Preliminary Stormwater Management Report

Leblanc Enterprises

Croft Street Development

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1 Introduction & Background

Jewell Engineering Inc. (Jewell) has prepared this preliminary stormwater management (SWM) report to support the Zoning Bylaw Amendment (ZBA) and Official Plan Amendment (OPA) for the site plan within the yellow boundary shown in **Figure 1-1**.

It is located within the Municipality of Port Hope and within the jurisdiction of Ganaraska Region Conservation Authority (GRCA).

The Site Plan would complete the *Croft Street Subdivision (44 – 360 Croft Street)* as described in the 2011 SWM report prepared by D. M. Wills (see **Subsection 1.4**).

1.1 Site Location

The site location is presented by the yellow line in Figure 1-1. It is bound by the recent townhome development to the northwest, Beatrice Strong Public School and Rose Glen Road to the east, and agricultural fields to the south. The Site Plan and Preliminary Grading Plan are shown in **Appendix A**.

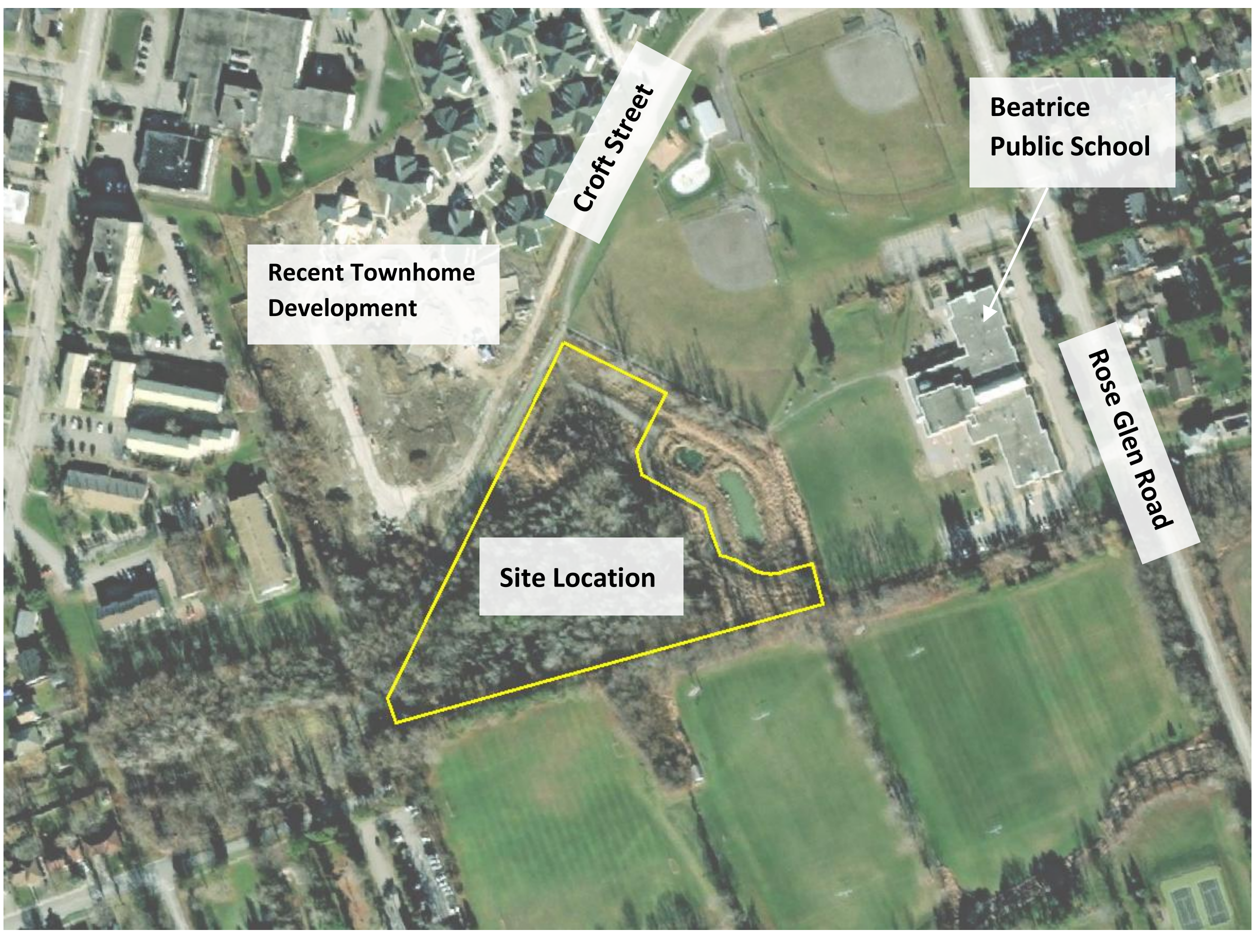


Figure 1-1: Site Location (Yellow Boundary)

1.2 Stormwater Management Objectives

The SWM objectives for this site are primarily discussed in terms of quality and quantity control. Some discussion relative to sediment and erosion controls and maintenance requirements is also included.

1. Quality control:

   Achieve Enhanced (Level 1) treatment as defined in the *2003 MOE SWM Planning and Design Guide*.

   This corresponds to 80% total suspended solids removal for the proposed development lands.

2. Quantity control:

   Achieve post-development peak flows at the Outlet that meet the outflow targets established in the *2007 West Gage Creek MDP* (see **Subsection 2.3 and 2.4**).

   The objective is to ensure no negative impacts to downstream lands.

3. Provide sediment and erosion controls to control and mitigate the release of sediment off-site during construction.

4. Provide operation and maintenance guidance for the proposed SWM facilities.

The objectives above were established based on the following documents:

- GRCA's *Technical and Engineering Guidelines for Stormwater Management Submissions*
- The Ontario Ministry of Environment's *Stormwater Management Planning and Design Manual* (2003)
- Toronto and Region Conservation Authority's *Stormwater Management Criteria* (2012)

1.3 West Gage Creek Master Drainage Plan

The *2007 West Gage Creek MDP* prepared by Urban Watershed Group Ltd. provides guidance on SWM controls for the local area.

Sections 6.5.2 and 9.1.1 of the MDP discuss the 2007 conceptual design for the Rose Glen Road central SWM facility.

Page 42 of the MDP includes a figure that shows the sub-catchment delineations. Following the MDP's naming conventions, **Sub-Catchments 103, 104, 105, 200 and 201** were intended to drain to the central Rose Glen Road SWM facility. The MDP intended for the SWM facility to be a wet pond. An excerpt of the MDP figure that zooms in to these sub-catchments of interest is provided in **Figure 1-2**.

Figure 1-2: Excerpt of 2007 MDP Sub-Catchment Figure

Page 44 and 45 of the MDP identify the following flow control targets at the watercourse location immediately downstream of the proposed municipal SWM facility (see **Table 1-1**).

Table 1-1: 2007 MDP Rose Glen SWM Facility Outflow Targets

Target Discharge Rates at Outlet (m^3/s)	
Erosion Threshold	0.41
2-Yr	0.75
100-Yr	2.50

Jewell completed a review of the MDP's hydrologic model files to obtain the input parameters applied for the sub-catchments draining to the proposed Rose Glen Municipal SWM facility. These parameters are summarized in **Table 1-2** for the MDP's existing conditions, and **Table 1-3** for the MDP's proposed conditions. **Sub-Catchment 104** includes the Leblanc townhome development that has since been constructed. **Sub-Catchment 201** includes the subject site from **Figure 1-1** and has not yet been developed.

Table 1-2: 2007 MDP Existing Conditions Inputs for Rose Glen SWM Facility Catchment Area

Sub-Catchment	Area (ha)	CN	XIMP	TIMP	TP	LGI (m)
103	4.36	68	-	-	0.28	-
104	9.79	-	0.20	0.35	-	255.4
105	5.92	-	0.35	0.40	-	198.7
200	2.06	-	0.20	0.35	-	117.1
201	3.73	70.9	-	-	0.20	-

Table 1-3: 2007 MDP Proposed Conditions Inputs for Rose Glen SWM Facility Catchment Area

Sub-Catchment	Area (ha)	CN	XIMP	TIMP	TP	LGI (m)
103	3.66	68	-	-	0.28	-
104	9.79	-	0.28	0.55	-	255.4
105	5.92	-	0.28	0.55	-	198.7
200	2.06	-	0.20	0.35	-	117.1
201	4.43	-	0.28	0.55	-	171.8

1.4 2011 SWM Report: Croft Street Subdivision (44 – 360 Croft Street)

Since the publishing of the *West Gage Creek MDP*, a wet pond facility has been constructed in the approximate location of the MDP's Rose Glen SWM Facility.

The recently constructed wet pond was intended to accommodate development of the *Croft Street Subdivision (44 – 360 Croft Street).* The *Croft Street Subdivision* is the recent townhouse development constructed within Sub-Catchment 104 of **Figure 1-2**. It was also intended to accommodate the subject site that is within Sub-Catchment 201 of **Figure 1-2**.

The design for the recently constructed wet pond is based on the MDP, but details are described in the *2011 Croft Street Subdivision SWM Report* prepared by D. M. Wills.

A significant difference between the MDP and the 2011 SWM report is that the MDP assumed Sub-Catchments 103, 104, 105, 200 and 201 from Figure 1-2 would enter the wet pond. The 2011 design focused only on Sub-Catchments 104 and 201 from Figure 1-2 and allowed the other sub-catchments to bypass the facility.

The 2011 SWM report used a different naming convention for its sub-catchments relative to the MDP. The 2011 inputs are summarized below. Details describing each sub-catchment can be found on *Pages 2 and 3* of the *2011 Croft Street Subdivision SWM Report*.

Table 1-4: Summary of 2011 SWM Report Existing Conditions Hydrology Inputs

Sub-Catchment	Area (ha)	CN	Ia (mm)	TIMP	XIMP	TP	Nearest Catchment to 2007 MDP
EX. WS1	3.7	66	1.50	66.00	-	-	104
EX. WS2	5.82	73	5.00	-	-	0.39	104
EX. WS3	2.5	67	6.90	-		0.44	201

Table 1-5: Summary of 2011 SWM Report Proposed Conditions Hydrology Inputs

Sub-Catchment	Area (ha)	CN	Ia (mm)	TIMP	XIMP	TP	Nearest Catchment to 2007 MDP
PR. WS1	3.7	66	1.50	0.66	0.66	-	104
PR. WS2	5.82	66	1.50	0.49	0.49	-	104
PR. WS3	1.77	64	2.70	0.66	0.66	-	201
PR. WS4	0.74	67	7.00	-	-	0.43	201

The 2011 SWM report was designed to accommodate the subject site with an assumed imperviousness of 66%. The revised SWM pond design is provided herein to make more efficient use of the site area. Additionally, the revised pond design accommodates current rainfall totals based on discussions with GRCA.

A review of the 2011 parameters and report content was completed in preparation of the pond revisions. Some supplemental notes from Jewell's review are listed below.

The 2011 report:

- used *conceptual* model results rather than the stated MDP targets,
- has VO output that shows 65mm precipitation total; a similar value to the MDP,
- allowed 66% impervious for the subject site (2011 report referred to as PR. WS3),
- does not include Sub-Catchments 103, 105, and 200,
- applied a Chicago distribution whereas the MDP applied an AES distribution, and
- applied XIMP equivalent to TIMP, meaning it was assumed that all development is directly connected to the impervious surfaces. The *West Gage Creek MDP* shows XIMP less than the TIMP value to account for rooftops/road areas that drain to pervious surfaces before entering the stormwater infrastructure.

1.5 Ditch Realignment

A man-made ditch on the property is to be realigned in accordance with the GRCA permit application submitted by Jewell on behalf of Leblanc Enterprises.

The *Ditch Realignment Letter* dated July 18, 2025, provided the details regarding the ditch realignment. Ultimately, the intent is to move the existing man-made ditch to follow more closely along the hydro easement on near the south property limit. The ditch realignment makes for more efficient use of the site. An investigation by Cambium Inc. was completed to confirm no negative ecological impacts. The calculations by Jewell in the July letter confirmed the realigned dimensions can accommodate the 100-yr and Hurricane Hazel peak flows. Jewell's letter also investigated velocities in the 25mm rainfall event to confirm no appreciable erosion concerns. The drainage area to the ditch is very small from a *flood hazard perspective* at 0.06 km^2.

