UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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PRELIMINARY
FUNCTIONAL SERVICING REPORT

3285 THUNDER BAY ROAD
TOWN OF FORT ERIE
JUNE 2021

INTRODUCTION

Upper Canada Planning & Engineering Ltd. (UCC) has been retained to provide a Functional Servicing Report to address both the municipal servicing and stormwater management needs for the proposed residential development located at 3285 Thunder Bay Road, as part of the Draft Plan of Subdivision and Zoning By-law Amendment application for the Town of Fort Erie.

The subject property is bound to the north by Thunder Bay Road, to the west by Burleigh Road South, and to the south by Lake Erie. The existing site is largely undeveloped, primarily consisting of dense vegetation with two residential buildings and a gravel driveway on the eastern limit of the property. The surrounding land use is primarily residential.

The subject property is 4.60 hectares in total is bisected west to east by an Environmental Protection Area (Block 41). The northern portion of the site will consist of multiple single-detached residential dwellings which will include associated asphalt roads, concrete curb, catchbasins, storm sewers, sanitary sewers, watermain and a park. The southern portion of the site will consist of a park area (Block 42) and Lake Erie shoreline dedication area (Block 43).

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.
3. Identify stormwater management needs for the site.

WATER SERVICING

There is an existing 150mm diameter watermain located on the west side of Burleigh Road South, and an existing 300mm diameter watermain on the north side of Thunder Bay Road. It is proposed to construct a 150mm diameter watermain to provide both domestic water supply and fire protection within the site. The proposed 150mm diameter watermain will be extended within the site to connect to the existing 150mm and 300mm diameter watermains at proposed entrance locations. The proposed dwellings fronting on Thunder Bay Road will be directly serviced from the existing 300mm diameter watermain on Thunder Bay Road.

At the request of the Town of Fort Erie, the existing 300mm diameter cast iron watermain on Thunder Bay Road is to be replaced from the intersection of Burleigh Road South to Cook Avenue with a new 300mm diameter watermain.

Fire protection will be provided by fire hydrant(s) proposed within the site, with locations to be identified as part of future detailed design, and the existing municipal fire hydrant located at the intersection of Thunder Bay Road and Burleigh Road South.

SANITARY SERVICING

There is an existing 200mm diameter sanitary sewer flowing west to east on Thunder Bay Road and an existing 250mm diameter sanitary sewer located in an existing easement within the southern portion of the subject property, conveying sewage flows easterly and eventually outletting to the existing sanitary sewers on Thunder Bay Road from between the existing #3161 and #3173 Thunder Bay Road properties.

As shown in the accompanying Sanitary Drainage Plan and associated Sanitary Sewer Design Sheet, the majority of the site will outlet to the existing 250mm diameter sanitary sewers within the existing easement within the southern portion of the site. The remaining dwellings fronting on Thunder Bay Road will connect directly to the existing 200mm diameter sanitary sewer on Thunder Bay Road, with a new sanitary sewer extending from the western-most existing sanitary manhole to service the two western-most dwellings fronting on Thunder Bay Road.

The existing 250mm diameter sanitary sewer flowing east within the existing easement has a full flow capacity of approximately 34.5 L/s. The peak sanitary flows from site will total approximately 1.95 L/s and in combination with upstream peak flows from the existing dwellings on Lakecrest Court, the total peak flow will occupy approximately 8.2% of the total capacity within the 250mm diameter sewer. Therefore, there is expected to be adequate capacity in the existing sanitary sewers to service the proposed development.

The existing 200mm diameter sanitary sewer flowing east on Thunder Bay Road has a full flow capacity of 25.8 L/s. The peak flows from proposed dwellings fronting Thunder Bay Road, combined with existing residences, will total approximately 1.10 L/s and occupy approximately 4.2% of the total capacity within the 200mm diameter sewer. Therefore, there is expected to be adequate capacity in the existing sanitary sewers to service 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.

Existing Conditions

As indicated on Figure 1 in Appendix A, stormwater flows from 2.94 hectares of the site (EX1) presently generally flow southerly overland to the easterly flowing ditch to the south of the site, and ultimately to Lake Erie (Outlet B).

The site primarily consists of greenspace and therefore has been assigned a Run-off Coefficient of R= 0.20. The remaining 0.89 hectares of the property (EX2), south of the existing ditch, are mostly undeveloped lands with two existing residential buildings discharging overland to Lake Erie.

A 1.10-hectare drainage area (EX FE) is also shown on Figure 1. This drainage area is delineated from the portion of the drainage area from the Thunder Bay Drainage Improvement Overall Drainage Area Plan (Town of Fort Erie, 2007) that includes the subject lands, and allocates a portion of the storm flows from the subject property to the existing 1500mm diameter storm sewers on Thunder Bay Road, at Cook Avenue (Outlet A). The Thunder Bay Road storm sewers ultimately outlet to Lake Erie via a storm sewer on Bernard Avenue. A Run-off Coefficient of R=0.40 is assigned to this area in accordance with the Thunder Bay Drainage Improvement design drawings.

Future Conditions

It is proposed to control the future 5 year storm flows from the site to Outlet A to the conditions reflective of the Thunder Bay Drainage Improvement Overall Drainage Area Plan (2007). Stormwater flows produced by the 100 year storm event will be split between Outlets A and B, to allowable levels.

The future stormwater drainage areas have been delineated as shown in Figure 2 in Appendix A and will convey peak stormwater flows as follows:

- Area A1 will convey both 5 year and 100 year flows to Outlet A with a Run-off Coefficient of R = 0.40.
- Area A2 will convey 5 year flows to Outlet A and 100 year flows will be conveyed overland to Outlet B through the proposed Park (Block 44), with a Run-off Coefficient of R=0.40.
- Area A3 will convey both 5 year and 100 year flows uncontrolled to Outlet B with a Runoff Coefficient of R=0.40.
- Area A4 will continue to convey 5 year and 100 year flows to Lake Erie and remains unchanged from existing conditions. Therefore, for the purposes of this stormwater management analysis, the peak flows from A4 will not be considered.

All stormwater flows were evaluated for the 5 and 100 year design storm events using the Town of Fort Erie IDF curves, and modelled for the existing and future conditions using Modified Rational Method. Peak flows for each outlet are summarized in Table 1 using the stormwater drainage conditions for existing and future conditions without stormwater management. All calculations regarding the existing and future stormwater flows can be found in Appendix B.

Table 1. Stormwater Peak Flow Assessment

OUTLET A: Thunder Bay Road			
Design Storm (Return Period)	**Peak Flows (L/s)**		
	Town of Fort Erie Allowable	**Future without SWM**	**Change**
5 Year	104.7	202.8	+98.1
OUTLET B: Channel			
Design Storm (Return Period)	**Peak Flows (L/s)**		
	Existing	**Future without SWM**	**Change**
5 Year	142.3	80.9	-61.4
100 Year	228.1	422.6	+194.5

As seen in Table 1, the 5 year future peak flows being directed towards Thunder Bay Road are greater than the allowable flows. Therefore, stormwater quantity controls are required to control flows for the 5 year storm event before outletting to Outlet A. The future peak flow for the 5 year storm event directed towards Lake Erie will be less than existing conditions, however, future peak flows during the 100 year storm will increase above existing levels. Therefore, on-site quantity controls will be required to reduce the future peak flows discharging to Outlet B to existing levels.

The ultimate outlet for the site stormwater flows is Lake Erie. Therefore, per Niagara Regional requirements, stormwater quality improvements will be required to MECP Enhanced Levels (80% TSS Removal) prior to discharging from the site.

QUANTITY ASSESSMENT

To limit the proposed future stormwater flows to the allowable design capacity, typically a control structure is placed on the outlet from the site that may include an orifice and on-site stormwater storage.

Using the Modified Rational Method, the stormwater peak flows requiring control from the site to each outlet are summarized in Table 2 using stormwater drainage conditions shown in Appendix B.

Table 2. Allowable Stormwater Peak Flows and Storage Volumes			
OUTLET A: Thunder Bay Road			
Design Storm (Return Period)	**Peak Flows (L/s)**		
	Allocated Flow	**Future Uncontrolled (Area A1)**	**Future Allowable Outflow (Area A2)**
5 Year	104.7	20.0	84.7
OUTLET B: Channel			
Design Storm (Return Period)	**Peak Flows (L/s)**		
	Existing Condition	**Future Uncontrolled (Area A3)**	**Future Allowable Overland Flow (Area A2)**
100 Year	228.1	129.7	98.4

As shown in the Modified Rational Method calculations found Appendix B, 40.8 m^3 of stormwater storage is required to control the future peak 5 year flows from area A2 to the allowable level of 84.7 L/s as summarized in Table 2. With the preliminary stage storage-discharge calculations (see Appendix B), a total stormwater storage volume of 104.3 m^3 can be provided by three (3) 675mm diameter storm sewers with a corresponding outflow of 83.4 L/s from the proposed 150mm diameter control orifice without surcharging the proposed storm sewer system. Therefore, there will be adequate stormwater storage to reduce the peak 5 year flows discharging to the Thunder Bay Road storm sewers to allowable levels.

To control the flows to Outlet B to the existing 224.3 L/s, part of the flows generated from A2 will be stored and controlled to allowable 5 year levels and discharged through Outlet A. As shown in the Modified Rational Method calculations provided in Appendix B and summarized in Table 2, the allowable overland flow from A2 was found to be 98.4 L/s. This value represents the allowable peak flow from A2 which may flow overland uncontrolled to Outlet B. Additional stormwater storage within the proposed storm sewers is required to control the peak flows from the 100 year design storm generated within A2 to 5 year allowable levels, such that the major overland flows to Outlet B are within allowable levels.

As shown in the Modified Rational Method calculations in Appendix B, the peak 100 year flow generated from area A2 is 292.9 L/s. With a maximum allowable overland flow of 98.4 L/s, the proposed stormwater storage system will be required to provide additional stormwater storage for the remaining peak flow of 194.5 L/s.

With the maximum outflow of 84.7 L/s, a total storage volume of 102.6 m^3 will be required to control the peak 100 year flows from Area A2 while allowing 98.4 L/s of overland flow discharge through the park to Outlet B, which is less than the 104.5 m^3 of storage volume provided within just the proposed 675mm diameter pipes. Therefore, there will be adequate stormwater storage volume to control the peak 100 year flows to allowable 5 year levels.

