UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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UCC File: 21132

FUNCTIONAL SERVICING REPORT

Northland Estates
City of Port Colborne
Revised July 2022

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 Northland Estates as part of the Draft Plan of Subdivision application process for the City of Port Colborne.

The project site is located in the City of Port Colborne as part of Lot 31 and Concession 2 and is situated north of Coronation Drive North, east of Minor Road, south of Barrick Road and west of West Side Road (Regional Road 58) with site entrances on Northland Avenue. The site is bound by a Locally Significant Wetland at the west limits of the site, and the development area has historically been agricultural/vacant land.

The development site is approximately 16.65 hectares and shall consist of 122 single family dwellings, 50 townhouse units, and a mixed commercial/residential block with 50 residential units for a total unit count of 222 units. The site shall include associated asphalt road, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

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.

WATER SERVICING

There is an existing municipal 300mm diameter Ductile Iron watermain located on the north side of Northland Avenue as well as a municipal 400mm diameter PVC watermain on the west side of West Side Road (Regional Road 58). Two connections will be made to the Northland Avenue watermain to provide an internal loop within the development to provide both domestic water supply and fire protection. Four single family dwellings are to be constructed fronting West Side Road and will be provided service via the 400mm diameter watermain fronting the units.

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 municipal fire hydrants within the subdivision and private fire hydrants within the mixed-use condominium block. The spacing and location shall be identified as part future detailed design. Fire protection will be provided to the four proposed units fronting West Side Road via an existing hydrant fronting #339 West Side Road.

SANITARY SERVICING

There is an existing 200mm diameter municipal sanitary sewer on the west side of West Side Road (Regional Road 58) as well as a 250mm diameter sanitary sewer on Northland Avenue. The three proposed single family dwellings fronting West Side Road will be provided service via the existing 200mm diameter sewer on West Side Road, with the remaining majority of the development block discharging sanitary flows to the existing sanitary sewer on Northland Avenue. All sanitary sewers will convey flows via gravity to their respective outlets.

A sanitary analysis has been conducted for the sanitary sewer immediately downstream of the proposed development site on Northland Avenue. The analysis includes the adjacent commercial development as part of the Port Colborne Mall (287 West Side Mall) outletting flows to the sanitary sewer at a rate of 28m^3/ha/day. The combination of sanitary flows from the proposed Northland Estates subdivision in addition to the Port Colborne Mall will produce a peak sanitary outflow of approximately 13.46L/s to the downstream sanitary system. As the existing 250mm dia. sanitary sewer on Northland Avenue has a full flow capacity of approximately 32.83L/s, the combined flows will occupy 41.0% of the overall capacity. Therefore, the existing sanitary sewer system immediately downstream of the site will have adequate capacity for the proposed development.

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 City of Port Colborne 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 wetpond 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 channel will be created to convey stormwater flows from the proposed stormwater management facility and surrounding lands to the Eagle March Drain. Roadway overland flows will be directed to the stormwater management facility at the north end of the site. 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 300mm diameter municipal watermain will have sufficient capacity to provide both domestic and fire protection water supply.

2. The existing 250mm diameter municipal sanitary sewer on Northland Avenue will have adequate capacity for the proposed residential development.

3. Stormwater quality controls are being provided to Normal Protection (70% TSS removal) levels by a stormwater wetpond facility before outletting to the Eagle Marsh Drain.

4. Stormwater quantity controls are being provided by a stormwater management wetpond facility up to the 100 year design storm event before outletting to the Eagle Marsh Drain.

5. The site stormwater overland route from the road system is to the proposed stormwater management facility before outletting to the Eagle Marsh Drain.

6. A channel will be created as an extension to the Eagle Marsh Drain to convey stormwater flows from the proposed stormwater management facility and surrounding lands to the Eagle Marsh Drain.

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.
Revised July 11, 2022

LICENSED PROFESSIONAL ENGINEER
J. P. SCHOOLEY
PROVINCE OF ONTARIO

Encl.

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APPENDICES

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APPENDIX A

Overall Sanitary Sewer Calculations

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

DESIGN FLOWS

RESIDENTIAL: 320 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
COMMERCIAL 28 m^3/ha/day
INFILTRATION RATE: 0.18 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: CITY OF PORT COLBORNE
PROJECT : NORTHLAND ESTATES
PROJECT NO: 21132

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**
Port Colborne Mall																		
obeys/Canadian Tire Gas Station			3.88	3.88		28 m^3/ha/day				1.26								
Calibrated population for commercial lands					26.5	3.0	80	80	4.27	1.26								
Total	EX MH	EX MH		3.88				80	4.27	1.26	0.70	1.96	200	19.0	0.69	0.88	28.42	6.9%
Northland Estates																		
Residential					225.0	3.0	675											
Commercial				0.69		28 m^3/ha/day				0.22								
Calibrated population for commercial lands					4.6	3.0	14	14	4.40	0.22								
Total		EX MH		9.69				689	3.90	9.95								
Northland Avenue	EX MH	EX MH		13.57				768	3.87	11.01	2.44	13.46	250	19.0	0.28	0.65	32.83	41.0%

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APPENDIX B

Northland Estates – Stormwater Management Plan

STORMWATER MANAGEMENT PLAN

NORTHLAND ESTATES

CITY OF PORT COLBORNE

Prepared for:

2600261 Ontario Inc.

Prepared by:

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July 2022

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Appendix B	MIDUSS Output Files

REFERENCES

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

STORMWATER MANAGEMENT PLAN

NORTHLAND ESTATES

CITY OF PORT COLBORNE

1.0 INTRODUCTION

1.1 Study Area

The proposed residential development is located in the City of Port Colborne as part of Lot 31 and Concession 2. As shown on the enclosed Site Location Plan (Figure 1), the subject property is situated north of Coronation Drive North, east of Minor Road, south of Barrick Road and west of West Side Road (Regional Road 58) with site entrances on Northland Avenue. This Stormwater Management Plan has been written to obtain approvals as part of the Draft Plan of Subdivision process.

The approximately 16.65ha property is bound by a Locally Significant Wetland to the west, a commercial plaza at the south east corner, and multiple residential properties to the north, east and south. 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 Eagle Marsh Drain.

