447-455 YONGE STREET – CITY OF BARRIE
APARTMENT & RETAIL DEVELOPMENT
FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

Prepared by:

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1.0 INTRODUCTION

1.1 General

The proposed development site is located on lots 447-455 Yonge Street in the City of Barrie. The property is legally described as Lots 26 – 30 on Registered Plan 885, in the Township of Innisfil, Now in the City of Barrie, County of Simcoe.

The subject site is approximately 0.56 hectares in area and is currently occupied by five (5) single-family residential homes. Access to the existing dwellings is provided by individual driveways off Yonge Street. The site is bounded by MacLaren Avenue to the west, Yonge Street to the south and existing residential development to the north and east. The location of the subject site is illustrated on Figure 1.

The developer is proposing construction of a 7-storey apartment building, totaling 176 residential units, with ground floor retail space, surface parking facility, and an underground parking garage. Access to the development will be provided from a new paved driveway entrance off MacLaren Avenue. A reduced copy of the proposed site plan concept and parking lot layout plan, prepared by Architecture Unfolded, is included in Appendix A for additional information.

1.2 Purpose and Scope

Pinestone Engineering Ltd. (PEL) has been retained by the developer to provide professional engineering services related to the preparation of a Functional Servicing & Stormwater Management Report. This report has been prepared to support a Site Plan Application for the subject lands. The purpose of this report is to describe the existing servicing infrastructure in the vicinity of the site, and provide recommendations for the provision of sanitary drainage, water distribution, and stormwater management in accordance with City of Barrie criteria.

2.0 EXISTING CONDITIONS

2.1 General

The subject site is approximately 0.56 hectares in area and is currently occupied by five (5) single-family residential homes. Access to the existing dwellings is provided by individual driveways off Yonge Street. The site is located within the City's urban servicing area and municipal services are readily available for connection beneath Yonge Street and MacLaren Avenue. Existing vegetation on the site generally consists of maintained grass area throughout, with sporadic tree growth along the peripheral of the property.

2.2 Topography

Based on a review of the topographic survey provided by KRCMAR Surveyors Ltd., the property is moderately sloped and generally slopes from southwest to northeast towards the

adjacent residential properties at an average slope of 2.5%. Elevations across the site range between 254.21m ASL at the southwestern property corner to 251.71m ASL at the northeastern corner of the property.

2.3 Site Geology

A geotechnical investigation was completed by GEI Consultants in February 2022. Field work for this investigation consisted of five boreholes advanced approximately 10.4-10.8m deep. Based on our review of their report, the borehole logs reveal topsoil was encountered over a shallow layer of earth fill, followed by a deep layer of silty sand to sand and silt glacial till. As stipulated in Sections 4.3.2 and 4.4 of the Hydrogeological Report, the native silty sand to sand & silt glacial till soils have an estimated hydraulic conductivity of 6.0×10^{-6} m/s and an unfactored infiltration rate of 30-75 mm/hr.

Monitoring wells were installed within three of the boreholes to determine seasonally high groundwater table elevations over a period of 12 months. Groundwater was evident in the boreholes during the investigation and recorded as 1.53-2.58m below the ground surface on April 28th, 2022. Recorded groundwater table elevations are provided in a copy of the Hydrogeological Report, prepared by GEI Consultants, included in Appendix B.

Based on our review of the soil descriptions outlined in the MTO Drainage Manual on Chart 1.08, we have classified the site material as a Type B under the Soil Conservation Service, hydrologic soil group. Considering the shallow condition of the groundwater table, low-impact development measures are not recommended for the stormwater management strategy of the proposed development. A copy of the geotechnical investigation, prepared by GEI Consultants, and Chart 1.08 of the MTO Drainage Manual is included in Appendix B.

2.4 Drainage Conditions

Drainage from the site is generally conveyed northeasterly in the form of overland sheet flow through the adjacent residential development towards the Tomlin Crescent ROW. Runoff is conveyed southeasterly via curb and gutters and enters the existing municipal storm sewer system. The Tomlin Crescent storm sewer conveys drainage to an existing stormwater management detention pond prior to discharging to Lovers Creek.

The subject property is part of the existing Little Avenue & Highway #11 Subdivision Storm Drainage Plan. According to Drawing No. 1995-057-007 of the City of Barrie engineering records, the downstream stormwater management pond (Lovers Creek SWMF LV13) is sized to accommodate drainage generated from the subject property with a design runoff coefficient of 0.4. A copy of the referenced storm drainage plan is included in Appendix D.

The site is not located within a Lake Simcoe Regional Conservation Authority (LSRCA) regulated area based on available mapping on their website, however, the site is considered a “major development” as defined in the Lake Simcoe Protection Plan, therefore stormwater phosphorus control measures and a water balance analysis are required in accordance with the LSRCA Phosphorus Offsetting Policy (2023) and the LSRCA Water Balance Recharge Offsetting Policy (2023).





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PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

LOCATION PLAN

DATE:	SCALE:	PROJECT No.	FIGURE No.
MAY 2024	N.T.S.	22-11672B	FIGURE 1

3.0 SANITARY SERVICING

3.1 Existing Sanitary Servicing

An existing 250mm diameter sanitary sewer exists beneath the east lane of Yonge Street and services lots 449 to 455. Captured flows are ultimately conveyed northwesterly to City Pumping Station 10 (Barrie WwTF) located on Bradford Street. Lot 447 is serviced by the existing 250mm dia. sanitary sewer beneath Maclaren Avenue which also conveys flows to the Barrie WwTF. According to the information provided in the City of Barrie Wastewater Collection Master Plan (Cole Engineering, July 15th, 2019), the Barrie WwTF has a firm capacity of 2,205 L/sec and is currently operating around 1,931 L/sec, or 87.6% capacity.

Based on our review of the existing wastewater collection performance assessments completed by Cole Engineering in the Wastewater Collection Master Plan, under 2019 wet weather flow conditions for the 25-year storm event, the downstream sewers maintain a peak conduit depth ratio of less than 0.5 and a freeboard of greater than 1.8m. Therefore, no surcharging of downstream sanitary sewers from the subject site were noted.

The development area is currently serviced with five (5) 100mm diameter sanitary laterals, one to each of the existing homes. As part of the development works, the existing sanitary laterals not utilized by the proposed building will be decommissioned per City of Barrie standards.

3.2 Proposed Sanitary Flows

Contributing sanitary flows from the proposed development were calculated using design criteria for high density apartment dwellings and commercial space per the City of Barrie Sanitary Infrastructure Design Standard (2023), as follows:

- A residential average sewage flow of 225 litres/capita/day.
- A residential population density of 1.67 persons/unit.
- An average commercial design flowrate of 28 m^3/day/ha.
- An extraneous flow rate of 0.1 litres/sec/ha.
- A peaking factor based on Harmon's equation for residential flows and a peaking factor of 2 for commercial flows.

With a total residential count of 176 apartment units, the total population to be serviced is 294 persons based on the above distribution. Incorporating commercial flows and extraneous flows, the combined peak sewage flow generated by the proposed development is calculated to be approximately 3.21L/sec. Detailed sanitary calculations are included in Appendix C.

A review of the existing capacity of the immediate downstream reach of 250mm sanitary

sewer beneath Yonge Street was completed. The existing reach of sewer has a conveyance capacity of approximately 70.6L/sec and the proposed peak sanitary flows from the development represents approximately 4.6% of the total pipe capacity.

Based on the total conveyance capacity of the immediate downstream reach of sewer, the existing infrastructure is expected to have the available capacity necessary to support the development without the need for external sanitary upgrades.

3.3 Proposed Sanitary Servicing

The proposed development will utilize the existing 250mm diameter sanitary sewer beneath Yonge Street. A new 200mm dia. service will connect to EXSANMH SAP13089 and extend to a new maintenance hole at lot-line prior to extending to the building's mechanical room at the P1 level. Servicing details will conform to City of Barrie standards and the exact size and location of the service lateral is provided on drawing SERV-1 provided in Appendix E.

4.0 WATER SERVICING

4.1 Existing Water Servicing

A 300mm dia. ductile iron watermain exists beneath the eastern boulevard of Yonge Street. The site is currently serviced by five (5) 19mm dia. copper water services, one connection off the existing watermain to each of the residential homes. These services will require decommissioning by turning off the main stop and cutting the service at the main.

For the site plan application to support the proposed development, onsite pressures and flows have been confirmed to ensure there is sufficient capacity available for both domestic and firefighting conditions.

We have utilized information obtained from the municipal hydrants in the vicinity of the subject site connected to the existing 300mm dia. watermain including Hydrants #2999 and #1079. Table 1 illustrates the flow results of the testing conducted by Vipond Inc.

Table 1
Results of Hydrant Flow Tests

Test #	Outlet Inside Dia. (in.)	Number of Outlets	Residual Reading (PSI)	Flow@ Residual (gal/min)
0	---	---	85 (Static)	---
1	1.75	1	83	654
2	2.5	1	82	924
3	2.5	2	80	1582

Refer to Appendix C for the flow testing information obtained from Vipond Inc.

4.2 Proposed Water Demands

The subject site is located within Water Pressure Zone 2S. As per the City of Barrie Water Supply Masterplan (WSP, July 2019), domestic water demands for the development are listed in Table 2 below. Domestic water demand calculation parameters are as follows:

- Max day factor of 1.75 per Table 3.5 of the Water Supply Masterplan, and peak hour factor of 2.25 based on Table 3-1 of the MECP Design Guidelines for Drinking Water Systems (2008).
- High Density Apartment Dwellings – 1.67 persons per unit (City of Barrie Drinking Water Infrastructure Design Standard, 2023).
- Residential water demand of 129 L/cap/day per Table 3.5 of the Water Supply Masterplan.
- Commercial average consumption rate of 28m^3/ha/day (City of Barrie Drinking Water Infrastructure Design Standard, 2023).

Table 2
Domestic Water Demand

Population	Residential Consumption (L/sec)	Commercial Area (ha)	Commercial Consumption (L/sec)	Peaking Factors		Domestic Flows (L/sec)	
				Peak Hour	Maximum Day	Peak Hour	Maximum Day
294	0.44	0.0572	0.019	2.25	1.75	1.03	0.80

Fire demands for the proposed development were calculated in accordance with the Fire Underwriters Survey (FUS) as follows:

$$RFF = 220C(A)^{0.5}$$

Where,

RFF = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
A = total floor area of building (excluding basements)

Table 3
Water Requirements for Fire Fighting

Total Area (m^2)	Construction Coefficient "C"	Base Required Fire Flow (RFF) (L/min)	Occupancy and Contents Adjustment Factor	Automatic Sprinkler Protection Credit	Exposure Adjustment Charge	Design Required Fire Flow (RFF)
13,609	1.0	26,000	-15% (-3,900L/min)	-30% (-6,630L/min)	+19% (+4,199L/min)	20,000L/min (333.3L/sec)

Based on the guidance provided in the FUS, and applying the relevant reductions and

charges in flow for construction type (Type III), occupancy (Groups C and D), a sprinkler system conforming to NFPA standards, and exposure distances due to the proximity of other buildings, the estimated required fire flow for the development will be reduced to 20,000L/min (333.3L/sec). Detailed FUS calculations are provided in Appendix C.

4.3 Proposed Water Servicing

The proposed development will be serviced via a new 200mm dia. fire service connection and a new 100mm dia. domestic water service connection off the existing 300mm dia. watermain located beneath the eastern boulevard of Yonge Street. Servicing details will conform to City of Barrie standards and the exact size and location of the service laterals is provided on drawing SERV-1 included in Appendix E.

City fire hydrant #2999, located 8.9m from the primary entrance of the proposed apartment building, will serve as the connection point of water supply for firefighting by the BFES.

Based on the provided flow test results, it can be concluded that the max day plus fire flow rate of 334.1L/sec can be delivered to the proposed building from City fire hydrant #2999 with a residual pressure of 38.2psi. Fire flow calculations are provided in Appendix C.

5.0 HYDROLOGY

5.1 Design Criteria

Based on a review of the City of Barrie's Stormwater Infrastructure Design Standard, and the LSRCA's Offsetting Policies, the following design criteria, in accordance with the current MECP SWM Planning and Design Manual (MECP, 2003) were established for the proposed development:

Quantity Control:

- Peak flow attenuation for the 2-year through 100-year storm events to pre-development rates based on the rainfall runoff event simulation model Visual OTTHYMO using the City of Barrie's WPCC IDF parameters.

- Both the 4-hour Chicago and 24-hour SCS Type II storms will be modelled for the specified storm events.

- Safe conveyance of the Regulatory flows through the site to a sufficient outlet is required. The Regulatory flows are taken as the greater of the uncontrolled 100-year or Hurricane Hazel flows through the development.

Quality Control:

- The City of Barrie and the LSRCA in accordance with Ontario Regulation 219/09 regarding water quality and phosphorus loading to Lake Simcoe, requires that all

new storm water management facilities provide as a minimum the “enhanced” level of protection in accordance with the MECP Storm Water Management Planning and Design Manual.

- Preparation of phosphorus and water balance calculations to meet City of Barrie guidelines and LSRCA Offsetting Policies in accordance with the Lake Simcoe Protection Plan.

- Preparation of detailed erosion, sediment control and construction mitigation plan to be implemented as part of the construction program.

5.2 Design Storms

We have selected the following design storms as part of our evaluation:

- 2-year design storm
- 5-year design storm
- 10-year design storm
- 25-year design storm
- 50-year design storm
- 100-year design storm
- Hurricane Hazel

Rainfall intensity - duration - frequency (IDF) values for the Barrie Area were entered into an equation that expresses the time relationship intensity for specific frequency, in the form of:

$$i = \frac{a}{(t+b)^c}$$

where: i = intensity, mm/hr.
t = time of concentration, minutes
a,b,c = constants developed to fit IDF curve

The rainfall runoff event simulation model Visual OTTHYMO was used to simulate watershed response to design rainfall events. Derivation of the design storm hyetographs were based on the "Chicago" 4-hour distribution using the intensity, duration, frequency (IDF) data. In addition to the “Chicago” storms, the 24-hour SCS Type II storms, and the Hurricane Hazel regional storm were also modelled as required by the City of Barrie.

The IDF curve parameters for the City of Barrie are outlined in Table 4, below. A copy of the IDF values taken from the City’s Stormwater Infrastructure Design Standard are included in Appendix D.

Table 4
Barrie WPCC IDF Curve Parameters

Rainfall Event	Parameter		
	A	B	C
2 Yr	675.586	4.681	0.780
5 Yr	843.019	4.582	0.763
10 Yr	976.898	4.745	0.760
25 Yr	1133.123	4.734	0.756
50 Yr	1251.473	4.847	0.753
100 Yr	1383.628	4.905	0.754

5.3 Drainage Catchments

One (1) pre-development and three (3) post-development catchments have been delineated for the site in order to estimate the corresponding peak runoff rates for the site. The pre-development catchment area represents the existing condition of the development area, which consists of single-family dwellings, paved driveways, and lawn. A design runoff coefficient of 0.4 for the property will be utilized in the hydrological modelling. The post-development catchments represent the new grading concept for the proposed development area with the addition of an apartment building, paved surfaces, and landscape area. The pre-development and post-development catchment parameters are included in Appendix D. Pre-development and post-development catchment areas are illustrated on drawings PRE-1 and POST-1 included in Appendix E.

5.4 Model Results

The results of the hydrologic modelling are displayed in Tables 5 and 6 below for the Hurricane Hazel storm event, and the 2-year to 100-year return frequency storm events for the 4-hour Chicago distribution, and the 24-hour SCS Type II distribution. The model outputs for all events are included in Appendix D.

Table 5
Model Results – 4-hour Chicago Distributions

	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr
PRE-DEVELOPMENT (m^3/sec)						
Catchment 101	0.017	0.030	0.040	0.054	0.066	0.078
Total Pre-Development Runoff Rate	**0.017**	**0.030**	**0.040**	**0.054**	**0.066**	**0.078**
POST-DEVELOPMENT (m^3/sec)						
Catchment 201	0.133	0.175	0.202	0.237	0.262	0.288
Catchment 202	0.006	0.009	0.011	0.013	0.015	0.017
Catchment 203	0.001	0.002	0.003	0.004	0.005	0.006
Total Post-Development Runoff Rate	**0.139**	**0.184**	**0.214**	**0.252**	**0.279**	**0.308**

Table 6
Model Results – 24-hour SCS Type II and Hurricane Hazel Regional Storm Distributions

	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr	Hazel
PRE-DEVELOPMENT (m^3/sec)							
Catchment 101	0.030	0.055	0.073	0.096	0.115	0.132	0.078
Total Pre-Development Runoff Rate	**0.030**	**0.055**	**0.073**	**0.096**	**0.115**	**0.132**	**0.078**
POST-DEVELOPMENT (m^3/sec)							
Catchment 201	0.080	0.113	0.134	0.161	0.181	0.199	0.063
Catchment 202	0.005	0.008	0.010	0.013	0.016	0.018	0.008
Catchment 203	0.002	0.004	0.006	0.008	0.010	0.012	0.010
Total Post-Development Runoff Rate	**0.088**	**0.126**	**0.151**	**0.182**	**0.207**	**0.228**	**0.080**

Based on the calculated results of the hydrological modelling, it is expected that post-development flows will increase due to the proposed construction of the building and paved surfaces. Visual OTTHYMO input/output calculations are included in Appendix D.

6.0 STORM WATER MANAGEMENT PLAN

6.1 Quantity Control

As noted in the comparison of the pre-development and post-development flows, an increase in runoff will occur due to the proposed construction of the building and paved surfaces. To satisfy the selected design criteria, peak flow attenuation of post-development flows to pre-development levels for all storm events up to and including the 100-year storm event will be provided by utilizing a stormwater management facility consisting of subsurface tank storage and parking lot surface storage.

Peak flow attenuation for catchment 201, consisting of the building's rooftop and parking lot area, will be achieved using a combination of parking lot ponding and storage within a subsurface stormwater detention tank. Area drains installed within the asphalt parking lot will capture runoff and convey flows through the basement parking garage, via internal building plumbing, to a 123m^3 cast-in-place concrete detention tank located at the northwest corner of the basement parking garage. The roof drains will also be connected to the internal plumbing that discharges to the cast-in-place concrete detention tank.

Peak flows will be attenuated by an 80mm dia. online orifice plate installed on the outlet pipe from the stormwater detention tank at an elevation of 251.00m ASL. Additional storage volume (192m^3) is provided in surface cells created within the parking lot once ponding elevations exceed the top of grate of the area drains at an elevation of 253.55m ASL. The maximum ponding elevation for the 5-year and 100-year events will be 252.80m ASL and 253.79m ASL, respectively. This limits ponding during the 5-year event to below the asphalt surface and the 100-year event to only 0.24m above the asphalt surface.

Attenuated flows will outlet through a hydrodynamic separator for treatment, prior to discharging offsite via a storm sewer connection to the existing storm sewer network beneath MacLaren Avenue. Major overland flow from catchment 201 during severe storm events in excess of the 100-year event, or in the event of drain clogging, will be directed to the MacLaren Avenue ROW through the driveway entrance once ponding levels exceed the driveway grade.

Drainage generated from catchment 202, consisting of perimeter landscape and the driveway entrance, will continue to flow offsite uncontrolled like pre-development conditions.

As part of the external storm servicing works, a 48.7m - 300mm dia. storm sewer extension is proposed from existing storm manhole DDLV00520 on MacLaren Avenue to the subject property. The storm sewer is sized to convey the 100-year controlled flowrates from the subject site and controlled external drainage from the development of 427-437 Yonge Street to the existing municipal storm sewer beneath MacLaren Avenue.

Drainage generated from catchment 203, consisting of perimeter landscape, will be captured by lot-line swales that convey drainage to a catch basin located at the northeastern property limit. Flows are conveyed via storm sewers to the proposed municipal sewer extension beneath MacLaren Avenue.

The stage-storage-discharge relationship of the SWM facility is summarized in Table 7.

Table 7
Stage-Storage-Discharge Relationship of Storage Cells

	Description	Control Stage (m)	Elevation (m)	Volume (m^3)	Discharge (m^3/s)
Catchment 201: Subsurface Tank Storage and Parking Lot Surface Ponding (80mm Dia. Orifice in Detention Tank)	Tank / Orifice Invert	0.00	251.00	0.00	0.0000
	Contour	0.16	251.20	13.62	0.0056
	Contour	0.36	251.40	27.25	0.0084
	Contour	0.56	251.60	40.87	0.0105
	Contour	0.76	251.80	54.50	0.0122
	Contour	0.96	252.00	68.12	0.0137
	Contour	1.16	252.20	81.74	0.0151
	Contour	1.36	252.40	95.37	0.0164
	Contour	1.56	252.60	108.99	0.0175
	Underside of Tank Lid	1.76	252.80	122.62	0.0186
	Contour	1.96	253.00	122.62	0.0196
	Contour	2.16	253.20	122.62	0.0206
	Contour	2.36	253.40	122.62	0.0215
	Top of CB Grates	2.51	253.55	122.62	0.0222
	Contour	2.56	253.60	124.18	0.0224
	Contour	2.61	253.65	128.87	0.0227
	Contour	2.66	253.70	145.15	0.0229
	Contour	2.71	253.75	181.49	0.0231
	Overflow Spillway	2.76	253.80	237.90	0.0233
	Contour	2.81	253.85	314.37	0.1450

Design sheets and calculations related to the stage-storage-discharge relationship of the proposed stormwater management facility, and the capacity of the proposed storm sewers, are provided in Appendix D. The location of the stormwater management facility and further design details are illustrated on the engineering drawings included in Appendix E.

6.1.1. Effectiveness of SWM Facility

Table 8 and Table 9 summarize the effectiveness of the proposed stormwater attenuation features based on the hydrological model results.

Table 8
Model Results – 4-hour Chicago Distributions

	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr
PRE-DEVELOPMENT (m^3/sec)						
Total Pre-Development Runoff Rate	**0.017**	**0.030**	**0.040**	**0.054**	**0.066**	**0.078**
POST-DEVELOPMENT (m^3/sec)						
Total Post-Development Runoff Rate	**0.139**	**0.184**	**0.213**	**0.252**	**0.279**	**0.307**
POST-DEVELOPMENT WITH SWM (m^3/sec)						
Catchment 201	0.015	0.018	0.023	0.023	0.023	0.023
Catchment 202	0.006	0.009	0.011	0.013	0.015	0.017
Catchment 203	0.001	0.002	0.003	0.004	0.005	0.006
Total Post-Development Runoff Rate With SWM	**0.017**	**0.022**	**0.029**	**0.033**	**0.035**	**0.038**
Catchment 201 SWM Facility Storage Volume / Ponding Elevation (m^3 / m ASL)	80 / 252.18	112 / 252.65	131 / 253.66	160 / 253.72	184 / 253.76	207 / 253.77

Table 9
Model Results – 24-hour SCS Type II and Hurricane Hazel Regional Storm Distributions

	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr	Hazel
PRE-DEVELOPMENT (m^3/sec)							
Catchment 101	0.030	0.055	0.073	0.096	0.115	0.132	0.078
Total Pre-Development Runoff Rate	**0.030**	**0.055**	**0.073**	**0.096**	**0.115**	**0.132**	**0.078**
POST-DEVELOPMENT (m^3/sec)							
Total Post-Development Runoff Rate	**0.087**	**0.125**	**0.150**	**0.181**	**0.206**	**0.228**	**0.080**
POST-DEVELOPMENT WITH SWM (m^3/sec)							
Catchment 201	0.015	0.019	0.023	0.023	0.023	0.023	0.045
Catchment 202	0.005	0.008	0.010	0.013	0.016	0.018	0.008
Catchment 203	0.002	0.004	0.006	0.008	0.010	0.012	0.010
Total Post-Development Runoff Rate With SWM	**0.021**	**0.030**	**0.039**	**0.044**	**0.048**	**0.052**	**0.058**
Catchment 201 SWM Facility Storage Volume / Ponding Elevation (m^3 / m ASL)	84 / 252.24	122 / 252.80	146 / 253.70	179 / 253.75	204 / 253.77	228 / 253.79	251 / 253.81

With the implementation of this stormwater management strategy, peak flow attenuation of post-development flows to pre-development levels, will be achieved. There will be no increase in runoff directed to adjacent private properties and there is no downstream flood impact concern associated with this development on the municipal sewer system beneath MacLaren Avenue, nor the ultimate receiving waterbody, Lovers Creek.

6.2 Quality Control

The primary objective of the stormwater management plan for this development is to maintain acceptable water quality within the receiving storm sewer network and ultimate outfall, Lovers Creek, by maintaining existing site drainage patterns and flowrates. In order to provide water quality enhancement to an “enhanced” level of protection (80% TSS removal) for this development, we have incorporated a “treatment train” approach consisting of the following elements:

- Provision of “soft” landscaping where feasible.
- Yard grading using minimal surface slopes where possible to promote infiltration.
- Provision of a Hydroworks Hydrostorm HS-4 treatment unit for oil and sediment removal from runoff generated in catchment 201. The Hydrodynamic Separator Sizing Program, by Hydroworks, was utilized to design the appropriate treatment unit. For a 0.425-hectare drainage area that is 100% impervious, a Hydrostorm HS-4 treatment unit (or an approved equivalent) is required. An HS-4 unit will provide

82% removal of total suspended solids. Design calculations using the manufacturer's software, and applicable reports are included in Appendix D.

- Suitable construction mitigation measures to be utilized during the site development.

The potential treatment alternatives have been evaluated with respect to their applicability for this development and implemented in a manner to achieve the best total suspended solids (TSS) removal possible. Table 10 summarizes the proposed measures and their overall effectiveness.

Table 10
Site TSS Removal Rates

Catchment	Surface	Method	Effective TSS	Area (m^2)	% Area of Site	Overall TSS Removal
201	Building Rooftop	Inherent	100%	2190	39.2	39.2%
	Impervious Surfaces	Hydroworks Hydrostorm HS-4	82%	2060	36.9	30.4%
202	Uncontrolled Landscape Surface	Filtration / Evapotranspiration	50%	370	6.6	3.3%
	Uncontrolled Impervious Surfaces	None	0%	190	3.4	0.0%
203	Uncontrolled Landscape Surface	Filtration / Evapotranspiration	50%	770	13.8	7.0%
Total	Total			5580	100.0	80.0%

With the implementation of the proposed quality control plan, the proposed measures in conglomeration will provide an overall long term TSS removal of 80% for the site.

6.3 Water Balance

A water budget analysis was conducted in accordance with the LSRCA's Water Balance Recharge Offsetting Policy and the Lake Simcoe Protection Plan. The analysis follows the Thornthwaite and Mather approach, where surplus is estimated based on precipitation minus evapotranspiration (Steenhuis and Van Der Molen, 1986). Annual precipitation and evapotranspiration data for sites within the Lovers Creek watershed was taken from the LSRCA Lake Simcoe Climate Data: A Reference Document to Support the Completion of Water Balance Assessments (April 2017). In the pre-development and post-development condition, the property was broken down into rooftop, pavement, and landscape land uses. Results of the annual pre-development and post-development water balance are displayed in Table 11, below.

Table 11
Water Balance Summary

Characteristic	Site		
	Pre-Development	Post-Development	Change (Pre to Post)
Inputs (Volumes)			
Precipitation (m^3/yr)	5100	5100	0.0%
Run-on (m^3/yr)	0	0	0.0%
Other Inputs (m^3/yr)	0	0	0.0%
Total Inputs (m^3/yr)	5100	5100	0.0%
Output (Volumes)			
Precipitation Surplus (m^3/yr)	2318	3638	56.9%
Net Surplus (m^3/yr)	2318	3638	56.9%
Evapotranspiration (m^3/yr)	2782	1463	-47.4%
Infiltration (m^3/yr)	638	160	-74.9%
Rooftop Infiltration (m^3/yr)	0	0	0.0%
Total Infiltration (m^3/yr)	638	160	-74.9%
Runoff Pervious Areas (m^3/yr)	919	231	-74.9%
Runoff Impervious Areas (m^3/yr)	760	3247	0.0%
Total Runoff (m^3/yr)	1679	3477	107.1%
Total Outputs (m^3/yr)	5100	5100	0.0%

Based on the results of the water balance analysis, the site yields an infiltration rate of 638m^3/year in the pre-development condition and 160m^3/year in the post-development condition, resulting in a water balance deficit of 478m^3/year.

Since the use of infiltration measures are infeasible on this site, due to the seasonally high groundwater table, an offsetting fee is required by the LSRCA, in accordance with the Water Balance Recharge Offsetting Policy, for the water balance deficit of 478m^3/year.

6.4 Phosphorus Budget

In accordance with the LSRCA's Phosphorus Offsetting Policy, all new development must control phosphorus loading in the post-development scenario to pre-development levels, otherwise a phosphorus offsetting fee will be required by the LSRCA for the remaining load difference.

The MECP's P-Tool was utilized to determine pre and post development phosphorus loadings for the proposed development area. In the pre-development condition, low intensity residential development was used to determine the phosphorus loading. For the post-development condition, the development was broken down into low-intensity and high-

intensity residential land uses. The calculated phosphorus loadings are illustrated in Table 12.

Table 12
Pre & Post Phosphorus Loading

	P Load (kg/year)
Pre-Development	0.04
Post Development with no BMP's	0.59
Post Development with BMP's	0.43

The proposed Hydroworks Hydrostorm unit will provide 20% TP removal for intercepted flows from catchment 201 prior to discharging to the municipal storm sewer beneath MacLaren Avenue.

