Groundwork Engineering Limited

Halfmoon Bay Subdivision

Stormwater Management Design Brief

Part of Lot A, Concession South of Prince Edward Bay
COUNTY OF PRINCE EDWARD, ONTARIO

Prepared for: **URSTONG**

Prepared by: **Groundwork Engineering Limited**

Project No. **GW-21014**

Date: **16 April, 2021**

Revised: **23 September, 2022**

GEOTECHNICAL • CIVIL • STORMWATER • ONSITE WASTEWATER

Contents

1.0 Introduction

This report is written in support of the planning application for the proposed residential development at Part of Lot A, Concession of South Prince Edward Bay, Township of South Marysburgh, County of Prince Edward, Ontario. The proposed development will consist of 16 new residential lots ranging in size from 0.81 to 1.12 hectares (ha). The property is approximately 20.59 ha of treed lands with a 5.73 ha wetland. URSTONG has retained the services of Groundwork Engineering Limited to complete a preliminary stormwater management design.

2.0 Site Overview

The property is located on a peninsula north of County Road 13 and falls in the jurisdiction of The Quinte Conservation Authority (QCA), and Prince Edward County. The property is bordered by Prince Edward Bay to the north, Halfmoon Bay to the east, and rural land to the west and south.

The site topography rises from the water up to two high points along the south west property line. One high point is near the western corner of the property. The other high point is around the midpoint of the property line. There is a wetland on the eastern portion of the property that a part of the property drains into. The overall grade change from the water to the high points is approximately 3.5m. There is a single lot south of the wetland that will be considered under a separate consent application, not the plan of subdivision proposed herein.

3.0 Stormwater Management

Stormwater management protects the receiving watercourses from contaminants caused by runoff and reduces the strain on existing infrastructure in the event of a major storm event. A pre-development flow rate was calculated for 2, 5, 25, and 100 year 15-minute storm events. QCA guidelines state that “all developments must consider the impacts for return period events from 2-year to 100-year frequency”. The site outlets directly to Lake Ontario therefore quantity control is not considered.

Using the Ministry of Environment, Conservation, and Parks (MECP) Stormwater Management Planning and Design Manual, the development has been designed to provide adequate stormwater management control and improve runoff quality. It is our goal to utilize low sloping swales along the property lines and roadside ditches, along with rock flow check dams, and to provide Total Suspended Solids (TSS) reduction.

3.1 Pre-Development Drainage Areas

Using 3-D modelling of the existing topographic information pre-development drainage areas are determined. The site consists of five drainage areas.

Area P-1 is located in the northwest corner of the site which drains to the north and into the lake by sheet flow.

Area P-2 is located in the northern half of the site and drains northeast into the lake by sheet flow.

Area P-3 is located in the northeastern corner of the site. This area drains to the northeast into the lake by sheet flow.

Area P-4 represents the southeast portion of the property. This area drains by sheet flow to the east and into the wetland.

Area P-5 represents the wetland. This area will remain undisturbed and therefore will not be considered in calculations.

All of the pre-development drainage areas are vegetated with tall grasses and are heavily treed. The pre-development drainage areas are illustrated in Appendix A. The site is covered in shallow clay soils over limestone bedrock.

3.2 Design Methodology

Surface water runoff calculations in this brief are derived using the Rational Method. The Rational Method calculates the peak flow rate of a catchment area due to the runoff contributing from the upstream catchment area. The peak flow rate is calculated by the following equation:

$$Q = 0.0028 \cdot A \cdot I \cdot C$$

Where:
C = Runoff Coefficient
I = Rainfall Intensity (mm/hr)
A = Drainage Area (ha)

The Airport Method and the Bransby-Williams Formula can be used to calculate the time of concentration (T_c) for peak runoff flows for pre and post-development flow rates. The Airport Method is used when the runoff coefficient is less than 0.40. The Bransby-Williams Formula is used when the runoff coefficient is greater than 0.40. If the calculated time of concentration was less than 15 minutes, then 15 minutes will be used to calculate the intensity. The Airport Method is calculated by the following equation:

$$T_c = \frac{3.26\ (1.1-C)\ L^{0.5}}{Sw^{0.33}}$$

Where:

C = Runoff Coefficient
L = Catchment Length (m)
Sw = Catchment Slope

The Bransby-Williams formula is calculated by the following equation:

$$T_c = \frac{0.057L}{Sw^{0.2}A^{0.1}}$$

Where:

A = Catchment Area (ha)
L = Catchment Length (m)
Sw = Catchment Slope

Based on the proposed site conditions the following runoff coefficients were used to develop a weighted coefficient for each drainage area and to determine runoff flow rates:

Gravel	0.90
Asphalt	0.90
Concrete	0.90
Grassed Areas	0.25
Building Roof Areas	0.90

Rainfall intensities were derived from Intensity-Duration-Frequency (IDF) curves from Ministry of Transportation (MTO) Rainfall data. IDF data was obtained from MTO Lookup. (Appendix B). Detailed stormwater calculation sheets are provided in Appendix C.

3.3 Post-Development Drainage Areas

Using 3-D modelling of the proposed topographic information, post-development drainage areas were established. The post-development drainage areas can be found in Appendix D.