Table 3 summarizes the characteristics of stormwater management required for the site to control stormwater flows to the allowable 5 year and 100 year levels for Outlet A and B respectively.

Table 3. Stormwater Management Facility Characteristics

OUTLET A: Thunder Bay Road				
Design Storm Event	**Allowable Flows (L/s)**	**Maximum Controlled Outflow (L/s)**	**Minimum Required Volume (m^3)**	**Provided Volume (m^3)**
5 year	84.7	83.4	40.8	104.3

OUTLET B: Channel					
Design Storm Event	**Allowable Flows (L/s)**	**Future Controlled flow to Outlet B (L/s)**	**Controlled Flow to Outlet A (L/s)**	**Minimum Required Volume (m^3)**	**Provided Volume (m^3)**
100 year	228.1	228.1	84.7	102.6	104.5

As shown in Table 3, the proposed stormwater management facility can provide adequate storage to control the peak 5 and 100 year flows to allowable levels to both outlets A and B.

QUALITY ASSESSMENT

To improve stormwater quality, typically a stormwater oil/grit separator provides TSS (Total Suspended Solids) removal for this type of development.

It is required the unit will provide a minimum average of 80% TSS removal which achieves MECP Enhanced Quality Protection. A conservative contributing area to the proposed oil/grit separator was used to model the sizing of the unit. This area includes drainage areas A1 and A2 and the south-of-centreline section of Thunder Bay Road along the site frontage, totalling an approximate area of 3.21 hectares with an approximate impervious coverage of approximately 30%. The modelling for a Hydroworks unit has indicated that an HG 5 will provide 82% TSS overall removal and capture 97% of the stormwater flows. Therefore, a Hydroworks HG 5 is proposed for this site development. Output calculations for the quality assessment can be found in Appendix C.

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MAINTENANCE OF STORMWATER MANAGEMENT FACILITY

Oil/Grit Separator

The function of the proposed stormwater quality protection facility, a stormwater oil/grit separator, will require maintenance on an annual basis. The following is a summary of the maintenance activities required.

Regular inspections of the stormwater Maintenance Hole (MH) oil/grit interceptor will indicate whether maintenance is required or not. They should be made after every significant storm during the first two years of operation to ensure that it is functioning properly. This will translate into an average of six inspections per year.

Points of regular inspections are as follows:

a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the oil/grit separator via a dipstick tube equipped with a ball valve (Sludge Judge) or with a graduated pole with a flat attached to the bottom.

b) Is there oil in the separator sump? This can be checked from the surface by inserting a dipstick in the 150mm vent tube. The presence of oil is usually indicated by an oily sheen, frothing or unusual colouring. The separator should be cleaned in the event of a major spill contamination.

c) Is there debris or trash at the inlet weir and drop pipe? This can be observed from the surface without entry into the separator. Clogging at the inlet drop pipe will cause stormwater to bypass the sedimentation section and continue downstream without treatment.

d) Completion of the Inspection Report (a sample report is included in Appendix D for reference purposes). These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, stormwater MH oil/grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches sediment storage specified by the manufacturer and after any major spills have occurred. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

Generally, the sediment removed from the separator will not be contaminated to the point that it would be classified as hazardous waste. The removal of sediment is to be undertaken by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual upon installation, which explains the function, maintenance requirements and procedures for the facility with extensive use. It is recommended to follow the manufacturers instructions to allow the oil/grit separator to perform as intended.

The future site owners should perform regular cleaning and vacuuming of the on-site catch basins, as well as regular flushing and vacuuming of the storm sewers.

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 watermain on Thunder Bay Road and existing 150mm diameter watermain on Burleigh Road South are expected to have sufficient capacity to provide both domestic and fire protection water supply to the proposed subdivision.

2. The existing 250mm diameter sanitary sewer within the easement in the southeast of the site is expected to have adequate capacity to service the subdivision.

3. The existing 200m diameter sanitary on Thunder Bay Road is expected to have adequate capacity to service the subdivision.

4. Stormwater quantity controls are being provided to existing conditions to control up to and including the 100 year design storm by a control structure and underground storage prior to discharging to Lake Erie.

5. Stormwater quality protection is being provided by a Hydroguard HG 5 stormwater oil/grit separator or approved equivalent in the proposed development.

Based on the above, the accompanying General Servicing Plan, Drainage Area Plans and Design Sheets, 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.

Prepared By:

Brendan Kapteyn, EIT

Reviewed By:

Jason Schooley, P.Eng.

Encl.

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APPENDICES

UPPER CANADA CONSULTANTS
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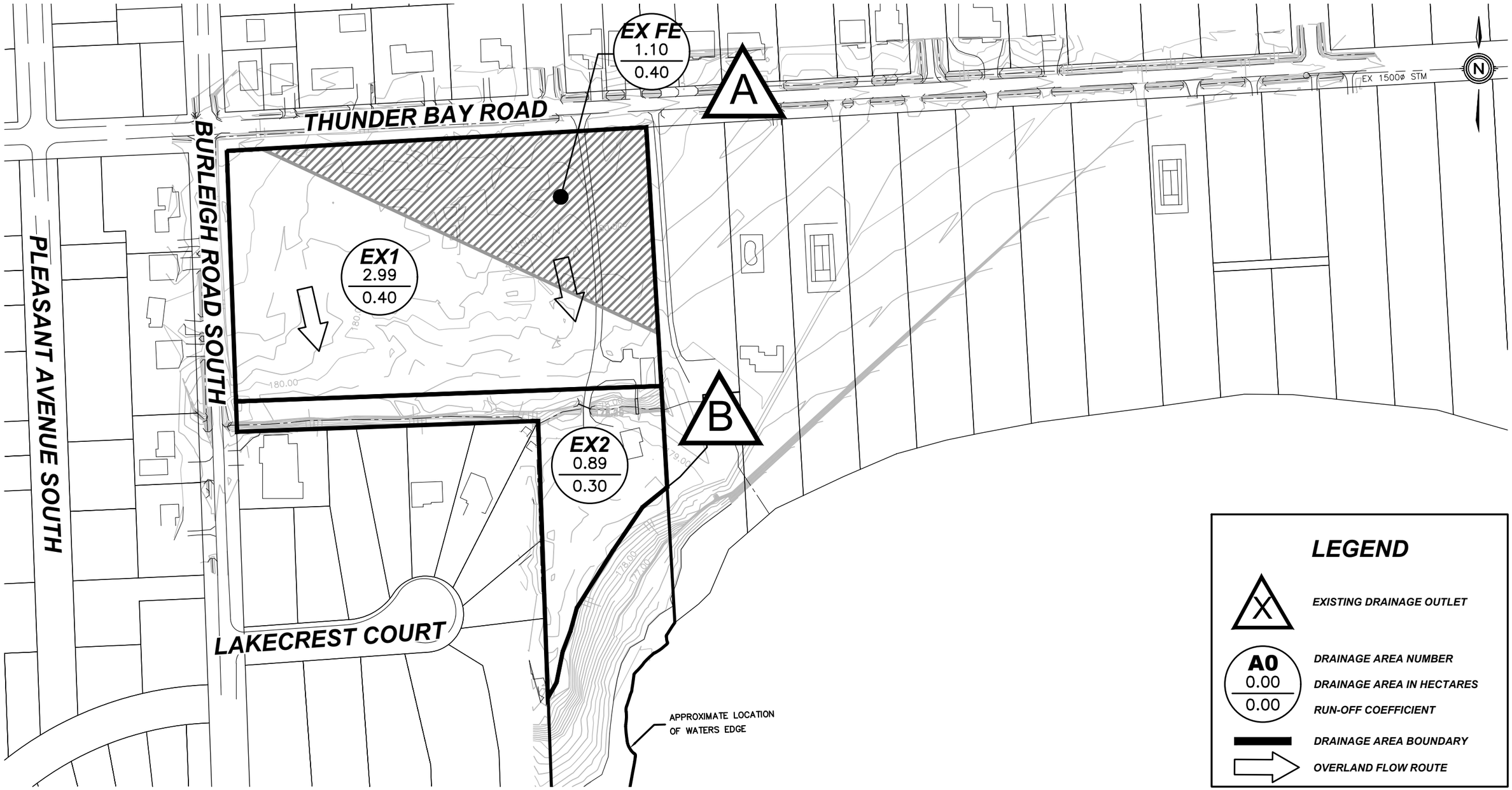
APPENDIX A