1.6 Geotechnical Information

A 2013 *Geotechnical Investigation Report* was prepared by Geo-Logic Inc. to support the adjacent residential development that corresponds to the 2011 SWM report by D. M. Wills.

Section 6.5 of the *Geotechnical Investigation Report* provides guidance and recommendations regarding the geotechnical aspects of pond construction. Since the revised pond is in a similar location and maintains the same permanent pool and top of pond elevations, it is expected that the findings and recommendations from the 2013 *Geotechnical Investigation Report* remain valid.

LiDAR data obtained since the construction of the pond suggests the main cell is not holding water to its intended elevation. A clay liner, as specified by the Geotechnical Engineer, is recommended to be included as a repair during construction of the pond modifications.

2 Hydrology

This section discusses:

- the hydrologic modelling approach,
- target discharge rates (per *West Gage Creek MDP*),
- catchment areas & drainage characteristics, and
- the need for SWM controls.

2.1 Visual OTTHYMO

Jewell selected Visual OTTHYMO (VO) for the hydrologic model since it is the preferred runoff model for stormwater applications as noted in multiple conservation authority guidelines (examples: LTC, LSRCA).

The model was used to simulate peak runoff rates for all return period events before and after the development, including a model for the controlled outflow scenario. The design storm from the MDP was also included.

Further discussion on model inputs and catchment characteristics is provided below.

2.2 Precipitation

Master Drainage Plans are used to establish the storm type and duration for their study area.

The 2007 *West Gage Creek MDP* established the 6-hr duration storm with an AES distribution as the critical storm. It used a rainfall total of **65.8mm**. An updated rainfall value of **80.6mm** was applied based on discussions with GRCA.

Two rainfall sources were reviewed for the updated rainfall depth.

First was the Environment Canada (EC) published IDFs at the Bowmanville Mostert station. This station has a 31-year record of data. This was selected over the Cobourg station that only has 15 years of data, although the Bowmanville Mostert station is still imperfect since its record spans from 1968 – 2001, meaning the past 20+ years are not included.

The second was Western University's IDF_CC Tool 7.5 with a Gumbel distribution, which uses pre-loaded data from EC rainfall stations for a specific location of interest. (Source: Simonovic, S.P., A. Schardong, R. Srivastav, and D. Sandink (2015), *IDF_CC Web-based Tool for Updating Intensity-Duration-Frequency Curves to Changing Climate – ver 7.5*, Western University Facility for Intelligent Decision Support and Institute for Catastrophic Loss Reduction, open access https://www.idf-cc-uwo.ca.)

Review agencies typically request the source with the greater rainfall volume be applied. Therefore, the IDF_CC Tool was selected rather than the IDF_CC Tool (**80.6mm** vs. 69.7mm for 100-yr, 6-hr precipitation total).

Refer to **Appendix B** for the applied IDF data.

2.3 Target Discharge Rates

The target discharge rates are established in the 2007 *West Gage Creek MDP*. These were discussed in **Section 1.3** and re-iterated in the table below.

Table 2-1: Target Discharge Rates from 2007 West Gage Creek MDP

Target Discharge Rates at Outlet (m^3/s)	
Erosion Threshold	0.41
2-Yr	0.75
100-Yr	2.50

2.4 Catchment Areas & Drainage Characteristics

A catchment drawing that identifies the Catchment IDs, areas, and curve numbers/impervious values is provided in **Appendix C**.

Appendix D provides a VO schematic that represents the routing of the hydrology model.

The catchment discretization and input parameters are based on the previous hydrology work in the area for the 2011 *Croft Street Subdivision SWM Report* and the 2007 *West Gage Creek MDP*. The drainage areas to the recently constructed pond were based on the 2011 SWM report since it had more specific catchment delineations relative to the MDP. The MDP catchments and inputs were the basis of the external drainage areas that contribute to the man-made ditch that bypasses the SWM facility. A 2025 review of detailed LiDAR data was used to adjust catchment boundaries to their most current and accurate location.

Site Outlet

The outlet of interest, referred to as “the Outlet” in this report, is the confluence of the wet pond outlet, the baseball field drainage, and the man-made ditch located at the southeast corner of the property. This is the same location as the outlet for the Rose Glen SWM Facility referenced in the *West Gage Creek MDP.* The site outlet is labelled in **Appendix C**.

Catchment Descriptions

For ease of reference, an updated catchment description for each sub-catchment is provided below.

Catchment 103 represents the baseball fields to the northeast of the SWM facility. These lands bypass the SWM facility but are included to assess the total peak flow at the outlet.

Catchment 104A represents the townhome development by Leblanc Enterprises that was constructed based on the drawings and submission associated with the *2011 Croft Street Subdivision SWM Report.*

Catchment 104B represents the external drainage that is received by the *Croft Street Subdivision*. The 2011 report included these lands to the SWM facility that has since been constructed.

Catchment 105 represents the external lands on the west side of the Croft Street Road Allowance that bypass the SWM facility but drain to the Outlet.

Catchment 200 represents the existing residential external lands on the south side of Croft Street that bypass the SWM facility but drain to the Outlet.

Catchment 201A represents the portion of the subject site that will drain directly to the realigned channel and bypass the SWM facility.

Catchment 201B represents the portion of the subject site that will drain to the wet pond SWM facility.

The hydrology inputs are summarized below.

Table 2-2: Hydrology Input Summary

Sub-Catchment	Area (ha)	CN	XIMP	TIMP	TP	LGI (m)
103	3.63	68	N_A	N_A	0.24	N_A
104A	5.51	N_A	0.39	0.49	N_A	255.4
104B	5.56	N_A	0.56	0.66	N_A	N_A
105	3.16	N_A	0.28	0.55	N_A	198.7
200	1.40	N_A	0.20	0.35	N_A	117.1
201A	1.26	70.9	N_A	N_A	0.20	N_A
201B	1.50	N_A	0.66	0.66	N_A	N_A

**For input values, except for revised drainage areas and the TIMP values from the DM Wills report for the subject lands draining to the pond, preference was given to the values in the West Gage Creek MDP.*

3 Stormwater Management Solution

The wet pond design herein is a revision of the design in 2011 *Croft Street Subdivision SWM Report* and based on guidance in the 2007 *West Gage Creek MDP*.

The objective of the revisions is to improve the land use efficiency of the site and to ensure the pond has sufficient capacity to meet flow targets for current rainfall totals.

Based on the 2003 MOE manual, a wet pond is suitable since its drainage area is relatively large at **12.9 ha** with a weighted impervious value of 58%.

For context, the 2003 MOE SWM manual recommends a wet pond for development areas > 5 ha.

3.1 Croft Street Subdivision vs. External Lands

The Croft Street Subdivision requires quality and quantity controls from the wet pond. The 2011 design included external drainage from the residential area adjacent to the Croft Street Subdivision. Since that conveyance infrastructure has already been constructed, the revised wet pond will continue to receive these external lands.

The Leblanc lands (Croft Street Subdivision) will contribute 7.3 ha of area requiring controls at combined weighted imperviousness of 52.5%. This translates to an impervious area of 3.9 ha.

The external residential/commercial lands will contribute 5.6 ha at an assumed imperviousness of 66%. This translates to an impervious area of 3.7 ha.

The impervious area is a common parameter used for cost share purposes. Based on the assumed impervious areas above, and the guidance in the MDP, the external development lands would have a 49% share, and Leblanc would have a 51% share. This assumption is based on contributing impervious areas only and other parameters such as land value could be considered in discussions among stakeholders.

To our knowledge, there has been no expressed interest from the adjacent land owner(s), or the Municipality, in participating in the cost share for the central facility described in the MDP. Therefore, the revised pond design focuses on quality and quantity controls with respect to Leblanc's *Croft Street Subdivision (44 – 360 Croft Street).*

For developments with external drainage, the 2003 MOE manual notes that a lumped drainage area and imperviousness can be utilized. The problem with this approach in this scenario is that the external drainage is already developed and with no SWM controls. Therefore, providing an Enhanced wet pond for the full drainage area would be an unjustifiable cost to the Leblanc development since it would be providing quality treatment for a central facility that was intended to be a joint undertaking with an appropriately allocated cost share agreement.

For this scenario, assuming no interest from the adjacent lands or Municipality, the better approach is to review sediment loading rates and size the wet pond to achieve an amount of sediment removal that corresponds to *Enhanced* treatment levels for the Croft Street Subdivision only. *Enhanced* quality treatment means 80% TSS removal on an annual basis.

At 7.33 ha and 52.5% weighted imperviousness, the Leblanc lands have an annual sediment loading rate of 12.8 m^3 based on *Table 6.3* the 2003 MOE manual. Therefore, 10.3 m^3 of annual sediment removal is required to achieve an 80% (*Enhanced)* removal rate.

The full contributing area to the wet pond at 12.9 ha and 58% weighted imperviousness has an annual TSS loading rate of 27.1 m^3. Therefore, a *Basic* (60%) quality treatment level for the *full drainage area* to the wet pond would achieve 16.2 m^3.

The 16.2 m^3 is much greater than the 10.3 m^3 target that would achieve an 80% TSS removal for the Leblanc lands. Therefore, a *Basic* wet pond achieves 60% TSS removal for its total drainage area, but 157% TSS removal when compared to the *Enhanced* target for the Leblanc lands. This means the proposed wet pond still provides complimentary quality treatment to the external lands. This complimentary treatment is still provided since the 60% removal for the full drainage area is the minimum total removal rate identified in the 2003 *MOE SWM Planning and Design Manual*.

3.2 SWM Facility Features

The wet pond storage and outlet controls allow runoff to be attenuated for quantity control purposes, and the permanent pool and low-flow orifice allow for *Enhanced* treatment levels.

The wet pond is located near the southeast corner of the site and has the following features:

- A length to width ratio of 3:1 based on MOE and LTC SWM requirements, with a forebay in the upstream 1/3rd of the pond.
- A 200mm orifice to meet the erosion control target and flow control in lesser return period events.
- A 1.4m sharp-crested weir to achieve the quantity control target in large return period events.
- A broad-crested weir for an emergency spillway. It is sized to convey the 100-yr uncontrolled peak flow while assuming the other outlet controls are blocked. It also allows potential severe storms due to climate change to be routed through the pond.
- Fencing and/or signage may be required around the perimeter for safety reasons. The Municipality’s preference is to be taken into consideration and relevant details are to be included in the detailed drawings.

Key elevations for the preliminary wet pond are summarized in **Table 3-1**.

Table 3-1: Key Elevations for Proposed Wet Pond

Bottom of Basin	102.9
Top of Berm	106.3
Top of Full Storage	106.0
Inv. of 1st Outlet Control (150mm Φ)	104.4
Inv. of 2nd Outlet Control (1.8m weir)	104.9
Inv. of Overflow Spillway (6.0m weir)	106.0

**Units in m, datum CGVD 28 unless otherwise specified*

The VO output results are provided in **Appendix E** for the critical 100-yr, 6-hr storm as identified in the MDP.

3.3 Quality Control

Quality controls were selected with the objective of achieving 80% TSS removal for the *Croft Street Subdivision* that would achieve the highest level of treatment described in MOE guidelines. Since there are combined urban areas contributing to the SWM facility, a mass balance was used to quantify the TSS removal target. As noted in Section 3.1, this would be achieved with a *Basic* wet pond for the full urban area draining to the SWM facility. Not only would the TSS removal target be achieved for the Leblanc lands, but the removal would be nearly double the amount if the *Croft Street Subdivision* provided *Enhanced* TSS removal for its lands only. The additional TSS removal is bonus quality treatment for the external urban lands that currently receive no quality or quantity controls. Storage requirements and forebay sizing are provided in this subsection.