Area A-1 encompasses a majority of pre-development area P-1. The area will utilize grassed swales to convey stormwater into the lake. The difference in pre-development flows in area A-1 is minor and will not require quantity or quality control.

Area A-2 encompasses most of the pre-development area P-2 and a portion of pre-development area P-3. This area will utilize roadside ditches, sheet flow, and grassed swales to convey flow towards the lake. Quality control will be used before the stormwater outlets into the lake and within the roadside ditches.

Area A-3 encompasses parts of pre-development areas P-2 and P-3. The area will utilize grassed swales to convey stormwater into the lake. The difference in pre-development flows in area A-3 is minor and will not require quantity or quality control.

Area A-4 encompasses a majority of the pre-development area P-4 and a portion of pre-development area P-2. The area will drain by sheet flow and grassed swales into the existing wetland.

Area P-5 encompasses the wetland. This area will remain unchanged and will not be included in calculations.

3.4 Stormwater Quantity Control

Post-Development Areas A-1, A-3, A-4, and A-5 consist of residential development only. These areas will only increase pre-development flows minimally so grassed swales will be used to convey flow to the outlet points.

3.4.1 Post-Development Area A-2

Area A-2 encompasses most of the pre-development area P-2 and a portion of pre-development area P-3. This area will utilize roadside ditches, sheet flow, and grassed swales to convey flow towards the lake. Quality control will take place before the stormwater outlets into the lake and within the roadside ditches. Since the site outlets to Lake Ontario quantity control is not a consideration.

Stormwater will be conveyed by sheet flow and grassed swales from the residential lots into roadside ditches, the roadside ditches will convey runoff toward the Open Space block where it will be stored and treated before being released into a riprap swale that flows into the wetland area.

The roadside ditches will be a minimum 0.5m deep and will be at slopes ranging between 0.5% and 1.5%. culverts will be elevated 10 cm above the bottom of the ditches to provide a wet pool that will reduce velocity, promote infiltration, and aid in the removal of TSS. The ditches will be vegetated.

Stormwater management calculation sheets are provided in Appendix C. For more detailed information on the planned lot grading and overall project stormwater drainage please refer to drawing C-101 in the design drawing set provided in Appendix E.

3.5 Quality Control

The entire development will employ Best Management Practices (BMPs) wherever possible. The intent of implementing stormwater BMPs throughout the development is to ensure that water quality concerns are met. Based on the MECP guidelines an enhanced level of protection is assumed which calls for a minimum of 80% TSS reduction from the stormwater runoff. By employing BMPs at all stages of the development, TSS levels of the runoff storage will be greatly reduced.

The assumption that an enhanced level of protection will be required is based on the aquatic life of the downstream receiver, in this case, the receiver being Lake Ontario.

With the proposed development having total area, excluding the wetland, of 153,254m^2 and a proposed impervious area of 8,001m^2 the total percent of impervious area is less than 35%. Table 3.2. of the MECP guideline states that a wetland is able to provide an enhanced level of TSS removal of 80%. Table 3.2 of the MECP guideline states that in order to use a wetland for stormwater control 80m^3 of storage shall be provided for each hectare.

The proposed wetland compensation area to the south of the development has at least 345 m^3 of storage. Based on the above-mentioned requirements, the wetland is able to treat up to 4.31ha to an enhanced level. With the proposed area of the development being 3.42 ha (Area A-2), the use of a wetland will be able to provide an enhanced level of protection to the receiving watercourse.

Lot level BMPs include the minimizing of ground slopes and maintaining as much of the lot as possible in a natural state. Recent recommendations by a number of Conservation Authorities and the MECP suggest that yard grading as flat as 0.5% be implemented to promote infiltration. The target range for finished ground slopes on this development is recommended to be between 0.5% - 3% where possible for ease of grading. This range of slope will provide a significant opportunity for the absorption and filtration process. The side slope of all swales and drainage ditches shall not exceed 3:1. Side slopes steeper than 3:1 are prone to erosion and are difficult to maintain. In addition, swales are to be built with minimum depth and slope to allow for the opportunity for filtration and settlement of TSS in grassed swales. All vegetation is to be maintained at a minimum height of 15 cm for optimum filtration.

The conveyance methods to be used in the development are grassed swales and overland flow. All swales will be constructed at minimal gradient where possible, thus promoting absorption and infiltration.

3.6 Maintenance

As the stormwater swales are on private property, it will be the responsibility of the Contractor to carry out routine visual inspections of the swale on a quarterly basis as well as after major storm events, until all vegetation is well established. The inspection should also check for sediment build up. Sediment removal is to be included with regular maintenance. Sediment build up should not exceed 5 cm in height. Once vegetation is established it will be the responsibility of the owner to carry out the maintenance. This will aid in the long-term performance of the stormwater swales. It is recommended that all drainage swales be kept clear of debris.

4.0 Temporary Sediment and Erosion Control

During construction, the risk of contamination by sediment to the stormwater receiver increases. Temporary sediment and erosion control measures will be implemented before construction and remain in place until construction and reinstatement of the lands are completed.