1.2 Objectives

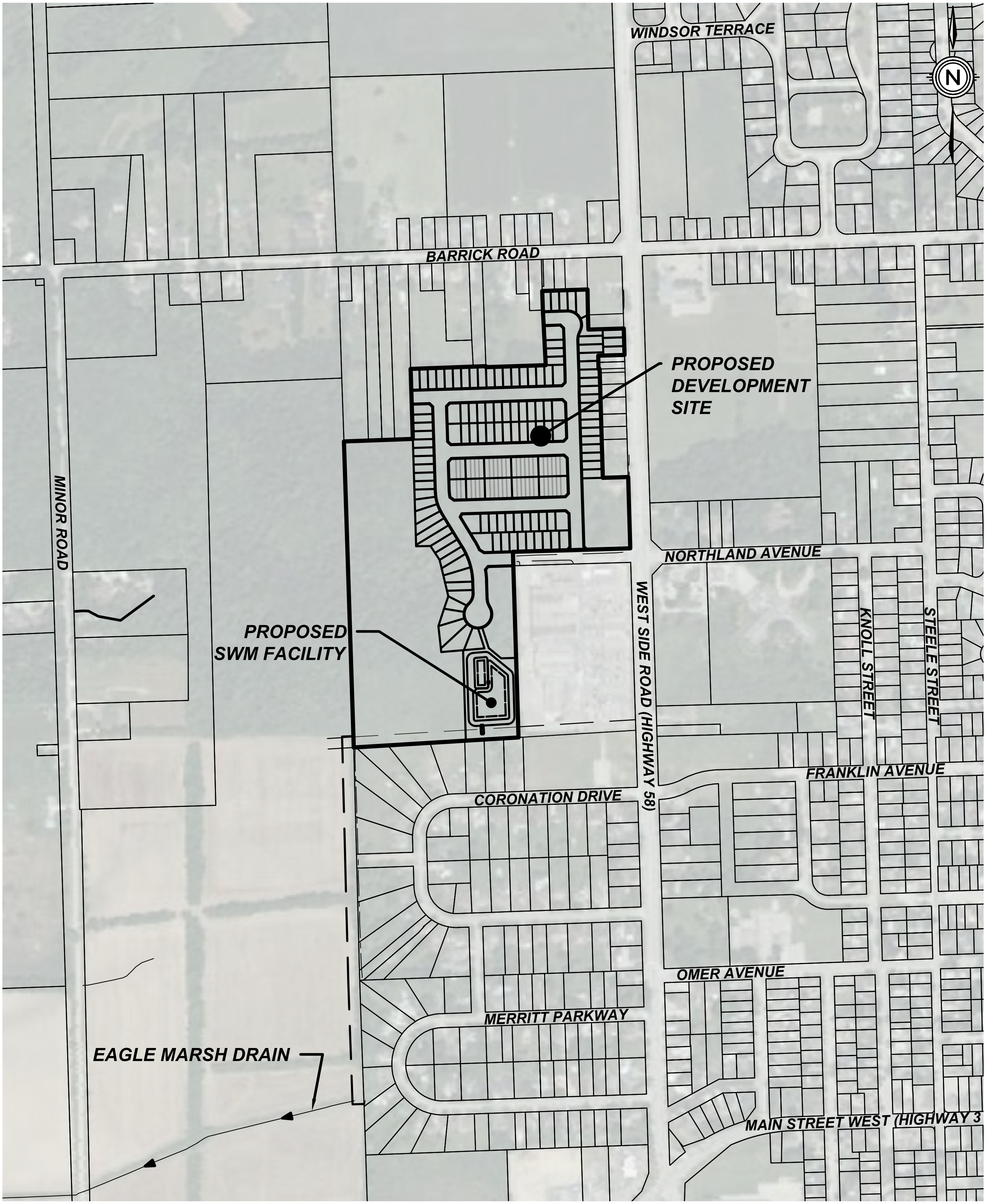
The objectives of this study are as follows:

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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NORTHLAND ESTATES

CITY OF PORT COLBORNE

SITE LOCATION PLAN

DATE	2022-07-11
SCALE	1:7,500 m
REF No.	21132
DWG No.	FIGURE 1

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1.3 Existing & Proposed Conditions

a) Existing Conditions

Historically, the site has been used for agricultural purposes, though more recently has been vacant land. The approximately 16.65-hectare property includes 5.70 hectares of undevelopable lands along the western limits comprised of an existing Locally Significant Wetland. The proposed development is located within the upper reaches of the Eagle Marsh Drain drainage area, with the actual drain located approximately 500m south of the south-west corner of the site. The existing topography of the site generally directs flows to the south-east to the adjacent Locally Significant Wetland or Eagle Marsh Drain with all flows ultimately outletting to the Eagle Marsh Drain.

The majority of native soils within the study area have been characterized as imperfectly drained loam/clay loam Franktown Soils (hydrologic soil group CB) with bedrock located less than 1m below the surface. Within the south-western portion of the site, the soil transitions to a low permeability clay and silt resulting in the perched water necessary to create the Locally Significant Wetlands.

b) Proposed Conditions

Approximately 11.0 hectares of the site is proposed to be developed, consisting of 122 single family dwellings, 50 townhouse units, and a mixed-use commercial/residential block with 50 units, resulting in a total unit count of 222 units. The site shall be provided with full municipal services including sanitary sewers, storm sewers and watermain with asphalt pavement, concrete curbs and gutters. The proposed 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 (City of Port Colborne, 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, Eagle Marsh Drain has been identified by the Ministry of Natural Resources watercourse evaluation as a **Type 2** (*Important*) fish habitat. Based on this fish habitat, the corresponding MECP level of protection for stormwater management quality practices on all new developments shall be *Normal*.
- The site outlets to the Eagle Marsh Drain which contains lands that would be negatively impacted by 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 MECP guidelines. It is proposed to provide Normal Protection (70% TSS removal) to the stormwater before outletting to the Eagle Marsh Drain.

- Stormwater **quantity** controls are to be provided for the outlet to limit the proposed development peak flows from the 25mm, 2, 5, 10, 25, 50, and 100 year storm events to existing peak flow levels

3.0 STORMWATER ANALYSIS

A stormwater analysis has been conducted by Upper Canada Consultants as part of the design of the Northland Estates development using the MIDUSS computer modelling program. A new stormwater analysis was conducted to represent the existing and future conditions to the Eagle Marsh Drain.

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 City of Welland Intensity-Duration-Frequency curves. Hyetographs for the 25mm, 2, 5, 10, 25, 50 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	397.149	0.0	0.699
5 Year	524.867	0.0	0.699
10 Year	608.845	0.0	0.699
25 Year	715.568	0.0	0.699
50 Year	794.298	0.0	0.699
100 Year	871.279	0.0	0.699

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

3.2 Existing Conditions

The existing conditions were modelled to establish the stormwater peak flows and volumes prior to development within this site. The existing drainage area for this subwatershed is shown on Figure 2. This area was determined from field investigations and a combination of recent topographic surveys as well as topographic information gathered from the Niagara Peninsula Conservation Authority (NPCA). Input parameters for the computer model for the 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 drainage areas for the proposed development, shown in Figure 3, were modelled to establish the stormwater peak flows and volumes once development has been completed at the proposed site. It is proposed to construct an internal storm sewer system to collect peak stormwater flows from the 17.65-hectare drainage area, and discharge to a proposed stormwater management facility prior to outletting to a proposed channel conveying flows to the Eagle Marsh Drain. Stormwater flows from the rear of lots 55 to 77 will outlet uncontrolled to the adjacent Locally Significant Wetland to maintain runoff volumes as required by the Water Balance Study (Terra-Dynamics, 2022)

Input parameters for the computer model with the proposed development conditions are shown in Table 2. Impervious Calculations for existing conditions are included in Appendix A.

