FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

SHADOW CREEK SUBDIVISION
LIV COMMUNITIES

TOWNSHIP OF SEVERN

PREPARED BY:

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1.0 INTRODUCTION

CF Crozier & Associates Inc. (Crozier) was retained by LIV Communities (LIV) to complete a Functional Servicing and Stormwater Management Report to support a Draft Plan of Subdivision Application for a proposed residential development in the Township of Severn (Township). The proposed development is referred to as Shadow Creek and will herein be referred to as the Subject Development/Subject Lands. Shadow Creek is located in the West Shore region of the Township.

The Subject Lands are approximately 45.5 ha and are bounded by existing commercial establishments to the north, Menoke Beach Road to the south, Amigo Drive, Shadow Creek and an existing residential development to the east and Highway 11 to the West. Refer to **Figure 1** for the Site Location Plan and **Figure 2** for the Draft Plan (MHBC, January 2022).

The Subject Development, per the attached Draft Plan, consists of low density single detached houses and medium density townhouse units. The residential areas will be private developments. The Concept Plan also includes 20.0 m public Right-Of-Way (ROW) allowances, two stormwater management (SWM) facilities, a Sewage Pumping Station (SPS), open space areas, a waterfront access block and a tributary to Shadow Creek.

Based on the aforementioned unit distribution, the Draft Plan is comprised of 319 low-density units and 215 townhouse units, for a total of 534 units. The proposed servicing and stormwater management strategy outlined herein is predicated on the current Draft Plan.

LIV has assembled a multi-disciplinary team which includes MHBC (Planning), Azimuth Environmental Consulting Inc. (Azimuth) (Environmental and Hydrogeological), Soil-Mat Engineers & Consultants Ltd. (Soil-Mat) (Geotechnical), C.F. Crozier & Associates (Civil and Transportation Engineering). These consultants have prepared studies/plans to support the planning application. This report prepared by Crozier should be read in conjunction with the work of the other team members.

This Functional Servicing and Preliminary Stormwater Management Report has been prepared to outline the proposed servicing, grading and stormwater management strategy for the Subject Lands.

2.0 BACKGROUND

The Subject Lands are located in the West Shore region of the Township of Severn. They are currently designated as "Settlement Living Area" in the Township of Severn's Official Plan (September 2010) and zoned "Rural" and "Environmental Protection" in the Township of Severn's Zoning By-Law.

The following report has been based on pre-consultation meetings and discussions as well as review of existing servicing and infrastructure material acquired from the Township of Severn. In addition, several documents/plans were reviewed in the course of this engineering assessment. They include:

- As-Constructed Plan and Profile Road Drawings (RG Robinson and Associates Ltd., February 2002)
- Township of Severn Engineering Design Criteria (Tatham Engineering, May 2014)
- Cumberland Beach Functional Servicing Report (Tatham Engineering, October 2017)
- Wastewater Treatment and Collection System West Shore 2020 Annual Report (Township of Severn, 2020)
- Water Supply and Distribution System West Shore 2020 Summary Report (Township of Severn, 2020)
- Preliminary Geotechnical Investigation (Soil-Mat, May 2021)
- Township of Severn 2020 Uncommitted Capacity Report (Tatham Engineering, August 2021)
- Environmental Impact Study – Shadow Creek Subdivision (Azimuth, January 2022)
- Preliminary Hydrogeological Assessment (Azimuth, January 2022)

3.0 SITE DESCRIPTION

The Subject Lands are currently characterized by existing residential and farm buildings, agricultural lands, treed areas, wetlands and five tributaries to Shadow Creek. Each tributary conveys external drainage through the Subject Lands, generally from west to east, and ultimately drain to Lake Couchiching. Each onsite tributary will herein be referred to as Tributary #1 – Tributary #5, from north to south. There is an additional tributary south of the Subject Lands that also drains to Lake Couchiching and will be referred to as Tributary #6.

The existing soil is comprised of Tioga Loamy Sand, Alliston Sandy Loam, and Lovering Silty Clay Loam which are classified as Hydrologic Group A, B and C, respectively (Soil Survey Complex, 2019).

A topographical survey was completed for the Subject Lands which is referenced within the provided figures. The site generally slopes from west to east, with average onsite grades in the order of 1-2%.

A geotechnical investigation was completed for the proposed development by Soil-Mat in May 2021. A total of nine boreholes and four monitoring wells were advanced across the Subject Lands as part of the geotechnical investigation. These boreholes revealed that the site is underlain by silt, sandy silt and clayey silt. The geotechnical investigation has been provided in **Appendix A**.

A hydrogeological investigation was also completed for the proposed development by Azimuth in January 2022. As part of the hydrogeological investigation, groundwater levels were monitored within each of the four monitoring wells installed on the Subject Lands. Within the monitoring wells, groundwater was encountered at depths ranging between 0.1 to 1.5 m below ground surface. Please refer to the Preliminary Hydrogeological Assessment (Azimuth, January 2022), submitted under separate cover, for additional details.

4.0 TRANSPORTATION

Access to the Subject Development will be provided via two connections to Menoke Beach Road. There are 11 streets proposed throughout the Subject Development (Street A – K). All streets will have a 20.0 m public ROW width and be constructed according to Township design standards. Please refer to the Traffic Impact Study (Crozier, January 2022), submitted under separate cover, which identifies future operating conditions of the boundary road network surrounding the development.

5.0 GRADING

The site grading will be influenced by the existing and proposed drainage systems within the Subject Development. Grading will tie into the existing elevations along the property limits, match the pre-development overland stormwater flow patterns where possible and provide sufficient cover for the proposed water, sanitary and storm servicing.
The road network will have slopes at or greater than 0.5% and less than 8.0%, in accordance with Township Standards. Grading of roadways will be completed to ensure no flooding of private property, nor will flow depths greater than 0.30 m occur during the 100-year storm event to ensure that safe access and egress is provided.

Drainage will be directed away from adjacent land as much as practical using interceptor swales and drainage infrastructure. Detailed design of this drainage infrastructure, including lot grading and supporting SWM modelling, will be completed at the detailed design stage to secure approval for construction. Where proposed grading blocks passage of external drainage, flows will be captured and conveyed through the Subject Development to a feasible outlet. Refer to Section 8.0 for further details.

Please refer to **Figure 3** for the Preliminary Site Grading Plan.

6.0 SANITARY SERVICING

6.1 Existing Sanitary System Infrastructure

Sanitary servicing in the West Shore region is provided by way of the Township of Severn West Shore Wastewater Treatment Plant (WWTP) located at 3333 New Brailey Line. Wastewater is conveyed to the WWTP by a series of sanitary sewers and forcemains that collect wastewater from the Township. Per the Township's 2020 Uncommitted Capacity Report, the West Shore WWTP is currently operating at 48% of its rated wastewater capacity, however it will need to be expanded to accommodate the forecasted growth for the West Shore region (Tatham Engineering, August 2021). Through discussions with the Township, it is understood that an expansion of the West Shore WWTP is currently being considered to accommodate this growth.

Per the Township's 2020 Uncommitted Capacity Report, there are nine SPS's that service the existing residential units in the West Shore region and ultimately discharge to the West Shore WWTP. The closest four SPS facilities to the Subject Development are on Bayou Road (two locations), Timberline Avenue and Wood Avenue.

6.2 Proposed Sanitary Servicing Strategy

6.2.1 Internal Sanitary Servicing Strategy

The proposed sanitary servicing solution for the Subject Development will be to construct a permanent SPS in the southeast portion of the site (shown as Block 47 on the Draft Plan). The permanent SPS will herein be referred to as the Shadow Creek SPS. The Shadow Creek SPS will receive flows from the Subject Development by a series of gravity sewers. Sanitary sewers will be designed and constructed in accordance with Township design standards, at a size and depth sufficient to service each lot and building. The preliminary internal sanitary sewer layout is presented in **Figure 4.** Refer to Section 6.2.2 for additional details regarding the external sanitary servicing strategy.

General design criteria for the proposed Shadow Creek SPS are provided in **Table 1**. Further details regarding the Shadow Creek SPS will be provided at detailed design.

Table 1: Shadow Creek SPS High Level Design Criteria

Pumping Station Design
• Submersible Pumping Station configuration • 2.4 m - 3.0 m diameter FRP or precast concrete wet well • 2-3 pump configuration (1-2 duty pumps and 1 standby pump) depending on phasing of development and cost implications related to pump motor sizing • Pump sizes between 7.5 hp - 20 hp • Comminutor to eliminate large inorganic debris • Single 150 mm – 200 mm diameter forcemain depending on phasing of development and potentially issues related to security of supply • Variable Frequency Drives to drive pump motors • Requires 575 V/3 Phase/60 Hz power supply • Emergency Storage - likely requiring 1 hour of storage at peak flows (total volume provided within upstream collection system and in wet well/emergency storage tank at station) • Odour control requirement due to proximity of residential development and potentially to mitigate H_2S and methane gas formation • Outdoor Standby Generator set requirement (Approximately 50 kW Generator Set) with weatherproof/sound attenuating enclosure • The approximate 2.4 km forcemain will require Surge Relief Valve(s) to mitigate hydraulic transient pressures • Estimated site footprint (0.1 ha) to house wet well, pad-mounted control panel, standby generator set, odour control unit and access roadway/parking

Preliminary sanitary flows for the site were estimated in conjunction with Township standards and the W21-032 Uncommitted Capacity Report. Applicable design criteria have been summarized in **Table 2**.

Table 2: Sanitary Design Criteria

Criteria	Value
Average Flow Rate (L/cap/day)[1]	253
Infiltration (L/s/ha)	0.23
Peaking Factor (Harmon Formula)	3.69
Residential Density (PPU)	2.7

[1] *Average flow rate is from the Township of Severn Uncommitted Capacity Report and is derived from 5 years of historical flows*

Based on above criteria and the proposed unit totals, it is estimated that peak sanitary flow from the Subject Development is 22.1 L/s. Refer to **Appendix B** for sanitary flow calculations and relevant design brief excerpts.

6.2.2 External Sanitary Servicing Strategy

Two options were analyzed to determine the optimal external servicing strategy for the Subject Development. Below is a description of each option.

Option 1: Connection to Existing SPS on Bayou Rd.

Option 1 consists of extending a forcemain north from the Shadow Creek SPS, through the Subject Development and the existing commercial areas and along Grand Tamarack Crescent to Bayou Road. The forcemain would then discharge to the existing SPS located on Bayou Road, south of Highway 11, which discharges directly to the West Shore WWTP. Further information regarding the Bayou Road SPS is required to assess its capacity and to determine if upgrades are needed to support this option.

Option 2: Direct Connection to West Shore WWTP

Option 2 consists of the same forcemain route as Option 1, but the forcemain would bypass the Bayou Road SPS, continue under Highway 11 and discharge directly to the West Shore WWTP. This option would require coordination with the Ministry of Transportation (MTO), an increased length of forcemain and would potentially warrant the jack and bore procedure to extend the forcemain under Highway 11.

Proposed External Sanitary Servicing Solution

Option 1 is the preferred external sanitary servicing solution for the Subject Development because it avoids crossing a MTO controlled highway. A further review of Option 1 and the capacity of the Bayou Road SPS will be completed when additional information is received regarding the Bayou Road SPS.

The preliminary external sanitary sewer layout is presented in **Figure 5.**

7.0 WATER SERVICING

7.1 Existing Water Infrastructure

Domestic water in the West Shore region is provided by way of the West Shore Water Treatment Plant (WTP) which is located at 3333 New Brailey Line. Water is distributed through the municipal drinking water system to service the West Shore region from the WTP. Per the Township's 2020 Uncommitted Capacity Report, the West Shore WTP is currently operating at 37% of its rated drinking water capacity (Tatham Engineering, August 2021).

There is an existing 200 mm diameter watermain on Amigo Drive and a 200 mm diameter watermain on Grand Tamarack Crescent that services the existing residential developments in these areas (RG Robinson and Associates Ltd., February 2002).

7.2 Proposed Water Servicing Strategy

The proposed water servicing solution for the Subject Development will be to connect to the existing 200 mm watermain on Amigo Drive and 200 mm diameter watermain on Grand Tamarack Crescent. Watermain internal to the Subject Development will follow the alignment of the road network complete with individual service connections for each lot and building. Fire hydrants will be spaced as required to provide the necessary fire protection and to meet municipal standards. The watermain will also be looped. The preliminary internal water distribution layout has been shown in **Figure 4** and the external water distribution layout has been shown in **Figure 5**.

Preliminary water demands for the Subject Development have been estimated in conjunction with Township standards that concur with Table 3-1 of the Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems. Applicable design criteria have been summarized in **Table 3** below.

Table 3: Watermain Design Criteria

Criteria	Standard
Average Flow Rate (L/cap/day)	450
Maximum Day/Peak Hour	2.5/4.5
Residential Density (PPU)	2.7

The following water demands have been calculated for the Subject Development per the Township of Severn standards identified above:

- Average Daily Flow Rate – 7.5 L/s
- Max Daily Flow Rate – 18.8 L/s
- Peak Hour Flow Rate – 33.8 L/s

Refer to **Appendix C** for the water demand calculations.

Fire Flow Estimates

Per municipal requirements the Water Supply for Fire Protection, A Guide to Recommend Practice (Fire Underwriters Survey (FUS), 1999) was used to estimate fire flows for the Subject Development. The required fire flow to service subdivision is approximately 100 L/s.

Estimated flows are based on building floor area, construction type and structure exposure distance. Fire flow calculations have been provided in **Appendix C**. If required, fire hydrant testing will be completed to confirm that fire flows can be sufficiently accommodated.

8.0 STORMWATER MANAGEMENT

Stormwater Management Design Criteria

With regards to the proposed development, stormwater management and drainage conditions must comply with the policies and standards of:

- The Township of Severn
- The Ministry of the Environment, Conservation and Parks (MECP)

A stormwater management strategy and accompanying recommendations regarding the proposed development have been included below:

- Water Quality Control
    - "Enhanced Protection" given Shadow Creek as the ultimate receiver.

- Water Quantity Control
    - Control of the post development peak flows to pre-development levels for all storms up to and including the 100-year at the selected point of interest.

- Erosion Control
    - Use of extended detention of the 25 mm event for 48 hours to respect natural geomorphic characteristics of receiving watercourse.

- Development Standard
  - Urban road cross section;
  - Lot grading at 2% optimum; and,
  - Minor and major drainage systems to convey frequent and infrequent rainfall/runoff events, respectively.

- External Drainage Management
  - An external drainage area of approximately 162.2 ha is conveyed across the site under existing conditions. The stormwater management strategy for the Subject Development must accommodate these external flows to ensure safe conveyance.

8.1 Existing Drainage Conditions

The Subject Lands are currently characterized by agricultural lands, treed areas and wetlands. As previously noted, there are also five tributaries to Shadow Creek on the Subject Lands that flow from west to east. Based on the existing contours, the majority of the Subject Lands currently drain to one of these five tributaries. The Subject Lands also accepts and conveys approximately 162.2 ha of external drainage from the west, which drains through the Subject Lands via the five tributaries.

To facilitate the pre-development stormwater analysis, the following 16 catchments have been discretized based on the existing drainage conditions.

- **Catchment PRE-1:** This catchment area is approximately 0.5 ha and is located in the northern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the east property line.

- **Catchment PRE-2:** This catchment area is approximately 3.4 ha and is located in the northern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the Tributary #1.

- **Catchment PRE-3:** This catchment area is approximately 4.8 ha and is located in the northern portion of the site. It consists of agricultural, wooded and wetland areas, as well as existing residential and farm buildings. Stormwater from this catchment drains to the east property line.

- **Catchment PRE-4:** This catchment area is approximately 4.6 ha and is located in the northern portion of the site. It consists of agricultural, wooded and wetland areas, as well as existing residential and farm buildings. Stormwater from this catchment drains to the Tributary #2.

- **Catchment PRE-5:** This catchment area is approximately 8.0 ha and is located in the northern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the east property line.

- **Catchment PRE-6:** This catchment area is approximately 8.6 ha and is located in the northern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the Tributary #3.

- **Catchment PRE-7:** This catchment area is approximately 1.8 ha and is located in the southern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the east property line.

- **Catchment PRE-8:** This catchment area is approximately 2.2 ha and is located in the southern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the east property line.

- **Catchment PRE-9:** This catchment area is approximately 4.5 ha and is located in the southern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the Tributary #4.

- **Catchment PRE-10:** This catchment area is approximately 4.3 ha and is located in the southern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the Tributary #5.

- **Catchment PRE-11:** This catchment area is approximately 1.1 ha and is located in the southern portion of the site. It consists of agricultural, wooded and wetland areas. Stormwater from this catchment drains to the south property line.

- **Catchment EXT-1:** This catchment area is approximately 51.3 ha and represents external drainage area along the west of the Subject Lands. It consists mainly of agricultural and wooded areas. Stormwater from this catchment drains east to Tributary #1.

- **Catchment EXT-2:** This catchment area is approximately 42.3 ha and represents external drainage area along the west of the Subject Lands. It consists mainly of agricultural and wooded areas. Stormwater from this catchment drains east to Tributary #2.

- **Catchment EXT-3:** This catchment area is approximately 41.6 ha and represents external drainage area along the west of the Subject Lands. It consists mainly of agricultural and wooded areas. Stormwater from this catchment drains east to Tributary #3.

- **Catchment EXT-4:** This catchment area is approximately 9.8 ha and represents external drainage area along the west of the Subject Lands. It consists mainly of agricultural, wooded and wetlands areas. Stormwater from this catchment drains east to Tributary #4.

- **Catchment EXT-5:** This catchment area is approximately 17.2 ha and represents external drainage area along the west of the Subject Lands. It consists mainly of agricultural, wooded and wetlands areas. Stormwater from this catchment drains east to Tributary #5.

The pre-development drainage conditions have been presented in **Figure 6**.

8.2 Proposed Drainage Conditions

The proposed development will be constructed to a fully urbanized system complete with curb and gutter and storm sewers. The minor drainage system will consist of storm sewers and catchbasins sized to convey to the 5-year design storm event, per Township standards. The major drainage system will provide overland flow routes within the road allowance. The post-development drainage conditions have been presented in **Figure 7**. The preliminary storm servicing layout is presented in **Figure 8**.

In post-development conditions Tributary #3 will remain and bisect the Subject Development. Tributary #2, #4 and #5 will be removed, but the external drainage each tributary conveys in pre-development conditions will be conveyed through the Subject Development via storm sewers in post-development conditions. Refer to Section 8.6 for further details on the external drainage management.

In order to meet the SWM criteria, the minor and major storm flows will be conveyed to two SWM Facilities located along the east property line of the Subject Development on the north and south side of Tributary #3. The north and south SWM Facilities will be referred to as SWM Facility #1 and SWM Facility #2, respectively. The flows will be treated and controlled by the SWM Facilities prior to being released. SWM Facility #1 will outlet to Shadow Creek and SWM Facility #2 will outlet to Tributary #3.

Preliminary site grading and storm sewer routing have been completed to ensure that the provided minor and major storm drainage systems to the SWM Facilities are feasible. The outlet location and storm sewer sizing will be confirmed at the detailed design stage.

To facilitate the post-development stormwater analysis, the following 15 catchments have been discretized based on the proposed drainage conditions.

- **Catchment POST-1:** This catchment area is approximately 17.7 ha and consists of the northern portion of the proposed developed area of the Subject Lands. It consists of single-detached and townhouse residential areas, roads and open areas. Runoff from this catchment will be conveyed to SWM Facility #1 via storm sewers and overland flow routes.

- **Catchment POST-2:** This catchment area is approximately 10.7 ha and consists of the southern portion of the proposed developed area of the Subject Lands. It consists of single-detached and townhouse residential areas, roads, open areas and the Shadow Creek SPS. Runoff from this catchment will be conveyed to SWM Facility #2 via storm sewers and overland flow routes.

- **Catchment POST-3:** This catchment area is approximately 2.9 ha and consists of wooded and wetland areas. Stormwater from this catchment will drain east to Shadow Creek.

- **Catchment POST-4:** This catchment area is approximately 0.6 ha and consists of a portion of Tributary #3. Runoff from this catchment will be conveyed within the Tributary #3.

- **Catchment POST-5:** This catchment area is approximately 0.1 ha and consists of a portion of Tributary #3. Runoff from this catchment will be conveyed within Tributary #3.

- **Catchment POST-6:** This catchment area is approximately 2.3 ha and consists of a portion of Tributary #3. Runoff from this catchment will be conveyed within Tributary #3.

- **Catchment POST-7:** This catchment area is approximately 0.2 ha and consists of the waterfront access. Runoff from this catchment will drain east to Shadow Creek.

- **Catchment POST-8:** This catchment area is approximately 6.3 ha and consists of a portion of Tributary #3, wooded and wetland areas. Stormwater from this catchment will be conveyed within Tributary #3 and drain to Shadow Creek.

- **SWMF #1:** This catchment represents the proposed northern SWM Facility block. Runoff from this catchment will be directed to the SWM Facility. The SWM Facility will outlet to Shadow Creek.

- **SWMF #2:** This catchment represents the proposed southern SWM Facility block. Runoff from this catchment will be directed to the SWM Facility. The SWM Facility will outlet to Tributary #3.

- **Catchment EXT-1:** This catchment area is approximately 51.3 ha and represents the external drainage area along the west of the Subject Lands. It consists mainly of agricultural and wooded areas. Stormwater from this catchment drains east to Tributary #1.

- **Catchment EXT-2:** This catchment area is approximately 42.3 ha and represents the external drainage area along the west of the Subject Lands. It consists mainly of agricultural and wooded areas. Stormwater from this catchment drains east to Tributary #2.

- **Catchment EXT-3:** This catchment area is approximately 41.6 ha and represents the external drainage area along the west of the Subject Lands. It consists mainly of agricultural and wooded areas. Stormwater from this catchment drains east to Tributary #3.

- **Catchment EXT-4:** This catchment area is approximately 9.8 ha and represents the external drainage area along the west of the Subject Lands. It consists mainly of agricultural, wooded and wetlands areas. Stormwater from this catchment drains east to Tributary #4.

- **Catchment EXT-5:** This catchment area is approximately 17.2 ha and represents the external drainage area along the west of the Subject Lands. It consists mainly of agricultural, wooded and wetlands areas. Stormwater from this catchment drains east to Tributary #5.

The post-development drainage conditions and catchment areas have been presented in the **Figure 7.**

8.3 Hydrologic Analysis

Hydrologic modelling was prepared for the pre-development and post-development scenarios using the stormwater management hydrologic computer program Visual OTTHYMO 6.1 (VO). The purpose of the modelling was to determine the detention storage volumes and corresponding SWM block sizing required for the Subject Lands to ensure post-development peak flow rates do not exceed the pre-development target flows (i.e., quantity control).

In order to accurately assess the peak flows from the individual catchments, the NASHYD command in VO was used to model rural conditions, whereas the STANHYD command was used to model urban development conditions. 2, 5, 10, 25, 50 and 100-year rainfall was simulated using a four-hour Chicago and 24-hour SCS Type II distribution consistent with municipal design standards.

8.3.1 Pre-Development Model Setup

To establish pre-development flows, the contributing drainage areas to the Subject Lands were first subdivided into internal and external drainage areas. Catchments PRE-1 – PRE-11 consist of the Subject Lands and Catchments EXT-1 – EXT-5 consist of the external drainage area. Refer to **Figure 6** for the Pre-Development Drainage Plan and **Appendix D** for hydrologic parameter sheets.

Table 4 summarizes the pre-development peak flows rates for each tributary obtained from the VO model.

Table 4: Summary of Internal Pre-Development Flow Rates

Return Period (Years)	Pre-Development Flow Rates (m^3/s)		
	Northern Flow Rates (21.3 ha)	Southern Flow Rates (13.9 ha)	Total Site (inc. External Area) (206.1 ha)
4 Hour Chicago			
2	0.14	0.19	0.68
5	0.28	0.39	1.37
10	0.40	0.55	1.94
25	0.57	0.78	2.75
50	0.70	0.96	3.41
100	0.85	1.16	4.14
24 Hour SCS Type II			
2	0.44	0.64	1.99
5	0.77	1.09	3.58
10	1.02	1.41	4.79
25	1.36	1.84	6.47
50	1.62	2.17	7.79
100	1.90	2.51	9.21
Regional (Timmins)	1.62	1.32	10.43

Pre-development VO input and output files have been provided in **Appendix E.**

8.3.2 Post-Development Model Setup

The post-development model was prepared by replacing the pre-development catchments from the pre-development model with the post-development catchments identified in Section 8.2. Catchments EXT-1 – EXT-5 and associated hydrologic parameters from the pre-development model were maintained. Refer to **Figure 7** for the Post-Development Drainage Plan and **Appendix D** for hydrologic parameter sheets.

The proposed SWM Facility #1 will be a SWM hybrid wet pond/wetland located on the northern portion of the development that will provide the required stormwater quantity, quality and erosion controls. It will outlet to Shadow Creek. A preliminary outlet structure has been designed as a multi-stage outlet to address both quality and quantity control requirements. The outlet structure will consist of a 190 mm diameter extended detention orifice positioned at the permanent pool elevation. A weir has been included above the extended detention storage elevation to control effluent from the pond for storms exceeding the 25 mm event. A wetland deck has been provided in the southeast portion of the SWM Facility.

The proposed SWM Facility #1 will be a SWM hybrid wet pond/wetland located on the northern portion of the development that will provide the required stormwater quantity, quality and erosion controls. It will outlet to Tributary #3. A preliminary outlet structure has been designed as a multi-stage outlet to address both quality and quantity control requirements. The outlet structure will consist of a 145 mm diameter extended detention orifice positioned at the permanent pool elevation. A weir has been included above the extended detention storage elevation to control effluent from the pond for storms exceeding the 25 mm event. A wetland deck has been provided in the northwest portion of the SWM Facility.

The wetland areas within each SWM Facility will contribute to the wetland compensation areas for the Subject Development. Please refer to the Environmental Impact Study (Azimuth, January 2022), submitted under separate cover, for additional information.

Under post-development conditions, the majority of the stormwater from the Subject Development is currently proposed to outlet to Shadow Creek and Tributary #3 via the SWM Facilities. However, as identified in the Environmental Impact Study (Azimuth, January 2022), pre-development flow regimes should be maintained to Sites 6 and 7 along the east property line of the Subject Development in post-development conditions to maintain the ecological function of these features. This will be accomplished through techniques that include but are not limited to directing clean roof and rear lot drainage or clean water from the SWM facilities to the wetland areas. Preliminary calculations are summarized in **Table 5** below to show equivalent rooftops required to supplement existing runoff volumes under 25mm storm conditions.

Table 5: Preliminary Runoff Volume Balancing Summary

Feature ID	Contributing Area (ha)	25mm Runoff Volume (m^3)	Equivalent Roof Area (m^2)	Equivalent Roof Count (at 120m^2/Roof)
Site 6	1.81	58.9	2356	20
Site 7	2.15	64.4	2576	21.5

The preliminary runoff volume balancing calculations demonstrate that the runoff from 41.5 single detached units can be directed to Sites 6 and 7 to mimic pre-development runoff volumes tributary to Sites 6 and 7. Equivalent volumes can also be directed to these features from Stormwater Management Facility 2. The techniques and flow controls involved in directing clean water to Sites 6 and 7 will be further evaluated at detailed design. Please refer to the Environmental Impact Study (Azimuth, January 2022), submitted under separate cover, for additional details.

Using the ROUTE RESERVOIR command in VO, the volume of detention storage required to attenuate the post-development peak flows from the site in SWM Facility #1 and #2 to target peak flow levels was determined based on a storage – discharge relationship. The ROUTE RESERVOIR command was used to model the pond storage. To meet quantity control requirements, it was concluded that approximately 9,790 m^3 of active storage is required in SWM Facility #1 and approximately 6,285 m^3 of active storage is required in SWM Facility #2.

The results of the post-development model are summarized in **Table 6** and **Table 7** below.

Table 6: Summary of SWM Facilities Storage Volumes

Return Period (Years)	Storage Volume (m^3)	
	4 Hour Chicago	24 Hour SCS Type II
SWM Facility #1		
2	2711	3992
5	3843	5458
10	4485	6508
25	5281	7850
50	5876	8798
100	6507	9787
SWM Facility #2		
2	1775	2677
5	2566	3592
10	2986	4235
25	3442	5052
50	3792	5655
100	4152	6283

Table 7: Summary of Post-Development Peak Flow Rates

Return Period (Years)	Northern Flow Rates (m^3/s)		Southern Flow Rates (m^3/s)		Total Flow Rates (inc. External Area) (m^3/s)	
	Pre-Development (21.3 ha)	Post-Development (20.9 ha)	Pre-Development (13.9 ha)	Post-Development (13.0 ha)	Pre-Development (206.1 ha)	Post-Development (206.1 ha)
4 Hour Chicago						
2	0.14	0.04	0.19	0.04	0.68	0.59
5	0.28	0.08	0.39	0.05	1.37	1.16
10	0.40	0.12	0.55	0.09	1.94	1.67
25	0.57	0.18	0.78	0.14	2.75	2.42
50	0.70	0.21	0.96	0.17	3.41	3.02
100	0.85	0.25	1.16	0.21	4.14	3.69
24 Hour SCS Type II						
2	0.44	0.09	0.64	0.06	1.99	1.67
5	0.77	0.19	1.09	0.15	3.58	3.12
10	1.02	0.25	1.41	0.22	4.79	4.24
25	1.36	0.37	1.84	0.33	6.47	5.81
50	1.62	0.48	2.17	0.41	7.79	7.07
100	1.90	0.59	2.51	0.49	9.21	8.42
Regional (Timmins)	1.62	0.96	1.32	0.66	10.4	10.0

As evidenced by in **Table 6** and **Table 7**, 'Post-to-Pre' quantity control has been provided for all storm events up to and including the 100-year event. Post-development input and output files have been provided in **Appendix E.** Refer to **Appendix F** for relevant SWM facility calculations.

8.4 Quality and Erosion Control Analysis

Stormwater quality to an Enhanced Protection Level (Stormwater Management and Design Manual, MECP, 2003) and erosion control for the Subject Development will be provided by SWM Facility #1 and #2.

Erosion control will be principally achieved by incorporating the erosion control requirements into the extended detention operation of SWM Facility #1 and #2. Sizing was based on providing 24-hour drawdown of the runoff volume produced during a 25 mm design storm event, per Township requirements.

Water quality control will also be provided by SWM Facility #1 and #2. Based on a contributing drainage area of 17.7 ha, the required water quality volume for SWM Facility 1 is 153 m^3/ha to provide enhanced level of treatment (Stormwater Management and Design Manual, MECP, 2003). This water quality volume consists of 113 m^3/ha for permanent pool and 40 m^3/ha for extended detention. Based on a contributing drainage area of 10.7 ha, the required water quality volume for SWM Facility #2 is 155 m^3/ha to provide enhanced level of treatment (Stormwater Management and Design Manual, MECP, 2003). This water quality volume consists of 115 m^3/ha for permanent pool and 40 m^3/ha for extended detention.

The required and provided water quality volumes for SWM Facility #1 and #2 have been summarized in **Table 8**.

Table 8: SWM Facility #1 and #2 Quality and Erosion Control Characteristics

	Required Volume (m^3)	Provided Volume (m^3)
SWMF #1		
Permanent Pool	1997	6688
MECP Extended Detention	1931	3346
Erosion Control	707	3346
SWMF #2		
Permanent Pool	1232	3184
MECP Extended Detention	1325	1762
Erosion Control	428	1762

8.5 Stormwater Management Facility Operating Characteristics

Considering the water quantity and quality storage requirements, a preliminary design for the SWM Facilities has been completed to demonstrate that the SWM blocks are adequately sized. A preliminary operating profile of the SWM Facilities is presented in **Table 9** below.

Table 9: SWM Facility #1 and #2 Operating Characteristics

Component	Elevation (m)	Storage Required (m^3)	Storage Provided (m^3)
SWMF #1			
Bottom	217.80	--	--
Permanent Pool	219.30	1997	6688
Extended Detention	219.80	1931	3346
100-Year High Water Level	221.10	9787	15247
Top of Berm	221.40	--	18626
SWMF#2			
Bottom	217.87	--	--
Permanent Pool	219.37	1232	3184
Extended Detention	219.87	1325	1762
100-Year High Water Level	221.17	6283	8280
Top of Berm	221.47	--	10129

As evidenced by **Table 9** the SWM Facilities presented herein are sufficiently sized to provide the required stormwater quantity and quality controls. Permits and other regulatory instruments such as an Environmental Compliance Approval (MECP) will be secured at the detailed design stage.

The preliminary design of SWM Facility #1 and #2 have been presented in **Figure 9** and **Figure 10**, respectively.

8.6 External Drainage Management

The Subject Lands currently accepts and conveys 162.2 ha of external drainage under existing conditions. The proposed stormwater management strategy for the site will convey this external drainage to Shadow Creek via storm sewers and Tributary #3.

The 162.2 ha of external drainage area was delineated using ground surface topography. The external drainage was split into five catchments (EXT-1 – EXT-5), as discussed in Section 8.1 and 8.2. Under existing conditions, flow from EXT-1 and EXT-2 drain across the northern portion of the site and flow from EXT-2 – EXT-5 drain across the southern portion of the site to Shadow Creek.

In post-development conditions, flow from EXT-1 will be captured in a storm sewer at the west property line and conveyed to Block 33, where it will outlet to a swale and drain to Shadow Creek. Flows from EXT-2, EXT-4 and EXT-5 will be captured in storm sewers at the west property line and conveyed to Tributary #3. Flow from EXT-3 will enter Tributary #3 at the west property line. The drainage from EXT-2 – EXT-5 will then be conveyed through Tributary #3 and outlet to Shadow Creek.

The Subject Development will require the installation of culverts under the roadways to maintain conveyance of flows within Tributary #3. Each culvert was sized in CulvertMaster to convey the Regional storm event without overtopping the road and were centered on the tributary crossings. A summary of the flows and dimensions required for each culvert can be found in **Table 10**. Refer to **Appendix G** for the CulvertMaster calculations and **Figure 7** for the crossing numbering.

Table 10: External Catchment Flow and Required Culvert Size

Proposed Crossings	Regional Flow (m^3/s)	Minimum Required Culvert Size	Provided Culvert Size	Openness Ratio
#1	4.13	1220 mm x 910 mm	1800 mm x 1200 mm	0.11
#2	3.58	1220 mm x 610 mm	1800 mm x 1200 mm	0.11
#3	5.64	1520 mm x 910 mm	1800 mm x 1200 mm	0.11

The Environmental Impact Study (Azimuth, January 2022) recommends that each crossing include considerations for wildlife passage. As such, each culvert size was increased to meet the openness ratio for small to medium sized wildlife, which can be seen in **Table 10**. Refer to the Environmental Impact Study (Azimuth, January 2022), submitted under separate cover, for additional details on the crossings. It is recommended that a geomorphologist assess the proposed crossing designs to confirm that the designs are supportable from an erosion perspective.

8.7 Floodplain Assessment

A Floodplain Assessment was completed for the tributaries north and south of the Subject Lands to establish the Regulatory floodplain limits for the Subject Lands. The regulatory floodline has been presented in **Figure 11**. Refer to **Appendix H** for additional details regarding the Floodplain Assessment.

9.0 UTILITIES

The development will be serviced with natural gas, telephone, cable TV and hydro. The design of such utilities will be coordinated with the local utility companies servicing the Township. Utilities are proposed to follow the alignment of the internal road network, with individual service connections to each lot.

10.0 EROSION & SEDIMENT CONTROLS

Erosion and sediment controls will be installed prior to the commencement of any earthworks and maintained throughout until the site is stabilized or as directed by the Engineer and/or Township. Controls are to be inspected regularly, after each significant rainfall, and maintained in proper working condition. Erosion and sediment controls measures to be considered include, but are not limited to, the following:

- Silt Fence

Silt fence will be installed where required to intercept sheet flow. Heavy duty silt fence will be located around the perimeter of the work zone limits. It should be noted that additional silt fencing may be added based on field decisions by the Site Engineer and Owner prior to, during and following construction.

- Mud Mat

Mud mat will be installed at the main access point to the site along Menoke Beach Road to reduce the amount of mud tracking onto existing paved roadways during site servicing operations.

- Flow Check Dams

Temporary check dams will be utilized on-site in order to prevent any silt mitigation off site during and after construction activities. These dams will promote settling of suspended solids and will reduce flow velocities. Sediment accumulation will be monitored and removed as necessary.

- Dust Suppression

During earthwork activities, the Contractor will ensure that measures for dust suppression are provided as required, such as the application of water or lime.

11.0 SUMMARY

Based on the foregoing we conclude that the proposed development can be adequately serviced.

1. Access to the site will be provided via two connections to Menoke Beach Road. Municipal roads will be designed in accordance with Township of Severn Standards.

2. The development will be serviced via an internal gravity sanitary sewer system that will outlet to the proposed Shadow Creek SPS. The Shadow Creek SPS will ultimately discharge to the existing SPS on Bayou Road.

3. Internal watermain will follow the alignment of the internal road network complete with all valving, appurtenances and hydrants to meet Township of Severn Standards. The proposed watermain will connect to existing 200 mm diameter watermains on Amigo Drive and Grand Tamarack Crescent, respectively.

4. The Subject Development will be designed with a dual drainage system. Minor storm events will be conveyed within a storm sewer system, which follows the alignment of the internal roadways. The major system will be conveyed overland within the internal road network. Both the major and minor storm systems will outlet to the SWM Facilities.

5. Two SWM facilities are proposed to meet the stormwater quality, quantity and erosion control criteria, as well as wetland compensation benefits. SWM Facility #1 will outlet to Shadow Creek and SWM Facility #2 will outlet to Tributary #3.

6. Stormwater quantity control up to and including the 100-year storm event will be provided to meet the 'post-to-pre' peak flow objectives.

7. Water quality control to an 'enhanced' level of protection will be provided via the SWM Facilities along with 24 hour extended detention of the 25 mm event runoff volume.
8. The SWM facility blocks shown on the Draft Plan are sufficiently sized to meet the SWM objectives.

9. Utilities are available to service the site.

10. Erosion and sediment controls will be specified as to ensure effective prevention and control of sediment from migrating into nearby swales, ditches and watercourses.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

Brittany Robertson, P. Eng.
Manager of Land Development, Associate

C.F. CROZIER & ASSOCIATES INC.

Nicole O'Connor, P. Eng.
Project Engineer

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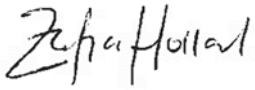

Zofia Holland, E.I.T.
Engineering Intern

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APPENDIX A

Geotechnical Investigation

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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Hamilton: 130 Lancing Drive L8W 3A1 T: 905.318.7440 F: 905.318.7455

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Project No.: SM 301553-G May 14, 2021

LIV COMMUNITIES
1005 SKYVIEW ROAD – SUITE 301
Burlingotn, Ontario
L7P 5B1

Attention: Sam Bedawi, BES, MBA
Land Development Manager

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED SHADOW CREEK RESIDENTIAL DEVELOPMENT
HIGHWAY 11 AND MENOKE BEACH ROAD
TOWNSHIP OF SEVERN, ONTARIO

Dear Mr. Bedawi,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The scope of work was completed in general accordance with our proposal P301553, dated March 12, 2021. Our comments and recommendations based on our findings at the nine [9] borehole locations are presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will involve the construction of a residential development on the property located south west of the intersection of Highway 11 and Menoke Beach Road in the Township of Severn, Ontario. The details of the development have not been established at present but is anticipated to consist of single-family dwellings and townhouse blocks, as well as the installation of associated underground municipal services and a stormwater management pong, along asphalt paved roadways. The purpose of this geotechnical investigation work was to assess the subsurface soil and groundwater conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project

design may void the recommendations given in this report. If significant changes are made to the proposed design, this office must be consulted to review the new design with respect to the results of this investigation. It is noted that the information contained in this report does not reflect upon the environmental aspects of the site.

2. PROCEDURE

A total of nine [9] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment on April 8 and 9, 2021 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD., to termination or practical auger refusal on assumed bedrock at depths of between approximately 2.3 and 11 metres below the existing ground surface.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings. Selected samples were also subjected to laboratory grain size analyses.

Upon completion of drilling, a monitoring well was installed at Borehole Nos. 3, 6, 7, and 9 to allow for the future monitoring of the static groundwater level. The monitoring wells consisted of 50-millimetre PVC pipe, screened in the lower 1.5 to 3.0 metres. The monitoring well was encased in well filter sand up to approximately 0.3 metres above the screened portion, then with bentonite 'hole plug' to the surface and fitted with a protective steel 'stick up' casing. The remaining boreholes were backfilled in general accordance with Ontario Regulation 903, and the ground surface was reinstated even with the surrounding grade.