In accordance with Ontario Provincial Standard Drawing 219.130, heavy duty silt fence will be placed around the construction area. Straw bale flow check dams will be placed at drainage outlets. The sediment and erosion control measures will be inspected periodically and maintained during construction by the Contractor. These measures will be removed upon completion of the permanent quality control devices and establishment of vegetation in ditches and swales.

5.0 Summary

This project entails the development of a 16-lot residential development with a new road. Stormwater management techniques have been implemented to provide an enhanced level of protection to the receiving water body and promote best practices. The site outlets to Lake Ontario therefor quantity control is not a consideration

The development will provide a stormwater management plan for the newly developed portion of the property, which provides quantity and quality control. The plan will require the construction of gently sloped ditches and culverts convey flows to Lake Ontario to provide runoff control. The stormwater management plan will incorporate use of the existing wetland to the south of the development to provide enhanced quality control measures.

Report prepared by: Lucas McCallum

Lucas McCallum, B. Eng., C. Tech.

Report Reviewed by:

Martin Burger, M.Eng., P.Eng.

Statement of Qualifications and Limitations

The attached Report has been prepared by Groundwork Engineering Limited (the Consultant) for the benefit of the Client in accordance with their Agreement.

The information, data, recommendations and conclusions contained in the Report:

1. is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report;
2. represents the Consultant's judgement in light of the limitations and industry standards for the preparation of similar reports;
3. may be based on information provided to Consultant which has not been independently verified;
4. has not been updated since the date of issuance of the Report and its accuracy is limited to the time and circumstances in which it was prepared; and
5. Must be read as a whole and sections should not be read out of context.

The Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared.

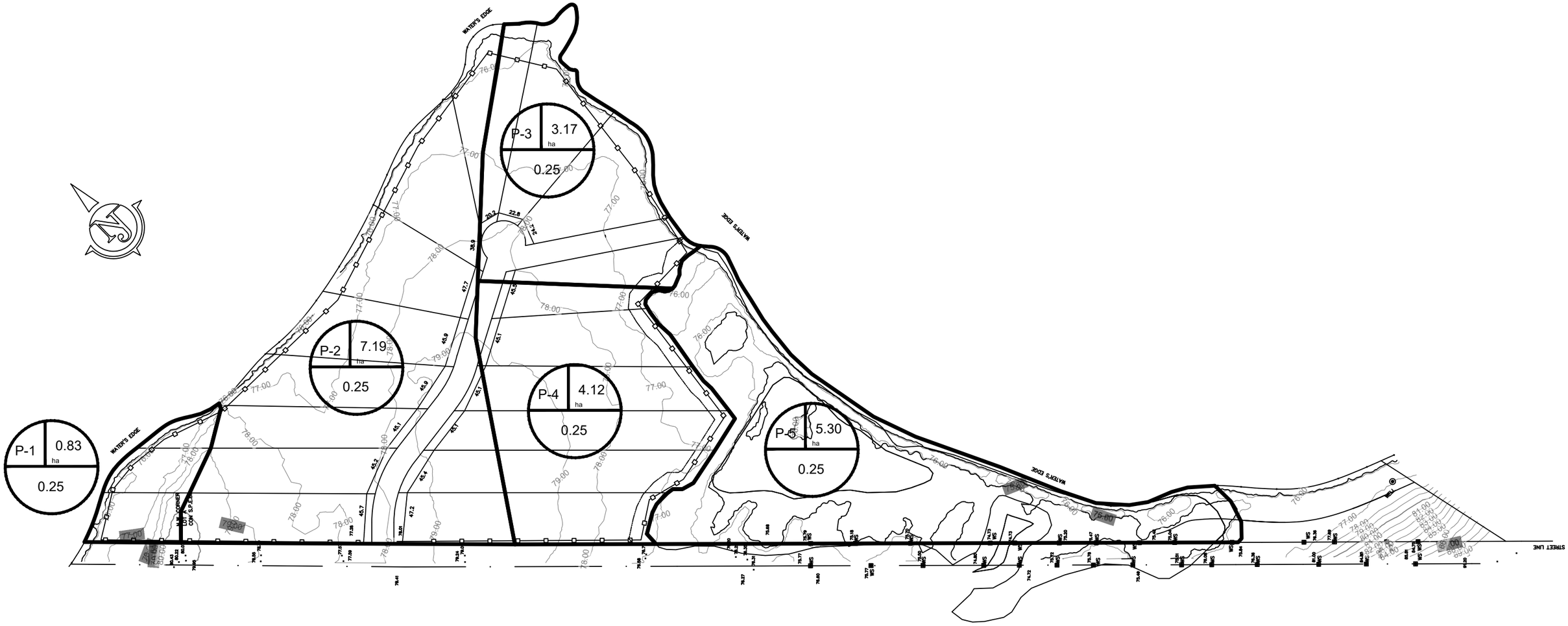
Any estimates or opinions regarding expected construction costs or construction schedule provided by Consultant represent Consultant's judgement in light of its experience and the knowledge and information available to it at the time of preparation. The Consultant does not make any representations, with respect to such estimates or opinions, and accepts no responsibility for any loss or damage arising from them. Persons relying on such estimates or opinions do so at their own risk.