Table 2. Hydrologic Parameters

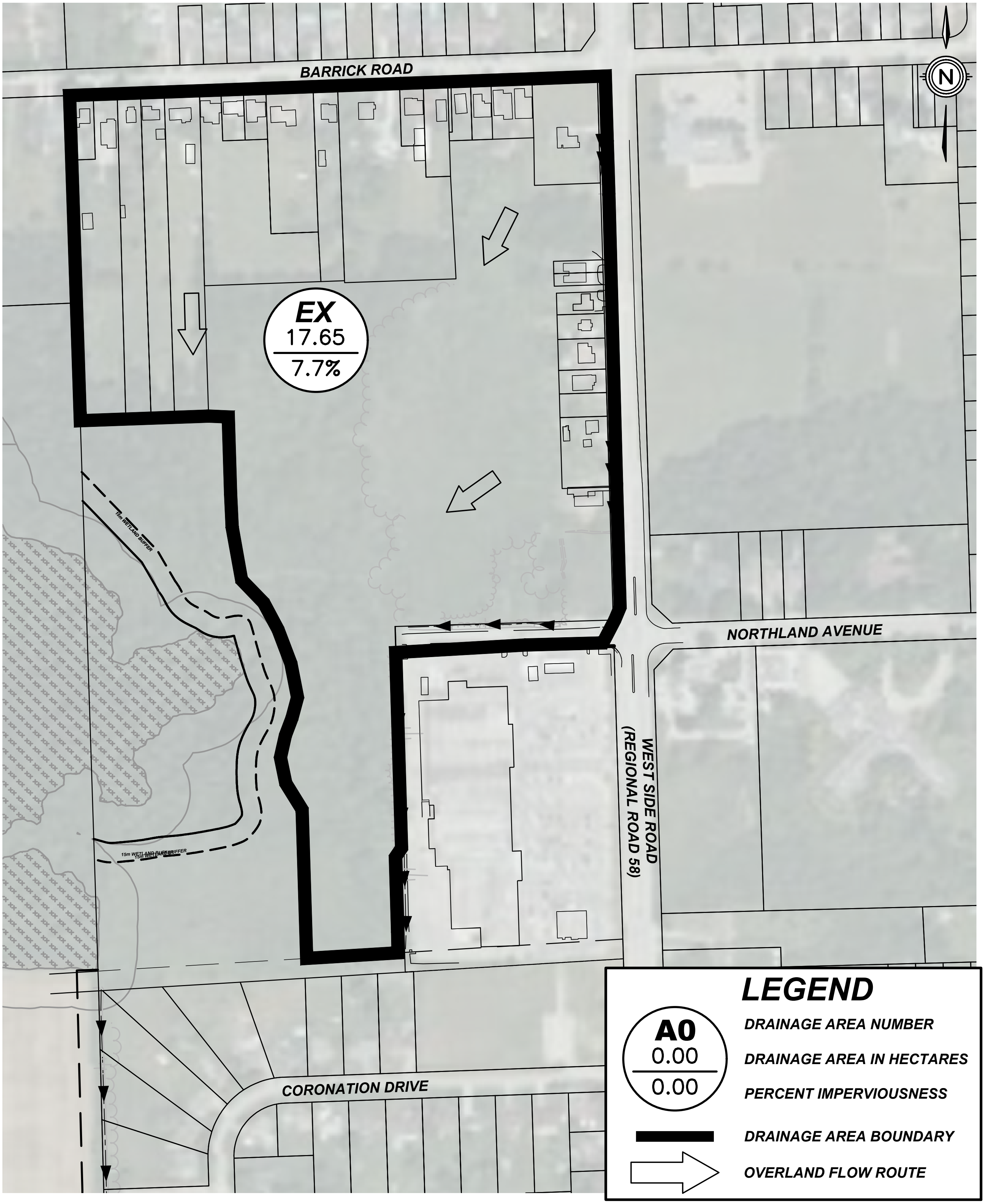
Area No.	Area (ha)	Length (m)	Slope (%)	SCS CN	Percent Impervious
Existing Conditions					
EX	17.65	500	2.0	77	5.8
	17.65	**Total Area**			
Future Conditions					
PROP	17.65	500	1.0	77	70.0
	17.65	**Total Area**			

The results of the modelling are shown in Table 3, where the peak flows and runoff volumes were calculated for the 25mm, 2, 5, 10, 25, 50 and 100 year design storm events. The future peak flows and volumes in Table 3 are for 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	0.091	0.868	+854%	748	2,659	+1,911
2 Year	0.142	1.547	+989%	1,466	3,995	+2,549
5 Year	0.213	2.185	+926%	2,515	5,584	+3,069
10 Year	0.267	2.602	+874%	3,294	6,714	+3,420
25 Year	0.390	3.126	+702%	4,365	8,185	+3,820
50 Year	0.513	3.507	+584%	5,204	9,278	+4,074
100 Year	0.626	3.875	+519%	6,056	10,351	+4,295

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 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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NORTHLAND ESTATES

CITY OF PORT COLBORNE

EXISTING OVERALL STORM DRAINAGE AREA PLAN

DATE	2022–05–17
SCALE	1:4000 m
REF No.	21132
DWG No.	FIGURE 2

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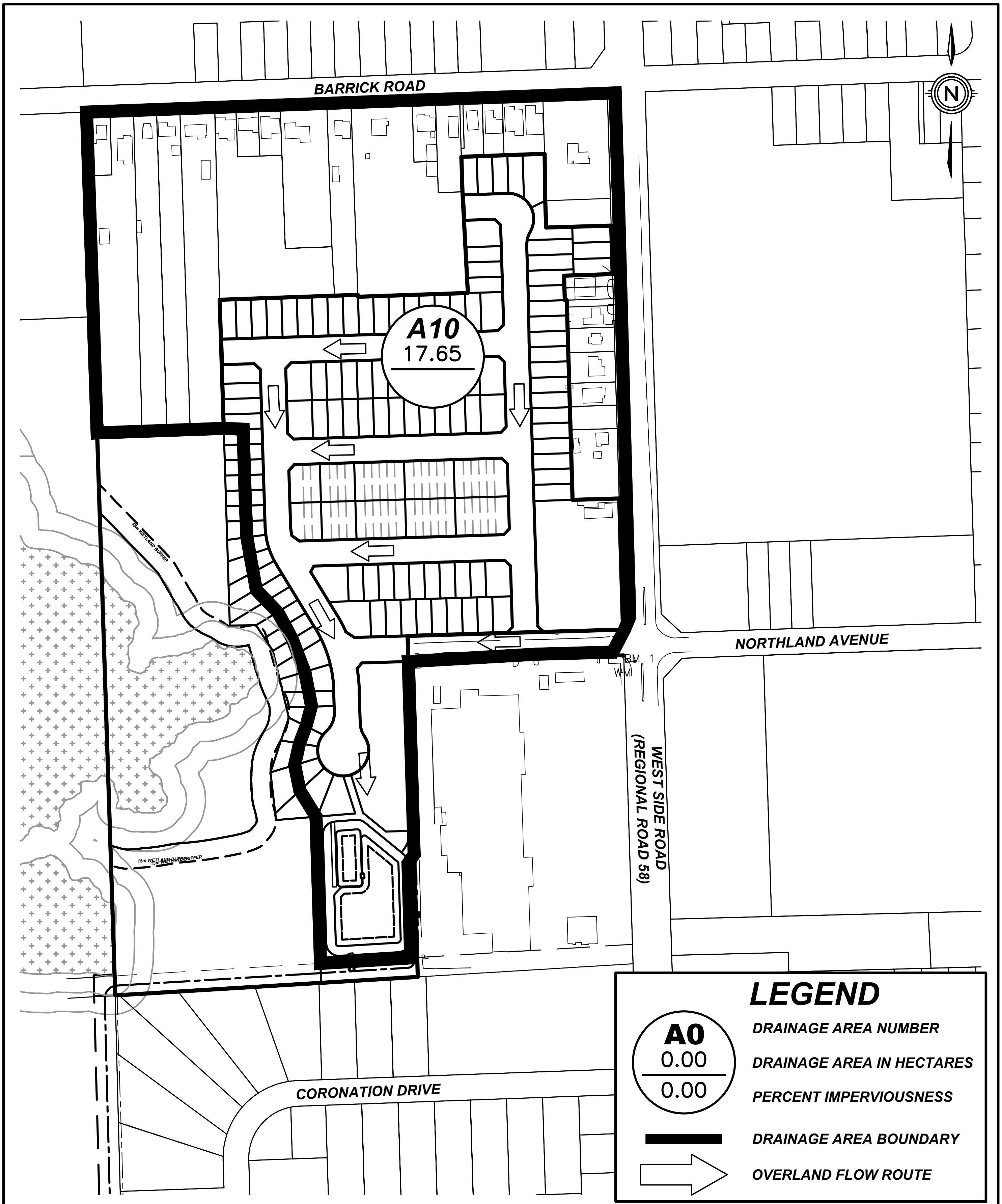