MOE Quality Storage Requirements

SWM quality control facilities provide a permanent pool and quality drawdown based on the sizing criteria provided in *Table 3.2* of MOE, 2003. This is a simple sizing chart that gives the volume of the permanent pool and the extended detention as a function of imperviousness and level of treatment. The pond receives a drainage area of 12.9 ha with a weighted impervious level of 58.3%. The sizing chart provides permanent pool and active storage required per hectare for impervious levels for 35%, 55%, 70% and 85%. Designers may interpolate imperviousness.

Storage requirements for quality treatment and the 25mm, 4-hr duration erosion control event are summarized below. The values provided exceed the values required. Therefore, the wet pond is appropriately sized for quality treatment objectives.

Table 3-2: Summary of Wet Pond Storage Requirements for Quality Control

Storage Volume (m^3)	Required	Provided	Surplus	Satisfied
Permanent Pool (Dead)	480	540	60	✓
Extended Detention	516	553	37	✓
Erosion Control Target	770	830	60	✓

Erosion Control Requirements

Erosion control storage is intended to reduce the impacts on downstream receiving waters by providing sufficient storage in a SWM facility to reduce velocity of outgoing water. The West Gage Creek MDP identified the erosion control target as the 25mm event with a peak rate of 0.41 m^3/s at the Outlet.

A hydrologic model was employed to determine the storage volume and outlet size in the pond that would achieve this erosion control target. The erosion control event was simulated using the 25mm, 4-hour Chicago distribution.

The simulated 25mm erosion control event produced a pond outflow of 0.24 m^3/s. The total peak outflow at the Outlet in the 25mm event is 0.34 m^3/s, below the 0.41 m^3/s target.

Based on a review of the stage-storage-discharge, the wet pond could store up to 830 m^3 of runoff while maintaining the erosion control target. Therefore, there is sufficient surplus.

Forebay Sizing

The theory used in the development of the wet pond sizing tables in MOE, 2003 is that the larger sediment fractions will settle out in the forebay area, which is typically less than 1/3 of the permanent pool area. This is a portion of the wet pond at the inlet that is separated from the rest of the permanent pool by a submerged berm. The expectation is that future sediment removal maintenance activities may be simplified by limiting the need for excavation of sediment to the forebay, while leaving the main pond. In practice, it is common for sediment excavation to extend to the entire pond.

The forebay size is determined using four equations in the MOE Design Manual (Ontario Ministry of the Environment, 2003). The required forebay length is 12m governed by the settling length equation. The forebay length provided is 31m. Average velocity in the forebay is 0.05m/s assuming an inflow rate from the 5-yr event and this is less than the 0.15m/s targeted velocity to minimize resuspension.

The forebay provides good settling opportunity and has little risk of resuspension. A summary of forebay sizing parameters is provided below.

Table 3-3: Forebay Sizing Summary

Parameter	Required	Provided	Satisfied
Depth (m)	1.0 < x < 2.0	1.5	✓
Settling Length (m)	≥ 12	31	✓
Dispersion Length (m)	≥ 21	31	✓
Average Velocity (m/s)	≤ 0.15	0.05	✓

3.4 Quantity Control

The quantity control targets could be those set by the MDP. Alternatively, standard pre-to-post controls could be employed since Leblanc Enterprises is the only developer with known interest in achieving quality and quantity controls for the area. The targets established in the MDP assumed that the controls for the subject facility would be a collective effort with opportunity for the municipality to contribute to the costs for watershed users not considering further development. Refer to *Page 90* of the MDP for further details.

In a review of the quantity control targets in the MDP and the standard pre-to-post controls, it was found that the SWM facility would have a similar quantity control volume in either scenario. Therefore, preference was given to the control targets in the MDP.

Recall that the MDP applied a 100-yr rainfall volume of 65.8mm. The current quantity controls apply a rainfall total of 80.6mm. Therefore, the quantity controls in the revised design account for current rainfall totals.

The active storage component of the wet pond is used to control release rates after the development. The route-reservoir command in VO was applied to determine storage requirements and outlet sizes. The storage calculation for the facility was prepared using incremental CAD volumes.

Two outlet controls are recommended to attenuate pond outflows for each basin. An orifice is used for erosion control and attenuation for smaller return period storms. A 2^{nd}, larger outlet control is used to attenuate flows for storms with greater rainfall volumes.

The size of the quantity control portion of the wet pond is determined based on a stage-storage-discharge (SSD) relationship (see **Appendix F**). The orifice and weir equations in **Section 3.3** are applied to determine outflows at varying elevations and storage volumes. The SSD relationship is used to ensure the wet pond has sufficient storage to attenuate flows to desired levels with its available storage volume.

A summary of key basin volumes and corresponding water levels is provided in **Table 3-4**.

Although not required since the targets in the MDP govern the quantity control rates, a comparison of pre- and post-development peak flows are provided for the range of return period events outlined in the GRCA SWM guidelines. These tables are provided to demonstrate that the pond would also satisfy the standard pre-to-post controls, providing added confidence there will be no negative impacts or peak flow increases to downstream lands (see **Tables 3-5 and 3-6**).

Table 3-4: Key Basin Volumes & Water Levels

Parameter	Erosion Control	2-Yr	100-Yr
Required storage (m^3)	870	1,140	1,990
Provided storage (m^3)	920	2,612	2,612
Peak water level (m)	105.1	105.4	105.7
Basin inflow (cms)	0.70	0.99	2.95
Basin outflow (cms)	0.24	0.53	1.69
Flow attenuation (%)	66%	46%	43%
Peak Flow at Outlet (cms)	0.34	0.74	2.4
Flow Limit at Outlet (cms)	0.41	0.75	2.5

6-hr duration shown with AES distribution for 2- and 100-yr storms per West Gage Creek MDP.

Table 3-5: Pre vs. Controlled Post Peak Flows at Outlet from *Croft Street Subdivision + External Lands (Sub-Catchment 104A)* for SCS Type II Distribution

Return Period	SCS Type II					
	12-Hr			24-Hr		
	Pre	Post	Check:	Pre	Post	Check:
2	0.38	0.14	✓	0.43	0.17	✓
5	0.64	0.39	✓	0.67	0.38	✓
10	0.83	0.59	✓	0.89	0.62	✓
25	1.09	0.87	✓	1.12	0.88	✓
50	1.27	1.07	✓	1.31	1.08	✓
100	1.47	1.28	✓	1.51	1.30	✓

Table 3-6: Pre vs. Controlled Post Peak Flows at Outlet from *Croft Street Subdivision + External Lands (Sub-Catchment 104A)* for Chicago Distribution

Return Period	Chicago					
	1-Hr			4-Hr		
	Pre	Post	Check:	Pre	Post	Check:
2	0.13	0.05	✓	0.19	0.06	✓
5	0.23	0.08	✓	0.33	0.15	✓
10	0.32	0.11	✓	0.46	0.26	✓
25	0.44	0.26	✓	0.62	0.42	✓
50	0.54	0.36	✓	0.76	0.54	✓
100	0.65	0.47	✓	0.91	0.68	✓

3.5 Conveyance

The subject site will achieve conveyance through a storm sewer network sized for the 5-yr storm event. Major overland flows will be routed within the parking areas and road allowance towards the overland flow route to the pond.

Due to grading constraints that require the site entrance to have positive drainage towards Croft Street, the parking area and site entrance will have an overland flow route that drains towards the Croft Street road allowance. In the detailed grading for the Site Plan application, the Croft Street extension previously designed by D. M. Wills will be reviewed and modified if necessary to ensure the overland flows drain as intended towards the pond.

The rooftop runoff can enter the pond directly as overland drainage through the landscaped area on the south side of the building. It does not need to enter the pond via the storm network since roof runoff is generally considered clean and therefore its runoff does not need to be routed through the full length to width ratio of the quality component of the pond.

Landscaped areas (no surface hardening) on the south side of the building that cannot drain to the pond due to grading constraints can drain directly to the realigned ditch along the hydro easement. This ditch was sized to accommodate this drainage.

During detailed design, a check on the 100-yr gradeline along the storm sewer network and into the SWM facility is recommended to ensure no adverse backwater impacts at the site from the selected pond elevations.

Orifice Flow

Jewell used the orifice flow equation in the sizing of a quality control outlet structure for the SWM facility (see Equation 1). A 200mm orifice is used at an elevation of 104.4m, which is equal to the top of permanent pool elevation.

Equation 1: Orifice Equation

$$Q = CA\sqrt{2gH}$$

Where:

Q = discharge (m^3/s)

C = discharge coefficient (dimensionless)

A = area of opening (m^2)

H = hydraulic head (m)

g = acceleration due to gravity (m/s^2)

Sharp-Crested Weir Flow

A sharp-crested weir was selected to control pond outflows for the 2 to 100-yr return period events. The weir has a 1400mm length at an elevation of 104.900m. A calculation of rectangular sharp-crested weir flow is completed using Equation 2.

Equation 2: Sharp-Crested Weir Formula

$$Q = 1.84LH^{3/2}$$

Where:

Q = Discharge (m^3/s)

L = Length of Weir (m)

H = Depth of flow (m)

Note: Jewell reduced the length by 0.2H to account for end contractions.

Emergency Spillway

It is common to use a broad-crested weir in a SWM facility to provide an emergency spillway for storm events exceeding the 100-yr return period (see Equation 3). An earth berm with rip rap will be utilized to simulate a broad-crested weir with a 11m length and 0.3m depth. The invert elevation of the emergency spillway is 106.0m. The spillway can pass 3.0 m^3/s without overtopping the pond. This is greater than the entire uncontrolled 100-yr inflow and provides adequate flow conveyance in the event of blockage.

Equation 3: Broad-Crested Weir Formula

$$Q = 1.67LH^{3/2}$$

Where:

Q = Flow over the road in cms

L = Length of Weir (m)

H = Depth of flow (m)

4 Sediment and Erosion Control

Typical site development requires removal of some vegetated cover. While it is the intention to reduce vegetation removal, exposed soils from the work will be at risk of eroding into the receiving drainage system. Measures will need to be put in place to reduce erosion during construction, and for a period of up to one year after construction is completed. Typical sediment and erosion control measures include:

- Siltation fencing.
- Strawbale check dams.
- Rip-rap check dams.

Controls are to be placed downstream of all active work areas and upstream of protected receivers. Controls should also be placed around stockpiles of topsoil and fill materials.

Typical OPSDs provide good instruction on the correct placement and construction of the controls. The controls provide some protection if they are properly maintained, but they should be considered last-resort measures. The most effective means of control are those which prevent or reduce erosion at the source. This would include diligent stabilization of exposed areas immediately after grading is completed. Stabilization measures include sod, erosion blankets, or rip-rap and filter cloth on steep slopes, as well as topsoil and hydroseed on gently sloped areas (with slope 10% or less).

A silt fence should be located along the south, west, and east property lines during the construction and be maintained until the land has stabilized or as directed by the municipality.

Sediment control ponds may be recommended as part of detailed design.

5 Maintenance

Since the proposed wet pond performs both quality and quantity control, good maintenance is important to ensure it functions as designed. Some simple maintenance practices are recommended that include both surveillance and general cleaning/trash removal. Some maintenance items, such as sediment removal, take place at infrequent intervals.

This maintenance plan provides basic instructions on good maintenance of the SWM controls.

Routine (Monthly, Quarterly, or as needed):

The routine inspection is for the purpose of determining if the facility is operating normally and confirming there are no obvious safety concerns. Trash that could block the outlet structure should be removed. Water levels should be noted to confirm there are no unusual circumstances that could affect the pond performance.

SWM facility operators should remove any trash that may be impeding any outlet structures. Additionally, grass and weeds should be cut as needed. During and after a large rainfall event the operator should also perform a visual check to see that pond elevations are within expected levels.

Inspections of lot level controls should be completed by homeowners to ensure roof leaders are directed to grass surfaces rather than impervious surfaces. Inspection forms should be kept for a routine maintenance record and note the routine maintenance efforts taken to ensure the ongoing functionality of the proposed SWM controls.

