, is a minimum requirement. After this, trash removal is performed as required basis on observation of trash build-up during inspections.

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically to ensure that sediment in not deposited throughout the facility. For sediment removal operations, typical grading/excavating equipment should be used to remove sediment from the inlet forebay and detention areas. Care should be taken to ensure that limited damage occurs to existing vegetation and habitat.

Generally the sediment which is removed from the detention pond will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, the following conclusions are offered:

- Infiltration techniques are not suitable for this site as the primary control facility due to the low soil infiltration rates and the large drainage area for this development.

- The proposed stormwater management facilities will provide stormwater quality and quantity controls for the approximately 5.0 hectare catchment area of the High Pointe East development and expected development area within the #1199 Pettit Road lands (discussed in this report as High Pointe Extension).

- The proposed Pettit Road storm sewer will convey stormwater flows from the proposed stormwater management facility and surrounding lands directly to the Garrison Road Storm Sewer.

- Various lot level vegetative stormwater management practices can be implemented to enhance stormwater quality.

- This report was prepared in accordance with the provincial guidelines contained in "Stormwater Management Planning and Design Manual, March 2003".

The above conclusions lead to the following recommendations:

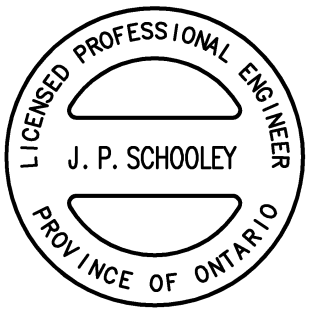
- That the stormwater management criteria established in this report be accepted.

- That a stormwater management wet pond facility be constructed to provide stormwater quality protection to MECP *Normal* Protection levels and quantity controls as outlined in this report.

- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.

Prepared By:

Kurt Tiessen, E.I.T.



Reviewed By:

Jason Schooley, P.Eng.
February 9, 2023

APPENDICES

APPENDIX A

Weighted Impervious Calculation Sheet

Weighted Imperviousness Percentage Calculation Worksheet

Project Name:	High Pointe Estates
Project Number:	21132
Date:	January 2023
Person:	K. Tiessen E.I.T

EX1 - EXISTING CONDITIONS (HIGH POINTE EAST)

	Footprint	*Runoff Coefficient*	*Effective Impervious Area*
Drainage Area 1	27187.9 m^2	0.20	5437.6 m^2
Drainage Area 2	1160.9 m^2	0.45	522.4 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS			5,960 m^2
TOTAL CATCHMENT AREA			28,349 m^2
		RUNOFF COEFFICIENT	**0.21**
		EFFECTIVE WEIGHTED CATCHMENT % IMPERVIOUS	**1.5%**

EX2 - EXISTING CONDITIONS (HIGH POINTE EXTENSION)

	Footprint	*Runoff Coefficient*	*Effective Impervious Area*
Drainage Area 1	33727.7 m^2	0.20	6745.5 m^2
Drainage Area 2	1707.8 m^2	0.45	768.5 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS			7,514 m^2
TOTAL CATCHMENT AREA			35,436 m^2
		RUNOFF COEFFICIENT	**0.21**
		EFFECTIVE WEIGHTED CATCHMENT % IMPERVIOUS	**1.7%**

APPENDIX B

Stormwater Management Facility Calculations – High Pointe East
MIDUSS Output Files – High Pointe East Design

Upper Canada Consultants
30 HANNOVER DRIVE, UNIT 3
St. Catharines, Ontario L2W 1A3