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CITY OF PORT COLBORNE

PROPOSED OVERALL STORM DRAINAGE AREA PLAN

DATE	2022–07–11
SCALE	1:4000 m
REF No.	*21132*
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) <u>Lot Level Controls</u>

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) <u>Vegetative Alternatives</u>

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) <u>Infiltration Alternatives</u>

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) <u>End-of-Pipe Alternatives</u>

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

Northland Estates	Criteria for Implementation of Stormwater Management Practices (SWMP)					Technical	Recommend	
	Topography	**Soils**	**Bedrock**	**Groundwater**	**Area**			
Site Conditions	***Variable 1 to 3%***	***Clay Loam <12mm/hr***	***At Considerable Depth***	***At Considerable Depth***	***± 17.7ha***	**Effectiveness (10 high)**	**Implementation Yes / No**	**Comments**
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.

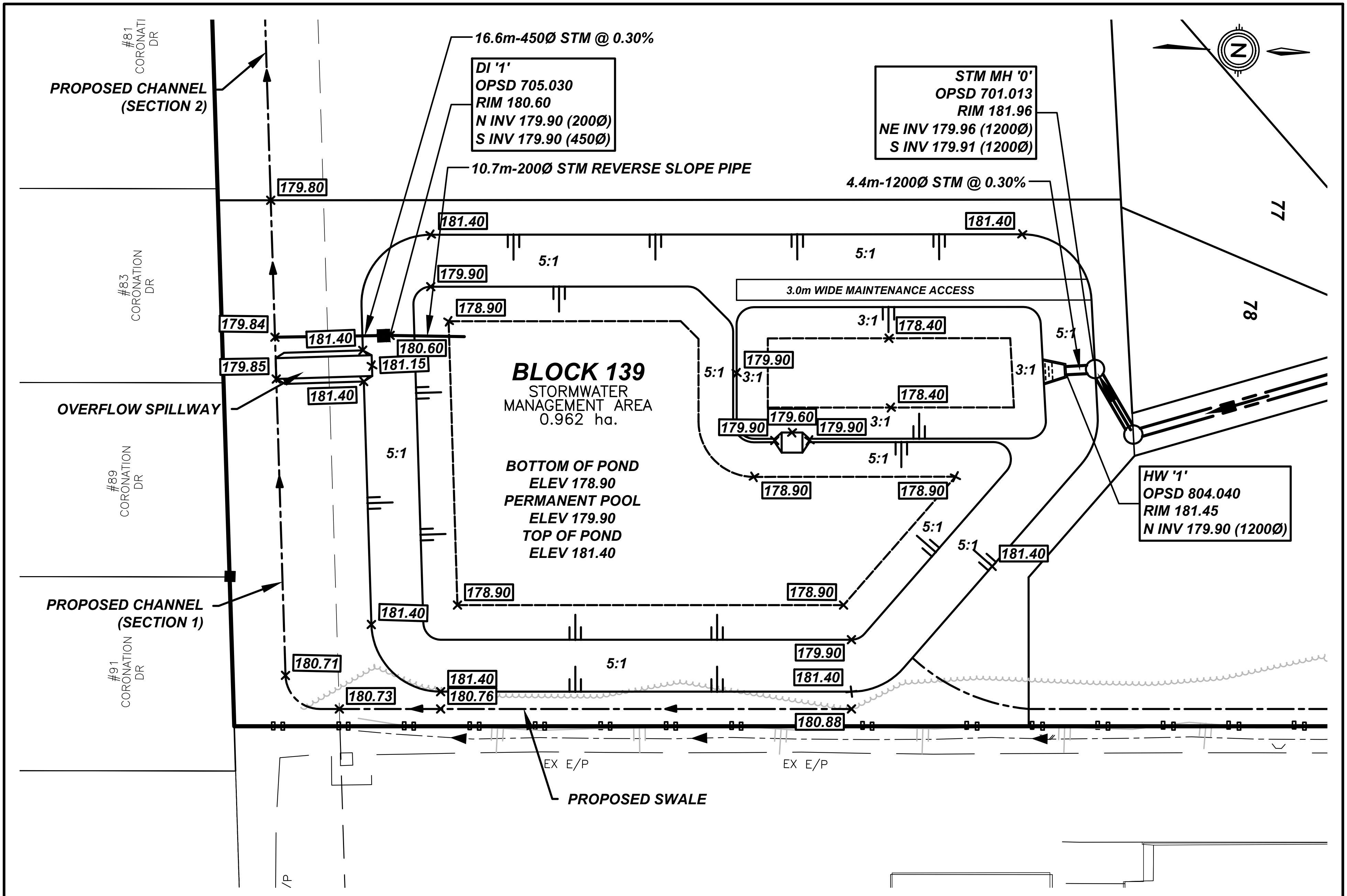
5.0 STORMWATER MANAGEMENT PLAN

A MIDUSS model was created to assess existing, future and ultimate development peak flows and stormwater volumes generated by the proposed subdivision. The stormwater management facility was sized according to MECP Guidelines (MECP, March 2003) as follows:

5.1 Proposed Stormwater Management Facility

5.1.1 Stormwater Quality

The stormwater drainage outlet for the proposed development is the Eagle Marsh Drain, which has been identified by the Ministry of Natural Resources watercourse evaluation as a **Type 2** fish habitat. Based on this fish habitat, 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 17.65 hectares. The storage volumes required for this proposed facility are shown in Table 5.



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NORTHLAND ESTATES

CITY OF PORT COLBORNE
PROPOSED STORMWATER MANAGEMENT FACILITY

DATE	2022-06-06
SCALE	1:750 m
REF No.	21132
DWG No.	FIGURE 4

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Table 5. Stormwater Quality Volume Calculations	
Total Water Quality Volume = 17.65 ha x 130 m^3/ha = 2,294.5 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 17.65 ha x 90 m^3/ha = 1,588.5 m^3	**Extended Detention Volume** = 17.65 ha x 40 m^3/ha = 706 m^3

5.1.3 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.

5.1.4 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 sewer outlet to a proposed ditch immediately south of the proposed SWM facility. The ditch will convey flows west through the natural gas easement, and turn south to ultimately outlet to the Eagle Marsh Drain.

It is proposed to construct a three stage outlet for the stormwater management facility as shown in Figure 4. The first stage of control consists of a reverse slope pipe acting as a 200mm 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.

The proposed effective bottom elevation of the facility is 178.90m, and the permanent pool water level is 179.90m for a water depth of 1.0 metres. The configuration of the facility provides 3,712m^3 of permanent pool volume, which is more than the required 1,588.5m^3. The proposed top of pond is at an elevation of 181.40m which provides a total active volume of 7,814.2m^3.

Based on the configuration of the proposed facility, it was determined that a 200mm diameter quality orifice shall provide 25.7 hours of detention (24hrs is the minimum required duration of detention). The rim elevation for the proposed ditch inlet chamber is 180.60m and will provide an extended detention volume of 3229.4m^3, which is more than the required 706m^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 channel ultimately conveying flows to the Eagle Marsh Drain. 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 181.19m, and an active storage volume of 6,526m^3 for the 100-year design storm event.