Existing and Proposed Storm Drainage Area Plans



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3285 THUNDERBAY ROAD

TOWN OF FORT ERIE

EXISTING STORM DRAINAGE PLAN

DATE	2021–06–25
SCALE	1:2000 m
REF No.	*17143*
DWG No.	*FIGURE 1*

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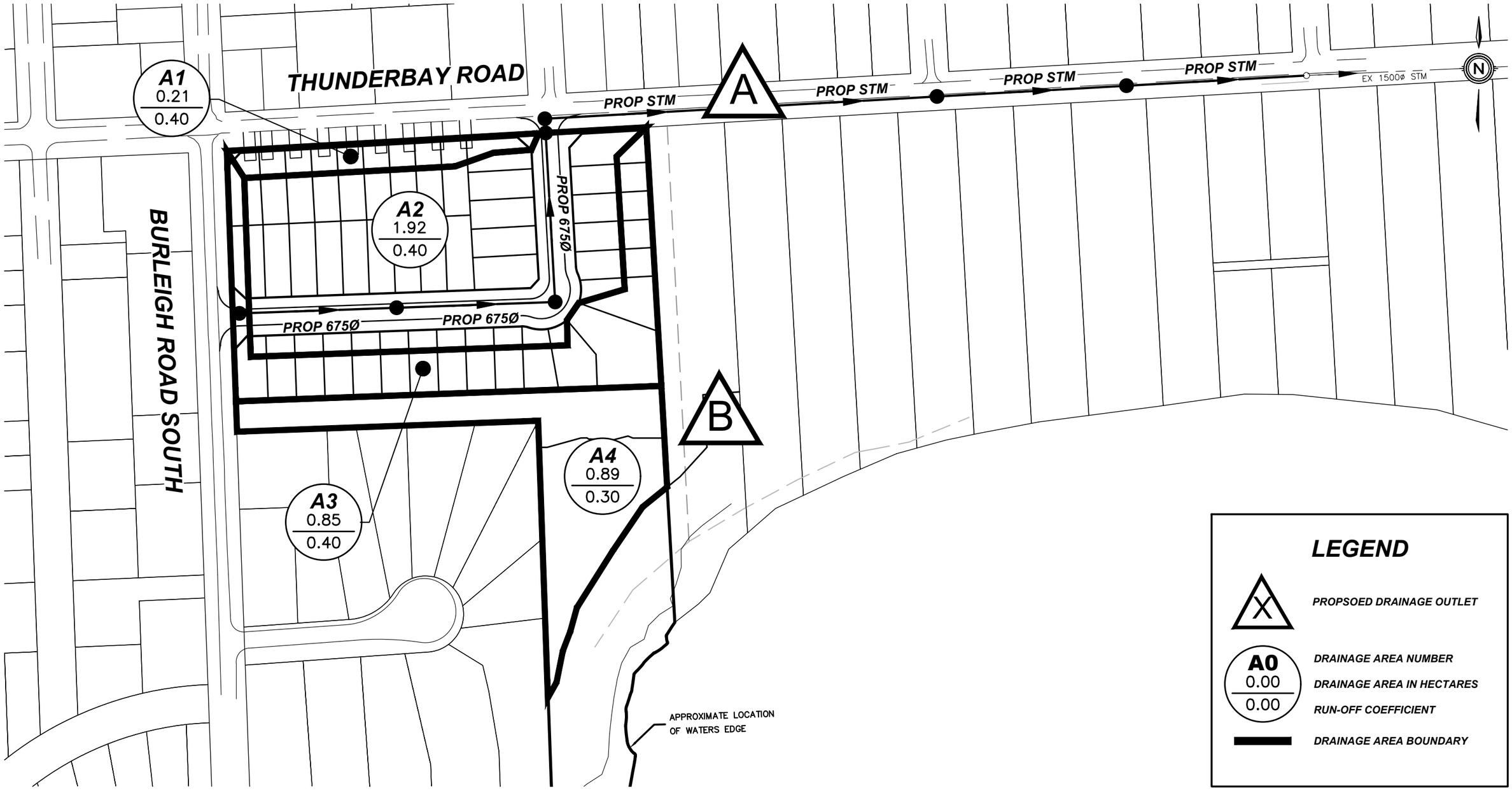

LEGEND

- PROPSOED DRAINAGE OUTLET
- A0 / 0.00 / 0.00 — DRAINAGE AREA NUMBER; DRAINAGE AREA IN HECTARES; RUN-OFF COEFFICIENT
- DRAINAGE AREA BOUNDARY

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3285 THUNDERBAY ROAD

TOWN OF FORT ERIE

PROPOSED STORM DRAINAGE PLAN

DATE	2021–06–25
SCALE	1:2000 m
REF No.	17143
DWG No.	FIGURE 2

DRAWING FILE: C:\Users\brendan\Desktop\17143_BASE_NEW.dwg PLOTTED: Jun 25, 2021 – 12:25pm PLOTTED BY: brendan

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APPENDIX B

MRM Storage Calculations and Stage Storage/Discharge Curve

Town of Fort Erie
STORM SEWER DESIGN SHEET

PROJECT / SUBDIVISION: 3285 Thunder Bay Road

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	**FROM M.H.**	**TO M.H.**	**PIPE LENGTH (m)**	**INCREMENT AREA (hectares)**	**TOTAL AREA (hectares)**	**TO UPPER END (min)**	**IN SECTION (min)**	**RUNOFF COEFF**	**SECTION A X R**	**ACCUMLD A x R**	**RAINFALL INTENSITY (mm/hr)**	**PEAK FLOW (L/s)**
PRE-DEVELOPMENT CONDITIONS												
EX FE	SITE	OUTLET A		1.10	1.10	10.00	0.00	0.400	0.440	0.440	85.669	**104.7**
EX1	SITE	OUTLET B		2.99	2.99	10.00	0.00	0.200	0.598	0.598	85.669	**142.3**
POST-DEVELOPMENT CONDITIONS												
A1 - Uncontrolled	SITE	OUTLET A		0.21	0.21	10.00	0.00	0.400	0.084	0.084	85.669	20.0
A2 - Controlled	SITE	OUTLET A		1.92	1.92	10.00	0.00	0.400	0.768	0.768	85.669	182.8
										Allowable Outflow to Outlet A (L/s) =		84.7
A3 - Uncontrolled	SITE	OUTLET B		0.85	0.85	10.00	0.00	0.400	0.340	0.340	85.669	80.9

DESIGN BY: **UPPER CANADA CONSULTANTS**
3-30 HANNOVER DRIVE
ST. CATHARINES, ON L2W 1A3
DESIGN BY:

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
Town of Fort Erie - 5 Year IDF Curve

a = 747.93 mm/hr
b = 6.80 minutes
c = 0.77

Modified Rational Method (MRM) Required Storage Volume

Project: 3285 Thunder Bay Road
Project No: 17143
Date: June 2021
Design By:

Description: *Stormwater Management Plan, Quantity Control Storage Volume Calculation*

Storm Event: **Town of Fort Erie - 5 Year IDF Curve**

a = 747.93 mm/hr
b = 6.80 minutes
c = 0.77

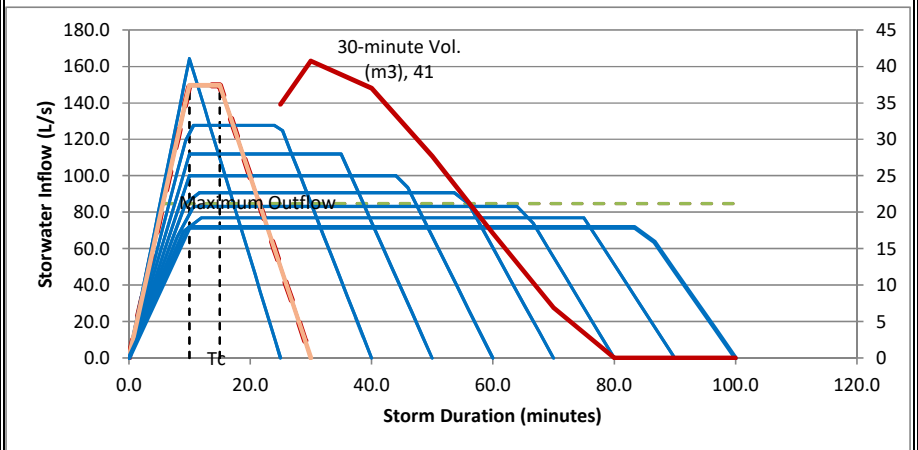
Critical Storm Duration: 30.00 minutes Tail Multiplier (x1-1.5) 1.5
Tc From Design: 10.00 minutes
Storm Tail Time: 15.00 minutes

Accumulated Area x R (Ha): 0.768 <-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity: 70.13 mm/hr
Peak Inflow at Tc: 149.62 L/s
Maximum Release Rate: 84.72 <-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded: 5.66

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	84.72	-5.1	0.0
1.0	7.01	14.96	84.72	-4.2	0.0
2.0	14.03	29.92	84.72	-3.3	0.0
3.0	21.04	44.89	84.72	-2.4	0.0
4.0	28.05	59.85	84.72	-1.5	0.0
5.0	35.07	74.81	84.72	-0.6	0.0
6.0	42.08	89.77	84.72	0.3	0.3
7.0	49.09	104.73	84.72	1.2	1.5
8.0	56.11	119.69	84.72	2.1	3.6
9.0	63.12	134.66	84.72	3.0	6.6
10.0	70.13	149.62	84.72	3.9	10.5
11.0	70.13	149.62	84.72	3.9	14.4
12.0	70.13	149.62	84.72	3.9	18.3
13.0	70.13	149.62	84.72	3.9	22.2
14.0	70.13	149.62	84.72	3.9	26.1
15.0	70.13	149.62	84.72	3.9	30.0
16.0	65.46	139.64	84.72	3.3	33.3
17.0	60.78	129.67	84.72	2.7	36.0
18.0	56.11	119.69	84.72	2.1	38.1
19.0	51.43	109.72	84.72	1.5	39.6
20.0	46.76	99.75	84.72	0.9	40.5
21.0	42.08	89.77	84.72	0.3	***40.8***
22.0	37.40	79.80	84.72	-0.3	40.5
23.0	32.73	69.82	84.72	-0.9	39.6
24.0	28.05	59.85	84.72	-1.5	38.1
25.0	23.38	49.87	84.72	-2.1	36.0
26.0	18.70	39.90	84.72	-2.7	33.3
27.0	14.03	29.92	84.72	-3.3	30.0
28.0	9.35	19.95	84.72	-3.9	26.1
29.0	4.68	9.97	84.72	-4.5	21.6
30.0	0.00	0.00	84.72	-5.1	16.6

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	34.8 m3	50 Min	27.7 m3	80 Min	0.0 m3
30 Min	**40.8 m3**	60 Min	17.1 m3	90 Min	0.0 m3
40 Min	37.0 m3	70 Min	6.9 m3	100 Min	0.0 m3



Town of Fort Erie
STORM SEWER DESIGN SHEET

PROJECT / SUBDIVISION: 3285 Thunder Bay Road

	LOCATION					TIME OF FLOW		STORMWATER ANALYSIS					
DESCRIPTION	**FROM M.H.**	**TO M.H.**	**PIPE LENGTH (m)**	**INCREMENT AREA (hectares)**	**TOTAL AREA (hectares)**	**TO UPPER END (min)**	**IN SECTION (min)**	**RUNOFF COEFF**	**SECTION A X R**	**ACCUMLD A x R**	**RAINFALL INTENSITY (mm/hr)**	**PEAK FLOW (L/s)**	
PRE-DEVELOPMENT CONDITIONS													
EX1	SITE	OUTLET B		2.99	2.99	10.00	0.00	0.200	0.598	0.598	137.317	**228.1**	**(1)**
POST-DEVELOPMENT CONDITIONS													
A3 - Uncontrolled	SITE	OUTLET B		0.85	0.85	10.00	0.00	0.400	0.340	0.340	137.317	129.7	**(2)**
						Allowable Major Overland Flow from A2 to Outlet B [(1) - (2)]						98.4	**(3)**
A2 - Uncontrolled	SITE			1.92	1.92	10.00	0.00	0.400	0.768	0.768	137.317	292.9	**(4)**
				Peak 100 Year Flow to be Controlled to Allowable 5 Year Levels to Outlet A [(4) - (3)]								194.5	**(5)**