DATE: JANUARY 2023

PROJECT NAME: HIGH POINTE EAST
PROJECT NO.: 22116

STORMWATER MANAGEMENT FACILITY WETPOND
HIGH POINTE EAST

Quality Requirements		Quality Orifice		Ditch Inlet Weir		Outflow Pipe Orifice		Overflow Spillway	
Drainage Area (ha) =	4.14	Diameter (m) =	0.100	Length (m) =	0.60	Diameter (m) =	0.450	Minor Length (m) =	3.00
Normal (m^3/ha) =	130	(@ 70% Imp) Cd =	0.63	Width (m) =	0.60	Cd =	0.63	Slopes (X:1) =	3.00
Perm Pool (m^3/ha) =	90	Invert (m) =	0.00	Grate Slope (X:1) =	5	Invert (m) =	0.00	Minor Invert (m) =	1.75
Perm Pool Vol (m^3) =	373			Inlet Elevation (m) =	1.00	Overt (m) =	0.45	Major Length (m) =	0.00
Active Vol (m^3)	166			Cd =	1.84			Major Invert (m) =	2.25
Perm. Pool Elev. =	0.00	m						MOE Equation 4.10 Drawdown Coefficient 'C2' =	699
								MOE Equation 4.10 Drawdown Coefficient 'C3' =	904
								MOE Equation 4.10 Drawdown Time (h) =	**30.2**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m^2)	Average Surface Area (m^2)	Increment Volume (m^3)	Permanent Volume (m^3)	Active Volume (m^3)	Quality Orifice (m^3/s)	Ditch Inlet (m^3/s)	Max Pipe Orifice (m^3/s)	Overflow Spillway (m^3/s)	Total Outflow (m^3/s)	Average Discharge (m^3/s)
-1.60		-1.60	48			0							
	0.85			138	117								
-0.75		-0.75	227			117							
	0.00			243	0								
-0.75		-0.75	260			117							
	0.75			447	335								
0.00		0.00	634			452							
	0.00			769	0								
0.00		0.00	903				0.0	0.000	0.000	0.00	0.00	0.00	
	0.75			1,167	875								0.009
0.75		0.75	1,430				874.9	0.018	0.000	0.298	0.000	0.0181	
	0.25			1,515	379								0.020
1.00		1.00	1,601				1253.7	0.021	0.000	0.371	0.000	0.0212	
	0.75			1,873	1,404								0.204
1.75		1.75	2,144				2658.1	0.028	0.359	0.534	0.000	0.3870	
	0.10			2,213	221								0.424
1.85		1.85	2,282				2879.4	0.029	0.433	0.553	0.150	0.4618	

Notes

1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
3. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
4. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