Table 7 details the difference in peak stormwater flows for existing and future conditions with the constructed and operational stormwater management 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	0.868	0.048	180.36	2,026
2 Year	1.547	0.064	180.57	3,087
5 Year	2.185	0.126	180.77	4,139
10 Year	2.602	0.170	180.89	4,807
25 Year	3.126	0.247	181.03	5,579
50 Year	3.507	0.304	181.13	6,139
100 Year	3.875	0.429	181.19	6,526

Table 7. Impacts of Wet Pond Facility on Peak Flows

Design Storm	Peak Flow (m^3/s)		
	Existing	Future with SWM	Change*
25mm	0.091	0.048	-47.3%
2 Year	0.142	0.064	-54.9%
5 Year	0.213	0.126	-40.8%
10 Year	0.267	0.170	-36.3%
25 Year	0.390	0.247	-36.3%
50 Year	0.513	0.304	-40.7%
100 Year	0.626	0.429	-31.5%

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 Tables 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 =	3.5	:1	(Length:Width Ratio)
Q_p =	0.048	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **23.66 m**

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

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

Q =	2.185	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 = **23.31 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

23.66 m (minimum required length)

Width = **2.96 m** (minimum required width)

d) Average Velocity of Flow

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

Q =	0.868	m^3/s	(Quality Design Inflow)
A =	21.75	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	10.00	m	(Proposed Bottom Width)
S =	3	:1	(Side slopes - minimum)

Average Velocity = **0.03 m/s**

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

e) Cleanout Frequency

Is this Acceptable? **Yes**

L =	35.0	m	(Proposed Bottom Length)
ASL =	2.8	m^3/ha	(Annual Sediment Loading)
A =	17.65	ha	(Drainage Area)
FRC =	70	%	(Facility Removal Efficiency)
FV =	889.50	m^3	(Forebay Volume)

Cleanout Frequency = **12.6 years**

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

5.1.5 Proposed Channel (Municipal Drain Extension)

As part of the proposed stormwater management plan, a channel will be constructed to provide an outlet for stormwater flows discharged from the stormwater management facility and surrounding lands. The proposed channel will begin at the south-east corner of the site, providing an outlet for stormwater flows discharging from the adjacent commercial property (287 West Side Road) and surrounding residential lands. The channel will continue west within the existing natural gas easement to the south-west corner of the development and turn south ultimately outletting to the Eagle Marsh Drain approximately 500m south.

As part of the stormwater analysis of this development, the channel has been modelled using the MIDUSS computer modelling program to have capacity for flows up to and including the 100 year design storm event. The channel has been modelled in three sections as follows:

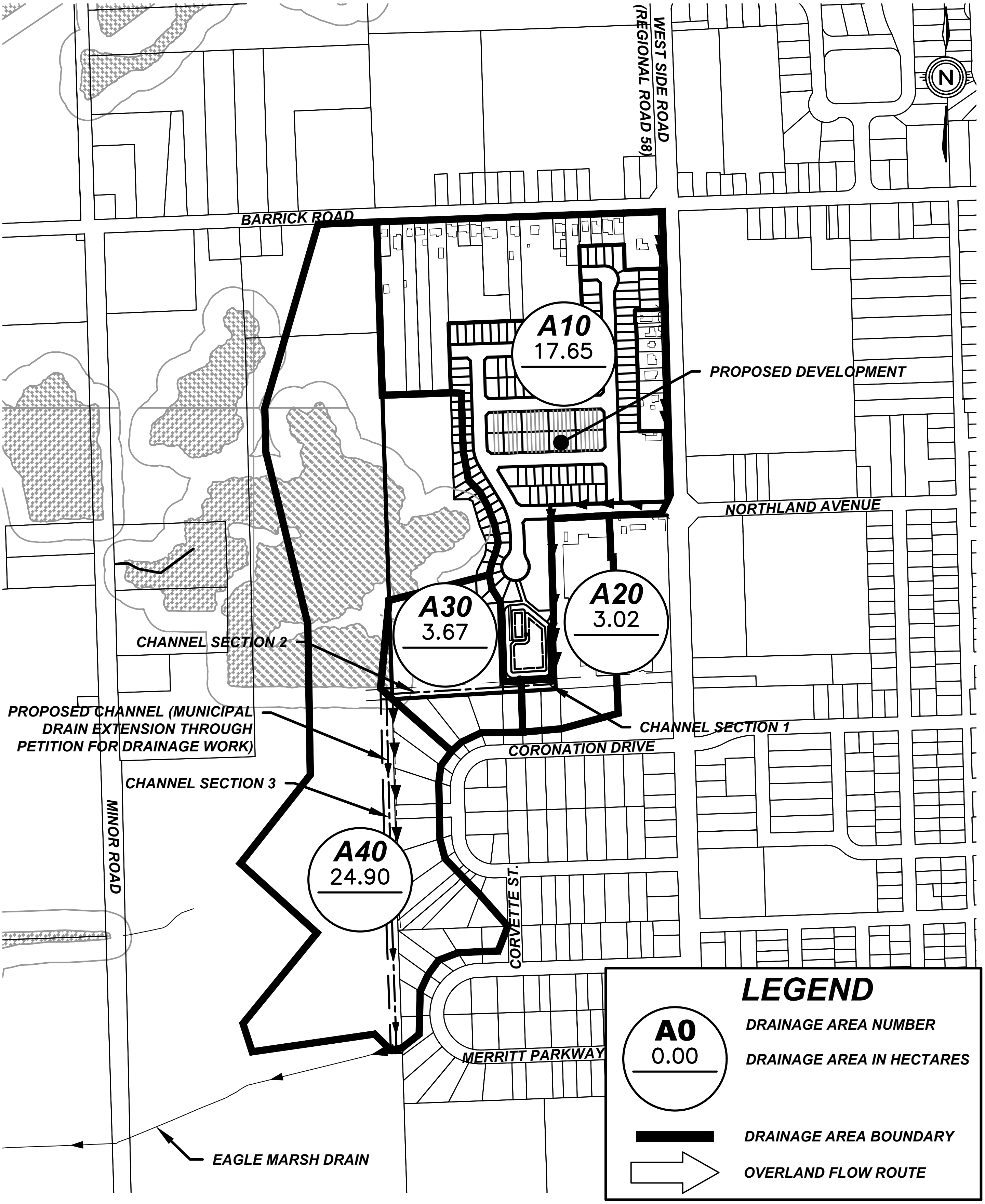
1. Start of channel at south-east corner of development to proposed stormwater management facility outlet.
2. SWM facility outlet to south-west corner of development property.
3. South-west corner of development property to Eagle Marsh Drain outlet.

Input parameters for the computer model with the proposed development conditions are shown in Table 9 below for the drainage conditions depicted in Figure 5 on the following page. Weighted Impervious Calculations were conducted for all areas outside of the proposed development area and can be found in Appendix A.