- Complete a walk-around inspection of the facility looking for:
  - Trash accumulation
  - Water levels – draining between events (permanent pool at 104.4m)
  - Signs of erosion
  - Safety concerns

- Perform general facility maintenance including:
  - Mowing of the perimeter berm
  - Application of weed suppression on the access routes (if required)
  - Removal of trash from perimeter fencing and outlet structure (if required)

Staff should not enter the pond without floatation devices. Inspection and maintenance of the following components is recommended:

- Outlet structure
  - Inspect relevant conveyance structures such as orifice plates, valves, weirs, inlet and/or outlet pipes. Manhole lids and/or ditch inlet grates often need to be lifted to view these structures.
  - Check conditions of any grating over outlet structures.
  - Check for any blockages restricting outflow conveyance.
- Inlet pipes/culverts

    - Check for sediment accumulation at all inlet pipes/culverts to ensure free-flow conditions. Sediment may accumulate in structures upstream of the facility.
    - Check for deterioration of the inlet or loss of material surrounding the inlet that could indicate overtopping or seepage.
- Ditching
    - Check for sediment accumulation in any nearby ditching that may impede flow.
- Perimeter berms
    - Check for line and grade of the berms for evidence of subsidence.
    - Check for leakage through the perimeter berms.
- Vegetation
    - Check for evidence of vegetation loss that may indicate chemical spills or vermin activity.
    - Remove excessive vegetation in ditching and around all water control structures.
- Perimeter Fencing
    - Check condition of fencing to ensure there are no safety concerns.

Infrequent Maintenance:

Major maintenance on the facility is triggered by the accumulation of sediment within the permanent pool of the wet pond approaching the maximum allowable accumulation volume over time.

The Ontario MECP guidelines suggest the pond removal efficiency should not fall more than 5% below design. For facilities with a major maintenance interval more than 30 years, a 30-year maintenance interval is used.

Confirmatory sampling should be completed to determine suitable disposal options.

The proposed wet pond has a permanent pool with a sufficient buffer of excess volume (540 provided vs. 480 m^3 required). Based on theoretical loading rates from the 2003 MOE SWM Planning and Design Manual, the expected major cleanout interval is expected to be more than 30 years. If the available permanent pool volume decreases to 480 m^3 from its original design volume within less than 30 years, then a cleanout is likely imminent.

A 30-yr maintenance interval can be applied unless otherwise observed from sediment surveys. Sediment surveys are recommended to take place every 5 – 10 years to identify the accumulation rates of the local sediment loading to determine the rate of depletion of the available permanent pool volume.

Troubleshooting:

Some basic issues that can develop with a pond and the remedies are described below.

Symptom – Pond is not emptying

The orifice plate/outlet controls may become blocked with debris. Outlets should be monitored after every large runoff event. Observe that the pond is draining to permanent pool between events and not overfilling.

Symptom – Pond does not fill

The orifice plate/outlet controls should impose ponding during runoff events. If the pond does not retain a permanent pool between rainfall events, water may be unintentionally entering the subsurface which should be noted in the inspection form. If applicable, a new pond liner or a correction to an existing pond liner may be required.

Symptom – Pond routinely overfills

If the stored water discharges through the emergency spillway, the cause is blockage of the outlet control. The pond may require a cleanout.

Pond Features:

Features below are based on preliminary design only and are to be updated during detailed pond design.

- Pond Bottom 102.9m
- Permanent Pool 104.4m
- Max. 25mm event 105.1m

- Quality Control 200mm orifice at invert 105.1m
- Quantity Control 1800mm concrete weir within MH structure at invert 104.9m
- Emergency Spillway 11m broad-crested weir at invert 106.0m

- Contributing Area 12.9 ha
  (Croft Street Subdivision plus portion of external developed lands with Sub-Catchment 104)

Spill Response

In the event of a contamination spill (for example, a fuel tank spill) that enters the storm sewer network and/or SWMF, the spill must be immediately reported to Ontario's Spills Action Centre in accordance with provincial regulations. The phone numbers for spill reporting are provided below.

Public pollution reporting hotline	1-866-663-8477
Spills Action Centre	1-800-268-6060

MECP Peterborough ON Regional Office (705) 755-4300 or 1-800-558-0595

The facility has been designed with the understanding that some oils and floatables will be present from everyday use associated with subdivisions. This spill response section is for contaminants outside of the pond's intended function.

Cleanup and remediation of a spill must be in accordance with the Environmental Protection Act and a licensed spill contractor can be contacted.

Manholes and OGS Units upstream and downstream of the facility will likely require a full cleanout as part of spill containment and remediation.

Public Concerns

If a member of the public has a concern with the SWM facility, they can report their concerns to the Municipality. Upon receipt of the complaint, the Municipality should file the complaint with other relevant files, such as the inspection forms.

The complaint should be addressed with a written response within a reasonable time frame. If the complaint requires follow-up actions, then these actions should also be recorded by the owner in relevant files.

6 Conclusions

Jewell has prepared this report to support the ZBA and OBA for the subject site.

The Site Plan for the subject site would complete the *Croft Street Subdivision (*44 – 360 Croft Street).

The proposed pond is a revision of the recently constructed wet pond. Its revised location and supporting calculations offer improved land efficiency for the site while accommodating increased rainfall with current IDF curves.

The revised wet pond meets quality treatment objectives by removing >80% TSS loading from the *Croft Street Subdivision*.

The revised wet pond meets quantity control objectives by meeting the flow control targets set in the *2007 West Gage Creek MDP*, even after accounting for increased rainfall depths. As a supplemental check, the pond was tested vs. standard pre-to-post objectives, which were also met.

Conveyance will be achieved with a storm sewer network for minor flows and an overland flow route for major flows.

With a reasonable permanent pool surplus, major maintenance cleanouts are anticipated approximately every 30 years. Sediment surveys every 5-10 years are recommended to measure the rate of volume loss in the pond since theoretical loading rates may differ from theoretical loading rates identified in the *2003 MOE Manual*.

The proposed SWM plan, combined with Jewell's preliminary grading plan, confirms the revised pond design meets the SWM objectives established in **Section 1.2**.

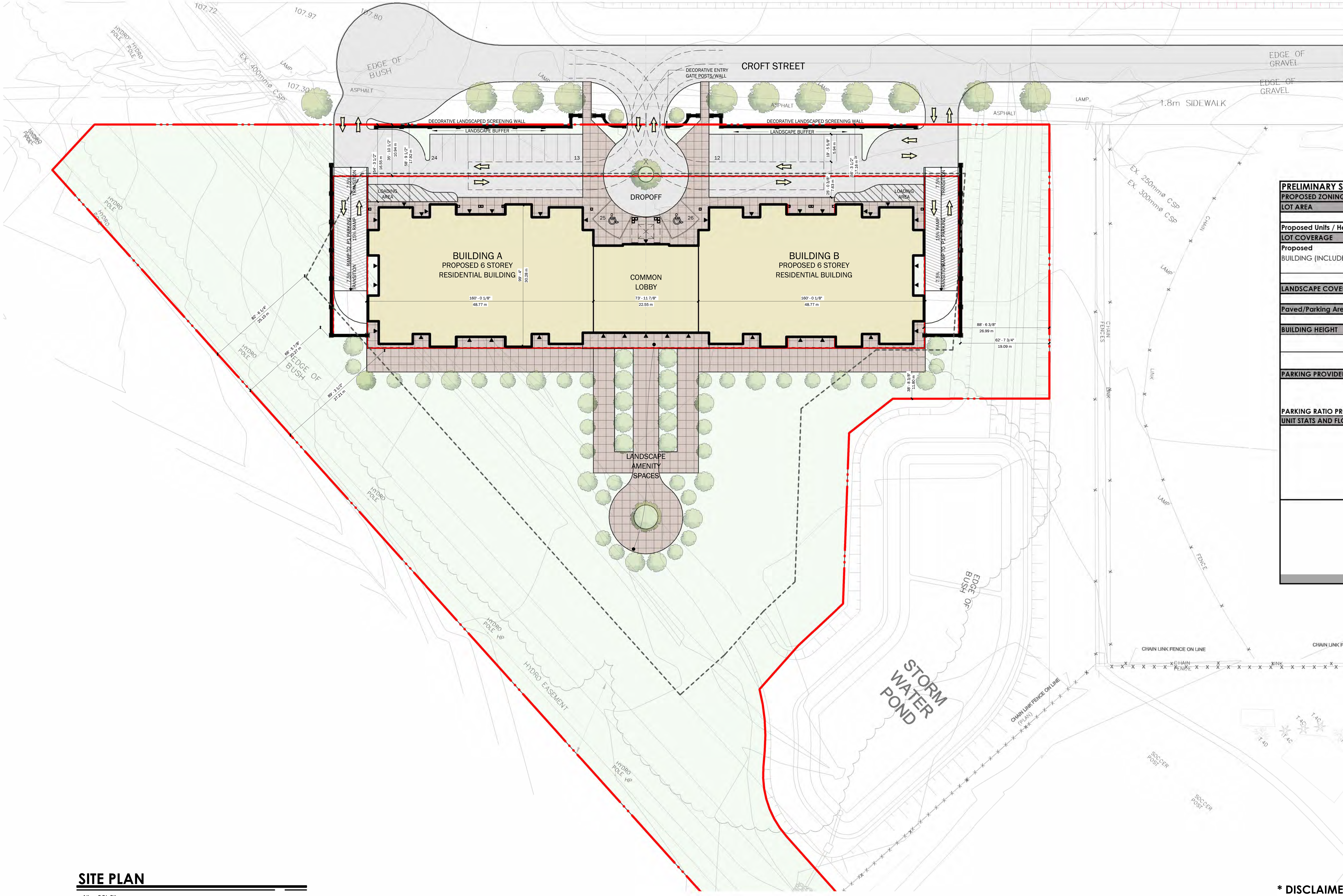
Prepared by:

Elliott Fledderus, P. Eng.

Jewell Engineering Inc.

Appendix A:

Site Plan & Preliminary Grading Plan



SITE PLAN

1" = 30'-0"

PRELIMINARY SITE STATS	HECTARES	ft²	m²	%
PROPOSED ZONING - (RES4 HIGH DENSITY RESIDENTIAL)				
LOT AREA				
	1.8581	200000.00	18,580.6	100%
Proposed Units / Hectare	58.1251			
LOT COVERAGE				
Proposed				
BUILDING (INCLUDES PROJECTIONS)		39000.0	3,623.2	19.5%
	Total	**39000.0**	**3623.2**	**19.5%**
LANDSCAPE COVERAGE (INCLUDES SIDEWALKS/PATIOS)				
	Proposed	135000.0	12,541.9	67.5%
Paved/Parking Areas Not Covered By Building				
		26000.0	2,415.5	13.0%
BUILDING HEIGHT				
	Building A	**6 Storey**		23m (Top of Roof')
	Building B	**6 Storey**		23m (Top of Roof')
PARKING PROVIDED				
	P1 UNDERGROUND			132
	Surface			26
	Total			**158**
PARKING RATIO PROVIDED	**1.46**	**Spaces Per Unit**		
UNIT STATS AND FLOOR AREAS				
BuildingA		Units		
1st FLOOR		8		
2nd FLOOR		10		
3rd FLOOR		10		
4th FLOOR		10		
5th FLOOR		10		
6th FLOOR		6		
Total Building A		**54**		
BuildingB		Units		
1st FLOOR		8		
2nd FLOOR		10		
3rd FLOOR		10		
4th FLOOR		10		
5th FLOOR		10		
6th FLOOR		6		
Total Building B		**54**		
Total Units Provided		**108**		