Existing Conditions – High Pointe East

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           24   144    10.000       are MAXDT MAXHYD & DTMIN values
       Licensee: UPPER CANADA CONSULTANTS
 35     COMMENT
       4    line(s) of comment
       PROJECT NAME: HIGH POINTE EAST, FORT ERIE
       PROJECT NO.:  22116
       STORMWATER MANAGEMENT ANALYSIS JANUARY 2023
       EXISTING CONDITIONS
 14     START
       1    1=Zero; 2=Define
 35     COMMENT
       1    line(s) of comment
       25mm DESIGN STORM EVENT
  2     STORM
           1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      512.000    Coefficient  a
        6.000    Constant  b   (min)
         .800    Exponent  c
         .400    Fraction to peak  r
      240.000    Duration ó  240 min
              25.036 mm    Total depth
  3     IMPERVIOUS
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013    Manning "n"
       98.000    SCS Curve No or C
         .100    Ia/S Coefficient
         .518    Initial Abstraction
  4     CATCHMENT
        1.000    ID No.ó 99999
        2.830    Area in hectares
       80.000    Length (PERV) metres
        2.000    Gradient (%)
        1.500    Per cent Impervious
       80.000    Length (IMPERV)
         .000    %Imp. with Zero Dpth
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250    Manning "n"
       77.000    SCS Curve No or C
         .100    Ia/S Coefficient
        7.587    Initial Abstraction
           1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .011      .000      .000      .000 c.m/s
            .130      .798      .140    C perv/imperv/total
 15     ADD RUNOFF
            .011      .011      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5    is # of Hyeto/Hydrograph chosen
       Volume  =  .9937796E+02 c.m
 14     START
       1    1=Zero; 2=Define
 35     COMMENT
       1    line(s) of comment
        2 YEAR DESIGN STORM EVENT
  2     STORM
           1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      628.050    Coefficient  a
        6.652    Constant  b   (min)
         .796    Exponent  c
         .400    Fraction to peak  r
      240.000    Duration ó  240 min
             31.329 mm    Total depth
  3     IMPERVIOUS
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013    Manning "n"
       98.000    SCS Curve No or C
         .100    Ia/S Coefficient
         .518    Initial Abstraction
  4     CATCHMENT
        1.000    ID No.ó 99999
        2.830    Area in hectares
       80.000    Length (PERV) metres
        2.000    Gradient (%)
        1.500    Per cent Impervious
       80.000    Length (IMPERV)
         .000    %Imp. with Zero Dpth
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250    Manning "n"
       77.000    SCS Curve No or C
         .100    Ia/S Coefficient
        7.587    Initial Abstraction
           1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .022      .000      .000      .000 c.m/s
            .181      .830      .190    C perv/imperv/total
 15     ADD RUNOFF
            .022      .022      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5    is # of Hyeto/Hydrograph chosen
       Volume  =  .1686360E+03 c.m
 14     START
       1    1=Zero; 2=Define
 35     COMMENT
       1    line(s) of comment
        5 YEAR DESIGN STORM EVENT
  2     STORM
           1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      747.930    Coefficient  a
        6.800    Constant  b   (min)
         .768    Exponent  c
         .400    Fraction to peak  r
      240.000    Duration ó  240 min
             43.510 mm    Total depth
  3     IMPERVIOUS
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013    Manning "n"
       98.000    SCS Curve No or C
         .100    Ia/S Coefficient
         .518    Initial Abstraction
  4     CATCHMENT
        1.000    ID No.ó 99999
        2.830    Area in hectares
       80.000    Length (PERV) metres
        2.000    Gradient (%)
        1.500    Per cent Impervious
       80.000    Length (IMPERV)
         .000    %Imp. with Zero Dpth
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250    Manning "n"
       77.000    SCS Curve No or C
         .100    Ia/S Coefficient
        7.587    Initial Abstraction
           1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .053      .000      .000      .000 c.m/s
              .265      .869      .274    C perv/imperv/total
 15     ADD RUNOFF
            .053      .053      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5    is # of Hyeto/Hydrograph chosen
       Volume  =  .3375713E+03 c.m
 14     START
       1    1=Zero; 2=Define
 35     COMMENT
       1    line(s) of comment
       100 YEAR DESIGN STORM EVENT
  2     STORM
           1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     1083.550    Coefficient  a
        6.618    Constant  b   (min)
         .735    Exponent  c
         .400    Fraction to peak  r
      240.000    Duration ó  240 min
             75.641 mm    Total depth
  3     IMPERVIOUS
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013    Manning "n"
       98.000    SCS Curve No or C
         .100    Ia/S Coefficient
         .518    Initial Abstraction
  4     CATCHMENT
        1.000    ID No.ó 99999
        2.830    Area in hectares
       80.000    Length (PERV) metres
        2.000    Gradient (%)
        1.500    Per cent Impervious
       80.000    Length (IMPERV)
         .000    %Imp. with Zero Dpth
           1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250    Manning "n"
       77.000    SCS Curve No or C
         .100    Ia/S Coefficient
        7.587    Initial Abstraction
           1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .201      .000      .000      .000 c.m/s
              .424      .914      .432    C perv/imperv/total
 15     ADD RUNOFF
            .201      .201      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5    is # of Hyeto/Hydrograph chosen
       Volume  =  .9237175E+03 c.m
 20     MANUAL
```

Developed Conditions – High Pointe East