As previously mentioned, the subject property is part of the existing Little Avenue & Highway #11 Subdivision Storm Drainage Plan. According to Drawing No. 1995-057-007 of the City of Barrie engineering records, the downstream stormwater management pond (Lovers Creek SWMF LV13) is sized to accommodate drainage generated from the subject property (runoff coefficient of 0.4) for treatment and attenuation, prior to discharging to Lovers Creek. According to the MECP Phosphorus Budget Tool Report, dry detention ponds are credited with a TP removal rate of 10%.

An overall 27% (1-(0.43 kg/0.59kg)*100) post-development TP reduction can be achieved on the site by implementing best management practices, when considering the high groundwater table. Pre and post development phosphorus budget calculations are included in Appendix D.

Given that the phosphorus reduction needed to achieve post-to-pre development levels is 0.39kg/year, the total amount of phosphorus needing to be offset is as follows:

0.39kg/year X 2.5 (offset ratio) **= 0.97kg/year**

A compensation fee is required by the LSRCA in accordance with the LSPOP for the phosphorus deficit of 0.97 kg/year.

6.5 Monitoring and Maintenance of Stormwater Management Facilities

6.5.1. Hydrodynamic Separator

During construction operations, the Hydroworks Hydrostorm separator should be inspected every four weeks and after every large storm (>25 mm) due to the un-stabilized nature of the site (exposed soils and material stockpiles).

During post-construction operation for a normal stabilized site (paved driveways and vegetation established), the separator should be inspected on an annual basis. The initial

inspection will indicate the required future frequency of inspection and maintenance if the unit was maintained after the construction period. A sample inspection checklist is provided in the Hydroworks Hydrostorm Operations & Maintenance Manual included in Appendix D.

Inspection procedure for a Hydrostorm separator consists of a visual inspection of floatable material and measurements of sediment accumulation in the unit.

Visual inspection for floatable material can be carried out by removing the top cover and looking down into the centre access tube of the separator. An inspection should be made for trash/debris and presence of an oil spill. If an oily sheen, frothing, or unusual colouring of the water is noticed, this may indicate the occurrence of an oil spill, and the unit should be cleaned out immediately.

Inspection for TSS build-up can be conducted using a sampling device such as a Sludge Judge, Core Pro, AccuSludge, or an equivalent device to measure the depth of water and sediment in the unit. Several readings (2-3) should be made at each access cover to ensure that an accurate sediment depth measurement is recorded.

During the construction phase, the Hydrostorm separator should be cleaned out when the depth of sediment within the unit reaches 24" (600mm). During normal operating conditions, post construction, clean-out for separators with standard sump depths should occur once sediment accumulation reaches the sediment maintenance depth provided in Table 2 of the Operations & Maintenance Manual. As a rule of thumb, a measurement of the total depth in the separator through the central access tube should be taken and compared to the sump depth given in Table 1 of the Hydroworks Hydrostorm Operations & Maintenance Manual. If the measured reading is larger than the standard sump depth value in Table 1, then the separator is designed with a larger sump for sediment storage and the sediment maintenance depth will be increased to the value given in Table 2 plus the difference in sump depth between the actual measured reading and the standard dimension provided in Table 1.

The Hydroworks Hydrostorm unit is typically maintained using a vacuum truck. The vacuum truck will remove all the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility. A central access opening (24" or greater) is provided to gain access to the lower treatment tank of the unit. This is the primary location to maintain by the vacuum truck. The pre-treatment area can also be vacuumed or flushed into the lower treatment tank of the separator for cleaning via the central access once the water level is lowered below the pre-treatment floor.

6.5.2. Conveyance System and SWM Tanks

It is important to inspect all stormwater attenuation and conveyance features (sewer pipes, catch basins, manholes, concrete tank, etc..) on a regular basis for signs of sediment accumulation, blockages, or damage that may result in performance issues or system failure.

In order for the stormwater management facility to operate effectively, regular maintenance of the facility will be required. The frequency of cleaning will be governed by the site

operations including the extent of sanding and salting carried out during the winter months. At minimum, structures should be inspected and cleaned out annually.

We recommend inspections be carried out as follows:

- After every major rainfall event (>25mm).
- Prior to first snowfall.
- Following a winter thaw.
- At a minimum once a week during spring thaw.

Inspection of the stormwater management facility during the construction phase and in the long-term should include the following:

- Implement appropriate traffic safety procedures (e.g., traffic cones) prior to and during the catch basin inspection and cleaning process.
- Work upstream to downstream while inspecting the system's catch basins and manholes.
- Inspect grate openings for trash, debris, and sediment. Remove any potential blockages as necessary.
- Inspect frame and grates for cracks or missing components. Replace if necessary.
- Remove the grates and visually inspect the inside of the catch basin or maintenance hole to determine cleaning needs.
    - If an oily sheen, frothing, or unusual colouring is observed in the sump of the catch basin or manhole, this may indicate the occurrence of an oil spill, and the structure should be cleaned out immediately.
    - If sediment/debris accumulation exceeds 60% of the sump depth within the catch basin or manhole, removal is required.
- Inspect inlet and outlet pipes for sedimentation, blockage, or damage. Cleaning is required when the sediment depth exceeds 20% of the pipe diameter.
- Inspect the physical condition of the catch basin/manhole/tank structure. Cracks or fractures in the walls, bottom, or inlet/outlet pipe parging indicate need for repair.
- Inspect the inside of the stormwater management tank for excessive sediment build-up. Cleaning is required when the sediment depth exceeds 10% of the storage depth for half of the tank length, or any point where the sediment depth exceeds 15% of the storage depth.

- Inspect orifice restriction within the control manhole. Remove accumulated sediment, trash, and debris. Cracks, fractures, or missing components indicate need for repair or replacement if necessary.

Observations and findings during inspection of the stormwater management facility can be recorded and logged within the Inspection and Maintenance Checklist provided in Appendix D.

The following is a list of equipment and cleaning methods for the stormwater management facility:

- During the dry season, sediment can be removed by hand with a bucket and shovel. Where conditions permit, a bucket loader can be used to remove accumulated sediment. Use a high-pressure washer to clean any remaining material out of the structure while capturing the slurry with a vacuum. If necessary, after the structure is cleaned, use the rodder of the vacuum truck to clean the downstream pipe and pull back sediment that might have entered it.

- JetVac maintenance is recommended if sediment has accumulated within the storm sewer and clogged the pipes. The JetVac process utilizes a high-pressure water nozzle to propel itself down the storm sewer while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” (1143 mm) are best.

7.0 EROSION AND SEDIMENT CONTROL

7.1 Mitigation Measures

Sedimentation and erosion control measures are required during construction and until such a time that all lot grading and building construction has been completed, the driveway has received its final surface treatment, and vegetation has been established in all landscape areas so that there are no open soils.

The use of various siltation control measures will be implemented to protect the adjacent properties and receiving waterbodies from migrating sediments. These works include but may not be limited to:

- Installation of siltation fencing along the perimeter of the development area, prior to earthwork operations.

- Installation of a vehicle tracking mud mat at the entrance to the site.

- Installation of silt sacks within existing and proposed storm structures to prevent

sedimentation.

Prior to carrying out site grading, the siltation barriers and mud mats shall be in place. Any onsite storm sewer works will not be permitted to outlet to the municipal storm sewer network until the site has been stabilized.

Other temporary installations of silt fence or other appropriate measures may be required during grading to minimize silt migration from the site. The measures will need to be removed, replaced and relocated as required during the construction period until the site works have been completed and vegetation established. During construction, all stockpiled material will be placed up-gradient of the siltation controls with additional siltation fencing installed around the stockpiles.

7.2 Monitoring and Maintenance During Construction

It is the responsibility of the contractor and owner to maintain the siltation control devices until suitable grass cover has been established upon completion of construction.

A regular review of the facilities by the contractor should be carried out during the construction period to ensure that the facilities are being properly maintained, and if necessary, replaced. Inspection reports are to be completed monthly and distributed to the owner, contractor, and City.

If site works are to continue through the winter and spring the engineer should be contacted by the owner to review the measures in place with the contractor on a regular basis to ensure that the facilities are adequate and in good working order.

All reasonable methods to control erosion and sedimentation are to be taken during construction. The contractor should inspect the siltation devices immediately after each rainfall. Damaged devices should be repaired immediately, and additional devices installed if necessary. Silt should be removed from the fencing and related siltation devices when deposits are noticeable.

Should the erosion control measures fail, and sediment migrate beyond the limits of the control works, the following tasks should be carried out:

- The City of Barrie and the LSRCA should be notified of the event. The area will be assessed and cleaned up to the satisfaction of the agencies.
- Additional sedimentation facilities be installed in the area of the migration and down gradient to contain the sediment.
- The Ministry of Natural Resources should be contacted in the event that sediment is transported downgradient of the site.

8.0 SUMMARY AND CONCLUSIONS

The findings of this report are summarized as follows:

- The proposed development will be serviced by the existing 250mm diameter sanitary sewer beneath Yonge Street via a new 200mm dia. service connection to EXSANMH SAP13089. The existing sanitary service laterals not utilized by the proposed development will be decommissioned in accordance with City of Barrie standards.

- The proposed development will be serviced via a new 200mm dia. fire service connection and a new 100mm dia. domestic water service connection off the existing 300mm dia. watermain located beneath the eastern boulevard of Yonge Street. The max day plus fire flowrate of 334.1L/sec can be delivered to the proposed development from the existing municipal hydrants in the vicinity of the property with a residual pressure estimated at 38.2psi. All existing water services not utilized by the proposed development will be decommissioned in accordance with City of Barrie standards.

- This site is considered a “major development” as defined in the Lake Simcoe Protection Plan, therefore a phosphorus loading and water balance analysis is required in accordance with the LSRCA.

- Attenuation of peak post-development flowrates to below pre-development levels will be provided by utilizing a combination of parking lot surface ponding and subsurface detention tank storage for catchment 201. An orifice plate installed on the outlet pipe from the detention tank will control flows to or below pre-development levels.

- Quality control for the development will be provided by a treatment train approach consisting of the installation of a Hydroworks Hydrostorm unit (or approved equivalent) sized to provide a minimum of 82% TSS and 20% TP removal for catchment 201. Lovers Creek SWMF LV13 will also provide a 10% TP removal benefit for site runoff.

- An offsetting fee is required by the LSRCA, in accordance with the LSPP Water Balance Recharge Policy, and the Phosphorus Offsetting Policy, for the water balance deficit of 478m^3/year or phosphorus deficit of 0.97kg/year, whichever value is greater.

- Storm servicing works include a 48.7m – 300mm dia. sewer extension from existing storm manhole DDLV00520 on MacLaren Avenue to the subject property.

- Suitable measures can be implemented during construction to protect the adjacent properties and receiving storm sewers from migrating sediments.

It is therefore recommended that this report and drawings be submitted to the City of Barrie and the LSRCA for review and approval.

We trust this is satisfactory and should you have any questions, please call.

All of which is respectfully submitted by,

PINESTONE ENGINEERING LTD.



Dwight Hordyk, P.Eng.
Project Engineer

APPENDIX A

Site Plan

PINESTONE ENGINEERING LTD.

Copyright of this drawing and design is reserved by the Designer. The drawing and all associated documents are an instrument of service by the Designer. The drawing and the information contained therein may not be reproduced in whole or in part without prior written permission of the designer.

These Contract Documents are the property of the architect. The architect bears no responsibility for the interpretation of these documents by the Contractor. Upon written application the architect will provide written/graphic clarification or supplementary information regarding the intent of the Contract Documents. The architect will review Shop Drawings submitted by the Contractor for design conformance only.

Drawings are not to be scaled for construction. Contractor to verify all existing conditions and dimensions required to perform the work and report any discrepancies with the Contract Documents to the architect before commencing work.

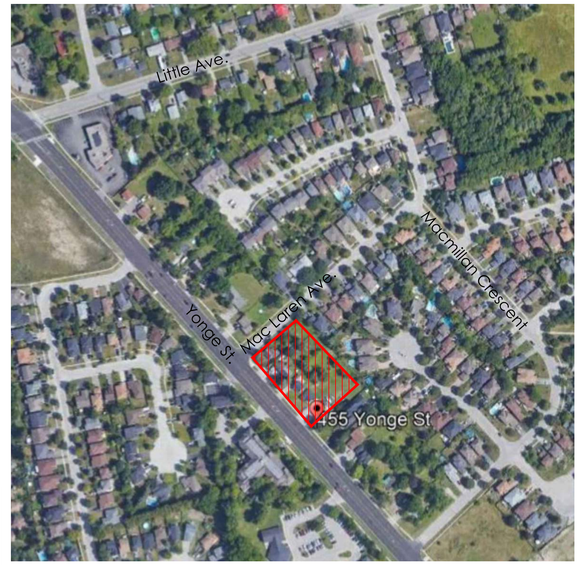
Positions of exposed or finished mechanical or electrical devices, fittings, and fixtures are indicated on architectural drawings. The locations shown on the architectural drawings govern over the Mechanical and Electrical drawings. Those items not clearly located will be located as directed by the architect.

These drawings are not to be used for construction unless noted below as "Issued for Construction"

All work to be carried out in conformance with the Code and bylaws of the authorities having jurisdiction.

The Designer of these plans and specifications gives no warranty or representation to any party about the constructability of the represented by them, all contractors or subcontractors must satisfy themselves when bidding and at all times that they can properly construct the work represented by these plans.

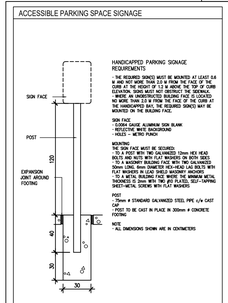
context plan



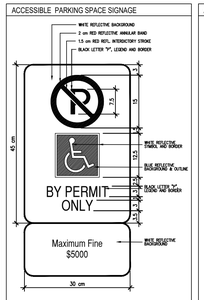
notes:

LEGEND					
000.000	FINISH ELEVATION	▲	DENOTES BUILDING ENTRANCE	C.B. □	CATCH BASIN, ROOF DRAIN
+ 123.18	EXISTING ELEVATION	▽	DENOTES BUILDING EXIT	◎	MAINTENANCE HOLE COVER
♿	HANDICAPPED PARKING SPACE	△	DENOTES BUILDING SERVICE ENTRANCE	D.C.	DEPRESSED CURB
	SIAMESE CONNECTION	⊕	FIRE HYDRANT		SITE LIGHTING (REFER TO LANDSCAPE DWGS)

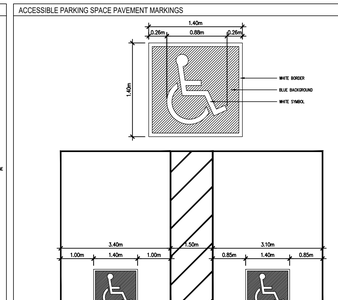
ACCESSIBLE PARKING SPACE SIGNAGE



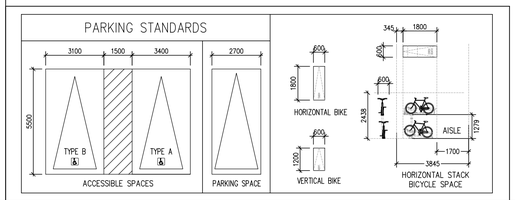
ACCESSIBLE PARKING SPACE SIGNAGE

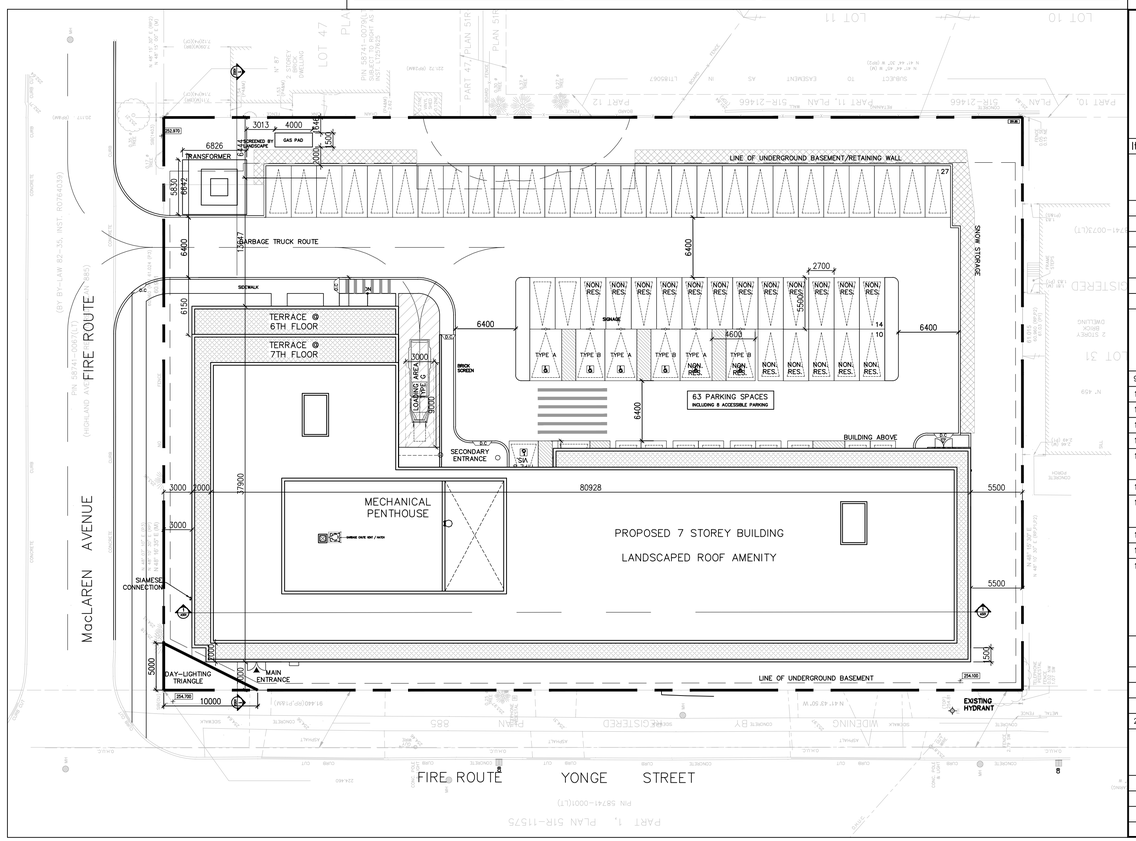


ACCESSIBLE PARKING SPACE PAVEMENT MARKINGS



PARKING STANDARDS





APPENDIX B

Geotechnical & Hydrogeological Reports

PEL
PINESTONE ENGINEERING LTD.

GEI Consultants

Consulting Engineers and Scientists

Geotechnical Investigation

Proposed Residential Apartment Building Development

447 to 455 Yonge Street, Barrie, Ontario

Submitted to:
Barrie Yonge Developments GP Inc.
80 Maritime Ontario Blvd, Unit#239
Brampton, Ontario, L6S 0E7
647-515-2815

Submitted by:
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647 Welham Road, Unit 14
Barrie, Ontario, L4N 0B7
705-719-7994

September 12, 2022
Project No. 2200334

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1. Introduction

GEI Consultants (GEI) was retained by Barrie Yonge Developments GP Inc. to complete a subsurface investigation and geotechnical engineering report for the proposed residential development at 447 to 455 Yonge Street, in Barrie, Ontario. A site location plan is provided as Figure 1. This revision of the report is being provided to reflect the most recent plans provided to GEI.

The site consists of the residential properties of 447, 449, 451, 453 and 455 Yonge Street. Each of the residential properties currently contain a single-family residential dwelling, driveway, and grassed front yards and backyards. Assuming Yonge Street runs north to south, the property is approximately 90 metres long (north to south) by 60 metres wide (east to west) and is rectangular with an area of approximately 0.54 hectares. The property is bounded by Yonge Street to the west, Maclaren Avenue to the north and residential properties to the south and east. At the time of the field work program, the residential dwellings were vacant. The existing site is relatively flat with an approximate elevation of 254 metres. An aerial image of the site from 2020 is provided on Figure 2A.

GEI was provided with the following drawings for review in preparation of this report:

- *"Site Plan – 455 Yonge St, Barrie,"* dated July 29, 2022, by Architecture Unfolded.

Currently, it is proposed to construct a 7 storey apartment building in the southern half of the site and on-grade parking and roadways in the northern half of the site. The majority of the site will contain 1 level of underground parking (under both the apartment building and on-grade parking areas). A preliminary site plan is provided as Figure 2B.

It is noted that the site plan is currently preliminary and may be subject to change. Finished floor elevations, final grading and site servicing plans were not available at the time of writing this report. It is assumed that the development will be municipally serviced.

The geotechnical investigation was required to provide engineering design parameters for design and construction of the proposed development. This includes design recommendations for foundations, slabs-on-grade, earth pressures, temporary shoring, site servicing, basement drainage and pavements, as well as considerations for constructability such as soil excavation, compaction, and temporary groundwater control. GEI was retained to complete a hydrogeological study at the site, under a separate cover.

2. Procedures and Methodology

The fieldwork for the drilling program was carried out between February 2nd and 4th, 2022, to assess the soil conditions present at the site. A total of five (5) boreholes (Boreholes 201 to 205) were advanced throughout the site to depths from 10.4 to 10.8 metres below existing grade (Local Elev. 86.6 to 88.6 metres). The boreholes were distributed evenly across the property to assess the composition of the subsurface soils throughout the property.

The borehole locations were laid out in the field by GEI field staff prior to commencement of drilling operations. Ground surface elevations of the boreholes were surveyed by GEI relative to the top of fire hydrant 1081 and was assigned a local elevation of 100.00 metres. Borehole positions and coordinates (referencing NAD 83 geodetic datum) were provided by a handheld Garmin eTrex 10 GPS receiver and are shown on the borehole logs in Appendix A. Borehole locations are shown on Figure 2A (aerial image of the site) and 2B (proposed site plan).

Drilling and sampling of the boreholes was completed using a rubber-tire mounted drill rig operated by a drilling subcontractor retained and supervised by GEI. The boreholes were advanced to predetermined depths using solid stem augers, and sampling was conducted using 51 mm O.D. split spoon (SS) samplers. Standard Penetration Test (SPT) "N" Values were recorded for the sampled intervals as the number of blows required to drive an SS sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, in accordance with ASTM D1586. Soil sampling was conducted at 0.75 metre intervals for the upper 3.0 metres of each borehole and at 1.5 metre intervals thereafter.

The GEI field staff examined, and classified characteristics of the soils encountered in the boreholes, including the presence of fill materials, made groundwater observations during and upon completion of the drilling, recorded observations of borehole advancement, and processed the recovered samples. All recovered soil samples were logged in the field, carefully packaged, and transported to the laboratory for more detailed examination and classification.

Three (3) monitoring wells were installed in boreholes 202, 203, and 204 to determine the static groundwater elevation at the site, subsequent monitoring or testing purposes, and for use by GEI during the hydrogeological investigation. All borehole backfilling/capping activities and monitoring well installations were performed in accordance with Ontario Regulation (O.Reg.) 903.

In the laboratory, the samples were classified as to their visual and textural characteristics and geotechnical laboratory testing for grain size was carried out with the results provided in Appendix B. Each of the boreholes were backfilled upon completion.

3. Subsurface Conditions

3.1 General Overview

The soil conditions at the site generally consisted of topsoil and earth fill overlying silty sand to sand and silt glacial till. These soils were encountered throughout each of the boreholes to their respective termination depths. Bedrock was not encountered in the boreholes.

The borehole locations are shown on Figures 2A and 2B. Detailed soil profiles encountered in the GEI boreholes are indicated on the attached borehole logs in Appendix A, with the results of geotechnical laboratory testing included in Appendix B. A subsurface profile beneath the site is included as Figure 3 and the profile alignment is shown in plan view on Figures 2A and 2B.

It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the locations. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.). The passage of time also may result in changes in conditions interpreted to exist at locations where sampling was conducted.

3.2 Stratigraphy

3.2.1 Topsoil, Asphalt and Earth Fill

Boreholes 201 and 203 to 205 encountered topsoil at ground surface that ranged in thickness from 200 to 450 mm.

Borehole 202 encountered a pavement structure at the ground surface that consisted of 50 mm of asphalt underlain by 100 mm of granular base material. The pavement was underlain by 300 mm of topsoil.

Underlying the topsoil in Boreholes 201, 202, 204 and 204, earth fill was encountered that extended to depths of 1.5 to 2.3 metres below grade (local Elev. 97.9 to 95.0 metres). The earth fill consisted of sandy silt to silty sand, with trace to some clay and trace gravel, and appeared to consist of re-worked glacial till. The earth fill was brown and moist to wet, and trace amounts

of organics were encountered in some locations. The SPT "N" Values ranged from 5 to 14, indicating a loose to compact relative density.

3.2.2 Native Soils

Underlying the earth fill in Boreholes 201, 202, 204 and 205, and underlying the topsoil in Borehole 203, a deposit of glacial till was encountered with a cohesionless matrix consisting of silty sand to sandy silt, with trace to some clay and gravel. Cobbles and boulders are likely embedded within the glacial till as evidenced by auger grinding during drilling. The upper 0.5 metres of the glacial till in Borehole 201 was weathered and contained trace organics. The glacial till extended beyond the vertical depth of exploration at 10.4 to 10.8 metres below grade (local Elev. 88.6 to 86.6 metres), was brown, turning grey with depth, and moist to wet. The SPT "N" Values ranged from 9 to greater than 100 blows per 300 mm, indicating a loose to very dense relative density. The glacial till was uniformly very dense at 3 metres below grade and deeper.

The glacial till was interbedded with a deposit consisting of sand with trace to some silt and trace gravel in Boreholes 203 and 204 at depths of 2.6 to 4.6 metres below grade, extending to 3.1 to 6.1 metres below grade. The sand was wet and brown, and the measured "N" Values were 28 to greater than 100 blows per 300 mm of penetration, indicating a compact to very dense relative density.

3.3 Groundwater

Unstabilized groundwater level measurements and borehole sloughing (caving) measurements were taken upon completion of drilling of each borehole. These measurements provide an estimate of possible excavation and temporary groundwater control issues that may arise during construction. The depth of caving in Boreholes 201 and 205 was 4.9 to 8.2 metres below grade, and the unstabilized water level ranged from 2.4 to 5.2 metres below grade. Caving and unstabilized water levels were not measured in the other boreholes due to the monitoring well installations.

Boreholes 202 to 204 were outfitted as monitoring wells with 50 mm diameter PVC standpipes and 3.0-metre-long screens. Monitoring well configurations and groundwater observations are summarized on the borehole logs in Appendix A and presented in the table below.

Borehole	Well Screen Location		Strata Screened	Depth / Local Elev. (m) of Groundwater Table on Feb 18, 2022
	Depth (m)	Local Elev. (m)		
BH 202	7.5 to 10.5	91.9 to 88.9	Sandy Silt to Silt & Sand Glacial Till	2.71 / 96.67
BH 203	7.6 to 10.6	90.0 to 87.0		1.83 / 95.74
BH 204	6.8 to 9.8	91.8 to 88.8		2.23 / 96.40

Based on the stabilized groundwater measurements in the monitoring wells, the groundwater table is located at 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) for the proposed development area.

The cohesionless silty sand to sand and silt glacial till soils at the site contain 30 to 52% fines and are moderately permeable but will generally resist the free flow of water when wet. Some free-flowing water could be encountered from more permeable zones within the earth fill or from sand seams within the glacial till. Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions. Additional considerations are provided in GEI's hydrogeological report under a separate cover.

4. Engineering Design Parameters & Analysis

Currently, it is proposed to construct a 7 storey apartment building in the southern half of the site and on-grade parking and roadways in the northern half of the site. The majority of the site will contain 1 level of underground parking (under both the apartment building and on-grade parking areas). A preliminary site plan is provided as Figure 2B.

It is noted that the site plan is currently preliminary and may be subject to change. Finished floor elevations, final grading and site servicing plans were not available at the time of writing this report. It is assumed that the development will be municipally serviced.

4.1 Site Grading

Grading plans were not available for review at the time of preparing this report, however some site grading may be required to accommodate the parking lot and land development. The earth fill and native glacial till at the site are competent to support moderate grade raises throughout the site.

The existing topsoil, pavement structures, organic rich soils, deleterious soils, and vegetation must be stripped from any location where grades will be raised, prior to placing any new fill. Exposed soil subgrade must be proof-rolled and inspected by the geotechnical engineer in advance of placing fill. Any soil subgrade areas observed containing excessive organics, soft or weak areas, or deleterious material should be further sub-excavated to a competent subgrade under the direction of the geotechnical engineer.

Once the subgrade is approved, all new material placed to raise the grades shall be inorganic soil sourced from the site or suitable imported fill compacted to a minimum of 98% SPMDD. The purpose of this compaction specification is to provide uniform support and to mitigate the potential of significant differential settlements. Additional soil compaction recommendations are provided in Section 5.3 of this report.

4.2 Frost Penetration Depth

Based on review of Ontario Provincial Standard Drawing (OPSD) 3090.101, the frost penetration depth beneath the site is estimated to be 1.5 metres.

4.3 Foundation Design

The boreholes were distributed across the site in support of the proposed residential development. The surficial topsoil, pavement structures, earth fill, any weathered or disturbed

soils, or zones with organic content are not suitable for the support of new foundations. The undisturbed silty sand to sand and silt glacial till is suitable for the support or conventional spread and strip footing foundations. In general, the glacial till was loose to dense to a depth of 3.0 metres below grade, after which the deposit was uniformly very dense.