Additionally, six [6] selected samples of the subsurface soils recovered from the boreholes were submitted to AGAT Laboratories, an independent Canadian accredited analytical laboratory for background environmental testing for a standard panel of metal and inorganic parameters, as well as petroleum hydrocarbons [PHCs] and volatile organic compounds [VOCs]. The purpose of this testing was to assess the background environmental characteristics of the subsurface soils for comparison to the relevant Standards under Ontario Regulation 406/19 [as amended] and provide comment

regarding off-site disposal of surplus soil from the project. The results of this background analytical testing have been appended to the end of this report.

The boreholes were located in the field by representatives of SOIL-MAT ENGINEERS, based accessibility over the site and clearance of underground utilities. The ground surface elevation at the borehole locations have been referenced to a site specific temporary benchmark, described as the base of the hydro pole on the east side of Highway 11 - assuming a north-south orientation of Highway 11 - as illustrated in the attached Drawing No. 1. This benchmark was assigned an elevation of 100.0 metres for convenience.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 9, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed at the exact depths of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is the agricultural plot of land located northeast of the intersection of Highway 11 and Menoke Beach Road in the Township of Severn, Ontario. Wet and dry drainage channels run from west to east across the subject lands leading to a creek tributary which outlets at Lake Couchiching to the east. Of note, the large natural drainage channel that roughly divides the northern half from the southern half was wet during the time of our drilling operations. The site is bound to the north by Webers, – a fast food eatery – to the east by forested lands and existing residential dwellings, to the south by Menoke Beach Road, and to the west by Highway 11. The site is relatively flat and even with gentle undulations, and an overall drop in grade from west to east resulting in elevation variations of up to approximately 7 to 8 metres across the site.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Topsoil

A surficial veneer of topsoil approximately 150 to 300 millimetres in thickness was encountered at all borehole locations. It is noted that the depth of topsoil may vary

across the site and from the depths encountered at the borehole locations. In particular, greater depths of topsoil would be expected in the area of drainage courses or treed areas of the site. It is also noted that the term 'topsoil' has been used from a geotechnical point of view, and does not necessarily reflect its nutrient content or ability to support plant life.

Silt, Sandy Silt and Clayey Silt

Native silt, sandy silt and clayey silt soils were encountered beneath the topsoil at all borehole locations. The fine-grained granular to slightly cohesive soils were brown to greyish brown in colour, contained traces of to some sand and clay, trace gravel, and were generally in a loose to compact condition. There were noted to be variable seams of more clayey, sandy or gravelly soil with depth and across the site. Black staining was noted within the upper levels of some of the boreholes, suggesting residual organics associated with natural drainage courses, wooded areas, and possible former marsh deposits. A transition to grey was noted within all boreholes, with the exception of Borehole Nos. 2 and 4, at depths of between approximately 2.2 and 4.1 metres below the ground surface. The material was generally more silty in the upper levels becoming more clayey with depth. The silt soil tended to be in a wet to saturated condition. It is noted that due to the fine-grained nature of the native soils, and the wet condition, they are considered sensitive to disturbance caused by drill activities and moisture, and as such the measured 'N' values may be artificially low in the more saturated silt soils.

Bedrock

Bedrock was inferred from auger and spoon refusal, at depths of between of approximately 2.3 and 11 metres at all borehole locations with the exception of Borehole No. 3. The depth and elevation of the inferred bedrock surface at each borehole location is summarised in the following table:

TABLE A
INFERRED BEDROCK DEPTHS AND ELEVATIONS

Borehole No.	Surface Elevation [m]	Inferred Bedrock Depth [m]	Inferred Bedrock Elevation [m]
1	100.81	4.4	96.40
2	98.08	2.3	95.80
3	95.58	>6.7	<88.90

4	100.91	4.8	96.10
5	95.66	9.1	86.60
6	94.13	6.7	87.40
7	93.27	11.0	82.30
8	99.28	6.5	92.80
9	96.07	4.3	91.80

Note: elevations are based on temporary benchmark and are not geodetic.

Based on the bedrock elevations noted above, the bedrock was encountered at elevations of approximately 82.3 to 96.40 metres, however may step to deeper or shallower elevations across the site. From a review of available published information, the bedrock consists of Limestone, Dolostone and Shale of the Shadow Creek formation. The site is also close to a transition to zone of igneous bedrock comprised of granite and gneiss, and so this type of rock may be present. In any case, the bedrock is considered competent to very competent in terms of excavation and foundation requirements for the project, however the upper levels of shale or limestone bedrock are often weathered and fractured. The bedrock was not cored as part of this investigation.

Grain Size Analyses

Grain size analyses were conducted on six [6] selected samples of the native soils recovered from the boreholes. The results of this grain size testing can be found appended to the end of this report, and are summarized as follows:

TABLE B
SUMMARY OF GRAIN SIZE ANALYSES

Sample ID	Depth	% Clay	% Silt	% Sand	% Gravel	Hydraulic Conductivity, k [cm/s]	Estimated Infiltration Rate, [mm/hr]
BH1 SS4	2.3 m	11	70	14	5	10^{-6}	<10
BH3 SS5	3.0 m	32	66	2	0	10^{-7}	<10
BH4 SS4	2.3 m	9	67	24	0	10^{-5}	15
BH6 SS7	6.1 m	10	33	35	22	10^{-7}	10 to 15
BH7 SS6	4.6 m	13	86	1	0	10^{-6}	<10
BH9 SS5	3.0 m	9	88	3	0	10^{-6}	<10

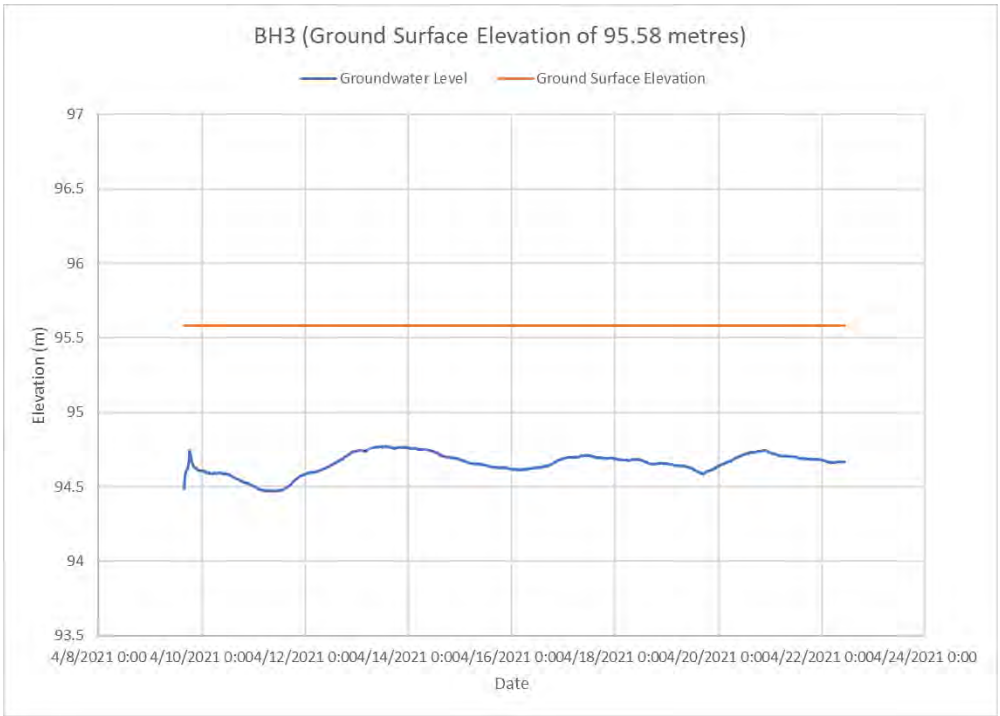
Note 1: Infiltration rate estimated using Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SB-6 Percolation Time and Soil Descriptions. Toronto, Ontario.

The field and laboratory testing demonstrate the native soils to consist of predominantly silt with trace of to some sand and clay with traces of gravel. According to the Unified Soil Classification System (USCS), the soils are classified as M.L. – Inorganic silts and very fine sands, to C.L. – Inorganic clays of low to medium plasticity within the layers containing a higher clay content, to S.C. – clayey sands, sand-clay mixtures. These soils would generally behave as a low permeability material, prone to significant disturbance from groundwater conditions, construction traffic, as well as high frost susceptibility. The more clayey layers, with clay content above about 15 to 20 percent, would tend to be effectively impermeable cohesive soil, and would be well suited for use in constructing and impermeable liner as part of the on-site stormwater management pond.

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the subsurface soils to consist of fine-textured glaciolacustrine deposits of silt and clay, with minor sand and gravel to coarse-textured glaciolacustrine deposits of sand and gravel with minor silt and clay. These conditions are consistent with our observations during drilling and laboratory testing. It is also noted that the subject area is in an area noting consist of pockets of natural organic deposits of peat, muck, and organic remains. This would explain the presence of trace black staining at depth in a number of the boreholes, as noted above. While specific deposits of peat or highly organic material were not encountered in the boreholes, they may be present within the area of natural drainage features, or closer to Lake Couchiching.

Groundwater Observations

All of the boreholes were noted to be in a generally wet condition, with ‘wet’ sample spoons noted below depths of about 1 to 2 metres. Borehole Nos. 3, 6, and 7 were noted to have ‘caved’ to depths of between approximately 3.7 to 4.3 metres and ‘wet’, while Borehole No. 8 was noted to have ‘caved’ and ‘wet’ at a depth of 2.7 metres upon completion. The remainder of the boreholes were noted as being open and ‘dry’ [i.e. no free groundwater present] upon completion of drilling. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes. As noted above, a monitoring well was installed at Borehole Nos. 3, 6, 7, and 9, to allow for future measurements of the static groundwater level. A data logger was installed in the monitoring wells to allow for continuous monitoring of the groundwater level between April 7 and April 22, 2021, the readings of which have been illustrated in the following graphs:


BH3 (Ground Surface Elevation of 95.58 metres)
Groundwater Level
Ground Surface Elevation
97
96.5
96
95.5
95
94.5
94
93.5
Elevation (m)
4/8/2021 0:00
4/10/2021 0:00
4/12/2021 0:00
4/14/2021 0:00
4/16/2021 0:00
4/18/2021 0:00
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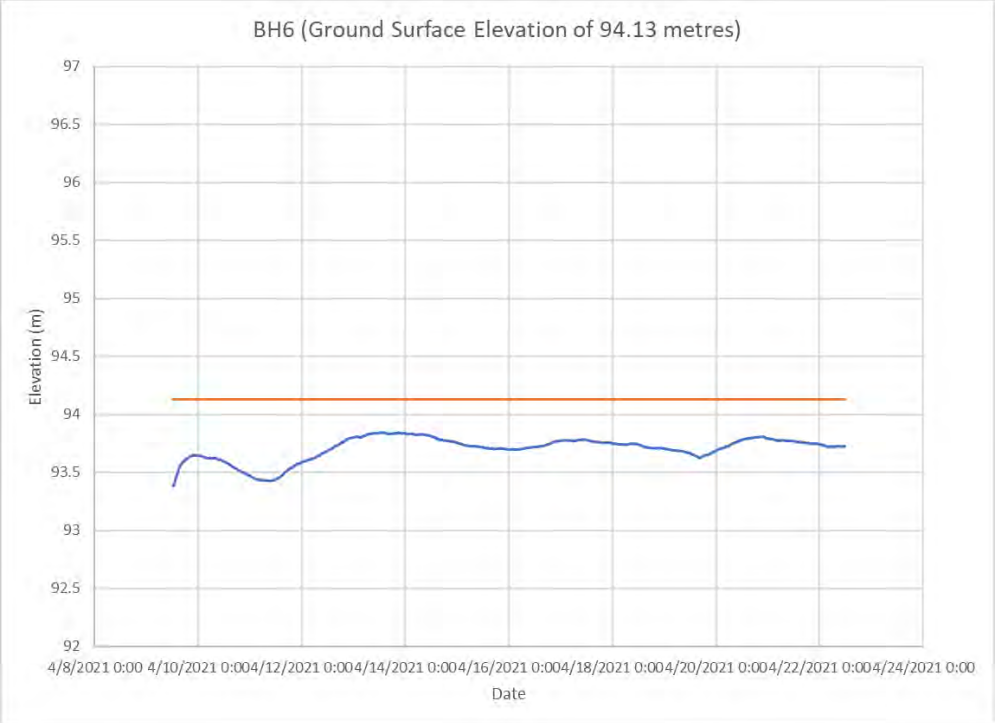
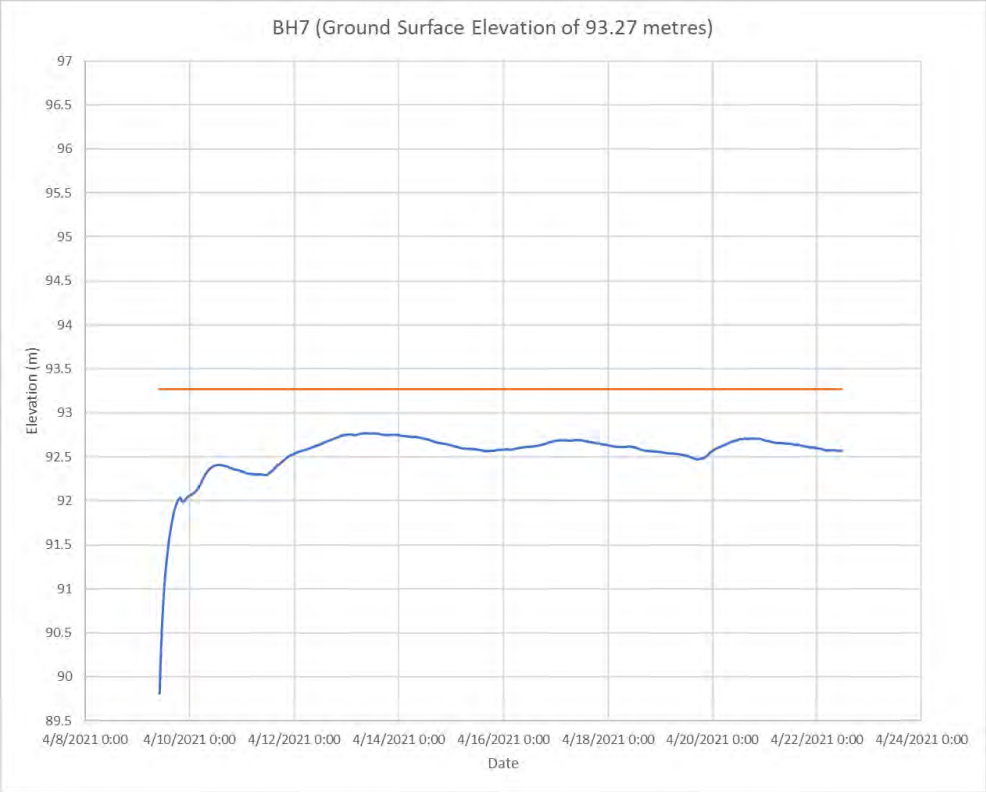
4/24/2021 0:00
Date


BH6 (Ground Surface Elevation of 94.13 metres)
97
96.5
96
95.5
95
94.5
94
93.5
93
92.5
92
Elevation (m)
4/8/2021 0:00
4/10/2021 0:00
4/12/2021 0:00
4/14/2021 0:00
4/16/2021 0:00
4/18/2021 0:00
4/20/2021 0:00
4/22/2021 0:00
4/24/2021 0:00
Date


BH7 (Ground Surface Elevation of 93.27 metres)
Elevation (m)
97
96.5
96
95.5
95
94.5
94
93.5
93
92.5
92
91.5
91
90.5
90
89.5
4/8/2021 0:00
4/10/2021 0:00
4/12/2021 0:00
4/14/2021 0:00
4/16/2021 0:00
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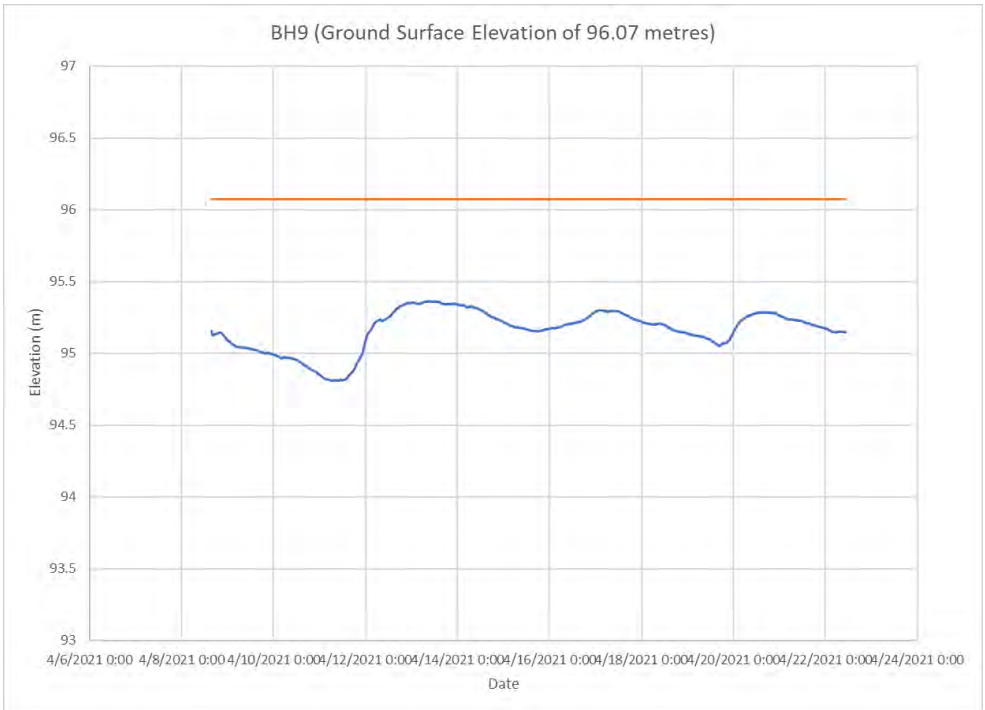

BH9 (Ground Surface Elevation of 96.07 metres)
Elevation (m)
97
96.5
96
95.5
95
94.5
94
93.5
93
4/6/2021 0:00
4/8/2021 0:00
4/10/2021 0:00
4/12/2021 0:00
4/14/2021 0:00
4/16/2021 0:00
4/18/2021 0:00
4/20/2021 0:00
4/22/2021 0:00
4/24/2021 0:00
Date

SUMMARY OF GROUNDWATER LEVELS

Monitoring Well	Ground Surface [m]	Groundwater Depth [m]	Groundwater Elevation [m]
MW-3	95.58	0.8 to 1.1	94.5 to 94.8
MW-6	94.13	0.3 to 0.5	93.6 to 93.8
MW-7	93.27	0.6 to 0.8	92.5 to 92.7
MW-9	96.07	0.7 to 1.1	95.0 to 95.4

It is noted that the groundwater elevations indicated are based on reference to a temporary benchmark with an assumed elevation, as noted above, and should be corrected upon determination of the geodetic elevation of the benchmark utilised.

The groundwater level observed indicates a groundwater level on the order of approximately 0.3 to 1.1 metres below the existing grade, at an elevation of roughly 90.5 to 95.5 metres, varying with the physical topography of the land. It is noted that the observed groundwater level in the area may be influenced by the adjacent drainage courses running through the area. Furthermore, given the time of year of monitoring, the measured levels would be considered generally representative of a seasonal 'high' condition. Further long-term monitoring with additional monitoring wells may allow for a more accurate estimate of the static groundwater level over the various seasons of the year. It is noted that the observed high groundwater levels are likely due to the proximity and relative elevation to Lake Couchiching.

Discussion of Site Soil and Groundwater Conditions

As noted above the subsurface conditions are characterized as predominantly silt soils with clayey layers in a saturated state due to relatively high groundwater conditions. The on-site soils over the subject site are generally suitable for the proposed development but will present some challenges. Fine-grained soils such as these are quite susceptible to disturbance due to moisture conditions, and will be further exacerbated due to the relatively high groundwater conditions. As such the silt soils are prone to base instability, disturbance from foot and construction traffic, etc., and will present difficulties for compaction and earthworks. This may require modified or alternative placement and compaction efforts.

Due to the conditions noted above, site servicing and grading, roadway construction, excavations for foundations, and general earthworks will present difficulties, with the south and east half of the site likely to encounter the greatest challenges. This area is notably lower than the north and west half in elevation, and as seen from the groundwater level data will be in a wet to saturated state as shallow as approximately

0.3 metres below the existing ground surface. To account for these conditions, it would be beneficial to raise the grade as much as possible so that the underside of footings are not more than roughly 0.3 to 1.0 metres below the existing ground surface, while also ensuring proper frost coverage. This will be even more prudent in the southern half of the site where groundwater conditions are very high as noted above. Conducting earthworks and engineered fill during the dry summer months of the year would tend to improve the effectiveness of compaction and achieve better results. Conversely, roadway construction during the wet periods would tend to increase the need for subgrade stabilisation.

Additional investigations of the subject site would be prudent, including the advancement of a series of test pits to further assess the effect of the soil and groundwater conditions on the proposed earthworks for the development.

4. EXCAVATIONS

Excavations for the installation of foundations and underground services are anticipated to extend to depths of up to approximately 2 to 3 metres below the existing grade. As noted above, efforts to raise the site grade as much as possible and thus reduce the depth of excavation required below the existing grade will help to simplify excavation requirements. Excavations through any surficial fill and the fine-grained silt soils would be expected to remain stable at inclinations of up to 45 degrees to the horizontal. Where wet/more permeable seams are encountered, during periods of extended precipitation, or where excavations extend below the static groundwater level, the sides of excavations should be expected to 'slough in' to as flat as 3 horizontal to 1 vertical, or flatter. Not withstanding the foregoing, however, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects. The native silt soils anticipated would be considered a Type 3 soil, as outlined in the Ontario Health and Safety Act III – Excavation. Excavation slopes steeper than those required in the Safety Act must be supported and a senior geotechnical engineer from this office should monitor the work.

Depending on the depth of excavation and the weather conditions at the time of construction, stabilisation of the excavation bases may be required. Given the generally wet silt soils some degree of base stabilization should be anticipated, such as additional bedding or ballast stone, or the placement of coarse crushed aggregate 'punched' into the disturbed excavation base. With the excavation base in a stable condition, stabilised where required, standard pipe bedding material as specified by the Ontario Provincial Standard Specification [OPSS] or Township of Severn should be

satisfactory, however as noted above some base stabilisation may be required for deeper excavations. The bedding should be well compacted to provide sufficient support to the pipes and components (i.e. valve chambers, manholes etc.), and to minimize settlements of the roadway above the service trenches. Special attention should be paid to compaction under the pipe haunches.

As noted above the groundwater levels were measured to be on the order of approximately 0.3 to 1.1 metres below the existing ground surface. With some excavations likely extending near or below this level some groundwater infiltration into open excavations should be anticipated. The generally fine grained granular to cohesive soils should yield a relatively low rate of groundwater infiltration such that it should be possible to adequately control groundwater infiltration for the short construction period, in excavations extending a short distance below the groundwater level, using conventional construction dewatering techniques. Surface water should be directed away from the excavations.

Where deeper excavations are required, extending significantly below the groundwater level or into the perched water deposits, or where excavations are required to be open for a longer period of time, some difficulty may be encountered with base and side slope stability, groundwater control, etc. The sides of excavations may tend to slump in to flatter stable inclinations. The base of excavations may have a tendency to become unstable, requiring the placement of coarse ballast stone material, additional bedding material, etc. Additional sumps may be required to control groundwater infiltration, and the use of more sophisticated groundwater control methods may be considered necessary for excavations deeper than about 1 to 2 metres below the present grade, as noted above. The presence of the more ‘silty’ layers will tend to exacerbate the difficulties associated with groundwater infiltration. In this regard it would be prudent to advance a series of test excavations to observe first hand how the groundwater level will impact open excavations, including rate of groundwater infiltration, stability, etc.

Contractors may be successful in undertaking servicing construction ‘in the wet’, anticipating wider trench excavation and the need for base stabilisation. Excavations should begin at the low-end of the sewer alignment to allow drainage away from the working area. The work should be coordinated so that a section of pipe is installed as quickly as possible after excavation and provided with an initial cover of at least 0.6 metres to 0.9 metres of backfill on the same day it is installed.

We recommend that the invert elevations of any storm sewer pipes for rear yard catch basins be located above the proposed underside of footing elevations of adjacent residential structures, or that the trench excavations should be filled with 5 MPa ‘lean

mix' concrete product to the proposed underside of footing level where the excavations extend below an imaginary 10 horizontal to 7 vertical line extending outwards and down from a point 0.3 metres beyond the proposed townhouse foundations.

Any utility poles, light poles, etc. located within 3 metres of the top of an excavation slope should be braced to ensure their stability. Likewise, temporary support might be required for other existing above and below ground structures, including existing underground services, roadways, existing dwellings, etc. depending on their proximity to the trench excavations. It is recommended that a pre-condition survey of any existing adjacent structures/dwellings prior to construction.

5. BACKFILL CONSIDERATIONS

The excavated material will consist primarily of the silt, clayey silt and sandy silt soils encountered in the boreholes as described above. These soils are generally considered suitable for use as engineered fill, trench backfill, etc., provided that they are free of organics, construction debris, or other deleterious material, and that its moisture content can be controlled to within 3 per cent of its standard Proctor optimum moisture content.

It is noted that the on-site soils encountered are not considered to be free draining and should not be used where this characteristic is necessary. It is also noted that these fine grained granular to cohesive soils will present difficulties in achieving effective compaction where access with compaction equipment is restricted. The on-site soils encountered are generally considered to be 'wet' of their standard Proctor optimum moisture content, and often in a saturated condition. Some moisture conditioning will be required depending upon the weather conditions at the time of construction. It is noted that these soils will become nearly impossible to compact when wet of its optimum moisture content. Any material that becomes wet to saturated should be spread out to allow to dry, or removed and discarded, or utilised in non-settlement sensitive areas. It may also be necessary to modify the compaction methods based on the material condition, adjusting the lift thickness and reducing the use of vibration. In this regard, conducting earthworks during the dry summer months of the year will tend to help achieve a more effective compaction process.

It is anticipated that excavations for the installation of site services will extend approximately near or below the groundwater table, depending on the final grading of the site. Such excavations will have the potential for intercepting the shallow groundwater and thus creating a "French Drain" within the bedding material, with possible local affect to the groundwater level. Consequently, if groundwater is

encountered during digging of the service trenches, measures may need to be implemented to mitigate/eliminate groundwater interference. These would include clay 'cut-offs' within the service trench fill encasing the pipe/service. Such clay cut-offs should be installed in accordance with OPSD 802.095, using a suitable clay soil or alternatively a blend of 1 part bentonite chips to 3 parts OPSS Granular A.

We note that where backfill material is placed near or slightly above its optimum moisture content, the potential for long term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of the 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic and therefore impacting roadway construction. If the soil is well dry of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. The fine grained to cohesive soils encountered may require high compaction energy to achieve acceptable densities if the moisture content is not close to its standard Proctor optimum value. It is therefore very important that the moisture content of the backfill soils be within 3 per cent of its standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

A representative of SOIL-MAT should be present on-site during the backfilling and compaction operations to confirm the uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. Backfill within service trenches, areas to be paved, etc., should be placed in loose lifts not exceeding 300 millimetres in thickness and compacted to a minimum of 95 per cent of its standard Proctor maximum dry density [SPMDD], and to 100 per cent of its SPMDD in the upper 1 metre below the design subgrade level. All structural fill should be compacted to 100 per cent of its SPMDD. The appropriate compaction equipment should be employed based on soil type, i.e. pad-toe for cohesive soils and smooth drum/vibratory plate for granular soils. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

6. MANHOLES, CATCH BASINS AND THRUST BLOCKS

Properly prepared bearing surfaces for manholes, valve chambers, etc. in the native competent soils, stabilised where required, will be practically non-yielding under the anticipated loads. Proper preparation of the founding soils will tend to accentuate the protrusion of these structures above the pavement surface if compaction of the fill around these structures is not adequate, causing settlement of the surrounding paved surfaces. Conversely, the pavement surfaces may rise above the valve chambers and around manholes under frost action. To alleviate the potential for these types of differential movements, free-draining, non-frost susceptible material should be employed as backfill around the structures located within the paved roadway limits, and compacted to 100 per cent of its standard Proctor maximum dry density. A geofabric separator should be provided between the free draining material and the on-site silt soils to prevent the intrusion of fines.

The thrust blocks in the native soils or engineered fill may be conservatively sized as recommended by the applicable Ontario Provincial Standard Specification conservatively using a horizontal allowable bearing pressure of up to 100 kPa [~2,000 psf]. Any backfill required behind the blocks should be a well-graded granular product and should be compacted to 100 per cent of its standard Proctor maximum dry density.

7. PAVEMENT STRUCTURE DESIGN CONSIDERATIONS

All areas to be paved must be cleared of all organic and otherwise unsuitable materials, and the exposed subgrade proof rolled with 3 to 4 passes of a loaded tandem-axle truck in the presence of a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means should be subexcavated and replaced with suitable backfill material. Where the subgrade condition is poorer it may be necessary to implement more aggressive stabilisation methods, such as the use of coarse aggregate [50-millimetre clear stone, ‘rip rap’, etc.] ‘punched’ into the soft areas. It may also be prudent to consider the provision of a heavy geofabric over the subgrade to act as a separator between the subgrade and granular base where the subgrade is wet and saturated.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface

water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. SOIL-MAT should be given the opportunity to review the final pavement structure design and subdrain scheme prior to construction to ensure that they are consistent with the recommendations of this report.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as during the fall and spring months, it should be anticipated that additional subgrade preparation will be required, such as additional depth of Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II (crushed bedrock) sub-base material. It is also important that the sub-base and base granular layers of the pavement structure be placed as soon as possible after exposure, preparation and approval of the subgrade level. Based on the established site soil and groundwater conditions, the need for additional subgrade preparation should be anticipated, such as additional granular material, the use of geogrid products, etc.

The roadways through the residential subdivision would be required to adequately support cars, trucks and intermittent delivery and garbage trucks. For this project, a recommended minimum pavement structure would consist of 350 millimetres of OPSS Granular 'B', Type II (crushed bedrock) sub-base course, 150 millimetres of OPSS Granular 'A' base course, 65 millimetres of HL8 binder course asphaltic concrete, and 40 millimetres of HL3 surface course asphaltic concrete. Notwithstanding, the pavement structure should conform to the relevant Township of Severn requirements where they are to be assumed by the Town. It is our opinion that this design is suitable for use on a residential roadway section, provided that the subgrade has been prepared as specified and is good and firm before the sub-base course material is placed. If the subgrade is soft, remedial measures as discussed above may have to be implemented and/or the sub-base thickness may have to be increased. The granular sub-base and base courses and asphaltic concrete layers should be compacted to OPSS or Township of Severn requirements. A program of in-place density testing must be carried out to monitor that compaction requirements are being met. We note that this pavement structure is not to be considered as a construction roadway design.

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often, significant temperature gradients exist in the delivered and placed asphalt with the

cooler portions of the mat resisting compaction and presenting a honeycomb surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure a smooth uniform surface. The contractor can mitigate the surface segregation by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

Asphalt paving of driveways should be consistent with the general recommendations provided above. Proper preparation of the subgrade soils is essential to good long-term performance of the pavement. Likewise, sufficient depth and compaction of granular base materials and adequate drainage will be important in achieving good long-term performance, i.e. preventing/limiting premature cracking, subgrade failure, rutting, etc. A recommended light duty pavement structure for residential driveways would consist of a minimum of 200 millimetres of OPSS Granular 'A' base course, compacted to 100 percent standard Proctor maximum dry density, followed by a minimum of 50 millimetres of HL3 or HL3F asphaltic concrete, compacted to a minimum of 92 per cent of their Marshall maximum relative density [MRD].

8. HOUSE AND TOWNHOUSE CONSTRUCTION

Based on the observed groundwater conditions, it is recommended that the design founding level for residential dwellings and townhouse blocks be limited to depths of no greater than 0.3 to 1.0 metres below the existing grade, perhaps less pending a more detailed assessment of the seasonal variation in groundwater level across the site. The native soils encountered at the borehole locations are considered capable of supporting the loads associated with typical residential dwelling and townhouse structures on conventional spread footings, below any fill, organic, or otherwise unsuitable materials. This typically considers a nominal design bearing pressure of 75 kPa [~1,500 psf]. The founding surfaces must be hand cleaned of any loose or disturbed material, along with any ponded water, immediately prior to placement of foundation concrete.

It is anticipated that the site grading works will require engineered fill below founding elevations over portions of the site; where this is the case the general recommendations presented in the Backfill Considerations above should be strictly adhered to, with compaction to 100 percent standard Proctor maximum dry density, verified by monitoring and testing by a representative of SOIL-MAT ENGINEERS present on a full time basis. If there is a short fall in the volume of fill required, then the source of imported fill should be reviewed for gradation, Proctor value, compatibility with existing fill, environmental

characteristics and be approved by this office prior to use. On a preliminary basis the design bearing capacity for footings within the engineered fill should be limited to 100 kPa [~2,000 psf] SLS and 150 kPa [~3,000 psf] ULS, pending confirmation based on monitoring and testing of the engineered fill works.

The support conditions afforded by the native soils and/or engineered fill are generally not uniform across the building footprint, nor are the loads on the various foundation elements. As such it is recommended that consideration be given to the provision of nominal reinforcement in the footings and foundation walls to account for variable support and loading conditions. The use of nominal reinforcement is considered good construction practice as it will act to reduce the potential for cracking in the foundation walls due to minor settlements, heaving, shrinkage, etc. and will assist in resisting the pressures generated against the foundation walls by the backfill. Such nominal reinforcement is an economical approach to the reduction and prevention of costly foundation repairs after completion and later in the life of the buildings. This reinforcement would typically consist of two continuous 15M steel bars placed in the footings [directly below the foundation wall], and similarly two steel bars placed approximately 300 millimeters from the top of the foundation walls at a minimum, depending on ground conditions exposed during construction. These reinforcement bars would be bent to reinforce all corners and under basement windows, and be provided with sufficient overlap at staggered splice locations. At ‘steps’ in the foundations and at window locations, the reinforcing steel should transition diagonally, rather than at 90 degrees, to maintain the continuous tensile capacity of the reinforcement. Where footings are founded on, or partially on, engineered fill the above provision for nominal reinforcement would be required.

All basement foundation walls should be suitably damp proofed, including the provision of a ‘dimple board’ type drainage product, and provided with a perimeter drainage tile system outlet to a gravity sewer connection or positive sump pit a minimum of 150 millimetres below the basement floor slab. The clear stone material surrounding the weeping tile should be encased with a geotextile material to prevent the migration of fines from the foundation wall backfill into the clear stone product. In the event that sump pit systems are required we would recommend that the sump pump system should be constructed with an ‘oversized’ reservoir and a ‘back-flow’ prevention valve so that the sump pump will not cycle repeatedly within short time periods. In addition, consideration should be given to the installation of an automatic back-up system in order to ensure operation in the event of loss of power or mechanical failure of the primary pump.

All footings exposed to the environment must be provided with a minimum of 1.5 meters of earth or equivalent insulation to protect against frost penetration. This frost protection would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Provincial Building Code.

It is imperative that a soils engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations outlined in this report, and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the borehole locations.

9. ENVIRONMENTAL CONSIDERATIONS

As noted above, six [6] representative samples of the subsurface soils recovered from the boreholes were submitted to AGAT Laboratories, an independent Canadian accredited analytical laboratory for background analytical testing for a standard panel of metal and inorganic parameters as well as petroleum hydrocarbons [PHCs] and volatile organic compounds [VOCs]. The purpose of this testing was to characterise the subsurface soils and provide comments with respect to the off-site disposal of surplus soil during construction. The results of this testing are presented in the attached AGAT Certificate of Analysis [21T733225].

The laboratory test results received in our office were compared to the applicable standard from the Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act*, as follows:

- **Table 1**: Full Depth Background Site Condition Standards.
- **Table 2.1**: Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition for a Residential/ Parkland/ Institutional property use, [RPI], as well as for an Industrial/ Commercial/ Community [ICC] property use.
- **Table 3.1**: Full Depth Excess Soil Quality Standards in a Non-Potable Ground Water Condition for a Residential/ Parkland/ Institutional property use, [RPI], as well as for an Industrial/ Commercial/ Community [ICC] property use.

Based on SOIL-MAT ENGINEERS' field observations and the analytical test results from AGAT, SOIL-MAT ENGINEERS has the following comments to offer:

1. The sampled material was found to meet the Table 1 [RPI/ICC] Standards for all parameters tested.
2. The submitted samples were found to meet the Table 2.1 and 3.1 [RPI] Standards all the parameters tested.
3. The submitted samples were found to meet the Table 2.1 and 3.1 [ICC] Standards for the tested parameters.
4. The samples secured for analytical testing are believed to be representative of the soil conditions at the borehole locations only. No hydrocarbon staining or odours were observed during the fieldwork. If any significant changes are noted, i.e., odours, staining etc., SOIL-MAT should be contacted to reassess the environmental characteristics of the soil.

Given the above test results the following disposal options are applicable under Regulation 406/19, as amended:

- As the tested material has been shown to meet the Table 1 [RPI/ICC] Standards, surplus material may be accepted at an off-site Table 1 property, including property subject to a Record of Site Condition or MECP Certificate of Authorisation, pending approval of the receiving property owner.
- As the tested material has been shown to meet the Table 2.1 and 3.1 [RPI] Standards, surplus material may reasonably be accepted at an off-site RPI property, pending approval of the receiving property owner.
- As the tested material has been shown to meet the Table 2.1 and 3.1 [ICC] Standards, surplus material may reasonably be accepted at an off-site ICC property, pending approval of the receiving property owner.
- Depending on the volume of surplus soil to be handled, as well as the environmental requirements of the receiving site, additional testing may be required.
- Excavated soil may be reused on site.

It is noted that where surplus soil is identified to be removed from the site, it may be necessary to undertake additional testing as a function of volume, as outlined in Regulation 406/19, in order to satisfy the requirements of a given receiving site. Likewise, where it is required for fill material to be imported to the site, it would be necessary to develop a Fill Management Plan in accordance with the requirements of Regulation 406/19.

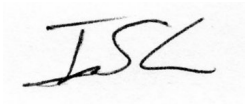
10. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The material in it reflects SOIL-MAT ENGINEERS' best judgement in light of the information available at the time of preparation. The subsurface descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SOIL-MAT ENGINEERS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Scott Wylie, B.Eng., EIT.