DESIGN BY: **UPPER CANADA CONSULTANTS**
3-30 HANNOVER DRIVE
ST. CATHARINES, ON L2W 1A3

DESIGN BY:

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
Town of Fort Erie - 100 Year IDF Curve

a = 1083.55 mm/hr
b = 6.62 minutes
c = 0.74

Modified Rational Method (MRM) Required Storage Volume

Project: 3285 Thunder Bay Road
Project No: 17143
Date: June 2021
Design By:

Description: *Stormwater Management Plan, Quantity Control Storage Volume Calculation*

Storm Event: **Town of Fort Erie - 100 Year IDF Curve**

a = 1083.55 mm/hr
b = 6.62 minutes
c = 0.74

Critical Storm Duration: 30.00 minutes Tail Multiplier (x1-1.5 1.5
Tc From Design: 10.00 minutes
Storm Tail Time: 15.00 minutes

Accumulated Area x R (Ha): 0.768 <-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity: 113.18 mm/hr
Peak Inflow at Tc: 241.45 L/s
Maximum Release Rate: 84.70 <-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded: 3.51

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	84.70	-5.1	0.0
1.0	11.32	24.14	84.70	-3.6	0.0
2.0	22.64	48.29	84.70	-2.2	0.0
3.0	33.95	72.43	84.70	-0.7	0.0
4.0	45.27	96.58	84.70	0.7	0.7
5.0	56.59	120.72	84.70	2.2	2.9
6.0	67.91	144.87	84.70	3.6	6.5
7.0	79.22	169.01	84.70	5.1	11.5
8.0	90.54	193.16	84.70	6.5	18.1
9.0	101.86	194.50	84.70	6.6	24.6
10.0	113.18	194.50	84.70	6.6	31.2
11.0	113.18	194.50	84.70	6.6	37.8
12.0	113.18	194.50	84.70	6.6	44.4
13.0	113.18	194.50	84.70	6.6	51.0
14.0	113.18	194.50	84.70	6.6	57.6
15.0	113.18	194.50	84.70	6.6	64.2
16.0	105.63	194.50	84.70	6.6	70.8
17.0	98.09	194.50	84.70	6.6	77.3
18.0	90.54	193.16	84.70	6.5	83.8
19.0	83.00	177.06	84.70	5.5	89.4
20.0	75.45	160.96	84.70	4.6	94.0
21.0	67.91	144.87	84.70	3.6	97.6
22.0	60.36	128.77	84.70	2.6	100.2
23.0	52.82	112.67	84.70	1.7	101.9
24.0	45.27	96.58	84.70	0.7	***102.6***
25.0	37.73	80.48	84.70	-0.3	102.4
26.0	30.18	64.39	84.70	-1.2	101.1
27.0	22.64	48.29	84.70	-2.2	99.0
28.0	15.09	32.19	84.70	-3.2	95.8
29.0	7.55	16.10	84.70	-4.1	91.7
30.0	0.00	0.00	84.70	-5.1	86.6

Underground Superpipe Stage Storage/Discharge Curve

Project **3285 Thunderbay Road, Town of Fort Erie**
Project No. **17143**
Date: **June, 2021**

Preliminary Controlling Rim Elevation:	**180.25**	**MH 1 - MH 2**		**MH 2 - MH 3**		**MH 3 - MH 4**		**Quantity Orifice**	
INVERT:		177.80	177.80	177.69	177.66	177.57	177.52	Dia (m) =	0.150
PIPE DIAMETER (m)			0.675		0.675		0.675	Cd =	0.63
STRUCTURE/PIPE LENGTH:		1200	82.9	1200	83.6	1500	89.2	Invert (m) =	177.29
		STORAGE						**DISCHARGE**	
Elevation (m)		MH 1 (m^3)	675mm Pipe (m^3)	MH 2 (m^3)	675mm Pipe (m^3)	MH 3 (m^3)	675mm Pipe (m^3)	Total (m^3)	Orifice (L/s)
180.34		2.9	30.6	2.3	30.9	4.9	32.9	104.5	84.7
180.25		2.8	30.6	2.3	30.9	4.7	32.9	104.3	83.4
180.15		2.7	30.6	2.3	30.9	4.6	32.9	104.0	81.9
178.97		1.3	30.6	1.5	30.9	2.5	32.9	99.7	62.0
178.75		1.1	30.6	1.2	30.9	2.1	32.9	98.8	57.5
178.38		0.7	27.6	0.8	30.9	1.4	32.9	94.3	49.1
178.05		0.3	10.0	0.4	18.2	0.8	27.3	57.0	40.0
177.65		-	-	-	-	0.1	4.4	4.5	25.1
177.60		-	-	-	-	0.1	2.2	2.2	22.6
177.50		-	-	-	-	-	-	0.0	16.4
177.29		-	-	-	-	-	-	0.0	-