Conventional spread and strip footing foundations set on the undisturbed and loose to dense glacial till encountered in the boreholes at depths of 0.2 to 2.3 metres below grade (local Elev. 97.9 to 95.0 metres) can be designed using a geotechnical reaction at SLS of 150 kPa, for 25 mm or less of total settlement. The maximum factored geotechnical resistance at ULS is 225 kPa.

Conventional spread and strip footing foundations set on the undisturbed and uniformly very dense glacial till at or below a depth of 3 metres below existing grade (local Elev. 96.4 to 94.3 metres) can be designed using a geotechnical reaction at SLS of 350 kPa, for an estimated settlement of 25 mm or less. The maximum factored geotechnical resistance at ULS is 500 kPa.

The minimum strip and spread footing widths to be used shall be dictated as per the Ontario Building Code, regardless of loading considerations. Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal. This concept should also be applied to excavations for new foundations in relation to existing footings or underground services unless rigid shoring is provided. All footings exposed to ambient air temperature throughout the year must be provided with a minimum of 1.5 metres of earth cover or equivalent insulation for frost protection. If the proposed structures contain a continuously heated basement, the required earth cover may be reduced to 1.2 metres for footings exposed to ambient air temperatures.

The foundation design parameters provided above are predicated on the assumption that the foundation subgrade surface is undisturbed, and that all deleterious, softened, disturbed, organic, and caved material is removed. The foundation excavation must be done in such a way that groundwater is controlled to prevent any disturbance to the foundation base. Temporary groundwater control during construction is discussed in Section 5.2.

The foundation subgrade must be reviewed by the geotechnical engineer prior to the placement of any fill or concrete to verify the foundation design parameters provided are applicable, and to provide remedial recommendations if necessary. If foundation excavations will be open for a prolonged period of time, the foundation subgrade should be protected with a skim coat of lean mix concrete (after inspection by the geotechnical engineer), to ensure that no deterioration will occur due to weather effects.

4.4 Earth Pressure Design Parameters

The structures must be designed to resist unbalanced lateral earth pressures imparted from the weight of adjacent soils. Lateral earth pressures are calculated using the following equation:

$$\boldsymbol{P = K[\gamma h + q]}$$

where, **P** = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (dimensionless)
h = depth below surface in metres
γ = the bulk unit weight of soil, (kN/m^3)
q = surcharge loading (kPa)

The above equation assumes that a drainage system is present which prevents the build up of any hydrostatic pressure behind the structure subjected to the unbalanced lateral earth pressures. If this is not the case, the equation must be revised to also incorporate the submerged unit weight of the soil multiplied by the earth pressure coefficient, in addition to the water pressure itself.

The values for use in the design of structures subjected to unbalanced lateral earth pressures at this site are as follows:

Soil Type	γ - Bulk Unit Weight (kN/m^3)	φ - Friction Angle (degrees)	Earth Pressure Coefficient (dimensionless)		
			K_a - Active	K_o – At-Rest	K_p - Passive
Granular 'B' (OPSS.MUNI 1010)	21.0	32	0.31	0.47	3.25
Earth Fill and Loose Glacial Till	19.0	30	0.33	0.50	3.00
Compact to Dense Glacial Till	20.0	34	0.28	0.44	3.54
Very Dense Glacial Till	21.0	38	0.24	0.38	4.20

The calculation of the earth pressure coefficients is based on Rankine theory, which provides a conservative estimate as no friction between the soil and the structure is accounted for. The earth pressure coefficients provided above are only applicable for flat ground surfaces beyond the structure and will change for sloping ground surfaces.

The earth pressure coefficients referenced within the above table are a function of the friction angle of the adjacent soil, and both the degree and direction of movement of the structure subjected to unbalanced lateral earth pressures. For structures that are restrained at the top (such as basement walls), the at-rest earth pressure coefficient will apply. For structures that allow for 0.1 to 1% of movement away from the soil, the full active earth pressure coefficient will apply. For structures that allow for 1 to 10% of movement into the soil, the full passive earth pressure coefficient will apply. The percentage movement is based on the height of the structure.

Other types of structures such as shoring walls with multiple rows of tiebacks and soil nail walls are subject to different loading conditions and must be analyzed separately.

4.5 Slab on Grade Design

The topsoil and any earth fill or native soil containing excessive organics are not suitable for the support of a slab on grade. There are vacant residential dwellings on site, and the full depth of any existing foundations must be removed from beneath the slab. For the apartment building with one basement level, it is expected the slab will be made on very dense silty sand to sand and silt glacial till.

The earth fill and glacial till are suitable for the support of a lightly supported unreinforced concrete slab-on-grade, provided the subgrade is proof-rolled, inspected and approved by the geotechnical engineer, prior to the placement of an aggregate base. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material, they must be locally sub-excavated and backfilled with approved clean earth fill or imported granular material and compacted to a minimum of 98% SPMDD within 2% of optimum moisture content.

All building floor slabs must be provided with a capillary moisture barrier and drainage layer. This is made by placing the concrete slab on a minimum 200 mm layer of 19 mm clear stone (OPSS.MUNI 1004) compacted by vibration to a dense state. The upper 50 mm of clear stone can be replaced with 19 mm crusher run limestone for a working surface. To prevent the migration of fines into the clear stone, filter fabric such as Terrafix 270R or approved equivalent should be placed between the clear stone and the cohesionless soil subgrade.

4.6 Basement Drainage

Based on the stabilized groundwater measurements in the monitoring wells, the groundwater table appears to be at a depth on the order of 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) for the proposed development area. Any structures with a basement level will extend into the groundwater table.

For new structures that will be slab on grade with no basement levels, perimeter drainage at the foundation level is not required, provided that the underside of concrete slab is at least 200 mm above the prevailing grade of the site and the surrounding surfaces slope away from the building at a gradient of at least 2% to promote surface water run-off and to reduce groundwater infiltration adjacent to foundations. To minimize infiltration of surface water, the upper 150 mm of backfill could comprise relatively impervious compacted soil material.

Where basements are constructed, all basement foundation walls must be provided with damp-proofing provisions in conformance to the Ontario Building Code. Backfill along the foundation wall must consist of Granular ‘B’ Type 1 (OPSS 1010) for a minimum lateral distance of 600 mm out from the foundation wall. Alternatively, if a filtered cellular drainage

media is provided adjacent to the foundation wall, the backfill may consist of common earth fill. The prevailing grade of the site should slope away from the building at a gradient of at least 2% to promote surface water run-off and reduce groundwater infiltration. The upper 150 mm of backfill should also consist of relatively impervious compacted material.

A perimeter drainage system must be installed that will remove any water that infiltrates into the building backfill, to ensure that any water does not infiltrate into the basement. The perimeter drains must consist of minimum 100 mm diameter perforated pipes wrapped in filter socks, sufficiently covered on all sides by 19 mm clear stone. Perimeter drains should be directed to the sump underneath the basement floor in solid pipes so as not to surcharge the underfloor drainage layer with water. Subfloor drainage is also recommended, consisting of minimum 100 mm diameter perforated drainage pipes wrapped in a filter sock trenched below the basement slab and surrounded by 19 mm clear stone. The subdrains should be spaced at 6 metres on-centre. The clear stone must be surrounded with filter fabric to prevent the migration of fines (Terrafix 270R or approved equivalent). All sump pumps should be on emergency power for redundancy in case of a power outage. A typical basement drainage detail is included in Appendix C.

If a shoring system is used to support the excavation, prefabricated drainage panels are typically installed between the foundation wall and shoring system to facilitate drainage. The panels typically tie into non-perforated drainage pipes beneath the slab using drainage ports or pipes through the foundation wall, which connect separately to the sump system. Typical details are provided in Appendix C for a caisson wall or soldier pile and lagging system.

In conditions where there is a high groundwater level and relatively permeable soils coupled with a basement level as part of the proposed building design, it is common practice to set the basement level a minimum of 0.5 metres above the seasonally high groundwater level. If the basement level is set near or within the prevailing groundwater level, it is possible that perimeter drainage issues may occur in the future (e.g. sump pump failure, blockage of drainage pipes, etc.), which would lead to potential foundation cracking and basement flooding. Basements can be set below the groundwater table provided these risks are fully acknowledged and all obligations set by the governing bodies in the jurisdiction are met which stipulate minimum clearance distances between basement slab elevation and seasonal high groundwater table.

Alternatively, if a fully waterproof structure is designed (including resistance to hydrostatic pressures), then basement and perimeter drainage is not required and there would be no permanent discharge of groundwater.

4.7 Site Servicing

It is understood that the servicing for this project will likely entail watermain and sanitary or storm sewer construction for the proposed development. Detailed civil engineering drawings

or other detailed design information were not available at the time of preparing this report. It is expected that the services could be installed between 1.5 to 3 metres below grade.

Based on the monitoring well measurements, the groundwater table appears to be at a depth on the order of 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) for the proposed development area. The soil encountered in the trenches will consist of silty sand to sandy silt earth fill or cohesionless glacial till.

4.7.1 Bedding

The type of material and depth of granular bedding below the pipe will, to some extent, depend on the method of construction used by the contractor. Pipe bedding for flexible pipes should follow the requirements in Ontario Provincial Standard Drawing 802.010 or 802.013 or applicable municipal standards. Pipe bedding for rigid pipes should follow the requirements in Ontario Provincial Standard Drawings 802.030 to 802.033 or applicable municipal standards.

Where disturbance of the trench base has occurred from groundwater seepage, construction traffic, etc., the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill. Details on temporary groundwater control are provided in Section 5.2.

Regardless of whether flexible or rigid pipes are implemented, granular bedding and cover material should consist of a well graded, free draining material, such as Granular "A" (OPSS.MUNI 1010). All granular bedding must be compacted to a minimum of 98% SPMDD. Clear stone or high-performance bedding is permitted at this site provided it is fully wrapped in a non-woven filter fabric to prevent the migration of fines and loss of pipe support.

4.7.2 Backfill

Excavated soils may be used as backfill in trenches provided they are moisture conditioned so that the moisture content is within 2% of optimum. The backfill should be compacted to a minimum of 98% SPMDD. In confined areas the layer thickness will have to be reduced to utilize smaller compaction equipment efficiently or by using granular material instead of locally sourced fill. Any backfill that is frozen, contains a high percentage of organic material (topsoil, peat, etc.) or moisture, or has otherwise unsuitable deleterious inclusion should not be used as backfill. The maximum cobble or boulder size should not exceed half of the loose lift thickness (i.e. all particles with a diameter greater than 100 mm should be removed).

Where trenches are within the traveled portions of the parking lot, backfill within the frost penetration depth of 1.5 metres should consist of native, non-organic, excavated material consistent with the soils surrounding the trench. If this technique is not undertaken, then frequently problems arise with yearly differential frost heave movements between the trench backfill and the adjacent native soil. This would occur, for example, if imported granular material is used to backfill trenches which is less susceptible to frost effects compared to the native soils on site. Alternatively, if different soil is used as the backfill due to issues with

achieving compaction, a frost taper of 10H:1V can be implemented to help mitigate the potential for differential settlement and frost heave.

4.8 Pavement Design

The pavement design provided below assumes that the internal roadway through the middle of the site will be on-grade (made on soil) and will not be underlain by an underground parking structure.

4.8.1 Subgrade Preparation

Surficial topsoil and organic rich soils are not a suitable subgrade and must be removed. The pavement subgrade throughout the site will likely consist of loose earth fill, compacted trench backfill, or loose to compact glacial till. These types of soils are considered an adequate subgrade for the support of a pavement structure, provided the subgrade is proof-rolled and approved by the geotechnical engineer at the time of construction and does not contain excessive amounts of organics, moisture or deleterious materials. Zones with high moisture, deleterious materials, or excessive organics must be sub-excavated and replaced with clean earth fill, placed and compacted following the specifications in Section 5.3 to a minimum of 98% SPMDD.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

4.8.2 Frost Susceptibility

The frost susceptibility of soils is correlated to the percentage of particles within a grain size range of 5-75 µm (silt and very fine sand) and divided into three categories summarized below from the Pavement Design and Rehabilitation Manual (2nd Edition, MTO, 2013):

Percentage of Particles Between 5-75 µm by Mass	Susceptibility to Frost Heaving
0 to <40%	Low Susceptibility to Frost Heaving (LSFH)
40% to 55%	Moderate Susceptibility to Frost Heaving (MSFH)
>55 to 100%	High Susceptibility to Frost Heaving (HSFH)

Based on grain size analysis of select soil samples, the site soils appear to have a low susceptibility to frost heaving with contents of particles between 5-75 µm ranging from 20 to 30%.

4.8.3 Drainage

Control of surface water is an important factor in long lasting pavements and the need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (at a minimum grade of 2 percent) to provide positive drainage to the edges of the roadway platform. Grading adjacent to pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement.

The roadway drainage can be managed by conventional catch basins and storm sewers, or ditches / swales adjacent to the roadway. To minimize movement between the pavement and any manhole or catch basin structures due to frost action, the backfill around the structures should consist of free draining granular materials. Typical pavement drainage details are provided in Appendix C.

4.8.4 Pavement Structure

The projected traffic volumes for the proposed development were unknown at the time of writing of this report. There are two different types of pavements that need to be designed for:

- Light duty: Includes roadways which will not see frequent heavy traffic loads such as buses, delivery or fire trucks, etc., and will mostly service small vehicles such as cars or pickup trucks.
- Heavy Duty: Includes roadways which are designated fire truck routes, or will see frequent heavy traffic loads such as buses, delivery or garbage trucks, etc.

The industry pavement design methods are based on a design life of 15 to 20 years for typical weather conditions depending on actual traffic volumes. The following pavement thickness designs are provided on the above noted considerations and subgrade basis for an asphaltic concrete pavement structure.

Pavement Layer	Compaction Requirements	Light Duty Minimum Thickness	Heavy Duty Minimum Thickness
Surface Course Asphaltic Concrete: HL-3 (OPSS.MUNI 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)	OPSS.MUNI 310	40 mm	40 mm

Pavement Layer	Compaction Requirements	Light Duty Minimum Thickness	Heavy Duty Minimum Thickness
Binder Course Asphaltic Concrete: HL-4 (OPSS.MUNI 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)		50 mm	70 mm
Base Course: Granular A (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Subbase Course: Granular B Type I or Type II (OPSS.MUNI 1010)		300 mm	450 mm

The granular materials should be placed in lifts 200 mm thick or less and be compacted to a minimum of 100% SPMDD for both granular base and subbase. Asphalt materials should be rolled and compacted as per OPSS.MUNI 310. The granular and asphalt pavement materials and their placement should conform to OPSS.MUNI 310, 501, 1010 and 1150.

Smooth transitions are required in all areas where the new pavement meets the existing asphalt surface. All longitudinal and transverse joints should meet the requirements of OPSS.MUNI 310. All longitudinal joints should be staggered between the asphalt lifts. The staggering of the longitudinal joints should be accomplished by offsetting the paving edge in the upper asphalt course by a minimum of 150 mm.

If the pavement construction occurs in wet, winter, or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular subbase, base, or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of granular materials.

It should be noted that in addition to adherence of the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, it is recommended that regular inspection and testing should be conducted during the pavement construction to confirm material quality, thickness, and to ensure adequate compaction.

4.9 Shoring Design

Based on the apartment building footprint in the conceptual site plan, it appears there may be sufficient space for an open cut excavation for one basement level. If the basement level will be adjacent to the property lines, a shoring system such as soldier piles and lagging or a continuous caisson wall may be required to support a vertical excavation.

No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. The shoring designer should review the subsurface and proposed site conditions to select the appropriate shoring system.

For one basement level, a cantilevered shoring system may be feasible. The shoring system could also be supported by pre-stressed soil anchors extending beneath the adjacent lands. Pre-stressed anchors are installed and stressed in advance of excavation and this limits movement of the shoring system as much as is practically possible. The use of anchors on adjacent properties requires the consent of the adjacent landowners, expressed in encroachment agreements. The City Transportation and Works Department negotiates permits for the encroachment in City lands, which are generally allowed. Where a cantilevered system or tiebacks cannot be constructed, the use of rakers can be used which provide support to the shoring wall internally.

4.9.1 Earth Pressures

If a cantilevered structure or single level of support (e.g. anchors, tie-backs, or bracing) are used to support the excavation, the pressure distribution on the wall is triangular and can be calculated as discussed in Section 4.4.

For groundwater pressure distribution along the shoring wall in conjunction with the above soil pressures, the groundwater level for design should be taken at 1.8 metres below existing grades. The groundwater pressure distribution is only applicable where an impermeable boundary condition is created along the perimeter of the excavation, as is the case with an interlocking caisson wall. If the site is continuously dewatered for the duration of construction, hydrostatic pressures will not be applied on the system.

4.9.2 Soldier Pile Toe Design

The lateral resistance for the toe of the shoring piles will be developed by passive earth pressure in the dense to very dense glacial till below the base of the excavation. The factored vertical axial resistance at ULS is 500 kPa, where the pile toes are installed deeper than 3 metres below existing grade. It needs to be noted that the glacial till beneath the site is cohesionless and wet such that augered borings for soldier piles made into the sand may become unstable. Augered borings that extend below the groundwater table at 1.8 to 2.7 metres below existing grade may become disturbed by the ingress of water. It may be necessary to advance temporarily cased holes to prevent excess caving during the soldier pile installations. The base of the boring can be protected from groundwater ingress by drilling with mud or temporarily dewatering the site. The design and installation methods will be determined by the shoring designer and contractor. It must also be noted that cobbles and boulders could be embedded within the glacial till.

4.9.3 Shoring Support

The design adhesion for earth anchors is controlled as much by the installation technique as the soil and therefore a proto-type anchor must be made in each anchor level executed to demonstrate the anchor capacity and validate the design assumptions to 200% of the ULS design load (performance test). All production anchors must be proof-tested to 133% of the ULS design load, to validate the design assumptions.

Conventional earth anchors made in the glacial till can be designed using a maximum factored geotechnical resistance (ULS) of 35 kPa for design. It is expected that post-grouted anchors (typically 150 mm diameter) can be made such that an anchor will safely carry about 75 kN/m of adhered anchor length. Where anchors cannot be used, internal bracing or rakers would be necessary. The footings for the rakers would be made on dense to very dense glacial till where they could be designed using a factored geotechnical resistance at ULS of 150 kPa when inclined at 45 degrees.

4.9.4 General Considerations

The strata in the anchor zones will be cohesionless and potentially wet. The shoring designer and contractor must decide if the borings made for anchorages will be completely cased as the holes are advanced and that there is no excess removal of soil beyond the volume of the boring made.

Once the shoring system is configured for immediate support and anchorage it is imperative that a global stability assessment be made of the soil and excavation to ensure that there is not a potential failure condition that is beyond the shoring anchor zone.

It is recommended that the contract have a performance specification limiting movement. A maximum of 13 mm is generally acceptable for a street where movement sensitive utilities are not nearby. Otherwise, the engineering departments of the utility companies must be contacted to assess what movement is acceptable. Anchor spacing and elevation, and the timing of the excavation and anchoring operations are critical in determining the movements.

The shoring designer should be retained to monitor installation and testing of the system, and to monitor the shoring during all phases of the excavation. Inclinometers should be installed at locations where sensitive buildings or services lie close to the excavation. Careful monitoring is needed in any shored excavation, especially when buildings are located in close proximity. This is necessary not only to anticipate when and if additional support is needed, but also to provide data to meet claims from adjacent property owners. In this regard, it is essential that detailed precondition surveys be made on adjacent buildings.

5. Constructability Considerations

5.1 Excavations

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III - Excavations, Section 222 through 242. Where workers must enter a trench or excavation the soil must be suitably sloped and/or braced in accordance with the OHSA. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. The regulation stipulates safe slopes of excavation as follows based on the soils encountered at this site:

- *Type 3 Soils – All soils on site above the groundwater table or when dewatered:* Trench sidewalls to be constructed no steeper than 1 horizontal to 1 vertical from the base of the excavation.
- *Type 4 Soils – All soils on site within the groundwater table:* Trench sidewalls to be constructed no steeper than 3 horizontal to 1 vertical from the base of the excavation.

If more than one soil type is encountered in an excavation, the most conservative soil type must be followed for sloping the sidewalls of the excavation. Assuming the excavation will be dewatered, excavations should be conducted following a Type 3 soil unless otherwise directed by a geotechnical engineer on site.

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the OHSA and include provisions for timbering, shoring and moveable trench boxes. To reduce the potential for instability of the trench excavations, materials excavated from the service trenches and/or other fill materials or heavy equipment should not be placed near the crest of the trench excavations.

It is important to note that soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the boreholes advanced on site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that GEI be contacted immediately to evaluate the conditions encountered. Cobbles and boulders may be encountered within the glacial till deposit.

5.2 Temporary Construction Groundwater Control

Based on the stabilized groundwater measurements in the monitoring wells, the groundwater table appears to be at a depth on the order of 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) for the proposed development area.

The cohesionless native sand and silt to silty sand glacial till soils at the site are moderately permeable but are expected to generally resist the free flow of water when wet. Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions.

It is important to control the groundwater adequately. If the groundwater table is not controlled during construction, the base for the servicing, foundations or basement slabs may become unstable. It is typical to lower the groundwater table about 1 metre below the base of the excavation. If the basement excavations will be supported by a shoring wall, dewatering may also be required in advance of shoring wall construction (e.g. to facilitate the installation of wooden lagging in dry conditions), to be determined by the shoring designer and contractor.

The following conditions are assumed for the site:

- Site services could extend 1.5 to 3 metres below grade, or up to about 1.2 metres into the groundwater table.
- For one basement level, the slab subgrade could extend about 1.2 metres into the groundwater table, with footings extending an additional 0.5 to 1 metre deeper. Total drawdown could be approximately 3.2 metres to maintain dry working conditions and prevent disturbance to the foundation subgrade soil.

For excavations kept above the prevailing groundwater table, any seepage from precipitation or minor perched water zones can be controlled using a conventional sump pump system. It is expected that sump pumps can also be used to control seepage into the servicing trenches.

For the basement excavations, well points or deep wells may be required to lower the groundwater table. The exact scenario where these groundwater control techniques will work are estimates only and are directly correlated to how coarse/fine the native soils are in an excavation, and both the lateral and vertical extent of the cohesionless deposits encountered. If the groundwater table is not controlled during construction, the base of the excavations will probably be unstable, leading to difficulties in excavating and placement of pipes, footings or basement slabs. A dewatering contractor must review and assess the subsurface conditions to verify which dewatering techniques will work for the site and proposed utility installations, based on their experience and interpretation of the data. A test dig could be carried out to assist prospective contractors with determining the most appropriate dewatering methods based on their own means and methods.

The hydrogeological study being completed for the site concurrently by GEI should be referenced for additional dewatering and hydrogeological considerations.

5.3 Compaction Specifications

Standard Proctor Maximum Dry Density (SPMDD) is the level to which a soil or aggregate is compacted. To achieve the specified SPMDD as indicated in this report, all soils or aggregates must be placed in lift thicknesses no greater than 200 mm. If this is not the case, only the upper portion of the lift will be adequately compacted, and the lower portion of the lift has a high probability of not meeting compaction specifications. In addition, industry standard equipment used to determine the degree of compaction consists of nuclear densometers. These devices have an inherent limitation in that they cannot test beyond 300 mm in depth, and so the degree of compaction beyond this depth cannot be quantitatively determined.

Along with lift thickness, ensuring that the soil or aggregate is within 2% of its optimum moisture content ensures that the specified compaction can be reached. If the soil or aggregate is too dry/wet, it is either very difficult or impossible to reach the specified compaction. This is especially true for when higher compaction specifications such as 98% and 100% SPMDD are required. Based on our review of the soil types encountered in the boreholes with associated moisture contents, the soils at this site are as follows:

- About one-third of the existing site soils are at or near optimum moisture content.
- About one-third of the existing site soils are above optimum moisture content.
- About one-third of the existing site soils are below optimum moisture content.

Moisture can be increased by adding water and mixing the soil prior to re-use, or by importing soil to the site that is at optimum and can be readily compacted. Moisture can be reduced by tilling or spreading out the soil to dry or blending it with drier material. In-situ moisture contents can change based on the season and local groundwater levels and can also change for stockpiled material due to precipitation.

In addition to the above compaction specifications, in any areas where compacted fill will be placed over the exposed native soil subgrade, any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill or Granular ‘B’ (OPSS.MUNI 1010) compacted to a minimum of 98% SPMDD. This recommendation applies to site servicing, slab, and pavement subgrades.

5.4 Quality Verification Services

On-site quality verification services are an integral part of the geotechnical design function, and for foundations and retaining walls, are required under the Ontario Building Code (OBC). Quality verification services are used to confirm that construction is being conducted in general conformance with the requirements as outlined in the drawings, reports and specifications prepared for the proposed development.

GEI Consultants can provide all the on-site quality verification services outlined below:

- The subgrade for the shallow foundations must be field reviewed by the geotechnical engineer.
- The installation of any shoring wall systems must be field reviewed by the shoring design engineer.
- Part-time monitoring of the subgrade support capabilities, material quality, lift thickness, moisture content, degree of compaction, etc. is recommended for the following areas to ensure the recommendations within this report are followed and they perform adequately in the long-term:
    - Slabs-on-grade;
    - Pavement structure (granular layers and asphalt); and
    - Bedding/backfilling of site servicing.
- Testing of the concrete (compressive strength, slump, air content, etc.) and testing of the asphalt (asphalt content and gradation) are recommended to ensure that the quality of the materials being brought to site meet the requirements of the project.

5.5 Site Work

The soils found at this site may become weakened when subjected to traffic, particularly when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of granular fill material for site restoration or underfloor fill that is not intrinsic to the project requirements.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work may be required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this project development.

6. Limitations and Conclusions

6.1 Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

GEI should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, GEI will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was prepared by GEI for the account of Barrie Yonge Developments GP Inc. 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. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

6.2 Conclusion

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

Yours Truly,

GEI Consultants

Prepared By:



Russell Wiginton, P.Eng.
Senior Geotechnical Engineer

Reviewed By:



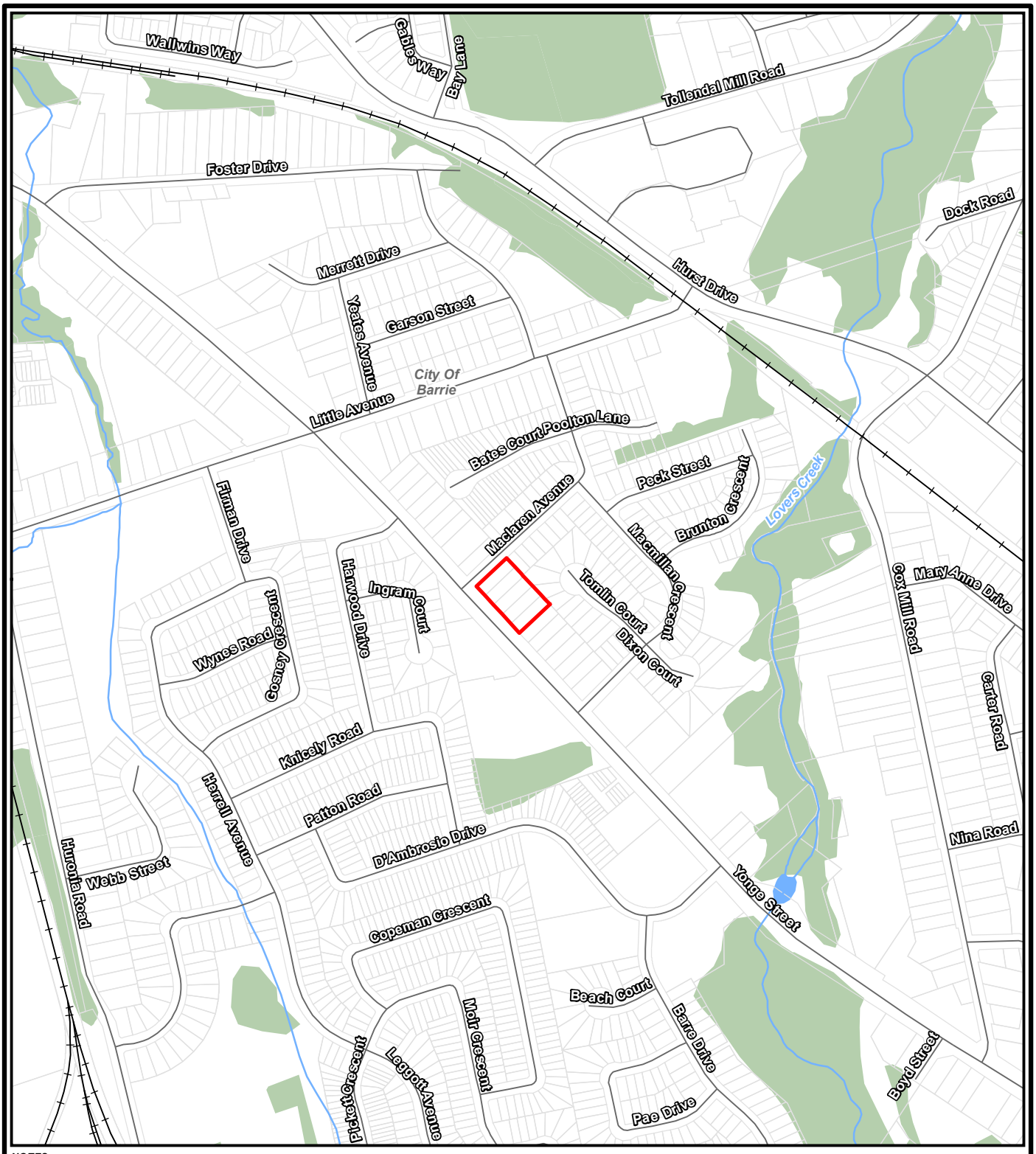
Alexander Winkelmann, P.Eng.
Geotechnical and Earth Sciences Manager

Figures

Site Location Plan

Borehole Location Plans

Geological Cross-Section A-A’



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Parcels from 'Tax Parcels', City of Barrie, AGOL. Accessed March 2022.