Ian Shaw, P. Eng., QP_{ESA}
Senior Engineer

Enclosures: Drawing No.1, Borehole Location Plan
Log of Borehole Nos. 1 to 9, inclusive
Grain Size Analyses
Drawing No. 2, Recommended Design Requirements for Basement Construction
AGAT Certificate of Analyses [21T733225]

Distribution: LIV Communities [1, plus pdf]

LEGEND

Borehole Location
BH#

Temporary Benchmark
Base of hydro pole.
TBM Assumed elevation of 100.00 metres

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Geotechnical Report SM 301553-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Shadow Creek Residential Development
Highway 11 and Menoke Beach Road
Orillia, Ontario

Borehole Location Plan

Project No. SM 301553-G

Date: April 2021

Drawn: SW	Checked: IS

SM 301553-G Borehole Location Plan

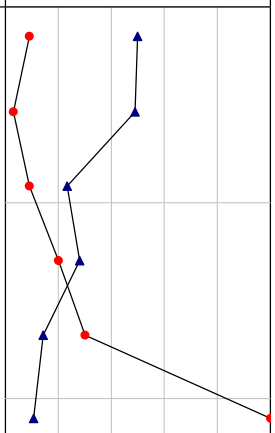
Drawing No. 1

Log of Borehole No. 1

Project No: SM 301553-G
Project Manager: Ian Shaw, P. Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Highway 11 and Menoke Beach Road
UTM Coordinates - N: 4949733
Client: LIV Communities
E: 626783

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		100.81	Ground Surface							
0	0		**Topsoil** Approximately 150 millimetres of topsoil.	SS	1	3 4 5 7	9			
3	1	99.30	**Silt** Brown, trace sand and gravel, with some clay, firm to hard.	SS	2	3 2 1 5	3			
6	2	98.50	Cobbles and gravel	SS	3	5 5 4 45	9			
9	3		Transition to grey	SS	4	5 9 11 16 wet spoon	20			
12	4	96.40		SS	5	40 17 13 25	30			
15	5		End of Borehole Practical auger and spoon refusal on assumed bedrock	SS	6	50/2"	100			
18	6									
21	7									
24	8									
27	9									
30	10									
33	11									
36	12									
39										

Moisture Content w%: 10 20 30 40
Standard Penetration Test blows/300mm: 20 40 60 80



NOTES:

1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to practical auger and spoon refusal on assumed bedrock at a depth of 4.4 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: April 8, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 301553-G
Project: Proposed Residential Development
Location: Highway 11 and Menoke Beach Road
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4949897
E: 626787

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		98.08	Ground Surface							
0	0	97.78	**Topsoil** Approximately 300 millimetres of topsoil.	SS	1	2 1 1 1	2			
3	1		**Silt** Greyish brown, trace sand and gravel, with some clay, firm to hard.	SS	2	5 7 7 4 moist spoon	14			
7	2	95.80		SS	3	1 1 1 16 wet spoon	2			
			End of Borehole Practical auger and spoon refusal on assumed bedrock	SS	4	50/2" wet spoon	100			

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to practical auger and spoon refusal on assumed bedrock at a depth of 2.3 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

Drill Method: Solid Stem Augers
Drill Date: April 8, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

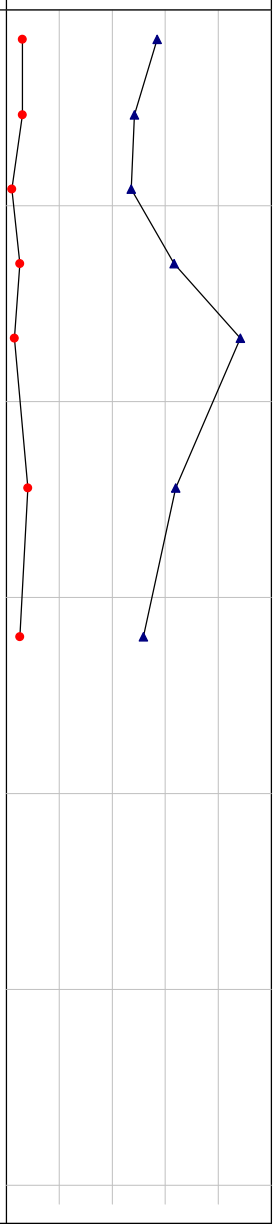
Log of Borehole No. 3

Project No: SM 301553-G
Project: Proposed Residential Development
Location: Highway 11 and Menoke Beach Road
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4949948
E: 626945

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	95.58	Ground Surface							
0 / 0	95.33	**Topsoil** Approximately 250 millimetres of topsoil.							
3 / 1		**Silt** Greyish brown, trace sand and gravel, with some clay, traces of black staining, firm to hard.	SS	1	2 1 5 5	6			
			SS	2	4 3 3 5 moist spoon	6			
6 / 2			SS	3	2 1 1 0 moist spoon	2			
9 / 3	92.60		SS	4	2 2 3 2 moist spoon	5			
		Clayey Silt/Silt Greyish brown, trace sand, soft to firm.	SS	5	2 2 1 3 moist spoon	3			
13 / 4	91.50	Transition to grey							
16 / 5			SS	6	3 3 5 6 moist spoon	8		<1.0	
20 / 6									
21 / 6	88.90		SS	7	3 2 3 3 moist spoon	5		<1.0	
22 / 7		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open until 3.7 metres and 'wet' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed at this location upon completion and equipped with a data logger to monitor long-term groundwater fluctuations.

Drill Method: Solid Stem Augers
Drill Date: April 8, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
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Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 301553-G
Project: Proposed Residential Development
Location: Highway 11 and Menoke Beach Road
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4949593
E: 626704

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		100.91	Ground Surface							
0	0		**Topsoil** Approximately 100 millimetres of topsoil.							
1			**Silt** Greyish brown, trace sand and gravel, with some clay, traces of black staining, firm to hard.	SS	1	2 2 4 5	6			
2	1			SS	2	2 3 3 4 moist spoon	6			
3				SS	3	5 9 10 12 moist spoon	19			
4	2			SS	4	9 14 20 28 moist spoon	34			
5				SS	5	18 18 21 26 moist spoon	39			
6	3									
7		96.10		SS	6	7 50/3" moist spoon	100			
8	4		End of Borehole Practical auger and spoon refusal on assumed bedrock							
9			NOTES: 1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 4.8 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.							
10	5									
11										
12	6									
13										
14	7									
15										
16	8									
17										
18	9									
19										
20	10									
21										
22	11									
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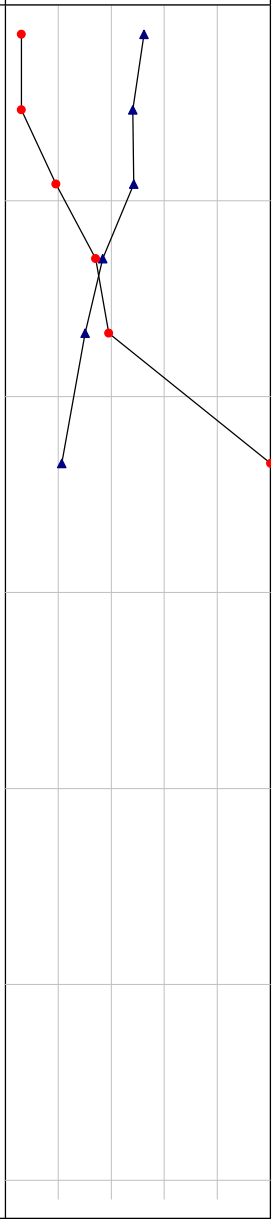
38										
39										
40										

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Augers
Drill Date: April 8, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 5

Project No: SM 301553-G
Project: Proposed Residential Development
Location: Highway 11 and Menoke Beach Road
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4949250
E: 626858

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	95.66	Ground Surface								
0 / 0	95.41	**Topsoil** Approximately 250 millimetres of topsoil.		SS	1	1 2 3 5	5			
3 / 1		**Silt** Greyish brown, trace sand and gravel, with some clay, traces of black staining, firm.		SS	2	0 0 0 1 moist spoon	0			
6 / 2	93.90	Increased clay content		SS	3	2 1 1 3 moist spoon	2		<1.0	
9 / 3				SS	4	2 1 2 1 moist spoon	3		<1.0	
12 / 4				SS	5	2 1 2 3 moist spoon	3		<1.0	
13 / 4	91.60	Transition to grey								
15 / 5	91.10	High clay content		SS	6	3 1 3 3 moist spoon	4		<1.0	
21 / 6				SS	7	2 5 2 2 moist spoon	7		<1.0	
29 / 9	86.60	End of Borehole Practical auger refusal on assumed bedrock								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to practical auger refusal at a depth of 9.1 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: April 8, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

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Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM 301553-G
Project: Proposed Residential Development
Location: Highway 11 and Menoke Beach Road
Client: LIV Communities

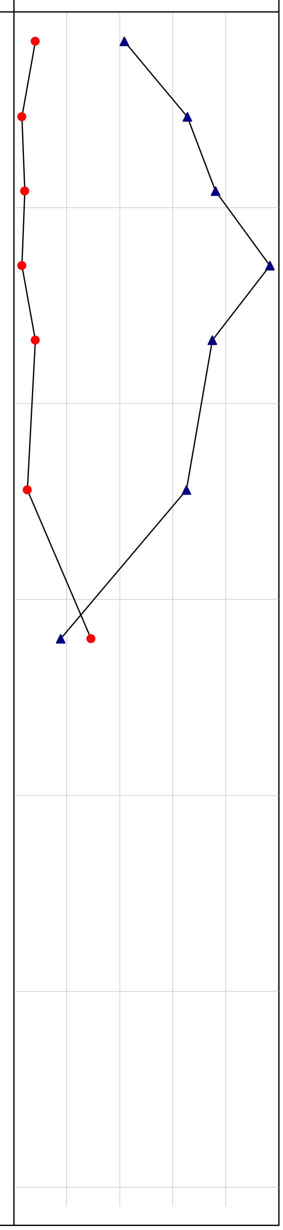
Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4949096
E: 626907

Soil-Mat

Depth (m)	Elevation (m)	Description
0	94.13	Ground Surface
0 – 0.15		**Topsoil** Approximately 150 millimetres of topsoil.
– 1.5	92.60	**Silt** Greyish brown, trace sand and gravel, with some clay, traces of black staining, firm to very stiff.
		Increased clay content
3.2	90.90	Transition to grey
6.7	87.40	End of Borehole Spoon refusal on assumed bedrock

Type	Number	Blow Counts	Blows/300mm	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2 3 5 7	8		
SS	2	2 1 2 3 moist spoon	3		
SS	3	2 2 2 2 wet spoon	4		
SS	4	2 2 1 2 wet spoon	3	<1.0	
SS	5	4 3 5 4 wet spoon	8		
SS	6	2 3 2 3 wet spoon	5		
SS	7	4 8 21 50/4" wet spoon	29		

Moisture Content w% (10, 20, 30, 40) / Standard Penetration Test blows/300mm (20, 40, 60, 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open until 4.3 metres and 'wet' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed at this location upon completion and equipped with a data logger to monitor long-term groundwater fluctuations.

Drill Method: Solid Stem Augers
Drill Date: April 9, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
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Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 7

Project No: SM 301553-G
Project: Proposed Residential Development
Location: Highway 11 and Menoke Beach Road
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4949329
E: 627095

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	93.27	Ground Surface							
		Topsoil Approximately 150 millimetres of topsoil.	SS	1	2 2 4 6	6			
		Silt Greyish brown, trace sand and gravel, with some clay, traces of black staining, firm to very stiff.	SS	2	1 1 1 1	2			
			SS	3	1 2 2 2	4		<1.0	
			SS	4	1 1 3 3	4		<1.0	
10 / 3	89.90	Transition to grey	SS	5	2 3 4 6 wet spoon	7		<1.0	
			SS	6	2 3 2 4 wet spoon	5			
		NOTES: 1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 6.7 metres. A dynamic cone was then driven to a depth of approximately 11.0 metres. 2. Borehole was recorded as open until 4.0 metres and 'wet' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client. 4. A monitoring well was installed at this location upon completion and equipped with a data logger to monitor long-term groundwater fluctuations.	SS	7	1 0 2 3 wet spoon	2			
			DC	8		4			
			DC	8		3			
			DC	9		5			
			DC	10		7			
			DC	11		6			
			DC	12		8			
			DC	13		12			
			DC	14		23			
			DC	15		12			
			DC	16		16			
			DC	17		14			
			DC	18		13			
			DC	19		18			
36 / 11	82.30	End of Borehole Dynamic cone refusal on assumed bedrock	DC	20		28			

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

Drill Method: Solid Stem Augers
Drill Date: April 9, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
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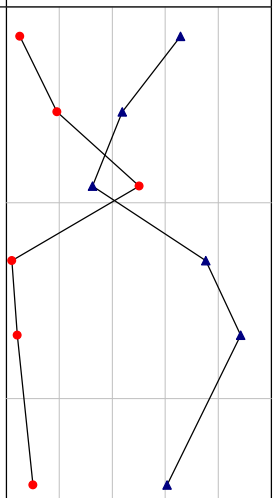
Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 8

Project No: SM 301553-G
Project Manager: Ian Shaw, P. Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Highway 11 and Menoke Beach Road
UTM Coordinates - N: 4949384
Client: LIV Communities
E: 626701

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	99.28	Ground Surface								
0 / 0		**Topsoil** Approximately 200 millimetres of topsoil.		SS	1	1 2 3 5	5			
3 / 1	98.20	**Silt** Greyish brown, trace sand and gravel, with some clay, hard to firm.		SS	2	5 8 11 15	19			
6 / 2		Transition to grey		SS	3	15 23 27 17 moist spoon	50			
7 / 2	97.00	Increased clay content		SS	4	2 1 1 2 wet spoon	2		<1.0	
10 / 3				SS	5	2 1 3 2 wet spoon	4		<1.0	
16 / 5				SS	6	7 5 5 7 wet spoon	10		<1.0	
21 / 6	92.80	End of Borehole Practical auger refusal on assumed bedrock								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on April 9, 2021 to practical auger refusal at a depth of 6.5 metres.

2. Borehole was recorded as open and 'wet' at a depth of 2.7 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: April 9, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
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E: info@soil-mat.ca

Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 9

Project No: SM 301553-G
Project Manager: Ian Shaw, P. Eng.
Project: Proposed Residential Development
Borehole Location: See Drawing No. 1
Location: Highway 11 and Menoke Beach Road
UTM Coordinates - N: 4949700
Client: LIV Communities
E: 626905

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	96.07	Ground Surface								
0 / 0		**Topsoil** Approximately 200 millimetres of topsoil.		SS	1	2 3 6 7	9			
3 / 1		**Silt** Greyish brown, trace sand and gravel, with some clay, firm to stiff.		SS	2	2 3 3 4 wet spoon	6			
6 / 2	93.90	Transition to grey		SS	3	4 6 6 5 wet spoon	12			
9 / 3	93.20	Increased clay content		SS	4	3 4 6 6 wet spoon	10			
13 / 4	91.80			SS	5	4 3 3 6 wet spoon	6			
14 / 5		End of Borehole Practical auger and spoon refusal on assumed bedrock								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 9, 2021 to termination at a depth of 4.3 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

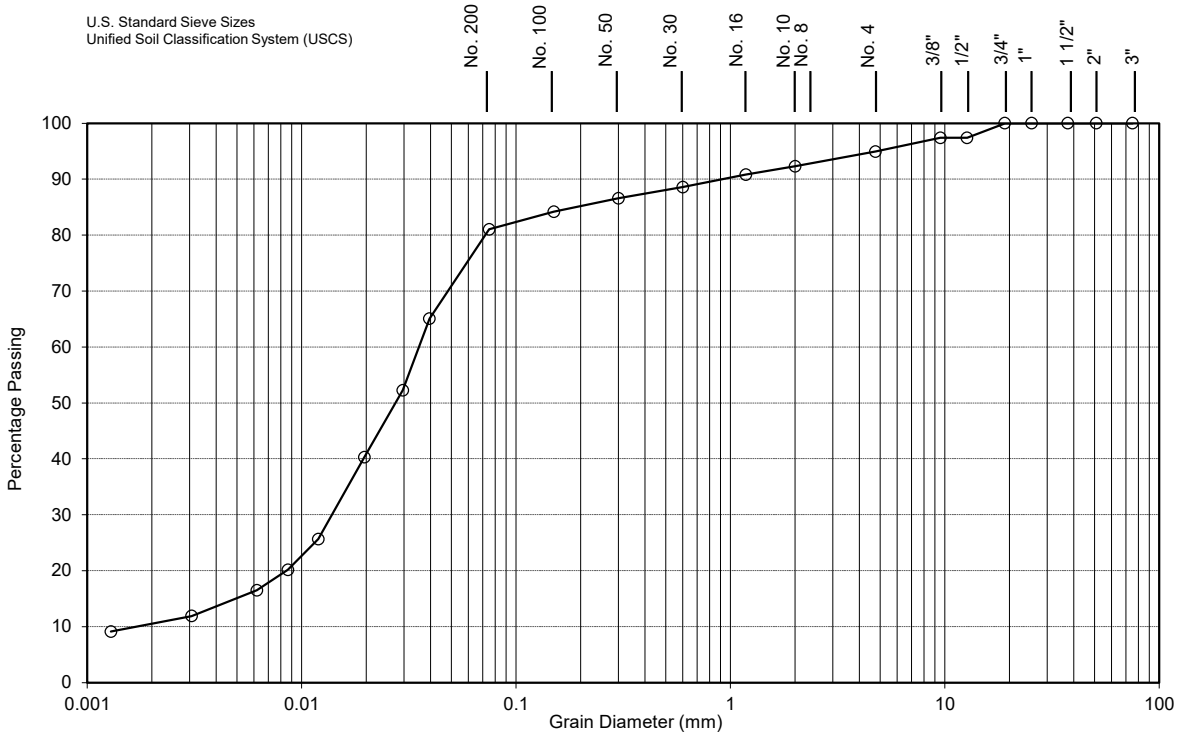
4. A monitoring well was installed at this location upon completion and equipped with a data logger to monitor long-term groundwater fluctuations.

Drill Method: Solid Stem Augers
Drill Date: April 9, 2021
Hole Size: 150 millimetres
Drilling Contractor: Walker Drilling

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Temporary
Field Logged by: SW
Checked by: IS
Sheet: 1 of 1

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**21-143**	Notes: Depth 7.5'			
Sample No.:	SS4				
Borehole No.:	1				
CLAY [%]:	**11**	Soil Description:	**Brown Silt w/ some Sand and Clay and traces of Gravel**		
SILT [%]:	**70**		**M.L. - Inorganic silts and very fine Sands, silty fine sands**		
SAND [%]:	**14**				
GRAVEL [%]:	**5**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.0018**	Coefficient of Uniformity C_U:	**19.4**	Coefficient of Curvature C_C:	**3.6**

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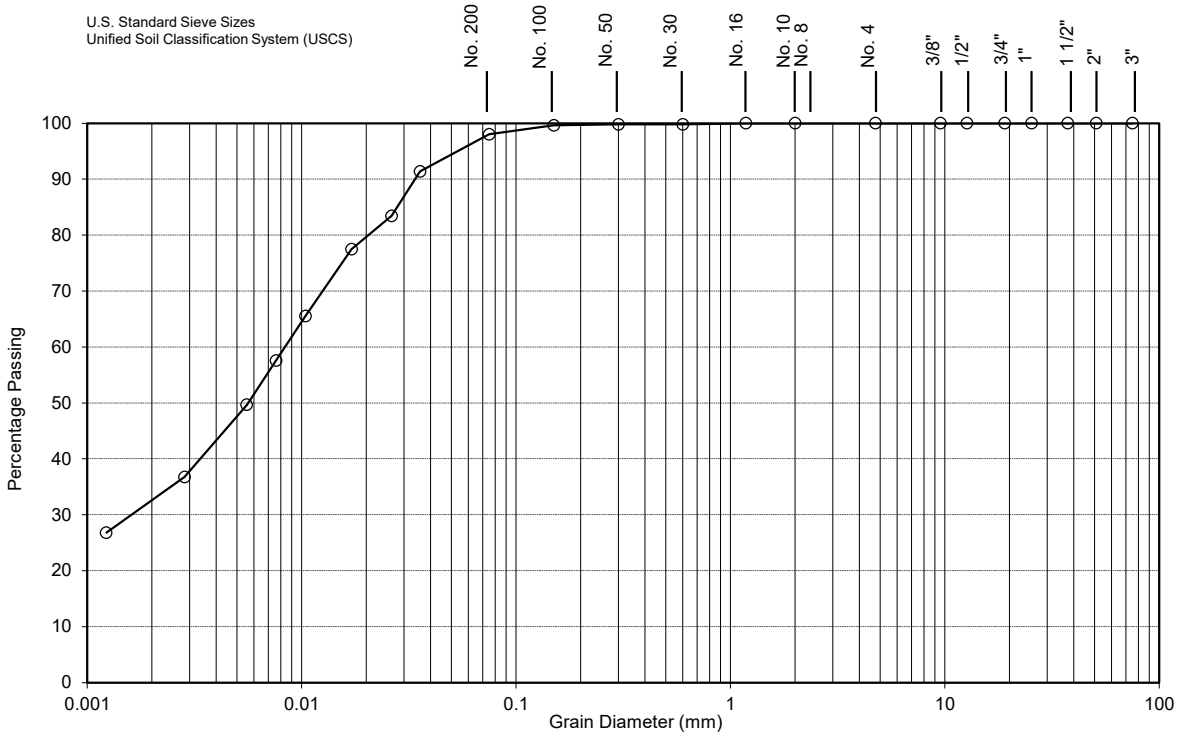
Shadow Creek, Township of Severn, Ontario

April 2020	**Grain Size Analysis No. 1**	**Project No.: SM 301553-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

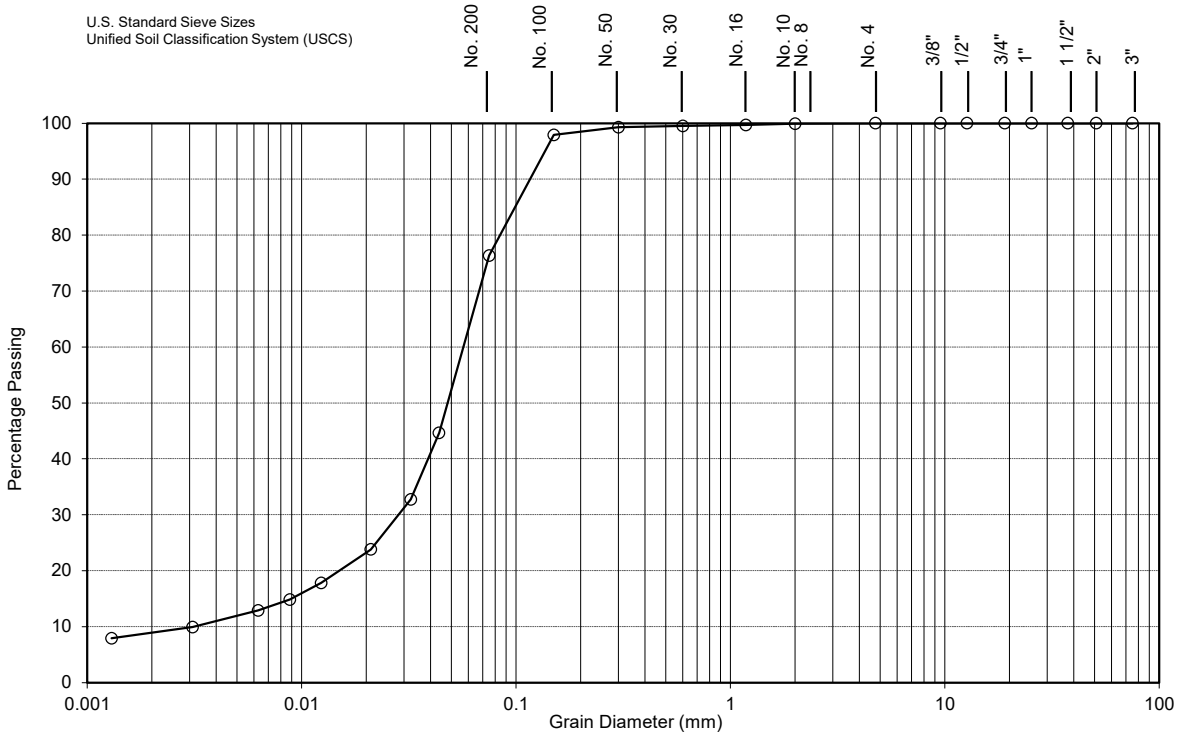
Lab No.:	**21-141**	Notes: Depth 10'			
Sample No.:	SS5				
Borehole No.:	3				
CLAY [%]:	**32**	Soil Description: **Brown Clayey Silt w/ traces of Sand**			
SILT [%]:	**66**	**M.L. - Inorganic silts, clayey silts with slight plasticity to C.L. - Inorganic clays of low to meduim plasticity**			
SAND [%]:	**2**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0008**	Coefficient of Uniformity C_U:	**10.6**	Coefficient of Curvature C_C:	**0.4**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Shadow Creek, Township of Severn, Ontario

April 2020	**Grain Size Analysis No. 2**	**Project No.: SM 301553-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**21-144**	Notes: Depth 7.5'			
Sample No.:	SS4				
Borehole No.:	4				
CLAY [%]:	**9**	Soil Description:	**Brown Sandy Silt w/ traces of Clay**		
SILT [%]:	**67**		**M.L. - Inorganic silts and very fine Sands, silty fine sands**		
SAND [%]:	**24**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**15**	Estimated Permeability, k [cm/s]	**10^{-5}**
D_{10} (Effective Diam. in mm):	**0.003**	Coefficient of Uniformity C_U:	**19.0**	Coefficient of Curvature C_C:	**4.9**

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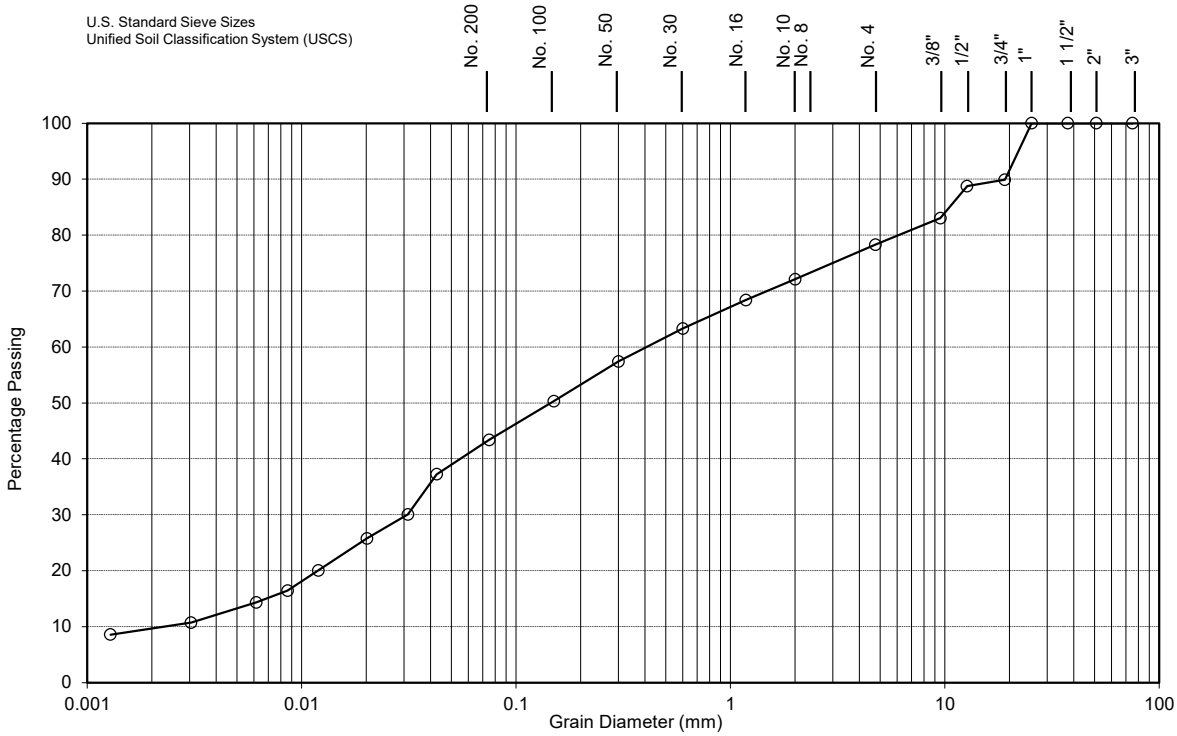
Shadow Creek, Township of Severn, Ontario

April 2020	**Grain Size Analysis No. 3**	**Project No.: SM 301553-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**21-142**	Notes: Depth 20'			
Sample No.:	SS7				
Borehole No.:	6				
CLAY [%]:	**10**	Soil Description: **Brown Gravelly Silty Sand w/ some Clay**			
SILT [%]:	**33**	**M.L. - Inorganic silts and very fine Sands, silty fine sands; to S.C. - clayey sands, sand-clay mixtures**			
SAND [%]:	**35**	**to S.C. - clayey sands, sand-clay mixtures**			
GRAVEL [%]:	**22**	Estimated Infiltration Rate [mm/hr] :	**12**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.002**	Coefficient of Uniformity C_U:	**200.0**	Coefficient of Curvature C_C:	**1.1**

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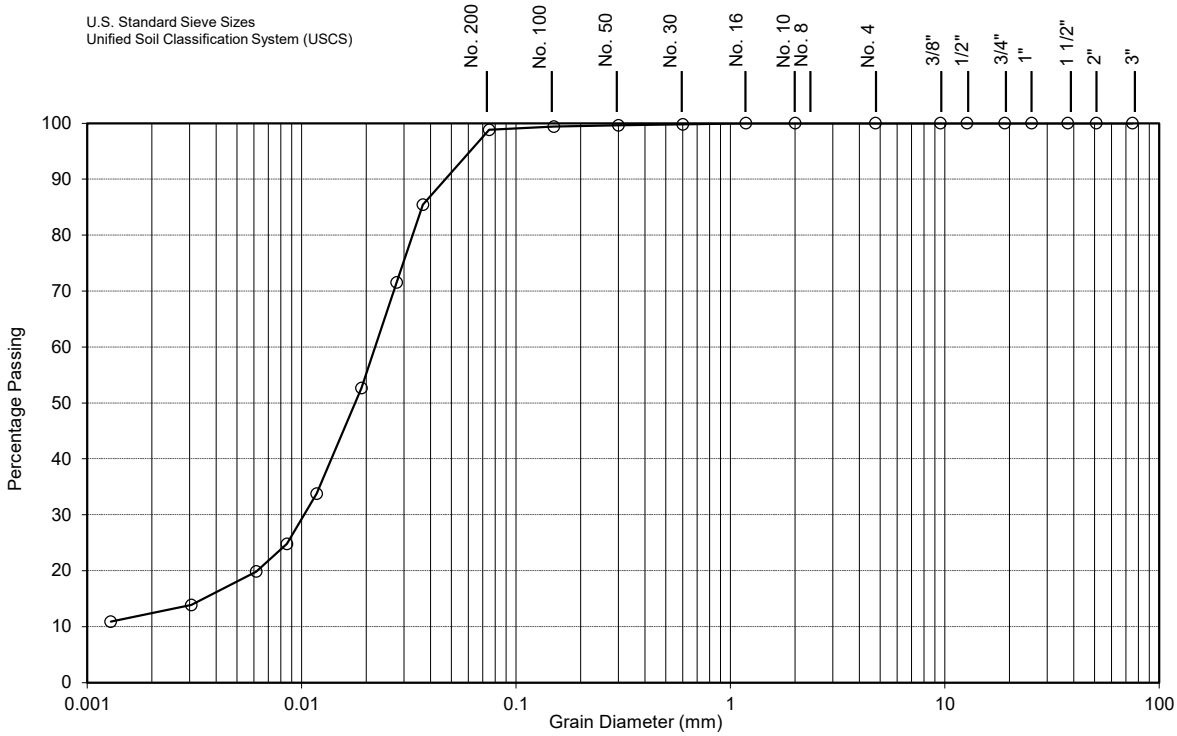
Shadow Creek, Township of Severn, Ontario

April 2020	**Grain Size Analysis No. 4**	**Project No.: SM 301553-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**21-140**	Notes: Depth 15'			
Sample No.:	SS6				
Borehole No.:	7				
CLAY [%]:	**13**	Soil Description:	**Brown Silt w/ some Clay and traces of Sand**		
SILT [%]:	**86**		**M.L. - Inorganic silts, clayey silts with slight plasticity**		
SAND [%]:	**1**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.0012**	Coefficient of Uniformity C_U:	**18.3**	Coefficient of Curvature C_C:	**4.6**

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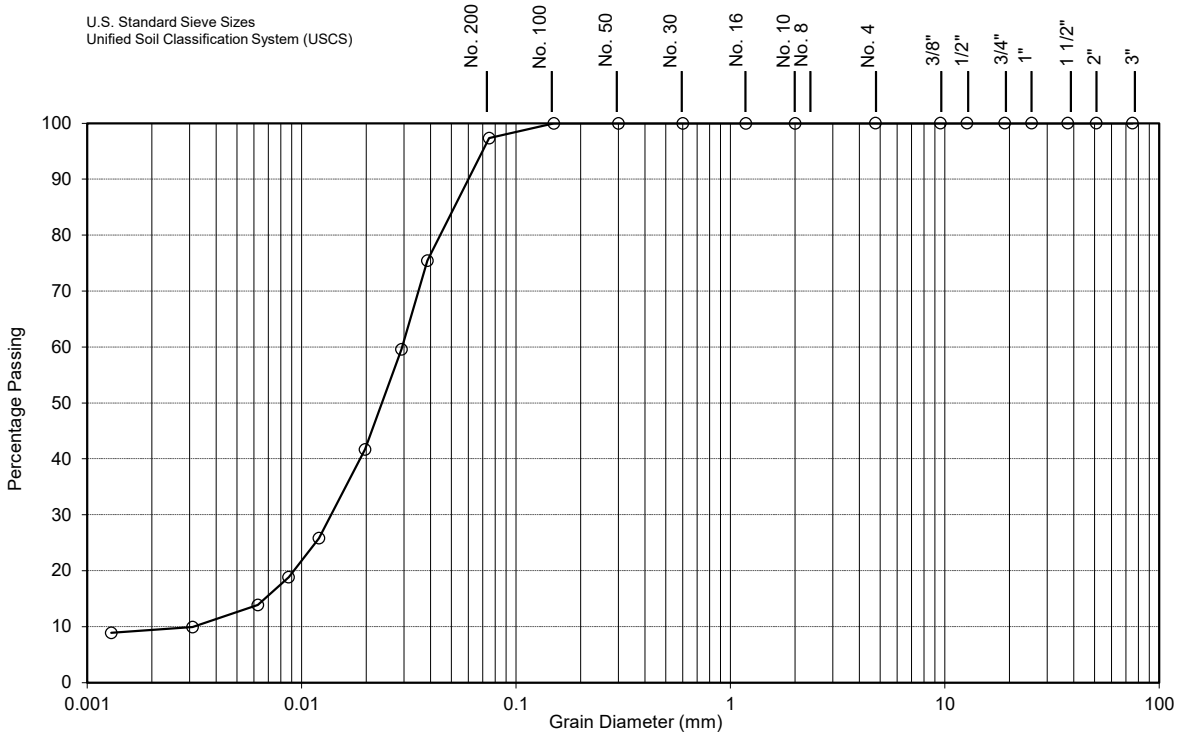
Shadow Creek, Township of Severn, Ontario

April 2020	**Grain Size Analysis No. 5**	**Project No.: SM 301553-T**

Mechanical & Hydrometer Analyses



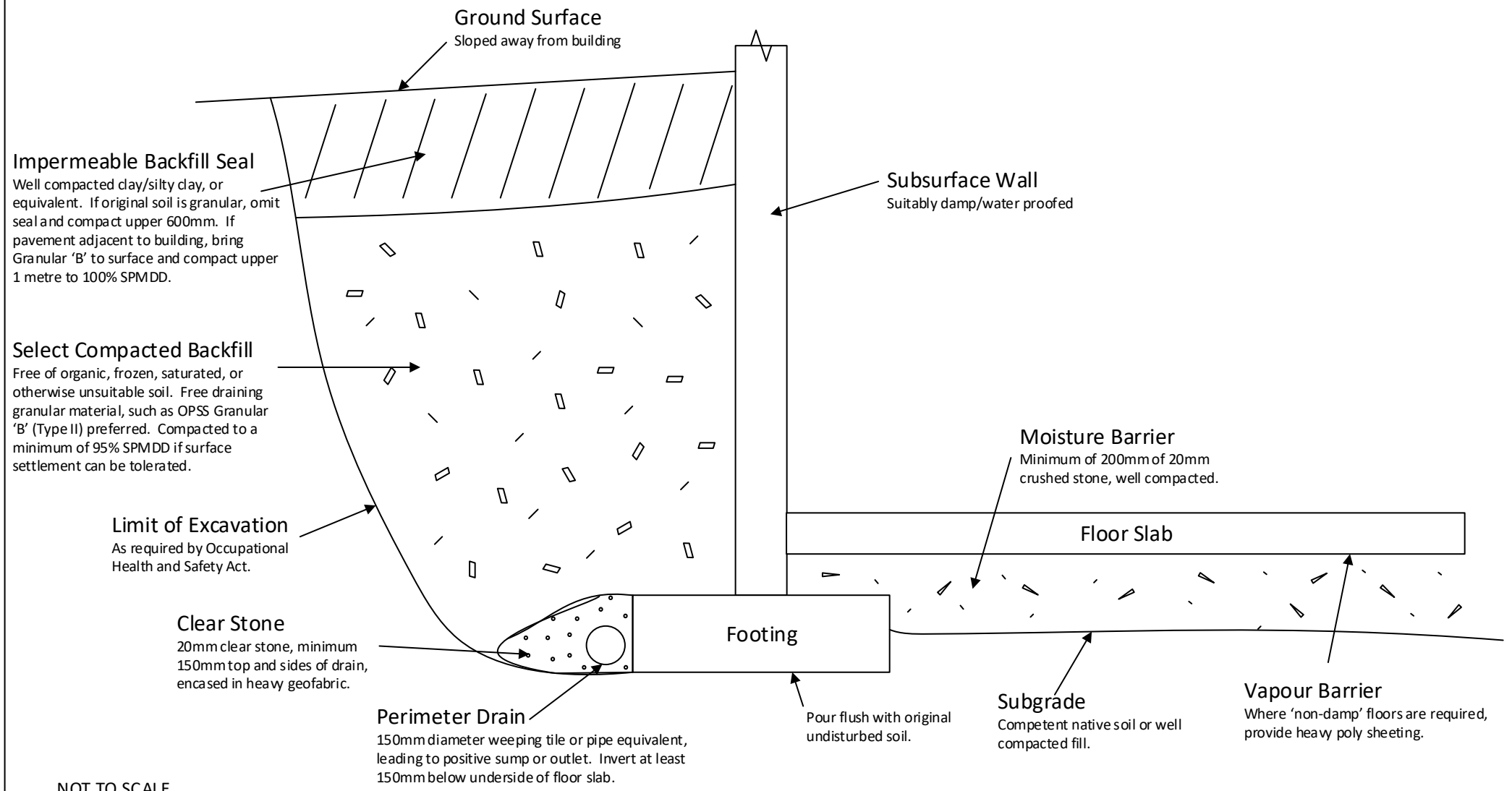
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**21-145**	Notes: Depth 10'			
Sample No.:	SS5				
Borehole No.:	9				
CLAY [%]:	**9**	Soil Description:	**Brown Silt w/ traces of Clay and Sand**		
SILT [%]:	**88**		**M.L. - Inorganic silts, silts with slight plasicity**		
SAND [%]:	**3**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.0032**	Coefficient of Uniformity C_U:	**14.5**	Coefficient of Curvature C_C:	**3.9**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Shadow Creek, Township of Severn, Ontario

April 2020	**Grain Size Analysis No. 6**	**Project No.: SM 301553-T**



NOT TO SCALE

Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.:	SM 301553-G
Date:	May 2021

Typical Design Requirements
Drainage and Backfill for Basement Walls

Drawing No. 2

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT
130 LANCING DRIVE
HAMILTON, ON L8W3A1
(905) 318-7440

ATTENTION TO: Ian Shaw

PROJECT: Shadow Creek, Orillia

AGAT WORK ORDER: 21T733225

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Apr 19, 2021

PAGES (INCLUDING COVER): 14

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2021-04-13

DATE REPORTED: 2021-04-19

		SAMPLE DESCRIPTION:		BH1 SS2	BH3 SS2	BH4 SS2	BH6 SS2	BH7 SS2	BH9 SS2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2021-04-08	2021-04-08	2021-04-08	2021-04-09	2021-04-09	2021-04-09 12:00
Parameter	Unit	G / S	RDL	2342511	2342512	2342513	2342514	2342515	2342516
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	1	2	2	2	2	1
Barium	µg/g	220	2.0	61.3	66.9	78.4	73.0	51.5	38.4
Beryllium	µg/g	2.5	0.4	<0.4	0.4	0.4	0.4	<0.4	<0.4
Boron	µg/g	36	5	<5	5	<5	7	<5	<5
Boron (Hot Water Soluble)	µg/g	NA	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	5	20	27	24	26	20	16
Cobalt	µg/g	21	0.5	4.6	5.9	6.1	7.0	5.6	4.0
Copper	µg/g	92	1.0	11.9	10.7	13.6	15.2	12.5	9.6
Lead	µg/g	120	1	2	3	3	4	3	2
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	8	13	12	14	11	8
Selenium	µg/g	1.5	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Silver	µg/g	0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	µg/g	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	µg/g	2.5	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vanadium	µg/g	86	0.4	41.4	38.8	50.6	46.5	37.8	35.8
Zinc	µg/g	290	5	26	26	35	33	27	19
Chromium, Hexavalent	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.194	0.128	0.169	0.090	0.051	0.080
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	2.4	N/A	0.247	0.286	0.506	0.210	0.207	0.207
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.32	7.20	7.10	7.14	6.74	7.38

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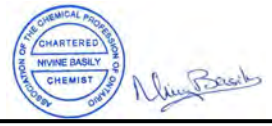

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Certificate of Analysis

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2021-04-13

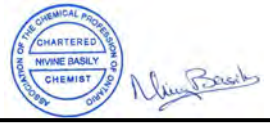
DATE REPORTED: 2021-04-19

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 406/19 TABLE 1: Full Depth Background Site Condition - RPIC
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