Table 9. Hydrologic Parameters

Area No.	Area (ha)	Length (m)	Slope (%)	SCS CN	Percent Impervious
Existing Conditions					
A10	17.65	500	1.0	77	70.0
A20	3.02	150	0.5	77	72.6
A30	3.67	80	1.0	77	1.4
A40	24.90	250	1.0	77	1.4

The proposed channel has been modelled to have capacity for stormwater flows from the proposed development and surrounding lands for storm events up to and including the 100 year design storm event. Detailed channel characteristics are located on Table 10, following the Channel Drainage Area Plan.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHLAND ESTATES

CITY OF PORT COLBORNE

PROPOSED CHANNEL DRAINAGE AREA PLAN

DATE	2022–06–06
SCALE	1:7,500 m
REF No.	21132
DWG No.	FIGURE 5

DRAWING FILE: F:\21132\Engineering\21132–BASE.dwg PLOTTED: Jun 06, 2022 – 11:30am PLOTTED BY: kurt

Table 10 below details the stormwater characteristics of the proposed channel conveying stormwater flows from upstream of the SWM facility outlet to the Eagle Marsh Drain during the 100 year design storm event. It is proposed to construct a channel with a bottom width of 0.5m and side slopes as detailed in Table 10.

Table 10. Channel Characteristics

Channel Section	Length (m)	Slope (%)	Side Slopes	Minimum Proposed Channel Depth (m)	Flow Rate (m^3/s)	100-Year Peak Flow Depth (m)
1 – Start	50	0.20	3:1	0.70m	0.636	0.67
2 – Middle	200	0.20	3:1	1.00m	0.872	0.77
3 – End	500	0.20	5:1	1.00m	1.675	0.837

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 17.65 hectare catchment area.

- The proposed channel will convey stormwater flows from the proposed stormwater management facility and surrounding lands directly to the Eagle Marsh Drain.

- 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: Reviewed By:

LICENSED PROFESSIONAL ENGINEER
J. P. SCHOOLEY
PROVINCE OF ONTARIO

Kurt Tiessen, E.I.T. Jason Schooley, P.Eng.

Revised July 11, 2022

APPENDICES

APPENDIX A

Weighted Impervious Calculation Sheet
Stormwater Management Facility Calculations

Weighted Imperviousness Percentage Calculation Worksheet

Project Name:	Northland Estates
Project Number:	21132
Date:	May, 2022
Person:	K. Tiessen E.I.T

EX - EXISTING CONDITIONS

	Footprint	*% Impervious*		*Effective Impervious Area*
Residential Dwellings	5108.1 m^2	100.0%	ea	5108.1 m^2
Open Space	169639.0 m^2	2%	ea	3392.8 m^2
Northland Roadway	1731.0 m^2	100%	ea	1731.0 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS				10,232 m^2
TOTAL CATCHMENT AREA				176,478 m^2
		EFFECTIVE WEIGHTED CATCHMENT % IMPERVIOUS		**5.8 %**
		RUNOFF COEFFICIENT		**0.24**

A20 - FUTURE CONDITIONS

	Footprint	*% Impervious*		*Effective Impervious Area*
Residential Dwellings	265.2 m^2	100.0%	ea	265.2 m^2
Commercial Area	21633.8 m^2	100%	ea	21633.8 m^2
Open Space	8284.3 m^2	0%	ea	8.3 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS				21,907 m^2
TOTAL CATCHMENT AREA				30,183 m^2
		EFFECTIVE WEIGHTED CATCHMENT % IMPERVIOUS		**72.6 %**
		RUNOFF COEFFICIENT		**0.71**

A30 - FUTURE CONDITIONS

	Footprint	*% Impervious*		*Effective Impervious Area*
Residential Dwellings	468.4 m^2	100.0%	ea	468.4 m^2
Open Space	36189.6 m^2	0%	ea	36.2 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS				505 m^2
TOTAL CATCHMENT AREA				36,658 m^2
		EFFECTIVE WEIGHTED CATCHMENT % IMPERVIOUS		**1.4 %**
		RUNOFF COEFFICIENT		**0.21**

A40 - FUTURE CONDITIONS

	Footprint	*% Impervious*		*Effective Impervious Area*
Residential Dwellings	3192.3 m^2	100.0%	ea	3192.3 m^2
Open Space	245767.7 m^2	0%	ea	245.8 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS				3,438 m^2
TOTAL CATCHMENT AREA				248,960 m^2
		EFFECTIVE WEIGHTED CATCHMENT % IMPERVIOUS		**1.4 %**
		RUNOFF COEFFICIENT		**0.21**

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

DATE: MAY 2022

PROJECT NAME: NORTHLAND ESTATES
PROJECT NO.: 21132

STORMWATER MANAGEMENT FACILITY WETPOND

Quality Requirements
Drainage Area (ha) = 17.65
Normal (m^3/ha) = 130 (@ 70% Imp)
Perm Pool (m^3/ha) = 90
Perm Pool Vol (m^3) = 1,589
Active Vol (m^3) 706
25mm MOEE (m^3) 2,447 m^3
Perm. Pool Elev. = 179.90 m

Quality Orifice
Diameter (m) = 0.200
Cd = 0.63
Invert (m) = 179.90

Ditch Inlet Weir
Length (m) = 0.60
Width (m) = 0.60
Grate Slope (X:1) = 5
Inlet Elevation (m) = 180.60
Cd = 1.84

Outflow Pipe Orifice
Diameter (m) = 0.450
Cd = 0.63
Invert (m) = 179.90
Overt (m) = 180.35

Overflow Spillway
Minor Length (m) = 3.00
Slopes (X:1) = 3.00
Minor Invert (m) = 181.15
Major Length (m) = 0.00
Major Invert (m) = 181.40

MOE Equation 4.10 Drawdown Coefficient 'C2' = 1,577
MOE Equation 4.10 Drawdown Coefficient 'C3' = 4,055
MOE Equation 4.10 Drawdown Time (h) = **25.7**

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)
178.90		-1.00	2,000			0							
	1.00			2,280	2,280								
179.40		-0.50	2,559			2,280							
	0.50			2,864	1,432								
179.90		0.00	**3,168**			**3,712**							
	0.00			3,609	0								
179.90		0.00	4,050				0.0	0.000	0.000	0.00	0.00	0.00	
	0.50			4,457	2,229								0.027
180.40		0.50	4,864				2228.5	0.053	0.000	0.198	0.000	0.0531	
	0.20			5,005	1,001								0.060
180.60		0.70	5,145				**3229.4**	0.066	0.000	0.281	0.000	0.0660	
	0.30			5,362	1,608								0.119
180.90		1.00	5,578				4837.9	0.082	0.091	0.371	0.000	0.1723	
	0.25			5,764	1,441								0.245
181.15		1.25	5,950				6279.0	0.093	0.225	0.433	0.000	0.3178	
	0.25			6,141	1,535								0.663
181.40		1.50	6,332				**7814.2**	0.102	0.395	0.486	0.521	1.0073	

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.