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area
- Parcels

N

0 80 160 m

1:8,000

447-455 Yonge Street
Barrie, Ontario

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GEI Consultants

Project 2200334

SITE LOCATION PLAN

March 2022 Fig. 1



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Orthoimagery © First Base Solutions, 2022. Imagery taken in 2020.

Legend

- Site Limit
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location
- Cross Section Location

N

0 6 12 m

1:600

447-455 Yonge Street
Barrie, Ontario

Innovative Planning Solutions

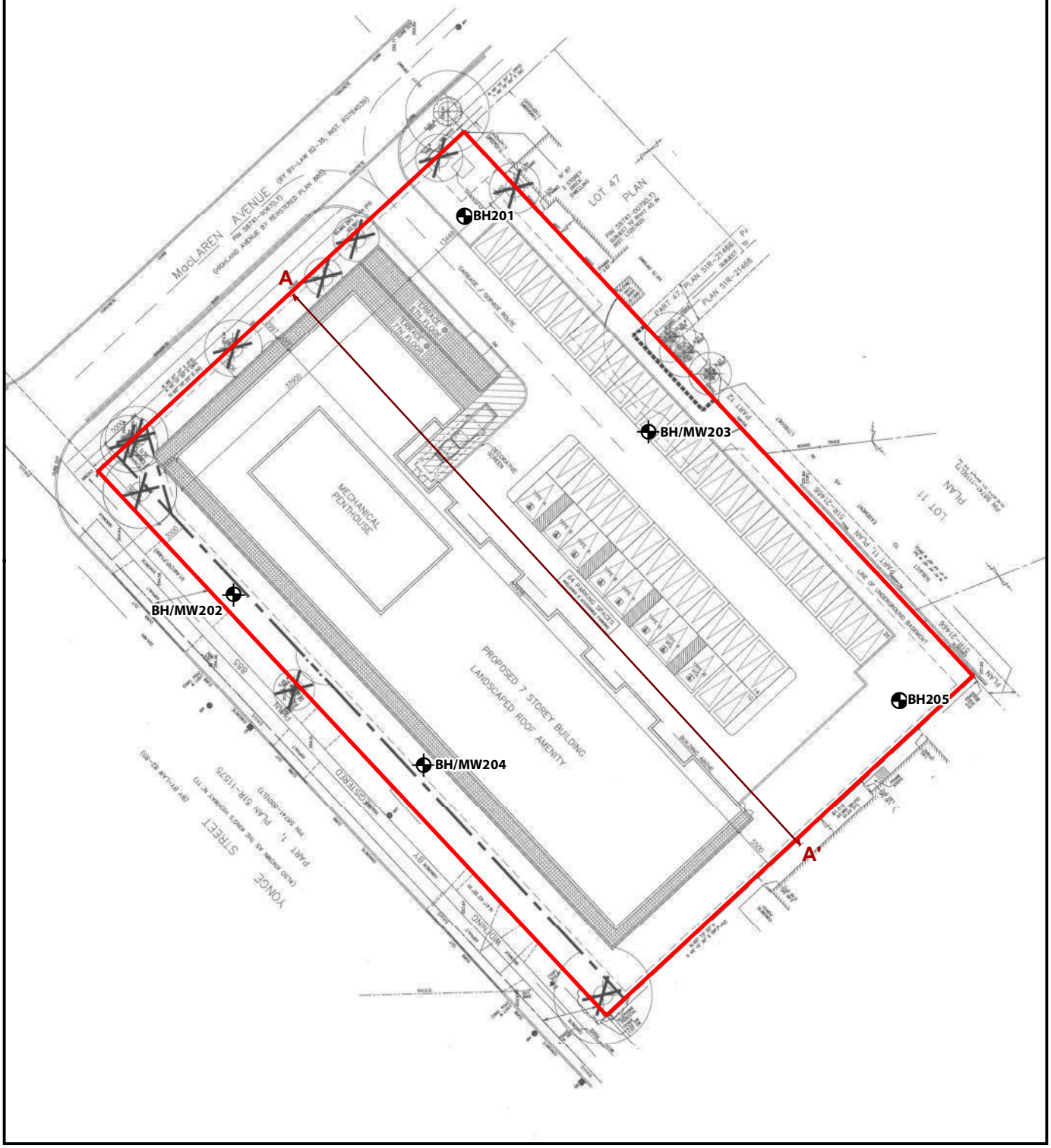
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BOREHOLE LOCATION PLAN

Project 2200334

March 2022

Fig. 2A



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.

Legend

- Site Location
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location
- Cross Section Location

N

0 7 14 m

1:700

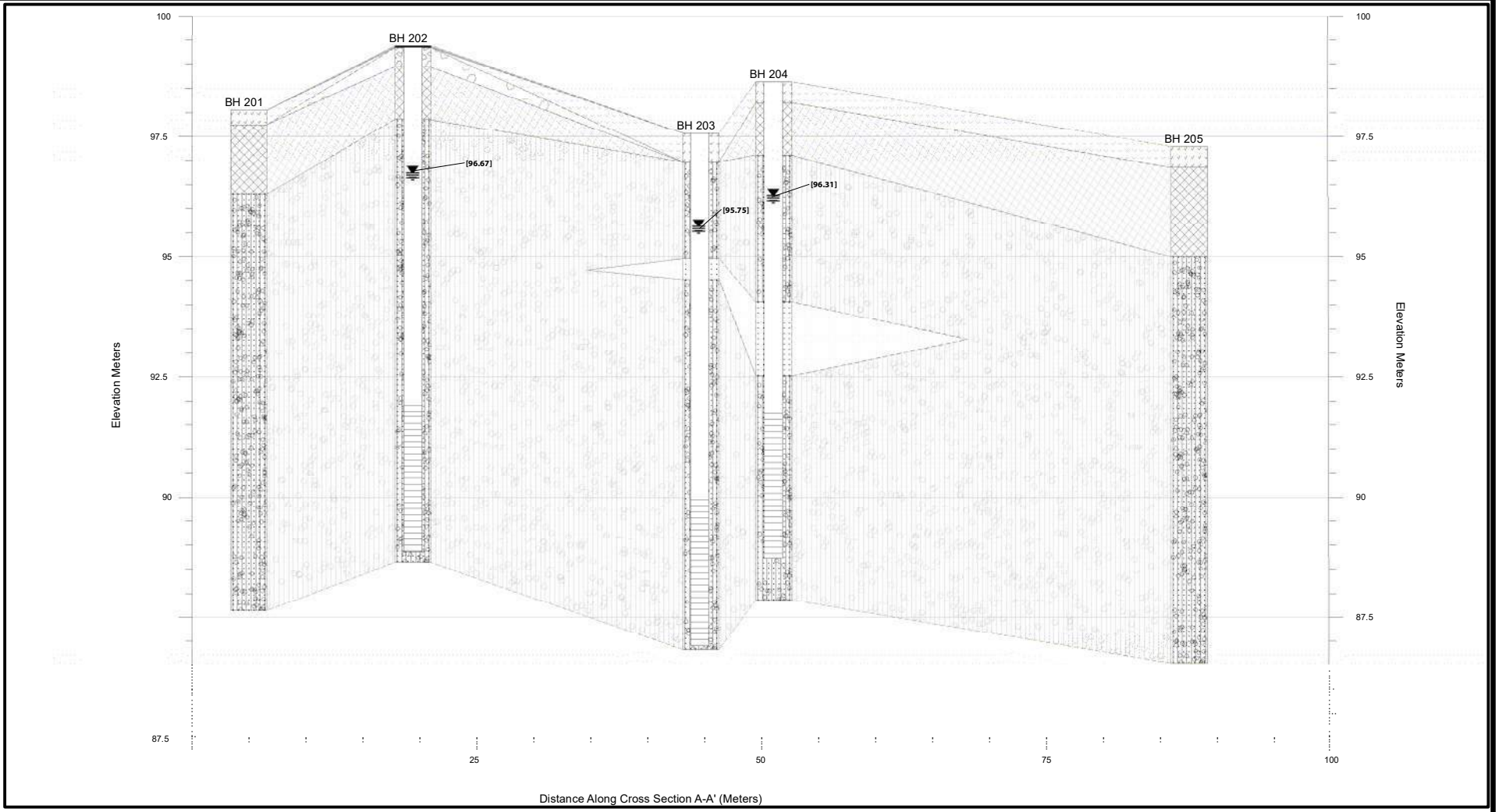
447-455 Yonge Street
Barrie, Ontario

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BOREHOLE LOCATION PLAN (PROPOSED SITE PLAN)

Project 2200334 | September 2022 | Fig. 2B



Legend

Water Level In Monitoring Well

Strata

Asphalt

Topsoil

Earth Fill

Granular

Silty Sand to Sand and Silt Glacial Till

Sand

[ ] Groundwater level (m bgs), measured February 18, 2022

NOTES:

1. Subsurface conditions known only at borehole locations.
2. Horizontal distances are approximate

447-455 Yonge Street
Barrie, Ontario

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GEOLOGICAL CROSS SECTION A-A'

Project 2200334

March 2022

Fig. 3

Appendix A

Borehole Logs

RECORD OF BOREHOLE No. 201

Project Number:	**2200334**						
Project Client:	**Barrie Yonge Developments GP Inc.**						
Project Name:	**447 - 455 Yonge Street**	Drilling Method:	**Solid stems**	Drilling Machine:	**CME 85, buggy**		
Project Location:	**Barrie, Ontario**	Logged By:	**SP**	Northing:	**4913274**	Date Started:	**Feb 3/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By:	**AB**	Easting:	**606818**	Date Completed:	**Feb 3/22**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	GR	SA	SI	CL
	Local 98.05 m										
	0.3 97.8 TOPSOIL: 300 mm	SS	1	75	7	0	97.5				
	EARTH FILL: sandy silt, trace to some clay, trace gravel, moist, brown loose	SS	2	100	7	1.5	96				
	1.8 96.3	SS	3	100	5						
	WEATHERED: trace organics, trace gravel, wet, loose 2.3 95.8	SS	4	100	52	3	94.5	16	55	24	5
	SILTY SAND to SAND & SILT GLACIAL TILL: trace to some gravel, trace to some clay, brown, moist, very dense	SS	5	100	84	4.5	93				
		SS	6	100	100+	6	91.5				
	- - - grey - - -	SS	7	100	100+	7.5	90				
		SS	8	100	100+	9	88.5				
		SS	9	100	100+						
	10.4 87.6	SS	10	100	100+						
	Borehole terminated 10.4 m										

FIELD TESTING: Shear Strength Testing (kPa) — Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); Penetration Testing — SPT; DCPT

LAB TESTING: Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits — PL; LL; Water Content (%)

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Augers grinding

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www.geiconsultants.com

Groundwater depth encountered on completion of drilling: **2.4 m**

Cave depth after auger removal: **4.9 m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 202

Project Number:	**2200334**						
Project Client:	**Barrie Yonge Developments GP Inc.**						
Project Name:	**447 - 455 Yonge Street**	Drilling Method:	**Solid Stems**	Drilling Machine:	**CME 85, buggy**		
Project Location:	**Barrie, Ontario**	Logged By:	**SP**	Northing:	**4913227**	Date Started:	**Feb 4/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By:	**AB**	Easting:	**606789**	Date Completed:	**Feb 4/22**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	Local 99.38 m						
	0.0 99.2 PAVEMENT: 50mm asphalt, 100mm granular 0.4 98.9	SS	1	100	48	0	99
	TOPSOIL: 300 mm						
	EARTH FILL: sandy silt, trace to some clay, trace gravel, trace organics, dark brown to brown, moist, loose 1.5 97.9	SS	2	100	8	1.5	97.5
	SANDY SILT to SAND & SILT GLACIAL TILL: trace to some clay, trace gravel, brown, moist to wet, compact	SS	3	100	21		
	- - - very dense, moist - - -	SS	4	45	54	3	96
		SS	5	50	52		
		SS	6	100	100+	4.5	94.5
		SS	7	100	100+	6	93
		SS	8	100	100+	7.5	91.5
	- - - grey - - -	SS	9	100	100+	9	90
	10.7 88.6 Borehole terminated at 10.7 m	SS	10	100	100+	10.5	

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test; + Pocket Penetrometer; ▲ Field Vane (Intact); △ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
✳ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ○ Water Content (%) LL
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
13	43	35	9

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Groundwater depth encountered on completion of drilling:

Cave depth after auger removal:

Groundwater depth observed on **Feb 18/22** at a depth of: **2.71m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 203

Project Number:	**2200334**				
Project Client:	**Barrie Yonge Developments GP Inc.**				
Project Name:	**447 - 455 Yonge Street**	Drilling Method: **Solid Stems**		Drilling Machine:	**CME 85, buggy**
Project Location:	**Barrie, Ontario**	Logged By: **SP**	Northing: **4913248**	Date Started:	**Feb 3/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By: **AB**	Easting: **606840**	Date Completed:	**Feb 3/22**

Depth (m)	Elevation (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Field Testing (SPT / DCPT)	Lab Testing (Combustible Organic Vapour (ppm) / Water Content (%))	GR	SA	SI	CL
0	97.5	Local 97.57 m										
0.2	97.4	TOPSOIL: 200 mm										
		SILTY SAND to SAND & SILT GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist, loose to compact	SS	1	100	5	5	18				
			SS	2	100	13	13	13				
1.5	96	- - - wet - - -	SS	3	100	9	9	13				
2.6	95.0		SS	4	100	28	28	15				
3.1	94.5	SAND: some silt, trace gravel, brown, wet, compact										
3	94.5	SANDY SILT to SILT & SAND GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist to wet, very dense	SS	5	90	69	69 →	14				
4.5	93	- - - grey, moist - - -	SS	6	100	50	50	7				
6	91.5		SS	7	100	100+	100+ →	7				
7.5	90		SS	8	100	100+	100+ →	8				
9	88.5		SS	9	100	100+	100+ →	8	8	49	34	9
10.5	87		SS	10	100	100+	100+ →	8				
10.7	86.8	Borehole terminated at 10.7 m										

Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160

Penetration Testing: SPT ○ DCPT ● 10 20 30 40

Combustible Organic Vapour (ppm) △; Combustible Organic Vapour (%LEL) ▲; Total Organic Vapour (ppm) ✳; 100 200 300 400

Atterberg Limits: PL — LL; Water Content (%) ○ 10 20 30 40

Instrumentation Installation: Groundwater depth observed on Feb 18/22 at a depth of: 1.83m

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Groundwater depth encountered on completion of drilling:

Cave depth after auger removal:

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 204

Project Number:	**2200334**						
Project Client:	**Barrie Yonge Developments GP Inc.**						
Project Name:	**447 - 455 Yonge Street**	Drilling Method:	**Solid stems**	Drilling Machine:	**CME85, buggy**		
Project Location:	**Barrie, Ontario**	Logged By:	**SP**	Northing:	**4913207**	Date Started:	**Feb 4/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By:	**AB**	Easting:	**606813**	Date Completed:	**Feb 4/22**

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Lithology Plot	DESCRIPTION (Local 98.63 m)	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing SPT/DCPT)	LAB TESTING (Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits PL–LL; Water Content (%))	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	TOPSOIL: 450 mm (0.4 / 98.2)	SS	1	80	6	0								
	EARTH FILL: silty sand, trace to some clay, trace organics, brown, moist to wet, loose (1.5 / 97.1)	SS	2	100	5	1.5	97.5							
	SILTY SAND to SAND & SILT GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist to wet, compact	SS	3	75	13									
	- - - dense - - -	SS	4	100	36	3	96							
	- - - very dense - - -	SS	5	100	58		94.5							
	(4.6 / 94.1) SAND: trace silt, brown, wet, very dense	SS	6	100	100+	4.5	93							
	(6.1 / 92.5) SANDY SILT to SILT & SAND GLACIAL TILL: trace to some clay, trace to some gravel, grey, moist to wet, very dense	SS	7	100	100+	6	91.5							
		SS	8	90	100+	7.5	90				4	44	39	13
	- - - moist - - -	SS	9	100	100+	9	88.5							
	(10.8 / 87.9) Borehole terminated at 10.8 m	SS	10	100	100+	10.5								

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Groundwater depth encountered on completion of drilling:

Cave depth after auger removal:

Groundwater depth observed on **Feb 18/22** at a depth of: **2.32m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 205

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Project Number:	**2200334**				
Project Client:	**Barrie Yonge Developments GP Inc.**				
Project Name:	**447 - 455 Yonge Street**	Drilling Method: **Solid Stems**		Drilling Machine:	**CME 85, Buggy**
Project Location:	**Barrie, Ontario**	Logged By: **SP**	Northing: **4913215**	Date Started:	**Feb 2/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By: **AB**	Easting: **606871**	Date Completed:	**Feb 2/22**

Lithology Plot	DESCRIPTION (Local 97.29 m)	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	GR	SA	SI	CL	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	TOPSOIL: 450 mm (0.4 / 96.9)	SS	1	100	11	0						
	EARTH FILL: sand and silt, trace to some clay, trace to some gravel, trace organics, brown, moist, compact	SS	2	90	14	1.5	96	11	44	37	8	
	(2.3 / 95.0)	SS	3	100	14							
	SILTY SAND to SAND AND SILT GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist, dense	SS	4	100	49	3	94.5					
	- - - very dense - - -	SS	5	100	79	4.5	93					
		SS	6	100	100+	6	91.5					
	- - - grey - - -	SS	7	100	100+	7.5	90					Auger grinding
		SS	8	100	100+	9	88.5					
		SS	9	100	100+	10.5	87					
	(10.7 / 86.6)	SS	10	100	100+							
	Borehole terminated at 10.7 m											

FIELD TESTING — Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160. Penetration Testing: SPT, DCPT; 10 20 30 40.

LAB TESTING — Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL, LL, Water Content (%); 10 20 30 40.

Instrumentation Installation

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Groundwater depth encountered on completion of drilling: **5.2 m**

Cave depth after auger removal: **7.6 m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

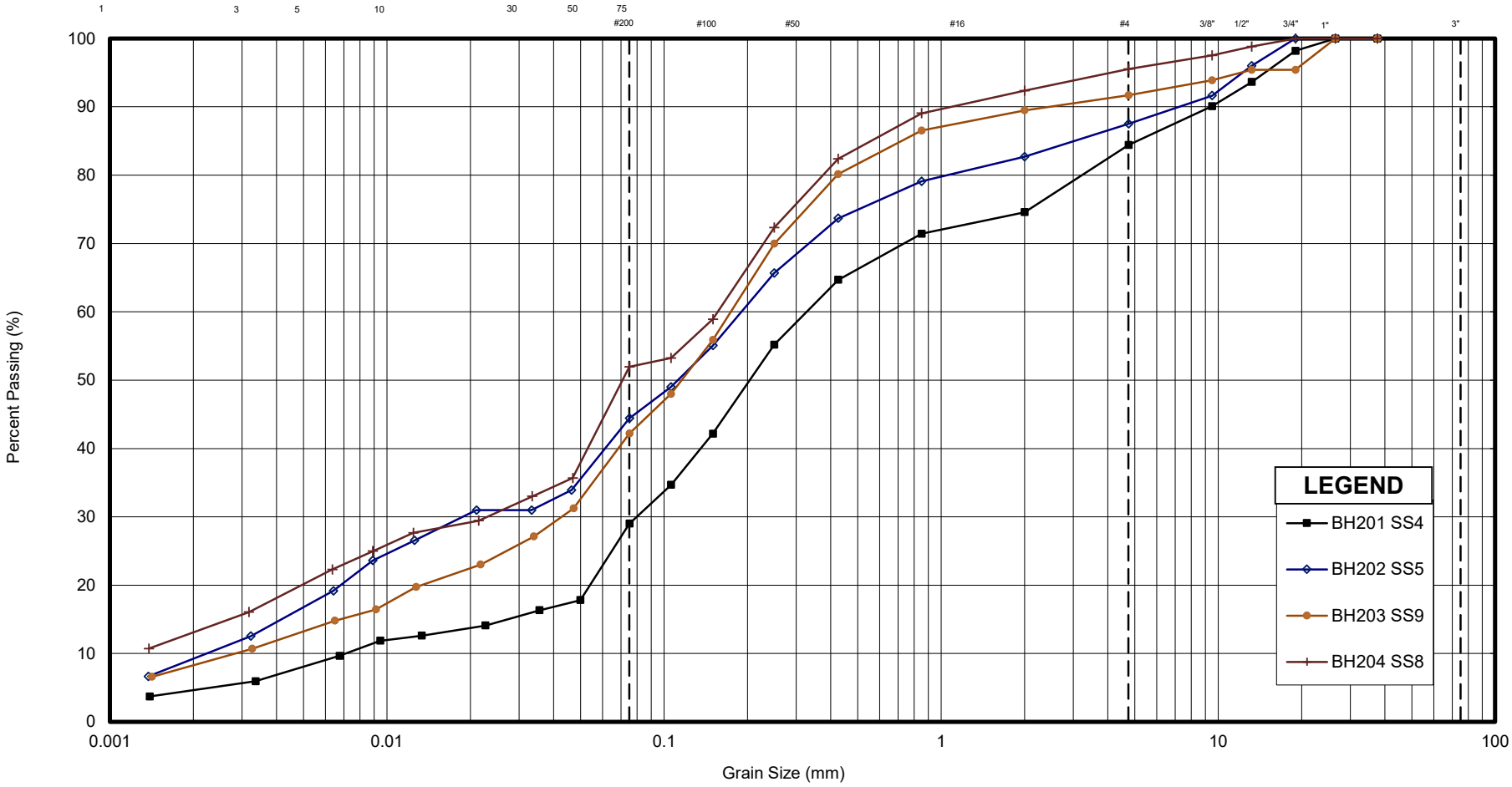
Appendix B

Geotechnical Laboratory Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS — SIEVE DESIGNATION (IMPERIAL)



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH201 SS4	SILTY SAND GLACIAL TILL, Some Gravel, Trace Clay	16	55	24	5	0.007	0.080	0.327	46.7	2.8
BH202 SS5	SAND AND SILT GLACIAL TILL, Some Gravel, Trace Clay	13	43	35	9	0.002	0.019	0.190	95.0	1.0
BH203 SS9	SILTY SAND GLACIAL TILL, Trace Clay, Trace Gravel	8	49	34	9	0.003	0.043	0.174	58.0	3.5
BH204 SS8	SAND AND SILT GLACIAL TILL, Some Clay, Trace Gravel	4	44	39	13	-	0.023	0.156	-	-

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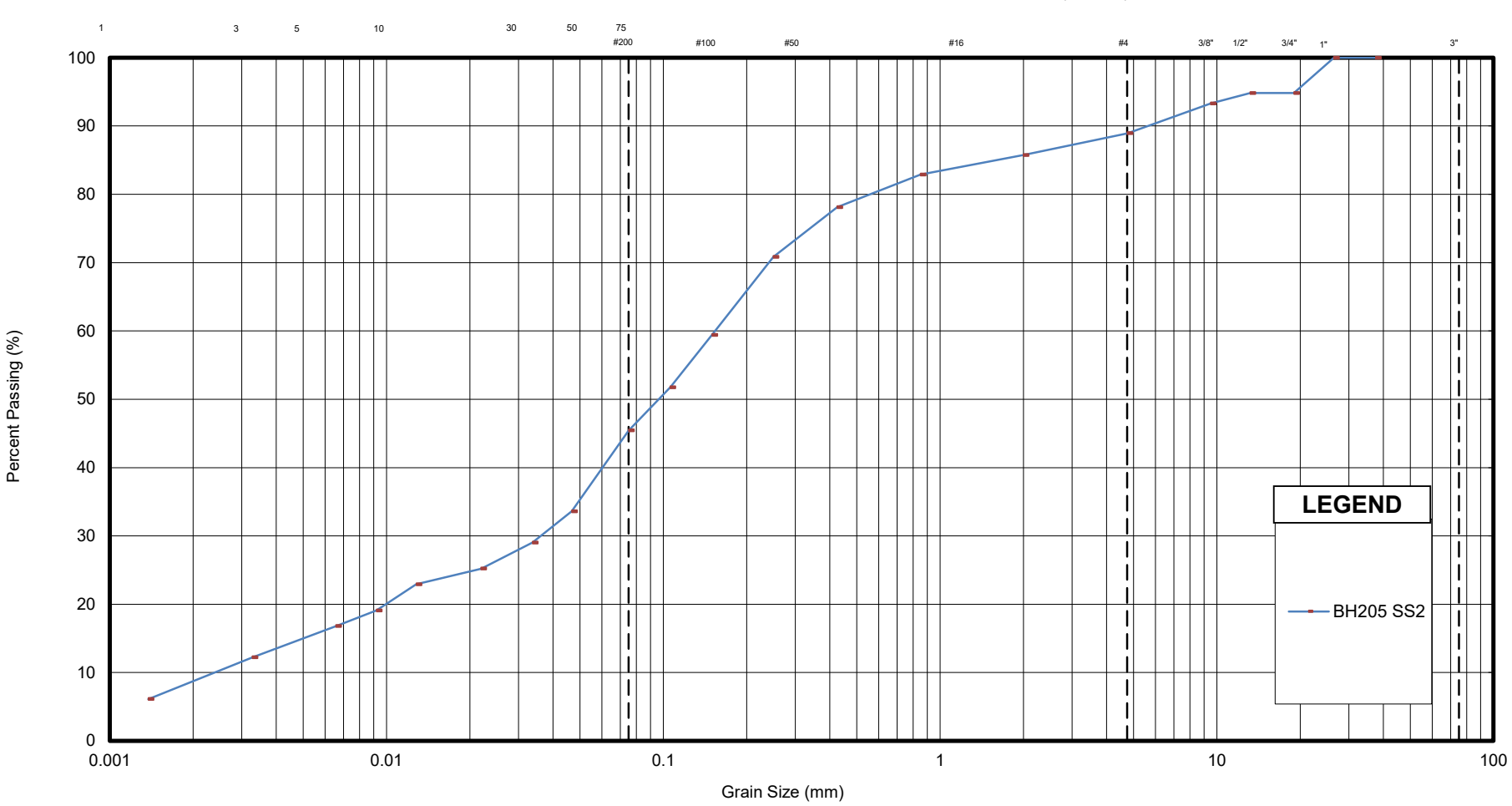
GRAIN SIZE DISTRIBUTION - 447 to 455 Yonge Street, Barrie

SILTY SAND TO SAND AND SILT GLACIAL TILL

FIGURE No.	BH 201-204 Graph
REF. No.	2200334
DATE	April 2022

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH205 SS2	EARTH FILL: Sand and Silt, Some Gravel, Trace Clay	11	44	37	8	0.002	0.036	0.154	77.0	4.2

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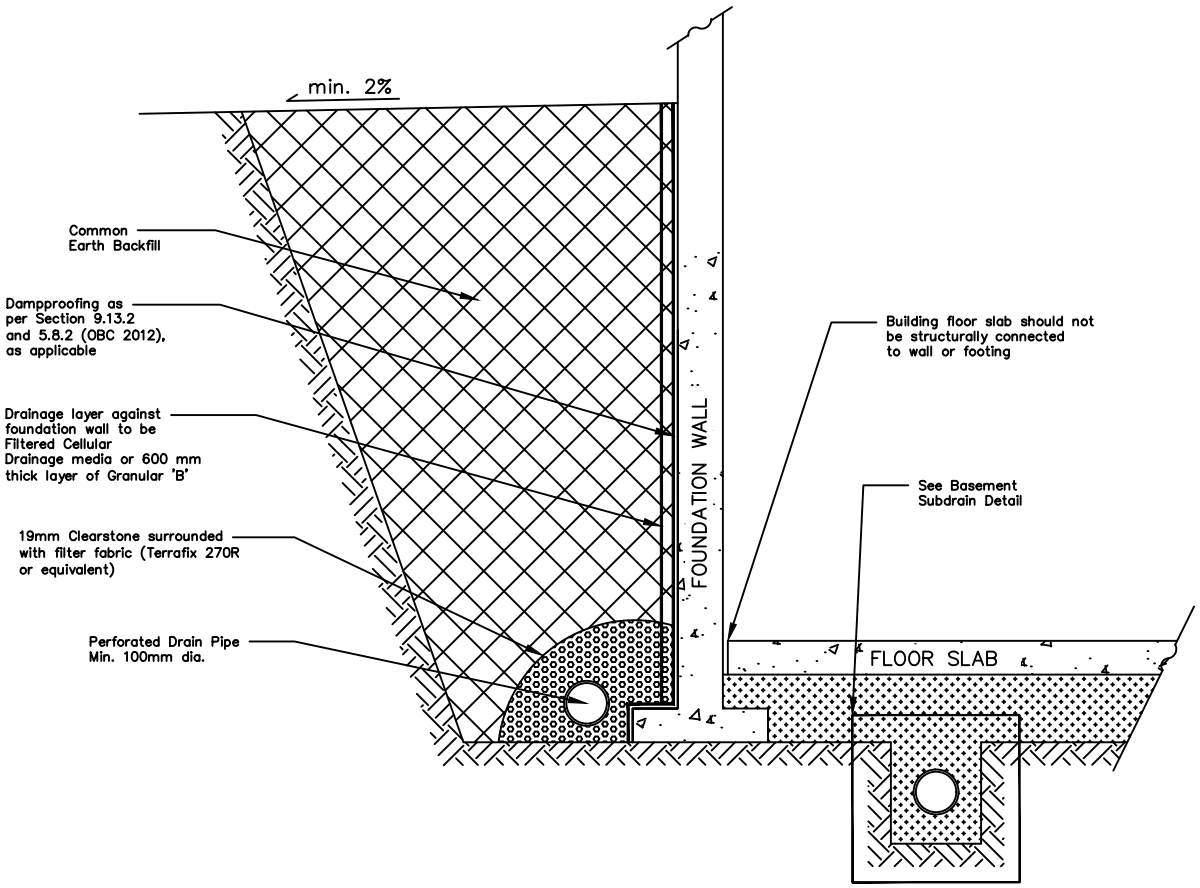
GRAIN SIZE DISTRIBUTION - 447 to 455 Yonge Street, Barrie