2342511-2342516 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

DATE RECEIVED: 2021-04-13 **DATE REPORTED: 2021-04-19**

				SAMPLE DESCRIPTION:	BH1 SS2	BH3 SS2	BH4 SS2	BH6 SS2	BH7 SS2	BH9 SS2
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	2021-04-08	2021-04-08	2021-04-08	2021-04-09	2021-04-09	2021-04-09 12:00
Parameter	**Unit**	**G / S**	**RDL**		**2342511**	**2342512**	**2342513**	**2342514**	**2342515**	**2342516**
F1 (C6 - C10)	µg/g		5		<5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5		<5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10		<10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50		<50	<50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50		<50	<50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50		NA	NA	NA	NA	NA	NA
Moisture Content	%		0.1		18.8	19.7	19.8	19.1	18.2	21.6
Surrogate	**Unit**	**Acceptable Limits**								
Toluene-d8	% Recovery	50-140			88	93	100	91	98	73
Terphenyl	%	60-140			87	82	62	93	75	72

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 406/19 TABLE 1: Full Depth Background Site Condition - RPIC
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

2342511-2342516 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
C6–C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contribution.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified without the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: N Popowkolof

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AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

O. Reg. 406/19 - VOCs (Soil)

DATE RECEIVED: 2021-04-13 **DATE REPORTED: 2021-04-19**

SAMPLE DESCRIPTION:				BH1 SS2	BH3 SS2	BH4 SS2	BH6 SS2	BH7 SS2	BH9 SS2
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2021-04-08	2021-04-08	2021-04-08	2021-04-09	2021-04-09	2021-04-09 12:00
Parameter	Unit	G / S	RDL	2342511	2342512	2342513	2342514	2342515	2342516
Dichlorodifluoromethane	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bromomethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trichlorofluoromethane	ug/g	0.25	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Acetone	ug/g	0.5	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trans- 1,2-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methyl tert-butyl Ether	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g	0.05	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Methyl Ethyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cis- 1,2-Dichloroethylene	ug/g	0.05	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloroform	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
1,2-Dichloroethane	ug/g	0.05	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,1,1-Trichloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzene	ug/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-Dichloropropane	ug/g	0.05	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Trichloroethylene	ug/g	0.05	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Bromodichloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methyl Isobutyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,2-Trichloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Toluene	ug/g	0.2	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibromochloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Chlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Certified By: N Popowkolof

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Certificate of Analysis

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

O. Reg. 406/19 - VOCs (Soil)

DATE RECEIVED: 2021-04-13 **DATE REPORTED: 2021-04-19**

				SAMPLE DESCRIPTION:	BH1 SS2	BH3 SS2	BH4 SS2	BH6 SS2	BH7 SS2	BH9 SS2
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	2021-04-08	2021-04-08	2021-04-08	2021-04-09	2021-04-09	2021-04-09 12:00
Parameter	**Unit**	**G / S**	**RDL**		**2342511**	**2342512**	**2342513**	**2342514**	**2342515**	**2342516**
m & p-Xylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Styrene	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylenes (Total)	ug/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichloropropene (Cis + Trans)	µg/g	0.05	0.04		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
n-Hexane	µg/g	0.05	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**								
Toluene-d8	% Recovery	50-140			96	99	83	98	98	85
4-Bromofluorobenzene	% Recovery	50-140			95	104	102	93	92	84

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 406/19 TABLE 1: Full Depth Background Site Condition - RPIC
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

2342511-2342516 The sample was analyzed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.
Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene + o-Xylene.
1,3-Dichloropropene total is a calculated parameter. The calculated value is the sum of Cis-1,3-Dichloropropene and Trans-1,3-Dichloropropene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: N Popowkolof

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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Apr 19, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	2353732		<0.8	<0.8	NA	< 0.8	134%	70%	130%	99%	80%	120%	85%	70%	130%
Arsenic	2353732		2	2	NA	< 1	120%	70%	130%	96%	80%	120%	97%	70%	130%
Barium	2353732		52.5	54.1	3.0%	< 2.0	96%	70%	130%	103%	80%	120%	103%	70%	130%
Beryllium	2353732		<0.4	<0.4	NA	< 0.4	113%	70%	130%	102%	80%	120%	105%	70%	130%
Boron	2353732		<5	5	NA	< 5	93%	70%	130%	113%	80%	120%	101%	70%	130%
Boron (Hot Water Soluble)	2342511	2342511	<0.10	<0.10	NA	< 0.10	84%	60%	140%	94%	70%	130%	96%	60%	140%
Cadmium	2353732		<0.5	<0.5	NA	< 0.5	89%	70%	130%	105%	80%	120%	104%	70%	130%
Chromium	2353732		17	17	NA	< 5	112%	70%	130%	108%	80%	120%	111%	70%	130%
Cobalt	2353732		4.1	3.9	5.0%	< 0.5	114%	70%	130%	107%	80%	120%	106%	70%	130%
Copper	2353732		7.6	7.5	1.3%	< 1.0	96%	70%	130%	103%	80%	120%	98%	70%	130%
Lead	2353732		17	15	12.5%	< 1	106%	70%	130%	104%	80%	120%	95%	70%	130%
Molybdenum	2353732		0.7	0.7	NA	< 0.5	117%	70%	130%	103%	80%	120%	108%	70%	130%
Nickel	2353732		7	7	0.0%	< 1	113%	70%	130%	105%	80%	120%	103%	70%	130%
Selenium	2353732		0.9	<0.8	NA	< 0.8	126%	70%	130%	100%	80%	120%	105%	70%	130%
Silver	2353732		<0.5	<0.5	NA	< 0.5	111%	70%	130%	109%	80%	120%	106%	70%	130%
Thallium	2353732		<0.5	<0.5	NA	< 0.5	102%	70%	130%	100%	80%	120%	96%	70%	130%
Uranium	2353732		<0.50	<0.50	NA	< 0.50	106%	70%	130%	102%	80%	120%	97%	70%	130%
Vanadium	2353732		34.2	34.1	0.3%	< 0.4	125%	70%	130%	107%	80%	120%	110%	70%	130%
Zinc	2353732		41	41	0.0%	< 5	104%	70%	130%	103%	80%	120%	101%	70%	130%
Chromium, Hexavalent	2342516	2342516	<0.2	<0.2	NA	< 0.2	96%	70%	130%	93%	80%	120%	84%	70%	130%
Cyanide, Free	2342511		<0.040	<0.040	NA	< 0.040	96%	70%	130%	100%	80%	120%	94%	70%	130%
Mercury	2353732		<0.10	<0.10	NA	< 0.10	111%	70%	130%	104%	80%	120%	102%	70%	130%
Electrical Conductivity (2:1)	2342511	2342511	0.194	0.195	0.5%	< 0.005	97%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	2342511	2342511	0.247	0.247	0.0%	NA									
pH, 2:1 CaCl2 Extraction	2343168		7.56	7.63	0.9%	NA	101%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

Certified By:

AGAT Laboratories

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TEL (905)712-5100
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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Apr 19, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)															
F1 (C6 - C10)	2341196		<5	<5	NA	< 5	106%	60%	140%	109%	60%	140%	92%	60%	140%
F2 (C10 to C16)	2342512	2342512	< 10	< 10	NA	< 10	110%	60%	140%	85%	60%	140%	80%	60%	140%
F3 (C16 to C34)	2342512	2342512	< 50	< 50	NA	< 50	109%	60%	140%	82%	60%	140%	79%	60%	140%
F4 (C34 to C50)	2342512	2342512	< 50	< 50	NA	< 50	102%	60%	140%	81%	60%	140%	85%	60%	140%
O. Reg. 406/19 - VOCs (Soil)															
Dichlorodifluoromethane	2343181		< 0.05	< 0.05	NA	< 0.05	86%	50%	140%	97%	50%	140%	108%	50%	140%
Vinyl Chloride	2343181		< 0.02	< 0.02	NA	< 0.02	106%	50%	140%	88%	50%	140%	108%	50%	140%
Bromomethane	2343181		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	78%	50%	140%	93%	50%	140%
Trichlorofluoromethane	2343181		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	89%	50%	140%	100%	50%	140%
Acetone	2343181		< 0.50	< 0.50	NA	< 0.50	90%	50%	140%	76%	50%	140%	106%	50%	140%
1,1-Dichloroethylene	2343181		< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	78%	60%	130%	85%	50%	140%
Methylene Chloride	2343181		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	109%	60%	130%	96%	50%	140%
Trans- 1,2-Dichloroethylene	2343181		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	100%	60%	130%	93%	50%	140%
Methyl tert-butyl Ether	2343181		< 0.05	< 0.05	NA	< 0.05	86%	50%	140%	80%	60%	130%	109%	50%	140%
1,1-Dichloroethane	2343181		< 0.02	< 0.02	NA	< 0.02	109%	50%	140%	113%	60%	130%	114%	50%	140%
Methyl Ethyl Ketone	2343181		< 0.50	< 0.50	NA	< 0.50	87%	50%	140%	85%	50%	140%	104%	50%	140%
Cis- 1,2-Dichloroethylene	2343181		< 0.02	< 0.02	NA	< 0.02	90%	50%	140%	105%	60%	130%	96%	50%	140%
Chloroform	2343181		< 0.04	< 0.04	NA	< 0.04	104%	50%	140%	96%	60%	130%	92%	50%	140%
1,2-Dichloroethane	2343181		< 0.03	< 0.03	NA	< 0.03	85%	50%	140%	105%	60%	130%	93%	50%	140%
1,1,1-Trichloroethane	2343181		< 0.05	< 0.05	NA	< 0.05	89%	50%	140%	100%	60%	130%	81%	50%	140%
Carbon Tetrachloride	2343181		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	89%	60%	130%	87%	50%	140%
Benzene	2343181		< 0.02	< 0.02	NA	< 0.02	99%	50%	140%	108%	60%	130%	113%	50%	140%
1,2-Dichloropropane	2343181		< 0.03	< 0.03	NA	< 0.03	87%	50%	140%	108%	60%	130%	113%	50%	140%
Trichloroethylene	2343181		< 0.03	< 0.03	NA	< 0.03	110%	50%	140%	90%	60%	130%	96%	50%	140%
Bromodichloromethane	2343181		< 0.05	< 0.05	NA	< 0.05	73%	50%	140%	95%	60%	130%	86%	50%	140%
Methyl Isobutyl Ketone	2343181		< 0.50	< 0.50	NA	< 0.50	102%	50%	140%	102%	50%	140%	113%	50%	140%
1,1,2-Trichloroethane	2343181		< 0.04	< 0.04	NA	< 0.04	91%	50%	140%	99%	60%	130%	98%	50%	140%
Toluene	2343181		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	109%	60%	130%	96%	50%	140%
Dibromochloromethane	2343181		< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	79%	60%	130%	87%	50%	140%
Ethylene Dibromide	2343181		< 0.04	< 0.04	NA	< 0.04	105%	50%	140%	88%	60%	130%	114%	50%	140%
Tetrachloroethylene	2343181		< 0.05	< 0.05	NA	< 0.05	114%	50%	140%	93%	60%	130%	94%	50%	140%
1,1,1,2-Tetrachloroethane	2343181		< 0.04	< 0.04	NA	< 0.04	97%	50%	140%	111%	60%	130%	92%	50%	140%
Chlorobenzene	2343181		< 0.05	< 0.05	NA	< 0.05	106%	50%	140%	108%	60%	130%	87%	50%	140%
Ethylbenzene	2343181		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	92%	60%	130%	89%	50%	140%
m & p-Xylene	2343181		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	101%	60%	130%	108%	50%	140%
Bromoform	2343181		< 0.05	< 0.05	NA	< 0.05	75%	50%	140%	78%	60%	130%	74%	50%	140%
Styrene	2343181		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	87%	60%	130%	97%	50%	140%
1,1,2,2-Tetrachloroethane	2343181		< 0.05	< 0.05	NA	< 0.05	92%	50%	140%	95%	60%	130%	96%	50%	140%
o-Xylene	2343181		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	92%	60%	130%	93%	50%	140%

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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Apr 19, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
1,3-Dichlorobenzene	2343181		< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	107%	60%	130%	108%	50%	140%
1,4-Dichlorobenzene	2343181		< 0.05	< 0.05	NA	< 0.05	119%	50%	140%	110%	60%	130%	115%	50%	140%
1,2-Dichlorobenzene	2343181		< 0.05	< 0.05	NA	< 0.05	112%	50%	140%	109%	60%	130%	111%	50%	140%
n-Hexane	2343181		< 0.05	< 0.05	NA	< 0.05	91%	50%	140%	103%	60%	130%	92%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: N Popowkolof

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QA Violation

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

ATTENTION TO: Ian Shaw

RPT Date: Apr 19, 2021

PARAMETER	Sample Id	Sample Description	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
				Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)											
Antimony		BH1 SS2	134%	70%	130%	99%	80%	120%	85%	70%	130%

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

ATTENTION TO: Ian Shaw

SAMPLING SITE:

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, Free	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER

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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
F1 (C6 - C10)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/FID
Toluene-d8	VOL-91-5009	modified from EPA SW-846 5030C & 8260D	(P&T)GC/MS
F2 (C10 to C16)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Moisture Content	ORG-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Benzene	VOL-91-5002	modified from EPA 5035C and EPA 8260D	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Xylenes (Total)	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS

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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 21T733225

PROJECT: Shadow Creek, Orillia

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SAMPLING SITE:

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
1,3-Dichloropropene (Cis + Trans)	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260D	(P&T)GC/MS
Toluene-d8	VOL-91-5002	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS

AGAT Laboratories

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Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Soil - Mat Engineers
Contact: Ian Shaw
Address: 130 Lancing Dr. Hamilton, ON
Phone: Fax:
Reports to be sent to:
1. Email: swylie@soilmat.ca
2. Email: ishaw@soilmat.ca

Project Information:

Project: Shadow Creek, Orillia
Site Location: Orillia
Sampled By: Scott Wylie
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis

Invoice Information:

Bill To Same: Yes ☐ No ☐
Company:
Contact:
Address:
Email:

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes) Table 406.

☐ Regulation 153/04
Table _____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region _____ *Indicate One*
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
_____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Laboratory Use Only

Work Order #: 21T733225
Cooler Quantity:
Arrival Temperatures: 8.2 | 8 | 7.6
6.4 | 6 | 6.8
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes:

Turnaround Time (TAT) Required:

Regular TAT ☐ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides))	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☒ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use							Potentially Hazardous or High Concentration (Y/N)
BH1 SS2	Apr 8/21	AM	3	Soil			X					X	X															
BH3 SS2	Apr 8/21	AM	3				X					X	X															
BH4 SS2	Apr 8/21	AM	3				X					X	X															
BH6 SS2	Apr 9/21	AM	3				X					X	X															
BH7 SS2	Apr 9/21	AM	3				X					X	X															
BH9 SS2	Apr 9/21	pm	3				X					X	X															

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign): Neil Ramnaraign	Date Apr. 13	Time 3:00
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign): Neil Ramnaraign	Date Apr. 13	Time 4:40
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page _____ of _____
N°: T 102325

APPENDIX B

Sanitary Flow Calculations

CROZIER CONSULTING ENGINEERS

Project: Shadow Creek
Project No.: 1935-6103
Date: January 12, 2022
Prepared By: I. Blechta
Checked By: N. O'Connor

Preliminary Sanitary Design Flow

Total Site Area	45.45	ha
Infiltration Area	28.38	ha
Number of Residential Units		
Number of Residential Units, Single Detached	319	units
Number of Residential Units, Townhouses	215	units
Total Number of Residential Units	**534**	**units**
Person Per Residential Unit (Per Township Engineering Stds.)	2.70	persons/unit
Residential Population	1,442	persons
Unit Sanitary Flows		
Infiltration Allowance (Per Township Engineering Stds.)	0.23	L/s/ha
Average Daily Domestic Flow per Capita (Recorded 5 Yr Avg Daily Volume to WWTP)*	253	L/C/day

Average Daily Flow Calculation*

Historical Flows (m^3/day)

Year	ADF	MDF	MDF Date
2016	540	1,669	Mar-16
2017	746	1,472	May-17
2018	634	1,374	Feb-18
2019	708	1,476	Apr-19
2020	712	1,362	Mar-20

5 Year Average Daily Flow (Per Uncommitted Capacity Report)	*668*	*m^3/day*
Existing Population (Per Uncommitted Capacity Report)	*2638*	*persons*
Average Daily Domestic Flow per Capita =	*0.253*	*m^3/C/day*
	253	*L/C/day*

Total Sanitary Design Flows		
Infiltration/Inflow	6.53	L/s
Average Residential Daily Domestic Flow	4.23	L/s
Residential Peak Factor (Harmon Formula)	3.69	
Maximum Peak Flow	15.60	L/s
Total Peak Sanitary Design Flow	**22.13**	**L/s**

Peak Wet Daily Flow (Residential)	**22.13**	**L/sec**
Average Dry Daily Flow (Residential)	**4.23**	**L/sec**
Average Wet Daily Flow (Residential)	**10.75**	**L/sec**

APPENDIX C

Water Demand Calculations

CROZIER
CONSULTING ENGINEERS

Project: Shadow Creek
Project No.: 1935-6103
Date: January 12, 2022
Prepared By: I. Blechta
Checked By: N. O'Connor

Preliminary Water Design Flow

Site Area	45.45	ha
Number of Residential Units		
Number of Residential Units, Single Detached	319	units
Number of Residential Units, Townhouses	215	units
Total Number of Residential Units	**534**	**units**
Person Per Residential Unit (Per Township Engineering Stds.)	2.70	persons/unit
Residential Population	1442	persons
Unit Water Flows		
Residential (Per Township Engineering Stds.)	450	L/C/day
Total Design Water Flows		
Average Residential Daily Flow	**7.51**	**L/s**
Max Day Peak Factor (per MOE Design of Water Works Table 3-1)	2.50	
Max Day Demand Flow	**18.78**	**L/s**
Peak Hour Factor (Min. per Township Engineering Stds.)	4.50	
Peak Hour Flow	**33.80**	**L/s**
Fire Flow Demand (per Fire Underwriters Survey)	100.0	L/s
Fire Flow (per OBC)	45.0	L/s
Peak Residential Design Flow (Fire Flow + Maximum Day Demand Hour)	**118.8**	**L/s**

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

where

F = Required fire flow in litres per minute
C = Coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings		Wood Frame
2	number of floors	1.5 C
91.5	sq.m. floor area	
183	sq.m. total floor area	

Therefore F= 4,000 L/min (rounded to nearest 1000 L/min)

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	No Charge		

Limited Combustible -15% reduction

-600 L/min reduction

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduce by up to 50% for complete automatic sprinkler protection.

Buildings will not have sprinklers (typical 30% reduction)

0 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings Towhouse each side and across street

Name		**Distance**			
North	Adjacent Dwelling	0	25%	850	Total percentage shall not
East	Adjacent Dwelling	15	15%	510	exceed 75%
South	Adjacent Dwelling	0	25%	850	
West	Adjacent Dwelling	35	5%	170	Calculated 70%
				2,380 L/min Surcharge	

Determine Required Fire Flow

No.1	4,000
No. 2	-600 reduction
No. 3	0 reduction
No. 4	2,380 surcharge
Required Flow:	**5,780 L/min**
Rounded to nearest 1000 l/min:	**6,000 L/min** or 100.0 L/s

Determine Required Fire Storage Volume

Flow from above 6,000 L/min

Required duratio 2.00 hours

Therefore: 720,000 Litres or
720 cu.m. is the required fire storage volume.

Required Duration of Fire Flow	
Flow Required L/min	Duration (hours)
2,000 or less	1.0
3,000	1.25
4,000	1.5
5,000	1.75
6,000	2.0
8,000	2.0
10,000	2.0
12,000	2.5
14,000	3.0
16,000	3.5
18,000	4.0
20,000	4.5
22,000	5.0
24,000	5.5
26,000	6.0
28,000	6.5
30,000	7.0
32,000	7.5
34,000	8.0
36,000	8.5
38,000	9.0
40,000 and over	9.5

Fire Protection Water Supply Guideline
Part 3 of the Ontario Building Code (2006)

$$Q = KVS_{TOT}$$

Q = Minimum supply of water in litres (L)
K = Water supply coefficient
V = Total building volume in cubic metres
S_{TOT} = Total of spatial coefficient values from property line exposures on all sides

K =	23.0	Group C building with combustible construction (Table 1)
V =	549	183sqm total floor area by 3m height
S_{TOT} =	2	S_{TOT} Need Not Exceed 2.0

Q = 25254 L

Based on ranges listed in Table 2, the required minimum water supply flow rate is **2700 L/min**

45 L/s

APPENDIX D

Hydrologic Parameter Sheets

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME	PRE-1
D.A. AREA (ha)	0.47

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-1

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Alliston Sandy Loam	Ans	B	90%	0.42
Tioga Loamy Sand	Tis	A	10%	0.05
				0
				0
Total Area				0.47

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Ans		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Ans	0.05	60	0.00	65	0.12	50	0.00	69	0.25	74	0.42	27.59
Tis	0.00	32	0.00	38	0.00	50	0.00	49	0.05	62	0.05	2.91
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.05		0.00		0.12		0.00		0.29			

Composite Area Calculations		
	Total Pervious Area	0.47
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	64.9
	Total Area Check	0.47

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Alliston Sandy RC	Alliston Sandy Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.05	0.55	0.25	0.05	0.08	0.00		0		0	0.01
Meadow	8	0.00	0.00	0.28	0.00	0.10	0.00		0		0	0.00
Wetland	16	0.12	1.96	0.05	0.12	0.05	0.00		0		0	0.01
Lawn	5	0.00	0.00	0.28	0.00	0.10	0.00		0		0	0.00
Cultivated	7	0.29	2.05	0.35	0.25	0.22	0.05		0		0	0.10
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		0.47	9.70	Composite Runoff Coefficient								0.25

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	220	6	2.73%	2.7	0.45	0.14	0.09	0.09	0.18	0.12	0.49	0.33

Appropriate calculated time to	0.33	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME **PRE-2**
D.A. AREA (ha) **3.35**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-2

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	64%	2.14
Tioga Loamy Sand	Tis	A	19%	0.64
Alliston Sandy Loam	Ans	B	17%	0.57
				0
Total Area				3.35

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
Ans		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.13	73	0.00	76	0.13	50	0.00	79	1.89	82	2.14	170.53
Tis	0.00	32	0.00	38	0.00	50	0.00	49	0.64	62	0.64	39.46
Ans	0.07	60	0.00	65	0.40	50	0.00	69	0.10	74	0.57	31.62
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.20		0.00		0.53		0.00		2.6			

Composite Area Calculations		
	Total Pervious Area	3.35
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	72.1
	Total Area Check	3.35

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
				Lovering Silty		Tioga Loamy Sand		Alliston Sandy		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	0.20	1.97	0.35	0.13	0.08	0.00	0.25	0.07		0	0.06
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00	0.28	0.00		0	0.00
Wetland	16	0.53	8.44	0.05	0.13	0.05	0.00	0.05	0.40		0	0.03
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00	0.28	0.00		0	0.00
Cultivated	7	2.63	18.38	0.55	1.89	0.22	0.64	0.35	0.10		0	1.21
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00	0.95	0.00		0	0.00
Composite IA		3.35	8.59	Composite Runoff Coefficient								0.39

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	280	5.28	1.89%	2.7	0.37	0.21	0.14	0.14	0.21	0.14	0.52	0.35

Appropriate calculated time to	0.35	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME **PRE-3**
D.A. AREA (ha) **4.83**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-3

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	69%	3.33
Tioga Loamy Sand	Tis	A	31%	1.50
				0
				0
Total Area				4.83

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0	0
Tis		98		98		98	0.08	98		98	0.08	7.84
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0.08		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.13	73	0.00	76	0.83	50	0.00	79	2.37	82	3.33	245.42
Tis	0.00	32	0.20	38	0.00	50	0.00	49	1.22	62	1.42	83.11
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.13		0.20		0.83		0.00		3.6			

Composite Area Calculations		
	Total Pervious Area	4.75
	Total Impervious Area	0.08
	% Impervious	1.7%
	Composite Curve Number	69.6
	Total Area Check	4.83

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.13	1.33	0.35	0.13	0.08	0.00		0		0	0.05
Meadow	8	0.20	1.59	0.40	0.00	0.10	0.20		0		0	0.02
Wetland	16	0.83	13.33	0.05	0.83	0.05	0.00		0		0	0.04
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	3.59	25.10	0.55	2.37	0.22	1.22		0		0	1.57
Impervious	2	0.08	0.16	0.95	0.00	0.95	0.08		0		0	0.08
Composite IA		4.83	8.59	Composite Runoff Coefficient								0.36

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	380	8.5	2.24%	2.7	0.40	0.26	0.18	0.18	0.26	0.18	0.60	0.40

Appropriate calculated time to	0.40	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME **PRE-4**
D.A. AREA (ha) **4.59**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-4

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	60%	2.75
Tioga Loamy Sand	Tis	A	40%	1.84
				0
				0
Total Area				4.59

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98	0.07	98		98	0.07	6.86
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0.07		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.11	73	0.00	76	0.33	50	0.00	79	2.31	82	2.75	214.26
Tis	0.00	32	0.41	38	0.00	50	0.00	49	1.36	62	1.77	99.74
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.11		0.41		0.33		0.00		3.7			

Composite Area Calculations		
	Total Pervious Area	4.52
	Total Impervious Area	0.07
	% Impervious	1.5%
	Composite Curve Number	69.9
	Total Area Check	4.59

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.11	1.1016	0.35	0.11	0.08	0.00		0		0	0.04
Meadow	8	0.41	3.25	0.40	0.00	0.10	0.41		0		0	0.04
Wetland	16	0.33	5.29	0.05	0.33	0.05	0.00		0		0	0.02
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	3.67	25.71	0.55	2.31	0.22	1.36		0		0	1.57
Impervious	2	0.07	0.14	0.95	0.00	0.95	0.07		0		0	0.07
Composite IA		4.59	7.73	Composite Runoff Coefficient								0.38

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	420	8.5	2.02%	2.7	0.38	0.30	0.20	0.20	0.30	0.20	0.64	0.43

Appropriate calculated time to	0.43	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME **PRE-5**
D.A. AREA (ha) **8.04**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-5

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	52%	4.18
Tioga Loamy Sand	Tis	A	48%	3.86
				0
				0
Total Area				8.04

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.13	73	0.00	76	0.38	50	0.00	79	3.68	82	4.18	329.66
Tis	0.00	32	0.00	38	0.00	50	0.00	49	3.82	62	3.82	236.88
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.13		0.00		0.38		0.00		7.50			

Composite Area Calculations		
	Total Pervious Area	8.00
	Total Impervious Area	0.0
	% Impervious	0.5%
	Composite Curve Number	70.5
	Total Area Check	8.04

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.13	1.25	0.35	0.13	0.08	0.00		0		0	0.04
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Wetland	16	0.38	6.02	0.05	0.38	0.05	0.00		0		0	0.02
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	7.50	52.50	0.55	3.68	0.22	3.82		0		0	2.86
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		8.00	7.47	Composite Runoff Coefficient								0.36

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	490	7.25	1.48%	2.7	0.33	0.41	0.28	0.28	0.35	0.23	0.78	0.52

Appropriate calculated time to	0.52	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME **PRE-6**
D.A. AREA (ha) **8.64**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-6

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	46%	3.97
Tioga Loamy Sand	Tis	A	54%	4.67
				0
				0
Total Area				8.64

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.91	73	0.00	76	2.11	50	0.00	79	0.95	82	3.97	250.27
Tis	0.75	32	0.00	38	0.89	50	0.00	49	3.03	62	4.67	256.23
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	1.66		0.00		2.99		0.00		3.99			

Composite Area Calculations		
	Total Pervious Area	8.64
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	58.6
	Total Area Check	8.64

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
				Lovering Silty		Tioga Loamy Sand		0		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	1.66	16.61	0.35	0.91	0.08	0.75		0		0	0.38
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Wetland	16	2.99	47.89	0.05	2.11	0.05	0.89		0		0	0.15
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	3.99	27.91	0.55	0.95	0.22	3.03		0		0	1.19
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		8.64	10.69	Composite Runoff Coefficient								0.20

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	580	7.53	1.30%	4.6	0.52	0.31	0.21	0.21	0.42	0.28	1.08	0.72

Appropriate calculated time to	0.72	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: N. Sproule

D.A. NAME **PRE-7**
D.A. AREA (ha) **1.81**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-7

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	100%	1.81
Tioga Loamy Sand	Tis	A	0%	0.00
				0
				0
Total Area				1.81

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Lvs	0.16	73	0.00	76	0.16	50	0.00	79	1.48	82	1.81	141.74
Tis	0.00	32	0.00	38	0.00	50	0.00	49	0.00	62	0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.16		0.00		0.16		0.00		1.48			

Composite Area Calculations		
	Total Pervious Area	1.81
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	78.3
	Total Area Check	1.81

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
				Lovering Silty		Tioga Loamy Sand		0		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	0.16	1.63	0.35	0.16	0.08	0.00		0		0	0.06
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Wetland	16	0.16	2.61	0.05	0.16	0.05	0.00		0		0	0.01
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	1.48	10.39	0.55	1.48	0.22	0.00		0		0	0.82
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		1.81	8.08	Composite Runoff Coefficient								0.49

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	260	2.75	1.06%	2.7	0.28	0.26	0.17	0.17	0.23	0.15	0.53	0.35

Appropriate calculated time to	0.15	Appropriate Method:	Bransby Williams

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-01
By: N. Sproule

D.A. NAME **PRE-8**
D.A. AREA (ha) **2.15**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-8

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	82%	1.76
Tioga Loamy Sand	Tis	A	18%	0.39
				0
				0
Total Area				2.15

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.09	73	0.00	76	0.16	50	0.00	79	1.52	82	1.76	138.70
Tis	0.00	32	0.00	38	0.00	50	0.00	49	0.39	62	0.39	23.99
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.09		0.00		0.16		0.00		1.90			

Composite Area Calculations		
	Total Pervious Area	2.15
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	75.7
	Total Area Check	2.15

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.09	0.88	0.35	0.09	0.08	0.00		0		0	0.03
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Wetland	16	0.16	2.54	0.05	0.16	0.05	0.00		0		0	0.01
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	1.90	13.32	0.55	1.52	0.22	0.39		0		0	0.92
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		2.15	7.79	Composite Runoff Coefficient								0.45

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	430	5.75	1.34%	2.7	0.31	0.38	0.26	0.26	0.36	0.24	0.67	0.45

Appropriate calculated time to	0.24	Appropriate Method:	Bransby Williams

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-01
By: N. Sproule

D.A. NAME **PRE-9**
D.A. AREA (ha) **4.52**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-9

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	74%	3.34
Tioga Loamy Sand	Tis	A	26%	1.18
				0
				0
Total Area				4.52

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.13	73	0.00	76	0.23	50	0.00	79	2.98	82	3.34	265.58
Tis	0.00	32	0.00	38	0.00	50	0.00	49	1.18	62	1.18	72.86
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.13		0.00		0.23		0.00		4.15			

Composite Area Calculations		
	Total Pervious Area	4.52
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	74.9
	Total Area Check	4.52

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.13	1.34	0.35	0.13	0.08	0.00		0		0	0.05
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Wetland	16	0.23	3.75	0.05	0.23	0.05	0.00		0		0	0.01
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	4.15	29.06	0.55	2.98	0.22	1.18		0		0	1.90
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		4.52	7.56	Composite Runoff Coefficient								0.43

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	430	5.75	1.34%	2.7	0.31	0.38	0.26	0.26	0.33	0.22	0.68	0.46

Appropriate calculated time to	0.22	Appropriate Method:	Bransby Williams

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-01
By: N. Sproule

D.A. NAME **PRE-10**
D.A. AREA (ha) **4.32**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-10

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	76%	3.28
Tioga Loamy Sand	Tis	A	24%	1.04
				0
				0
Total Area				4.32

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Lvs	0.10	73	0.00	76	0.07	50	0.00	79	3.12	82	3.28	266.23
Tis	0.00	32	0.00	38	0.00	50	0.00	49	1.04	62	1.04	64.28
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.10		0.00		0.07		0.00		4.16			

Composite Area Calculations		
	Total Pervious Area	4.32
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	76.5
	Total Area Check	4.32

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
				Lovering Silty		Tioga Loamy Sand		0		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	0.10	0.98	0.35	0.10	0.08	0.00		0		0	0.03
Meadow	8	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Wetland	16	0.07	1.05	0.05	0.07	0.05	0.00		0		0	0.00
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	4.16	29.09	0.55	3.12	0.22	1.04		0		0	1.94
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		4.32	7.21	Composite Runoff Coefficient								0.46

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	380	5.5	1.45%	2.7	0.32	0.32	0.22	0.22	0.29	0.19	0.60	0.40

Appropriate calculated time to	0.19	Appropriate Method:	Bransby Williams

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-01
By: N. Sproule

D.A. NAME	PRE-11
D.A. AREA (ha)	1.13

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-11

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	100%	1.13
				0
				0
				0
Total Area				1.13

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.09	73	0.09	76	0.17	50	0.00	79	0.78	82	1.13	85.88
0	0.00	32	0.00	38	0.00	50	0.00	49	0.00	62	0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.09		0.09		0.17		0.00		0.78			

Composite Area Calculations		
	Total Pervious Area	1.13
	Total Impervious Area	0.0
	% Impervious	0.0%
	Composite Curve Number	76.0
	Total Area Check	1.13

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	0 RC	0 Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.09	0.90	0.35	0.09	0.08	0.00		0		0	0.03
Meadow	8	0.09	0.72	0.40	0.09	0.10	0.00		0		0	0.04
Wetland	16	0.17	2.71	0.05	0.17	0.05	0.00		0		0	0.01
Lawn	5	0.00	0.00	0.40	0.00	0.10	0.00		0		0	0.00
Cultivated	7	0.78	5.46	0.55	0.78	0.22	0.00		0		0	0.43
Impervious	2	0.00	0.00	0.95	0.00	0.95	0.00		0		0	0.00
Composite IA		1.13	8.67	Composite Runoff Coefficient								0.45

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Pasture/ Meadow	200	1.75	0.88%	2.7	0.25	0.22	0.15	0.15	0.19	0.13	0.52	0.35

Appropriate calculated time to	0.13	Appropriate Method:	Bransby Williams

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project No.: 1935-6103
Date: 2022-01-13
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-1**
D.A. AREA (ha) **17.67**

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment POST-1

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic Group	% Area	Area
Alliston Sandy Loam	ASL	B	2	0.4
Tioga Loamy Sand	TIG	A	53	9.4
Lovering Silty	LVR	C	45	7.87
				0
Total Area Check				17.67

Impervious Landuses Present:

Soils	Roadway Area (ha)	CN	Sidewalk Area (ha)	CN	Driveway Area (ha)	CN	Building Area (ha)	CN	SWMF Area (ha)	CN	Subtotals Area	A*CN
ASL	0.07	98	0.01	98		98	0.03	98		98	0.10	10
TIG	3.13	98	0.18	98		98	2.20	98		98	5.51	540
LVR	2.64	98	0.20	98		98	1.54	98		98	4.37	428
0		98		98		98		98		98	0	0
Subtotal Area	5.84		0.38		0		3.76		0		9.98	

Pervious Landuses Present:

Soils	Woodland Area (ha)	CN	Meadow Area (ha)	CN	Wetland Area (ha)	CN	Lawn Area (ha)	CN	Cultivated Area (ha)	CN	Subtotals Area	A*CN
ASL	0		0		0		0.30	69	0		0.30	20.53
TIG	0		0		0		3.89	49	0		3.89	190.78
LVR	0		0		0		3.50	79	0		3.50	276.50
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		7.69		0			

Pervious Area Calculations	Total Pervious Area	7.69	
	Composite Pervious Curve Number	63.43	
Impervious Area Calculations	Total Directly Connected Area	6.22	
	Total Indirectly Connected Area	3.76	
	Total Impervious Area*	9.98	
	% X imp	35.2	
	% T imp	56.5	
	Total Area Check	17.67	

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	7.69	38.46
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	20	0.25
Impervious	2.0	0.5	343	0.013

*Impervious percentages for Single Detached and Townhouses taken from Township of Severn Standards.

Project Name:	Shadow Creek	**D.A. NAME**	**POST-2**
Project No.:	1935-6103	**D.A. AREA (ha)**	**10.71**
Date:	2022-01-13		
By:	Z. Holland		
Checked By:	N. O'Connor		

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment POST-2

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic Group	% Area	Area
Tioga Loamy Sand	TIG	A	22	2.4
Lovering Silty Clay Loam	LVR	C	78	8.31
				0
				0
Total Area Check				10.71

Impervious Landuses Present:

Soils	Roadway Area (ha)	CN	Sidewalk Area (ha)	CN	Driveway Area (ha)	CN	Building Area (ha)	CN	SWMF Area (ha)	CN	Subtotals Area	A*CN
TIG	0.86	98	0.06	98		98	0.55	98		98	1.47	144.11
LVR	2.85	98	0.18	98		98	1.71	98		98	5	465
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	3.71		0.24		0		2.26		0		6.21	

Pervious Landuses Present:

Soils	Woodland Area (ha)	CN	Meadow Area (ha)	CN	Wetland Area (ha)	CN	Lawn Area (ha)	CN	Cultivated Area (ha)	CN	Subtotals Area	A*CN
TIG	0		0		0		0.93	49	0		0.93	45.55
LVR	0		0		0		3.57	79	0		3.57	282.03
0	0		0		0		0		0		0.00	0.00
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		4.50		0			

Pervious Area Calculations	Total Pervious Area	4.50	
	Composite Pervious Curve Number	72.80	
Impervious Area Calculations	Total Directly Connected Area	3.95	
	Total Indirectly Connected Area	2.26	
	Total Impervious Area*	6.21	
	% X imp	36.9	
	% T imp	58.0	
	Total Area Check	10.71	

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	4.50	22.50
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	20	0.25
Impervious	2.0	0.5	267	0.013

*Impervious percentages for Single Detached and Townhouses taken from Township of Severn Standards.