APPENDIX B

MIDUSS Output Files

Existing Conditions

```
       Output File (4.7) EX.OUT      opened 2022-06-03  14:26
       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: NORTHLAND ESTATES, PORT COLBORNE
       PROJECT NO.:  21132
       STORMWATER MANAGEMENT ANALYSIS MAY 2022
       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
     17.650    Area in hectares
    500.000    Length (PERV) metres
      2.000    Gradient (%)
      5.800    Per cent Impervious
    500.000    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
            .091      .000      .000      .000 c.m/s
            .130      .804      .169    C perv/imperv/total
 15     ADD RUNOFF
            .091      .091      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .7483218E+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
    397.149    Coefficient  a
       .000    Constant  b   (min)
       .699    Exponent  c
       .400    Fraction to peak  r
    240.000    Duration ó  240 min
            34.453 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
     17.650    Area in hectares
    500.000    Length (PERV) metres
      2.000    Gradient (%)
      5.800    Per cent Impervious
    500.000    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
            .142      .000      .000      .000 c.m/s
            .204      .847      .241    C perv/imperv/total
 15     ADD RUNOFF
            .142      .142      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .1466246E+04 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
    524.867    Coefficient  a
       .000    Constant  b   (min)
       .699    Exponent  c
       .400    Fraction to peak  r
    240.000    Duration ó  240 min
            45.533 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
     17.650    Area in hectares
    500.000    Length (PERV) metres
      2.000    Gradient (%)
      5.800    Per cent Impervious
    500.000    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
            .213      .000      .000      .000 c.m/s
            .278      .884      .313    C perv/imperv/total
 15     ADD RUNOFF
            .213      .213      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .2515238E+04 c.m
 14     START
      1    1=Zero; 2=Define
 35     COMMENT
      1    line(s) of comment
       10 YEAR DESIGN STORM EVENT
  2     STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    608.845    Coefficient  a
       .000    Constant  b   (min)
       .699    Exponent  c
       .400    Fraction to peak  r
    240.000    Duration ó  240 min
            52.818 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
     17.650    Area in hectares
    500.000    Length (PERV) metres
      2.000    Gradient (%)
      5.800    Per cent Impervious
    500.000    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
            .267      .000      .000      .000 c.m/s
            .320      .898      .353    C perv/imperv/total
 15     ADD RUNOFF
            .267      .267      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .3293676E+04 c.m
 14     START
      1    1=Zero; 2=Define
 35     COMMENT
      1    line(s) of comment
       25 YEAR DESIGN STORM EVENT
  2     STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    715.568    Coefficient  a
       .000    Constant  b   (min)
       .699    Exponent  c
       .400    Fraction to peak  r
    240.000    Duration ó  240 min
            62.077 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
     17.650    Area in hectares
    500.000    Length (PERV) metres
      2.000    Gradient (%)
      5.800    Per cent Impervious
    500.000    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
            .390      .000      .000      .000 c.m/s
            .367      .911      .398    C perv/imperv/total
 15     ADD RUNOFF
            .390      .390      .000      .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5    is # of Hyeto/Hydrograph chosen
       Volume  =  .4364793E+04 c.m
 14     START
      1    1=Zero; 2=Define
 35     COMMENT
      1    line(s) of comment
       50 YEAR DESIGN STORM EVENT
  2     STORM
          1    1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    794.298    Coefficient  a
       .000    Constant  b   (min)
       .699    Exponent  c
       .400    Fraction to peak  r
    240.000    Duration ó  240 min
            68.907 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
     17.650    Area in hectares
    500.000    Length (PERV) metres
      2.000    Gradient (%)
      5.800    Per cent Impervious
    500.000    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
            .513      .000      .000      .000 c.m/s
            .398      .918      .428    C perv/imperv/total
15    ADD RUNOFF
            .513      .513      .000      .000 c.m/s
27    HYDROGRAPH DISPLAY
     5    is # of Hyeto/Hydrograph chosen
      Volume  =  .5203556E+04 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
     871.279    Coefficient  a
        .000    Constant  b   (min)
        .699    Exponent  c
        .400    Fraction to peak  r
     240.000    Duration ó  240 min
           75.585 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
      17.650    Area in hectares
     500.000    Length (PERV) metres
       2.000    Gradient (%)
       5.800    Per cent Impervious
     500.000    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
            .626      .000      .000      .000 c.m/s
            .425      .922      .454    C perv/imperv/total
15    ADD RUNOFF
            .626      .626      .000      .000 c.m/s
27    HYDROGRAPH DISPLAY
     5    is # of Hyeto/Hydrograph chosen
      Volume  =  .6055962E+04 c.m
20    MANUAL
```

Developed Conditions

```
         Output File (4.7) SWM.OUT      opened 2022-06-03  16:28
         Units used are defined by G =    9.810
             24   144    10.000        are MAXDT MAXHYD & DTMIN values
         Licensee: UPPER CANADA CONSULTANTS
 35      COMMENT
        3     line(s) of comment
         PROJECT NAME: NORTHLAND ESTATES
         PROJECT NO.:  21132
         PROPOSED CONDITIONS WITH SWM
 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
        17.650     Area in hectares
       500.000     Length (PERV) metres
         1.000     Gradient (%)
        70.000     Per cent Impervious
       500.000     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
                .868       .000       .000       .000 c.m/s
                .130       .806       .603     C perv/imperv/total
 15      ADD RUNOFF
                .868       .868       .000       .000 c.m/s
 27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .2659092E+04 c.m
 10      POND
        6 Depth - Discharge - Volume sets
         179.900        .000         .0
         180.400       .0531      2228.5
         180.600       .0660      3229.4
         180.900        .172      4837.9
         181.150        .318      6279.0
         181.400       1.007      7814.2
         Peak Outflow    =      .048 c.m/s
         Maximum Depth   =   180.355 metres
         Maximum Storage =     2026. c.m
                .868       .868       .048       .000 c.m/s
 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
       397.149     Coefficient  a
          .000     Constant  b    (min)
          .699     Exponent  c
          .400     Fraction to peak  r
       240.000     Duration ó  240 min
                34.453 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
        17.650     Area in hectares
       500.000     Length (PERV) metres
         1.000     Gradient (%)
        70.000     Per cent Impervious
       500.000     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
               1.547       .000       .048       .000 c.m/s
                .204       .852       .657     C perv/imperv/total
 15      ADD RUNOFF
               1.547      1.547       .048       .000 c.m/s
 27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .3995457E+04 c.m
 10      POND
        6 Depth - Discharge - Volume sets
         179.900        .000         .0
         180.400       .0531      2228.5
         180.600       .0660      3229.4
         180.900        .172      4837.9
         181.150        .318      6279.0
         181.400       1.007      7814.2
         Peak Outflow    =      .064 c.m/s
         Maximum Depth   =   180.572 metres
         Maximum Storage =     3087. c.m
               1.547      1.547       .064       .000 c.m/s
 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
       524.867     Coefficient  a
          .000     Constant  b    (min)
          .699     Exponent  c
          .400     Fraction to peak  r
       240.000     Duration ó  240 min
                45.533 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
        17.650     Area in hectares
       500.000     Length (PERV) metres
         1.000     Gradient (%)
        70.000     Per cent Impervious
       500.000     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
               2.185       .000       .064       .000 c.m/s
                .278       .874       .695     C perv/imperv/total
 15      ADD RUNOFF
               2.185      2.185       .064       .000 c.m/s
 27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .5584406E+04 c.m
 10      POND
        6 Depth - Discharge - Volume sets
         179.900        .000         .0
         180.400       .0531      2228.5
         180.600       .0660      3229.4
         180.900        .172      4837.9
         181.150        .318      6279.0
         181.400       1.007      7814.2
         Peak Outflow    =      .126 c.m/s
         Maximum Depth   =   180.770 metres
         Maximum Storage =     4139. c.m
               2.185      2.185       .126       .000 c.m/s
 14      START
        1     1=Zero; 2=Define
 35      COMMENT
        1     line(s) of comment
         10 YEAR DESIGN STORM EVENT
  2      STORM
             1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
       608.845     Coefficient  a
          .000     Constant  b    (min)
          .699     Exponent  c
          .400     Fraction to peak  r
       240.000     Duration ó  240 min
                52.818 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
        17.650     Area in hectares
       500.000     Length (PERV) metres
         1.000     Gradient (%)
        70.000     Per cent Impervious
       500.000     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
               2.602       .000       .126       .000 c.m/s
                .320       .892       .720     C perv/imperv/total
 15      ADD RUNOFF
               2.602      2.602       .126       .000 c.m/s
 27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .6713848E+04 c.m
 10      POND
        6 Depth - Discharge - Volume sets
         179.900        .000         .0
         180.400       .0531      2228.5
         180.600       .0660      3229.4
         180.900        .172      4837.9
         181.150        .318      6279.0
         181.400       1.007      7814.2
         Peak Outflow    =      .170 c.m/s
         Maximum Depth   =   180.894 metres
         Maximum Storage =     4807. c.m
               2.602      2.602       .170       .000 c.m/s
 14      START
        1     1=Zero; 2=Define
 35      COMMENT
        1     line(s) of comment
         25 YEAR DESIGN STORM EVENT
  2      STORM
             1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
       715.568     Coefficient  a
          .000     Constant  b    (min)
          .699     Exponent  c
          .400     Fraction to peak  r
       240.000     Duration ó  240 min
                62.077 mm     Total depth
  3      IMPERVIOUS
```