*** DISCLAIMER: ISSUED FOR PRELIMINARY DESIGN DISCUSSION ONLY**

LEBLANC ENTERPRISES CROFT STREET DEVELOPMENT

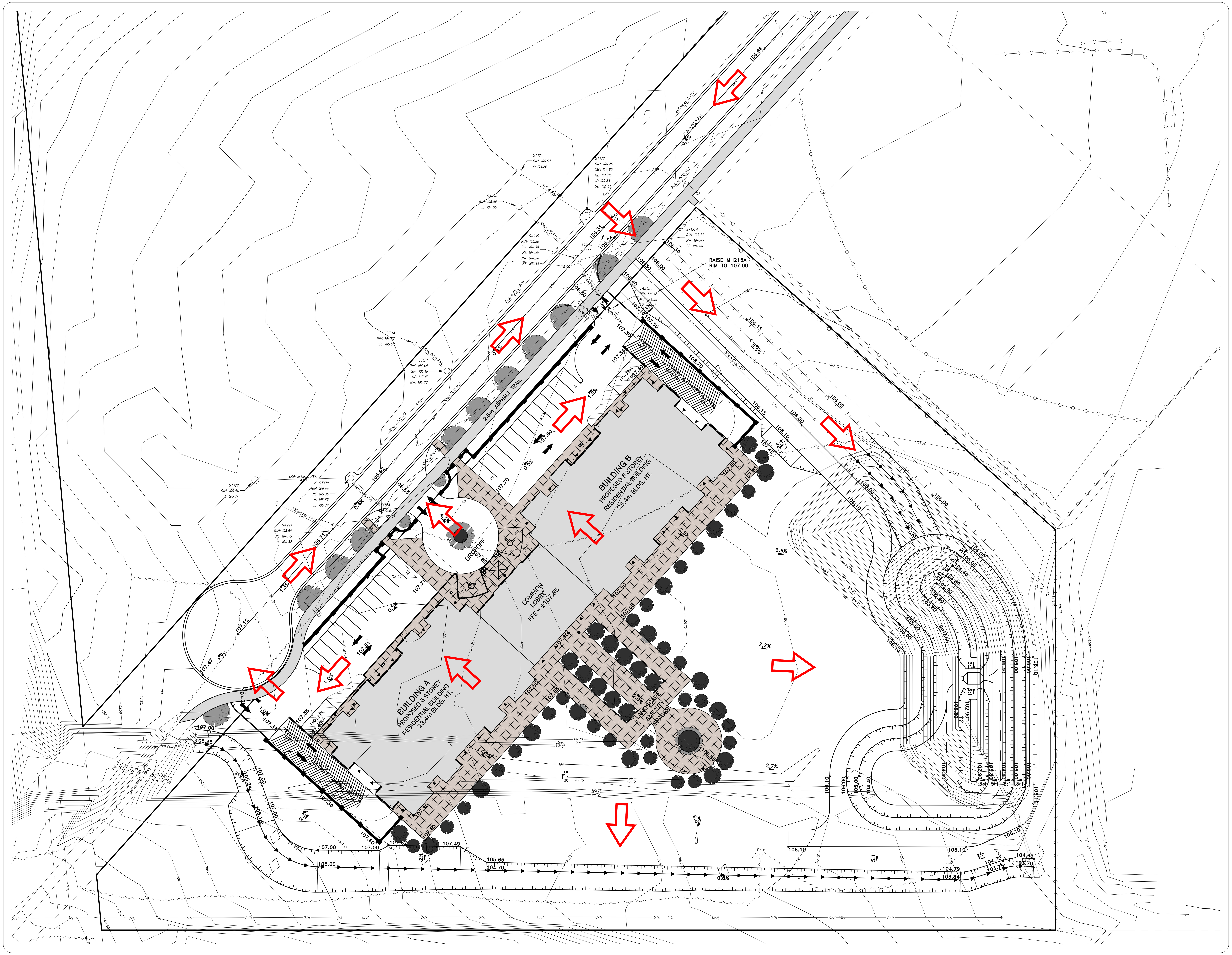
CROFT STREET | PORT HOPE | ONTARIO

A·C·K architects STUDIO INC.

SITE PLAN

DWG. No. .SP1

SCALE: AS SHOWN
DATE: JANUARY 2024
PROJECT No.: 2021-347S



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- ALL UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM THE LOCATION ON SITE AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

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GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 17 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

LEGEND

OVERLAND FLOW ROUTE

APPROXIMATE EXISTING ELEVATION

PRELIMINARY PROPOSED ELEVATION

NOTES:

- ELEVATION AND CROFT STREET EXTENSION INFORMATION FROM DM WILLS PROJECT 10-10322, FOURTH SUBMISSION - JUNE 13, 2024 AND IS APPROXIMATE ONLY.
- PROPERTY LINES ARE FROM IVAN B. WALLACE, PLAN 39R-12512 - JULY 11, 2011

JEWELL ENGINEERING

CROFT STREET
LEBLANC ENTERPRISES

PORT HOPE, ONTARIO

PRELIMINARY
SITE GRADING PLAN

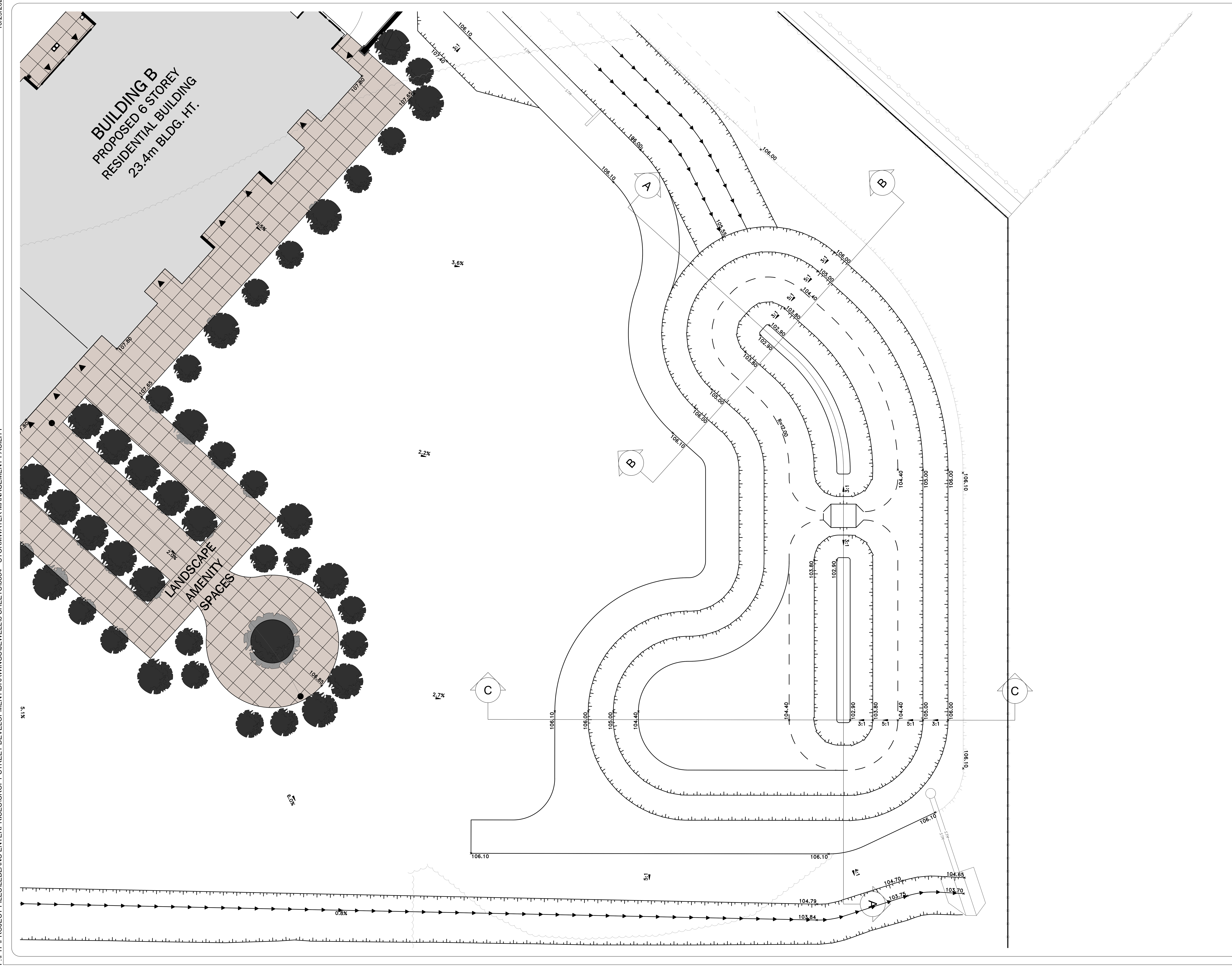
DRAWN BY: JH
PROJECT NO: 250-5864
DESIGNED BY: AMR
DATE: November 2025
CHECKED BY:
SCALE: HORIZONTAL - 1:400, VERTICAL - N/A
APPROVED BY:
CONTRACT NO:
DRAWING NO: SG-1

10/27/2025

F:\FTP\PROJECT FILES\LEBLANC ENTERPRISES\CROFT STREET DEVELOPMENT\DRAWINGS\JEWELL\3 SHEETS\5864 - SITE GRADING PLAN

10/29/2025

F:\FTP\PROJECT FILES\LEBLANC ENTERPRISES\CROFT STREET DEVELOPMENT\DRAWINGS\JEWELL\3 SHEETS\5864 - STORMWATER MANAGEMENT FACILITY



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* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

N
E
S
W

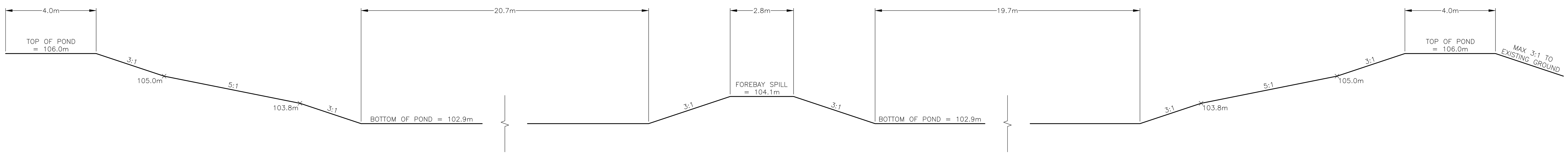
JEWELL
ENGINEERING

CROFT STREET
LEBLANC ENTERPRISES

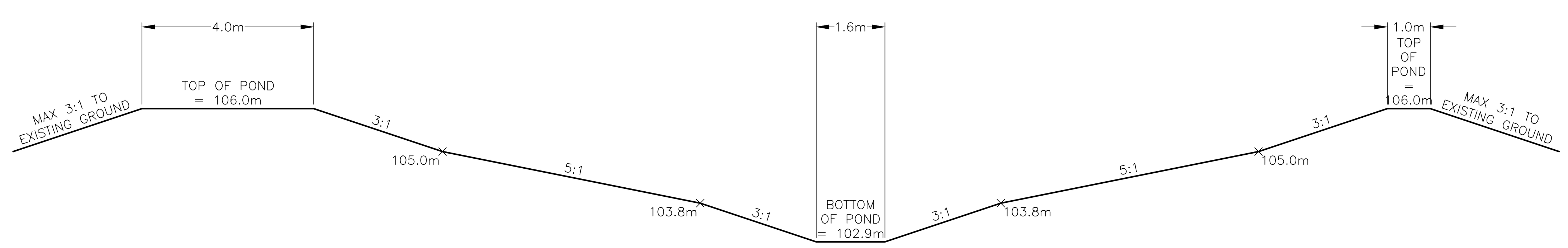
PORT HOPE, ONTARIO

STORMWATER MANAGEMENT
FACILITY
PLAN VIEW

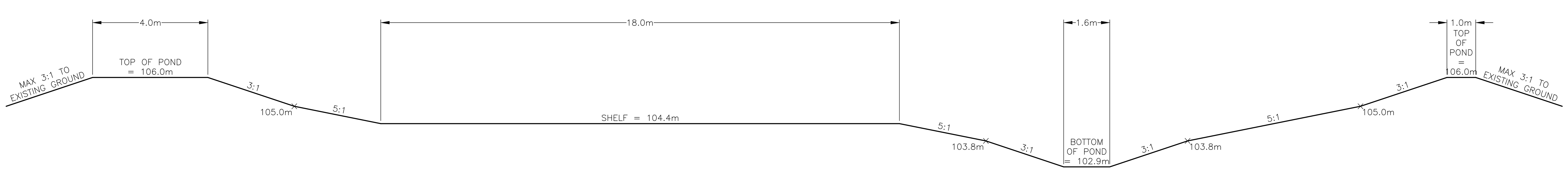
DRAWN BY: JH	PROJECT NO: 250-5864
DESIGNED BY: AMR	DATE: November 2025
CHECKED BY:	SCALE: HORIZONTAL - 1:200 VERTICAL - N/A
APPROVED BY:	CONTRACT NO:
	DRAWING NO: SWM-1