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2022-01-13
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-3**
D.A. AREA (ha) **2.92**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment POST-3

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Alliston Sandy Loam	ASL	B	21%	0.60
Lovering Silty Clay Loam	LVR	C	79%	2.32
				0
				0
Total Area				2.92

Impervious Landuses Present:

Soils		Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
ASL			98		98		98		98		98	0.00	0.00
LVR			98		98		98		98		98	0	0
	0		98		98		98		98		98	0	0
	0		98		98		98		98		98	0	0
Subtotal Area		0		0		0		0		0			

Pervious Landuses Present:

Soils		Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
ASL		0.14	60	0		0.46	50	0		0		0.60	31.40
LVR		0.27	73	0		2.05	50	0		0		2.32	122
	0	0		0		0		0		0		0	0
	0	0		0		0		0		0		0	0
Subtotal Area		0.41		0		2.51		0		0			

Composite Area Calculations		
	Total Pervious Area	2.92
	Total Impervious Area	0.0
	% Impervious	0%
	Composite Curve Number	52.6
	Total Area Check	2.92

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
				Alliston Sandy		Lovering Silty Clay		0		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	0.41	4.1	0.25	0.14	0.35	0.27		0		0	0.13
Meadow	8	0.00	0		0		0		0		0	0
Wetland	16	2.51	40.16	0.05	0.46	0.50	2.05		0		0	1.05
Lawn	5	0.00	0		0		0		0		0	0
Cultivated	7	0.00	0		0		0		0		0	0
Impervious	2	0.00	0		0		0		0		0	0
Composite IA		2.92	15.16	Composite Runoff Coefficient								0.40

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Overland	125	1.5	1.20%	2.7	0.30	0.12	0.08	0.08	0.10	0.07	0.40	0.27

Appropriate calculated time to	0.27	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2022-01-13
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-4**
D.A. AREA (ha) **0.63**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment POST-4

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Tioga Loamy Sand	Tis	A	100%	0.63
				0.00
				0
				0
Total Area				0.63

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Tis		98		98		98		98		98	0.00	0.00
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Tis	0.11	32	0.26	38	0.26	50	0		0		0.63	26.40
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0.11		0		0.26		0		0			

Composite Area Calculations		
	Total Pervious Area	0.63
	Total Impervious Area	0.0
	% Impervious	0%
	Composite Curve Number	41.9
	Total Area Check	0.63

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Tioga Loamy RC	Tioga Loamy Area	0 RC	0 Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.11	1.1	0.08	0.11		0		0		0	0.01
Meadow	8	0.26	2.08	0.10	0.26		0		0		0	0
Wetland	16	0.26	4.16	0.05	0.26		0		0		0	0.01
Lawn	5	0.00	0		0		0		0		0	0
Cultivated	7	0.00	0	0.22	0		0		0		0	0.00
Impervious	2	0.00	0		0		0		0		0	0
Composite IA		0.63	11.65	Composite Runoff Coefficient								0.08

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Overland	127	4.45	3.50%	4.6	0.86	0.04	0.03	0.03	0.10	0.07	0.41	0.28

Appropriate calculated time to	0.28	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2022-01-13
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-5**
D.A. AREA (ha) **0.12**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment POST-5

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Tioga Loamy Sand	Tis	A	100%	0.12
				0.00
				0
				0
Total Area				0.12

Impervious Landuses Present:

Soils		Roadway Area	CN	Sidewalk Area	CN	Driveway Area	CN	Building Area (ha)	CN	SWMF Area	CN	Subtotals Area	A*CN
Tis			98		98		98		98		98	0.00	0.00
	0		98		98		98		98		98	0	0
	0		98		98		98		98		98	0	0
	0		98		98		98		98		98	0	0
Subtotal Area		0		0		0		0		0			

Pervious Landuses Present:

Soils		Woodland Area	CN	Meadow Area	CN	Wetland Area	CN	Lawn Area (ha)	CN	Cultivated Area	CN	Subtotals Area	A*CN
Tis		0		0.09	38	0.03	50	0		0		0.12	4.92
	0	0		0		0		0		0		0	0
	0	0		0		0		0		0		0	0
	0	0		0		0		0		0		0	0
Subtotal Area		0		0.09		0.03		0		0			

Composite Area Calculations		
	Total Pervious Area	0.12
	Total Impervious Area	0.0
	% Impervious	0%
	Composite Curve Number	41.0
	Total Area Check	0.12

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Tioga Loamy RC	Tioga Loamy Area	0 RC	0 Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.00	0	0.08	0.00		0.00		0		0	0.00
Meadow	8	0.09	0.72	0.10	0.09		0		0		0	0
Wetland	16	0.03	0.48	0.05	0.03		0.00		0		0	0.00
Lawn	5	0.00	0		0		0		0		0	0
Cultivated	7	0.00	0	0.22	0		0.00		0		0	0.00
Impervious	2	0.00	0		0		0		0		0	0
Composite IA		0.12	10.00	Composite Runoff Coefficient								0.09

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Overland	56	1.83	3.27%	4.6	0.83	0.02	0.01	0.01	0.05	0.03	0.28	0.19

Appropriate calculated time to	0.19	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2021-12-07
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-6**
D.A. AREA (ha) **2.32**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment POST-6

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	22%	0.50
Tioga Loamy Sand	Tis	A	78%	1.82
				0
				0
Total Area				2.32

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
Tis		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	0.06	73	0.18	76	0.26	50	0		0		0.50	31.06
Tis	0.59	32	0.71	38	0.52	50	0		0		1.82	71.86
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0.65		0.89		0.78		0		0			

Composite Area Calculations		
	Total Pervious Area	2.32
	Total Impervious Area	0.0
	% Impervious	0%
	Composite Curve Number	44.4
	Total Area Check	2.32

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
				Lovering Silty		Tioga Loamy Sand		0		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	0.65	6.5	0.35	0.06	0.08	0.59		0		0	0.07
Meadow	8	0.89	7.12	0.40	0.18	0.10	0.71		0		0	0
Wetland	16	0.78	12.48	0.05	0.26	0.05	0.52		0		0	0.04
Lawn	5	0.00	0		0		0		0		0	0
Cultivated	7	0.00	0	0.55	0	0.22	0		0		0	0.00
Impervious	2	0.00	0		0		0		0		0	0
Composite IA		2.32	11.25	Composite Runoff Coefficient								0.11

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Overland	213	2.39	1.12%	4.6	0.49	0.12	0.08	0.08	0.18	0.12	0.76	0.51

Appropriate calculated time to	0.51	Appropriate Method:	Airport

CROZIER & ASSOCIATES
Consulting Engineers

Project Name: Shadow Creek
Project No.: 1935-6103
Date: 2021-11-25
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-7**
D.A. AREA (ha) **0.15**

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment POST-7

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic Group	% Area	Area
Lovering Silty Clay Loam	LVR	C	100	0.15
				0
				0
				0
Total Area Check				0.15

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
LVR	0.12	98		98		98		98		98	0.12	11.76
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0.12		0.00		0		0.00		0		0.12	

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
LVR	0		0		0		0.03	79	0		0.03	2.37
0	0		0		0		0		0		0.00	0.00
0	0		0		0		0		0		0.00	0.00
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.03		0			

Pervious Area Calculations	Total Pervious Area	0.03
	Composite Pervious Curve Number	79.00
Impervious Area Calculations	Total Directly Connected Area	0.12
	Total Indirectly Connected Area	0.00
	Total Impervious Area*	0.12
	% X imp	80.0
	% T imp	80.0
	Total Area Check	0.15

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.03	0.15
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	20	0.25
Impervious	2.0	0.5	32	0.013

*Impervious percentages for Single Detached and Townhouses taken from Township of Severn Standards.

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 2022-01-13
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **POST-8**
D.A. AREA (ha) **6.26**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment POST-8

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	100%	6.26
				0
				0
				0
Total Area				6.26

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
Lvs		98		98		98		98		98	0.00	0.00
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
Lvs	1.59	73	1.94	76	2.73	50	0		0		6.26	400.01
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	1.59		1.94		2.73		0		0			

Composite Area Calculations		
	Total Pervious Area	6.26
	Total Impervious Area	0.0
	% Impervious	0%
	Composite Curve Number	63.9
	Total Area Check	6.26

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Curve Number								
Landuse	IA (mm)	Area (ha)	A * IA	Lovering Silty RC	Lovering Silty Area	0 RC	0 Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	1.59	15.9	0.35	1.59		0		0		0	0.56
Meadow	8	1.94	15.52	0.40	1.94		0		0		0	1
Wetland	16	2.73	43.68	0.05	2.73		0		0		0	0.14
Lawn	5	0.00	0		0		0		0		0	0
Cultivated	7	0.00	0	0.55	0		0		0		0	0.00
Impervious	2	0.00	0		0		0		0		0	0
Composite IA		6.26	12.00	Composite Runoff Coefficient								0.23

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Overland	320	1.49	0.47%	4.6	0.31	0.28	0.19	0.19	0.29	0.20	1.08	0.73

Appropriate calculated time to	0.73	Appropriate Method:	Airport

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project No.: 1935-6103
Date: 2021-11-29
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **SWMF 1**
D.A. AREA (ha) **1.92**

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment SWMF 1

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	100.0	1.92
				0
				0
				0
Total Area Check				1.92

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Lvs		98		98		98		98	0.96	98	0.96	94.08
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0.96			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Lvs	0		0		0		0.96	79	0		0.96	75.84
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.96		0			

Pervious Area Calculations	Total Pervious Area	0.96
	Composite Pervious Curve Number	79
Impervious Area Calculations	Total Directly Connected Area	0.96
	Total Indirectly Connected Area	0
	Total Impervious Area	0.96
	% X imp	50.0
	% T imp	50.0
	Total Area Check	1.92

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.96	4.80
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	20	0.25
Impervious	2.0	2	113	0.013

CROZIER & ASSOCIATES Consulting Engineers

Project Name: Shadow Creek
Project No.: 1935-6103
Date: 2021-11-29
By: Z. Holland
Checked By: N. O'Connor

D.A. NAME **SWMF 2**
D.A. AREA (ha) **1.15**

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment SWMF 2

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Lovering Silty Clay Loam	Lvs	C	100.0	1.15
				0
				0
				0
Total Area Check				1.15

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Lvs		98		98		98		98	0.58	98	0.58	56.35
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0.58			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Lvs	0		0		0		0.58	79	0		0.58	45.43
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.58		0			

Pervious Area Calculations	Total Pervious Area	0.58
	Composite Pervious Curve Number	79
Impervious Area Calculations	Total Directly Connected Area	0.58
	Total Indirectly Connected Area	0
	Total Impervious Area	0.58
	% X imp	50.0
	% T imp	50.0
	Total Area Check	1.15

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.575	2.88
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	20	0.25
Impervious	2.0	2	88	0.013

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 24-Nov-21
Prepared By: S. Moneypenny
Checked By: N. O'Connor

D.A. NAME **EXT-1**
D.A. AREA (ha) **51.3**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment EXT-1

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Vasey Sandy Loam	Vasl	B	32	16.31
Tioga Loamy Sand Stoney	Tis-b	A	38	19.28
Tioga Loamy Sand	Tis	A	31	15.69
				0.00
				0.00
Total Area				51.28

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl		98		98		98		98		98	0.00	0.00
Tis-b	3.17	98		98		98		98		98	3.17	310.57
Tis		98		98		98		98		98	0.00	0.00
		98		98		98		98		98	0.00	0.00
		98		98		98		98		98	0.00	0.00
Subtotal Area	3.17		0.00		0.00		0.00		0.00			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl	0.94	60	0.00		0.00	50	0.00		15.36	74	16.31	1193.53
Tis-b	12.88	32	0.00		0.97	50	0.00		2.26	62	16.11	601.02
Tis	4.53	32	0.00		0.00	50	0.00		11.16	62	15.69	837.03
	0.00		0.00		0.00		0.00		0.00		0.00	0.00
	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	18.35		0		0.97		0		28.79			

Composite Area Calculations

Total Pervious Area	48.11
Total Impervious Area	3.17
% Impervious	6.18%
Composite Curve Number (AMC II)	57.4
Composite Curve Number (AMC III)	88.0
Total Area Check	51.28

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient										
				Vasey Sandy		Tioga Loamy Sand		Tioga Loamy						
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	18.35	183.46	0.25	0.94	0.08	12.88	0.08	4.53		0.00		0.00	1.63
Meadow	8	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Wetland	16	0.97	15.57	0.05	0.00	0.05	0.97	0.05	0.00		0.00		0.00	0.05
Lawn	5	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Cultivated	7	28.79	201.54	0.35	15.36	0.22	2.26	0.22	11.16		0.00		0.00	8.33
Impervious	2	3.17	6.34	0.95	0.00	0.95	3.17	0.95	0.00		0.00		0.00	3.01
Composite IA		51.3	7.94	Composite Runoff Coefficient										0.25

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Main	1480	32	2.16%	2.7	0.40	1.04	0.69	0.69	0.81	0.54	1.37	0.92

Appropriate calculated time to	0.92	Appropriate Method:	Airport

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 24-Nov-21
Prepared By: S. Moneypenny
Checked By: N. O'Connor

D.A. NAME **EXT-2**
D.A. AREA (ha) **42.3**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment EXT-2

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Vasey Sandy Loam	Vasl	B	47	19.90
Tioga Loamy Sand Stoney	Tis-b	A	26	10.93
Tioga Loamy Sand	Tis	A	21	8.78
Alliston Sandy Loam	Ans	B	6	2.69
				0.00
Total Area				42.30

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl		98		98		98		98		98	0.00	0.00
Tis-b		98		98		98		98		98	0.00	0.00
Tis	2.20	98		98		98		98		98	2.20	215.15
Ans		98		98		98		98		98	0.00	0.00
		98		98		98		98		98	0.00	0.00
Subtotal	2.20		0.00		0.00		0.00		0.00			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl	2.30	60	0.00		0.00	50	0.00		17.60	74	19.90	1440.58
Tis-b	10.93	32	0.00		0.00	50	0.00		0.00	62	10.93	349.91
Tis	0.00	32	0.00		0.12	50	0.00		6.46	62	6.58	406.63
Ans	0.87	60	0.00		0.00	50	0.00		1.82	74	2.69	186.61
	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal	14.10		0.00		0.12		0.00		25.88			

Composite Area Calculations		
	Total Pervious Area	40.10
	Total Impervious Area	2.20
	% Impervious	5.19%
	Composite Curve Number (AMC II)	61.4
	Composite Curve Number (AMC III)	88.0
	Total Area Check	42.30

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient										
				Vasey Sandy		Tioga Loamy Sand		Tioga Loamy		Alliston Sandy				
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	14.10	141.02	0.25	2.30	0.08	10.93	0.08	0.00	0.25	0.87		0.00	1.45
Meadow	8	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Wetland	16	0.12	1.93	0.05	0.00	0.05	0.00	0.05	0.12	0.05	0.00		0.00	0.01
Lawn	5	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Cultivated	7	25.88	181.18	0.35	17.60	0.22	0.00	0.22	6.46	0.35	1.82		0.00	7.58
Impervious	2	2.20	4.39	0.95	0.00	0.95	0.00	0.95	2.20	0.95	0.00		0.00	2.09
Composite		42.3	7.77	Composite Runoff Coefficient										0.26

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Main	2120	73	3.44%	2.7	0.50	1.18	0.79	0.79	1.08	0.72	1.39	0.93

Appropriate calculated time to peak:	0.93	Appropriate Method:	Airport

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 24-Nov-21
Prepared By: S. Moneypenny
Checked By: N. O'Connor

D.A. NAME **EXT-3**
D.A. AREA (ha) **41.6**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment EXT-3

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Vasey Sandy Loam	Vasl	B	6	2.39
Tioga Loamy Sand Stoney	Tis-b	A	34	13.99
Tioga Loamy Sand	Tis	A	29	12.26
Alliston Sandy Loam	Ans	B	31	12.99
				0.00
Total Area				41.63

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl		98		98		98		98		98	0.00	0.00
Tis-b		98		98		98		98		98	0.00	0.00
Tis	1.79	98		98		98		98		98	1.79	175.43
Ans		98		98		98		98		98	0.00	0.00
		98		98		98		98		98	0.00	0.00
Subtotal Area	1.79		0.00		0.00		0.00		0.00			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl	1.51	60	0.00		0.00	50	0.00		0.88	74	2.39	155.66
Tis-b	10.78	32	0.00		1.27	50	0.00		1.93	62	13.99	528.54
Tis	0.00	32	0.00		0.00	50	0.00		10.47	62	10.47	649.39
Ans	4.50	60	0.00		0.00	50	0.00		8.49	74	12.99	898.15
	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	16.79		0.00		1.27		0.00		21.77			

Composite Area Calculations

Total Pervious Area	39.84
Total Impervious Area	1.79
% Impervious	4.30%
Composite Curve Number (AMC II)	57.8
Composite Curve Number (AMC III)	88.0
Total Area Check	41.63

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient										
				Vasey Sandy		Tioga Loamy Sand		Tioga Loamy Sand		Alliston Sandy				
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	16.79	167.93	0.25	1.51	0.08	10.78	0.08	0.00	0.25	4.50		0.00	2.37
Meadow	8	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Wetland	16	1.27	20.39	0.05	0.00	0.05	1.27	0.05	0.00	0.05	0.00		0.00	0.06
Lawn	5	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Cultivated	7	21.77	152.41	0.35	0.88	0.22	1.93	0.22	10.47	0.35	8.49		0.00	6.01
Impervious	2	1.79	3.58	0.95	0.00	0.95	0.00	0.95	1.79	0.95	0.00		0.00	1.70
Composite IA		41.63	8.27	Composite Runoff Coefficient										0.24

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Main	1410	57	4.04%	2.7	0.54	0.72	0.48	0.48	0.70	0.47	1.10	0.74

Appropriate calculated time to peak:	0.74	Appropriate Method:	Airport

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 24-Nov-21
Prepared By: S. Moneypenny
Checked By: N. O'Connor

D.A. NAME **EXT-4**
D.A. AREA (ha) **9.8**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment EXT-4

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Tioga Loamy Sand	Tis	A	84	8.18
Alliston Sandy Loam	Ans	B	16	1.58
				0.00
				0.00
Total Area				9.76

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Tis	0.63	98		98		98		98		98	0.63	61.59
Ans		98		98		98		98		98	0.00	0.00
		98		98		98		98		98	0.00	0.00
		98		98		98		98		98	0.00	0.00
Subtotal Area	0.63		0.00		0.00		0.00		0.00			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Tis	0.00	32	0.00		0.00	50	0.00		7.55	62	7.55	468.01
Ans	0.08	60	0.00		0.21	50	0.00		1.30	74	1.58	111.06
	0.00		0.00		0.00		0.00		0.00		0.00	0.00
	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	0.08		0.00		0.21		0.00		8.85			

	Composite Area Calculations	Total Pervious Area	9.13
		Total Impervious Area	0.63
		% Impervious	6.44%
		Composite Curve Number (AMC II)	65.6
		Composite Curve Number (AMC III)	88.0
		Total Area Check	9.76

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
				Tioga Loamy		Alliston Sandy Loam						
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	0.08	0.77	0.08	0.00	0.25	0.08		0.00		0	0.02
Meadow	8	0.00	0.00		0.00		0.00		0.00		0	0.00
Wetland	16	0.21	3.34	0.05	0.00	0.05	0.21		0.00		0	0.01
Lawn	5	0.00	0.00		0.00		0.00		0.00		0	0.00
Cultivated	7	8.85	61.92	0.22	0.00	0.35	1.30		0.00		0	0.45
Impervious	2	0.6284	1.26	0.95	0.63	0.95	0.00		0.00		0	0.60
Composite IA		9.76	6.89	Composite Runoff Coefficient								0.11

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Main	625	16	2.56%	2.7	0.43	0.40	0.27	0.27	0.39	0.26	0.99	0.66

Appropriate calculated time to	0.66	Appropriate Method:	Airport

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 24-Nov-21
Prepared By: S. Moneypenny
Checked By: N. O'Connor

D.A. NAME **EXT-5**
D.A. AREA (ha) **17.2**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment EXT-5

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Tioga Loamy Sand Stoney	Tis-b	A	24	4.10
Tioga Loamy Sand	Tis	A	42	7.21
Alliston Sandy Loam	Ans	B	31	5.32
Otonabee Loam	Ol	B	3	0.57
Total Area				17.21

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Tis-b	0.83	98		98		98		98		98	0.83	81.29
Tis		98		98		98		98		98	0.00	0.00
Ans		98		98		98		98		98	0.00	0.00
Ol		98		98		98		98		98	0.00	0.00
Subtotal Area	0.83		0.00		0.00		0.00		0.00			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Tis-b	1.66	32	0.00		0.00	50	0.00		1.62	62	3.27	153.26
Tis	0.00	32	0.00		0.00	50	0.00		7.21	62	7.21	447.29
Ans	0.75	60	0.00		1.28	50	0.00		3.29	74	5.32	352.67
Ol	0.00	60	0.00		0.00	50	0.00		0.57	74	0.57	42.15
Subtotal Area	2.41		0.00		1.28		0.00		12.69			

Composite Area Calculations

Total Pervious Area	16.38
Total Impervious Area	0.83
% Impervious	4.82%
Composite Curve Number (AMC II)	62.6
Composite Curve Number (AMC III)	88.0
Total Area Check	17.21

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient										
Landuse	IA (mm)	Area (ha)	A * IA	Tioga Loamy RC	Tioga Loamy Area	Tioga Loamy Sand RC	Tioga Loamy Sand Area	Alliston Sandy RC	Alliston Sandy Area	RC	Area	Otonabee RC	Otonabee Area	A*RC
Woodland	10	2.41	24.05	0.08	0.00	0.08	1.66	0.25	0.75		0.00	0.25	0.00	0.32
Meadow	8	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Wetland	16	1.28	20.50	0.05	0.00	0.05	0.00	0.05	1.28		0.00	0.05	0.00	0.06
Lawn	5	0.00	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Cultivated	7	12.69	88.86	0.22	7.21	0.22	1.62	0.35	3.29		0.00	0.35	0.57	3.29
Impervious	2	0.8295	1.66	0.95	0.83	0.95	0.00	0.95	0.00		0.00	0.95	0.00	0.79
Composite IA		17.21	7.85	Composite Runoff Coefficient										0.26

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Main	1265	32	2.53%	2.7	0.43	0.82	0.55	0.55	0.75	0.50	1.20	0.80

Appropriate calculated time to peak:	0.80	Appropriate Method:	Airport

APPENDIX E

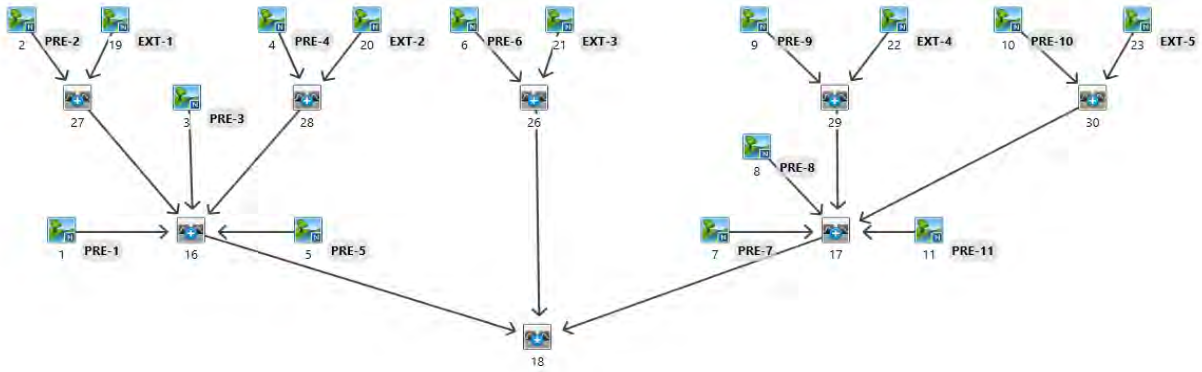
Visual OTTHYMO Files

CROZIER & ASSOCIATES
Consulting Engineers

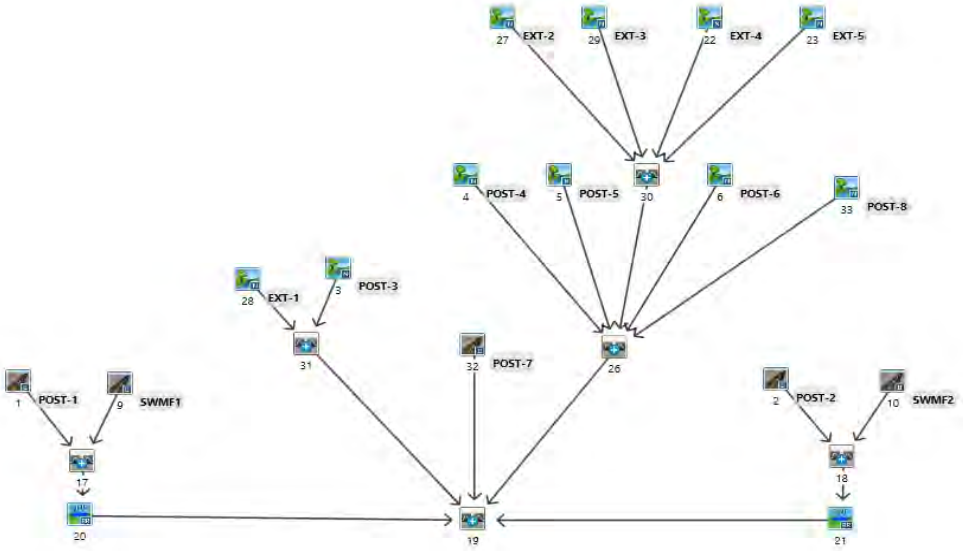
Project: Shadow Creek
Project No.: 1935-6103
File: Model Schematic
Design by: Z. Holland
Date: 2022-01-13

Visual OTTHYMO 6.1 Model Schematic

Pre-Development



Post-Development



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


       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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
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                  *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.1\VO2\voin.dat

  Output  filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\662
57cd3-b36b-4f58-ab68-ad8581347d99\sce
  Summary filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\662
57cd3-b36b-4f58-ab68-ad8581347d99\sce


DATE: 01-13-2022                          TIME: 09:28:20

USER:


COMMENTS: _____________________________________________________________


  ************************************************
  ** SIMULATION : A - 2yr CHI                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
```



```
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0001  1  5.0    0.50    0.00  1.83   3.27 0.10   0.000
    [CN=64.9         ]
    [ N = 3.0:Tp 0.33]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0003  1  5.0    4.83    0.03  1.92   4.28 0.13   0.000
    [CN=69.6         ]
    [ N = 3.0:Tp 0.40]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0005  1  5.0    8.04    0.05  2.08   4.81 0.15   0.000
    [CN=70.5         ]
    [ N = 3.0:Tp 0.52]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0002  1  5.0    3.35    0.02  1.83   4.72 0.14   0.000
    [CN=72.1         ]
    [ N = 3.0:Tp 0.35]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0019  1  5.0   51.30    0.14  2.83   2.82 0.09   0.000
    [CN=57.0         ]
    [ N = 3.0:Tp 0.92]
*
    ADD [  0019+  0002] 0027  3  5.0   54.65    0.15  2.75   2.93  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0004  1  5.0    4.59    0.03  1.92   4.61 0.14   0.000
    [CN=69.9         ]
    [ N = 3.0:Tp 0.43]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
```

```
 ** CALIB NASHYD         0020  1  5.0   42.30    0.14  2.83   3.42 0.10   0.000
    [CN=62.0         ]
    [ N = 3.0:Tp 0.93]
*
    ADD [  0020+  0004]  0028  3  5.0   46.89    0.15  2.67   3.54  n/a   0.000
*
    ADD [  0001+  0027]  0016  3  5.0   55.15    0.15  2.75   2.94  n/a   0.000
*
    ADD [  0016+  0028]  0016  1  5.0  102.04    0.31  2.67   3.21  n/a   0.000
*
    ADD [  0016+  0003]  0016  3  5.0  106.87    0.32  2.67   3.26  n/a   0.000
*
    ADD [  0016+  0005]  0016  1  5.0  114.91    0.37  2.50   3.37  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0007  1  5.0    1.81    0.03  1.42   6.31 0.19   0.000
    [CN=78.3         ]
    [ N = 3.0:Tp 0.15]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0008  1  5.0    2.15    0.03  1.58   5.79 0.18   0.000
    [CN=75.7         ]
    [ N = 3.0:Tp 0.24]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0011  1  5.0    1.13    0.02  1.42   5.45 0.17   0.000
    [CN=76.0         ]
    [ N = 3.0:Tp 0.13]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0010  1  5.0    4.32    0.06  1.50   6.23 0.19   0.000
    [CN=76.5         ]
    [ N = 3.0:Tp 0.19]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0023  1  5.0   17.20    0.06  2.58   3.66 0.11   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.80]
```



```
*
    ADD [  0010+  0023]  0030  3  5.0   21.52    0.09  2.33   4.18  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0009  1  5.0    4.52    0.05  1.58   5.69 0.17   0.000
    [CN=74.9         ]
    [ N = 3.0:Tp 0.22]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0022  1  5.0    9.80    0.04  2.25   3.93 0.12   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.66]
*
    ADD [  0022+  0009]  0029  3  5.0   14.32    0.08  1.75   4.48  n/a   0.000
*
    ADD [  0011+  0029]  0017  3  5.0   15.45    0.09  1.67   4.55  n/a   0.000
*
    ADD [  0017+  0030]  0017  1  5.0   36.97    0.17  1.67   4.33  n/a   0.000
*
    ADD [  0017+  0007]  0017  3  5.0   38.78    0.19  1.58   4.43  n/a   0.000
*
    ADD [  0017+  0008]  0017  1  5.0   40.93    0.22  1.58   4.50  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0006  1  5.0    8.64    0.02  2.58   2.39 0.07   0.000
    [CN=58.6         ]
    [ N = 3.0:Tp 0.72]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0021  1  5.0   41.60    0.12  2.50   2.85 0.09   0.000
    [CN=58.0         ]
    [ N = 3.0:Tp 0.74]
*
    ADD [  0021+  0006]  0026  3  5.0   50.24    0.14  2.50   2.77  n/a   0.000
*
    ADD [  0016+  0017]  0018  3  5.0  155.84    0.54  2.42   3.67  n/a   0.000
*
    ADD [  0018+  0026]  0018  1  5.0  206.08    0.68  2.42   3.45  n/a   0.000
*
================================================================================
```

```
       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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
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                  *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.1\VO2\voin.dat

  Output  filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\8c0
387c4-270d-43d2-874b-4530a286eb0c\sce
  Summary filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\8c0
387c4-270d-43d2-874b-4530a286eb0c\sce


DATE: 01-13-2022                          TIME: 09:28:21

USER:


COMMENTS: _____________________________________________________________


  ************************************************
  ** SIMULATION : B - 5yr CHI                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
```



```
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0001  1  5.0    0.50    0.01  1.75   6.63 0.15   0.000
    [CN=64.9         ]
    [ N = 3.0:Tp 0.33]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0003  1  5.0    4.83    0.06  1.83   8.31 0.19   0.000
    [CN=69.6         ]
    [ N = 3.0:Tp 0.40]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0005  1  5.0    8.04    0.10  2.00   9.07 0.21   0.000
    [CN=70.5         ]
    [ N = 3.0:Tp 0.52]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0002  1  5.0    3.35    0.05  1.75   9.10 0.21   0.000
    [CN=72.1         ]
    [ N = 3.0:Tp 0.35]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0019  1  5.0   51.30    0.27  2.67   5.54 0.13   0.000
    [CN=57.0         ]
    [ N = 3.0:Tp 0.92]
*
    ADD [  0019+  0002]  0027  3  5.0   54.65    0.30  2.58   5.75  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0004  1  5.0    4.59    0.06  1.83   8.77 0.20   0.000
    [CN=69.9         ]
    [ N = 3.0:Tp 0.43]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0020  1  5.0   42.30    0.27  2.67   6.63 0.15   0.000
```

```
    [CN=62.0         ]
    [ N = 3.0:Tp 0.93]
*
    ADD [  0020+  0004]  0028  3  5.0   46.89    0.31  2.58   6.84  n/a   0.000
*
    ADD [  0001+  0027]  0016  3  5.0   55.15    0.30  2.58   5.76  n/a   0.000
*
    ADD [  0016+  0028]  0016  1  5.0  102.04    0.61  2.58   6.26  n/a   0.000
*
    ADD [  0016+  0003]  0016  3  5.0  106.87    0.65  2.50   6.35  n/a   0.000
*
    ADD [  0016+  0005]  0016  1  5.0  114.91    0.73  2.42   6.54  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0007  1  5.0    1.81    0.06  1.42  11.73 0.27   0.000
    [CN=78.3         ]
    [ N = 3.0:Tp 0.15]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0008  1  5.0    2.15    0.05  1.58  10.81 0.25   0.000
    [CN=75.7         ]
    [ N = 3.0:Tp 0.24]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0011  1  5.0    1.13    0.04  1.42  10.39 0.24   0.000
    [CN=76.0         ]
    [ N = 3.0:Tp 0.13]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0010  1  5.0    4.32    0.13  1.50  11.44 0.26   0.000
    [CN=76.5         ]
    [ N = 3.0:Tp 0.19]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0023  1  5.0   17.20    0.13  2.50   7.08 0.16   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.80]
*
```



```
    ADD [  0010+  0023]  0030  3  5.0   21.52    0.17  2.25   7.96  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0009  1  5.0    4.52    0.11  1.50  10.60 0.24   0.000
    [CN=74.9         ]
    [ N = 3.0:Tp 0.22]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0022  1  5.0    9.80    0.09  2.25   7.43 0.17   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.66]
*
    ADD [  0022+  0009]  0029  3  5.0   14.32    0.16  1.67   8.43  n/a   0.000
*
    ADD [  0011+  0029]  0017  3  5.0   15.45    0.18  1.58   8.57  n/a   0.000
*
    ADD [  0017+  0030]  0017  1  5.0   36.97    0.34  1.58   8.21  n/a   0.000
*
    ADD [  0017+  0007]  0017  3  5.0   38.78    0.40  1.50   8.38  n/a   0.000
*
    ADD [  0017+  0008]  0017  1  5.0   40.93    0.45  1.50   8.51  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0006  1  5.0    8.64    0.05  2.42   5.04 0.12   0.000
    [CN=58.6         ]
    [ N = 3.0:Tp 0.72]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0021  1  5.0   41.60    0.25  2.42   5.63 0.13   0.000
    [CN=58.0         ]
    [ N = 3.0:Tp 0.74]
*
    ADD [  0021+  0006]  0026  3  5.0   50.24    0.30  2.42   5.53  n/a   0.000
*
    ADD [  0016+  0017]  0018  3  5.0  155.84    1.07  2.25   7.06  n/a   0.000
*
    ADD [  0018+  0026]  0018  1  5.0  206.08    1.37  2.33   6.69  n/a   0.000
*
```

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


       V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
       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
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                  *****  S U M M A R Y   O U T P U T  *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.1\VO2\voin.dat

  Output  filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\c83
0c2d1-c57c-4ff2-8d8c-da152c53111d\sce
  Summary filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\c83
0c2d1-c57c-4ff2-8d8c-da152c53111d\sce


DATE: 01-13-2022                          TIME: 09:29:40

USER:


COMMENTS: _____________________________________________________________


  ************************************************
  ** SIMULATION : A - 2yr CHI                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
```



```
     --------------------
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0003  1  5.0    2.92    0.00  2.00   1.24 0.04   0.000
    [CN=52.6         ]
    [ N = 3.0:Tp 0.27]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0028  1  5.0   51.30    0.14  2.83   2.82 0.09   0.000
    [CN=57.0         ]
    [ N = 3.0:Tp 0.92]
*
    ADD [  0028+  0003]  0031  3  5.0   54.22    0.14  2.75   2.73  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0004  1  5.0    0.63    0.00  1.75   1.18 0.04   0.000
    [CN=41.9         ]
    [ N = 3.0:Tp 0.28]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0005  1  5.0    0.12    0.00  1.58   1.31 0.04   0.000
    [CN=41.0         ]
    [ N = 3.0:Tp 0.19]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0006  1  5.0    2.32    0.00  2.25   1.34 0.04   0.000
    [CN=44.4         ]
    [ N = 3.0:Tp 0.51]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0027  1  5.0   42.30    0.14  2.83   3.42 0.10   0.000
    [CN=62.0         ]
    [ N = 3.0:Tp 0.93]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
```

```
 ** CALIB NASHYD         0029  1  5.0   41.60    0.12  2.50   2.85 0.09   0.000
    [CN=58.0         ]
    [ N = 3.0:Tp 0.74]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0022  1  5.0    9.80    0.04  2.25   3.93 0.12   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.66]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0023  1  5.0   17.20    0.06  2.58   3.66 0.11   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.80]
*
    ADD [  0022+  0023]  0030  3  5.0   27.00    0.11  2.42   3.76  n/a   0.000
*
    ADD [  0030+  0027]  0030  1  5.0   69.30    0.24  2.67   3.55  n/a   0.000
*
    ADD [  0030+  0029]  0030  3  5.0  110.90    0.36  2.58   3.29  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB NASHYD         0033  1  5.0    6.26    0.02  2.67   2.81 0.09   0.000
    [CN=66.0         ]
    [ N = 3.0:Tp 0.73]
*
    ADD [  0030+  0033]  0026  3  5.0  117.16    0.38  2.58   3.26  n/a   0.000
*
    ADD [  0026+  0004]  0026  1  5.0  117.79    0.38  2.58   3.25  n/a   0.000
*
    ADD [  0026+  0005]  0026  3  5.0  117.91    0.38  2.58   3.25  n/a   0.000
*
    ADD [  0026+  0006]  0026  1  5.0  120.23    0.38  2.58   3.21  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 ** CALIB STANDHYD       0001  1  5.0   17.67    1.15  1.33  15.42 0.47   0.000
    [I%=35.2:S%= 2.00]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
```



```
 *  CALIB STANDHYD       0009  1  5.0    1.92    0.20  1.33  19.82 0.61   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0001+  0009]  0017  3  5.0   19.59    1.35  1.33  15.85  n/a   0.000
*
 ** Reservoir
    OUTFLOW:             0020  1  5.0   19.59    0.04  4.17  15.76  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 *  CALIB STANDHYD       0002  1  5.0   10.71    0.81  1.33  17.56 0.54   0.000
    [I%=36.9:S%= 2.00]
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 *  CALIB STANDHYD       0010  1  5.0    1.15    0.12  1.33  19.81 0.61   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0010+  0002]  0018  3  5.0   11.86    0.93  1.33  17.78  n/a   0.000
*
 ** Reservoir
    OUTFLOW:             0021  1  5.0   11.86    0.04  4.08  17.67  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 32.62 mm ]
*
 *  CALIB STANDHYD       0032  1  5.0    0.15    0.03  1.33  26.96 0.83   0.000
    [I%=80.0:S%= 2.00]
*
    ADD [  0020+  0021]  0019  3  5.0   31.45    0.08  4.08  16.48  n/a   0.000
*
    ADD [  0019+  0026]  0019  1  5.0  151.68    0.45  2.58   5.96  n/a   0.000
*
    ADD [  0019+  0031]  0019  3  5.0  205.90    0.59  2.67   5.11  n/a   0.000
*
    ADD [  0019+  0032]  0019  1  5.0  206.05    0.59  2.67   5.13  n/a   0.000
*
================================================================================
========================


      V    V   I    SSSSS  U   U    A    L             (v 6.1.2003)
      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
```


***** S U M M A R Y O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.1\VO2\voin.dat

Output filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\d684e84b-7d42-41f1-a865-a2c86108af22\sce
Summary filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\d684e84b-7d42-41f1-a865-a2c86108af22\sce

DATE: 01-13-2022 TIME: 09:29:40

USER:

COMMENTS: _____

```
  ************************************************
  ** SIMULATION : B - 5yr CHI                   **
  ************************************************

  W/E COMMAND             HYD ID   DT    AREA  ' Qpeak Tpeak   R.V. R.C.   Qbase
                                   min     ha   '  cms   hrs     mm          cms

      START @  0.00 hrs
      --------------------
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0003  1  5.0    2.92    0.01  1.75   3.10 0.07   0.000
    [CN=52.6         ]
    [ N = 3.0:Tp 0.27]
*
    CHIC STORM                10.0
```



```
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0028  1  5.0   51.30    0.27  2.67   5.54 0.13   0.000
    [CN=57.0         ]
    [ N = 3.0:Tp 0.92]
*
    ADD [  0028+  0003]  0031  3  5.0   54.22    0.28  2.67   5.40  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0004  1  5.0    0.63    0.00  1.67   2.62 0.06   0.000
    [CN=41.9         ]
    [ N = 3.0:Tp 0.28]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0005  1  5.0    0.12    0.00  1.50   2.78 0.06   0.000
    [CN=41.0         ]
    [ N = 3.0:Tp 0.19]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0006  1  5.0    2.32    0.01  2.08   2.95 0.07   0.000
    [CN=44.4         ]
    [ N = 3.0:Tp 0.51]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0027  1  5.0   42.30    0.27  2.67   6.63 0.15   0.000
    [CN=62.0         ]
    [ N = 3.0:Tp 0.93]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0029  1  5.0   41.60    0.25  2.42   5.63 0.13   0.000
    [CN=58.0         ]
    [ N = 3.0:Tp 0.74]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0022  1  5.0    9.80    0.09  2.25   7.43 0.17   0.000
    [CN=64.0         ]
```

```
    [ N = 3.0:Tp 0.66]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0023  1  5.0   17.20    0.13  2.50   7.08 0.16   0.000
    [CN=64.0         ]
    [ N = 3.0:Tp 0.80]
*
    ADD [  0022+  0023]  0030  3  5.0   27.00    0.21  2.33   7.21  n/a   0.000
*
    ADD [  0030+  0027]  0030  1  5.0   69.30    0.48  2.50   6.86  n/a   0.000
*
    ADD [  0030+  0029]  0030  3  5.0  110.90    0.73  2.50   6.40  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB NASHYD         0033  1  5.0    6.26    0.04  2.50   6.07 0.14   0.000
    [CN=66.0         ]
    [ N = 3.0:Tp 0.73]
*
    ADD [  0030+  0033]  0026  3  5.0  117.16    0.77  2.50   6.38  n/a   0.000
*
    ADD [  0026+  0004]  0026  1  5.0  117.79    0.77  2.50   6.36  n/a   0.000
*
    ADD [  0026+  0005]  0026  3  5.0  117.91    0.77  2.50   6.36  n/a   0.000
*
    ADD [  0026+  0006]  0026  1  5.0  120.23    0.78  2.50   6.29  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 ** CALIB STANDHYD       0001  1  5.0   17.67    1.68  1.33  22.33 0.51   0.000
    [I%=35.2:S%= 2.00]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 *  CALIB STANDHYD       0009  1  5.0    1.92    0.30  1.33  28.15 0.65   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0001+  0009]  0017  3  5.0   19.59    1.98  1.33  22.90  n/a   0.000
*
 ** Reservoir
    OUTFLOW:              0020  1  5.0   19.59    0.08  4.08  22.82  n/a   0.000
*
    CHIC STORM                10.0
```



```
    [ Ptot= 43.39 mm ]
*
 *  CALIB STANDHYD       0002  1  5.0   10.71    1.29  1.33  25.52 0.59   0.000
    [I%=36.9:S%= 2.00]
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 *  CALIB STANDHYD       0010  1  5.0    1.15    0.18  1.33  28.15 0.65   0.000
    [I%=50.0:S%= 2.00]
*
    ADD [  0010+  0002]  0018  3  5.0   11.86    1.47  1.33  25.77  n/a   0.000
*
 ** Reservoir
    OUTFLOW:              0021  1  5.0   11.86    0.05  4.08  25.66  n/a   0.000
*
    CHIC STORM                10.0
    [ Ptot= 43.39 mm ]
*
 *  CALIB STANDHYD       0032  1  5.0    0.15    0.04  1.33  36.79 0.85   0.000
    [I%=80.0:S%= 2.00]
*
    ADD [  0020+  0021]  0019  3  5.0   31.45    0.14  4.08  23.89  n/a   0.000
*
    ADD [  0019+  0026]  0019  1  5.0  151.68    0.88  2.50   9.94  n/a   0.000
*
    ADD [  0019+  0031]  0019  3  5.0  205.90    1.16  2.58   8.75  n/a   0.000
*
    ADD [  0019+  0032]  0019  1  5.0  206.05    1.16  2.58   8.77  n/a   0.000
*
================================================================================
========================


       V    V   I    SSSSS  U   U    A    L              (v 6.1.2003)
       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
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```

***** S U M M A R Y O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.1\VO2\voin.dat

Output filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\d84bebd3-ce91-453f-8581-989fe260594a\sce
Summary filename:
C:\Users\zholland\AppData\Local\Civica\VH5\65069029-954c-4578-9a67-f0d6b102ae00\d84bebd3-ce91-453f-8581-989fe260594a\sce

DATE: 01-13-2022 TIME: 09:29:41

USER:

COMMENTS: _____

****
** SIMULATION : D - 25yr CHI **
****

W/E	COMMAND	HYD ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ 0.00 hrs								
	CHIC STORM		10.0						
	[Ptot= 59.48 mm]								
*									
**	CALIB NASHYD	0003	1	5.0	2.92	0.04	1.67	7.18	0.12 0.000
	[CN=52.6]								
	[N = 3.0:Tp 0.27]								
*									
	CHIC STORM		10.0						
	[Ptot= 59.48 mm]								
*									
**	CALIB NASHYD	0028	1	5.0	51.30	0.55	2.58	10.92	0.18 0.000
	[CN=57.0]								
	[N = 3.0:Tp 0.92]								
*									
	ADD [0028+ 0003]	0031	3	5.0	54.22	0.57	2.58	10.72	n/a 0.000
*									
	CHIC STORM		10.0						

	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0004	1	5.0	0.63	0.01	1.67	5.71	0.10	0.000
	[CN=41.9]									
	[N = 3.0:Tp 0.28]									
*										
	CHIC STORM		10.0							
	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0005	1	5.0	0.12	0.00	1.50	5.88	0.10	0.000
	[CN=41.0]									
	[N = 3.0:Tp 0.19]									
*										
	CHIC STORM		10.0							
	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0006	1	5.0	2.32	0.02	2.00	6.35	0.11	0.000
	[CN=44.4]									
	[N = 3.0:Tp 0.51]									
*										
	CHIC STORM		10.0							
	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0027	1	5.0	42.30	0.54	2.58	12.89	0.22	0.000
	[CN=62.0]									
	[N = 3.0:Tp 0.93]									
*										
	CHIC STORM		10.0							
	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0029	1	5.0	41.60	0.52	2.33	11.15	0.19	0.000
	[CN=58.0]									
	[N = 3.0:Tp 0.74]									
*										
	CHIC STORM		10.0							
	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0022	1	5.0	9.80	0.17	2.17	14.15	0.24	0.000
	[CN=64.0]									
	[N = 3.0:Tp 0.66]									
*										
	CHIC STORM		10.0							
	[Ptot= 59.48 mm]									
*										
**	CALIB NASHYD	0023	1	5.0	17.20	0.26	2.42	13.70	0.23	0.000
	[CN=64.0]									
	[N = 3.0:Tp 0.80]									
*										