Except as agreed to in writing by the Consultant and the Client; as required by-law; or to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by the Client.

The Consultant accepts no responsibility, to parties other than the Client who may obtain access to the Report or the information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report, except to the extent those parties have obtained the prior written consent of the Consultant to use and rely upon the Report and the information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

Appendix A

Pre-Development Drainage Areas



Groundwork Engineering Limited GEOTECHNICAL • CIVIL • STORMWATER • ONSITE WASTEWATER UNIT 640 - 654 NORRIS COURT KINGSTON, ONTARIO OFFICE (613) 634-1789	Client / Land Owner: URSTONG	Drawing Title: PRE-DEVELOPMENT DRAINAGE AREAS	Drawn by: DF
	Project: HALFMOON BAY SUBDIVISION PRINCE EDWARD COUNTY ONTARIO	Project Number: GW-21014	Drawing Number: SK-PRE SHEET 1 of 1
			Checked By: MB
			Scale: 1:3500
			Date: APRIL 15, 2021

LICENSED PROFESSIONAL ENGINEER
16 Apr 2021
M. H. BURGER
PROVINCE OF ONTARIO

REVISIONS

No.	Description	Date
#1	ISSUED FOR SWM REPORT	2021/04/16

P:\Projects\21000\21014 – Half Moon Bay Subdivision\02 – Design\03 – Drawings\01 – Preliminary Design (Pre-Submission)\GW-21014 – Half Moon Bay.dwg
5/28/2021 9:30 AM

Appendix B

MTO IDF Data

Ontario IDF CURVE LOOKUP

Active coordinate

43° 56' 15" N, 77° 0' 45" W (43.937500,-77.012500)

Retrieved: Fri, 26 Mar 2021 18:01:14 GMT

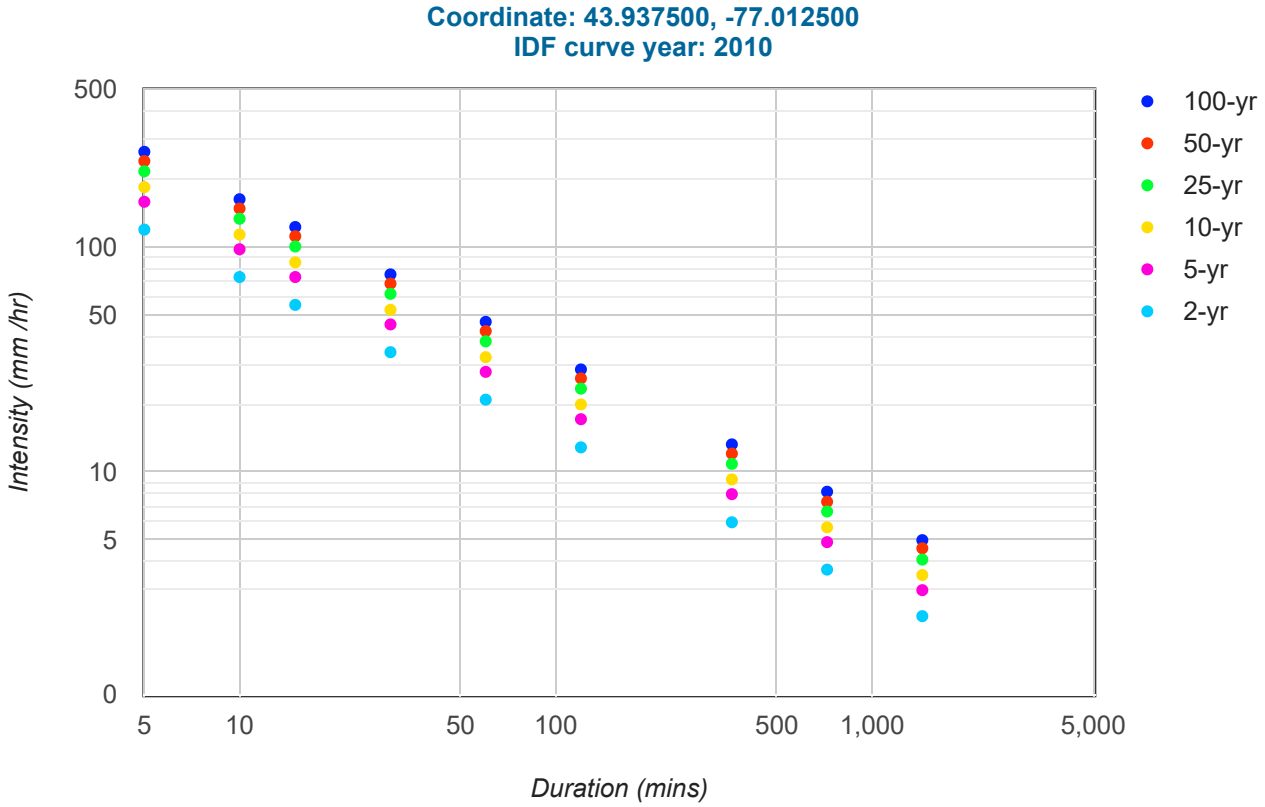
Location summary

These are the locations in the selection.