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX C

Stormwater Quality Analysis

```
          ************************************************
          *      Storm Water Management Sizing Model     *
          *               Hydroworks, LLC                *
          *                Version 4.4                   *
          *                                              *
          *        Continuous Simulation Program         *
          *             Based on SWMM 4.4H               *
          *             Hydroworks, LLC                  *
          *              Graham Bryant                   *
          *                2003 - 2013                   *
          ************************************************

                          Developed by

          ************************************************
          *               Hydroworks, LLC                *
          *             Metcalf & Eddy, Inc.             *
          *           University of Florida              *
          *       Water Resources Engineers, Inc.        *
          *     (Now Camp Dresser & McKee, Inc.)         *
          *              Modified SWMM 4.4               *
          ************************************************

                  Distributed and Maintained by

          ************************************************
          *                                              *
          *                Hydroworks, LLC               *
          *                 888-290-7900                 *
          *              www.hydroworks.com              *
          *                                              *
          ************************************************

          ************************************************
          *     If any problems occur executing this     *
          *     model, contact Mr. Graham Bryant at      *
          *     Hydroworks, LLC by phone at 908-272-4411 *
          *     or by e-mail: support@hydroworks.com     *
          ************************************************

          ************************************************
          *     This model is based on EPA SWMM 4.4      *
          *  "Nature is full of infinite causes which    *
          *   have never occurred in experience" da Vinci *
          ************************************************

*************************************************
* Entry made to the Rain Block                  *
* Created by the University of Florida - 1988   *
* Updated by Oregon State University, March 2000 *
*************************************************

          3285 Thunderbay Road
          Town of Fort Erie

      ########################################
      #  Precipitation Block Input Commands  #
      ########################################
     Station Name.........................  St. Catherines A
     Station Location.....................  Ontario
     Station, ISTA........................    7287
     Beginning date, IYBEG (Yr/Mo/Dy).....  1971/ 1/ 1
     Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
     Minimum interevent time, MIT.........     1
     Number of ranked storms, NPTS.........    10
     NWS format, IFORM (See text).........     1
     Print storm summary, ISUM (O-No 1-Yes)     0
     Print all rainfall, IYEAR (O-No 1-Yes)     0
     Save storm event data on NSCRAT(1)....     0
     (IFILE =0 -Do not save, =1 -Save data)
     IDECID 0 - Create interface file
            1 - Create file and analyze
            2 - Synoptic analysis..........     2
     Plotting position parameter, A........  0.40
     Storm event statistics, NOSTAT........  1100
     KODEA (from optional group B0)........     2
      = 0, Do not include NCDC cumulative values.
      = 1, Average NCDC cumulative values.
      = 2, Use NCDC cumulative value as inst. rain.
     KODEPR (from optional group B0).......     0
      Print NCDC special codes in event summary:
      = 0, only on days with events.
      = 1, on all days with codes present.
      Codes: A = accumulated value, I = incomplete value,
             M = missing value,     O = other code present

*********************************************************
*  Precipitation output created using the Rain block    *
*  Number of precipitation stations...        1         *
*********************************************************
Location Station Number
-------- --------------
       1.     7287

STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

#####################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
#####################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins     #
#####################################################
```

```
Snowmelt parameter - ISNOW.....................          0
Number of rain gages - NRGAG...................          1
Horton infiltration equation used - INFILM......          2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.
Quality is simulated - KWALTY..................          1
IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP..          1
Hour of day at start of storm - NHR............           1
Minute of hour at start of storm - NMN.........           1
Time TZERO at start of storm (hours)...........      1.017
Use Metric units for I/O - METRIC..............           1
 ===> Ft-sec units used in all internal computations
Runoff input print control...                             0
Runoff graph plot control....                             1
Runoff output print control..                             0
Print headers every 50 lines - NOHEAD (0=yes, 1=no)       0
Print land use load percentages -LANDUPR (0=no, 1=yes)    0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is:              1/ 1/1971
Wet time step length (seconds).......                   300.
Dry time step length (seconds).......                   900.
Wet/Dry time step length (seconds)...                   450.
Simulation length is......                     20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth    25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ........................................   0.01000

*********************************************************
*   Processed Precipitation will be read from file     *
*********************************************************

  ##############################
  #        Data Group F1       #
  # Evaporation Rate (mm/day) #
  ##############################
 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00

*************************************************************
*         C H A N N E L  A N D  P I P E  D A T A             *
*************************************************************
Input   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to      Channel  Width  Length    Slope   Slope    Slope   Depth   Depth   ings   Flow
umber    ID #       NGTO:    Type     (m)    (m)     (m/m)   (m/m)    (m/m)    (m)     (m)    "N"   (cms)
-----  ------------------ -------- ------ -------   ------- -------- ------- ------- ------- -----  -----
  1        201        200   Dummy     0.0     0.0    0.0000   0.0000  0.0000     0.0     0.0  0.0000 0.00E+00

 ************************************************
 *          S U B C A T C H M E N T  D A T A     *
 ************************************************
*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL      WIDTH    AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION   DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET       (M)    (HA)  IMPERV.    (M/M)     IMPERV.     PERV.   IMPERV.    PERV.      RATE(MM/HR)    (1/SEC)    NO.  VOLUME
                                                                                                          MAXIMUM MINIMUM                    (MM)
 ---  --------   -------- --------- --------  -----   -------    --------  --------    ------    ------     ----   -------  -------  ------ -------
  1       300        200    126.69     3.21  30.00    0.0200      0.015     0.250     0.510     5.080    63.50   10.16    0.00055     1  101.60000
TOTAL NUMBER OF SUBCATCHMENTS...              1
TOTAL TRIBUTARY AREA (HECTARES).             3.21
IMPERVIOUS AREA (HECTARES)......             0.96
PERVIOUS AREA (HECTARES)........             2.25
TOTAL WIDTH (METERS)............           126.69
PERCENT IMPERVIOUSNESS..........            30.00

*********************************************************
*     G R O U N D W A T E R   I N P U T   D A T A       *
*********************************************************

    SUB-     CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ============
    CATCH        OR      GROUND  BOTTOM   STAGE     BC      TW       A1         B1       A2         B2        A3
    NUMBER     INLET       (M)     (M)      (M)     (M)     (M) (MM/HR-M^B1)        (MM/HR-M^B2)        (MM/HR-M^2)
    ------     -----     -------  ------  ------  ------  ------ -----------  ------- -----------  ------- -----------
         0       602        3.05    0.00    0.00    0.61    0.61   3.484E-04    2.600   0.000E+00    1.000    0.00E+00

*************************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
*************************************************************
              S O I L   P R O P E R T I E S
                      SATURATED                                          PERCOLATION     E T  P A R A M E T E R S
       SUBCAT.          HYDRAULIC  WILTING  FIELD   INITIAL     MAX. DEEP   PARAMETERS         DEPTH  FRACTION OF ET
       NO.   POROSITY CONDUCTIVITY  POINT  CAPACITY MOISTURE  PERCOLATION   HCO    PCO        OF ET  TO UPPER ZONE
                        (mm/hr)                                  (mm/hr)                      (m)
      ----   ------     -------    ------  ------   ------    ----------  ------  ------     ------       ------
         0    .4000     127.000     .1500   .3000    .3000     5.080E-02   10.00    4.57       4.27       0.350

*********************************************************
*    Arrangement of Subcatchments and Channel/Pipes     *
*********************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
*********************************************************
   Channel
   or Pipe
       201     No Tributary Channel/Pipes
               No Tributary Subareas.....
    INLET
       200     Tributary Channel/Pipes...        201
               Tributary Subareas........        300

*************************************************************
* Hydrographs will be stored for the following   1 INLETS *
*************************************************************
           200
```

```
##################################################
#              Quality Simulation                #
##################################################
#      General Quality Control Data Groups       #
##################################################
 Description                          Variable       Value
 -----------                          --------       -----
 Number of quality constituents.....    NQS.......         1
 Number of land uses................  JLAND.......         1
 Standard catchbasin volume.........  CBVOL.......      1.22 cubic meters
 Erosion is not simulated.........    IROS........         0
 DRY DAYS PRIOR TO START OF STORM... DRYDAY.......      3.00 DAYS
 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......      5.00 DAYS
 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......     0.300
 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......       120
 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......       270

##########################################
#     Land use data on data group J2     #
##########################################
                                                                  LIMITING                                CLEANING  AVAIL.    DAYS SINCE
                                                                  BUILDUP    BUILDUP  BUILDUP  BUILDUP   INTERVAL  FACTOR       LAST
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF       QUANTITY   POWER    COEFF.   IN DAYS   FRACTION   SWEEPING
LNAME)            (METHOD)        BUILDUP PARAMETER(JACGUT)  (DDLIM)    (DDPOW)  (DDFACT) (CLFREQ)  (AVSWP)     (DSLCL)
-------   ---------------------   -------------------------  --------   -------  -------- --------  -------    ---------
Urban De  EXPONENTIAL(1)                  AREA(1)           2.802E+01     0.500    67.250    30.000     0.300    30.000

##############################################
#     Constituent data on data group J3      #
##############################################
                               Total Su
                               --------
Constituent units........      mg/l
Type of units............           0
KALC.....................           2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH....................           0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT...................           1
Dependence of buildup....          AREA(1)
LINKUP...................           0
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).         28.020
Buildup param 2 (QFACT2).          0.500
Buildup param 3 (QFACT3).         67.250
Buildup param 4 (QFACT4).          0.000
Buildup param 5 (QFACT5).          0.000
Washoff power (WASHPO)...          1.100
Washoff coef. (RCOEF)....          0.086
Init catchb conc (CBFACT)        100.000
Precip. conc. (CONCRN)...          0.000
Street sweep effic (REFF)          0.300
Remove fraction (REMOVE).          0.000
1st order QDECAY, 1/day..          0.000
Land use number.........              1

************************************************
* Constant Groundwater Quality Concentration(s) *
************************************************
 Total Susp has a concentration of..    0.0000   mg/l

************************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                                *
************************************************
  CHANNEL/   CONSTITUENT
     PIPE Total Susp
----------  --------
       201     0.000

******************************************************
*     Subcatchment surface quality on data group L1 *
******************************************************
                                Total   Number   Input
                      Land     Gutter     of    Loading
            Land      Use     Length    Catch-  load/ha
      No.  Usage     No.       Km      Basins   Total Su
   ------ --------  ----   -------- --------  -------
   1        300 Urban De  1         0.25     2.00  0.0E+00
   Totals (Loads in kg or other)    0.25     2.00  0.0E+00

    **********************
    *    DATA GROUP M1    *
    **********************
TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES............        0        0

    **********************
    *    DATA GROUP M3    *
    **********************
CHANNEL/INLET PRINT DATA GROUPS......       -200
```

```
          ****************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ****************************************
Rainfall Station    St. Catherines A
State/Province      Ontario
Rainfall Depth Summary (mm)
```

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971.	31.	0.	0.	0.	0.	0.	126.	93.	52.	60.	29.	0.	391.
1972.	0.	0.	0.	47.	65.	100.	39.	115.	63.	90.	1.	0.	521.
1973.	0.	0.	0.	103.	77.	71.	53.	29.	63.	139.	0.	0.	534.
1974.	0.	0.	0.	67.	105.	62.	50.	31.	74.	37.	110.	0.	536.
1975.	0.	0.	0.	0.	0.	94.	78.	76.	73.	56.	59.	6.	442.
1976.	0.	0.	0.	119.	136.	87.	101.	60.	72.	73.	13.	1.	662.
1977.	0.	0.	0.	94.	29.	69.	57.	150.	230.	71.	0.	1.	701.
1978.	0.	0.	0.	72.	43.	72.	43.	86.	156.	95.	0.	0.	567.
1979.	0.	0.	0.	84.	92.	33.	91.	88.	84.	129.	71.	0.	673.
1980.	0.	0.	0.	81.	39.	122.	60.	32.	79.	96.	45.	0.	554.
1981.	0.	0.	0.	91.	71.	106.	122.	61.	123.	91.	84.	0.	749.
1982.	0.	0.	0.	28.	65.	97.	36.	66.	82.	25.	143.	0.	544.
1983.	0.	0.	0.	78.	100.	65.	55.	106.	75.	122.	92.	0.	694.
1984.	0.	0.	0.	31.	113.	136.	19.	51.	144.	24.	44.	0.	562.
1985.	0.	0.	67.	32.	52.	64.	40.	94.	42.	109.	0.	1.	501.
1986.	0.	0.	0.	93.	113.	60.	85.	83.	98.	80.	43.	65.	719.
1987.	0.	2.	11.	77.	42.	80.	122.	97.	99.	71.	94.	34.	730.
1988.	0.	0.	41.	71.	42.	21.	110.	82.	70.	68.	75.	5.	585.
1989.	0.	0.	13.	63.	137.	108.	36.	45.	89.	73.	84.	0.	647.
1990.	0.	2.	38.	99.	124.	44.	68.	95.	56.	112.	96.	0.	735.
1991.	0.	0.	86.	124.	67.	31.	85.	57.	79.	64.	61.	28.	682.
1992.	0.	0.	29.	127.	56.	92.	185.	116.	77.	47.	103.	38.	869.
1993.	3.	0.	7.	83.	56.	86.	32.	61.	71.	92.	80.	38.	610.
1994.	0.	0.	44.	88.	105.	124.	48.	77.	117.	15.	0.	15.	633.
1995.	112.	23.	16.	48.	37.	60.	123.	66.	8.	137.	94.	0.	724.
1998.	0.	0.	0.	0.	51.	54.	64.	29.	9.	0.	1.	0.	207.
1999.	0.	0.	0.	79.	59.	35.	61.	58.	116.	78.	0.	0.	487.
2000.	0.	0.	0.	123.	134.	216.	51.	0.	0.	0.	10.	0.	534.
2001.	0.	0.	0.	56.	88.	45.	25.	30.	81.	129.	0.	0.	454.
2002.	0.	0.	0.	73.	104.	64.	53.	49.	52.	65.	8.	0.	468.
2003.	0.	0.	0.	10.	163.	77.	81.	64.	67.	73.	2.	0.	537.
2004.	0.	0.	0.	131.	126.	99.	115.	40.	88.	17.	0.	0.	616.
2005.	0.	0.	0.	38.	42.	78.	53.	120.	112.	0.	0.	0.	443.

```
Total Rainfall Depth for Simulation Period    19310. (mm)
```

```
Rainfall Intensity Analysis (mm/hr)
```

(mm/hr)	(#)	(%)	(mm)	(%)
2.50	21481	74.6	6454.	33.4
5.00	3585	12.4	3088.	16.0
7.50	1973	6.8	2886.	14.9
10.00	575	2.0	1233.	6.4
12.50	389	1.4	1070.	5.5
15.00	194	0.7	660.	3.4
17.50	210	0.7	846.	4.4
20.00	66	0.2	306.	1.6
22.50	92	0.3	487.	2.5
25.00	39	0.1	232.	1.2
27.50	37	0.1	246.	1.3
30.00	34	0.1	245.	1.3
32.50	29	0.1	228.	1.2
35.00	5	0.0	42.	0.2
37.50	10	0.0	90.	0.5
40.00	10	0.0	97.	0.5
42.50	12	0.0	124.	0.6
45.00	9	0.0	99.	0.5
47.50	1	0.0	12.	0.1
50.00	3	0.0	37.	0.2
>50.00	49	0.2	829.	4.3

```
Total # of Intensities  28803
```

```
Daily Rainfall Depth Analysis (mm)
```