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          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
     17.650      Area in hectares
    500.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    500.000      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
            3.126       .000       .170       .000 c.m/s
             .367       .910       .747     C perv/imperv/total
 15    ADD RUNOFF
            3.126      3.126       .170       .000 c.m/s
 27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .8185433E+04 c.m
 10    POND
     6 Depth - Discharge - Volume sets
      179.900        .000         .0
      180.400       .0531       2228.5
      180.600       .0660       3229.4
      180.900        .172       4837.9
      181.150        .318       6279.0
      181.400       1.007       7814.2
      Peak Outflow    =      .247 c.m/s
      Maximum Depth   =   181.029 metres
      Maximum Storage =     5579. c.m
            3.126      3.126       .247       .000 c.m/s
 14    START
     1     1=Zero; 2=Define
 35    COMMENT
     1     line(s) of comment
      50 YEAR DESIGN STORM EVENT
  2    STORM
          1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    794.298      Coefficient  a
       .000      Constant  b    (min)
       .699      Exponent  c
       .400      Fraction to peak  r
    240.000      Duration ó  240 min
           68.907 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
     17.650      Area in hectares
    500.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    500.000      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
            3.507       .000       .247       .000 c.m/s
             .398       .920       .763     C perv/imperv/total
 15    ADD RUNOFF
            3.507      3.507       .247       .000 c.m/s
 27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .9278342E+04 c.m
 10    POND
     6 Depth - Discharge - Volume sets
      179.900        .000         .0
      180.400       .0531       2228.5
      180.600       .0660       3229.4
      180.900        .172       4837.9
      181.150        .318       6279.0
      181.400       1.007       7814.2
      Peak Outflow    =      .304 c.m/s
      Maximum Depth   =   181.126 metres
      Maximum Storage =     6139. c.m
            3.507      3.507       .304       .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
    871.279      Coefficient  a
       .000      Constant  b    (min)
       .699      Exponent  c
       .400      Fraction to peak  r
    240.000      Duration ó  240 min
           75.585 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
     20.000      ID No.ó 99999
      3.020      Area in hectares
    150.000      Length (PERV) metres
       .500      Gradient (%)
     72.600      Per cent Impervious
    150.000      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
             .636       .000       .304       .000 c.m/s
             .425       .909       .776     C perv/imperv/total
 15    ADD RUNOFF
             .636       .636       .304       .000 c.m/s
 27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1771582E+04 c.m
 11    CHANNEL
       .500      Base Width     =
      3.000      Left  bank slope  1:
      3.000      Right bank slope  1:
       .060      Manning's "n"
      1.000      O/a Depth in metres
       .200      Select Grade in %
      Depth          =      .673 metres
      Velocity       =      .375 m/sec
      Flow Capacity  =     1.671 c.m/s
      Critical depth =      .318 metres
  9    ROUTE
     50.000      Conduit Length
       .000      Supply X-factor <.5
    100.065      Supply K-lag (sec)
       .800      Beta weighting factor
    300.000      Routing timestep
          1      No. of sub-reaches
             .636       .636       .632       .000 c.m/s
 17    COMBINE
     1     Junction Node No.
             .636       .636       .632       .632 c.m/s
 14    START
     1     1=Zero; 2=Define
  4    CATCHMENT
     10.000      ID No.ó 99999
     17.650      Area in hectares
    500.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    500.000      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
            3.875       .000       .632       .632 c.m/s
             .425       .926       .776     C perv/imperv/total
 15    ADD RUNOFF
            3.875      3.875       .632       .632 c.m/s
 27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1035101E+05 c.m
 10    POND
     6 Depth - Discharge - Volume sets
      179.900        .000         .0
      180.400       .0531       2228.5
      180.600       .0660       3229.4
      180.900        .172       4837.9
      181.150        .318       6279.0
      181.400       1.007       7814.2
      Peak Outflow    =      .429 c.m/s
      Maximum Depth   =   181.190 metres
      Maximum Storage =     6526. c.m
            3.875      3.875       .429       .632 c.m/s
 17    COMBINE
     1     Junction Node No.
            3.875      3.875       .429       .698 c.m/s
 18    CONFLUENCE
     1     Junction Node No.
            3.875       .698       .429       .000 c.m/s
  4    CATCHMENT
     30.000      ID No.ó 99999
      3.670      Area in hectares
     80.000      Length (PERV) metres
      1.000      Gradient (%)
      1.400      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
             .264       .698       .429       .000 c.m/s
             .425       .915       .432     C perv/imperv/total
 15    ADD RUNOFF
             .264       .872       .429       .000 c.m/s
 11    CHANNEL
       .500      Base Width     =
      3.000      Left  bank slope  1:
      3.000      Right bank slope  1:
       .060      Manning's "n"
      1.000      O/a Depth in metres
       .200      Select Grade in %
      Depth          =      .767 metres
      Velocity       =      .406 m/sec
      Flow Capacity  =     1.671 c.m/s
      Critical depth =      .370 metres
  9    ROUTE
    200.000      Conduit Length
       .106      Supply X-factor <.5
    369.739      Supply K-lag (sec)
       .500      Beta weighting factor
    600.000      Routing timestep
          1      No. of sub-reaches
             .264       .872       .785       .000 c.m/s
 16    NEXT LINK
             .264       .785       .785       .000 c.m/s
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   4     CATCHMENT
       40.000     ID No.ó 99999
       24.900     Area in hectares
      250.000     Length (PERV) metres
        1.000     Gradient (%)
        1.400     Per cent Impervious
      250.000     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
             1.048       .785       .785       .000 c.m/s
              .425       .900       .432     C perv/imperv/total
  15     ADD RUNOFF
             1.048      1.675       .785       .000 c.m/s
  11     CHANNEL
         .500     Base Width     =
        5.000     Left  bank slope  1:
        5.000     Right bank slope  1:
         .060     Manning's "n"
        1.000     O/a Depth in metres
         .200     Select Grade in %
         Depth          =      .837 metres
         Velocity       =      .427 m/sec
         Flow Capacity  =     2.631 c.m/s
         Critical depth =      .423 metres
   9     ROUTE
      500.000     Conduit Length
         .334     Supply X-factor <.5
      877.754     Supply K-lag (sec)
         .500     Beta weighting factor
      600.000     Routing timestep
           1      No. of sub-reaches
             1.048      1.675      1.617       .000 c.m/s
  20     MANUAL
```