IDF Curve: 43° 56' 15" N, 77° 0' 45" W (43.937500,-77.012500)

Results

An IDF curve was found.



Coefficient summary

IDF Curve: 43° 56' 15" N, 77° 0' 45" W (43.937500,-77.012500)

Retrieved: Fri, 26 Mar 2021 18:01:14 GMT

Data year: 2010
IDF curve year: 2010

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	21.0	27.9	32.4	38.1	42.3	46.5
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Statistics

Rainfall intensity (mm hr^{-1})

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	119.3	73.5	55.3	34.1	21.0	12.9	6.0	3.7	2.3
5-yr	158.5	97.6	73.5	45.3	27.9	17.2	8.0	4.9	3.0
10-yr	184.0	113.4	85.4	52.6	32.4	20.0	9.3	5.7	3.5
25-yr	216.4	133.3	100.4	61.9	38.1	23.5	10.9	6.7	4.1
50-yr	240.3	148.0	111.5	68.7	42.3	26.1	12.1	7.4	4.6
100-yr	264.1	162.7	122.5	75.5	46.5	28.6	13.3	8.2	5.0

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	9.9	12.2	13.8	17.0	21.0	25.9	36.0	44.4	54.7
5-yr	13.2	16.3	18.4	22.6	27.9	34.4	47.8	58.9	72.6
10-yr	15.3	18.9	21.3	26.3	32.4	39.9	55.6	68.5	84.3
25-yr	18.0	22.2	25.1	30.9	38.1	46.9	65.3	80.5	99.2
50-yr	20.0	24.7	27.9	34.3	42.3	52.1	72.5	89.4	110.1
100-yr	22.0	27.1	30.6	37.7	46.5	57.3	79.7	98.2	121.0

Terms of Use

Appendix C

Stormwater Management Calculation Sheets

Groundwork Engineering Limited

Stormwater Management - Halfmoon Bay Subdivion

New Development

Project Number: 21014 **Prepared for:** Site Plan Control

DESIGN **Thursday, April 8, 2021** **Prepared by:** Daniel Fox **Checked by:** Martin Burger

Pre-Development - 2 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel(m^2)	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc (min)		
P-1	8,288	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	8,288	0.25	0.21	0.25	93	5.00	15.7	54.3	31.28
P-2	71,936	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	71,936	0.25	1.80	0.25	280	1.30	42.5	28.6	142.99
P-3	31,712	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	31,712	0.25	0.79	0.25	201	1.30	36.0	31.5	69.38
P-4	41,237	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	41,237	0.25	1.03	0.25	219	1.50	35.9	31.5	90.34
TOTAL	153,173	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	153,173	0.25	3.83	0.25					**333.98**

$$Q = 2.78CIA$$

Pre-Development - 5 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel(m^2)	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
P-1	8,288	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	8,288	0.25	0.21	0.25	93	5.00	15.7	73.5	42.34
P-2	71,936	0.00	0.90	0.00	0.90	103.00	0.90	0.00	0.90	71,833	0.25	1.81	0.25	280	1.30	42.5	38.1	191.19
P-3	31,712	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	31,712	0.25	0.79	0.25	201	1.30	36.0	41.9	92.35
P-4	41,237	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	41,237	0.25	1.03	0.25	219	1.50	35.9	41.9	120.08
TOTAL	153,173	0.00	0.90	0.00	0.90	103.00	0.90	0.00	0.90	153,070	0.25	3.84	0.25					**445.96**

$$Q = 2.78CIA$$

Pre-Development - 25 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel(m^2)	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
P-1	8,288	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	8,288	0.25	0.21	0.25	93	5.00	15.7	100.4	57.83
P-2	71,936	0.00	0.90	0.00	0.90	103.00	0.90	0.00	0.90	71,833	0.25	1.81	0.25	280	1.30	42.5	52	260.94
P-3	31,712	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	31,712	0.25	0.79	0.25	201	1.30	36.0	57.1	125.85
P-4	41,237	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	41,237	0.25	1.03	0.25	219	1.50	35.9	57.1	163.65
TOTAL	153,173	0.00	0.90	0.00	0.90	103.00	0.90	0.00	0.90	153,070	0.25	3.84	0.25					**608.27**

$$Q = 2.78CIA$$

Pre-Development - 100 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel(m^2)	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
P-1	8,288	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	8,288	0.25	0.21	0.25	93	5.00	15.7	122.5	70.56
P-2	71,936	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	71,936	0.25	1.80	0.25	280	1.30	42.5	63.4	316.97
P-3	31,712	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	31,712	0.25	0.79	0.25	201	1.30	36.0	69.7	153.62
P-4	41,237	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	41,237	0.25	1.03	0.25	219	1.50	35.9	69.7	199.76
TOTAL	153,173	0.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	153,173	0.25	3.83	0.25					**740.91**

$$Q = 2.78CIA$$

Groundwork Engineering Limited

Stormwater Management - Halfmoon Bay Subdivion

New Development

Project Number: 21014 **Prepared for:** Site Plan Control

DESIGN **Thursday, April 8, 2021** **Prepared by:** Daniel Fox **Checked by:** Martin Burger