```
        Output File (4.7) SWM.OUT      opened 2023-02-01   9:58
        Units used are defined by G =    9.810
            24   144    10.000        are MAXDT MAXHYD & DTMIN values
        Licensee: UPPER CANADA CONSULTANTS
 35     COMMENT
       4     line(s) of comment
        PROJECT NAME: HIGH POINTE EAST, FORT ERIE
        PROJECT NO.:  22116
        STORMWATER MANAGEMENT ANALYSIS JANUARY 2023
        FUTURE CONDITIONS
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***************************
        * 25MM DESIGN STORM EVENT *
        ***************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      512.000     Coefficient  a
        6.000     Constant  b    (min)
         .800     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 25.036 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        4.210     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .266       .000       .000       .000 c.m/s
               .130       .806       .604     C perv/imperv/total
 15     ADD RUNOFF
               .266       .266       .000       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .6347526E+03 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1253.7
         1.750        .387      2658.1
         1.850        .462      2879.4
        Peak Outflow    =      .011 c.m/s
        Maximum Depth   =      .439 metres
        Maximum Storage =      512. c.m
               .266       .266       .011       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        *****************************
        * 2 YEAR DESIGN STORM EVENT *
        *****************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      628.050     Coefficient  a
        6.652     Constant  b    (min)
         .796     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 31.329 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        4.210     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .343       .000       .011       .000 c.m/s
               .181       .837       .640     C perv/imperv/total
 15     ADD RUNOFF
               .343       .343       .011       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .8438713E+03 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1253.7
         1.750        .387      2658.1
         1.850        .462      2879.4
        Peak Outflow    =      .014 c.m/s
        Maximum Depth   =      .584 metres
        Maximum Storage =      682. c.m
               .343       .343       .014       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        *****************************
        * 5 YEAR DESIGN STORM EVENT *
        *****************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      747.930     Coefficient  a
        6.800     Constant  b    (min)
         .768     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 43.510 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        4.210     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .468       .000       .014       .000 c.m/s
               .265       .870       .688     C perv/imperv/total
 15     ADD RUNOFF
               .468       .468       .014       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1260851E+04 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1253.7
         1.750        .387      2658.1
         1.850        .462      2879.4
        Peak Outflow    =      .019 c.m/s
        Maximum Depth   =      .851 metres
        Maximum Storage =     1028. c.m
               .468       .468       .019       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***********************************
        **  100 YEAR DESIGN STORM EVENT  **
        ***********************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     1083.550     Coefficient  a
        6.618     Constant  b    (min)
         .735     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 75.641 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        4.210     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .768       .000       .019       .000 c.m/s
               .425       .909       .764     C perv/imperv/total
 15     ADD RUNOFF
               .768       .768       .019       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .2432948E+04 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1253.7
         1.750        .387      2658.1
         1.850        .462      2879.4
        Peak Outflow    =      .112 c.m/s
        Maximum Depth   =     1.187 metres
        Maximum Storage =     1603. c.m
               .768       .768       .112       .000 c.m/s
 20     MANUAL
```

APPENDIX C

Stormwater Management Facility Calculations – High Pointe Extension
MIDUSS Output Files – High Pointe Extension Design

Upper Canada Consultants
30 HANNOVER DRIVE, UNIT 3
St. Catharines, Ontario L2W 1A3

DATE: JANUARY 2023

PROJECT NAME: HIGH POINTE EAST
PROJECT NO.: 22116

STORMWATER MANAGEMENT FACILITY WETPOND

HIGH POINTE EXTENSION

Quality Requirements		Quality Orifice		Ditch Inlet Weir		Outflow Pipe Orifice		Overflow Spillway	
Drainage Area (ha) =	5.00	Diameter (m) =	0.100	Length (m) =	0.60	Diameter (m) =	0.450	Minor Length (m) =	3.00
Normal (m^3/ha) =	130	(@ 70% Imp) Cd =	0.63	Width (m) =	0.60	Cd =	0.63	Slopes (X:1) =	3.00
Perm Pool (m^3/ha) =	90	Invert (m) =	0.00	Grate Slope (X:1) =	5	Invert (m) =	0.00	Minor Invert (m) =	1.75
Perm Pool Vol (m^3) =	450			Inlet Elevation (m) =	1.00	Overt (m) =	0.45	Major Length (m) =	0.00
Active Vol (m^3)	200			Cd =	1.84			Major Invert (m) =	2.25
Perm. Pool Elev. =	0.00 m							MOE Equation 4.10 Drawdown Coefficient 'C2' =	699
								MOE Equation 4.10 Drawdown Coefficient 'C3' =	904
								MOE Equation 4.10 Drawdown Time (h) =	**30.2**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m^2)	Average Surface Area (m^2)	Increment Volume (m^3)	Permanent Volume (m^3)	Active Volume (m^3)	Quality Orifice (m^3/s)	Ditch Inlet (m^3/s)	Max Pipe Orifice (m^3/s)	Overflow Spillway (m^3/s)	Total Outflow (m^3/s)	Average Discharge (m^3/s)
-1.60		-1.60	48			0							
	0.85			138	117								
-0.75		-0.75	227			117							
	0.00			244	0								
-0.75		-0.75	260			117							
	0.75			447	335								
0.00		0.00	634			452							
	0.00			769	0								
0.00		0.00	903				0.0	0.000	0.000	0.00	0.00	0.00	
	0.75			1,167	875								0.009
0.75		0.75	1,430				874.9	0.018	0.000	0.298	0.000	0.0181	
	0.25			1,515	379								0.020
1.00		1.00	1,601				1253.7	0.021	0.000	0.371	0.000	0.0212	
	0.75			1,873	1,404								0.204
1.75		1.75	2,144				2658.1	0.028	0.359	0.534	0.000	0.3870	
	0.10			2,213	221								0.424
1.85		1.85	2,282				2879.4	0.029	0.433	0.553	0.150	0.4618	

Notes

1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
3. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
4. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

Existing Conditions – High Pointe Extension