SECTION A



SECTION B



SECTION C

GENERAL NOTES:

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* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

JEWELL ENGINEERING

CROFT STREET
LEBLANC ENTERPRISES

PORT HOPE, ONTARIO

STORMWATER MANAGEMENT FACILITY
SECTION VIEWS

DRAWN BY: JH
PROJECT NO: 250-5864
DESIGNED BY: AMR
DATE: November 2025
CHECKED BY:
SCALE: HORIZONTAL - 1:100, VERTICAL - 1:100
APPROVED BY:
CONTRACT NO:
DRAWING NO: SWM-2

10/29/2025

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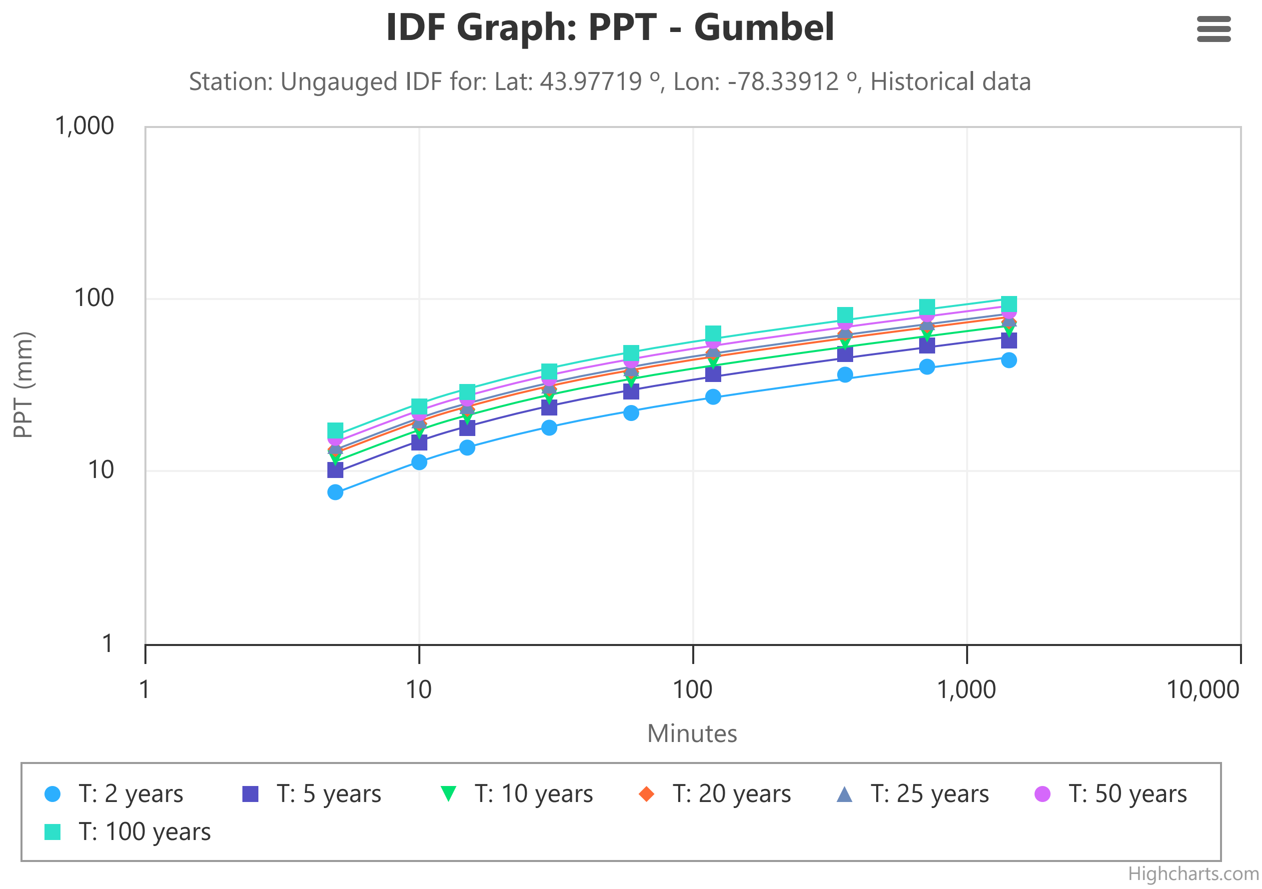
Appendix B:
IDF_CC Tool 7.5 Rainfall Data for Port Hope, ON


IDF Graph: PPT - Gumbel
Station: Ungauged IDF for: Lat: 43.97719 º, Lon: -78.33912 º, Historical data
1,000
100
10
1
PPT (mm)
1
10
100
1,000
10,000
Minutes
T: 2 years
T: 5 years
T: 10 years
T: 20 years
T: 25 years
T: 50 years
T: 100 years
Highcharts.com

T (years)	Return Period						
	2	5	10	20	25	50	100
5 min	7.57	10.18	11.9	13.43	14.04	15.63	17.2
10 min	11.3	14.69	16.96	18.94	19.73	21.8	23.79
15 min	13.72	17.83	20.51	22.93	23.9	26.41	28.86
30 min	17.89	23.35	26.9	30.1	31.38	34.63	37.86
1 h	21.76	28.91	33.64	37.87	39.56	43.98	48.33
2 h	27.01	36.67	43.04	48.79	51.08	57.01	62.9
6 h	36.28	47.8	55.75	62.9	65.75	73.21	80.62
12 h	40.34	53.39	62.06	69.97	73.12	81.33	89.69
24 h	44.03	57.2	65.86	73.63	76.72	84.92	92.87

Source: Simonovic, S.P., A. Schardong, R. Srivastav, and D. Sandink (2015), *IDF_CC Web-based Tool for Updating Intensity-Duration-Frequency Curves to Changing Climate – ver 7.5*, Western University Facility for Intelligent Decision Support and Institute for Catastrophic Loss Reduction, open access https://www.idf-cc-uwo.ca.

Appendix C:
Catchment Area Drawing

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* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

LEGEND

CATCHMENT ID: 201B

CATCHMENT AREA (ha): 1.50

%IMPERVIOUS (0.##) OR CURVE NUMBER: 0.66

CATCHMENT BOUNDARY

N W E S

JEWELL ENGINEERING

CROFT STREET
LEBLANC ENTERPRISES

PORT HOPE, ONTARIO

STORM
CATCHMENT PLAN

DRAWN BY: JH	PROJECT NO: 250-5864
DESIGNED BY: AMR	DATE: October 2025
CHECKED BY:	SCALE: HORIZONTAL - 1:1,500; VERTICAL - N/A
APPROVED BY:	CONTRACT NO:
	DRAWING NO: ST-1

10/31/2025

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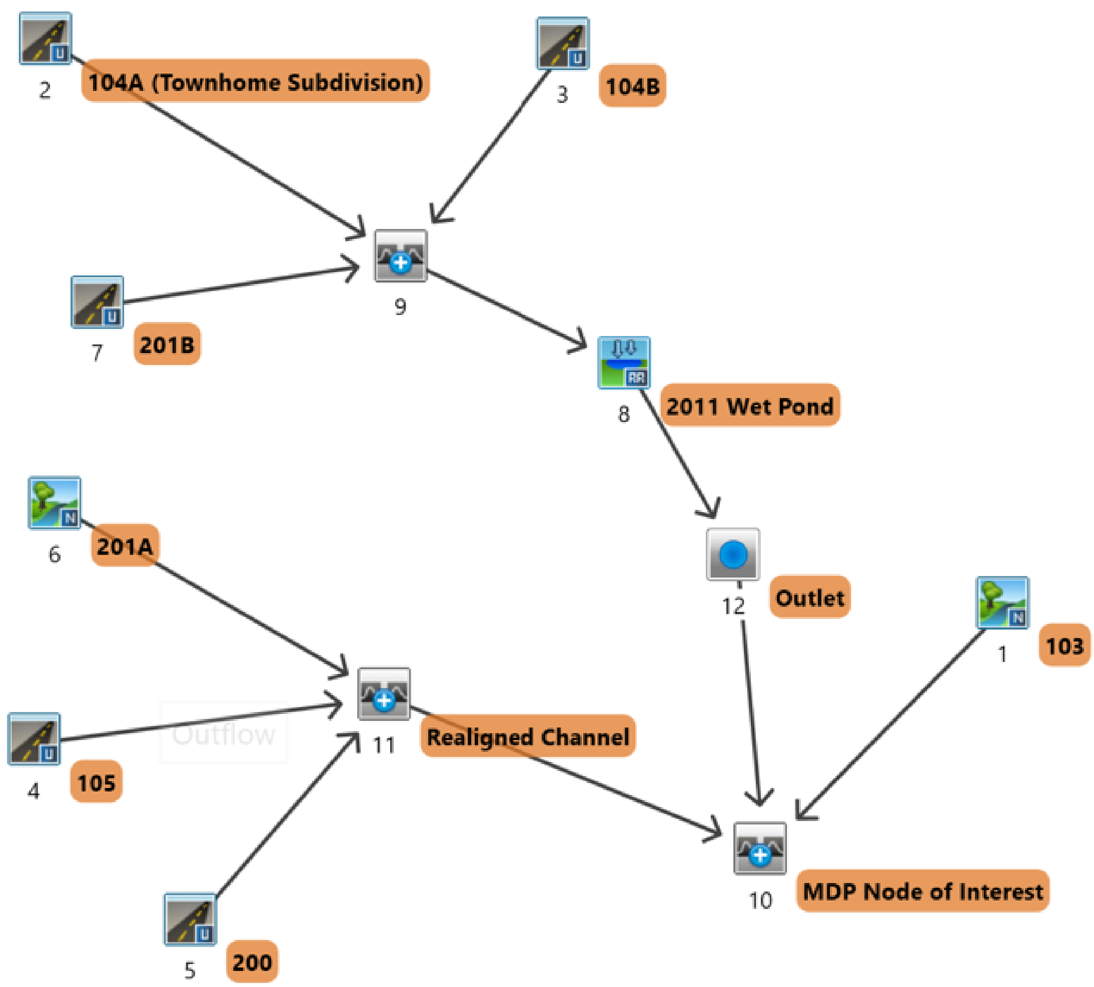
Appendix D:
VO Model Schematic


2
104A (Townhome Subdivision)
3
104B
9
7
201B
8
2011 Wet Pond
6
201A
12
Outlet
1
103
11
Realigned Channel
4
105
Outflow
10
MDP Node of Interest
5
200

Appendix E:
VO Digital Model Files (100Yr, 6Hr)

```
==========================================================================================
=======================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
```
Developed and Distributed by Smart City Water Inc

***** D E T A I L E D   O U T P U T *****

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  Output  filename:
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f566fe-f43f-490d-b7dc-9aeb9b1cee42\s


DATE: 08/27/2025                          TIME: 11:42:51

USER:



COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------------
-----------------------
  ************************************************
  ** SIMULATION : 100Yr, 6Hr AES Disbribution ( **
  ************************************************