Post-Development- 2 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
A-1	7,898	175.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	7,723	0.25	0.21	0.26	77	5	14.1	55.3	32.10
A-2	34,206	700.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	30,930	0.25	1.07	0.31	445	0.5	68.1	19.9	59.09
A-3	55,794	2450.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,344	0.25	1.55	0.28	102	3	18.8	49.9	215.59
A-4	55,356	2100.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,256	0.25	1.52	0.27	260	1.2	40.9	29.3	123.84
TOTAL	153,254	5425.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	145,253	0.25	4.35	0.28					**398.52**

$$Q = 2.78CIA$$

Post-Development- 5 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
A-1	7,898	175.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	7,723	0.25	0.21	0.26	77	5	14.1	73.5	42.67
A-2	34,206	700.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	30,930	0.25	1.07	0.31	445	0.5	68.1	26.5	78.69
A-3	55,794	2450.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,344	0.25	1.55	0.28	102	3	18.8	66.4	286.87
A-4	55,356	2100.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,256	0.25	1.52	0.27	260	1.2	40.9	39	164.84
TOTAL	153,254	5425.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	145,253	0.25	4.35	0.28					**530.40**

$$Q = 2.78CIA$$

Post-Development- 25 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
A-1	7,898	175.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	7,723	0.25	0.21	0.26	77	5	14.1	100.4	58.29
A-2	34,206	700.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	30,930	0.25	1.07	0.31	445	0.5	68.1	36.2	107.49
A-3	55,794	2450.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,344	0.25	1.55	0.28	102	3	18.8	90.6	391.43
A-4	55,356	2100.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,256	0.25	1.52	0.27	260	1.2	40.9	53.3	225.28
TOTAL	153,254	5425.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	145,253	0.25	4.35	0.28					**724.20**

$$Q = 2.78CIA$$

Post-Development - 100 Year Event

Drainage Area ID	Total Area (m^2)	Land Use & Topography								Grassed Area, Parkland		Product ha (AxR)	Average C	Time of Concentration			Intensity (mm/hr)	Q (L/s)
		Roof (m^2)	C	Asphalt (m^2)	C	Gravel	C	Concrete (m^2)	C	Area (m^2)	C*			Length (m)	Slope(%)	Tc		
A-1	7,898	175.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	7,723	0.25	0.21	0.26	77	5	14.1	122.5	71.12
A-2	34,206	700.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	30,930	0.25	1.07	0.31	445	0.5	68.1	44.2	131.24
A-3	55,794	2450.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,344	0.25	1.55	0.28	102	3	18.8	110.6	477.84
A-4	55,356	2100.00	0.90	0.00	0.90	0.00	0.90	0.00	0.90	53,256	0.25	1.52	0.27	260	1.2	40.9	65	274.74
TOTAL	153,254	5425.00	0.90	2576.00	0.90	0.00	0.90	0.00	0.90	145,253	0.25	4.35	0.28					**883.81**

$$Q = 2.78CIA$$

Groundwork Engineering Limited

Stormwater Management - Halfmoon Bay Subdivion

New Development

Project Number: 21014 **Prepared for:** Site Plan Control

DESIGN **Thursday, April 8, 2021** **Prepared by:** Daniel Fox **Checked by:** Martin Burger

2-yr Return Period - Post-Development A-2

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s) Pre=Post	Storage Rate (L/s)	Storage Volume (m^3)
10.00	73.50	218.24	69.38	148.86	89.32
15.00	55.30	164.20	69.38	94.82	85.34
30.00	34.10	101.25	69.38	31.87	57.37
60.00	21.00	62.36	69.38	0.00	0.00
120.00	12.90	38.30	69.38	-31.08	-223.75
				Approx. Storage	**89.32**

5-yr Return Period - Post-Development A-2

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s) Pre=Post	Storage Rate (L/s)	Storage Volume (m^3)
10.00	97.60	289.80	92.35	197.45	118.47
15.00	73.50	218.24	92.35	125.89	113.30
30.00	45.30	134.51	92.35	42.16	75.89
60.00	27.90	82.84	92.35	-9.51	-34.22
120.00	17.20	51.07	92.35	-41.28	-297.20
				Approx. Storage	**118.47**