```
       Output File (4.7) EX.OUT      opened 2023-02-01   8:58
       Units used are defined by G =    9.810
           24   144    10.000       are MAXDT MAXHYD & DTMIN values
       Licensee: UPPER CANADA CONSULTANTS
 35    COMMENT
      4    line(s) of comment
       PROJECT NAME: HIGH POINTE EAST, FORT ERIE
       PROJECT NO.:  22116
       STORMWATER MANAGEMENT ANALYSIS JANUARY 2023
       EXISTING CONDITIONS
 14    START
      1    1=Zero; 2=Define
 35    COMMENT
      1    line(s) of comment
       25mm DESIGN STORM EVENT
  2    STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     512.000    Coefficient  a
       6.000    Constant  b   (min)
        .800    Exponent  c
        .400    Fraction to peak  r
     240.000    Duration ó  240 min
              25.036 mm    Total depth
  3    IMPERVIOUS
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .013    Manning "n"
      98.000    SCS Curve No or C
        .100    Ia/S Coefficient
        .518    Initial Abstraction
  4    CATCHMENT
       1.000    ID No.ó 99999
       3.540    Area in hectares
      80.000    Length (PERV) metres
       2.000    Gradient (%)
       1.700    Per cent Impervious
      80.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      77.000    SCS Curve No or C
        .100    Ia/S Coefficient
       7.587    Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .013      .000      .000      .000 c.m/s
             .130      .798      .142    C perv/imperv/total
 15    ADD RUNOFF
             .013      .013      .000      .000 c.m/s
 27    HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .1254943E+03 c.m
 14    START
      1    1=Zero; 2=Define
 35    COMMENT
      1    line(s) of comment
       2 YEAR DESIGN STORM EVENT
  2    STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     628.050    Coefficient  a
       6.652    Constant  b   (min)
        .796    Exponent  c
        .400    Fraction to peak  r
     240.000    Duration ó  240 min
              31.329 mm    Total depth
  3    IMPERVIOUS
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .013    Manning "n"
      98.000    SCS Curve No or C
        .100    Ia/S Coefficient
        .518    Initial Abstraction
  4    CATCHMENT
       1.000    ID No.ó 99999
       3.540    Area in hectares
      80.000    Length (PERV) metres
       2.000    Gradient (%)
       1.700    Per cent Impervious
      80.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      77.000    SCS Curve No or C
        .100    Ia/S Coefficient
       7.587    Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .028      .000      .000      .000 c.m/s
             .181      .830      .192    C perv/imperv/total
 15    ADD RUNOFF
             .028      .028      .000      .000 c.m/s
 27    HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .2123855E+03 c.m
 14    START
      1    1=Zero; 2=Define
 35    COMMENT
      1    line(s) of comment
       5 YEAR DESIGN STORM EVENT
  2    STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     747.930    Coefficient  a
       6.800    Constant  b   (min)
        .768    Exponent  c
        .400    Fraction to peak  r
     240.000    Duration ó  240 min
              43.510 mm    Total depth
  3    IMPERVIOUS
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .013    Manning "n"
      98.000    SCS Curve No or C
        .100    Ia/S Coefficient
        .518    Initial Abstraction
  4    CATCHMENT
       1.000    ID No.ó 99999
       3.540    Area in hectares
      80.000    Length (PERV) metres
       2.000    Gradient (%)
       1.700    Per cent Impervious
      80.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      77.000    SCS Curve No or C
        .100    Ia/S Coefficient
       7.587    Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .067      .000      .000      .000 c.m/s
             .265      .869      .275    C perv/imperv/total
 15    ADD RUNOFF
             .067      .067      .000      .000 c.m/s
 27    HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .4241230E+03 c.m
 14    START
      1    1=Zero; 2=Define
 35    COMMENT
      1    line(s) of comment
       100 YEAR DESIGN STORM EVENT
  2    STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1083.550    Coefficient  a
       6.618    Constant  b   (min)
        .735    Exponent  c
        .400    Fraction to peak  r
     240.000    Duration ó  240 min
              75.641 mm    Total depth
  3    IMPERVIOUS
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .013    Manning "n"
      98.000    SCS Curve No or C
        .100    Ia/S Coefficient
        .518    Initial Abstraction
  4    CATCHMENT
       1.000    ID No.ó 99999
       3.540    Area in hectares
      80.000    Length (PERV) metres
       2.000    Gradient (%)
       1.700    Per cent Impervious
      80.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      77.000    SCS Curve No or C
        .100    Ia/S Coefficient
       7.587    Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .251      .000      .000      .000 c.m/s
             .424      .914      .433    C perv/imperv/total
 15    ADD RUNOFF
             .251      .251      .000      .000 c.m/s