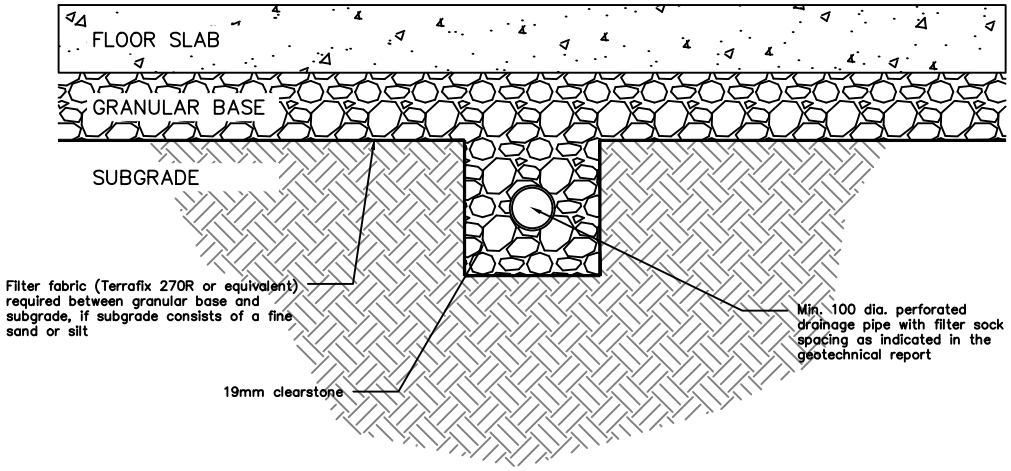
EARTH FILL (RE-WORKED GLACIAL TILL)

FIGURE No.	BH 205 Graph
REF. No.	2200334
DATE	April 2022

Appendix C

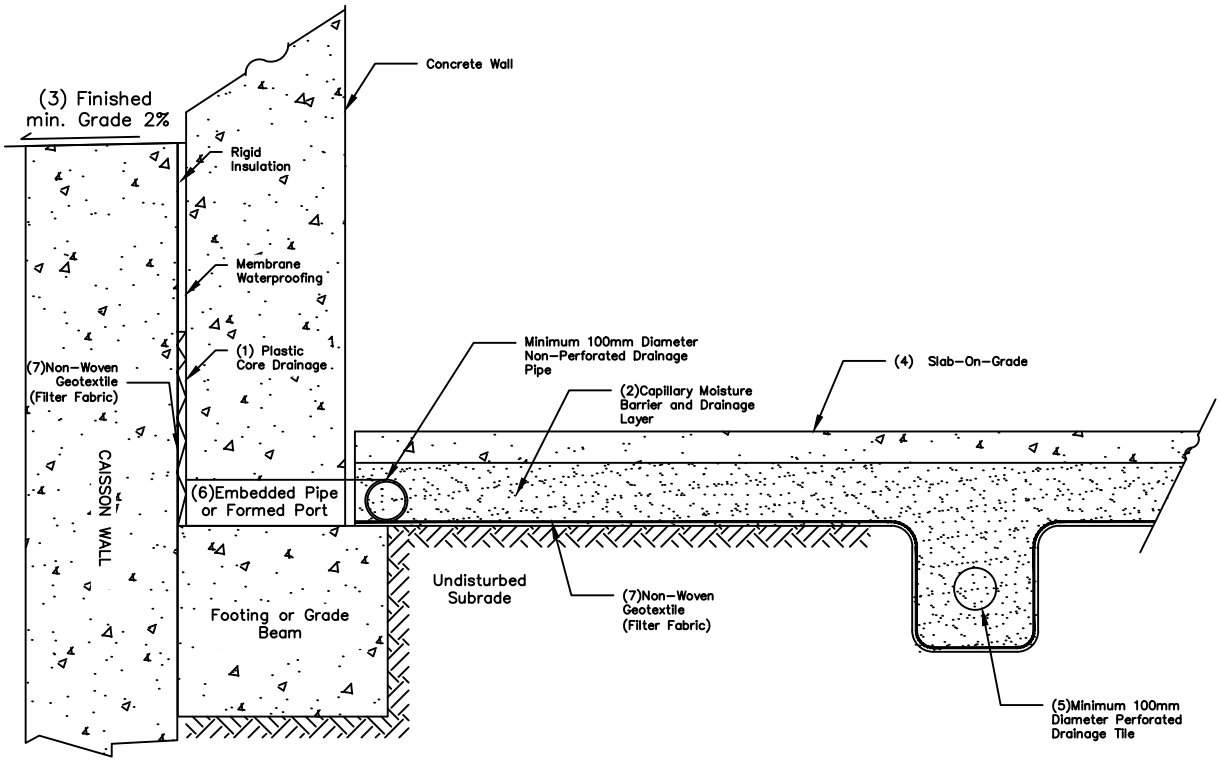
Typical Details





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BASEMENT FOUNDATION WALL & SUBFLOOR DRAINAGE TYPICAL DETAIL



NOTES

1) Prefabricated drainage panels to consist of Terrafix – TERRADRAIN 200, Mirafi–Miradrain 2000, or equivalent. Panels should provide continuous cover with a minimum overlap of 300mm.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS 1004) compacted to a dense state. Upper 50mm can be replaced with Granular 'A' (OPSS 1010) compacted to 98% SPMDD where vehicular traffic is required.

3) Exterior finished grade away from wall at a minimum grade of 2%.

4) Building floor slab–on–grade shall not be structurally connected to foundation wall or footing.

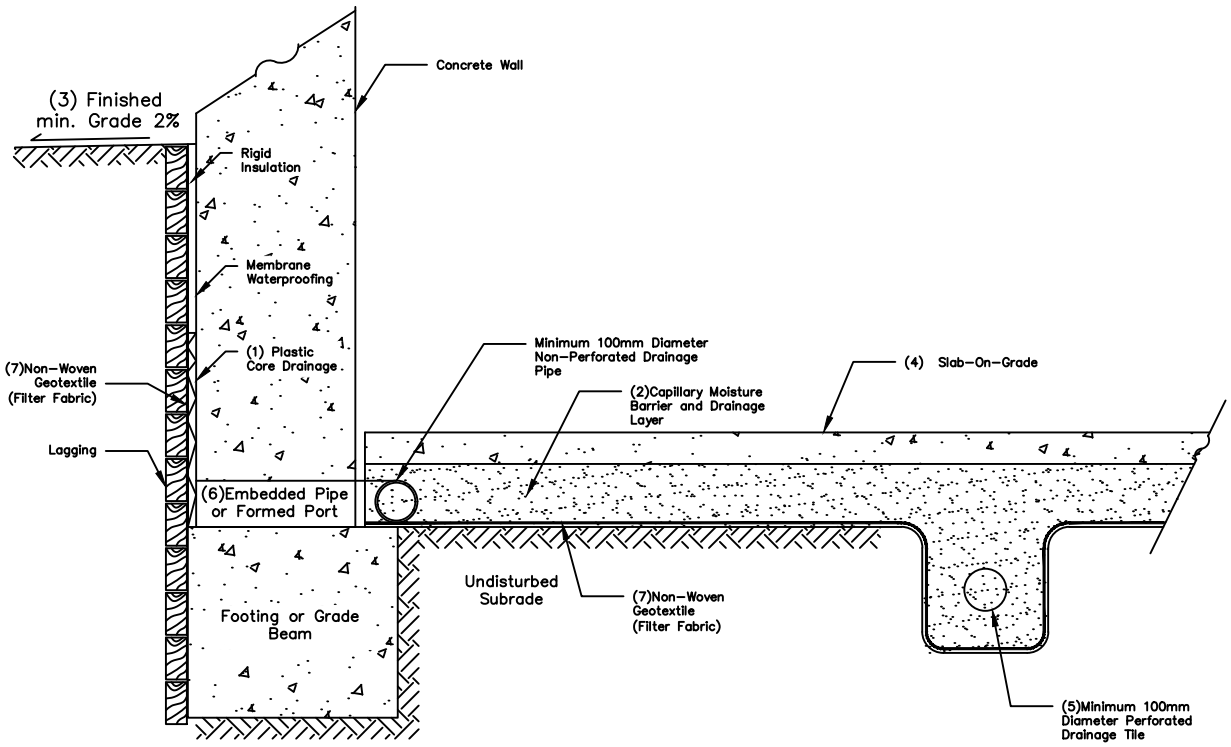
5) Drainage tile invert to be a minimum of 400mm below underside of floor slab, to be set in parallel rows, one way and at a distance of 3 to 6m on–centre, as structural foundations permit. Drainage tile should have a minimum 100mm cover (comprised of a free–draining material on all sides.)

6) Embedded pipes/formed ports to be set a distance of maximum 3m on–centre. Each part to have a minimum cross–sectional area of 1500mm^2. Do not connect the non–perforated perimeter drainage pipes to the under floor drainage tiles.

7) When the subgrade consists of a cohesionless soil, the subgrade must be seperated from the subfloor drainage layer using a non–woven geotextile (Terraflc 360R or equilvalent).

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SCHEMATIC DRAINAGE DETAIL
CAISSON WALL SHORING SYSTEM



NOTES

1) prefabricated drainage panels to consist of Terrafix–TERRADRAIN 200, Mirafi–Miradrain 2000, or equivalent. Panels should provide continuous cover with a minimum overlap of 300mm.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS 1004) compact to a dense state. Upper 50mm can be replaced with a Granular "A" (OPSS 1010) compacted to 98% SPMDD where vehicular traffic is required.

3) Exterior finished finished grade away from wall at a minimum grade of 2%.

4) Building floor slab–on–grade shall not be structurally connected to wall or footing.

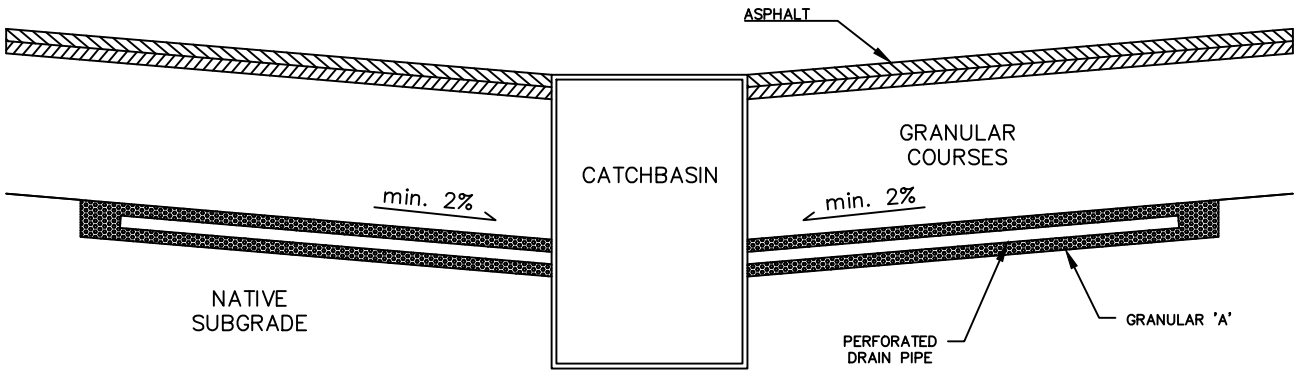
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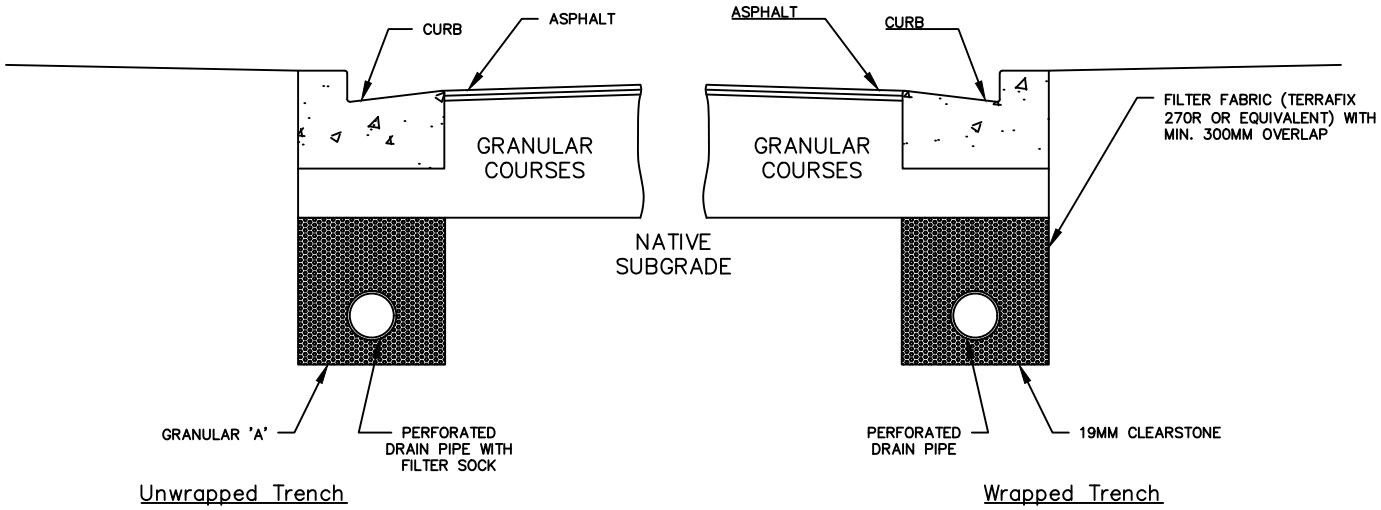
6) Embedded pipes/formed ports to be set a distance of 3m on–centre. Do not connect the non–perforated perimeter drainage pipes to the underfloor drainage tiles.

7) When the subgrade consists of a cohesionless soil, the subgrade must be seperated from the subfloor drainage layer using a non–woven geotextile (Terrafix 360R or equivalent).

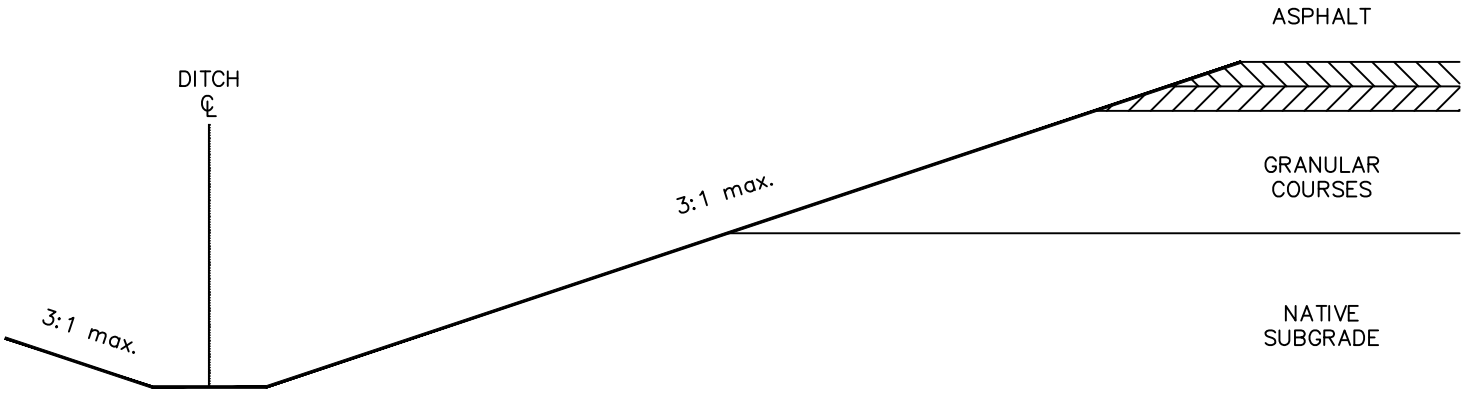
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SCHEMATIC DRAINAGE DETAIL
SOLDIER PILE & LAGGING SHORING SYSTEM





Urban Cross Sections



Rural Cross Section

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PAVEMENT DRAINAGE ALTERNATIVES TYPICAL DETAILS

GEI Consultants

Consulting Engineers and Scientists

Hydrogeological Investigation

Proposed Residential Apartment Building Development

447 to 455 Yonge Street, Barrie, Ontario

Submitted to:
Barrie Yonge Developments GP Inc.
80 Maritime Ontario Blvd, Unit#239
Brampton, Ontario, L6S 0E7
647-515-2815

Submitted by:
GEI Consultants, Ltd.
647 Welham Road, Unit 14
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705-719-7994

September 12, 2022
Project No. 2200334

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1. Introduction

GEI Consultants (GEI) was retained by Barrie Yonge Developments GP Inc. to complete a subsurface investigation and provide a hydrogeological report for the proposed residential apartment building at 447 to 455 Yonge Street, in Barrie, Ontario. A site location plan is provided as Figure 1. A site location plan is provided as Figure 1. This revision of the report is being provided to reflect the most recent plans provided to GEI.

The site consists of the residential properties of 447, 449, 451, 453 and 455 Yonge Street. Each of the residential properties currently contain a single-family residential dwelling, driveway, and grassed front yards and backyards. Assuming Yonge Street runs north to south, the property is approximately 90 metres long (north to south) by 60 metres wide (east to west) and is rectangular with an area of approximately 0.54 hectares. The property is bounded by Yonge Street to the west, Maclaren Avenue to the north and residential properties to the south and east. At the time of the field work program, the residential dwellings were vacant. The existing site is relatively flat with an approximate elevation of 254 metres. An aerial image of the site from 2020 is provided on Figure 2A.

GEI was provided with the following drawings for review in preparation of this report:

- *"Site Plan, 455 Yonge St, Barrie",* July 2, 2022, by Architecture Unfolded.

Currently, it is proposed to construct a 7 storey apartment building in the southern half of the site and on-grade parking and roadways in the northern half of the site. The majority of the site will contain 1 level of underground parking (under both the apartment building and on-grade parking areas). A preliminary site plan is provided as Figure 2B.

It is noted that the site plan is currently preliminary and may be subject to change. Also, the finished floor elevations, final grading or site servicing plans were not available at the time of writing this report. It is assumed the apartment and townhomes will be municipally serviced.

1.1 Purpose and Scope of Work

The main objectives of the Hydrogeological Investigation were to:

a) Establish the local hydrogeological settings of the site;

b) Provide an assessment of anticipated construction dewatering flow rates for a generic construction scenario;

c) Assess groundwater quality and compare the results to the applicable City of Barrie Sewer Use By-Law criteria, Provincial Water Quality Objectives and/or O.Reg. 153/04, as amended, Site Condition Standards (SCSs);

d) Qualitatively assess the potential impact to the nearby structures, water bodies and water uses, if any, and comment on future regulatory agency involvement;

e) Complete a water balance (pre- and post-construction) in general accordance with Lake Simcoe Region Conservation Authority (LSRCA) requirements; and,

f) Prepare a Hydrogeological Investigation Report.

To achieve the investigation objectives, GEI proposed and initiated the following scope of work:

a) Conduct a background desktop review of pertinent geological and hydrogeological resources, Ministry of Environment, Conservation and Parks (MECP) Water Well Records, previous reports, and proposed site plan drawings.

b) Visit the site and note existing site conditions, site setting, topography, drainage, water features, and potential water wells within 500 m of the site, if any.

c) Complete five (5) boreholes and install three (3) monitoring wells;

d) Revisit the site and measure groundwater levels, perform borehole permeability testing at selected monitoring wells, and retrieve a representative groundwater sample.

e) Submit one (1) representative unfiltered groundwater sample for laboratory testing to compare against the City of Barrie Sewer Use By-Law, PWQO for metals and O.Reg. 153/04, as amended, for Petroleum Hydrocarbons (PHCs), Volatile Organic Compounds (VOCs), and Polycyclic Aromatic Hydrocarbons (PAHs).

f) Submit one (1) representative filtered groundwater sample for laboratory testing to compare against the PWQO for metals and Total Suspended Solids (TSS).

g) Evaluate the background information, and field and laboratory data to assess construction dewatering and permanent dewatering requirements.

h) Complete a water balance (pre- and post-construction) for the proposed development.

i) Prepare a Hydrogeological Investigation report.

1.2 Regulatory Requirements

1.2.1 Water Taking – Temporary

The volume of water entering the excavation will be based on both ground water infiltration and precipitation events. Based on O.Reg. 63/16, the following dewatering limits and requirements are as follows:

- Construction Dewatering less than 50,000 L/day: The takings of both groundwater and stormwater do not require a hydrogeological report and does not require a Permit to Take Water (PTTW) from the MECP.
- Construction Dewatering greater than 50,000 L/day and less than 400,000 L/day: The taking of groundwater and/or stormwater requires a hydrogeological report and registration on the Environmental Activity and Sector Registry (EASR) but does not require a PTTW from the MECP.
- Construction Dewatering greater than 400,000 L/day: The taking of groundwater and/or stormwater requires a hydrogeological report and a PTTW from the MECP.

1.2.2 Source Water Protection

The site is within the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). The following documents should be used in determination of the regulatory requirements when it comes to maintaining hydrogeological function at this site:

- "*Lake Simcoe Protection Plan*", dated July 2009, by MOECC, MNR & LSRCA.
- "*Approved South Georgian Bay Lake Simcoe Source Protection Plan*", dated January 26, 2015, by LSRCA.
- *"Lake Simcoe Protection Plan Water Budget Policy for LSPP 4.8-DP and 6.40-DP,"* dated November 2018, by LSRCA.

Based on Source Water Protection online mapping, the following is noted:

- Wellhead Protection Area (WHPA): The site is not located within a WHPA Zone; however, is identified in area Q2 stress level low (Figure 3).
- Intake Protection Zone (IPZ): The site is not located within an IPZ 3 (Figure 4)
- Highly Vulnerable Aquifer (HVA): The site is not located within an HVA (Figure 5).
- Significant Groundwater Recharge Area (SGRA): The site is not located within an SGRA (Figure 6).
- The site is not located within the Oak Ridges Moraine or Niagara Escarpment.

"Lake Simcoe Protection Plan Water Budget Policy for LSPP 4.8-DP and 6.40-DP," (by LSRCA, dated November 2018) Section 6.0 describes the policy hierarchy for water balance required for Lake Simcoe Watershed. The policies from most to least stringent are described below:

- Source Protection Plan Land Use Policy (SPP LUP) 12: *"Planning Approval Authorities shall only permit new major development (excluding single detached residential, barns and non-commercial structures that are accessory to an agricultural operation) in a WHPA-Q2 where the activity would be a significant drinking water threat, where it can be demonstrated through the submission of a hydrogeological study that the existing water balance can be maintained through the use of best management practices such as*

low impact development. Where necessary, implementation and maximization of off-site recharge enhancement within the same WHPA-Q2 to compensate for any predicted loss of recharge from the development."

- Designated Policy (DP) 6.40: *"Outside of the Oak Ridges Moraine area, an application for major development within a significant groundwater recharge area (SGRA) shall be accompanied by an environmental impact study that demonstrates that the quality and quantity of groundwater in these areas and the function of the recharge areas will be protected, improved or restored."*
- Designated Policy (DP) 4.8d: *"An application for major development shall be accompanied by a stormwater management plan that demonstrates: through an evaluation of anticipated changes in the water balance between pre-development and post-development, how such changes shall be minimized."*

The site is a "major development," is within a WHPA Zone Q2, not within an HVA, and is not within an SGRA, therefore SPP LUP 12 and DP-4.8d both apply to the site. A water balance and recommended mitigation measures are discussed in Section 5. Based on Table 2 in *"Lake Simcoe Protection Plan Water Budget Policy for LSPP 4.8-DP and 6.40-DP,"* infiltration-based practices will likely be permitted for impervious areas such as roads and driveways for the residential development. Infiltration of runoff from vegetated areas and rooftops is always permitted.

2. Site Setting

2.1 Physiography, Surficial and Bedrock Geology

The site is located within the physiographic region denoted as the Peterborough Drumlin field comprising beach deposits, and towards the northeastern portion of the site the Simcoe Lowlands comprising sand plans (Chapman and Putnam, 1984).

Surficial and bedrock geology mapping of the site by the Ontario Geological Survey indicate that the surficial site stratigraphy consists of stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain. These findings are consistent with the subsurface soil conditions encountered in the boreholes advanced on site, as discussed in Section 4.2.

The bedrock in the general area consists of Verulam limestone and shale of the Simcoe Group. Bedrock was not encountered at the site, and is anticipated at depths greater than 100 m below existing grade base on the Ontario Division of Mines preliminary Map P.980 Drift Thickness Series for the Barrie Area.

2.2 Topography and Drainage

The existing site slopes from the northwest (local elevation 99.38 metres) down to the southeast (local elevation 97.29), about 2 metres of topographic relief across the site. As such, the site will generally drain towards the southeast towards Tomlin Court. Based on City of Barrie GIS mapping showing storm linear infrastructure, it appears that the catch-basins drain southeast towards Lovers Creek which eventually outlets into Kempenfelt Bay. The Ontario Flow Assessment Tool (OFAT) was also reviewed and confirmed these drainage patterns.

No water bodies are located on the site. The closest surface water is Lovers Creek, located approximately 300 m east of the site which flows into Kempenfelt Bay, approximately 1.1 km north. The site is in the Lovers Creeks Watershed, in the jurisdiction of LSRCA.

2.3 MECP Water Well Records

MECP water well records were obtained within 500 metres of the site area to assess the general nature of the groundwater resource in near vicinity of the site, and historical/current uses of wells in the area. Thirty-nine (39) well records were found, the approximate MECP well locations are shown on Figure 7 and a well records summary table is included in Appendix A.

The wells were installed for the following uses:

- Twenty-three (23) of the records indicate domestic use.
- One (1) of the records indicate public supply use.
- Two (2) of the records indicate commercial use.

- Four (4) of the records indicate monitoring/test hole use.
- Three (3) of the records indicate "not in use".
- Six (6) of the records did not specify the use and are considered to be of unknown use.

The stratigraphic descriptions within the MECP monitoring well records are typically inaccurate due to the methodology in which they are determined (observations of cuttings and no consistency between descriptions of soil between different drillers). Though this is the case, an overall sense of the deep stratigraphy can be determined by looking at commonalities between most stratigraphic descriptions and where the wells were terminated in an aquifer. The well records typically indicate that sands and silts deposits with variable clay and gravel contents were encountered. These conditions are relatively consistent with the aquifer and confining layer units located in this area of Barrie.

Where well screen information is available, the well records show that the domestic wells were primarily screened within the deeper confined sand deposits, at depths of 17 to 85 m below existing grade. Locally domestic wells were screened within the upper sand deposits at depths of 9 to 23 m below existing grade.

2.4 Visual Inspection of Site

A visual site inspection was carried out on February 18, 2022 by senior GEI staff to assess site drainage, topography and presence of surface water features.

The existing site is rectangular in shape and is approximately 5,560 m^2 (0.56 hectares). The site consists of the residential properties of 447, 449, 451, 453 and 455 Yonge Street. Assuming Yonge Street runs north to south, the property is approximately 90 metres long (north to south) and 60 metres wide (east to west). The property is bounded by Yonge Street to the west, Maclaren Avenue to the north and residential properties to the south and east.

The existing site is relatively flat with an approximate elevation of 254 m asl. The surrounding areas of the Site are all approximately at a similar elevation of 254 m asl. The site is currently occupied by multiple single-family residential dwellings, driveways, and grassed front yards and backyards. It is understood that the existing dwellings will be demolished as part of the proposed site plans.

3. Procedures and Methodology

Borehole locations are shown on Figures 2A/2B, borehole logs are provided in Appendix B, and results from the geotechnical laboratory testing are provided in Appendix C.

Prior to the commencement of drilling activities, the locations of the boreholes were staked in the field by GEI. GPS coordinates were measured with a handheld GPS unit and were referenced to the NAD 83 geodetic datum. Ground surface elevations of the boreholes were measured using survey equipment in relation to a temporary benchmark (top of fire hydrant 1081 located along Yonge Street in front of 455 Yonge Street), with an assumed local elevation of 100.00 metres. The underground utilities including natural gas, electrical, telephone, water, etc. were marked out by public and private utility locating companies.