--------------------
|    READ STORM     |    Filename: C:\Users\efledderus\AppD
|                   |              ata\Local\Temp\
```

| | 9a3b5390-ba6a-4398-9d50-ce6a019ff840\9620be13
| Ptotal= 80.75 mm | Comments: 100Yr, 6Hr AES Disbribution (80.62mm)

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
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0.10	3.74	1.70	11.52	3.30	9.02	4.90	4.67
0.20	4.04	1.80	13.69	3.40	8.41	5.00	4.67
0.30	4.04	1.90	17.42	3.50	8.09	5.10	4.35
0.40	4.35	2.00	24.90	3.60	7.46	5.20	4.35
0.50	4.67	2.10	51.66	3.70	7.16	5.30	4.04
0.60	4.67	2.20	226.56	3.80	6.85	5.40	4.04
0.70	4.97	2.30	61.62	3.90	6.53	5.50	4.04
0.80	5.29	2.40	34.23	4.00	6.22	5.60	4.04
0.90	5.62	2.50	24.90	4.10	5.92	5.70	3.74
1.00	5.92	2.60	19.60	4.20	5.92	5.80	3.74
1.10	6.22	2.70	16.49	4.30	5.62	5.90	3.74
1.20	6.85	2.80	14.31	4.40	5.29	6.00	3.74
1.30	7.46	2.90	12.75	4.50	5.29		
1.40	8.09	3.00	11.52	4.60	4.97		
1.50	8.71	3.10	10.57	4.70	4.97		

| CALIB |
| NASHYD (0001)| Area (ha)= 3.63 Curve Number (CN)= 68.0
|ID= 1 DT= 5.0 min | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.24

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.00	1.667	9.71	3.250	10.01	4.83	4.85
0.167	2.99	1.750	10.90	3.333	9.39	4.92	4.67
0.250	3.92	1.833	12.39	3.417	8.90	5.00	4.67
0.333	4.04	1.917	14.44	3.500	8.41	5.08	4.67
0.417	4.10	2.000	17.42	3.583	8.09	5.17	4.41
0.500	4.35	2.083	24.90	3.667	7.59	5.25	4.35
0.583	4.67	2.167	46.31	3.750	7.28	5.33	4.23
0.667	4.67	2.250	156.60	3.833	7.04	5.42	4.04
0.750	4.85	2.333	160.58	3.917	6.79	5.50	4.04
0.833	5.10	2.417	56.14	4.000	6.53	5.58	4.04
0.917	5.36	2.500	34.23	4.083	6.22	5.67	4.04
1.000	5.62	2.583	24.90	4.167	5.98	5.75	3.86
1.083	5.92	2.667	20.66	4.250	5.92	5.83	3.74
1.167	6.16	2.750	17.73	4.333	5.80	5.92	3.74

```
             1.250    6.60 | 2.833   15.62 | 4.417    5.55 |  6.00    3.74
             1.333    7.09 | 2.917   14.00 | 4.500    5.29 |  6.08    3.74
             1.417    7.59 | 3.000   12.75 | 4.583    5.29 |
             1.500    8.09 | 3.083   11.52 | 4.667    5.03 |
             1.583    8.71 | 3.167   10.76 | 4.750    4.97 |

    Unit Hyd Qpeak  (cms)=   0.578

    PEAK FLOW       (cms)=   0.268 (i)
    TIME TO PEAK    (hrs)=   2.500
    RUNOFF VOLUME    (mm)=  29.319
    TOTAL RAINFALL   (mm)=  80.691
    RUNOFF COEFFICIENT   =   0.363

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0006)|   Area    (ha)=   1.25   Curve Number   (CN)= 70.9
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
              TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
             0.083    0.00 | 1.667    9.71 | 3.250   10.01 |  4.83    4.85
             0.167    2.99 | 1.750   10.90 | 3.333    9.39 |  4.92    4.67
             0.250    3.92 | 1.833   12.39 | 3.417    8.90 |  5.00    4.67
             0.333    4.04 | 1.917   14.44 | 3.500    8.41 |  5.08    4.67
             0.417    4.10 | 2.000   17.42 | 3.583    8.09 |  5.17    4.41
             0.500    4.35 | 2.083   24.90 | 3.667    7.59 |  5.25    4.35
             0.583    4.67 | 2.167   46.31 | 3.750    7.28 |  5.33    4.23
             0.667    4.67 | 2.250  156.60 | 3.833    7.04 |  5.42    4.04
             0.750    4.85 | 2.333  160.58 | 3.917    6.79 |  5.50    4.04
             0.833    5.10 | 2.417   56.14 | 4.000    6.53 |  5.58    4.04
             0.917    5.36 | 2.500   34.23 | 4.083    6.22 |  5.67    4.04
             1.000    5.62 | 2.583   24.90 | 4.167    5.98 |  5.75    3.86
             1.083    5.92 | 2.667   20.66 | 4.250    5.92 |  5.83    3.74
             1.167    6.16 | 2.750   17.73 | 4.333    5.80 |  5.92    3.74
             1.250    6.60 | 2.833   15.62 | 4.417    5.55 |  6.00    3.74
             1.333    7.09 | 2.917   14.00 | 4.500    5.29 |  6.08    3.74
             1.417    7.59 | 3.000   12.75 | 4.583    5.29 |
             1.500    8.09 | 3.083   11.52 | 4.667    5.03 |
             1.583    8.71 | 3.167   10.76 | 4.750    4.97 |

    Unit Hyd Qpeak  (cms)=   0.239
```

```
     PEAK FLOW       (cms)=   0.114 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=  31.778
     TOTAL RAINFALL   (mm)=  80.691
     RUNOFF COEFFICIENT   =   0.394

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0004)|   Area    (ha)=   3.16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  28.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.74         1.42
     Dep. Storage     (mm)=        1.00         1.50
     Average Slope     (%)=        1.00         2.00
     Length            (m)=      145.14        40.00
     Mannings n           =       0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.00	1.667	9.71	3.250	10.01	4.83	4.85
0.167	2.99	1.750	10.90	3.333	9.39	4.92	4.67
0.250	3.92	1.833	12.39	3.417	8.90	5.00	4.67
0.333	4.04	1.917	14.44	3.500	8.41	5.08	4.67
0.417	4.10	2.000	17.42	3.583	8.09	5.17	4.41
0.500	4.35	2.083	24.90	3.667	7.59	5.25	4.35
0.583	4.67	2.167	46.31	3.750	7.28	5.33	4.23
0.667	4.67	2.250	156.60	3.833	7.04	5.42	4.04
0.750	4.85	2.333	160.58	3.917	6.79	5.50	4.04
0.833	5.10	2.417	56.14	4.000	6.53	5.58	4.04
0.917	5.36	2.500	34.23	4.083	6.22	5.67	4.04
1.000	5.62	2.583	24.90	4.167	5.98	5.75	3.86
1.083	5.92	2.667	20.66	4.250	5.92	5.83	3.74
1.167	6.16	2.750	17.73	4.333	5.80	5.92	3.74
1.250	6.60	2.833	15.62	4.417	5.55	6.00	3.74
1.333	7.09	2.917	14.00	4.500	5.29	6.08	3.74
1.417	7.59	3.000	12.75	4.583	5.29		
1.500	8.09	3.083	11.52	4.667	5.03		
1.583	8.71	3.167	10.76	4.750	4.97		

```
     Max.Eff.Inten.(mm/hr)=      160.58        50.75
                over (min)         5.00        15.00
```

```
     Storage Coeff.  (min)=       2.64 (ii)   11.90 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.29         0.09
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.39         0.11          0.464 (iii)
     TIME TO PEAK    (hrs)=       2.33         2.50           2.33
     RUNOFF VOLUME    (mm)=      79.69        15.95          33.80
     TOTAL RAINFALL   (mm)=      80.69        80.69          80.69
     RUNOFF COEFFICIENT   =       0.99         0.20           0.42

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) PROPORTIONAL LOSS FACTOR APPLIED TO RAINFALL:
            CIMP = 1.00    CPER = 0.20
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0005)|   Area    (ha)=   1.40
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  20.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.49         0.91
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      96.61        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.00 | 1.667    9.71 | 3.250   10.01 |  4.83    4.85
               0.167    2.99 | 1.750   10.90 | 3.333    9.39 |  4.92    4.67
               0.250    3.92 | 1.833   12.39 | 3.417    8.90 |  5.00    4.67
               0.333    4.04 | 1.917   14.44 | 3.500    8.41 |  5.08    4.67
               0.417    4.10 | 2.000   17.42 | 3.583    8.09 |  5.17    4.41
               0.500    4.35 | 2.083   24.90 | 3.667    7.59 |  5.25    4.35
               0.583    4.67 | 2.167   46.31 | 3.750    7.28 |  5.33    4.23
               0.667    4.67 | 2.250  156.60 | 3.833    7.04 |  5.42    4.04
               0.750    4.85 | 2.333  160.58 | 3.917    6.79 |  5.50    4.04
               0.833    5.10 | 2.417   56.14 | 4.000    6.53 |  5.58    4.04
               0.917    5.36 | 2.500   34.23 | 4.083    6.22 |  5.67    4.04
               1.000    5.62 | 2.583   24.90 | 4.167    5.98 |  5.75    3.86
               1.083    5.92 | 2.667   20.66 | 4.250    5.92 |  5.83    3.74
```

```
                1.167    6.16 | 2.750   17.73 | 4.333    5.80 |  5.92    3.74
                1.250    6.60 | 2.833   15.62 | 4.417    5.55 |  6.00    3.74
                1.333    7.09 | 2.917   14.00 | 4.500    5.29 |  6.08    3.74
                1.417    7.59 | 3.000   12.75 | 4.583    5.29 |
                1.500    8.09 | 3.083   11.52 | 4.667    5.03 |
                1.583    8.71 | 3.167   10.76 | 4.750    4.97 |

     Max.Eff.Inten.(mm/hr)=     160.58        30.63
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       2.07 (ii)   13.40 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.31         0.08
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.12         0.05             0.160 (iii)
     TIME TO PEAK    (hrs)=       2.33         2.50              2.33
     RUNOFF VOLUME    (mm)=      79.69        15.89             28.65
     TOTAL RAINFALL   (mm)=      80.69        80.69             80.69
     RUNOFF COEFFICIENT   =       0.99         0.20              0.36

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) PROPORTIONAL LOSS FACTOR APPLIED TO RAINFALL:
            CIMP = 1.00    CPER = 0.20
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0011)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0004):     3.16   0.464     2.33    33.80
      + ID2= 2 (  0005):     1.40   0.160     2.33    28.65
        =====================================================
        ID = 3 (  0011):     4.56   0.623     2.33    32.21

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0011)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0011):     4.56   0.623     2.33    32.21
      + ID2= 2 (  0006):     1.25   0.114     2.50    31.78
        =====================================================
```

```
      ID = 1 (  0011):     5.81   0.701     2.33    32.12

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0002)|   Area    (ha)=   5.51
|ID= 1 DT= 5.0 min |   Total Imp(%)=  49.00   Dir. Conn.(%)=  39.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
   Surface Area     (ha)=        2.70         2.81
   Dep. Storage     (mm)=        1.00         1.50
   Average Slope     (%)=        1.00         2.00
   Length            (m)=      191.66        40.00
   Mannings n           =       0.013        0.250

       NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN | TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |  hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.00 | 1.667    9.71 | 3.250   10.01 | 4.83    4.85
               0.167    2.99 | 1.750   10.90 | 3.333    9.39 | 4.92    4.67
               0.250    3.92 | 1.833   12.39 | 3.417    8.90 | 5.00    4.67
               0.333    4.04 | 1.917   14.44 | 3.500    8.41 | 5.08    4.67
               0.417    4.10 | 2.000   17.42 | 3.583    8.09 | 5.17    4.41
               0.500    4.35 | 2.083   24.90 | 3.667    7.59 | 5.25    4.35
               0.583    4.67 | 2.167   46.31 | 3.750    7.28 | 5.33    4.23
               0.667    4.67 | 2.250  156.60 | 3.833    7.04 | 5.42    4.04
               0.750    4.85 | 2.333  160.58 | 3.917    6.79 | 5.50    4.04
               0.833    5.10 | 2.417   56.14 | 4.000    6.53 | 5.58    4.04
               0.917    5.36 | 2.500   34.23 | 4.083    6.22 | 5.67    4.04
               1.000    5.62 | 2.583   24.90 | 4.167    5.98 | 5.75    3.86
               1.083    5.92 | 2.667   20.66 | 4.250    5.92 | 5.83    3.74
               1.167    6.16 | 2.750   17.73 | 4.333    5.80 | 5.92    3.74
               1.250    6.60 | 2.833   15.62 | 4.417    5.55 | 6.00    3.74
               1.333    7.09 | 2.917   14.00 | 4.500    5.29 | 6.08    3.74
               1.417    7.59 | 3.000   12.75 | 4.583    5.29 |
               1.500    8.09 | 3.083   11.52 | 4.667    5.03 |
               1.583    8.71 | 3.167   10.76 | 4.750    4.97 |

   Max.Eff.Inten.(mm/hr)=     160.58        29.77
              over (min)        5.00        15.00
   Storage Coeff.  (min)=       3.12 (ii)   14.58 (ii)
   Unit Hyd. Tpeak (min)=       5.00        15.00
   Unit Hyd. peak  (cms)=       0.27         0.08
                                                         *TOTALS*
   PEAK FLOW       (cms)=       0.93         0.15          1.029 (iii)
   TIME TO PEAK    (hrs)=       2.33         2.50           2.33
```

```
     RUNOFF VOLUME    (mm)=      79.69        15.89          40.77
     TOTAL RAINFALL   (mm)=      80.69        80.69          80.69
     RUNOFF COEFFICIENT   =       0.99         0.20           0.51

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) PROPORTIONAL LOSS FACTOR APPLIED TO RAINFALL:
            CIMP = 1.00    CPER = 0.20
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB             |
| STANDHYD (  0003)|   Area    (ha)=   5.56
|ID= 1 DT= 5.0 min |   Total Imp(%)=  66.00   Dir. Conn.(%)=  56.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.67         1.89
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     192.53        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.00	1.667	9.71	3.250	10.01	4.83	4.85
0.167	2.99	1.750	10.90	3.333	9.39	4.92	4.67
0.250	3.92	1.833	12.39	3.417	8.90	5.00	4.67
0.333	4.04	1.917	14.44	3.500	8.41	5.08	4.67
0.417	4.10	2.000	17.42	3.583	8.09	5.17	4.41
0.500	4.35	2.083	24.90	3.667	7.59	5.25	4.35
0.583	4.67	2.167	46.31	3.750	7.28	5.33	4.23
0.667	4.67	2.250	156.60	3.833	7.04	5.42	4.04
0.750	4.85	2.333	160.58	3.917	6.79	5.50	4.04
0.833	5.10	2.417	56.14	4.000	6.53	5.58	4.04
0.917	5.36	2.500	34.23	4.083	6.22	5.67	4.04
1.000	5.62	2.583	24.90	4.167	5.98	5.75	3.86
1.083	5.92	2.667	20.66	4.250	5.92	5.83	3.74
1.167	6.16	2.750	17.73	4.333	5.80	5.92	3.74
1.250	6.60	2.833	15.62	4.417	5.55	6.00	3.74
1.333	7.09	2.917	14.00	4.500	5.29	6.08	3.74
1.417	7.59	3.000	12.75	4.583	5.29		
1.500	8.09	3.083	11.52	4.667	5.03		
1.583	8.71	3.167	10.76	4.750	4.97		