 27    HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .1158089E+04 c.m
 20    MANUAL
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Developed Conditions – High Pointe East

```
        Output File (4.7) SWM.OUT      opened 2023-02-01   9:56
        Units used are defined by G =    9.810
            24   144    10.000        are MAXDT MAXHYD & DTMIN values
        Licensee: UPPER CANADA CONSULTANTS
 35     COMMENT
       4     line(s) of comment
        PROJECT NAME: HIGH POINTE EAST, FORT ERIE
        PROJECT NO.:  22116
        STORMWATER MANAGEMENT ANALYSIS JANUARY 2023
        FUTURE CONDITIONS
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***************************
        * 25MM DESIGN STORM EVENT *
        ***************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      512.000     Coefficient  a
        6.000     Constant  b    (min)
         .800     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 25.036 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        5.000     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .316       .000       .000       .000 c.m/s
               .130       .806       .604     C perv/imperv/total
 15     ADD RUNOFF
               .316       .316       .000       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .7538627E+03 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1260.0
         1.750        .387      2664.4
         1.850        .462      2885.7
        Peak Outflow    =      .013 c.m/s
        Maximum Depth   =      .521 metres
        Maximum Storage =      608. c.m
               .316       .316       .013       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        *****************************
        * 2 YEAR DESIGN STORM EVENT *
        *****************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      628.050     Coefficient  a
        6.652     Constant  b    (min)
         .796     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 31.329 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        5.000     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .408       .000       .013       .000 c.m/s
               .181       .837       .640     C perv/imperv/total
 15     ADD RUNOFF
               .408       .408       .013       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1002222E+04 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1260.0
         1.750        .387      2664.4
         1.850        .462      2885.7
        Peak Outflow    =      .017 c.m/s
        Maximum Depth   =      .694 metres
        Maximum Storage =      809. c.m
               .408       .408       .017       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        *****************************
        * 5 YEAR DESIGN STORM EVENT *
        *****************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      747.930     Coefficient  a
        6.800     Constant  b    (min)
         .768     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 43.510 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        5.000     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .556       .000       .017       .000 c.m/s
               .265       .870       .688     C perv/imperv/total
 15     ADD RUNOFF
               .556       .556       .017       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1497447E+04 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1260.0
         1.750        .387      2664.4
         1.850        .462      2885.7
        Peak Outflow    =      .021 c.m/s
        Maximum Depth   =      .985 metres
        Maximum Storage =     1237. c.m
               .556       .556       .021       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***********************************
        **  100 YEAR DESIGN STORM EVENT  **
        ***********************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     1083.550     Coefficient  a
        6.618     Constant  b    (min)
         .735     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 75.641 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .013     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
  4     CATCHMENT
        1.000     ID No.ó 99999
        5.000     Area in hectares
      200.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       77.000     SCS Curve No or C
         .100     Ia/S Coefficient
        7.587     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .912       .000       .021       .000 c.m/s
               .425       .909       .764     C perv/imperv/total
 15     ADD RUNOFF
               .912       .912       .021       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .2889488E+04 c.m
 10     POND
       5 Depth - Discharge - Volume sets
          .000        .000          .0
          .750       .0181       874.9
         1.000       .0212      1260.0
         1.750        .387      2664.4
         1.850        .462      2885.7
        Peak Outflow    =      .155 c.m/s
        Maximum Depth   =     1.274 metres
        Maximum Storage =     1772. c.m
               .912       .912       .155       .000 c.m/s
 20     MANUAL
```