The fieldwork for the drilling program was carried out on February 1 and 2, 2022. A total of five boreholes (Boreholes 201 to 205) were advanced on the site to depths of 10.4 to 10.7 metres below grade (local Elev. 86.8 to 88.6 metres).

Drilling and sampling of the boreholes was completed using rubber tire mounted drill rig operated by a specialty drilling subcontractor retained and supervised by GEI. The boreholes were advanced to predetermined depths though the use of solid and hollow stem augers and sampling was conducted using a 51 mm O.D. Split Spoon (SS) sampler. Standard Penetration Test (SPT) "N" Values were recorded for the sampled intervals as the number of blows required to drive an SS sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, in accordance with ASTM D1586 ("N" Values). Soil sampling was conducted at 0.75 metre intervals for the upper 3.0 metres of each borehole and at 1.5 metre intervals thereafter.

Monitoring wells were installed in three boreholes (BH/MW 202 to 204) to facilitate the measurement of stabilized groundwater levels across the site and for subsequent monitoring or testing purposes. All monitoring well installations were performed in accordance with Ontario Regulation (O.Reg.) 903.

The GEI field staff examined and classified characteristics of the soils encountered in the boreholes, including the presence of fill materials, made groundwater observations during and upon completion of the drilling, recorded observations of borehole advancement, and processed the recovered samples. All recovered soil samples were logged in the field, carefully packaged, and transported to the laboratory for more detailed examination and classification.

In the laboratory, the samples were classified as to their visual and textural characteristics. All samples were submitted for moisture content determination. Five soil samples were submitted for grain size analysis and the results are provided in Appendix C.

3.1 Groundwater Monitoring

Groundwater levels will be measured in three (3) monitoring wells each month for one (1) year to determine the seasonally high groundwater levels.

A supplemental groundwater level monitoring report will be issued following the completion of the 12-month groundwater level monitoring program.

3.2 Borehole Permeability Testing

Rising head tests were completed in the monitoring wells on February 18, 2022. Water was manually purged from monitoring wells using LDPE piping and a foot valve. The static water level was measured prior to the start of testing, and the change in water level was monitored using an electronic level logger. The level loggers were left in the monitoring wells for several hours to allow for adequate recovery of the groundwater. The tests were completed to estimate the horizontal hydraulic conductivity (K) of the soils at the well screen depths.

The semi-log plot for drawdown versus time for the tests are provided in Appendix D.

3.3 Ground Water Sampling

To establish baseline conditions and assess the suitability for discharge of pumped groundwater into City of Barrie sewer systems during potential dewatering activities, the following groundwater samples were collected from the BH/MW 202 on February 15, 2022 and tested relative to the City of Barrie Sewer Use Criteria, PWQO, and/or O.Reg.153/04, as amended, Table 1 SCSs (the most stringent SCSs):

- One (1) unfiltered groundwater sample was collected from BH103 and analyzed against The City of Barrie Storm and Sanitary Sewer Use Criteria, PWQO metals,O.Reg.153/04, as amended, PHCs, VOCs and PAHs.
- One (1) filtered groundwater sample was collected from BH103 and analyzed against PWQO metals and TSS only.

Prior to collection of the samples, approximately three (3) standing well volumes of groundwater were purged from the well. The samples were collected and placed into pre-cleaned laboratory- supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling. The field filtered samples were run through a 75 µm filter. The samples were submitted to CALA-accredited Caduceon Environmental Laboratories for analysis. The results of the groundwater chemistry are presented in the laboratory Certificates of Analysis provided in Appendix E.

4. Subsurface Conditions

4.1 General Overview

The soil conditions at the site generally consisted of topsoil and earth fill overlying silty sand to sand and silt glacial till. These soils were encountered throughout each of the boreholes to their respective termination depths. Bedrock was not encountered in the boreholes.

The borehole locations are shown on Figures 2A and 2B. Detailed soil profiles encountered in the GEI boreholes are indicated on the attached borehole logs in Appendix B, with the results of geotechnical laboratory testing included in Appendix C. A subsurface profile beneath the site is included as Figure 8 and the profile alignment is shown in plan view on Figures 2A and 2B.

It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the locations. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.). The passage of time also may result in changes in conditions interpreted to exist at locations where sampling was conducted.

4.2 Stratigraphy

4.2.1 Topsoil, Asphalt and Earth Fill

Boreholes 201 and 203 to 205 encountered topsoil at ground surface that ranged in thickness from 200 to 450 mm.

Borehole 202 encountered a pavement structure at the ground surface that consisted of 50 mm of asphalt underlain by 100 mm of granular base material. The pavement was underlain by 300 mm of topsoil.

Underlying the topsoil in Boreholes 201, 202, 204 and 204, earth fill was encountered that extended to depths of 1.5 to 2.3 metres below grade (local Elev. 97.9 to 95.0 metres). The earth fill consisted of sandy silt to silty sand, with trace to some clay and trace gravel, and appeared to consist of re-worked glacial till. The earth fill was brown and moist to wet, and trace amounts of organics were encountered in some locations. The SPT “N” Values ranged from 5 to 14, indicating a loose to compact relative density.

4.2.2 Native Soils

Underlying the earth fill in Boreholes 201, 202, 204 and 205, and underlying the topsoil in Borehole 203, a deposit of glacial till was encountered with a cohesionless matrix consisting of silty sand to sandy silt, with trace to some clay and gravel. Cobbles and boulders are likely embedded within the glacial till as evidenced by auger grinding during drilling. The upper 0.5 metres of the glacial till in Borehole 201 was weathered and contained trace organics. The glacial till extended beyond the vertical depth of exploration at 10.4 to 10.8 metres below grade (local Elev. 88.6 to 86.6 metres), was brown, turning grey with depth, and moist to wet. The SPT "N" Values ranged from 9 to greater than 100 blows per 300 mm, indicating a loose to very dense relative density. The glacial till was uniformly very dense at 3 metres below grade and deeper.

The glacial till was interbedded with a deposit consisting of sand with trace to some silt and trace gravel in Boreholes 203 and 204 at depths of 2.6 to 4.6 metres below grade, extending to 3.1 to 6.1 metres below grade. The sand was wet and brown, and the measured "N" Values were 28 to greater than 100 blows per 300 mm of penetration, indicating a compact to very dense relative density.

4.3 Groundwater

4.3.1 Groundwater Levels

Unstabilized groundwater level measurements and borehole sloughing (caving) measurements were taken upon completion of drilling of each borehole. These measurements provide an estimate of possible excavation and temporary groundwater control issues that may arise during construction. The depth of caving in Boreholes 201 and 205 was 4.9 to 8.2 metres below grade, and the unstabilized water level ranged from 2.4 to 5.2 metres below grade. Caving and unstabilized water levels were not measured in the other boreholes due to the monitoring well installations.

Boreholes 202 to 204 were outfitted as monitoring wells with 50 mm diameter PVC standpipes and 3.0-metre-long screens. Monitoring well configurations and groundwater observations are summarized on the borehole logs in Appendix A and presented in the table below.

Borehole	Well Screen Location		Strata Screened	Depth / Local Elev. (m) of Groundwater Table on Feb 18, 2022
	Depth (m)	Local Elev. (m)		
BH 202	7.5 to 10.5	91.9 to 88.9	Sandy Silt to Silt & Sand Glacial Till	2.71 / 96.67
BH 203	7.6 to 10.6	90.0 to 87.0		1.83 / 95.74
BH 204	6.8 to 9.8	91.8 to 88.8		2.23 / 96.40

Based on the stabilized groundwater measurements in the monitoring wells, the groundwater table is located at 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) for the proposed development area.

The cohesionless silty sand to sand and silt glacial till soils at the site contain 30 to 52% fines and are moderately permeable but will generally resist the free flow of water when wet. Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions. Some free-flowing water could be encountered from more permeable zones within the earth fill or from sand seams within the glacial till.

It is anticipated that the shallow groundwater flow will be southeasterly towards Lovers Creek. Local groundwater contours are shown on Figure 9.

GEI is carrying out monthly groundwater level measurements for one year and the seasonally high groundwater levels will be determined through the monthly monitoring and summarized in a separate letter report.

4.3.2 In-Situ Permeability

A hydraulic conductivity value was calculated from the rising head data using Hvorslev's solution (1951). The semi-log plot for drawdown versus time for the tests are provided in Appendix C and are summarized in the table below.

Monitoring Well	Well Depth (m bgs)	Strata Screened	Hydraulic Conductivity (m/s)
BH/MW202	10.6	Silty Sand to Sand & Silt Glacial Till	5.0×10^{-6}
BH/MW203	10.6		1.8×10^{-6}
BH/MW204	9.8		5.9×10^{-6}

In addition to the above-noted permeability data, the hydraulic conductivity of the soils encountered on site was estimated from grain size distribution curves (as provided in Appendix E). According to Freeze and Cherry (1979), the typical hydraulic conductivity of the strata investigated are:

- Glacial Till: 10^{-6} m/s to 10^{-10} m/s
- Silt: 10^{-5} m/s to 10^{-9} m/s
- Silty Sand: 10^{-3} m/s to 10^{-7} m/s

The actual measured hydraulic conductivity of the deposits are within the expected range. The cohesionless silty sand to sand and silt glacial till soils at the site contain 30 to 52% fines and are moderately permeable but will generally resist the free flow of water when wet. Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions.

For design purposes, the hydraulic conductivity of the glacial till deposits is 6.0 x 10^{-6} m/s.

4.3.3 Baseline Groundwater Chemistry Testing

To assess the suitability for discharge of pumped groundwater to the surface or the existing storm sewer system during dewatering activities, one (1) unfiltered and one (1) filtered groundwater samples were collected from BH/MW202 on February 15, 2022.

For the assessment purposes, the analytical results were compared to the City of Barrie Storm and Sanitary Sewer Use Criteria, PWQO, and/or the O.Reg.153/04, as amended, Table 1 SCSs.

The results of the groundwater chemistry are presented in the laboratory Certificates of Analysis provided in Appendix E and are summarized below.

Sample Location	Parameters Tested	City of Barrie Storm Sewer Use By-Law Criteria Exceedances	City of Barrie Sanitary/Combined Sewer Use By-Law Criteria Exceedances	PWQO	O.Reg 153/04 PHCs, VOCs and PAHs
BH202 Well (Unfiltered)	City of Barrie Storm and Sanitary Sewer Use Criteria, PWQO metals, and O.Reg.153/04, as amended, PHCs, VOCs and PAHs	TSS	None	PWQO: Iron Interim PWQO: Aluminum	None
BH202 Well (Filtered)	PWQO Metals, TSS	None	None	None	None

The unfiltered groundwater sample collected from BH/MW202 met the City of Barrie Sanitary Sewer Use By-Law Criteria, exceeded the City of Barrie Storm Sewer Use By-law for TSS, and met PWQO and O.Reg.153/04, as amended, Table 1 SCSs with the exception of iron. Further aluminum was noted as an exceedance with respect to the interim PWQO. The filtered groundwater samples met the PWQO for metals and TSS. If pumped groundwater will be discharged to surface it must be suitably treated to remove the parameter exceedances prior to discharge (treatment methods to be determined by the dewatering contractor or civil engineer).

The above chemical results suggest treatment of the dewatering discharge water by filtration will reduce the concentration of metals sufficiently to meet the applicable PWQO. Treatment of the dewatering discharge water by filtration or sedimentation to reduce the concentration of suspended solids, and thus reduce the concentrations of non-dissolved metals, is necessary and may be effective in achieving compliance with the PWQO. However, other treatment methods may be necessary to reduce the concentration of dissolved analytes.

It is expected that during construction dewatering, the pumped water is to be first discharged to a silt bag or sedimentation tank at a minimum before being discharged to surface.

4.4 Infiltration

Determination of percolation rates are based on the "*Ministry of Municipal Affairs and Housing (MMAH) Supplementary Guidelines SB-6, Percolation Time and Soil Descriptions, September 14, 2012*". The borehole logs indicate predominantly a silty sand to sand and silt glacial till, trace to some gravel, trace to some clay. The Unified Soil Classification System classifications for the predominant soils encountered on-site are summarized below with the interpreted unfactored percolation rates (T-Time) and unfactored infiltration rates:

Unified Soil Classification System Classification	Unfactored Percolation Rate (T-Time) (mins/cm)	Unfactored Infiltration Rate (mm/hr)
S.M. Silty sands, sand-silt mixtures	8 to 20	75 to 30

This infiltration rate is not applicable below the groundwater table and is not applicable to the existing zones of earth fill across the site. Appendix C of "Low Impact Development Stormwater Management and Planning Design Guide" (Version 1.0, 2010, by CVC and TRCA) suggests safety factors to be applied to infiltration rates. The safety factor applicable to the site is expected to be 2.5 but this must be confirmed once the final location and elevation of LID measures are known.

5. Discussion and Analysis

5.1 Temporary Construction Dewatering

Currently, it is proposed to construct a 7 storey apartment building in the southern half of the site and on-grade parking and roadways in the northern half of the site. The majority of the site will contain 1 level of underground parking (under both the apartment building and on-grade parking areas). A preliminary site plan is provided as Figure 2B.

. The finished floor elevations, final grading and site servicing plans were not available at the time of writing this report. It is assumed that the development will be municipally serviced. It has been assumed that excavations for utilities and basements are to extend to a depth of 3 m below existing grade.

The stabilized groundwater level measurements were found to range from 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) however, the groundwater level will change based on seasonal fluctuations. For conservative purposes, the construction dewatering calculation is based on an open cut excavation at the present time. To excavate under dry conditions, the water level is anticipated to be lowered at least to a minimum of approximately 1.0 m below the proposed excavation depth. Based on the soil encountered during the borehole drilling program a conservative hydraulic conductivity of 6.0×10^{-6} m/s has been applied to the entire site.

Additional dewatering capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. It should be noted that the dewatering estimates provided in this report are based on the assumed site servicing depths. GEI must be provided with final site servicing and grading plans to verify the design assumptions or update the water taking estimates as needed.

The exact scenario where these groundwater control techniques will work are estimates only and are directly correlated to how coarse/fine the native soils are in an excavation, and both the lateral and vertical extent of the cohesionless deposits encountered. If the groundwater table is not controlled during construction, the base of the excavations will probably be unstable, leading to difficulties in excavating and placement of pipes or footings. A dewatering contractor must review and assess the subsurface conditions to verify which dewatering techniques will work for the site and proposed utility installations, based on their experience and interpretation of the data. A test dig could be carried out to assist prospective contractors determine the most appropriate dewatering methods based on their own means and methods.

5.1.1 Construction Dewatering Flow Rate Assumptions

The assumptions used for the calculation of the dewatering rate for the proposed residential development are presented below:

- Existing grades are at an elevation of 97.6 m and 99.3 meters based on the completed boreholes.
- Municipal servicing including watermain, and storm and sanitary sewers, and basements will require excavations as deep as 3.0 m below existing grade.
- Groundwater levels should be lowered a minimum of 1.0 m below the excavation base.
- Based on the soil encountered during the borehole drilling program a conservative hydraulic conductivity of 6.0 x 10^{-6} m/s has been applied to the entire site.
- The highest groundwater levels measured on-site range from 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres)
- It has been assumed that surface water/runoff, will be managed sufficiently such that all surface water is diverted around the proposed excavations and surface water entering the proposed excavation would be minimal.
- The dewatering contractor may use smaller dewatering zones, thus limiting the dewatering discharge rates.

5.1.2 Radius of Influence

The Radius of Influence (ROI) for the construction dewatering is based on the empirical Sichardt Equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible. This equation is empirical and was developed to provide representative flow rates using the steady state flow dewatering equations, as discussed below.

It is noted that in steady state conditions, the radius of influence of pumping will extend until boundary flow conditions are reached and provide sufficient water inputs to the aquifer, such as recharge and surface water bodies. As a result, the distance of influence calculated using Sichardt equation is used to provide a representative flow rate calculation, but it is not precise in determining the actual radius influenced by pumping.

The ROI of pumping (dewatering) for radial flow is calculated based on the Sichardt equation, which is described as follows:

$$R_0 = 3000\ (\mathrm{H} - \mathrm{h})\sqrt{\mathrm{K}}$$

Where:

K = Hydraulic conductivity (m/s)
H = Static Saturated Head (m)
h = Dynamic Saturated Head (m)
R_0 = Radius of influence (m)

Based on the Sichardt equation and the hydraulic conductivity of 6.0 x 10^{-6} m/s, the ROI is approximately 15 to 16 m from the centre of the excavation for radial flow for site servicing, calculation details are provided in Appendix F, and the specific ROI's are summarized below:

Description	ROI (m)
Site Servicing	15.4
Seven Storey Residential Building with 1 Basement Level	15.4

The ROI calculation is a conservative methodology and is calculated based on the assumption of active pumping during the construction dewatering. It should be noted that most of the water will be pumped during the first stage of the construction period or when a rain event occurs.

5.1.3 Temporary Dewatering Flow Rate Equation

The Dupuit equation for linear flow from an unconfined aquifer for a fully penetrating excavation was used to obtain a flow rate estimate for the proposed linear infrastructure, and is expressed as follows:

$$Q_w = Kx\frac{H^2 - h^2}{L_0}$$

Where:

Q_w = Rate of pumping (m^3/s)
x = Length of excavation (m)
L_0 = Length of influence (m) ($L_0 = \frac{R_0}{2}$)
K = Hydraulic conductivity (m/s)
H = Head beyond the influence of pumping (static groundwater elevation) (m)
h = Head above base of aquifer at the excavation (m)

The Dupuit-Forcheimer method for radial flow from an unconfined aquifer for a fully penetrating excavation was used to obtain a flow rate estimate for the proposed building and townhome excavations, and is expressed as follows:

$$Q = \frac{\pi K(H^2 - h^2)}{In\,{}^{R_0}/_{r_s}} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where:

Q = Rate of pumping (m^3/s)
x = Length of excavation (m)
L = Length of excavation (m)
K = Hydraulic conductivity (m/s)
H = Head beyond the influence of pumping (static groundwater elevation) (m)
h = Head above base of aquifer at the excavation (m)
R_0 = Radius of Influence (m)
r_s = well radius (m)

It is expected that the initial dewatering rate will be higher in order to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint as groundwater will have been removed locally from storage resulting in lower seepage rates into the excavation.

5.1.4 Construction Dewatering Estimates

Based on the assumptions provided in this report, the results of the dewatering rate estimate are summarized below and calculation details are provided in Appendix F:

Location	Construction Dewatering Flow Rate Without Safety Factor (L/day)	Construction Dewatering Flow Rate Including Safety Factor of 2 (L/day)	Construction Dewatering Flow Rate Including Safety Factor of 2 (L/day) Including a 10 mm Rain Event
Site servicing	88,500	177,000	181,500 (60,500*)
Seven Storey Residential Building	35,202	70,404	119,904

**Construction Dewatering Flow Rate (L/day) Including Safety Factor of 2 and a 10 mm Rain Event per 50 m for site servicing.*

The total construction dewatering flow rate includes a factor of safety of 2.0 to account for seasonal fluctuations in the groundwater table, flow from beddings of existing sewers, and variation in hydrogeological properties beyond those encountered during the course of this study. This total dewatering flow rate also provides additional capacity for the dewatering contractors. Given that the predicted dewatering volume exceeds 50,000 L/day but remains below the 400,000 L/day limit, it is recommended that an EASR be obtained for the site.

Please note that it is the responsibility of the contractor to ensure dry conditions are maintained within the excavation at all times. Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events.

The maximum flow calculation is intended to provide a conservative estimate to account for unforeseeable conditions that may arise during construction. It should be noted that the

dewatering estimate provided in this report are based on the proposed development information available at this time. If changes to the design are implemented (e.g., increase to planned excavation depths, widening of excavations, etc.), the dewatering estimates must be revised to include and reflect future changes.

It should be noted that due to inherent uncertainties, there is a potential for required dewatering discharge volumes to still exceed 400,000 L/day, thus violating the EASR requirements and necessitating a PTTW. Dewatering volumes will need to be closely monitored and if required dewatering activities may need to be staged such that dewatering discharge rates remain below the 400,000 L/day threshold.

In accordance with O.Reg.63/19 and the EASR registration requirements both a water taking and discharge plan completed by a Qualified Person are provided in Appendix G and H, accordingly. The water taking plan provides a summary of the dewatering ROI, estimated settlement, assessment of potential impact on other water users, and a dewatering monitoring program. The discharge plan provides details regarding expected dewatering discharge rate(s), location(s) of discharge, method of water taking, and erosion and settlement control measures.

No dewatering more than 50,000 L/day will take place until the proposed water taking is registered on the EASR registry.

5.2 Construction Dewatering Impact Assessment

5.2.1 Impacts to Nearby Groundwater Users

The City of Barrie is underlain by complex and extensive regional aquifers. The four major aquifers identified beneath Barrie include aquifer A1 (upper and mostly unconfined), A2 (intermediate) and A3 / A4 (lower) aquifers. Aquifer A1 is mostly unconfined, but A2 is typically confined by 5 to 20 metres of fine-grained deposits. The lower aquifers A3 and A4 typically consist of sands and gravels, and most of Barrie's groundwater is supplied by these deep aquifers. Active City Wells 3A, 5, and 12 are screened within aquifer A4, City Wells 7, 9, 11, 13, 14, 15, 17 and 18 are screened in both aquifers A3 and A4, and City Wells 4, 10 and 16 are screened in aquifer A3. In the Barrie area, the elevation of aquifer A3 ranges from approximately Elev. 150 to 195 metres, and the elevation of aquifer A4 ranges from approximately Elev. 115 to 160 metres.

There are no Wellhead Protection Areas near the site as shown on Figure 9a-1 in the Chapter 8 of the report, *"Approved Assessment Report: Lake Simcoe and Couchiching-Black River Source Protection Area, Part 1: Lake Simcoe Watershed"* (January 2015). The closest municipal well is located 2.5 km northwest of the site towards Kempenfelt Bay.

The report, *"Barrie Creeks, Lovers Creek, and Hewitt's Creek Subwatershed Plan"* (LSRCA 2012) includes regional subsurface profiles and maps showing the extent of Aquifers A1 to A4 through the region. From Figure 2-23 in the report, it is estimated that surficial Aquifer A1 is

approximately 20 to 40 metres thick in the project area and may contain a thin upper confining unit of glacial till. The boreholes advanced on site extended to a maximum depth of 11.1 metres and encountered silty sand to sand and silt glacial till., which are assumed to be the upper confining unit and Aquifer A1, respectively. No water will be taken from the deep drinking water Aquifers A3 or A4.

The site lies within an municipally serviced area of Barrie, as such water well uses are not likely to be impacted.

As a precautionary measure even if impacts to the wells are not anticipated, if private well owners issue complaints regarding shortages or other interference with their water well, the complaints will be investigated, and if the problem is deemed to be an effect of the construction dewatering, a temporary supply of water will be made available to the well owner until ground water levels recover.

5.2.2 Natural Environment

Lovers Creeks lies approximately 300 m east of the site, which is outside of the anticipated ROI. Further the dewatering will be of short duration and the water removed will ultimately return to watershed after treatment and discharge. Therefore, it is not anticipated that the construction dewatering will negatively impact the groundwater flow to Lovers Creek.

5.2.3 Land Stability

For the assumed maximum groundwater drawdowns of 2.1 to 2.2 m in the vicinity of the proposed building and/or serving, settlement of the soil within the radius of influence must be calculated based on the increase in effective stress (10 kPa per metre of drawdown) from reducing the pore water pressures. Settlement has the potential to damage buried utilities, building foundations, or cause subsidence in adjacent lands. The amount of settlement will decrease exponentially to zero towards the radius of influence limit.

The drawdown will occur within the generally dense to very dense glacial till. The maximum estimated settlement to occur adjacent to the dewatering system is approximately 2 mm or less, and negligible impacts are anticipated to the roadways or residential properties near the site.

Another cause of significant dewatering related settlement is due to pumping of fines through the system. It is imperative that any dewatering systems shall be designed and installed adequately to ensure no soil is conveyed through the system. Sufficient filtering techniques are incorporated at the entry point to avoid migration fines in the pumping/dewatering system.

5.3 Monitoring, Mitigation, and Treatment Plan

Based on the results of the water quality analyses of the discharge, the following dewatering discharge options can be selected in the order of preference:

i. Discharge to existing City Storm Sewers, provided water quality results comply with City of Barrie Storm Sewer Use Criteria.

ii. Discharge to surface, provided water quality results comply with PWQO and/or O.Reg.153/04, as amended, Table 1 SCSs (strongly preferred option).

iii. Shut-down and re-evaluate treatment options.

The monitoring plan for discharge to the surface and/or storm is outlined on Table G-1.

The monitoring will be implemented both during a trial dewatering and during construction. The trial dewatering will be conducted for a short period of time once the dewatering wells, header pipes, and sediment control facilities (filtration bags, decantation tanks, sedimentation ponds, or the like) are installed to obtain a representative water sample from the outflow of the sediment control facility (the "discharge") for chemical analysis. The results of this water quality analysis will provide guidance in the selection of a discharge option and the discharge treatment requirements during construction dewatering.

5.3.1.1 Groundwater Level Monitoring

The groundwater level monitoring program is outlined on Table G-1. New monitoring wells will have to be installed if the old ones are found non-functional or are destroyed during the construction dewatering.

5.3.1.2 Settlement Monitoring

Settlement caused by a reduction in pore water pressure from dewatering is expected to be negligible and will not impact nearby buildings or infrastructure. Inspections should be carried out daily by the dewatering contractor around the dewatered area to confirm there are no visible signs of recent settlement or subsidence. If observed, this may indicate that fines are being pumped through the dewatering system, and dewatering must stop until corrective action can be taken to prevent the migration of fines through the system.

Settlement monitoring recommendations are outlined in Table G-1, appended.

5.3.1.3 Discharge Rate Monitoring

The total ground water volume pumped should be measured by the dewatering contractor using a flow measuring device, and the records are to be reported to the MECP through the water taking reporting system (WTRS).

The Contractor on behalf of Client will maintain a record of all water takings. This record will include the dates and duration of water takings, and the total measured volume of water pumped per day for each day that water is taken and will be updated and reported to the Client once each week. The Client will keep all the required records up to date and available at or near the site of

the water taking and will produce the records immediately for inspection by a Provincial Officer upon his or her request.

5.3.1.4 Remedial Dewatering Activities

The dewatering contractor is responsible for finalizing and implementing the discharge plan including information such as the exact discharge location, erosion control methods, method of conveyance, treatment systems, temperature of the discharged groundwater, etc. It is the contractor's responsibility to implement a treatment system to ensure that discharged groundwater meets the City of Barrie Storm Sewer Use Criteria, PWQO and/or O.Reg.153/04, as amended, applicable SCSs for the necessary parameters. This may be done by examining the hydrogeologic conditions in a test pit (and/or a full-range pumping test by the dewatering subcontractor).

The dewatering discharges should follow the best management practices, including sediment and erosion control measures, removal of suspended solids by a decanting tank, as well as a water quality and quantity control monitoring programs, as mentioned earlier.

The contractor should be aware that the purpose of the dewatering system is to maintain stable excavation slopes and dry working conditions during excavation. Short step pumping tests are recommended in order to confirm the aquifer conditions and the efficiency of each well or trench, if used.

The extent and details of the dewatering scheme (trench or well dimensions, spacing, pump levels, screen size and wick gradation) are left solely to the contractor's discretion to achieve the performance objectives for maintaining stable slopes and dry working conditions and will be based on his/her own interpretation and analysis of site conditions, equipment, experience and plant efficiency. The contractor should also appreciate that additional dewatering means and modifications may be required as variations in site conditions are encountered.

Once construction sequences are finalized, the contractor will identify the discharge locations, including UTM coordinates, a site plan, and the method of conveyance for normal operating conditions and also in the event of a 100-year storm event. This will include considerations to ensure temperature of the groundwater will not be increased during conveyance. The contractor will provide details on the erosion and sediment control measures that will be used, such as filtration, silt fences, check dams, etc. Additional ESC supplies should be kept on the site for immediate remediation of any issues noted during construction, and restoration plans (e.g. re-vegetation) should also be provided by the contractor. Any material retained by the ESC measures (e.g. sediments) will be disposed once construction is completed.

Any application submitted to the MECP for renewal or technical amendment of the permit will be accompanied by all records required by the conditions of the permit. The records will be interpreted by a qualified person and submitted in the form of a report.

5.4 Permanent Building Drainage

Based on the stabilized groundwater measurements in the monitoring wells, the groundwater table appears to be at a depth on the order of 1.8 to 2.7 metres below existing grade (Local Elev. 96.7 to 95.7 metres) for the proposed development area. Any structures with a basement level will extend into the groundwater table.

For new structures that will be slab on grade with no basement levels, perimeter drainage at the foundation level is not required, provided that the underside of concrete slab is at least 200 mm above the prevailing grade of the site and the surrounding surfaces slope away from the building at a gradient of at least 2% to promote surface water run-off and to reduce groundwater infiltration adjacent to foundations. To minimize infiltration of surface water, the upper 150 mm of backfill could comprise relatively impervious compacted soil material.

Where basements are constructed, all basement foundation walls must be provided with damp-proofing provisions in conformance to the Ontario Building Code. Backfill along the foundation wall must consist of Granular 'B' Type 1 (OPSS 1010) for a minimum lateral distance of 600 mm out from the foundation wall. Alternatively, if a filtered cellular drainage media is provided adjacent to the foundation wall, the backfill may consist of common earth fill.