```
   ADD [  0022+  0023]  0030  3  5.0   27.00    0.42  2.33  13.86  n/a   0.000
*
   ADD [  0030+  0027]  0030  1  5.0   69.30    0.95  2.50  13.27  n/a   0.000
*
   ADD [  0030+  0029]  0030  3  5.0  110.90    1.47  2.42  12.48  n/a   0.000
*
   CHIC STORM                10.0
   [ Ptot= 59.48 mm ]
*
 ** CALIB NASHYD         0033  1  5.0    6.26    0.09  2.33  12.64 0.21   0.000
   [CN=66.0         ]
   [ N = 3.0:Tp 0.73]
*
   ADD [  0030+  0033]  0026  3  5.0  117.16    1.56  2.42  12.48  n/a   0.000
*
   ADD [  0026+  0004]  0026  1  5.0  117.79    1.56  2.42  12.45  n/a   0.000
*
   ADD [  0026+  0005]  0026  3  5.0  117.91    1.56  2.42  12.44  n/a   0.000
*
   ADD [  0026+  0006]  0026  1  5.0  120.23    1.58  2.42  12.32  n/a   0.000
*
   CHIC STORM                10.0
   [ Ptot= 59.48 mm ]
*
 *  CALIB STANDHYD       0001  1  5.0   17.67    2.78  1.33  33.64 0.57   0.000
   [I%=35.2:S%= 2.00]
*
   CHIC STORM                10.0
   [ Ptot= 59.48 mm ]
*
 *  CALIB STANDHYD       0009  1  5.0    1.92    0.44  1.33  41.40 0.70   0.000
   [I%=50.0:S%= 2.00]
*
   ADD [  0001+  0009]  0017  3  5.0   19.59    3.23  1.33  34.40  n/a   0.000
*
 ** Reservoir
   OUTFLOW:             0020  1  5.0   19.59    0.17  4.00  34.32  n/a   0.000
*
   CHIC STORM                10.0
   [ Ptot= 59.48 mm ]
*
 *  CALIB STANDHYD       0002  1  5.0   10.71    1.97  1.33  38.34 0.64   0.000
   [I%=36.9:S%= 2.00]
*
   CHIC STORM                10.0
   [ Ptot= 59.48 mm ]
*
 *  CALIB STANDHYD       0010  1  5.0    1.15    0.27  1.33  41.40 0.70   0.000
```