(mm)	(#)	(%)	(mm)	(%)
2.50	1077	38.9	1247.	6.5
5.00	507	18.3	1850.	9.6
7.50	326	11.8	2006.	10.4
10.00	226	8.2	1958.	10.1
12.50	150	5.4	1672.	8.7
15.00	111	4.0	1495.	7.7
17.50	100	3.6	1620.	8.4
20.00	67	2.4	1260.	6.5
22.50	45	1.6	958.	5.0
25.00	37	1.3	881.	4.6
27.50	23	0.8	609.	3.2
30.00	20	0.7	575.	3.0
32.50	20	0.7	631.	3.3
35.00	12	0.4	405.	2.1
37.50	8	0.3	290.	1.5
40.00	9	0.3	350.	1.8
42.50	4	0.1	165.	0.9
45.00	4	0.1	173.	0.9
47.50	2	0.1	91.	0.5
50.00	4	0.1	192.	1.0
>50.00	15	0.5	882.	4.6

```
Total # Days with Rain   2767
************************************************
*      End of time step DO-loop in Runoff      *
************************************************
Final Date (Mo/Day/Year)   =                  1/ 1/2006
Total number of time steps =                    2056456
Final Julian Date  =                            2006001
Final time of day  =                                 3. seconds.
Final time of day  =                                0.00   hours.
Final running time =                           306816.0000   hours.
Final running time =                            12784.0000    days.

************************************************
*     Extrapolation Summary for Watersheds       *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
************************************************
 Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      300   6237727   1593817
```

```
************************************************
*     Extrapolation Summary for Channel/Pipes    *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls        *
************************************************
Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      201         0         0

*********************************************
*       Continuity Check for Surface Water   *
*********************************************
                                                                Millimeters over
                                                cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                 618323.     19263.
Total Infiltration                                   431970.     13457.
Total Evaporation                                     19449.       606.
Surface Runoff from Watersheds                       168334.      5244.
Total Water remaining in Surface Storage                  0.         0.
Infiltration over the Pervious Area...               431970.     19225.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........               619754.     19307.
Total Precipitation + Initial Storage.               618323.     19263.

The error in continuity is calculated as
**************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-------------------------------------*
* Precipitation + Initial Snow Cover  *
**************************************
Error.................................       -0.231 Percent

*********************************************
*       Continuity Check for Channel/Pipes   *
*********************************************
                                                                Millimeters over
                                                cubic meters  Total Basin
Initial Channel/Pipe Storage.................             0.         0.
Final Channel/Pipe Storage...................             0.         0.
Surface Runoff from Watersheds...............        168334.      5244.
Baseflow.....................................             0.
Groundwater Subsurface Inflow................             0.         0.
Evaporation Loss from Channels...............             0.         0.
Channel/Pipe/Inlet Outflow...................        168334.      5244.
Initial Storage + Inflow.....................        168334.      5244.
Final Storage + Outflow......................        168334.      5244.
**********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
**********************************************
Error.....................................      0.000 Percent

***************************************************
*     Continuity Check for Subsurface Water       *
***************************************************
                                                                 Millimeters over
                                                cubic meters       Subsurface Basin
Total Infiltration                                          0.         0.
Total Upper Zone ET                                         0.         0.
Total Lower Zone ET                                         0.         0.
Total Groundwater flow                                      0.         0.
Total Deep percolation                                      0.         0.
Initial Subsurface Storage                              29351.       914.
Final Subsurface Storage                                29351.       914.
Upper Zone ET over Pervious Area                            0.         0.
Lower Zone ET over Pervious Area                            0.         0.

****************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
****************************************
Error ....................................     0.000 Percent
```

SUMMARY STATISTICS FOR SUBCATCHMENTS

SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (HA)	PERCENT IMPER.	PERVIOUS AREA: TOTAL SIMULATED RAINFALL (MM)	PERVIOUS AREA: TOTAL RUNOFF DEPTH (MM)	PERVIOUS AREA: TOTAL LOSSES (MM)	PERVIOUS AREA: PEAK RUNOFF RATE (CMS)	IMPERVIOUS AREA: RUNOFF DEPTH (MM)	IMPERVIOUS AREA: PEAK RUNOFF RATE (CMS)	TOTAL SUBCATCHMENT AREA: RUNOFF DEPTH (MM)	TOTAL SUBCATCHMENT AREA: PEAK RUNOFF (CMS)	TOTAL SUBCATCHMENT AREA: PEAK UNIT RUNOFF (MM/HR)
300	200	3.21	30.01	9262.47	33.92	********	0.19417	397.699	0.524	5243.060	0.718	81.217

*** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

SUMMARY STATISTICS FOR CHANNEL/PIPES

CHANNEL NUMBER	FULL FLOW (CMS)	FULL VELOCITY (M/S)	FULL DEPTH (M)	MAXIMUM COMPUTED INFLOW (CMS)	MAXIMUM COMPUTED OUTFLOW (CMS)	MAXIMUM COMPUTED DEPTH (M)	MAXIMUM COMPUTED VELOCITY (M/S)	TIME OF OCCURRENCE DAY	TIME OF OCCURRENCE HR.	LENGTH OF SURCHARGE (HOUR)	MAXIMUM SURCHARGE VOLUME (CU-M)	RATIO OF MAX. TO FULL FLOW	RATIO OF MAX. DEPTH TO FULL DEPTH
201				0.00				1/	0/1900	0.00			
200				0.72				8/14/1972	14.25				

TOTAL NUMBER OF CHANNELS/PIPES = 2

*** NOTE *** THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
 ###################################################
 #             Runoff Quality Summary Page         #
 # If NDIM = 0 Units for:   loads    mass rates     #
 #             METRIC = 1    lb        lb/sec      #
 #             METRIC = 2    kg        kg/sec      #
 # If NDIM = 1 Loads are in units of quantity      #
 #             and mass rates are quantity/sec     #
 # If NDIM = 2 loads are in units of concentration #
 #             times volume and mass rates have units#
 #             of concentration times volume/second #
 ###################################################

Total Su NDIM =  0
METRIC =  2
```

	Total Su
Inputs	
1. INITIAL SURFACE LOAD	70.
2. TOTAL SURFACE BUILDUP	33368.
3. INITIAL CATCHBASIN LOAD	0.
4. TOTAL CATCHBASIN LOAD	0.
5. TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4)	33368.
Remaining Loads	
6. LOAD REMAINING ON SURFACE	49.
7. REMAINING IN CATCHBASINS	0.
8. REMAINING IN CHANNEL/PIPES	0.
Removals	
9. STREET SWEEPING REMOVAL	5030.
10. NET SURFACE BUILDUP (2-9)	28338.
11. SURFACE WASHOFF	28284.
12. CATCHBASIN WASHOFF	0.
13. TOTAL WASHOFF (11+12)	28284.
14. LOAD FROM OTHER CONSTITUENTS	0.
15. PRECIPITATION LOAD	0.
15a.SUM SURFACE LOAD (13+14+15)	28284.
16. TOTAL GROUNDWATER LOAD	0.
16a.TOTAL I/I LOAD	0.
17. NET SUBCATCHMENT LOAD (15a-15b-15c-15d+16+16a)	28284.
>>Removal in channel/pipes (17a, 17b):	
17a.REMOVE BY BMP FRACTION	0.
17b.REMOVE BY 1st ORDER DECAY	0.
18. TOTAL LOAD TO INLETS	28284.
19. FLOW WT'D AVE.CONCENTRATION mg/l (INLET LOAD/TOTAL FLOW)	168.
Percentages	
20. STREET SWEEPING (9/2)	15.
21. SURFACE WASHOFF (11/2)	85.
22. NET SURFACE WASHOFF(11/10)	100.
23. WASHOFF/SUBCAT LOAD(11/17)	100.
24. SURFACE WASHOFF/INLET LOAD (11/18)	100.
25. CATCHBASIN WASHOFF/ SUBCATCHMENT LOAD (12/17)	0.
26. CATCHBASIN WASHOFF/ INLET LOAD (12/18)	0.
27. OTHER CONSTITUENT LOAD/ SUBCATCHMENT LOAD (14/17)	0.
28. INSOLUBLE FRACTION/ INLET LOAD (14/18)	0.
29. PRECIPITATION/ SUBCATCHMENT LOAD (15/17)	0.
30. PRECIPITATION/ INLET LOAD (15/18)	0.
31. GROUNDWATER LOAD/ SUBCATCHMENT LOAD (16/17)	0.
32. GROUNDWATER LOAD/ INLET LOAD (16/18)	0.
32a.INFILTRATION/INFLOW LOAD/ SUBCATCHMENT LOAD (16a/17)	0.
32b.INFILTRATION/INFLOW LOAD/ INLET LOAD (16a/18)	0.
32c.CH/PIPE BMP FRACTION REMOVAL/ SUBCATCHMENT LOAD (17a/17)	0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/ SUBCATCHMENT LOAD (17b/17)	0.
33. INLET LOAD SUMMATION ERROR (18+8+6a+17a+17b-17)/17	0.

```
CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.

************************************************************
*            TSS Particle Size Distribution            *
************************************************************
```

Diameter (um)	%	Specific Gravity	Settling Velocity (m/s)	Critical Peclet Number
20.	20.0	2.65	0.000267	0.076000
60.	20.0	2.65	0.002319	0.216000
150.	20.0	2.65	0.012234	0.472500
400.	20.0	2.65	0.047806	0.675000
2000.	20.0	2.65	0.180097	0.675000

```
**************************************************
*                                                *
*              Summary of TSS Removal            *
*                                                *
**************************************************
TSS Removal based on Exponential Lab Performance Curve
 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)               (%)                 (%)
 HG 4         0.058          0.300               95.5                75.2
 HG 5         0.072          0.300               96.7                81.5
 HG 6         0.086          0.300               97.4                85.8
 Unavaila     0.117          0.300               98.5                89.3
 HG 8         0.135          0.300               98.9                91.6
 Unavaila     0.153          0.300               99.1                93.5
 HG 10        0.191          0.300               99.5                94.8
 HG 12        0.231          0.300               99.7                96.9

**************************************************
*  Summary of Quantity and Quality Results at    *
*  Location        200  INFlow in cms.           *
*  Values are instantaneous at indicated time step *
**************************************************
     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min       cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....        0.001      168.
Flow wtd std devs..        0.004       49.
Maximum value......        0.718      292.
Minimum value......        0.000        0.
Total loads........      168299.    28301.
                        Cub-Met  KILOGRAM
===> Runoff simulation ended normally.
===> SWMM 4.4    simulation ended normally.
     Always check output file for possible warning messages.