For buildings with basements, a perimeter drainage system must be installed that will remove any water that infiltrates into the building backfill, to ensure that any water does not infiltrate into the basement. The perimeter drains must consist of minimum 100 mm diameter perforated pipes wrapped in filter socks, sufficiently covered on all sides by 19 mm clear stone. Perimeter drains should be directed to the sump underneath the basement floor in solid pipes so as not to surcharge the underfloor drainage layer with water. Subfloor drainage is also recommended, consisting of a minimum 100 mm diameter perforated drainage pipe wrapped in a filter sock trenched below the basement slab and surrounded by 19 mm clear stone. The subdrains should be spaced at 6 metres on-centre. The clear stone must be surrounded with filter fabric to prevent the migration of fines (Terrafix 270R or approved equivalent). All sump pumps should be on emergency power for redundancy in case of a power outage. A typical basement drainage detail is included in Appendix C.

If the dwelling will have a basement level, in conditions where there is a high groundwater level and relatively permeable soils coupled with a basement level as part of the proposed building design, it is common practice to set the basement level a minimum of 0.5 metres above the seasonally high groundwater level. If the basement level is set near or within the prevailing groundwater level, it is possible that perimeter drainage issues may occur in the future (e.g. sump pump failure, blockage of drainage pipes, etc.), which would lead to potential foundation cracking and basement flooding. Basements can be set below the groundwater table provided these risks are fully acknowledged and all obligations set by the governing bodies in the jurisdiction are met which stipulate minimum clearance distances between basement slab elevation and seasonal high groundwater table.

Monthly water levels for one year are being measured in the monitoring wells at the site by GEI to determine the seasonally high groundwater table. The results will be provided in a separate letter report.

Basements at this site will extend into the groundwater table and permanent dewatering must be carried out to maintain dry basement levels. GEI can provide an assessment on long-term dewatering rates once the site plans and basement depths are finalized. It must be noted that the City of Barrie typically does not permit permanent dewatering. As an alternative, a fully waterproofed basement can be designed and constructed, in which case there will be no permanent dewatering or long-term discharge of groundwater for the basement (construction dewatering still required). The structure would need to be designed to resist hydrostatic pressures and uplift.

5.5 Preliminary Water Balance

5.5.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. The water balance equates the precipitation (P) over a given area to the summation of the change in ground water storage (S), evapotranspiration/evaporation (ET), surface water runoff (R) and infiltration (I) using the following equation:

$$\mathrm{P} = S + I + ET + R$$

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). For example, runoff occurs at a higher percentage during periods of snowmelt when the ground is frozen or during intense rainfall events.

Precise measurement of the water balance components is difficult, and as such, approximations and simplifications are made to characterize the water balance of a property. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important inputs to the water balance calculations.

- Precipitation (P): For the purposes of approximating the annual precipitation at this site, the monthly rainfall between 1981 and 2010 was used based on Environment Canada historical weather data for the Barrie WPCC weather station (Climate ID 6110557, Latitude 44.38 N, Longitude -79.69 W, Elevation 221 metres), which is located about 3 km northwest of the site.
- Storage (S): Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero.
- Evapotranspiration/Evaporation (PET): The evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of

vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. Evaporation occurs from a hard surface (such as flat rooftops, asphalt, gravel parking areas, etc.).

- Water Surplus (R + I): The difference between the mean precipitation and evapotranspiration is referred to as the water surplus. The water surplus is divided into two parts: as surface or overland runoff (R) and the infiltration into the surficial soil (I). The infiltration is comprised of two end member components: one component that moves vertically downward to underlying aquifers (referred to as percolation, deep infiltration or net recharge) and a second component that moves laterally through the near surface soil profile or shallow soils as interflow that re-emerges locally to surface (i.e., as runoff) at some short distance and time following precipitation.

5.5.2 Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre-development infiltration volumes. The detailed water balance calculation is provided in Appendix J, which is summarized in this and subsequent sections of the report. The following assumptions were used as part of the soil-moisture balance calculations:

- A soil moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists.
- During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Considering the nature of the near surface soils (silty sand to sand and silt glacial till), a soil moisture storage capacity of 75 mm was used for the site which is vegetated with shrubs, grasses and some trees. It is assumed that post-construction permeable areas will be shallow urban vegetation and the same storage capacity was used post-development for the permeable areas.
- Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

Monthly potential evapotranspiration calculations accounting for latitude, climate and the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions was calculated. The *MECP SWM Planning and Design Manual* (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding infiltration factor was calculated for pre and post-development conditions. The water surplus was multiplied by the infiltration factor to determine both the pre-existing and post-condition annual volumes for run-off and infiltration for the property.

The post-development water balance scenario was estimated based on the assumption that 65% of the 0.56-hectare lands would comprise impermeable components (e.g. residential building and parking lots), estimated from the conceptual site plan. The water balance must be updated following final site configuration to reflect the final site plans.

It is noted that the infiltration and runoff values presented in Appendix J are estimates only. Single values are used for the water balance calculations, but it is important to understand that infiltration rates are dependent upon the hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration and runoff component values are potentially quite large. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post-development conditions.

5.5.3 Pre and Post Development Water Balance

The detailed water balance calculations are included in Appendix J. The pre and post development calculations are summarized in this section are preliminary only and must be updated once site plans are finalized.

The table below summarizes the pre and post construction water balance for the 0.56 hectares of the site being developed.

Condition	Permeable Areas	Impermeable Areas	Average Annual Runoff Volume (m^3/year)	Average Annual Infiltration Volume (m^3/year)
Pre-Development Land Use	75% (vegetated area)	25% (houses, driveways, sheds	1,889.5	787.3
Post-Development Land Use (Preliminary Plan)	22% (Green space)	78% (7 Storey apartment, parking lots)	3669.9	230.9

These calculations suggest that, without mitigation such as low impact development (LID) measures, the proposed development will decrease average infiltration by about 556.3 m^3/year (71% decrease). The proposed development will increase runoff by about 1780.4 m^3/year (94% increase). This means about 556 m^3/year of infiltration is required to maintain the water balance. The potential impacts of these changes and recommended mitigation measures are discussed below.

5.6 Recommended Mitigation Measures

The three broad categories which typically need to be mitigated and accounted for are:

- Reducing the volume and speed in which additional surface water runoff occurs;

- Increasing the amount of infiltration to match pre-development conditions; and
- Ensuring that the quality of existing surface water features and groundwater will not be adversely impacted.

5.6.1 Runoff Quantity

Urban development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (e.g. roads, parking lots, driveways, rooftops). Impervious surfaces prevent infiltration of water into the underlying soils and the removal of the vegetation reduces the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 15% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (up to two thirds of precipitation). So, the net effect of the urbanization of the site is that most of the precipitation that falls onto impervious surfaces increases the surplus water resulting in more direct runoff from developed areas and reduced natural infiltration.

In conjunction with increased runoff, there is a reduction in infiltration to the shallow groundwater system. A reduction in infiltration can potentially lead to a lowering of the local water table and reduce the potential for this seasonal water table intersection and discharge.

Methods which do not necessarily increase infiltration rate, but decrease the volume and concentration of surface water runoff can be considered at this site include (but are not limited to):

- Increasing the topsoil thickness by about two times the normal thickness (up to 30 cm) to retain more water in storage; and
- Implementation of rainwater harvesting which intercepts, diverts and stores roof runoff (i.e. cisterns) for future use.

5.6.2 Mitigation Measures for Maintaining Infiltration

The increases in surface water runoff that will occur with urban development and mitigation of the potential impacts to the local water table due to reduction of infiltration may be minimized by using appropriate stormwater management and using low impact development (LID) measures to promote infiltration. These measures can be implemented on-site.

The basic premise for low impact development is to try to minimize changes to runoff and infiltration. As outlined in the *MECP SWMP Design Manual* (2003) and *Low Impact Development Stormwater Management Planning and Design Guide* published by the CVC and TRCA (2010), there are a suite of techniques that may be considered to promote infiltration and reduce runoff.

In order to maintain ground water function at the site the following typical LID measures can be considered as part of typical site developments (can depend on land use):

- Collection of runoff from the building rooftops and redirection to grass areas and overland flow. If feasible, it is recommended that there be a minimum 5 metre flow path over pervious areas to allow this mitigation method to be fully effective;
- Provision of gentle slopes in open areas or along grass swales in order to allow time for water infiltration;
- Construction of engineered infiltration measures such as soakaway pits, infiltration galleries or bioswales. Subsurface infiltration methods can only be considered in areas where there is sufficient soil permeability and depth to water table to accommodate the systems within the unsaturated zone (typically the infiltration elevation must be kept 1 metre or more above the seasonal high groundwater level); and
- Construction of grass channels or filter strips which allow infiltration, discharge at a lower rate and direct roof runoff to overland flow.

Implementation of LID measures will not only allow for infiltration of the surface water into the near-surface groundwater regime but will also allow for increases in natural filtration of surficial runoff, prevent sedimentation transport and potential erosion, and help reduce flooding by increasing the transit time for water on the site. These types of LID techniques promote natural infiltration by providing additional water volumes in the pervious areas. This is particularly effective in the summer months when natural infiltration would not generally occur because the additional water overcomes the natural soil moisture deficit.

Details and designs for LID measures will be provided in a stormwater management report for the site (by others). This includes demonstrating through plans and sections (including all dimensions, materials used and including the seasonal high groundwater level) how this infiltration deficit will be mitigated.

As it is typically a requirement of maintaining the same levels of infiltration post construction, no appreciable change in the groundwater table elevation should occur over the long-term condition.

If the water balance cannot be fully maintained due to low soil permeability and higher groundwater levels, minimal impacts are expected for the following reasons:

- The site is not within a Significant Groundwater Recharge Area.
- Future development of the land surrounding the site is expected to be serviced by City / Region water supply instead of domestic wells.
- Groundwater recharge and baseflow to creeks is known to be low in the area of the site due to the existing City of Barrie stormwater management system.

5.6.3 Groundwater Quality

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, phosphorous, bacteria and viruses. For groundwater, generally except for the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater flow through the soils.

LID measures or end treatments such as oil/grit separators or wet ponds also help to remove suspended solids and other contaminants in runoff prior to infiltration or conveying the flows off the site, especially when a treatment train approach is taken for stormwater management. The stormwater management facilities (to be designed by others) must be designed such that the water quality is maintained or improved prior to discharging water from the site or infiltrating water into the ground.

Runoff from residential developments (e.g. rooftops, landscaped areas) is considered "clean" and can be collected an infiltrated where possible. Based on Table 2 in *"Lake Simcoe Protection Plan Water Budget Policy for LSPP 4.8-DP and 6.40-DP,"* infiltration-based practices will likely be permitted for impervious areas such as roads and driveways for the residential development.

Since only clean or pre-treated runoff will be infiltrated, the groundwater quality will not be degraded and will not impact nearby domestic wells, the watercourse or other nearby environmental features. The surficial aquitard present across the site also limits the amount of water infiltrating deeper below grade as recharge.

6. Limitations and Conclusions

6.1 Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

GEI should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, GEI will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was prepared by GEI for the account of Barrie Yonge Developments GP Inc.. 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. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

6.2 Conclusion

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

Yours Truly,

GEI Consultants

Prepared By:	**Reviewed By:**
Aiden Belfrage, B.E.S., Senior Field Technician	
PROFESSIONAL GEOSCIENTIST ALICIA KIMBERLEY PRACTISING MEMBER 2949 Sep. 12, 2022 ONTARIO	LICENSED PROFESSIONAL ENGINEER R. M. WIGINTON 100193069 Sep. 12, 2022 PROVINCE OF ONTARIO
Alicia Kimberley, MSc., P.Geo. Geoenvironmental and Hydrogeological Practice Lead	Russell Wiginton, P.Eng. Senior Geotechnical Engineer

Figures

Site Location Plan

Borehole Location Plan (Aerial)

Borehole Location Plan (Conceptual Site Plan)

Wellhead Protection Areas

Intake Protection Zone

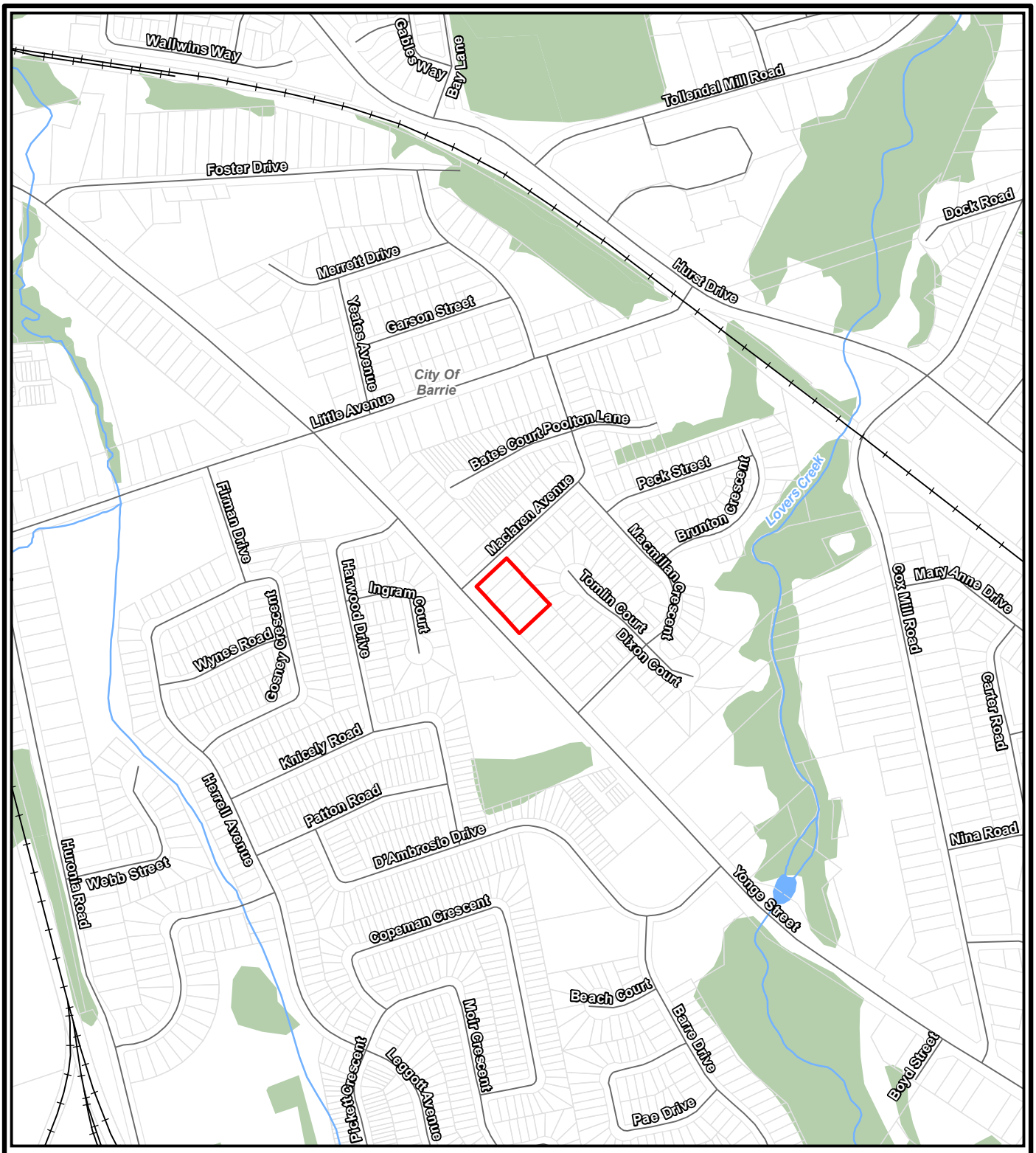
Highly Vulnerable Aquifers

Significant Groundwater Recharge Area

MECP Well Record Locations

Geological Cross Section

Groundwater Contours



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Parcels from 'Tax Parcels', City of Barrie, AGOL. Accessed March 2022.

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area
- Parcels

N

0 80 160 m

1:8,000

447-455 Yonge Street
Barrie, Ontario

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Project 2200334

SITE LOCATION PLAN

May 2022 Fig. 1



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Orthoimagery © First Base Solutions, 2022. Imagery taken in 2020.

Legend

- Site Limit
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location
- Cross Section Location

N

0 6 12 m

1:600

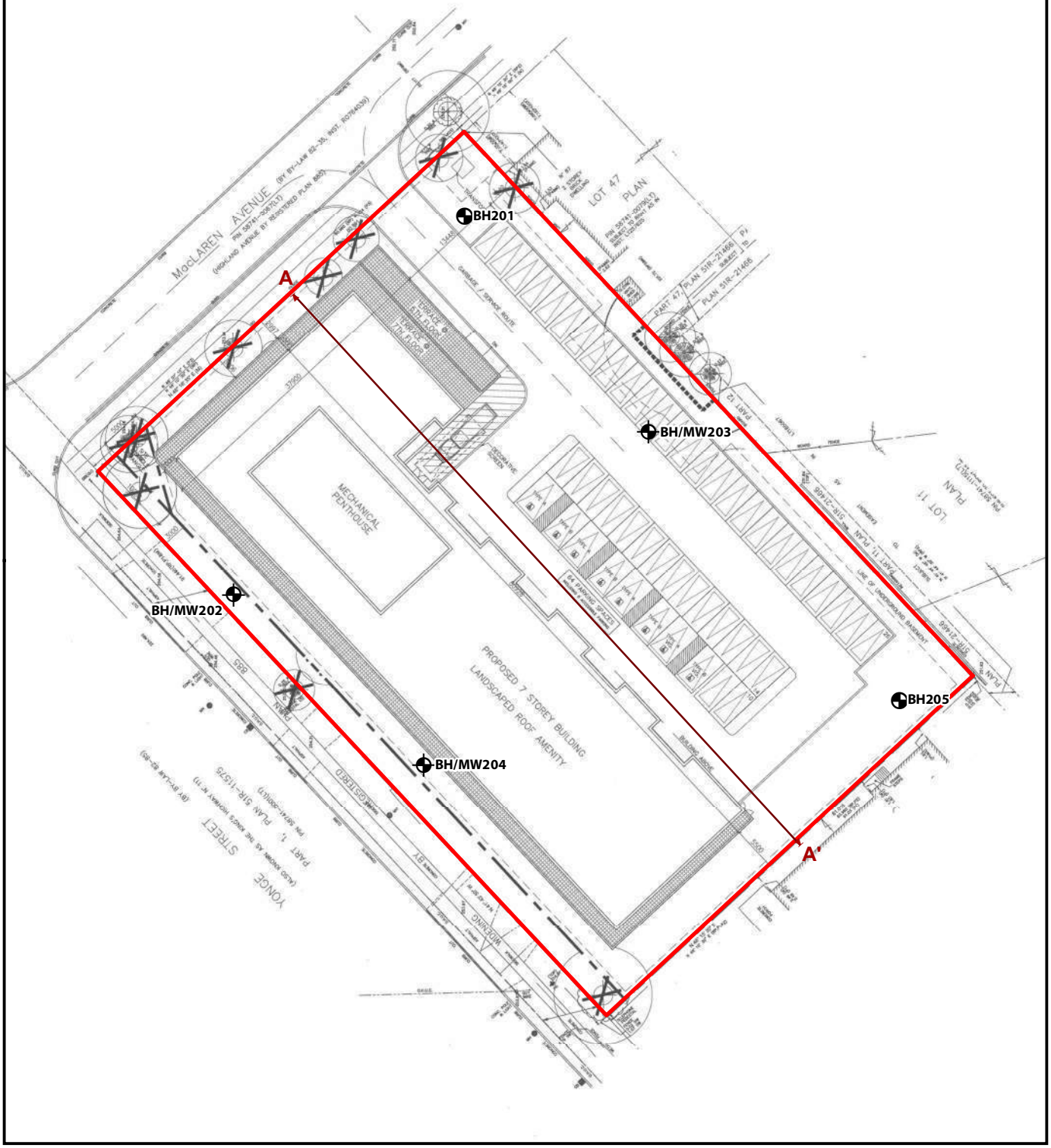
447-455 Yonge Street
Barrie, Ontario

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BOREHOLE LOCATION PLAN (AERIAL)

Project 2200334 | May 2022 | Fig. 2A



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.

Legend

- Site Location
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location
- Cross Section Location

N

0 7 14 m

1:700

447-455 Yonge Street
Barrie, Ontario

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BOREHOLE LOCATION PLAN (PROPOSED SITE PLAN)

Project 2200334 | September 2022 | Fig. 2B



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. LSRCA data from MECP Source Protection Information Atlas Image (Approximate). Accessed March 2022.

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area

Wellhead Protection Areas (LSRCA 2022)

Zone

- B
- C
- D
- Q1
- Q2

N

0 200 400 m

1:20,000

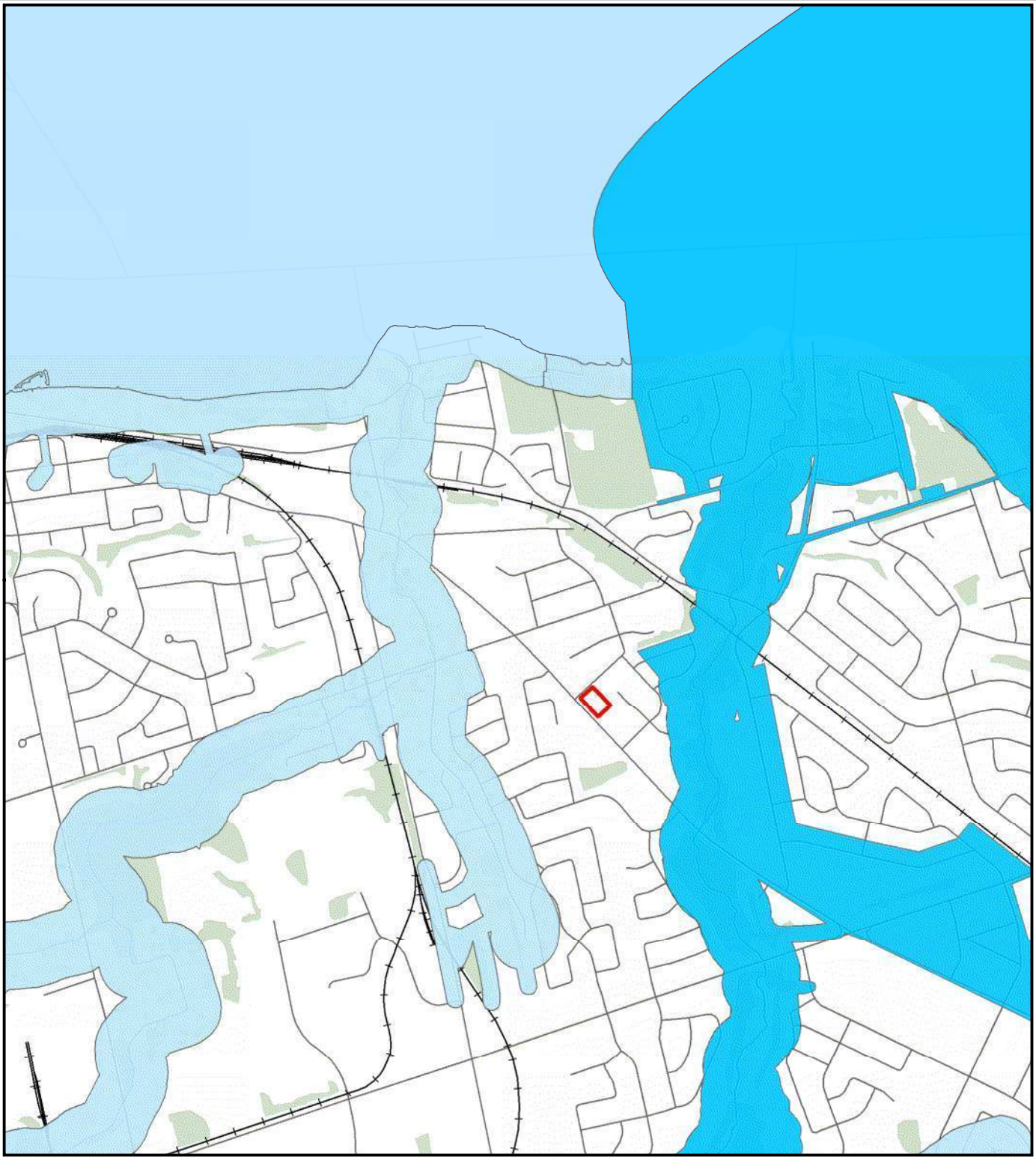
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Barrie, Ontario

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WELLHEAD PROTECTION AREA

Project 2200334 | May 2022 | Fig. 3



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Intake Protection Zones from from LSRCA open data (data.lsrca.on.ca).

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area

Intake Protection Zone (LSRCA 2022)

Zone
- 2
- 3

N

0 200 400 m

1:20,000

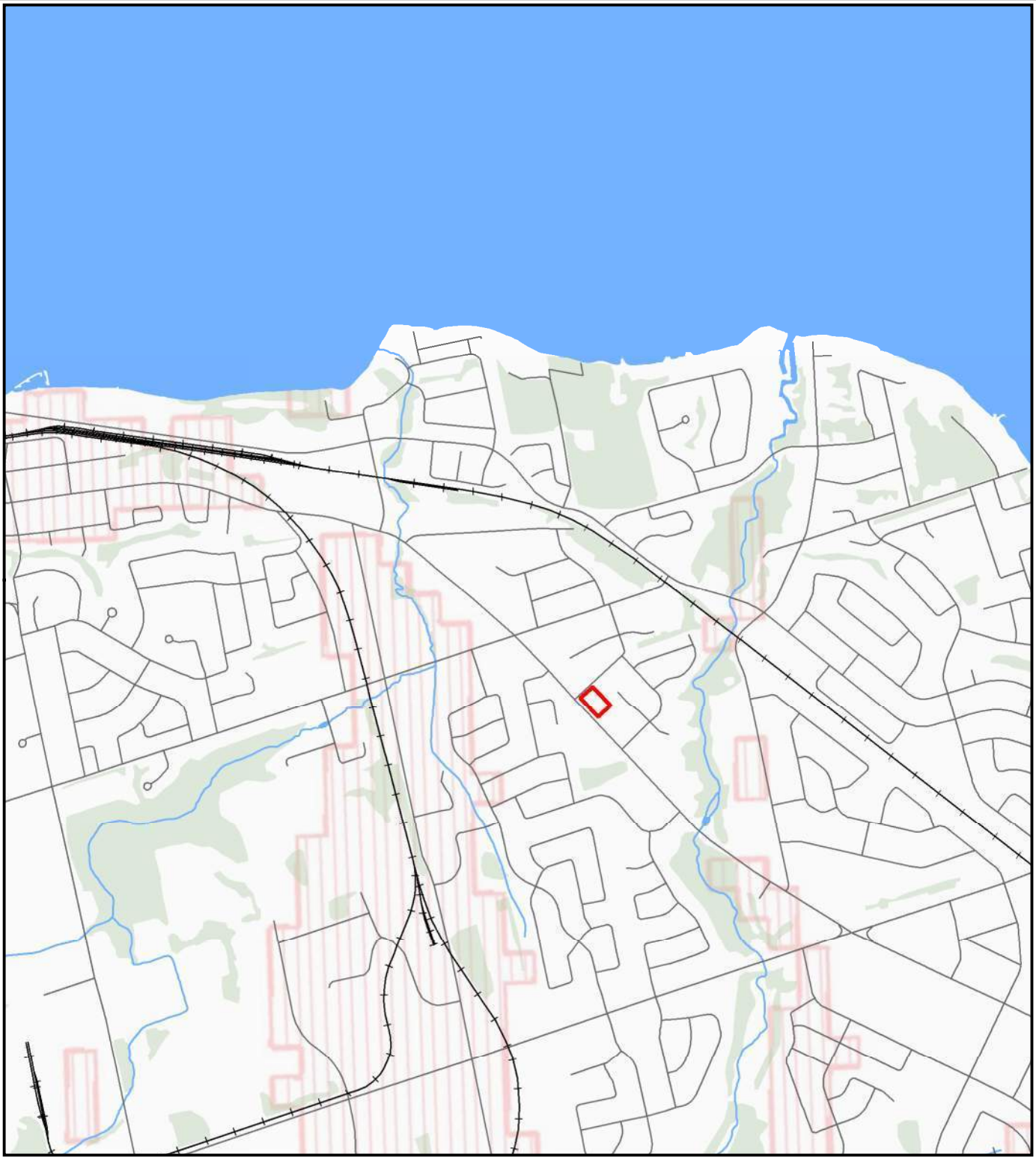
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INTAKE PROTECTION ZONES

Project 2200334 | May 2022 | Fig. 4



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. LSRCA data from MECP Source Protection Information Atlas Image, Approximate. Accessed March 2022.