```
   [I%=50.0:S%= 2.00]
*
   ADD [  0010+  0002]  0018  3  5.0   11.86    2.24  1.33  38.64  n/a   0.000
*
 ** Reservoir
   OUTFLOW:             0021  1  5.0   11.86    0.14  3.58  38.53  n/a   0.000
*
   CHIC STORM                10.0
   [ Ptot= 59.48 mm ]
*
 *  CALIB STANDHYD       0032  1  5.0    0.15    0.05  1.33  51.79 0.87   0.000
   [I%=80.0:S%= 2.00]
*
   ADD [  0020+  0021]  0019  3  5.0   31.45    0.31  3.92  35.91  n/a   0.000
*
   ADD [  0019+  0026]  0019  1  5.0  151.68    1.85  2.42  17.21  n/a   0.000
*
   ADD [  0019+  0031]  0019  3  5.0  205.90    2.42  2.50  15.50  n/a   0.000
*
   ADD [  0019+  0032]  0019  1  5.0  206.05    2.42  2.50  15.53  n/a   0.000
*
```

APPENDIX F

Stormwater Management Facility Calculations

Project No: 1935-6103
Project: Shadow Creek
File: Water Quality
Design by: Z. Holland
Checked by: N. O'Connor
Date: 2022-01-13

Post-Development Scenario Water Quality Requirements for SWM Facility 1

Areas Contributing	Area (ha)	% Imp	25mm RV (mm)	25mm RV (m^3)
POST-1	17.67	57	10.93	1931
Total	**17.67**	**57**		**1931**

MOE Total WQ Volume (m^3/ha)	153
MOE ED Volume (m^3/ha)	40
MOE ED Volume (m^3)	707
MOE PP Volume (m^3/ha)	113
MOE PP Volume (m^3)	1997
Pond Required PP Volume (m^3)	1997
Pond Required ED Volume (m^3)	1931
Pond Required AS Volume (m^3)	9787
Provided PP Volume (m^3)	6688
Provided ED Volume (m^3)	3346
Provided AS Volume (m^3)	15247

Project:	1935-6103
Project No.:	Shadow Creek
File:	Extended Detention
Design by:	Z. Holland
Checked by:	N. O'Connor
Date:	2022-01-13

EXTENDED DETENTION SPECIFICATIONS - SWM FACILITY 1

(Per MECP)

Extended Detention Volume (Area x runoff from 25mm event)		1931
t (drawdown time - seconds, *hours in italics*)	*24.0*	86400
Ao (cross section area of orifice - sqm)		0.0284
h (maximum water elevation above orifice for extended detention- m)		0.30
C (discharge coefficient)		0.64
Ap (average surface area for extended detention - sqm)		6550

t = 2*Ap*(h^0.5)/(C*Ao*(g*2)^0.5)

Ao = 0.029296465 sqm d = 193 mm

Extended Detention Orifice Diameter (as designed) d = **190** mm

ACTUAL DRAWDOWN TIME

Extended Detention Volume Used	3346
d (orifice diameter, mm)	190
h (maximum head acting on orifice for extended detention, m)	0.50
Ao (cross section area of orifice, m^2)	0.0284
C (discharge coefficient)	0.64
Ap (average surface area for extended detention, m^2)	6692

t = 2*Ap*(h^0.5)/(C*Ao*(g*2)^0.5)

t (hours) 33

CROZIER CONSULTING ENGINEERS

Project:	1935-6103
Project No.:	Shadow Creek
File:	Stage Storage Discharge
Design by:	Z. Holland
Checked by:	N. O'Connor
Date:	2022-01-13

STAGE STORAGE DISCHARGE - SWMF1

SWM Facility 1 Storage - Outflow Calculations

Outlet Structure		
E.D. Orifice Diameter:	0.190	m
E.D. Orifice Invert Elevation:	219.30	m
V-notch angle	0	degrees
V-notch constant	0.00	const
V-notch invert	0.00	m
Rect weir length	0.5	m
Rect weir invert	219.90	m
Extended Detention Depth:	0.50	m

Main Cell Spillway		
Emergency Spill Elev.	221.20	
Emerg Spill Bot. Width	10	
Trap. Side Slopes	7	:1

	Pond Dimensions				Outlet Structure			Cell Spillway			
	Elev.	Depth Above PP	Area	Volume	ED Orifice Discharge	V-notch Discharge	Rect. Weir Discharge	Emerg. Weir Ave. Width	Emerg. Weir Discharge	Total Discharge	Storage
	(m)	(m)	(sqm)	(cu.m)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(m)	(cu.m/s)	(cu.m/s)	(ha-m)
PP	219.30	0.00	5986	0	0.0000	0.0000	0.000	0.00	0.000	0.000	0.000
	219.40	0.10	6268	613	0.0057	0.0000	0.000	0.00	0.000	0.006	0.061
	219.50	0.20	6550	1254	0.0260	0.0000	0.000	0.00	0.000	0.026	0.125
	219.60	0.30	6833	1923	0.0364	0.0000	0.000	0.00	0.000	0.036	0.192
	219.70	0.40	7115	2620	0.0444	0.0000	0.000	0.00	0.000	0.044	0.262
ED	219.80	0.50	7397	3346	0.0512	0.0000	0.000	0.00	0.000	0.051	0.335
	219.90	0.60	7667	4099	0.0571	0.0000	0.000	0.00	0.000	0.057	0.410
	220.00	0.70	7938	4879	0.0625	0.0000	0.029	0.00	0.000	0.092	0.488
	220.10	0.80	8208	5687	0.0675	0.0000	0.082	0.00	0.000	0.150	0.569
	220.20	0.90	8479	6521	0.0721	0.0000	0.151	0.00	0.000	0.223	0.652
	220.30	1.00	8749	7382	0.0765	0.0000	0.233	0.00	0.000	0.309	0.738
	220.40	1.10	9020	8271	0.0806	0.0000	0.325	0.00	0.000	0.406	0.827
	220.50	1.20	9290	9186	0.0845	0.0000	0.428	0.00	0.000	0.512	0.919
	220.60	1.30	9561	10129	0.0882	0.0000	0.539	0.00	0.000	0.627	1.013
	220.70	1.40	9831	11098	0.0918	0.0000	0.658	0.00	0.000	0.750	1.110
	220.80	1.50	10102	12095	0.0953	0.0000	0.786	0.00	0.000	0.881	1.210
	220.90	1.60	10372	13119	0.0986	0.0000	0.920	0.00	0.000	1.019	1.312
	221.00	1.70	10643	14169	0.1018	0.0000	1.061	0.00	0.000	1.163	1.417
HWL	221.10	1.80	10913	15247	0.1050	0.0000	1.209	0.000	0.000	1.314	1.525
	221.20	1.90	11146	16350	0.1080	0.0000	1.364	10.000	0.000	1.472	1.635
	221.30	2.00	11378	17476	0.1109	0.0000	1.524	11.400	0.663	2.298	1.748
TOB	221.40	2.10	11611	18626	0.1138	0.0000	1.690	12.800	2.107	3.911	1.863

CROZIER CONSULTING ENGINEERS

Project #: 1935-6103
Project Name: Shadow Creek
File: Forebay Calculations
Prepared By: Z. Holland
Checked By: N. O'Connor
Date: 2022-01-13

SWM FACILITY #1 - FOREBAY DESIGN CALCULATIONS

	Variable	*Value*
Forebay Settling length	Length of forebay (m)	62.5
	Width of forebay (m)	15.8
	Length-to-width ratio of forebay	4.0
	Peak flow rate from forebay in quality event (m^3/s)	0.03
	Settling velocity (m/s)	0.0003
	Required Forebay length (m)	**20**
Dispersion Length	Inlet flowrate in 5 year event (m^3/s)	2.58
	Depth of of the permanent pool in the forebay (m)	0.80
	Desired velocity in the forebay (m/s)	0.5
	Length of dispersion (m)	**52**
Velocity in forebay check	Depth of Forebay in 10 Year Event (m)	0.90
	Cross sectional area (m^2)	16.9
	10 yr Flowrate (m^3/s)	3.17
	Velocity in forebay (m/s)*	**0.19**
Forbay Bottom Width	Length of forebay (m)	62.5
	Minimum Forebay Bottom Width (m)	**7.81**
DESIGN FOREBAY LENGTH (m)		**62.5**
DESIGN BOTTOM WIDTH (m)		**15.8**

* Desired maximum average velocity in the forebay is 0.15 m/s, per MOE, 2003, Page 4-56

Project No: 1935-6103
Project: Shadow Creek
File: Water Quality
Design by: Z. Holland
Checked by: N. O'Connor
Date: 2022-01-13

Post-Development Scenario Water Quality Requirements for SWM Facility 2

Areas Contributing	Area (ha)	% Imp	25mm RV (mm)	25mm RV (m^3)
POST-2	10.71	58	12.37	1325
Total	**10.71**	**58**		**1325**

MOE Total WQ Volume (m^3/ha)	155
MOE ED Volume (m^3/ha)	40
MOE ED Volume (m^3)	428
MOE PP Volume (m^3/ha)	115
MOE PP Volume (m^3)	1232
Pond Required PP Volume (m^3)	1232
Pond Required ED Volume (m^3)	1325
Pond Required AS Volume (m^3)	6283
Provided PP Volume (m^3)	3184
Provided ED Volume (m^3)	1762
Provided AS Volume (m^3)	8280

Project:	1935-6103
Project No.:	Shadow Creek
File:	Extended Detention
Design by:	Z. Holland
Checked by:	N. O'Connor
Date:	2022-01-13

EXTENDED DETENTION SPECIFICATIONS - SWM FACILITY 2

(Per MECP)

Extended Detention Volume (Area x runoff from 25mm event)		1325
t (drawdown time - seconds, *hours in italics*)	*24.0*	86400
Ao (cross section area of orifice - sqm)		0.0165
h (maximum water elevation above orifice for extended detention- m)		0.39
C (discharge coefficient)		0.64
Ap (average surface area for extended detention - sqm)		3434

t = 2*Ap*(h^0.5)/(C*Ao*(g*2)^0.5)

Ao = 0.01751134 sqm d = 149 mm

Extended Detention Orifice Diameter (as designed) d = **145** mm

ACTUAL DRAWDOWN TIME

Extended Detention Volume Used	1762
d (orifice diameter, mm)	145
h (maximum head acting on orifice for extended detention, m)	0.50
Ao (cross section area of orifice, m^2)	0.0165
C (discharge coefficient)	0.64
Ap (average surface area for extended detention, m^2)	3525

t = 2*Ap*(h^0.5)/(C*Ao*(g*2)^0.5)

t (hours) 30

CROZIER CONSULTING ENGINEERS

Project:	1935-6103
Project No.:	Shadow Creek
File:	Stage Storage Discharge
Design by:	Z. Holland
Checked by:	N. O'Connor
Date:	2022-01-13

STAGE STORAGE DISCHARGE - SWMF2

SWM Facility 1 Storage - Outflow Calculations

Outlet Structure		
E.D. Orifice Diameter:	0.145	m
E.D. Orifice Invert Elevation:	219.37	m
V-notch angle	0	degrees
V-notch constant	0.00	const
V-notch invert	0.00	m
Rect weir length	0.3	m
Rect weir invert	219.97	m
Extended Detention Depth:	0.50	m

Main Cell Spillway		
Emergency Spill Elev.	221.27	
Emerg Spill Bot. Width	10	
Trap. Side Slopes	7	:1

	Pond Dimensions				Outlet Structure			Cell Spillway			
	Elev.	Depth Above PP	Area	Volume	ED Orifice Discharge	V-notch Discharge	Rect. Weir Discharge	Emerg. Weir Ave. Width	Emerg. Weir Discharge	Total Discharge	Storage
	(m)	(m)	(sqm)	(cu.m)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(m)	(cu.m/s)	(cu.m/s)	(ha-m)
PP	219.37	0.00	3072	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000
	219.47	0.10	3253	316	0.0078	0.0000	0.000	0.000	0.000	0.008	0.032
	219.57	0.20	3434	651	0.0167	0.0000	0.000	0.000	0.000	0.017	0.065
	219.67	0.30	3615	1003	0.0223	0.0000	0.000	0.000	0.000	0.022	0.100
	219.77	0.40	3796	1374	0.0268	0.0000	0.000	0.000	0.000	0.027	0.137
ED	219.87	0.50	3977	1762	0.0306	0.0000	0.000	0.000	0.000	0.031	0.176
	219.97	0.60	4137	2168	0.0340	0.0000	0.000	0.000	0.000	0.034	0.217
	220.07	0.70	4296	2590	0.0371	0.0000	0.017	0.000	0.000	0.055	0.259
	220.17	0.80	4456	3027	0.0399	0.0000	0.049	0.000	0.000	0.089	0.303
	220.27	0.90	4615	3481	0.0426	0.0000	0.091	0.000	0.000	0.133	0.348
	220.37	1.00	4775	3950	0.0451	0.0000	0.140	0.000	0.000	0.185	0.395
	220.47	1.10	4934	4436	0.0475	0.0000	0.195	0.000	0.000	0.243	0.444
	220.57	1.20	5094	4937	0.0497	0.0000	0.257	0.000	0.000	0.306	0.494
	220.67	1.30	5253	5454	0.0519	0.0000	0.323	0.000	0.000	0.375	0.545
	220.77	1.40	5413	5988	0.0539	0.0000	0.395	0.000	0.000	0.449	0.599
	220.87	1.50	5572	6537	0.0559	0.0000	0.471	0.000	0.000	0.527	0.654
	220.97	1.60	5732	7102	0.0579	0.0000	0.552	0.000	0.000	0.610	0.710
	221.07	1.70	5891	7683	0.0597	0.0000	0.637	0.000	0.000	0.697	0.768
HWL	221.17	1.80	6051	8280	0.0615	0.0000	0.726	0.000	0.000	0.787	0.828
	221.27	1.90	6125	8889	0.0633	0.0000	0.818	10.000	0.000	0.881	0.889
	221.37	2.00	6198	9505	0.0650	0.0000	0.914	11.400	0.613	1.592	0.951
TOB	221.47	2.10	6272	10129	0.0667	0.0000	1.014	12.800	1.946	3.027	1.013

Project #: 1935-6103
Project Name: Shadow Creek
File: Forebay Calculations
Prepared By: Z. Holland
Checked By: N. O'Connor
Date: 2022-01-13

SWM FACILITY #2 - FOREBAY DESIGN CALCULATIONS

	Variable	*Value*
Forebay Settling length	Length of forebay (m)	17.8
	Width of forebay (m)	16.0
	Length-to-width ratio of forebay	1.1
	Peak flow rate from forebay in quality event (m^3/s)	0.03
	Settling velocity (m/s)	0.0003
	Required Forebay length (m)	**10**
Dispersion Length	Inlet flowrate in 5 year event (m^3/s)	1.92
	Depth of of the permanent pool in the forebay (m)	0.80
	Desired velocity in the forebay (m/s)	0.5
	Length of dispersion (m)	**38**
Velocity in forebay check	Depth of Forebay in 10 Year Event (m)	1.10
	Cross sectional area (m^2)	20.9
	10 yr Flowrate (m^3/s)	2.34
	Velocity in forebay (m/s)*	**0.11**
Forbay Bottom Width	Length of forebay (m)	17.8
	Minimum Forebay Bottom Width (m)	**2.22**
DESIGN FOREBAY LENGTH (m)		**17.8**
DESIGN BOTTOM WIDTH (m)		**16.0**

* Desired maximum average velocity in the forebay is 0.15 m/s, per MOE, 2003, Page 4-56

APPENDIX G

Culvert Calculations

Culvert Calculator Report
Crossing-1

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	226.99	m	Headwater Depth/Height	2.34	
Computed Headwater Eleva	225.87	m	Discharge	4.1280	m³/s
Inlet Control HW Elev.	225.87	m	Tailwater Elevation	222.79	m
Outlet Control HW Elev.	225.48	m	Control Type	Inlet Control	

Grades					
Upstream Invert	223.73	m	Downstream Invert	222.79	m
Length	20.00	m	Constructed Slope	0.047000	m/m

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.61	m
Slope Type	Steep		Normal Depth	0.49	m
Flow Regime	Supercritical		Critical Depth	0.91	m
Velocity Downstream	5.56	m/s	Critical Slope	0.013873	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.22	m
Section Size	1220 x 910 mm		Rise	0.91	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	225.48	m	Upstream Velocity Head	0.70	m
Ke	0.20		Entrance Loss	0.14	m

Inlet Control Properties					
Inlet Control HW Elev.	225.87	m	Flow Control	Submerged	
Inlet Type	90° headwall w 45° bevels		Area Full	1.1	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Culvert Calculator Report
Crossing-2

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	227.58	m	Headwater Depth/Height	6.09	
Computed Headwater Eleva	227.02	m	Discharge	3.5800	m³/s
Inlet Control HW Elev.	227.02	m	Tailwater Elevation	222.99	m
Outlet Control HW Elev.	226.27	m	Control Type	Inlet Control	

Grades					
Upstream Invert	223.31	m	Downstream Invert	222.99	m
Length	20.00	m	Constructed Slope	0.016000	m/m

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	0.61	m
Slope Type	N/A		Normal Depth	N/A	m
Flow Regime	N/A		Critical Depth	0.61	m
Velocity Downstream	4.82	m/s	Critical Slope	0.032823	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.22	m
Section Size	1220 x 610 mm		Rise	0.61	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	226.27	m	Upstream Velocity Head	1.18	m
Ke	0.70		Entrance Loss	0.83	m

Inlet Control Properties					
Inlet Control HW Elev.	227.02	m	Flow Control	Submerged	
Inlet Type	0° wingwall flares		Area Full	0.7	m²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	3	
C	0.04230		Equation Form	1	
Y	0.82000				

Culvert Calculator Report
Crossing-3

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	224.63	m	Headwater Depth/Height	3.30	
Computed Headwater Elev	223.42	m	Discharge	5.6380	m³/s
Inlet Control HW Elev.	223.42	m	Tailwater Elevation	220.28	m
Outlet Control HW Elev.	222.91	m	Control Type	Inlet Control	

Grades					
Upstream Invert	220.40	m	Downstream Invert	220.28	m
Length	20.00	m	Constructed Slope	0.006000	m/m

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	0.91	m
Slope Type	N/A		Normal Depth	N/A	m
Flow Regime	N/A		Critical Depth	0.91	m
Velocity Downstream	4.05	m/s	Critical Slope	0.014698	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.52	m
Section Size	1520 x 910 mm		Rise	0.91	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	222.91	m	Upstream Velocity Head	0.83	m
Ke	0.70		Entrance Loss	0.58	m

Inlet Control Properties					
Inlet Control HW Elev.	223.42	m	Flow Control	N/A	
Inlet Type	0° wingwall flares		Area Full	1.4	m²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	3	
C	0.04230		Equation Form	1	
Y	0.82000				

CROZIER CONSULTING ENGINEERS

Project: Shadow Creek
Project No.: 1935-6103
File: Openness Ratio
Date: January 25, 2022
Design: Z. Holland

Openness Ratio

Proposed Crossing	Culvert Width (mm)	Culvert Height (mm)	Culvert Length (m)	Openness Ratio
1	1800	1200	20	0.11
2	1800	1200	20	0.11
3	1800	1200	20	0.11

**Culvert dimensions based on typical culvert sizes*

APPENDIX H

Floodplain Assessment

CROZIER
CONSULTING ENGINEERS

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Collingwood, ON | F. 705.446.3520
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MEMO

DATE	January 2022	**PROJECT NO.**	1935-6103
RE	Floodplain Assessment Memo Shadow Creek Subdivision Township of Severn		
TO	LIV Communities		
FROM	Nicole O'Connor P.Eng. – C.F. Crozier and Associates		

CF Crozier & Associates Inc. (Crozier) was retained by LIV Communities (LIV) to complete a Floodplain Assessment in support of a Draft Plan of Subdivision Application for a proposed residential development located in the Township of Severn (Township). The proposed development is referred to as Shadow Creek and will herein be referred to as the Subject Development/Subject Lands.

The Subject Lands are approximately 45.5 ha and are bounded by existing commercial establishments to the north, Menoke Beach Road to the south, Amigo Drive, Shadow Creek and an existing residential development to the east and Highway 11 to the West.

This Floodplain Assessment has been prepared to establish the Regulatory floodplain limits for the Subject Lands.

1.0 SITE DESCRIPTION

The Subject Lands are currently characterized by existing residential and farm buildings, agricultural lands, treed areas, wetlands and five tributaries to Shadow Creek. Each tributary conveys external drainage through the Subject Lands, generally from west to east, and ultimately drain to Lake Couchiching. Each onsite tributary will herein be referred to as Tributary #1 – Tributary #5, from north to south. There are additional tributaries south and north of the Subject Lands that also drain to Lake Couchiching, and they will herein be referred to as Tributary #6 and Tributary #7, respectively. Tributary #6 flows from west to northeast towards Shadow Creek and Tributary #7 flows from north to south, also towards Shadow Creek.

This Floodplain Assessment was completed only for Tributary #6 and Tributary #7, as the catchment areas for Tributaries #1 - #5 were not large enough to trigger flood hazard delineation. Both tributaries are generally straight and contained within a mostly poorly-defined channel throughout the floodplain.

2.0 BACKGROUND

No hydraulic or hydrologic models or floodplain information existed for Tributary #6, and as such, were required to be created for this Floodplain Assessment. The following sections of the report outline the process used to create the hydraulic and hydrologic models and establish the Regional floodline for Tributary #6.

A Floodplain Assessment was previously completed by Tatham Engineering for Tributary #7 as part of the Cumberland Beach Functional Servicing Report (Tatham Engineering, October 2017). The Cumberland Beach development is immediately north of the Subject Development. The Cumberland Beach Floodplain Assessment provided Regional water surface elevations at various cross sections throughout its study area. The Regional water surface elevation provided in at the most downstream cross section (approximately at the north property line of the Subject Development) was used as the Regional floodline for Tributary #7 within the Subject Development.

3.0 STUDY AREA AND TOPOGRAPHIC DATA

The catchment area for Tributary #6 extends south from the Subject Lands and east to Stockdale Road. It covers an area of approximately 338.4 ha. The catchment area is currently mainly comprised agricultural, wetland and wooded areas, with a small portion of developed area. Tributary #6 drains northeast to Shadow Creek and ultimately Lake Couchiching.

Due to the total size of this catchment area, topographic survey for the entire catchment was impractical. As such, aerial-based topographic data from First Base Solutions (FBS) was used and supplemented with topographic survey of the Subject Lands. The topographic data from FBS was vertically adjusted (lowered) to better match the survey data for the Subject Lands by approximately 0.30 m.

4.0 HYDROLOGIC MODELING

Hydrologic modeling was undertaken to establish 100 year and Regional (Timmins) peak flow rates of Tributary #6 using Visual OTTHYMO Version 6.1.

Soil types were obtained from the Ontario Soil Survey Complex and land uses were obtained from OFAT to determine the Curve Number values for the watershed. Time of concentration was calculated using the Airport method. Refer to **Appendix A** for the hydrologic parameter sheet. Refer to **Table 1** for the peak flow values at the most downstream end of Tributary #6.

Table 1: Tributary #6 Peak Flow Rates

Event	Peak Flow Rate (m^3/s)
2 Year	3.35
25 Year	5.97
50 Year	10.68
100 Year	15.06
Regional (Timmins)	18.99

The peak flow rates presented in **Table 1** are the flow rates used in the hydraulic model presented in Section 5.0.

5.0 HYDRAULIC MODELING

5.1 HYDRAULIC MODEL SETUP

Floodplain analysis for the Subject Lands was performed using U.S. Army Corps' HEC-RAS hydraulic computer model, Version 5.0.6. The purpose of the analysis is to establish the existing Regulatory floodline across the Subject Lands.

Seven cross sections were extended across the Subject Lands with seven additional cross sections located upstream. Geometric data for the cross sections was based on the topographic survey and FBS topographic data.

The floodplain is characterized by an overall slope of 3.4% between the upstream and downstream limits within the Subject Lands. The slope of the main channel is approximately 2.1%. Based on aerial imagery, Manning's roughness values were selected at 0.06 for the main channel which reflects a natural watercourse with some weeds and heavy brush on the banks; while the overbank areas were selected at 0.07 which reflects areas with light to medium brush and trees. A subcritical flow regime was modeled to conservatively estimate the hydraulic profile.

The downstream boundary condition was set as the water surface elevation for the most downstream cross-section in the Cumberland Beach Floodplain Assessment (Tatham Engineering, October 2017) corresponding to each storm event. This assumption was confirmed against the Lake Simcoe historic high-water level of 219.49 reported by the Parks Canada Water Management InfoNet website (last updated Dec 17, 2021).

5.2 RESULTS

Results from the existing condition hydraulic analysis of Tributary #6 and Tributary #7 are presented in **Table 2**. The extent of the Regional floodline is shown on **Figure 11**. Refer to **Appendix B** for the detailed HEC-RAS outputs.

Table 2: Existing Conditions Regional Water Surface Elevations

Cross Section ID	Location	Regional Water Surface Elevation (m)