25-yr Return Period (IDF) - Post-Development A-2

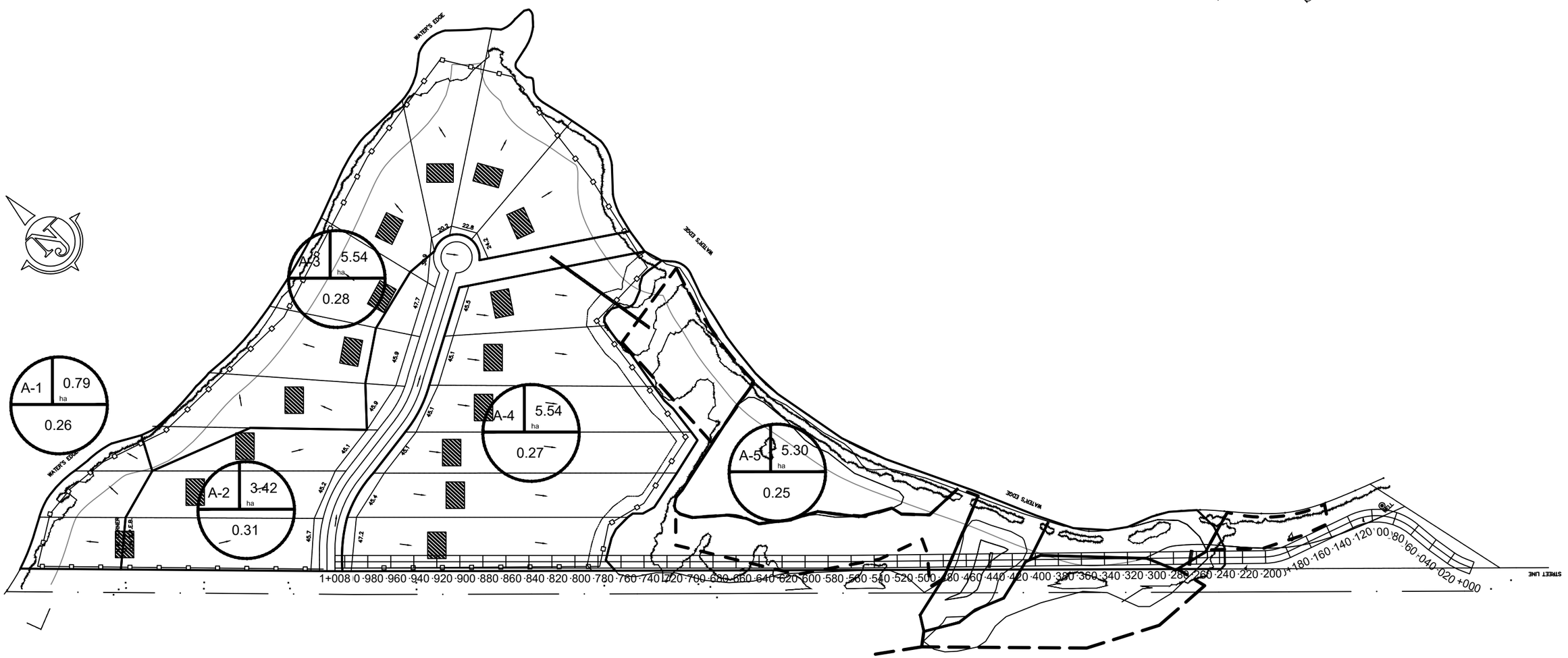
Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s) Pre=Post	Storage Rate (L/s)	Storage Volume (m^3)
10.00	133.30	395.81	125.85	269.96	161.97
15.00	100.40	298.12	125.85	172.27	155.04
30.00	61.90	183.80	125.85	57.95	104.31
60.00	38.10	113.13	125.85	-12.72	-45.79
120.00	20.00	59.39	125.85	-66.46	-478.54
				Approx. Storage	**161.97**

100-yr Return Period (IDF) - Post-Development A-2

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s) Pre=Post	Storage Rate (L/s)	Storage Volume (m^3)
10.00	162.70	483.10	153.62	329.48	197.69
15.00	122.50	363.74	153.62	210.12	189.11
30.00	75.50	224.18	153.62	70.56	127.01
60.00	46.50	138.07	153.62	-15.55	-55.97
120.00	28.60	84.92	153.62	-68.70	-494.63
				Approx. Storage	**197.69**

Appendix D

Post-Development Drainage Areas



Groundwork Engineering Limited
GEOTECHNICAL • CIVIL • STORMWATER • ONSITE WASTEWATER
UNIT 640 - 654 NORRIS COURT
KINGSTON, ONTARIO
OFFICE (613) 634-1789