**************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
**************************************************
* Starting Date... June       25, 2021               *
*          Time...         10:42:47.883               *
*   Ending Date... June       25, 2021               *
*          Time...         10:42:50.780               *
*  Elapsed Time...               0.048 minutes.      *
*  Elapsed Time...               2.897 seconds.      *
**************************************************
```

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX D

Oil/Grit Separator Sample Inspection Report

SAMPLE INSPECTION REPORT

Owner:

Location:

Manhole Oil/Grit Separator:

Type of Inspection ☐ Monthly ☐ Annually ☐ Special

Inlet/Outlet Information

	Inlet		Outlet	
Clear of Debris	☐ Yes	☐ No	☐ Yes	☐ No
Build Up of Sediment	☐ Yes	☐ No	☐ Yes	☐ No

Action Taken:

Sediment Tank Information

A. Manhole Sump Depth: ± m from cover rim (to be as-constructed verified)

B. Measurement from Rim to Sediment Level: m

C. Depth of Sediment: m (A - B)

Note: If the measured depth of sediment is greater than **200mm** then sediment removal is required.

Presence of Contaminants

Oil	☐ Yes	☐ No	Depth	m
Foam	☐ Yes	☐ No	Depth	m

Action Taken:

Name of Regulatory Agency Telephone No.:

Transaction No.:

Name of Licensed Waste Management Collector Telephone No.:

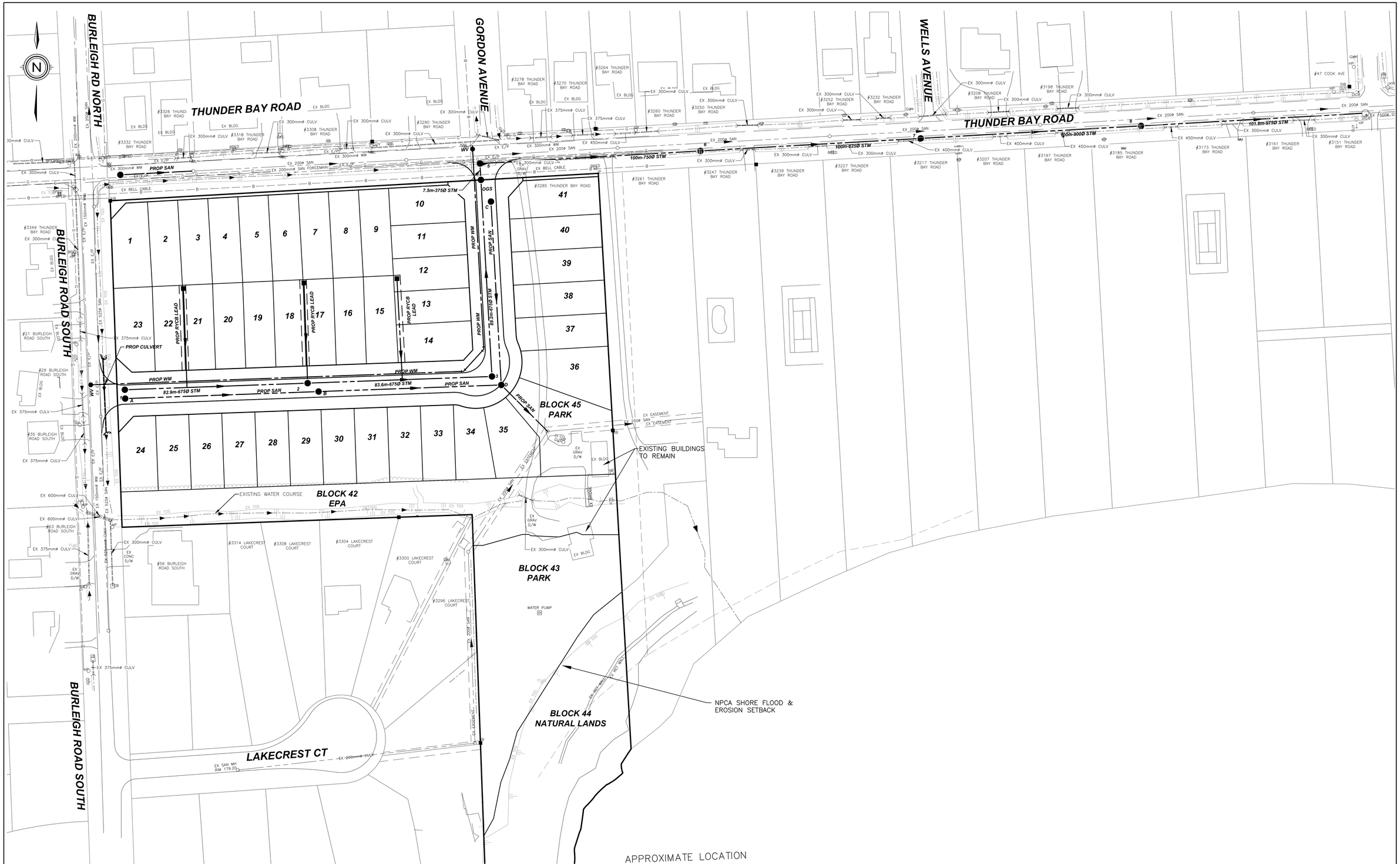
Transaction No.:

Owner Notification ☐ Yes ☐ No Other:

Time: Date:

Name of Inspector:

Signed: Date:



0	ISSUED FOR REVIEW	2021-06-17	TA
#	REVISION	DATE	INIT

NOTES:

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING	TA
DESIGN	BK
CHECKED BY	MH
APPROVED BY	MH

FORT ERIE ONTARIO

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

OWNER

WESTWIND DEVELOPMENTS LTD.
1219 SUNSET DRIVE
FORT ERIE ON
L2A 5M4

3285 THUNDER BAY ROAD
TOWN OF FORT ERIE

PRELIMINARY GENERAL SERVICING PLAN

CONSULTANT FILE No.	17143
DATE	2021-06-17
PRINTED	2021-06-25
SCALE	1:750
REF No.	
DWG No.	17143-GSP
REV	0

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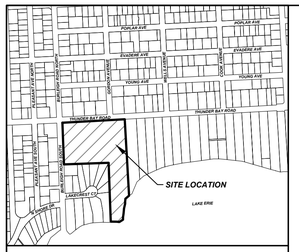
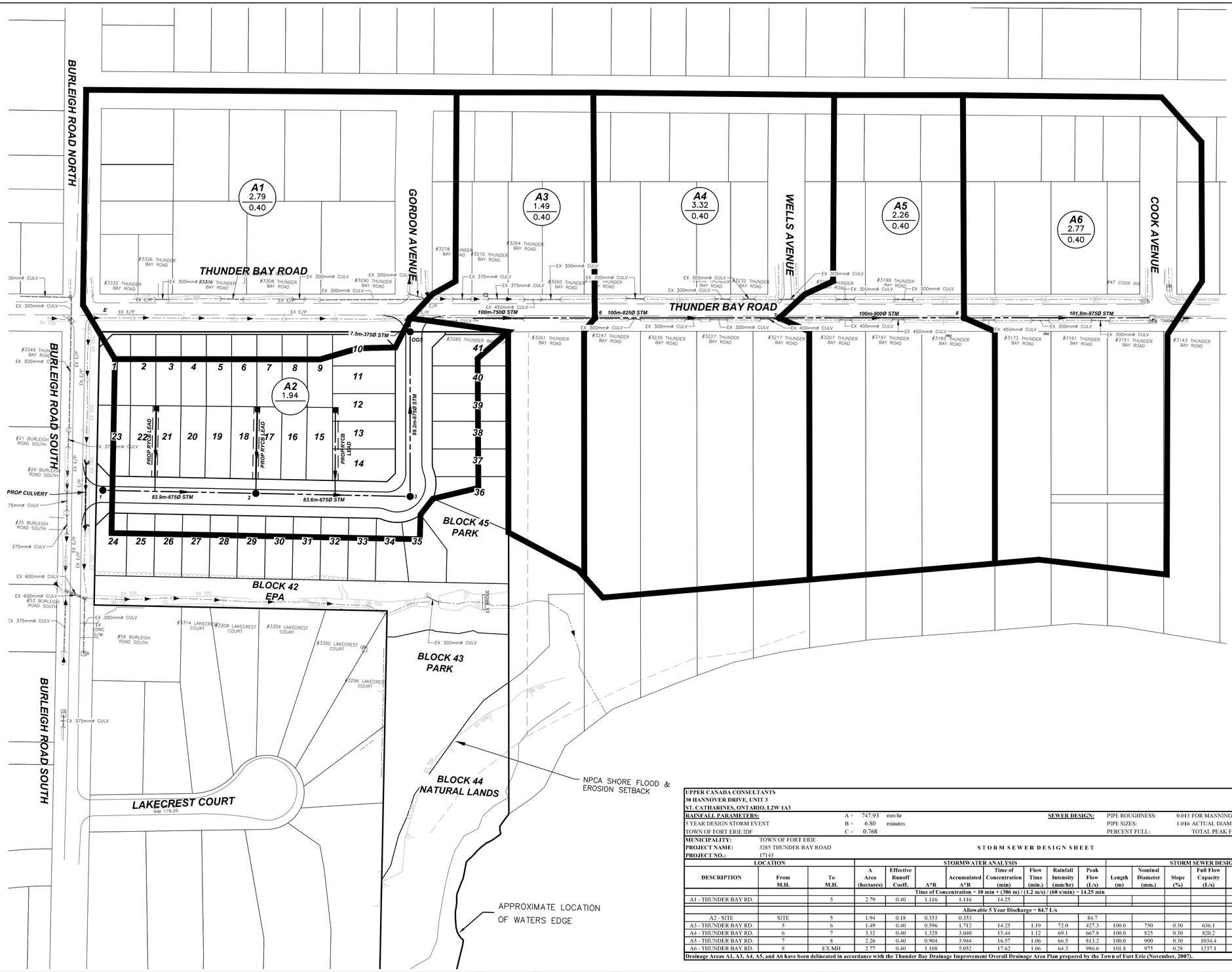


KEY PLAN
NTS

LEGEND

A0 / 0.00 / 0.00 — DRAINAGE AREA NUMBER; DRAINAGE AREA IN HECTARES; RUN-OFF COEFFICIENT

DRAINAGE AREA BOUNDARY



UPPER CANADA CONSULTANTS
30 HANNOVER DRIVE, UNIT 3
ST. CATHARINES, ONTARIO, L2W 1A3

RAINFALL PARAMETERS:
5 YEAR DESIGN STORM EVENT
TOWN OF FORT ERIE IDF
A = 747.93 mm/hr
B = 6.80 minutes
C = 0.768

SEWER DESIGN:
PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 ACTUAL DIAMETER SIZE FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: TOWN OF FORT ERIE
PROJECT NAME: 3285 THUNDER BAY ROAD
PROJECT NO.: 17143

STORM SEWER DESIGN SHEET

LOCATION			STORMWATER ANALYSIS								STORM SEWER DESIGN					
DESCRIPTION	From M.H.	To M.H.	A Area (hectares)	Effective Runoff Coeff.	A*R	Accumulated A*R	Time of Concentration (min)	Flow Time (min.)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Length (m)	Nominal Diameter (mm.)	Slope (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Percent Full
			Time of Concentration = 10 min + (306 m) / (1.2 m/s) / (60 s/min) = 14.25 min													
A1 - THUNDER BAY RD.		5	2.79	0.40	1.116	1.116	14.25									