```
     Max.Eff.Inten.(mm/hr)=     160.58        41.05
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.13 (ii)    7.91 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.27         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.34         0.15         1.482 (iii)
     TIME TO PEAK    (hrs)=       2.33         2.42          2.33
     RUNOFF VOLUME    (mm)=      79.69        15.91         51.62
     TOTAL RAINFALL   (mm)=      80.69        80.69         80.69
     RUNOFF COEFFICIENT   =       0.99         0.20          0.64

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) PROPORTIONAL LOSS FACTOR APPLIED TO RAINFALL:
            CIMP = 1.00    CPER = 0.20
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0007)|   Area    (ha)=   1.51
|ID= 1 DT= 5.0 min |   Total Imp(%)=  66.00   Dir. Conn.(%)=  66.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00         0.51
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     100.33        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.00 | 1.667    9.71 | 3.250   10.01 |  4.83    4.85
                0.167    2.99 | 1.750   10.90 | 3.333    9.39 |  4.92    4.67
                0.250    3.92 | 1.833   12.39 | 3.417    8.90 |  5.00    4.67
                0.333    4.04 | 1.917   14.44 | 3.500    8.41 |  5.08    4.67
                0.417    4.10 | 2.000   17.42 | 3.583    8.09 |  5.17    4.41
                0.500    4.35 | 2.083   24.90 | 3.667    7.59 |  5.25    4.35
                0.583    4.67 | 2.167   46.31 | 3.750    7.28 |  5.33    4.23
                0.667    4.67 | 2.250  156.60 | 3.833    7.04 |  5.42    4.04
                0.750    4.85 | 2.333  160.58 | 3.917    6.79 |  5.50    4.04
                0.833    5.10 | 2.417   56.14 | 4.000    6.53 |  5.58    4.04
```

```
               0.917    5.36 | 2.500   34.23 | 4.083    6.22 |  5.67    4.04
               1.000    5.62 | 2.583   24.90 | 4.167    5.98 |  5.75    3.86
               1.083    5.92 | 2.667   20.66 | 4.250    5.92 |  5.83    3.74
               1.167    6.16 | 2.750   17.73 | 4.333    5.80 |  5.92    3.74
               1.250    6.60 | 2.833   15.62 | 4.417    5.55 |  6.00    3.74
               1.333    7.09 | 2.917   14.00 | 4.500    5.29 |  6.08    3.74
               1.417    7.59 | 3.000   12.75 | 4.583    5.29 |
               1.500    8.09 | 3.083   11.52 | 4.667    5.03 |
               1.583    8.71 | 3.167   10.76 | 4.750    4.97 |

     Max.Eff.Inten.(mm/hr)=     160.58         0.00
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.12 (ii)    6.60 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.31         0.14
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.44         0.00         0.441 (iii)
     TIME TO PEAK    (hrs)=       2.33         0.00          2.33
     RUNOFF VOLUME    (mm)=      79.69         0.00         52.59
     TOTAL RAINFALL   (mm)=      80.69        80.69         80.69
     RUNOFF COEFFICIENT   =       0.99         0.00          0.65

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING: THE PERVIOUS AREA HAS NO FLOW .

       (i) PROPORTIONAL LOSS FACTOR APPLIED TO RAINFALL:
            CIMP = 1.00    CPER = 0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0009)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0002):     5.51   1.029     2.33    40.77
      + ID2= 2 (  0003):     5.56   1.482     2.33    51.62
        ===================================================
        ID = 3 (  0009):    11.07   2.511     2.33    46.22

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0009)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0009):    11.07   2.511     2.33    46.22
```

```
      + ID2= 2 (  0007):     1.51   0.441     2.33    52.59
        ====================================================
        ID = 1 (  0009):    12.58   2.951     2.33    46.99

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0008)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.6891      0.1255
                          0.0044     0.0093   |   0.9249      0.1431
                          0.0264     0.0209   |   1.1781      0.1613
                          0.0373     0.0334   |   1.4454      0.1801
                          0.0457     0.0467   |   1.7240      0.1995
                          0.0528     0.0609   |   2.0118      0.2195
                          0.1393     0.0761   |   2.3068      0.2400
                          0.2885     0.0920   |   2.6071      0.2612
                          0.4750     0.1085   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0009)     12.580      2.951      2.33      46.99
   OUTFLOW: ID= 1 (  0008)     12.580      1.690      2.42      46.94

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 57.28
                   TIME SHIFT OF PEAK FLOW        (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1987

-------------------------------------------------------------------------------


  -------------------------
  | Junction Command(0012) |
  -------------------------

                           AREA     QPEAK   TPEAK     R.V.
                           (ha)     (cms)    (hrs)    (mm)
  INFLOW : ID= 1(  0008)   12.58     1.69    2.42    46.94
  OUTFLOW: ID= 2(  0012)   12.58     1.69    2.42    46.94

  -------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0010)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     3.63   0.268     2.50    29.32
      + ID2= 2 (  0011):     5.81   0.701     2.33    32.12
        ====================================================
```

```
        ID = 3 (  0010):     9.44   0.855     2.33    31.04

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0010)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0010):     9.44   0.855     2.33    31.04
      + ID2= 2 (  0012):    12.58   1.690     2.42    46.94
        ====================================================
        ID = 1 (  0010):    22.02   2.418     2.42    40.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
```

Appendix F:

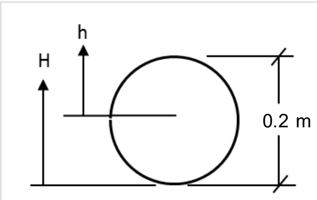
Stage-Storage-Discharge for Revised Wet Pond

Active Storage Calculations

Full Storage Elevation (m)	**106**	
Depth of Active Storage (m)	**1.6**	
Bottom of Active Storage (m)	**104.4**	
Active Volume (cu.m)	**2,612**	*(approx)*

Select Storage Value Method User Defined

Select Stage Increment (m) 0.1
(not less than 0.01 m)



Outlet 1			Outlet 2			Outlet 3		
Use Outet 1 ?	Yes		**Use Outlet 2 ?**	Yes		**Use Outlet 3 ?**	Yes	
Orifice			**Sharp Crested Weir**			**Broad Crested Weir**		
Formula			Formula			Formula		
$Q = CA_o(2gh)^{0.5}$			Q = 1.84LH^(3/2)			Q = 1.67LH13/2		
Invert =	104.40	m	**Invert =**	104.90	m	**Invert =**	106.00	m
Coeff =	0.60		**Coeff =**	0.60		**Length**	11.0	m
Orifice Dia =	0.20	m	**Length =**	1.400	m			
Circular?	Yes	*(Select Yes or No)*	*End Contractions: Reduces L by 0.2H*			*(No End Contractions)*		
Area =	0.031	m^2						
Obvert =	104.60	m						

Elevation	Length	Width	Incr Vol	Cum vol	Low Flow Outlet (Orifice) Weir (H)	Head (h)	Flow (Q)	Sharp Crested Weir Head (H)	Head (h)	Flow (Q)	Emergency Spillway Head (H)	Flow (Q)	Total Discharge
m	m	m	m3	m3	m	m	cms	m	m	cms	m	cms	cms
104.4				0	0.000	-0.100	0.000	0.000	-0.700	0.000	0.000	0.000	0.0000
104.5				93.3	0.100	0.000	0.004	0.000	-0.700	0.000	0.000	0.000	0.0044
104.6				209.2	0.200	0.100	0.026	0.000	-0.700	0.000	0.000	0.000	0.0264
104.7				333.7	0.300	0.200	0.037	0.000	-0.700	0.000	0.000	0.000	0.0373
104.8				467.1	0.400	0.300	0.046	0.000	-0.700	0.000	0.000	0.000	0.0457
104.9				609.5	0.500	0.400	0.053	0.000	-0.700	0.000	0.000	0.000	0.0528
105				761.1	0.600	0.500	0.059	0.100	-0.600	0.080	0.000	0.000	0.1393
105.1				920.1	0.700	0.600	0.065	0.200	-0.500	0.224	0.000	0.000	0.2885
105.2				1,084.7	0.800	0.700	0.070	0.300	-0.400	0.405	0.000	0.000	0.4750
105.3				1,255.1	0.900	0.800	0.075	0.400	-0.300	0.614	0.000	0.000	0.6891
105.4				1,431.2	1.000	0.900	0.079	0.500	-0.200	0.846	0.000	0.000	0.9249
105.5				1,613.2	1.100	1.000	0.083	0.600	-0.100	1.095	0.000	0.000	1.1781
105.6				1,801.0	1.200	1.100	0.088	0.700	0.000	1.358	0.000	0.000	1.4454
105.7				1,994.8	1.300	1.200	0.091	0.800	0.100	1.633	0.000	0.000	1.7240
105.8				2,194.6	1.400	1.300	0.095	0.900	0.200	1.917	0.000	0.000	2.0118
105.9				2,400.4	1.500	1.400	0.099	1.000	0.300	2.208	0.000	0.000	2.3068
106				2,612.3	1.600	1.500	0.102	1.100	0.400	2.505	0.000	0.000	2.6071
106.1				2,612	1.700	1.600	0.106	1.200	0.500	2.806	0.100	0.581	3.4923
106.2				2,612	1.800	1.700	0.109	1.300	0.600	3.109	0.200	1.643	4.8610
106.3				2,612	1.900	1.800	0.112	1.400	0.700	3.414	0.300	3.018	6.5442