Client / Land Owner:
URSTRONG

Project:
HALFMOON BAY SUBDIVISION
PRINCE EDWARD COUNTY ONTARIO

Drawing Title:
POST-DEVELOPMENT DRAINAGE AREAS

Project Number:
GW-21014

Drawing Number:
SK-POST
SHEET 1 of 1

Drawn by: LM
Checked By: MB
Scale: 1:3500
Date: SEPT 23, 2022

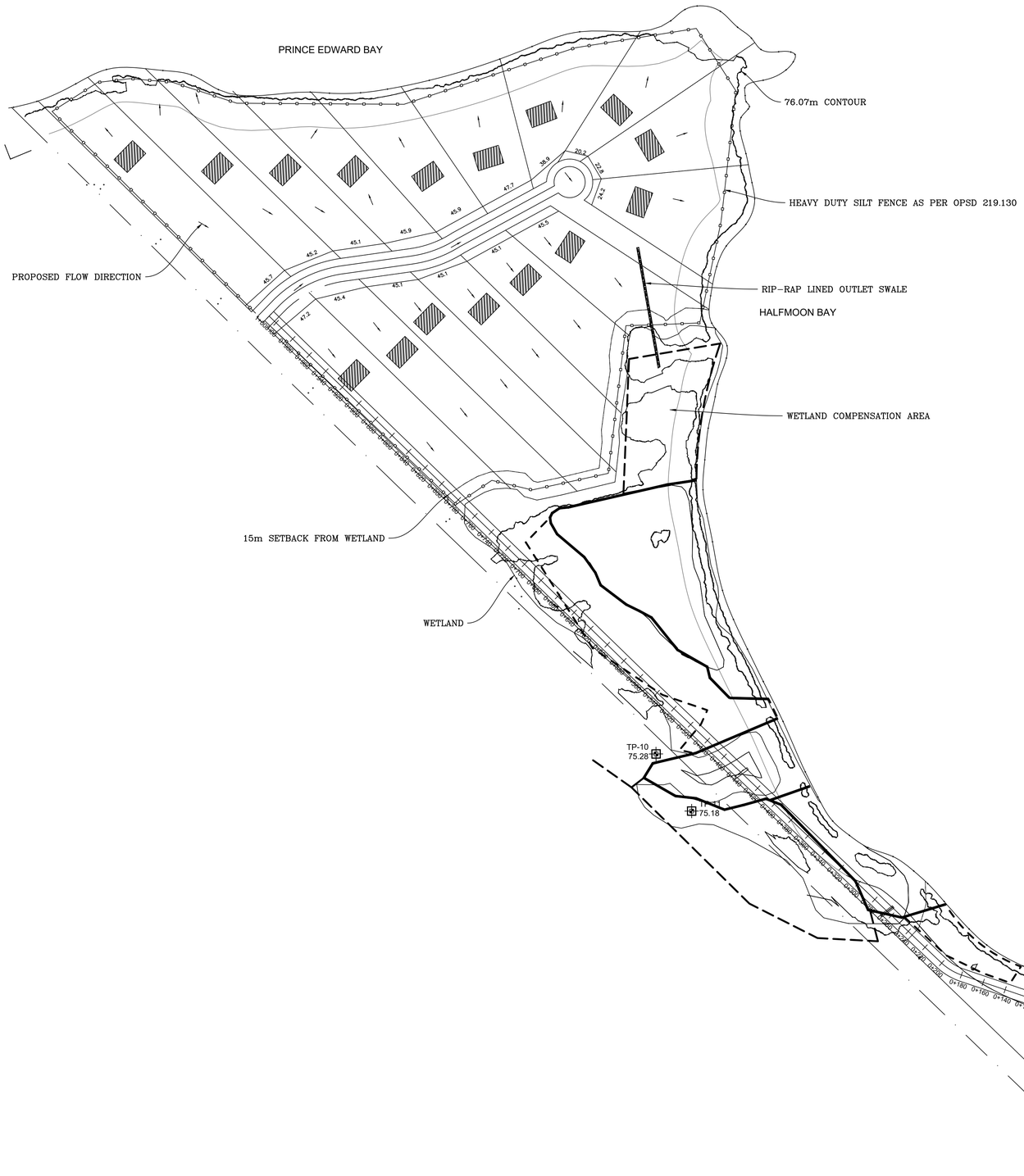
REVISIONS

No.	Description	Date
#1	ISSUED FOR SWM REPORT	2021/04/16
#2	REVISED PER COMMENTS	2022/09/23

P:\Projects\21000\21014 – Half Moon Bay Subdivision\02 – Design\03 – Drawings\03 – Design Review (June 2022)\GW-21014 – Half Moon Bay (2022-08-24)_recover.dwg
9/23/2022 2:08 PM

Appendix E

Design Drawings



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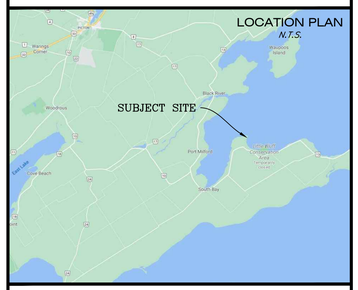
UNIT 640 - 654 NORRIS COURT
KINGSTON, ONTARIO
OFFICE (613) 634-1789

LOCATION PLAN
N.T.S.



LEGEND

- PROPOSED DWELLING
- PROPOSED FLOW DIRECTION
- EXISTING CONTOUR LINE
- ROCK FLOW CHECK DAM
- HEAVY DUTY SILT FENCE

REVISIONS

No.	Description	Date
#1	ISSUED FOR TERRAIN ANALYSIS REPORT	2021/04/16
#2	REVISED PER COMMENTS	2022/09/23

BENCHMARK:

No.	DESCRIPTION	ELEVATION
##.	XXX	XXX.XX

LICENSED PROFESSIONAL ENGINEER
M. H. BURGER
PROVINCE OF ONTARIO

Client / Land Owner:

URSTRONG

Project:

HALFMOON BAY

PRINCE EDWARD COUNTY — ONTARIO

Drawing Title:

PROPOSED STORMWATER GRADING PLAN

Drawn by: LM
Checked By: MB
Scale: 24"x36" 1:2000
Date: SEPT 23, 2022

Project Number: GW-21014
Drawing Number: C-101
SHEET 1 of 1

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