			Allowable 5 Year Discharge = 84.7 L/s													
A2 - SITE	SITE	5	1.94	0.18	0.353	0.353				84.7						
A3 - THUNDER BAY RD.	5	6	1.49	0.40	0.596	1.712	14.25	1.19	72.0	427.3	100.0	750	0.30	636.1	1.4	67.2%
A4 - THUNDER BAY RD.	6	7	3.32	0.40	1.328	3.040	15.44	1.12	69.1	667.8	100.0	825	0.30	820.2	1.5	81.4%
A5 - THUNDER BAY RD.	7	8	2.26	0.40	0.904	3.944	16.57	1.06	66.5	813.2	100.0	900	0.30	1034.4	1.6	78.6%
A6 - THUNDER BAY RD.	8	EX MH	2.77	0.40	1.108	5.052	17.62	1.06	64.3	986.6	101.8	975	0.28	1237.1	1.6	79.8%

Drainage Areas A1, A3, A4, A5, and A6 have been delineated in accordance with the Thunder Bay Drainage Improvement Overall Drainage Area Plan prepared by the Town of Fort Erie (November, 2007).

#	REVISION	DATE	INIT
0	ISSUED FOR REVIEW	2021-06-17	TA

NOTES:
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3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING TA
DESIGN BK
CHECKED BY MH
APPROVED BY MH

FORT ERIE ONTARIO
UPPER CANADA CONSULTANTS ENGINEERS / PLANNERS

THUNDER BAY ROAD
TOWN OF FORT ERIE
STORM DRAINAGE AREA PLAN

CONSULTANT FILE No. 17143
DATE 2021-06-17
PRINTED 2021-06-25
SCALE 1:1000 m
REF No.
DWG No. 17143-STMDA
REV 0

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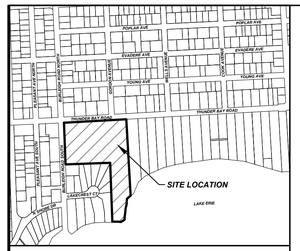
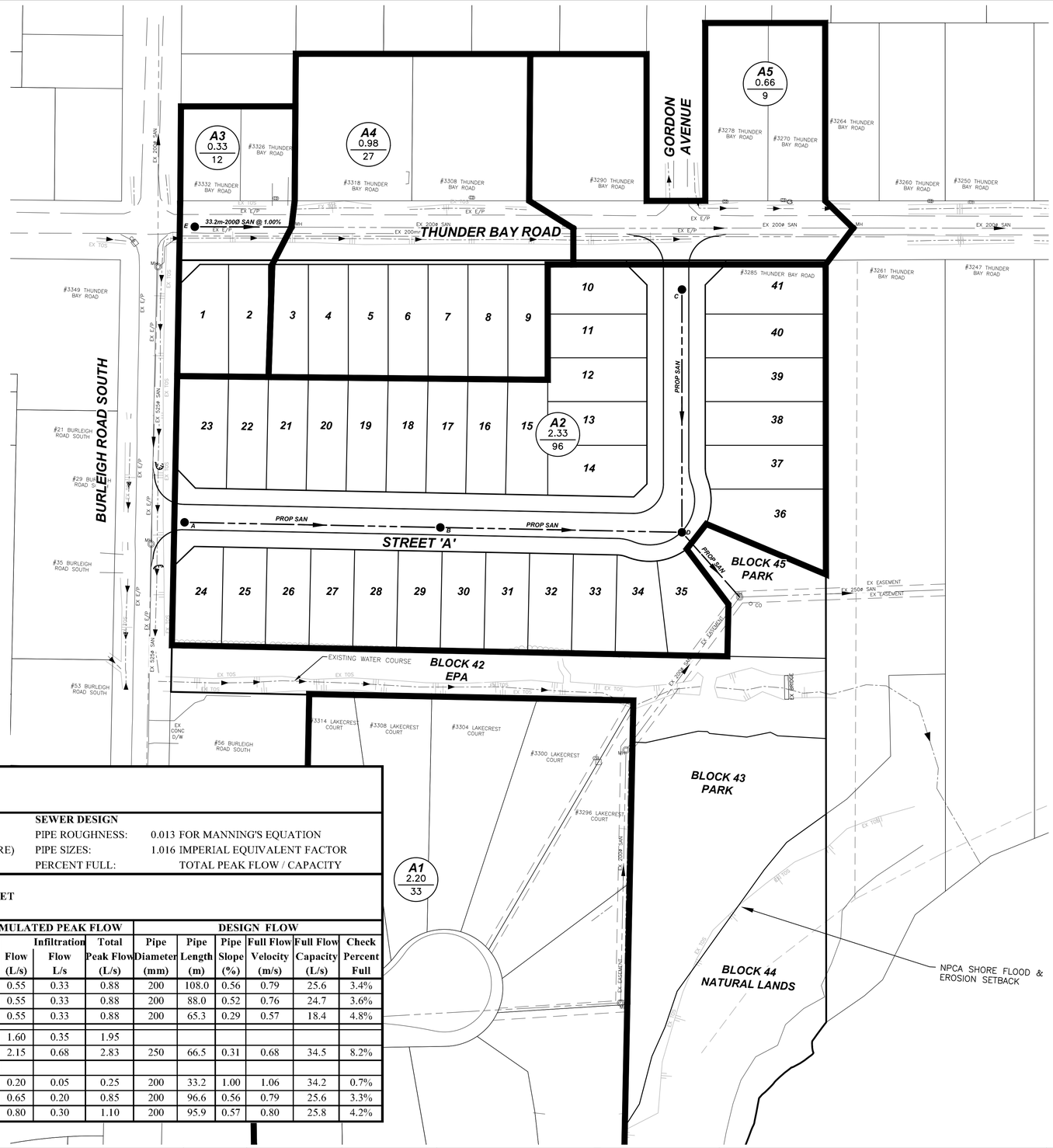


KEY PLAN
NTS

LEGEND

- **A0 / 0.00 / 00** — DRAINAGE AREA NUMBER / DRAINAGE AREA IN HECTARES / POPULATION
- DRAINAGE AREA BOUNDARY



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

DESIGN FLOWS

RESIDENTIAL:	320 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE:	0.15 LITRES/HECTARE (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 LITRES/HECTARE)
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 : 3285 THUNDER BAY ROAD
PROJECT NO: 17143

SANITARY SEWER DESIGN SHEET

LOCATION			AREA		POPULATION			ACCUMULATED PEAK FLOW				DESIGN FLOW					
Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Population Density (persons/hectare)	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)	Check Percent Full
A1 - EX DWELLINGS	EX MH	EX MH	2.20	2.20	15	33	33	4.5	0.55	0.33	0.88	200	108.0	0.56	0.79	25.6	3.4%
EX EASEMENT	EX MH	EX MH		2.20			33	4.5	0.55	0.33	0.88	200	88.0	0.52	0.76	24.7	3.6%
EX EASEMENT	EX MH	EX MH		2.20			33	4.5	0.55	0.33	0.88	200	65.3	0.29	0.57	18.4	4.8%
A2 - SITE	SITE	EX MH	2.33	2.33		96	96	4.5	1.60	0.35	1.95						
EX EASEMENT	EX MH	EX MH		4.53			129	4.5	2.15	0.68	2.83	250	66.5	0.31	0.68	34.5	8.2%
A3 - THUNDER BAY RD	PROP	EX MH	0.33	0.33	36	12	12	4.5	0.20	0.05	0.25	200	33.2	1.00	1.06	34.2	0.7%
A4 - THUNDER BAY RD	EX MH	EX MH	0.98	1.31	28	27	39	4.5	0.65	0.20	0.85	200	96.6	0.56	0.79	25.6	3.3%
A5 - THUNDER BAY RD	EX MH	EX MH	0.66	1.97	14	9	48	4.5	0.80	0.30	1.10	200	95.9	0.57	0.80	25.8	4.2%

#	REVISION	DATE	INIT
0	ISSUED FOR REVIEW	2021-06-17	TA

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DRAFTING	TA
DESIGN	BK
CHECKED BY	MH
APPROVED BY	MH

FORT ERIE ONTARIO
UPPER CANADA CONSULTANTS ENGINEERS / PLANNERS

THUNDER BAY ROAD
TOWN OF FORT ERIE

SANITARY DRAINAGE AREA PLAN

CONSULTANT FILE No.	17143
DATE	2021-06-17
PRINTED	2021-06-25
SCALE	1:750 m
REF No.	
DWG No.	17143-SANDA
REV	0

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