Tributary #6		
1201.63	Upstream of Subject Lands	221.21
1131.55		221.02
990.33		220.44
910.65		220.36
872.31		220.35
854.10		220.30
830.34		220.20
729.27		220.13
624.74	Subject Lands	220.11
525.56		220.09
416.78		219.99
336.6		219.86
210.37		219.60
83.12		219.54
Tributary #7		
-	Subject Lands	219.54

As shown on **Figure 11**, the Regional floodline for Tributary #6 and Tributary #7 encroaches slightly within the limit of development for the Subject Lands. However, the areas where the floodline encroaches within the development limit are considered ineffective flow areas and the flood storage provided within these areas is negligeable compared to the flood attenuation provided by Lake Couchiching. As such, under post-development conditions it is proposed to fill these areas to the Regulatory water surface elevation and provide an additional 0.30 m freeboard to floodproof the lots. In areas designated as significant fish habitat, it is proposed to maintain existing grade up to the 5-year floodline and fill between the 5-year floodline and the Regulatory Flood elevation.

6.0 Conclusion

Based on the foregoing we conclude the following:

- The proposed grading plan provides freeboard above the Regulatory floodplain.
- The proposed development is supportable with respect to flood hazards.

Therefore, we recommend approval of the Planning Applications for the Subject Lands from the perspective of floodplain management requirements.

Sincerely,

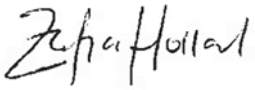
C.F. CROZIER & ASSOCIATES INC.

Brittany Robertson, P. Eng.
Manager of Land Development, Associate

C.F. CROZIER & ASSOCIATES INC.

Nicole O'Connor, P. Eng.
Project Engineer

C.F. CROZIER & ASSOCIATES INC.



Zofia Holland, E.I.T.
Engineering Intern

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APPENDIX A

Hydrologic Parameter Sheet

Project Name: Shadow Creek
Project Number: 1935-6103
Date: 24-Nov-21
Prepared By: S. Moneypenny
Checked By: N. O'Connor

D.A. NAME **TRIB-6**
D.A. AREA (ha) **338.40**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment TRIB-6

Curve Number Calculation

Soil Types Present:

Type	ID	Hydrologic	% Area	Area
Vasey Sandy Loam	Vasl	B	14	47.82
Tioga Loamy Sand Stoney	Tis-b	A	19	64.36
Tioga Loamy Sand	Tis	A	15	51.00
Alliston Sandy Loam	Ans	B	18	60.47
Lovering Silty Clay Loam	Lvs	C	22	75.09
Otonabee Loam	Ol	B	12	39.66
Total Area				338.40

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl		98		98		98		98		98	0.00	0.00
Tis-b		98		98		98		98		98	0.00	0.00
Tis	23.61	98		98		98		98		98	23.61	2313.53
Ans		98		98		98		98		98	0.00	0.00
Lvs		98		98		98		98		98	0.00	0.00
Ol	7.05	98		98		98		98		98	7.05	691.05
Subtotal Area	30.66		0.00		0.00		0.00		0.00			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Vasl	0.00	60	0.00		0.00	50	0		47.82	74	47.82	3538.38
Tis-b	44.84	32	0.00		11.80	50	0		7.72	62	64.36	2503.71
Tis	3.17	32	0.00		0.00	50	0		24.22	62	27.39	1603.08
Ans	16.84	60	0.00		11.06	50	0		32.57	74	60.47	3973.71
Lvs	19.86	73	0.00		2.85	50	0		52.38	82	75.09	5887.63
Ol	0.00	60	0.00		7.56	50	0		25.05	74	32.61	2231.73
Subtotal Area	84.71		0.00		33.26		0		189.77			

Composite Area Calculations

Total Pervious Area	307.74
Total Impervious Area	30.66
% Impervious	9.06%
Composite Curve Number (AMC II)	67.2
Composite Curve Number (AMC III)	88.0
Total Area Check	338.40

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient												
				Vasey Sandy		Tioga Loamy Sand		Tioga Loamy		Alliston Sandy		Lovering Silty Clay		Otonabee		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	84.71	847.14	0.25	0.00	0.08	44.84	0.08	3.17	0.25	16.84	0.35	19.86	0.25	0.00	15.00
Meadow	8	0.00	0.00		0.00		0.00		0.00		0.00		0.00		0.00	0.00
Wetland	16	33.26	532.15	0.05	0.00	0.05	11.80	0.05	0.00	0.05	11.06	0.05	2.85	0.05	7.56	1.66
Lawn	5	0.00	0.00		0.00		0.00		0.00		0.00		0.00		0.00	0.00
Cultivated	7	189.77	1328.37	0.35	47.82	0.22	7.72	0.22	24.22	0.35	32.57	0.55	52.38	0.35	25.05	72.74
Impervious	2	30.659	61.32	0.95	0.00	0.95	0.00	0.95	0.00	0.95	0.00	0.95	30.66	0.95	7.05	35.83
Composite IA		338.40	8.18	Composite Runoff Coefficient												0.37

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path	Length (m)	Drop	Slope	$V/S^{0.5}$	Velocity	Tc (hr)	Tp(hr)	TOTAL	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Main Channel	3555	76	2.14%	2.7	0.39	2.50	1.68	1.68	1.62	1.09	1.84	1.23

Appropriate calculated time to	1.23	Appropriate Method:	Airport

APPENDIX B

HEC-RAS Outputs

CROZIER & ASSOCIATES
Consulting Engineers

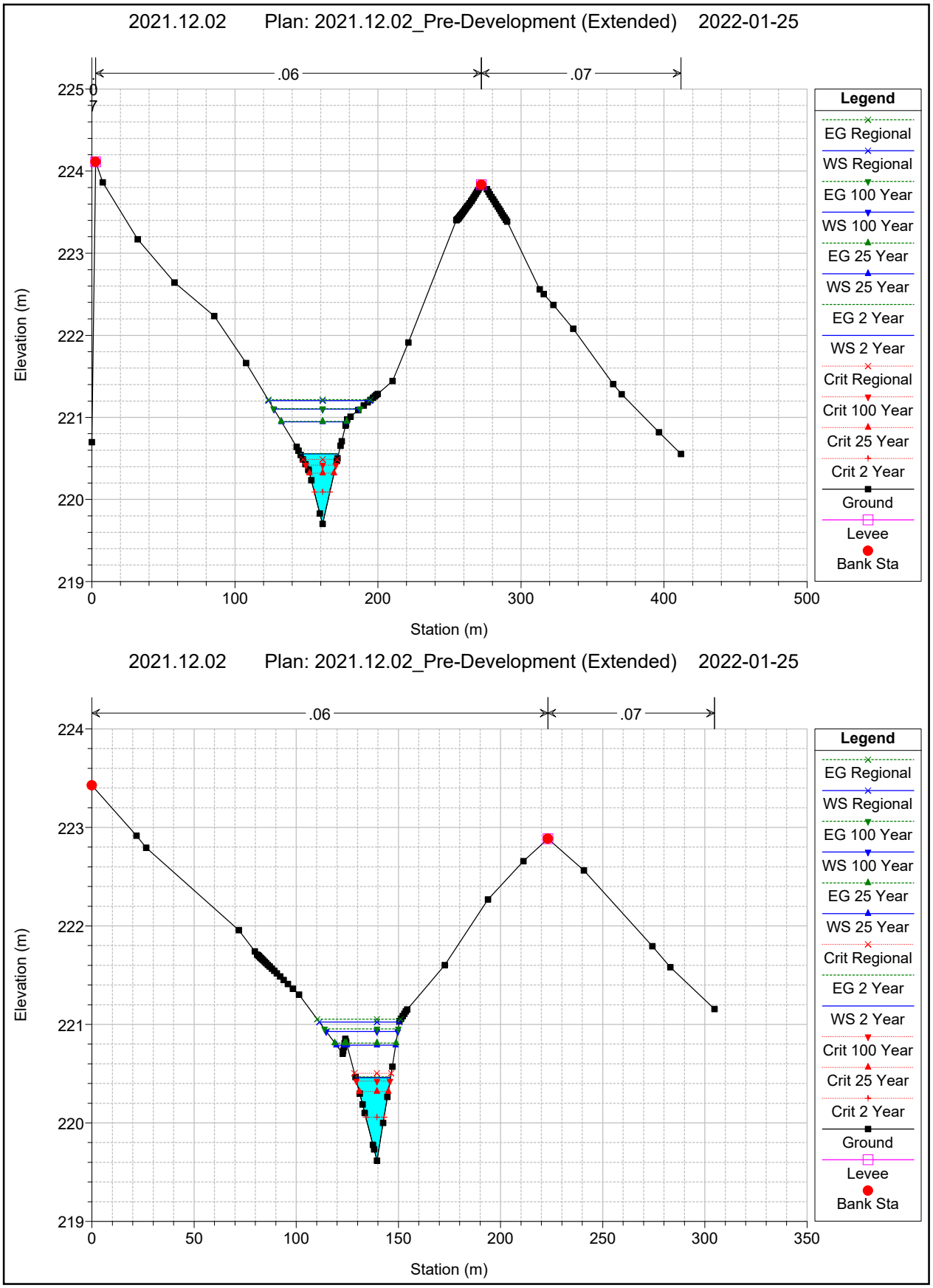
Project: Shadow Creek
Project Number: 1935-6103
Date: 2022-01-25
Prepared By: R. De Mesa
Checked By: N. O'Connor

Site Topo Comparison

Menoke Beach Site Topo Comparison				
Point No	**Site Topo Elev (m)**	**FBS Topo (m)**	**Difference (m)**	**Lower or Raise FBS Topo to match Site Topo**
1	220.21	220.81	0.60	Lower
2	219.28	220.15	0.87	Lower
3	219.82	220.06	0.24	Lower
4	220.28	220.46	0.18	Lower
5	220.34	220.45	0.11	Lower
6	220.61	220.61	0.00	N/A
7	221.11	221.57	0.46	Lower
8	221.81	222.63	0.82	Lower
9	222.29	222.36	0.07	Lower
10	221.37	221.47	0.10	Lower
11	219.96	220.78	0.82	Lower
12	219.75	220.38	0.63	Lower
13	219.49	219.55	0.06	Lower
14	219.52	219.96	0.44	Lower
15	218.85	218.24	-0.61	Raise
		Average	0.32	Lower

Notes

1 Average (including pt 15) was used to lower each FBS contour by 0.32 m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Elevation (m)
Station (m)
Legend
EG Regional
WS Regional
EG 100 Year
WS 100 Year
EG 25 Year
WS 25 Year
EG 2 Year
WS 2 Year
Crit Regional
Crit 100 Year
Crit 25 Year
Crit 2 Year
Ground
Levee
Bank Sta
2021.12.02 Plan: 2021.12.02_Pre-Development (Extended) 2022-01-25
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Elevation (m)
Station (m)
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WS Regional
EG 100 Year
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Ground
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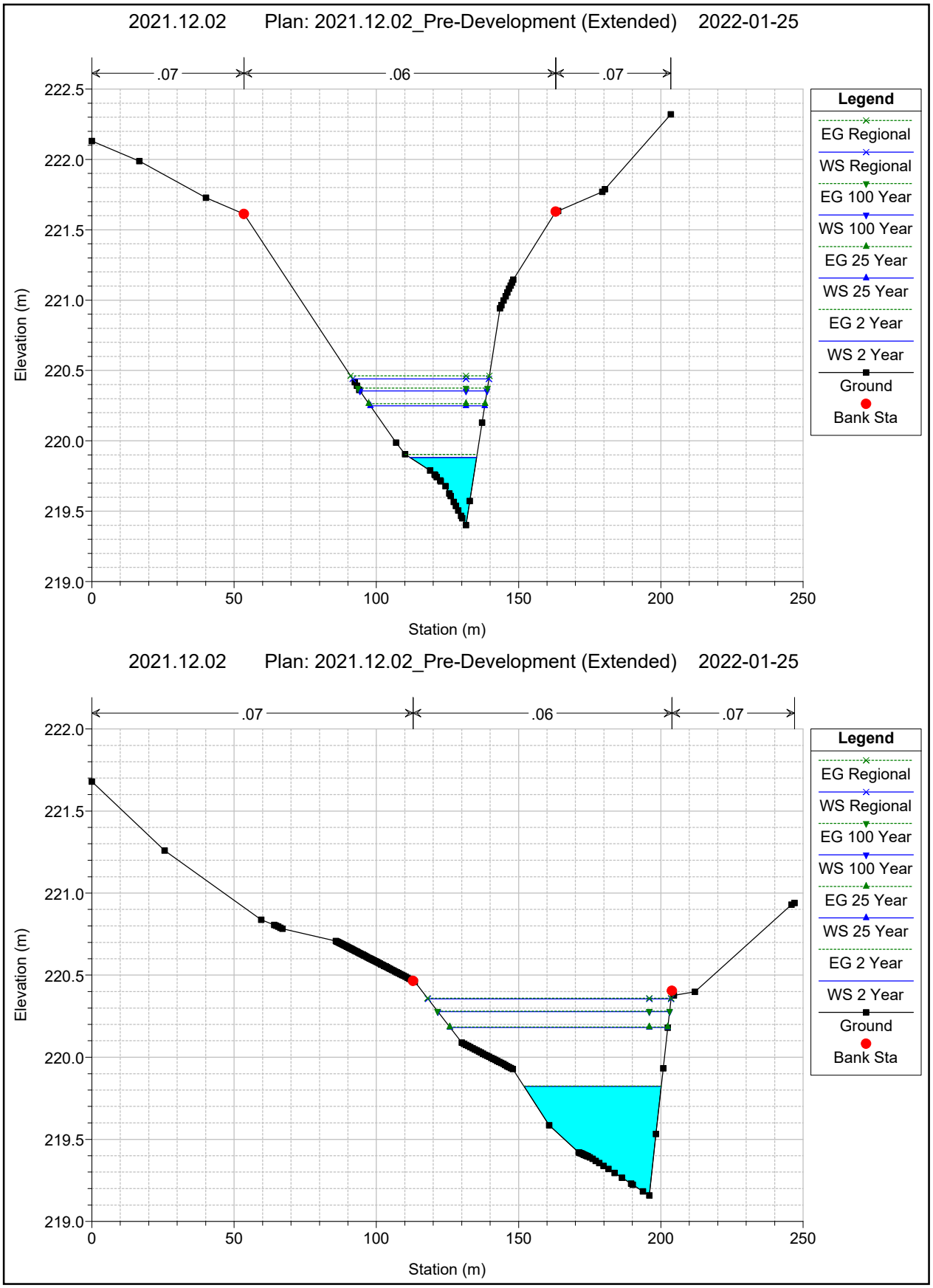
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Station (m)
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EG 2 Year
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Ground
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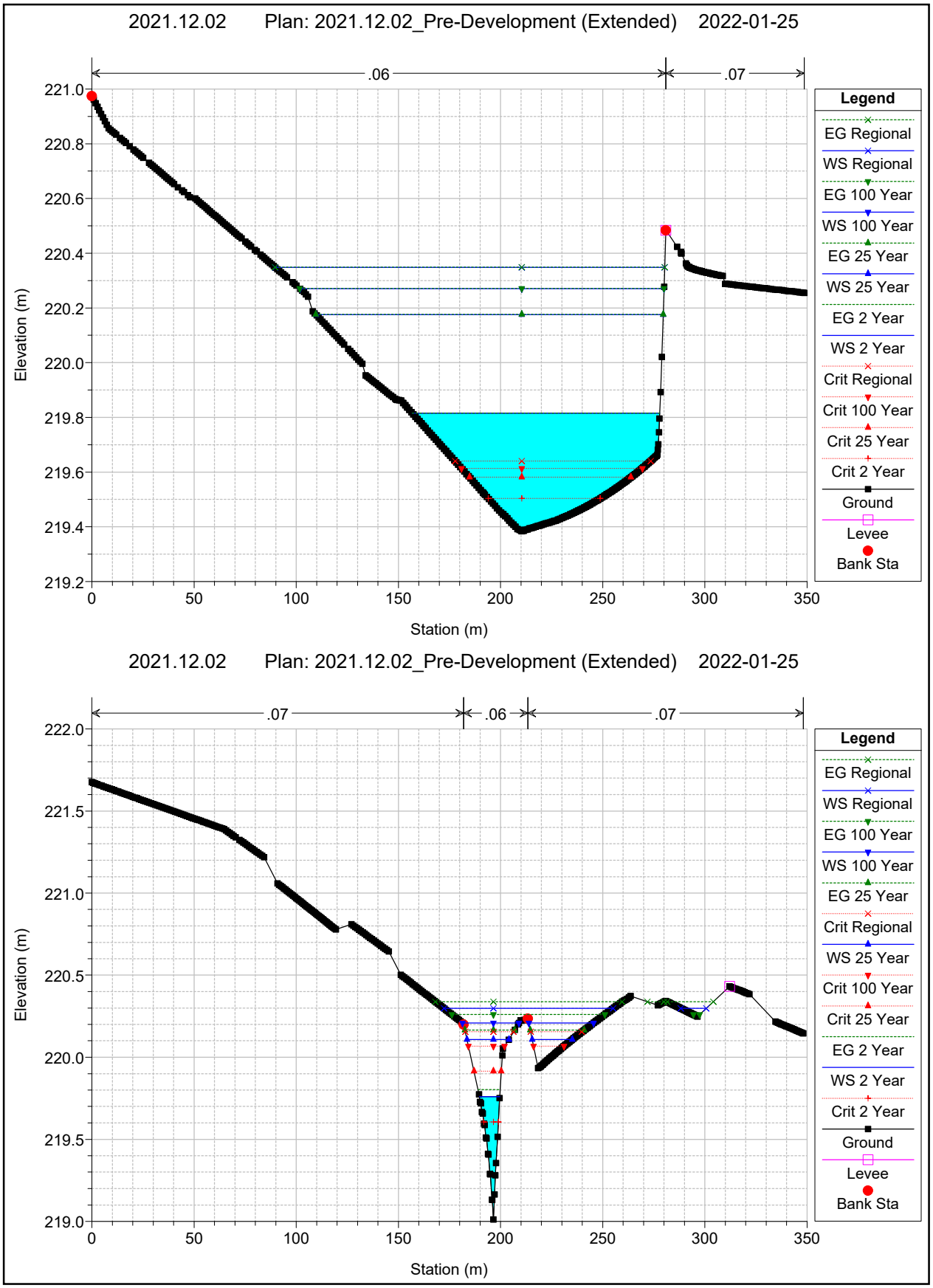
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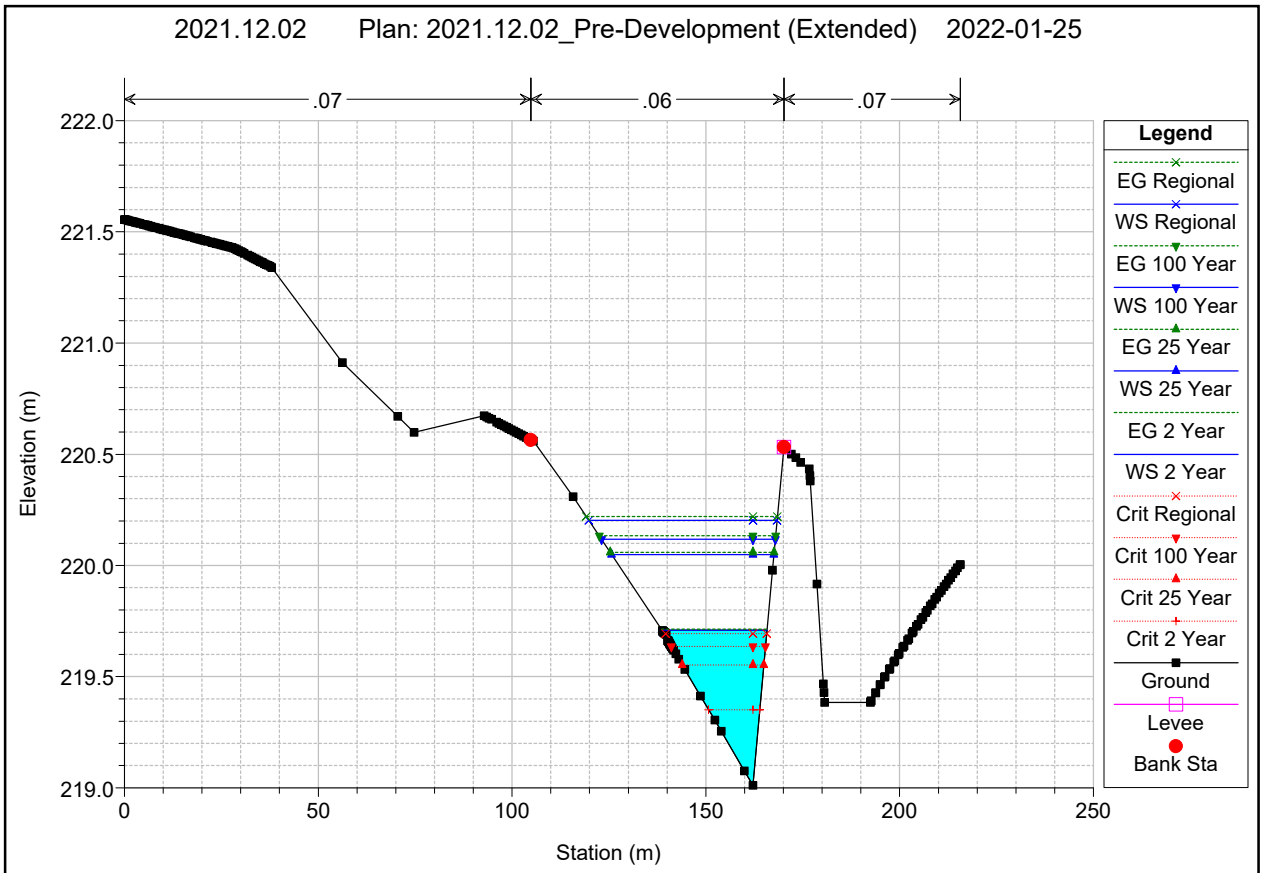
Levee
Bank Sta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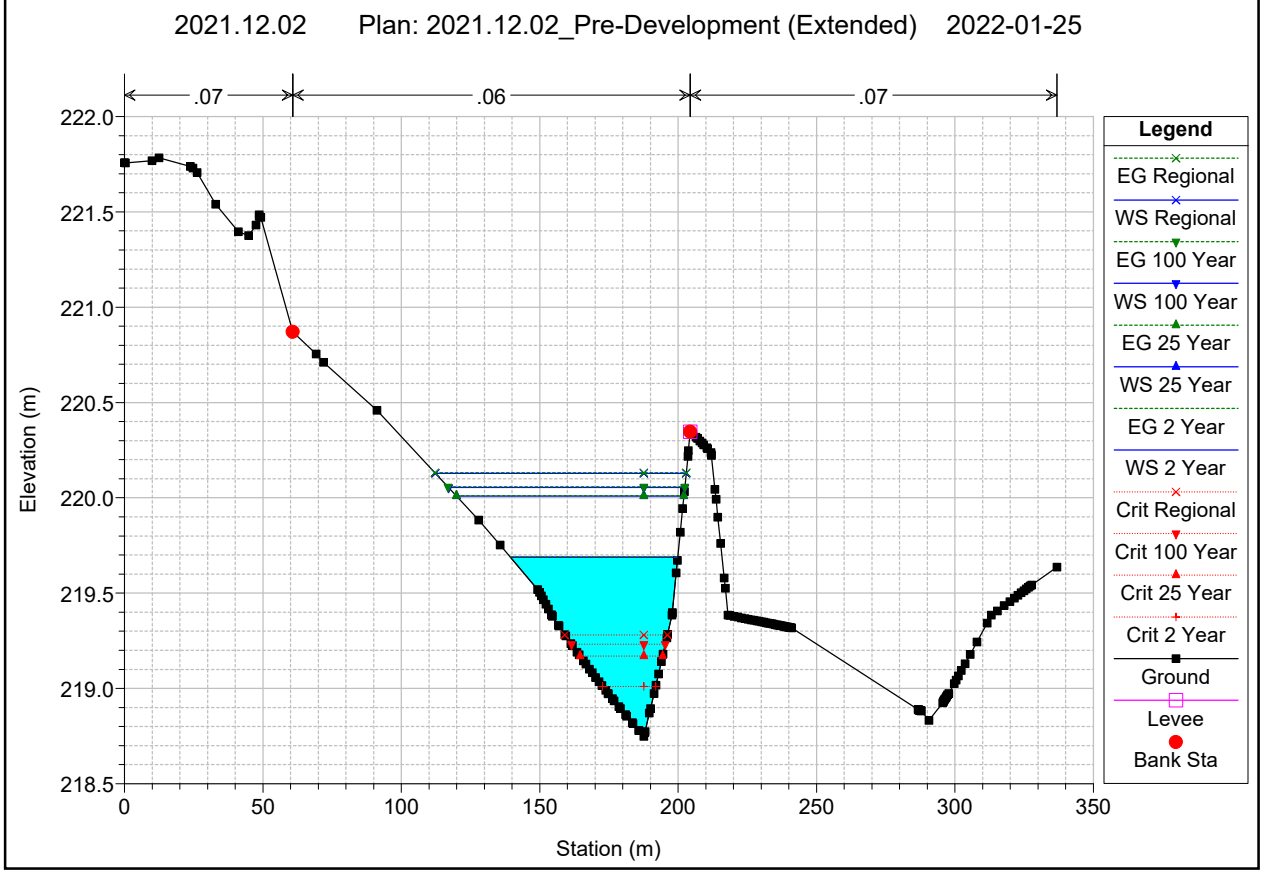
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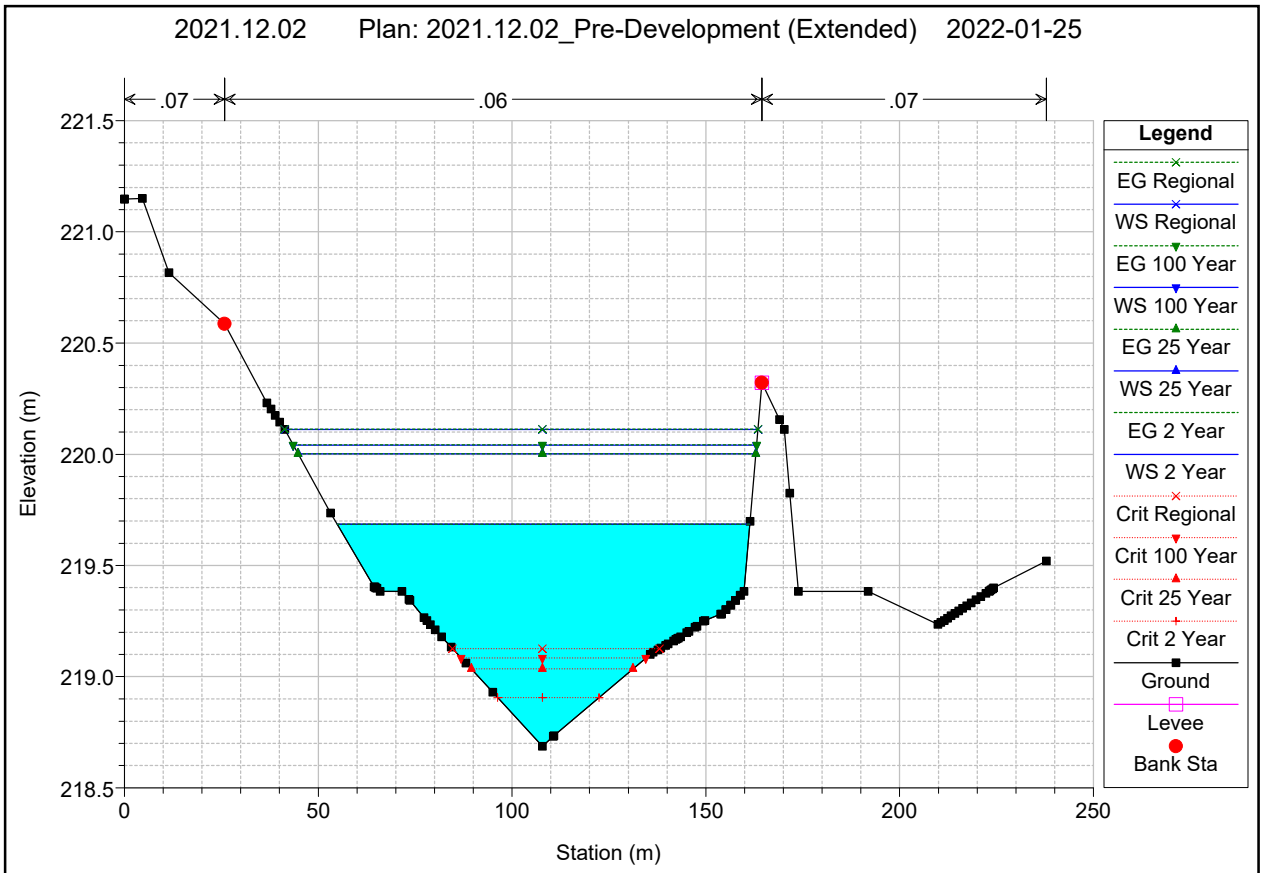
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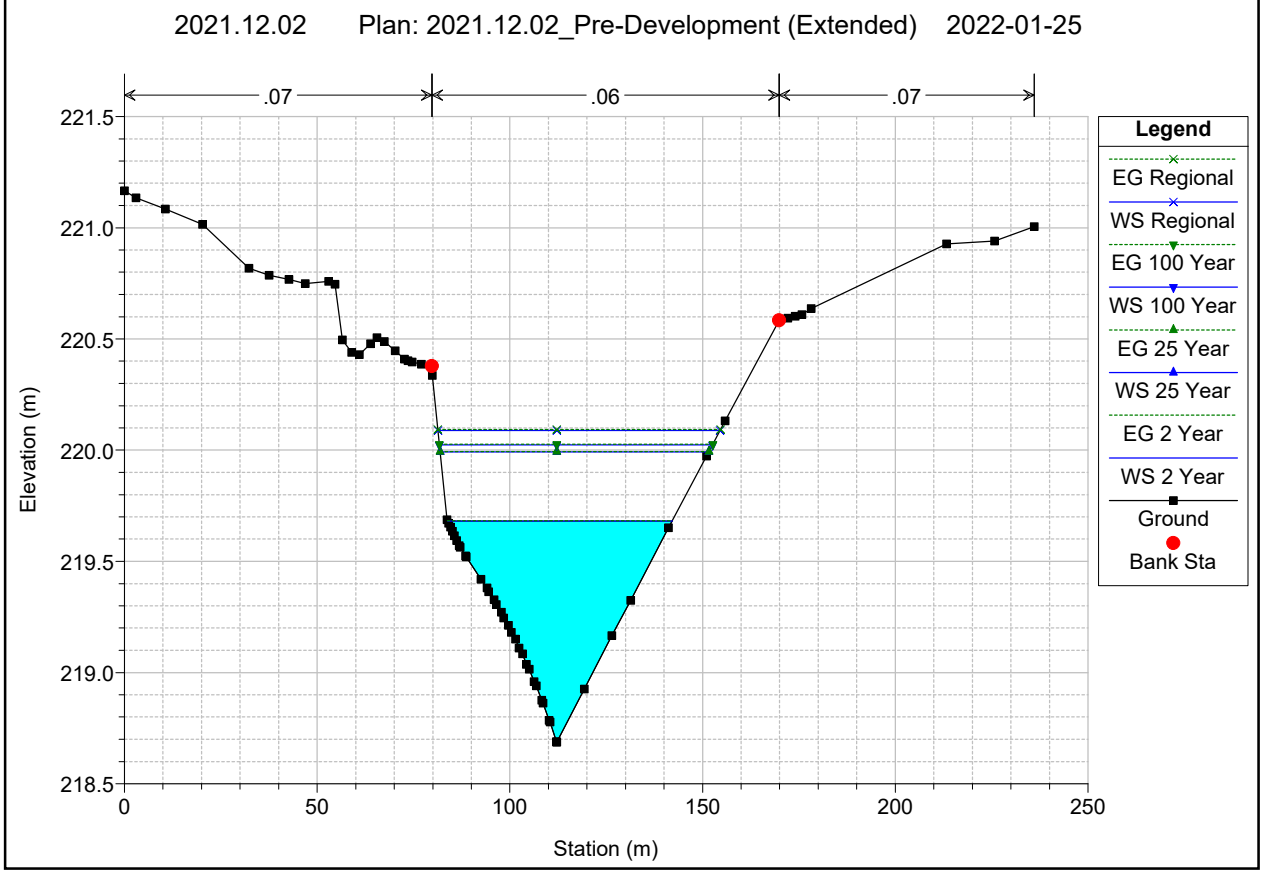
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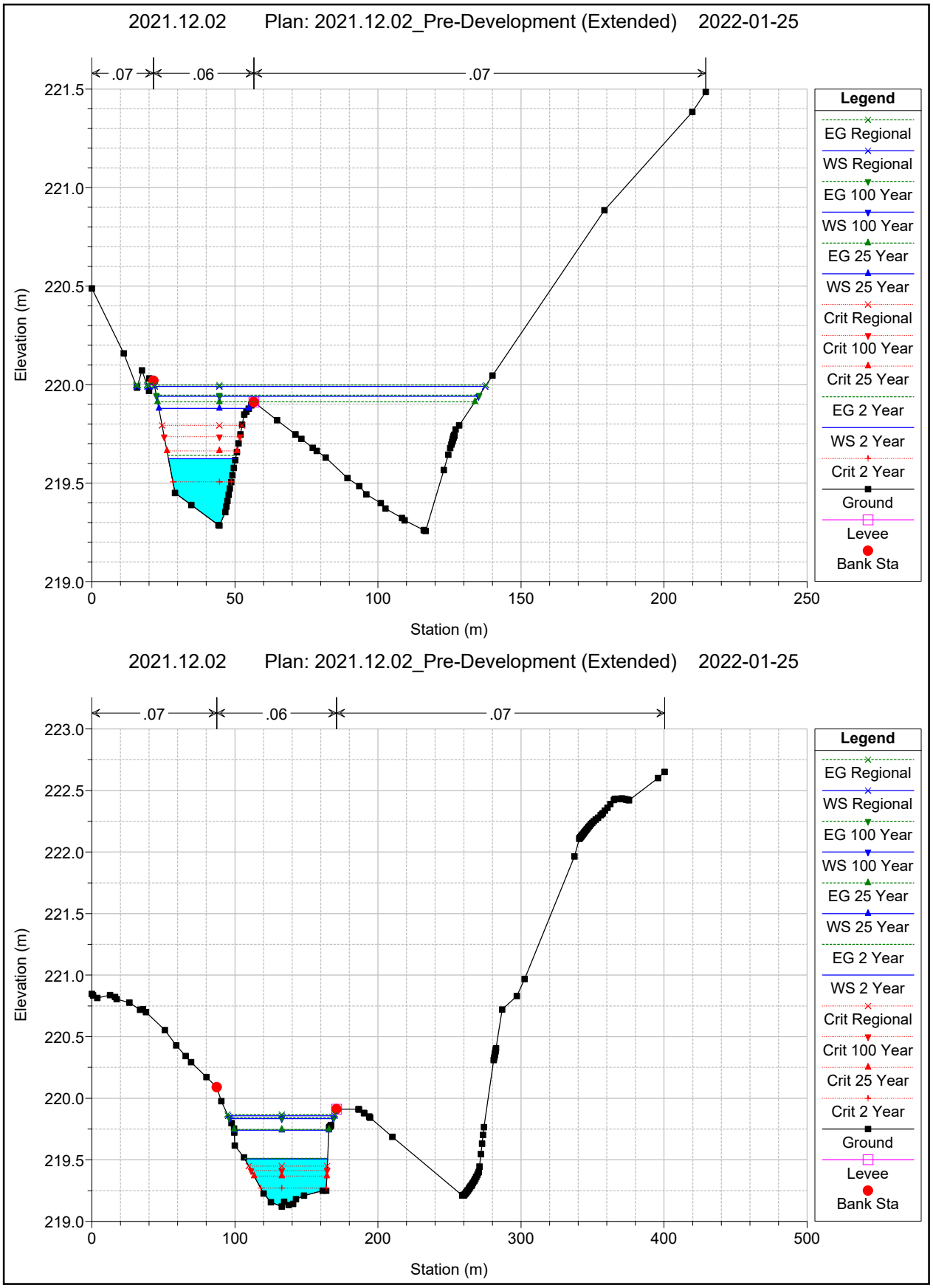
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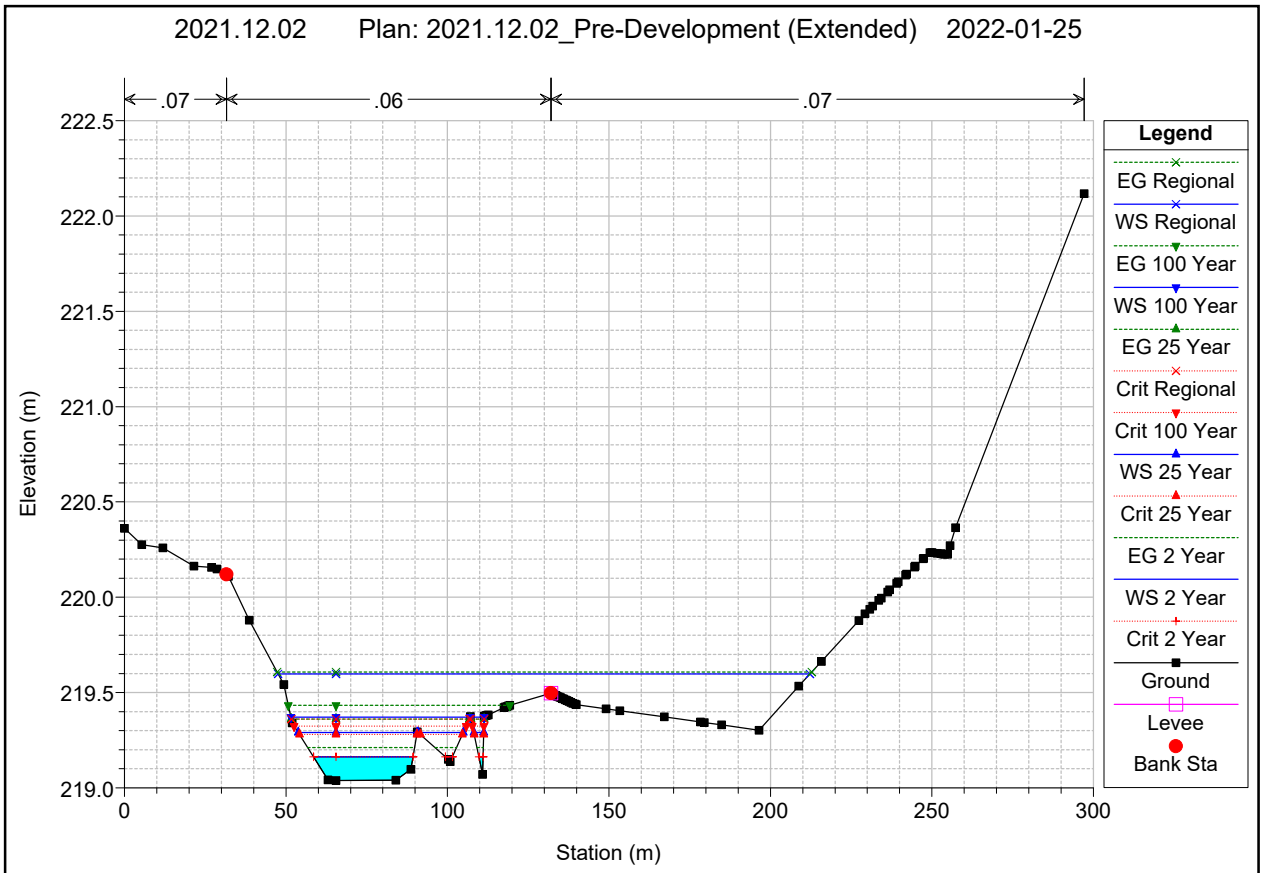
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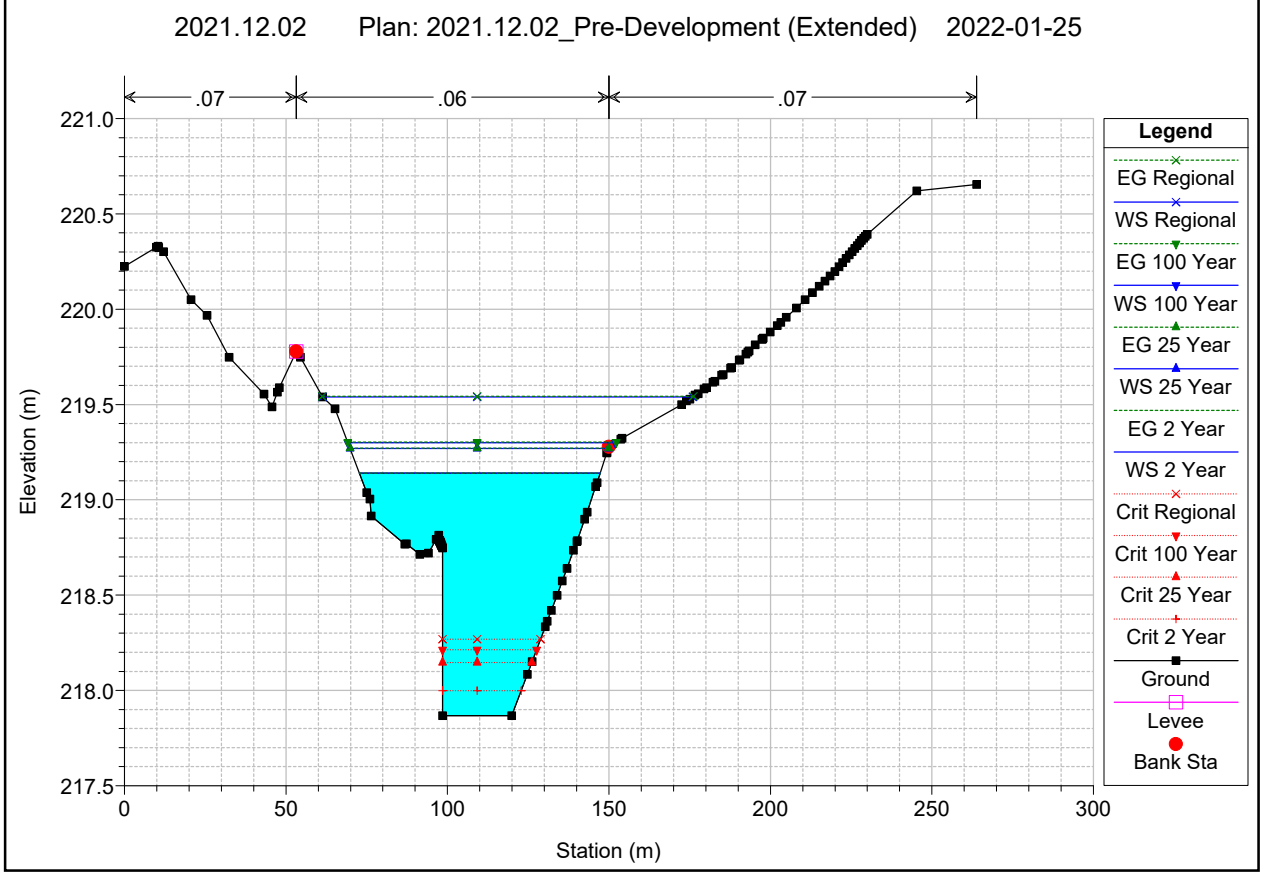
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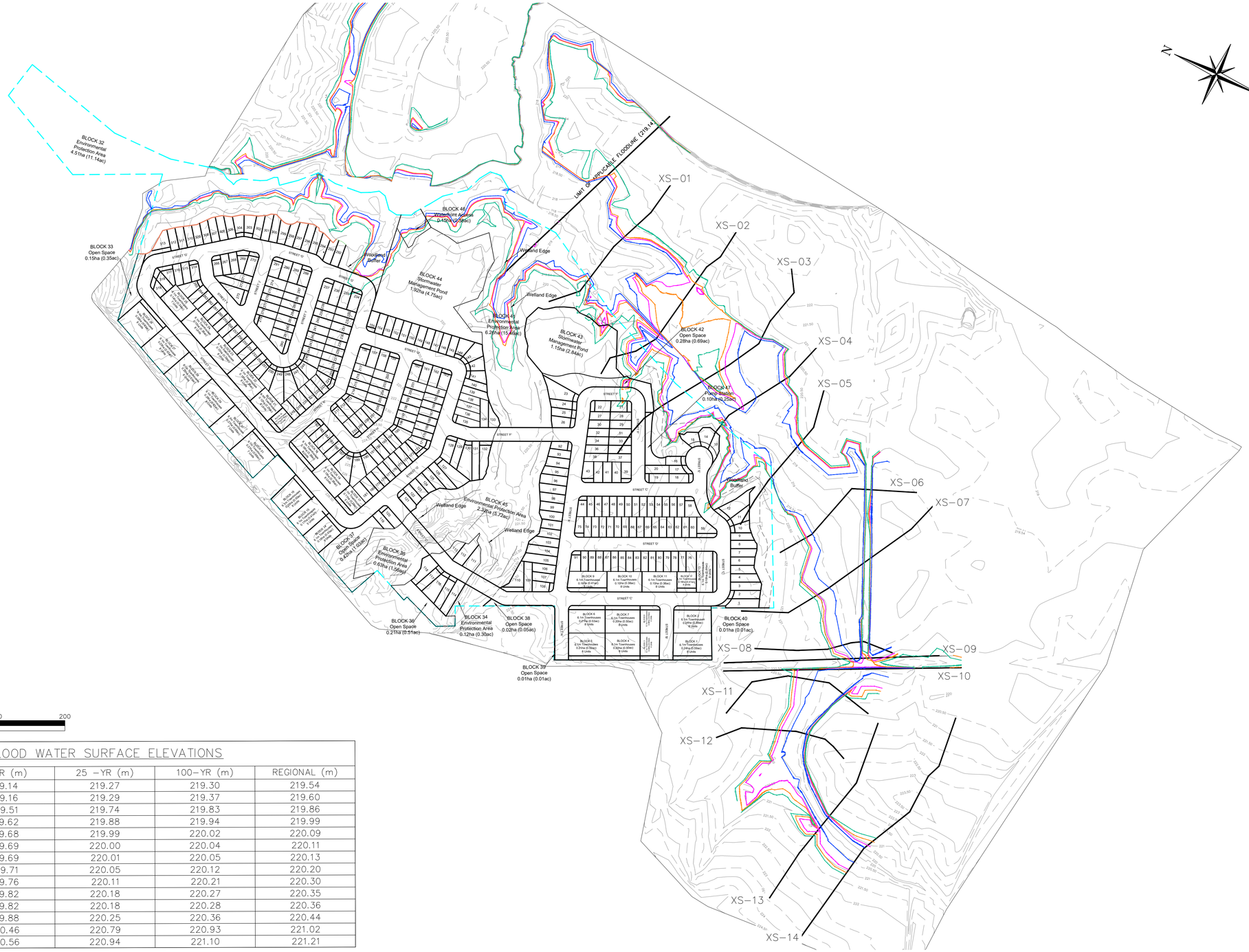
Crit 25 Year
Crit 2 Year
Ground
Levee
Bank Sta

HEC-RAS Plan: Extended River: Flood Centreline Reach: Flood Centreline

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Flood Centreline	1201.63	2 Year	2.91	219.70	220.56	220.09	220.56	0.000974	0.28	10.50	26.93	0.14
Flood Centreline	1201.63	25 Year	9.31	219.70	220.94	220.32	220.95	0.001193	0.38	24.46	45.44	0.17
Flood Centreline	1201.63	100 Year	13.13	219.70	221.10	220.42	221.11	0.001322	0.40	32.53	59.78	0.17
Flood Centreline	1201.63	Regional	16.65	219.70	221.21	220.49	221.21	0.001397	0.42	39.45	70.70	0.18
Flood Centreline	1131.55	2 Year	2.91	219.62	220.46	220.06	220.47	0.001865	0.40	7.22	17.12	0.20
Flood Centreline	1131.55	25 Year	9.31	219.62	220.79	220.32	220.81	0.003838	0.66	14.15	27.71	0.29
Flood Centreline	1131.55	100 Year	13.13	219.62	220.93	220.42	220.95	0.004239	0.71	18.54	35.01	0.31
Flood Centreline	1131.55	Regional	16.65	219.62	221.02	220.50	221.05	0.004418	0.75	22.07	39.12	0.32
Flood Centreline	990.33	2 Year	2.91	219.40	219.88		219.90	0.013772	0.65	4.49	23.44	0.47
Flood Centreline	990.33	25 Year	9.31	219.40	220.25		220.26	0.003889	0.57	16.34	40.18	0.29
Flood Centreline	990.33	100 Year	13.13	219.40	220.36		220.38	0.003935	0.63	20.88	44.72	0.29
Flood Centreline	990.33	Regional	16.65	219.40	220.44		220.46	0.003914	0.67	24.80	47.95	0.30
Flood Centreline	910.65	2 Year	2.91	219.16	219.82		219.82	0.000302	0.15	18.83	48.23	0.08
Flood Centreline	910.65	25 Year	9.31	219.16	220.18		220.18	0.000427	0.23	41.01	76.54	0.10
Flood Centreline	910.65	100 Year	13.13	219.16	220.28		220.28	0.000524	0.27	48.59	81.43	0.11
Flood Centreline	910.65	Regional	16.65	219.16	220.36		220.36	0.000591	0.30	55.09	85.41	0.12
Flood Centreline	872.31	2 Year	2.91	219.38	219.82	219.50	219.82	0.000154	0.09	33.29	121.11	0.05
Flood Centreline	872.31	25 Year	9.31	219.38	220.18	219.58	220.18	0.000104	0.11	86.15	169.96	0.05
Flood Centreline	872.31	100 Year	13.13	219.38	220.27	219.61	220.27	0.000123	0.13	102.67	178.16	0.05
Flood Centreline	872.31	Regional	16.65	219.38	220.35	219.64	220.35	0.000140	0.14	116.91	190.60	0.06
Flood Centreline	854.1	2 Year	2.91	219.01	219.76	219.61	219.80	0.014905	0.93	3.13	9.94	0.53
Flood Centreline	854.1	25 Year	9.31	219.01	220.11	219.91	220.16	0.015117	1.09	9.71	40.09	0.56
Flood Centreline	854.1	100 Year	13.13	219.01	220.21	220.07	220.26	0.014928	1.07	14.69	59.32	0.55
Flood Centreline	854.1	Regional	16.65	219.01	220.30	220.15	220.34	0.011129	0.98	21.47	95.32	0.48
Flood Centreline	830.34	2 Year	2.91	219.01	219.71	219.35	219.71	0.001405	0.31	9.43	27.08	0.17
Flood Centreline	830.34	25 Year	9.31	219.01	220.05	219.55	220.06	0.001733	0.44	21.17	41.86	0.20
Flood Centreline	830.34	100 Year	13.13	219.01	220.12	219.64	220.13	0.002434	0.54	24.16	44.86	0.24
Flood Centreline	830.34	Regional	16.65	219.01	220.20	219.69	220.22	0.002624	0.59	28.11	48.53	0.25
Flood Centreline	729.27	2 Year	2.91	218.75	219.69	219.01	219.69	0.000087	0.10	29.94	60.47	0.04
Flood Centreline	729.27	25 Year	9.31	218.75	220.01	219.17	220.01	0.000203	0.18	52.72	82.15	0.07
Flood Centreline	729.27	100 Year	13.13	218.75	220.05	219.23	220.06	0.000338	0.23	56.47	85.32	0.09
Flood Centreline	729.27	Regional	16.65	218.75	220.13	219.28	220.13	0.000410	0.26	62.92	90.51	0.10
Flood Centreline	625.74	2 Year	2.91	218.69	219.69	218.91	219.69	0.000018	0.05	60.53	106.46	0.02
Flood Centreline	625.74	25 Year	9.31	218.69	220.00	219.03	220.00	0.000045	0.10	96.00	118.11	0.03
Flood Centreline	625.74	100 Year	13.13	218.69	220.04	219.08	220.04	0.000077	0.13	100.68	119.55	0.05
Flood Centreline	625.74	Regional	16.65	218.69	220.11	219.13	220.11	0.000097	0.15	109.14	122.12	0.05
Flood Centreline	525.56	2 Year	2.91	218.69	219.68		219.68	0.000108	0.11	27.63	58.29	0.05
Flood Centreline	525.56	25 Year	9.31	218.69	219.99		219.99	0.000231	0.20	47.46	69.71	0.08
Flood Centreline	525.56	100 Year	13.13	218.69	220.02		220.03	0.000404	0.26	49.69	70.85	0.10
Flood Centreline	525.56	Regional	16.65	218.69	220.09		220.09	0.000502	0.31	54.39	73.20	0.11
Flood Centreline	416.78	2 Year	3.11	219.28	219.62	219.51	219.64	0.009005	0.59	5.30	23.48	0.39
Flood Centreline	416.78	25 Year	9.94	219.28	219.88	219.66	219.91	0.008509	0.82	12.18	31.47	0.42
Flood Centreline	416.78	100 Year	14.02	219.28	219.94	219.74	219.95	0.001833	0.40	41.72	112.55	0.20
Flood Centreline	416.78	Regional	17.68	219.28	219.99	219.79	220.00	0.001966	0.44	47.49	116.37	0.21
Flood Centreline	336.6	2 Year	3.35	219.12	219.51	219.27	219.51	0.000866	0.21	16.09	58.00	0.13
Flood Centreline	336.6	25 Year	10.68	219.12	219.74	219.37	219.75	0.001198	0.35	30.85	66.27	0.16
Flood Centreline	336.6	100 Year	15.06	219.12	219.83	219.41	219.84	0.001428	0.40	37.30	72.61	0.18
Flood Centreline	336.6	Regional	18.99	219.12	219.86	219.45	219.87	0.002017	0.49	39.00	74.21	0.21
Flood Centreline	210.37	2 Year	3.35	219.04	219.16	219.16	219.21	0.075203	0.98	3.42	34.31	0.99
Flood Centreline	210.37	25 Year	10.68	219.04	219.29	219.28	219.36	0.054509	1.18	9.04	53.94	0.92
Flood Centreline	210.37	100 Year	15.06	219.04	219.37	219.32	219.43	0.031286	1.10	13.67	59.73	0.74
Flood Centreline	210.37	Regional	18.99	219.04	219.60	219.36	219.61	0.003093	0.47	47.02	164.66	0.25
Flood Centreline	83.12	2 Year	3.35	217.87	219.14	218.00	219.14	0.000023	0.06	53.04	74.58	0.02
Flood Centreline	83.12	25 Year	10.68	217.87	219.27	218.15	219.27	0.000144	0.17	63.10	80.02	0.06
Flood Centreline	83.12	100 Year	15.06	217.87	219.30	218.21	219.30	0.000256	0.23	65.53	82.83	0.08
Flood Centreline	83.12	Regional	18.99	217.87	219.54	218.27	219.54	0.000185	0.22	89.06	114.65	0.07

FIGURE



100 0m 100 200

SCALE: 1:3000

FLOOD WATER SURFACE ELEVATIONS

STATION	2-YR (m)	25 -YR (m)	100-YR (m)	REGIONAL (m)
XS-01	219.14	219.27	219.30	219.54
XS-02	219.16	219.29	219.37	219.60
XS-03	219.51	219.74	219.83	219.86
XS-04	219.62	219.88	219.94	219.99
XS-05	219.68	219.99	220.02	220.09
XS-06	219.69	220.00	220.04	220.11
XS-07	219.69	220.01	220.05	220.13
XS-08	219.71	220.05	220.12	220.20
XS-09	219.76	220.11	220.21	220.30
XS-10	219.82	220.18	220.27	220.35
XS-11	219.82	220.18	220.28	220.36
XS-12	219.88	220.25	220.36	220.44
XS-13	220.46	220.79	220.93	221.02
XS-14	220.56	220.94	221.10	221.21

LEGEND

- 2-YR FLOODLINE
- 25-YR FLOODLINE
- 100-YR FLOODLINE
- REGIONAL FLOODLINE
- FLOOD CROSS SECTION
- 220.00 EXISTING CONTOUR
- PROPERTY LINE

Township of SEVERN

No.	ISSUE	DATE: MMM/DD/YYYY
0	ISSUED FOR REVIEW	JAN/14/2022
1	ISSUED FOR 1ST SUBMISSION	JAN/25/2022

Engineer

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Engineer

Project: SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing: FLOODPLAIN CROSS SECTIONS

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By	Design By	Project	
A.M. / R.D.M.	Z.H.		1935-6103
Check By	Check By	Scale	Drawing
B.R.	N.C.O.	1: 3000	FIG 11

FIGURES

Legend

= SUBJECT LANDS

Project

SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

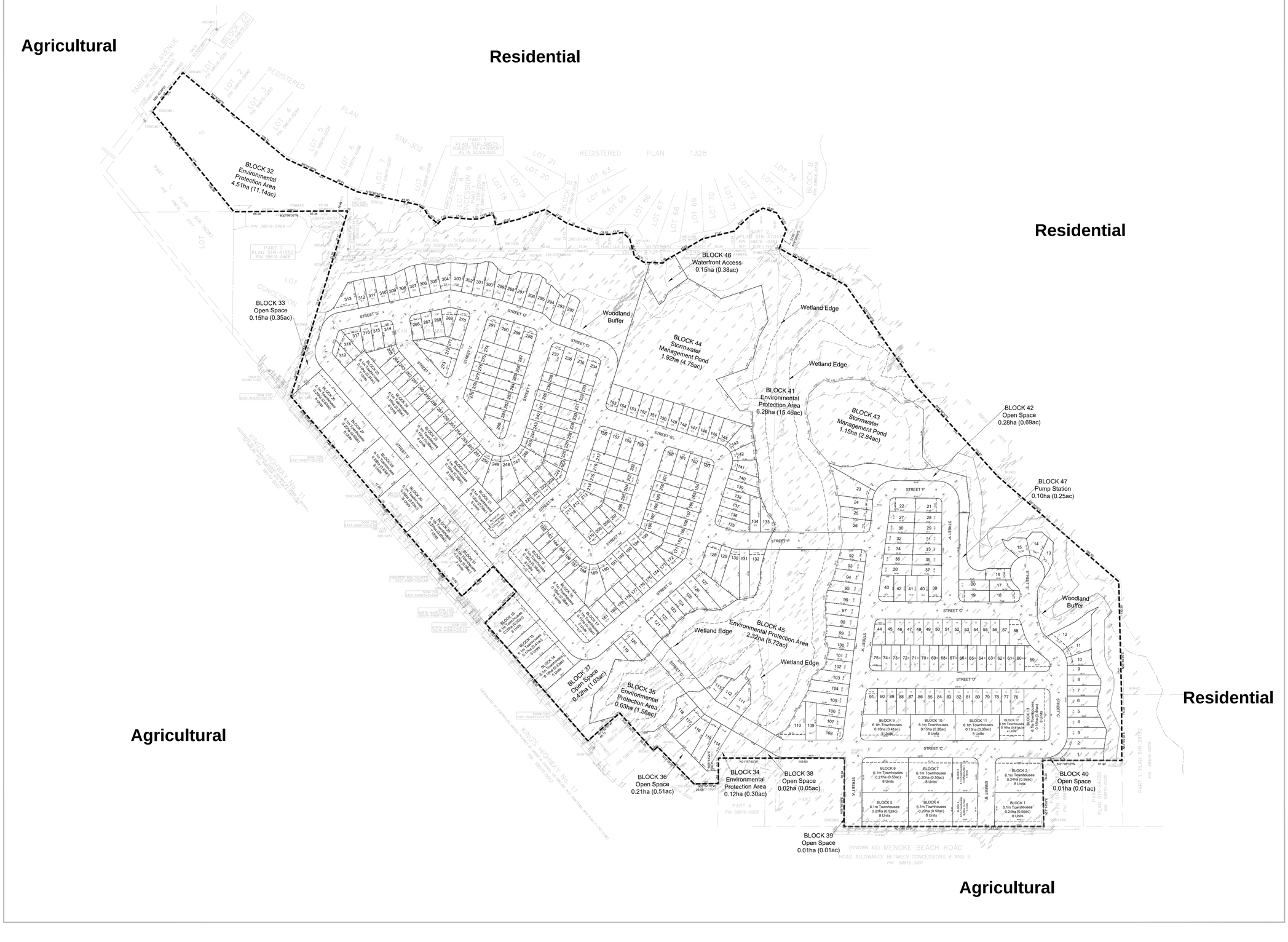
Drawing

SITE LOCATION

CROZIER CONSULTING ENGINEERS
Admiral Building
1 First Street, Suite 200
Collingwood, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
www.cfcrozier.ca
info@cfcrozier.ca

Drawn By	Design By	Project
R.D.M / A.M.	Z.H.	1935-6103

Scale	Date	Check By	Drawing
N.T.S.	JAN/25/2022	B.R. / N.C.O.	FIG. 1



Legal Description

PART OF LOTS 3, 4, AND 5
CONCESSION 9 (NORTH DIVISION)
(GEOGRAPHIC TOWNSHIP OF NORTH ORILLIA)
NOW IN THE
TOWNSHIP OF SEVERN
COUNTY OF SIMCOE

Owner's Certificate

I HEREBY AUTHORIZE MACNAUGHTON HERMSEN BRITTON CLARKSON PLANNING LIMITED TO SUBMIT THIS PLAN FOR APPROVAL.

DATE: _____

_____
LIV Communities

Surveyor's Certificate

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE: _____

_____
PIER DE ROSA- O.L.S.
J.D. BARNES LIMITED

Revision No.	Date	Issued / Revision	By

Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990, c.P.13 as Amended

A. As Shown
D. Residential, Parkland
G. As Shown
J. As Shown
L. As Shown
B. As Shown
E. As Shown
H. Municipal Water Supply (Piped)
K. All Services As Required
C. As Shown
F. As Shown
I. Tioga Loamy Sand
Lovering Silty Clay Loam
Alliston Sandy Loam

KEY PLAN

SUBJECT LANDS

NOT TO SCALE

County Signing Block

APPROVED IN ACCORDANCE WITH SECTION 51(31) OF THE PLANNING ACT RSO, 1990, CHAPTER P.13, AS AMENDED

THIS _____ DAY OF _____, 20____

_____
DIRECTOR OF PLANNING, DEVELOPMENT AND TOURISM
COUNTY OF SIMCOE

Area Schedule

Description	Lots/Blocks	Units	Area
11m (36') Single Detached	9-11, 44-91, 130-132, 135-140, 164-229, 232-233, 238-239, 242-265, 271-287	170	6.36 ha (15.70 ac)
12.2m (40') Single Detached	1-8, 12-43, 92-129, 133-134, 141-163, 230-231, 234-237, 240-241, 266-270, 288-318	149	6.94 ha (17.14 ac)
6.1m (20') Townhouses	Block 1-31	215	5.51 ha (13.62 ac)
Open Space	Block 33, 36, 37, 38, 39, 40, 42		1.07 ha (2.63 ac)
Pump Station	Block 47		0.10 ha (0.25 ac)
Environmental Protection Area	Block 32, 34, 35, 41, 45		13.83 ha (34.18 ac)
Stormwater Management Pond	Block 43, 44		3.07 ha (7.59 ac)
Waterfront Access	Block 46		0.15 ha (0.38 ac)
Street A-K			8.42 ha (20.80 ac)
Total		534	45.45 ha (112.31 ac)

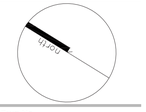
MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
230-7050 WESTON ROAD WOODBRIDGE, ON, L4L 8G7 | P: 905 761 5588 F: 905 761 5589 | WWW.MHBCPLAN.COM

Stamp

Date	November 9, 2021
File No.	15226X
Plan Scale	1:2000 (Arch D)
Drawn By	T.H.
Checked By	E.T.
Other	

Project

8743 Highway 11
Draft Plan of Subdivision



File Name
DRAFT PLAN OF SUBDIVISION

Dwg No.
1 of 1

Scale Bar

0 25 50 100 200

MEASUREMENTS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

N:\15226\X – MBR Phase III – Shadow Creek, Severn\1 – MHBC Documents\Draft Plan\CAD\15226X– Draft Plan of Subdivision– 03 January 2022.dwg

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Township of SEVERN

No.	ISSUE	DATE: MMM/DD/YYYY
0	ISSUED FOR REVIEW	JAN/14/2022
1	ISSUED FOR 1ST SUBMISSION	JAN/25/2022

Engineer

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Engineer

Project
SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing
PRELIMINARY GRADING PLAN

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705-446-3510 T
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WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

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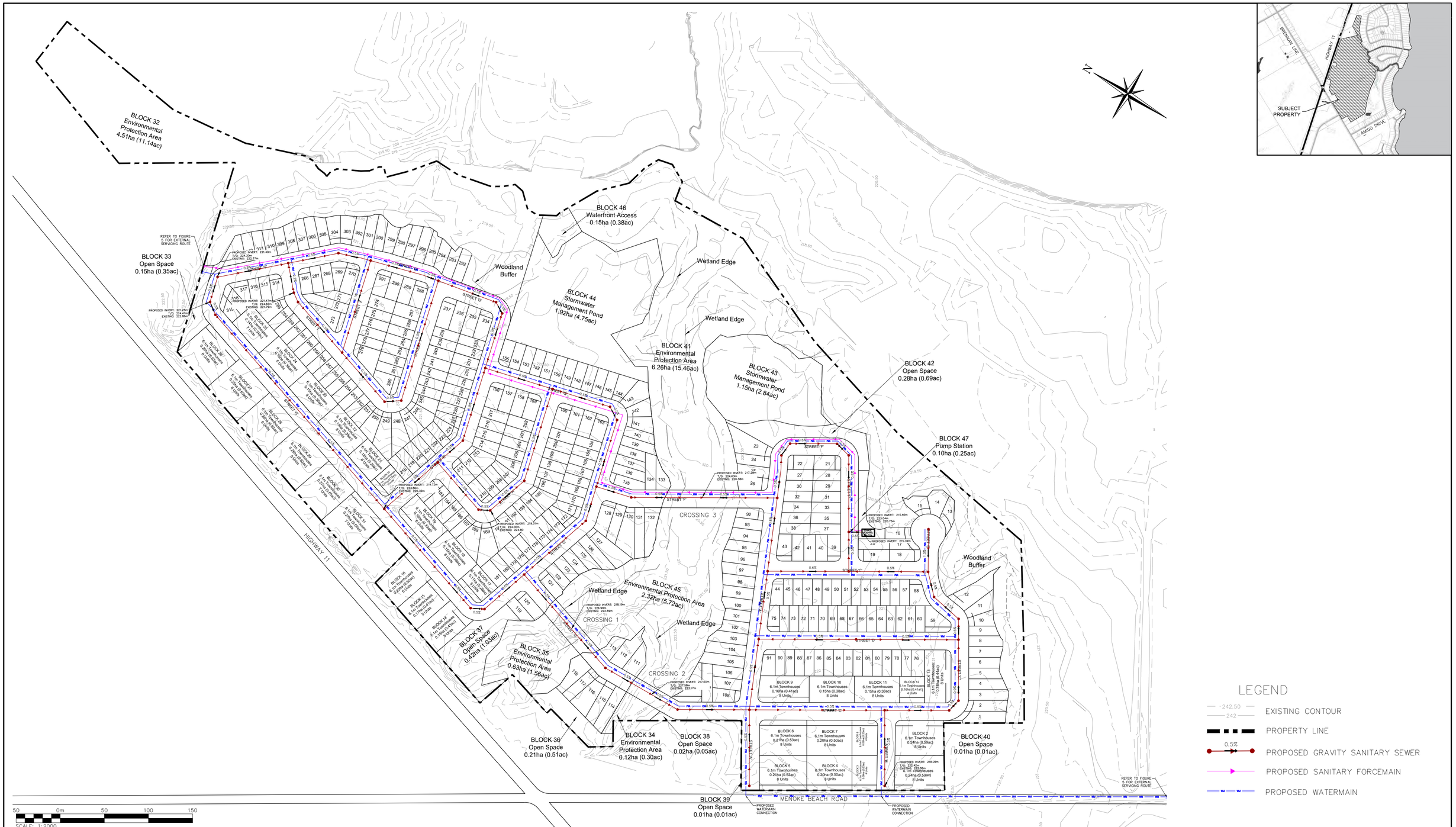
Check By	B.R.	Check By	N.C.O.	Scale	1: 2000
				Drawing	FIG 3



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Project: SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing: PRELIMINARY SERVICING PLAN

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705-446-3510 T
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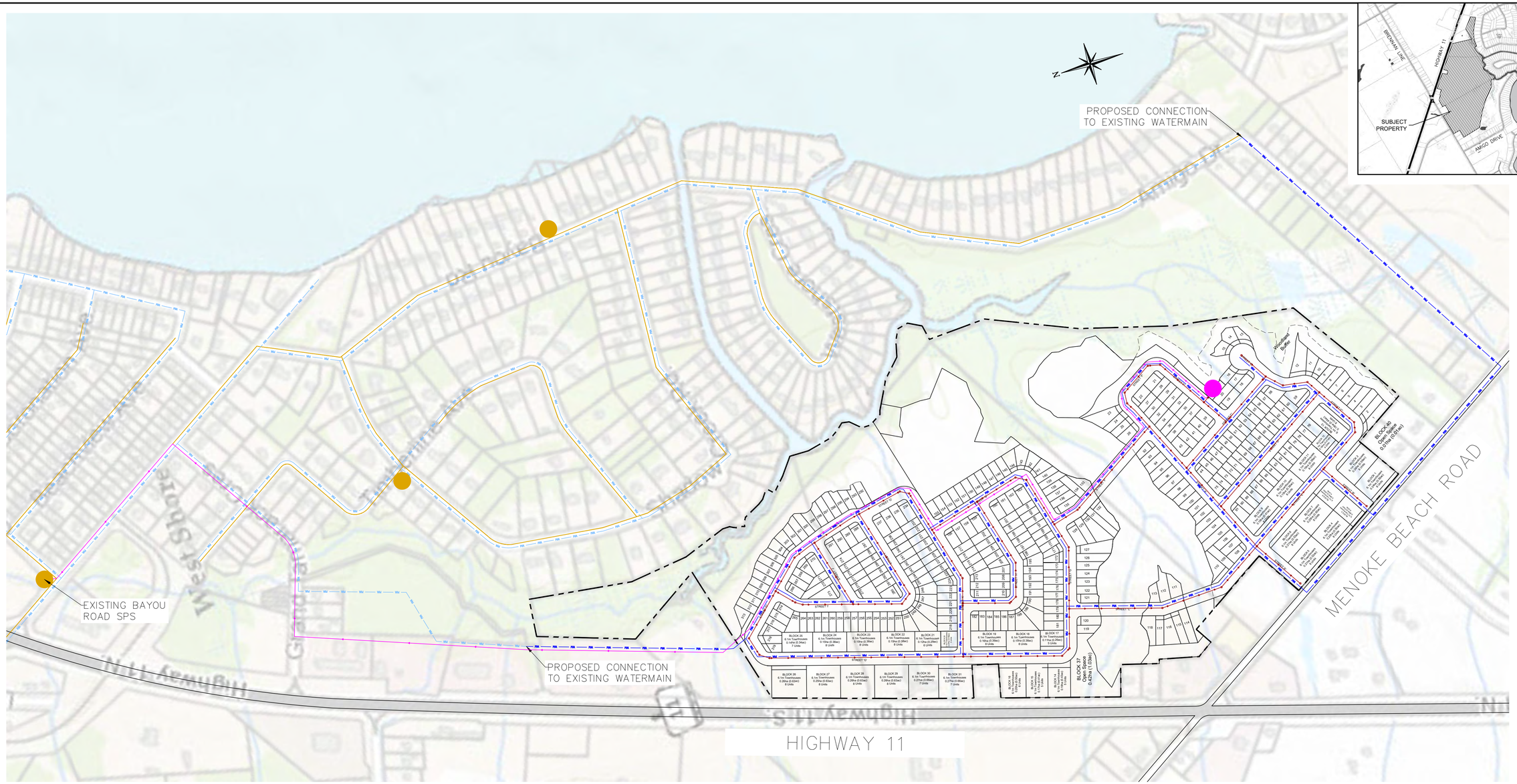
A.M. / R.D.M.	Z.H.		1935-6103
Check By	Check By	Scale	Drawing
B.R.	N.C.O.	1: 2000	FIG. 4



100 0m 100 200
SCALE: 1:3000

LEGEND

- PROPERTY LINE
- EXISTING SANITARY FORCEMAIN
- EXISTING PUMPING STATION
- EXISTING WATERMAIN
- PROPOSED GRAVITY SANITARY SEWER
- PROPOSED SANITARY FORCEMAIN
- PROPOSED PUMPING STATION
- PROPOSED WATERMAIN

Town: Township of SEVERN

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Engineer

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Engineer

Project: SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing: EXTERNAL SANITARY & WATER SERVICING PLAN

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
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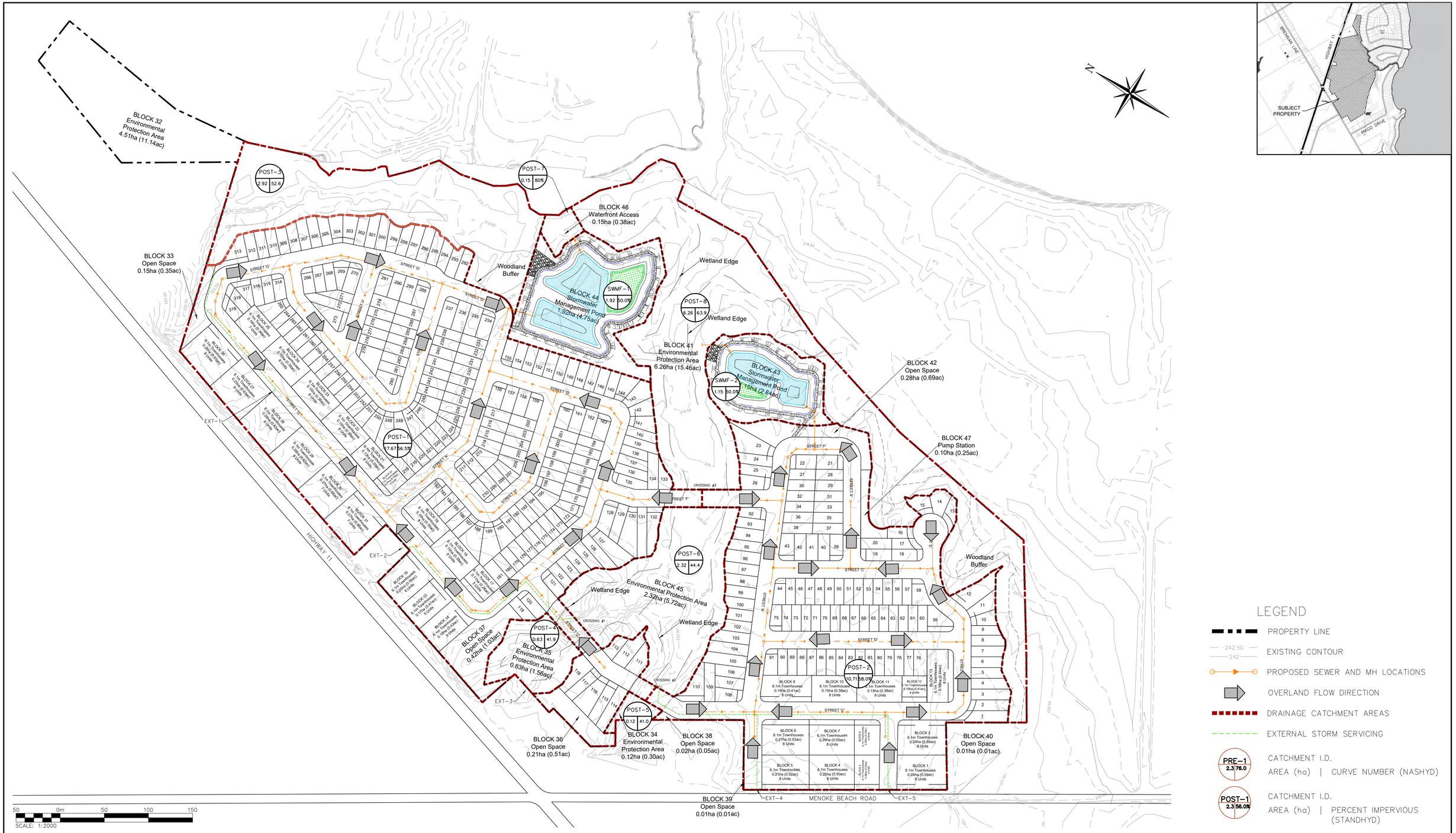
A.M. / R.D.M.	Z.H.		1935-6103
Check By	Check By	Scale	Drawing
B.R.	N.C.O.	1:3000	FIG. 5



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Town

Township of SEVERN

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Engineer

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Engineer

Project

SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing

POST–DEVELOPMENT DRAINAGE PLAN

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
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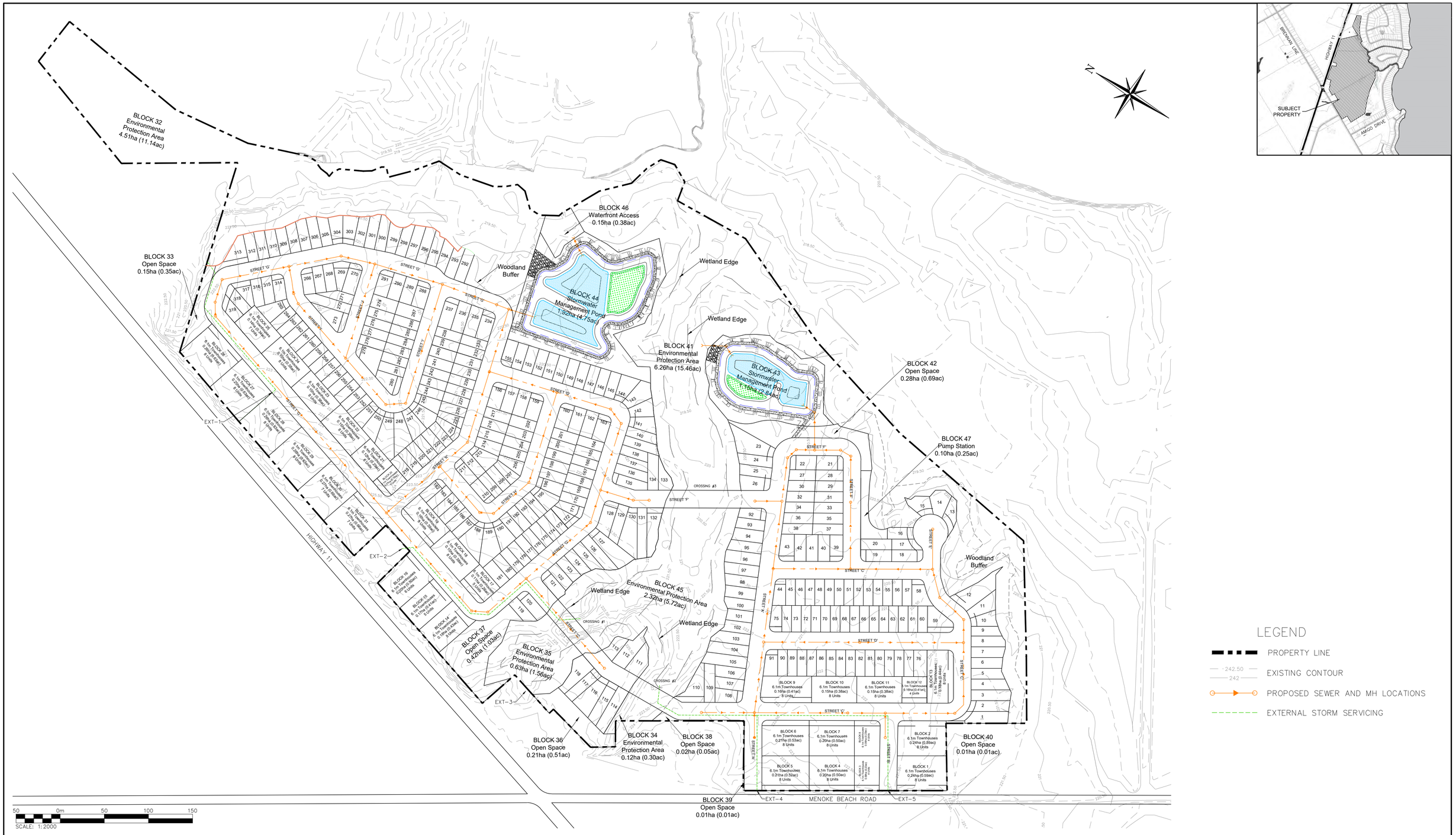
A.M. / R.D.M.	Z.H.	1935–6103
Check By	Check By	Scale / Drawing
B.R.	N.C.O.	1: 2000 / FIG. 7



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Project: SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing: PRELIMINARY STORM SERVICING PLAN

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
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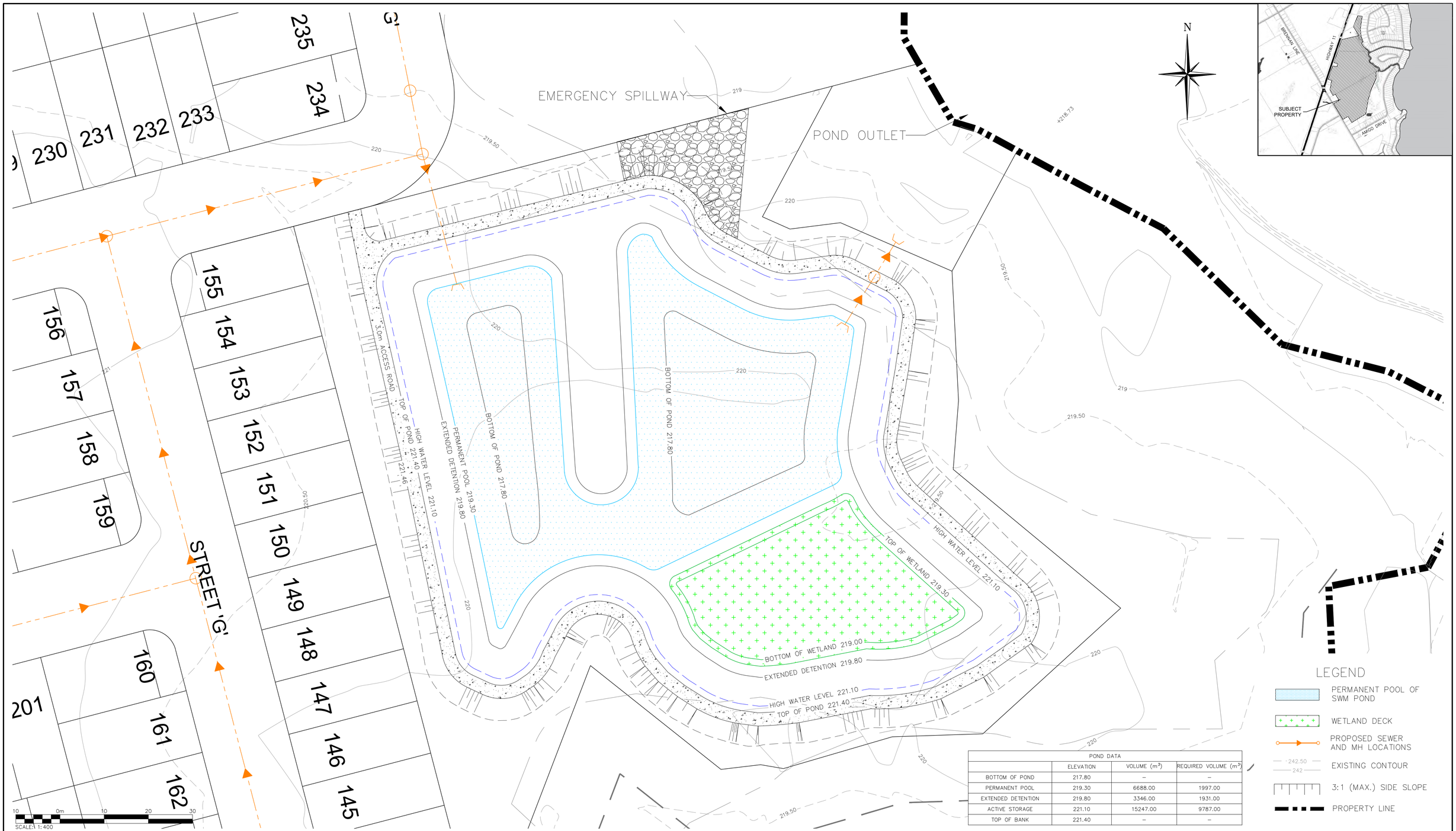
Check By	Check By	Scale / Drawing
B.R.	N.C.O.	1: 2000 / FIG. 8



POND DATA

	ELEVATION	VOLUME (m^3)	REQUIRED VOLUME (m^3)
BOTTOM OF POND	217.80	–	–
PERMANENT POOL	219.30	6688.00	1997.00
EXTENDED DETENTION	219.80	3346.00	1931.00
ACTIVE STORAGE	221.10	15247.00	9787.00
TOP OF BANK	221.40	–	–

LEGEND

- PERMANENT POOL OF SWM POND
- WETLAND DECK
- PROPOSED SEWER AND MH LOCATIONS
- 242.50 / 242 EXISTING CONTOUR
- 3:1 (MAX.) SIDE SLOPE
- PROPERTY LINE

Town: Township of SEVERN

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Engineer

Project: SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing: PRELIMINARY SWM FACILITY #1 PLAN

CROZIER CONSULTING ENGINEERS
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1 FIRST STREET, SUITE 200
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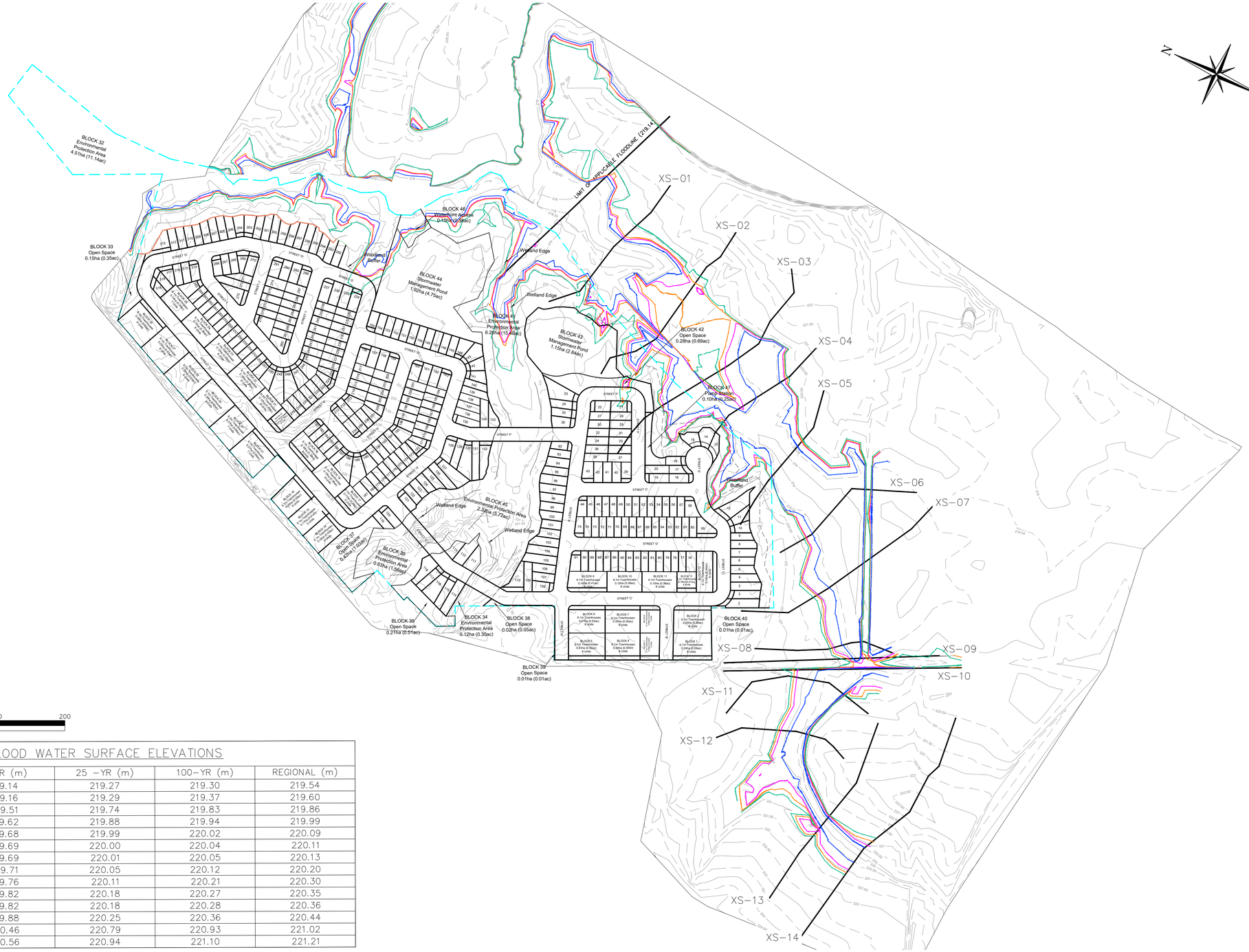
Check By	Check By	Scale / Drawing
B.R.	N.C.O.	1: 400 / FIG 9



100 0m 100 200

SCALE: 1:3000

FLOOD WATER SURFACE ELEVATIONS

STATION	2-YR (m)	25 -YR (m)	100-YR (m)	REGIONAL (m)
XS-01	219.14	219.27	219.30	219.54
XS-02	219.16	219.29	219.37	219.60
XS-03	219.51	219.74	219.83	219.86
XS-04	219.62	219.88	219.94	219.99
XS-05	219.68	219.99	220.02	220.09
XS-06	219.69	220.00	220.04	220.11
XS-07	219.69	220.01	220.05	220.13
XS-08	219.71	220.05	220.12	220.20
XS-09	219.76	220.11	220.21	220.30
XS-10	219.82	220.18	220.27	220.35
XS-11	219.82	220.18	220.28	220.36
XS-12	219.88	220.25	220.36	220.44
XS-13	220.46	220.79	220.93	221.02
XS-14	220.56	220.94	221.10	221.21

LEGEND

- 2-YR FLOODLINE
- 25-YR FLOODLINE
- 100-YR FLOODLINE
- REGIONAL FLOODLINE
- FLOOD CROSS SECTION
- 220.00 EXISTING CONTOUR
- PROPERTY LINE

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Project: SHADOW CREEK DEVELOPMENT
TOWNSHIP OF SEVERN

Drawing: FLOODPLAIN CROSS SECTIONS

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Check By	Check By	Scale	Drawing
B.R.	N.C.O.	1: 3000	FIG 11