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area
- Highly Vulnerable Aquifer (LSRCA 2022)

N

0 200 400 m

1:20,000

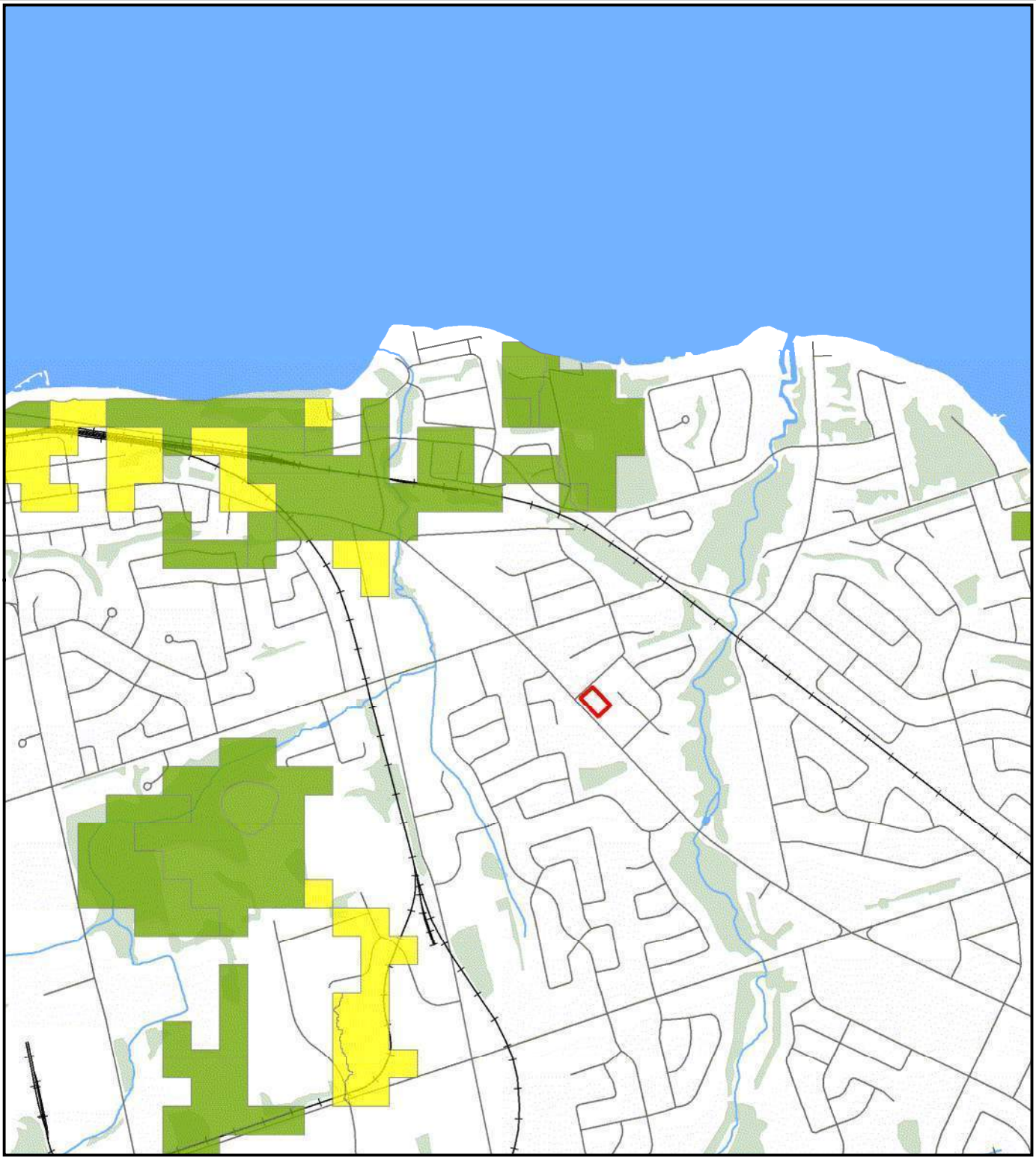
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HIGHLY VULNERABLE AQUIFER

Project 2200334 | May 2022 | Fig. 5



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Significant Groundwater Recharge Areas from LSRCA open data (data.lsrca.on.ca).

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area

Significant Groundwater Recharge Area (LSRCA 2022)

- 2
- 4
- 6

N

0 200 400 m

1:20,000

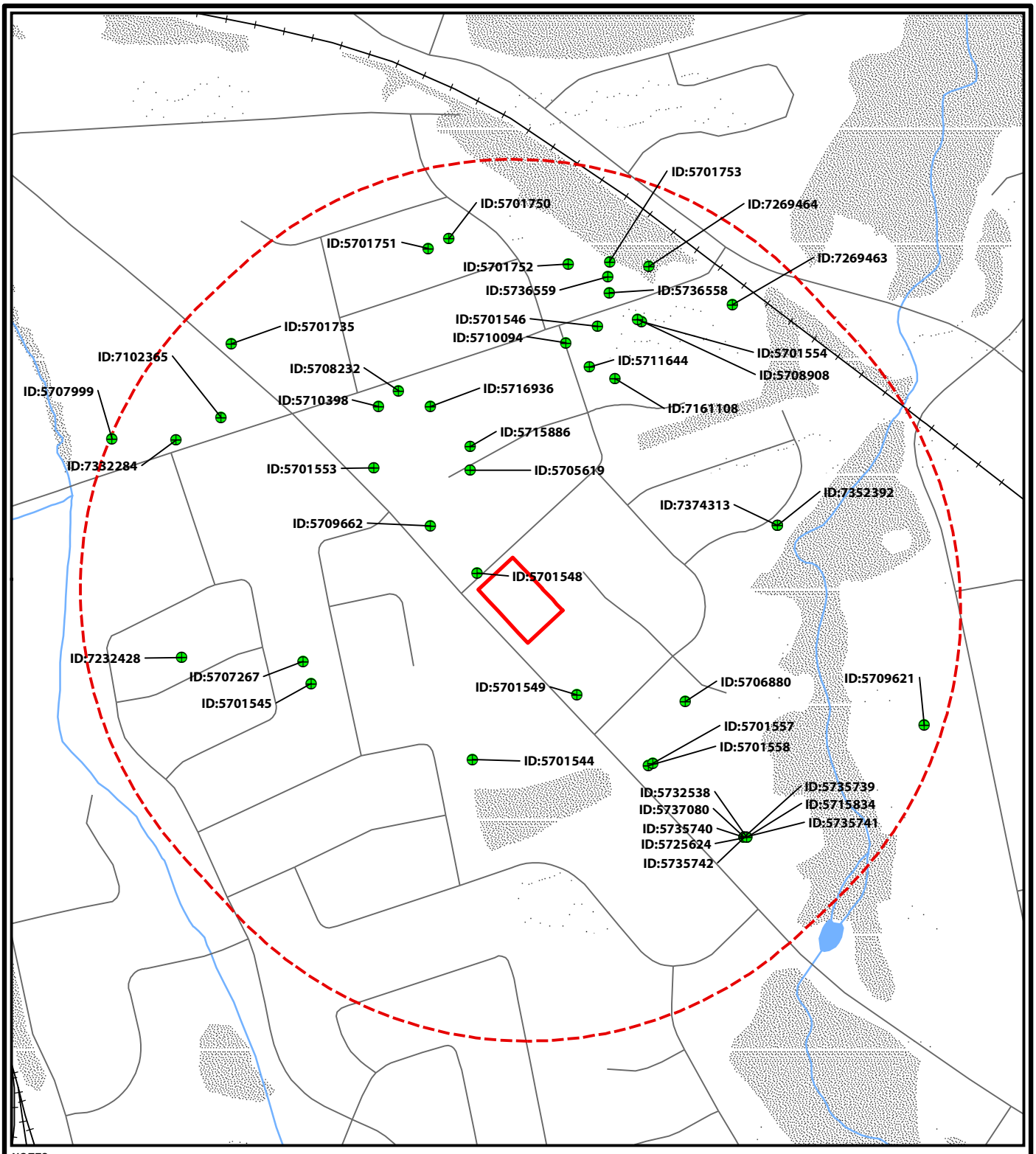
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SIGNIFICANT GROUNDWATER RECHARGE AREAS

Project 2200334 | May 2022 | Fig. 6



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.

Legend

- Site Location
- Site Location +500m
- MECP Well Water Records Within 500m of Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area

N

0 70 140 m

1:7,000

447-455 Yonge Street
Barrie, Ontario

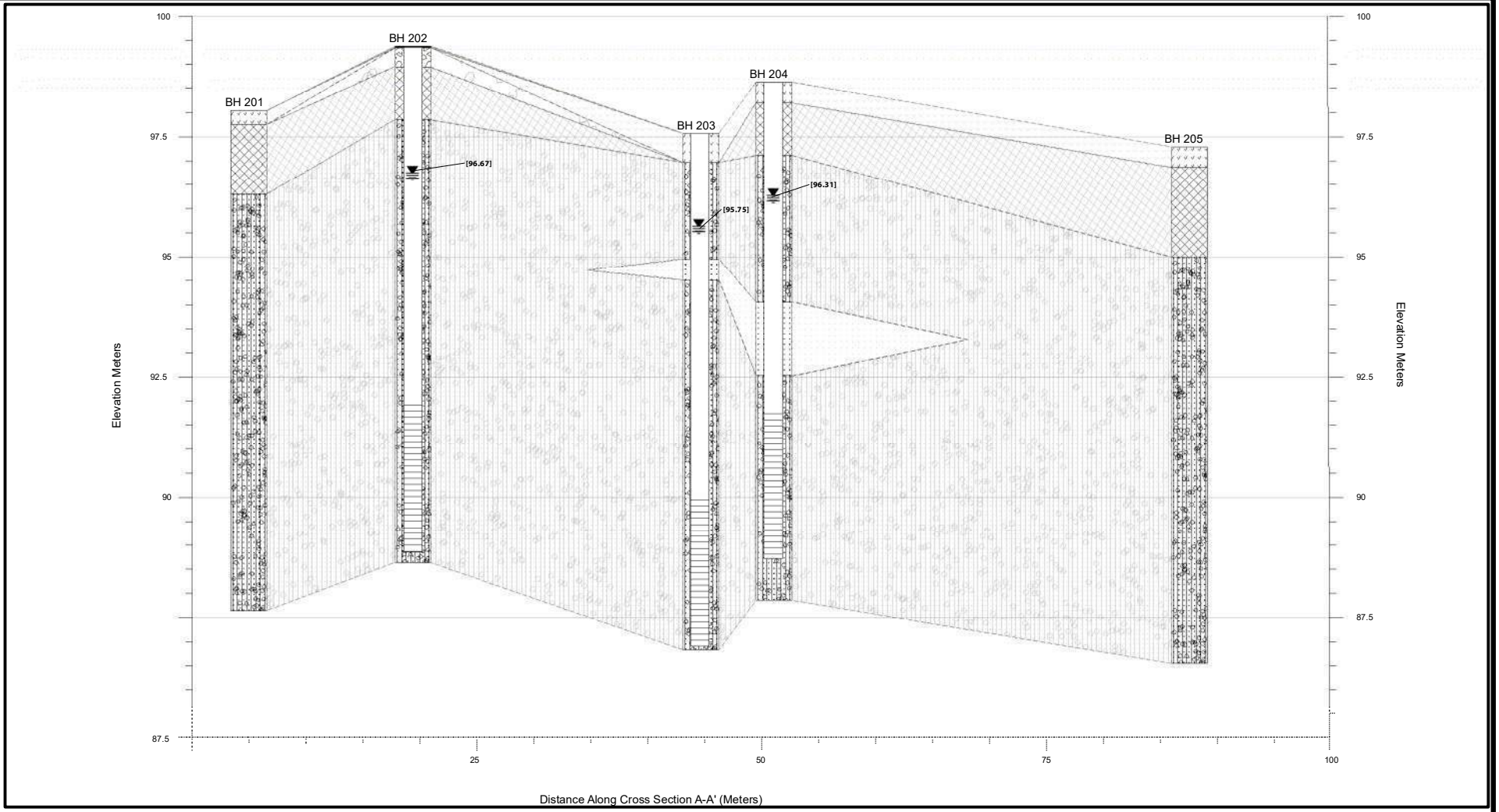
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Project 2200334

MECP WELL RECORD LOCATIONS

May 2022 Fig. 7



Legend

Water Level In Monitoring Well

Strata

Asphalt

Topsoil

Earth Fill

Granular

Silty Sand to Sand and Silt Glacial Till

Sand

[ ] Groundwater level (m bgs), measured February 18, 2022

NOTES:

1. Subsurface conditions known only at borehole locations.
2. Horizontal distances are approximate

447-455 Yonge Street
Barrie, Ontario

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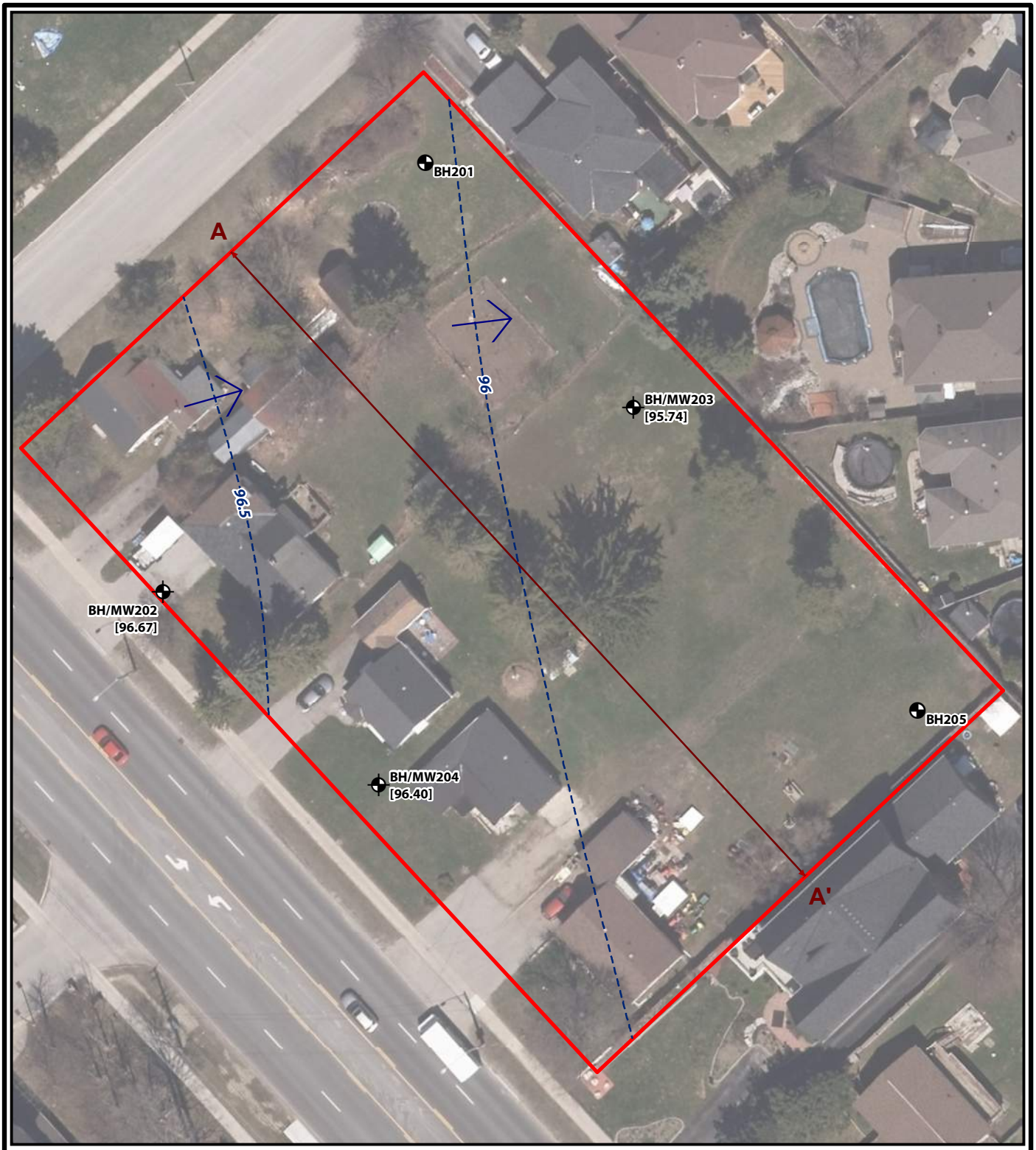
GEI Consultants

GEOLOGICAL CROSS SECTION A-A'

Project 2200334

May 2022

Fig. 8



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Orthoimagery © First Base Solutions, 2022. Imagery taken in 2020.

Legend

- Site Limit
- Cross Section Location
- Groundwater Contour
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location
- [xx.xx] Groundwater Level (m asl) (February 18, 2022)
- Interpreted Direction of Groundwater Flow

N

0 6 12 m

1:600

447-455 Yonge Street
Barrie, Ontario

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GROUNDWATER CONTOUR MAP

Project 2200334 | May 2022 | Fig. 9

Appendix A

MECP Well Record Summary Table

GEI Consultants

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
BARRIE CITY	17 606451 4913460 W	2008/02 7314	1.97	FR 0006		NU	0005 10	7102365 (Z59752) A066226	GREY FILL LOOS 0005 BRWN FILL SNDY 0015 SILT
BARRIE CITY (INNISFI	17 606395 4913431 W	6946						7332284 (C44700) A262885 P	
INNISFIL TOWNSHIP	17 607094 4913601 W	2016/06 7190	4 2	UT 0015 UT 0020		MO	0015 10	7269463 (Z228567) A156734	BRWN LOAM SOFT 0002 BRWN SAND GRVL HARD 0010 GREY SILT SAND GRVL 0020 GREY SILT LYRD 0025
INNISFIL TOWNSHIP	17 606402 4913158 W	2014/08 7360						7232428 (C25999) A167912 P	
INNISFIL TOWNSHIP	17 606946 4913508 W	2011/02 7391	2	UT 0012	20///:	MO	0010 10	7161108 (Z117440) A098195	BLCK HARD 0000 BRWN SAND GRVL DNSE 0002 BRWN SAND STNS DNSE 0005 GREY SAND FSND DNSE 0008 BRWN SAND CSND DNSE 0010 GREY SILT WBRG DNSE 0012 BRWN SILT WBRG DNSE 0020
INNISFIL TOWNSHIP CON 13	17 607150 4913324 W	6946	2			MO	0034 6	7352392 (Z318028) A285740	BRWN CLAY SAND GRVL 0040
INNISFIL TOWNSHIP CON 13 011	17 606554 4913153 W	1970/03 2514	6	FR 0275	73/207/9/1:30	DO	0275 3	5707267 ()	LOAM 0001 BRWN MSND CLAY BLDR 0115 BLUE CLAY 0133 GREY CLAY FSND 0177 GREY CLAY 0230 GREY SILT 0264 GREY CLAY 0275 MSND 0278
INNISFIL TOWNSHIP CON 13 011	17 606767 4913030 W	1962/08 2514	6	FR 0267	85/145/10/6:0	PS	0267 8	5701544 ()	PRDG 0020 MSND GRVL CLAY 0052 BLUE CLAY 0098 GREY FSND CLAY 0250 GREY FSND 0265 MSND 0276
INNISFIL TOWNSHIP CON 13 011	17 606564 4913125 W	1963/05 2514	6	FR 0026	24/37/2/2:30	DO	0026 3	5701545 ()	BRWN CLAY 0019 BRWN CLAY STNS 0024 CSND 0028 BRWN CLAY MSND GRVL 0036 BLUE CLAY 0040
INNISFIL TOWNSHIP CON 13 012	17 606914 4913523 W	1974/09 2514	6 6	FR 0067	58/65/6/1:0	DO		5711644 ()	LOAM DKCL LOOS 0002 GREY CLAY SOFT 0011 GREY HPAN BLDR HARD 0043 GREY CLAY SAND GRVL 0067 YLLW SAND GRVL SILT 0072
INNISFIL TOWNSHIP CON 13 012	17 606884 4913553 W	1973/08 1204	5	FR 0045	40/70/2/1:0	DO	0071 3	5710094 ()	BLCK CLAY 0003 GREY CLAY 0047 GREY GRVL CLAY 0052 GREY SAND GRVL 0077
INNISFIL TOWNSHIP CON 13 012	17 606649 4913473 W	1973/09 2514	6	FR 0094	16/89/7/3:0	DO		5710398 ()	BRWN CLAY SAND BLDR 0043 GREY CLAY GRVL BLDR 0094 GREY SAND GRVL CLAY 0096
INNISFIL TOWNSHIP CON 13 012	17 606974 4913583 W	1972/04 2514	6	FR 0067 FR 0076	39/70/25/1:0	DO	0073 3	5708908 ()	LOAM 0001 BRWN CLAY SAND GRVL 0067 YLLW FSND CSND 0076
INNISFIL TOWNSHIP CON 13 012	17 606674 4913493 W	1971/08 1637	6	FR 0090	74/90/2/3:30	DO		5708232 ()	CLAY LOAM 0012 CLAY STNS 0038 GRVL 0063 HPAN 0090 GRVL STNS CLAY 0096
INNISFIL TOWNSHIP CON 13 012	17 607034 4913103 W	1969/12 4608	30	FR 0007 FR 0014	6/12/3/1:0	DO		5706880 ()	GREY MSND STNS 0014
INNISFIL TOWNSHIP CON 13 012	17 606714 4913323 W	1973/01 1204	5	FR 0073	8/70/1/1:0	DO		5709662 ()	PRDG 0015 GREY CLAY SAND 0073 GREY SAND GRVL CLAY 0075

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
INNISFIL TOWNSHIP CON 13 012	17 606764 4913423 W	1979/01 3135	5	FR 0248	106/132/9/2 :30	CO	0250 4	5715886 ()	LOAM 0001 BRWN CLAY SAND GRVL 0023 GREY CLAY SAND GRVL 0167 GREY CLAY 0228 GREY SILT 0248 GREY FSND 0254
INNISFIL TOWNSHIP CON 13 012	17 606714 4913473 W	1980/05 1222	5	FR 0171	82/153/9/1: 30	DO	0171 3	5716936 ()	BLCK LOAM 0002 BRWN CLAY STNS 0009 BRWN CLAY SAND 0051 GREY CLAY SAND 0083 GREY CLAY SAND SILT 0101 GREY CLAY 0171 GREY FSND 0174
INNISFIL TOWNSHIP CON 13 012	17 606773 4913264 W	1961/02 2514	6	FR 0039	18/56/2/2:0	DO	0041 15	5701548 ()	PRDG 0004 BLUE CLAY 0039 BRWN CLAY MSND GRVL 0056 BLUE CLAY 0132 GREY FSND 0167
INNISFIL TOWNSHIP CON 13 012	17 606643 4913396 W	1965/01 2514	6	FR 0070	44/51/7/2:0	DO		5701553 ()	PRDG 0044 MSND GRVL 0060 MSND CLAY 0069 MSND GRVL 0071
INNISFIL TOWNSHIP CON 13 012	17 606898 4913111 W	1962/12 2514	6	FR 0046	5/44/2/3:30	DO		5701549 ()	LOAM 0001 BRWN CLAY STNS 0020 CLAY MSND 0025 BLUE CLAY GRVL 0046 GRVL 0047
INNISFIL TOWNSHIP CON 13 012	17 606924 4913574 W	1957/09 2514	6	FR 0084	59/71/13/5: 0	DO		5701546 ()	LOAM 0001 BRWN CLAY 0012 BLUE CLAY 0078 MSND GRVL 0084
INNISFIL TOWNSHIP CON 13 012	17 606979 4913580 W	1965/01 2514	6	FR 0066	20/62/4/3:0	DO		5701554 ()	PRDG 0020 BRWN CLAY MSND 0060 MSND GRVL CLAY 0066 MSND GRVL 0070
INNISFIL TOWNSHIP CON 13 012	17 606988 4913022 W	1967/09 4608	30	FR 0010	5//2/:	DO		5701558 ()	LOAM 0001 FILL 0003 BRWN CLAY STNS 0017
INNISFIL TOWNSHIP CON 13 012	17 606993 4913025 W	1966/10 4608	30	FR 0010	10//2/:	CO		5701557 ()	BRWN CLAY MSND STNS 0020
INNISFIL TOWNSHIP CON 13 012	17 606764 4913393 W	1968/06 2514	6	FR 0256	70/193/18/2 :30	DO	0256 8	5705619 ()	LOAM 0001 BRWN CLAY MSND BLDR 0014 BLUE CLAY MSND BLDR 0080 BLUE CLAY 0240 GREY CLAY FSND 0256 FSND MSND 0264
INNISFIL TOWNSHIP CON 14 011	17 606434 4913712 W	2016/02 7215	2				0006 10	7266838 (Z229920) A202941	BRWN SILT 0016
INNISFIL TOWNSHIP CON 14 011	17 606314 4913433 W	1971/04 3203	5	FR 0089	25/70/6/1:3 0	DO	0108 3	5707999 ()	BRWN LOAM 0001 BRWN MSND 0012 GREY CLAY MSND 0046 GREY CLAY 0089 GREY FSND 0111
INNISFIL TOWNSHIP CON 14 011	17 606464 4913552 W	1959/03 1637	4	FR 0215	47/125/1/:	DO		5701735 ()	BRWN CLAY 0018 BLDR CLAY 0028 GRVL CLAY 0074 CLAY 0090 QSND CLAY 0213 MSND GRVL 0215
INNISFIL TOWNSHIP CON 14 011	17 606397 4913623 W	1962/06 4102	30	FR 0012	12//2/:	DO		5701737 ()	MSND 0020
INNISFIL TOWNSHIP CON 14 012	17 606989 4913649 W	2016/06 7190	4 2			MO	0015 10	7269464 (Z213658) A156738	BRWN LOAM SOFT 0003 BRWN SILT SAND HARD 0015 GREY SILT SAND HARD 0025
INNISFIL TOWNSHIP CON 14 012	17 606937 4913636 W	2001/10 2801				NU		5736559 (232027) A	

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
INNISFIL TOWNSHIP CON 14 012	17 606939 4913616 W	2001/10 2801				NU		5736558 (232028) A	
INNISFIL TOWNSHIP CON 14 012	17 606814 4913823 W	1978/10 2801						5715729 ()	BRWN CLAY BLDR GRVL 0063 GREY CLAY GRVL 0171 GREY GRVL SAND CLAY 0191 GREY SAND GRVL CLAY 0220 GREY SAND GRVL LMSN 0232 GREY GRVL SAND CLAY 0290 GREY CLAY SAND GRVL 0394
INNISFIL TOWNSHIP CON 14 012	17 606737 4913684 W	1959/05 2801	5					5701750 ()	LOAM 0001 MSND SILT 0008 MSND GRVL BLDR 0034 BLDR 0036
INNISFIL TOWNSHIP CON 14 012	17 606656 4913798 W	1966/09 4608	30	FR 0022	22//2/:	DO		5701754 ()	GRVL 0002 BRWN CLAY STNS 0032
INNISFIL TOWNSHIP CON 14 012	17 606939 4913655 W	1966/03 2514	6	FR 0060	46/58/20/2: 0	DO	0063 4 0067 3	5701753 ()	LOAM 0002 CLAY MSND BLDR 0060 YLLW CSND 0070
INNISFIL TOWNSHIP CON 14 012	17 606711 4913672 W	1959/05 2801	5					5701751 ()	LOAM 0001 MSND SILT 0008 MSND GRVL BLDR 0036 CLAY GRVL BLDR 0083 BLUE CLAY GRVL BLDR 0153 BLUE CLAY 0281 CLAY MSND 0311 BLUE CLAY GRVL 0334 BLUE CLAY GRVL BLDR 0346 LMSN 0347
INNISFIL TOWNSHIP CON 14 012	17 606887 4913652 W	1965/04 2514	6	FR 0057	49/62/40/48 :0	DO	0058 3 0061 3	5701752 ()	LOAM 0001 BRWN CLAY STNS 0018 BRWN CLAY MSND GRVL 0057 CSND GRVL 0065 BLUE CLAY 0099

Appendix B

Borehole Logs

RECORD OF BOREHOLE No. 201

Project Number:	**2200334**						
Project Client:	**Barrie Yonge Developments GP Inc.**						
Project Name:	**447 - 455 Yonge Street**	Drilling Method:	**Solid stems**	Drilling Machine:	**CME 85, buggy**		
Project Location:	**Barrie, Ontario**	Logged By:	**SP**	Northing:	**4913274**	Date Started:	**Feb 3/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By:	**AB**	Easting:	**606818**	Date Completed:	**Feb 3/22**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	GR	SA	SI	CL
	Local 98.05 m										
	0.3 97.8 TOPSOIL: 300 mm	SS	1	75	7	0	97.5				
	EARTH FILL: sandy silt, trace to some clay, trace gravel, moist, brown loose	SS	2	100	7	1.5	96				
	1.8 96.3	SS	3	100	5						
	WEATHERED: trace organics, trace gravel, wet, loose 2.3 95.8	SS	4	100	52	3	94.5	16	55	24	5
	SILTY SAND to SAND & SILT GLACIAL TILL: trace to some gravel, trace to some clay, brown, moist, very dense	SS	5	100	84	4.5	93				
		SS	6	100	100+	6	91.5				
	- - - grey - - -	SS	7	100	100+	7.5	90				
		SS	8	100	100+	9	88.5				
		SS	9	100	100+						
	10.4 87.6	SS	10	100	100+						
	Borehole terminated 10.4 m										

FIELD TESTING: Shear Strength Testing (kPa) — Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); Penetration Testing — SPT; DCPT

LAB TESTING: Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits — PL; LL; Water Content (%)

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Augers grinding

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647 Welham Road, Unit 14
Barrie, Ontario L4N 0B8
T : (705) 719-7994
www.geiconsultants.com

Groundwater depth encountered on completion of drilling: **2.4 m**

Cave depth after auger removal: **4.9 m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 202

Project Number:	**2200334**						
Project Client:	**Barrie Yonge Developments GP Inc.**						
Project Name:	**447 - 455 Yonge Street**	Drilling Method:	**Solid Stems**	Drilling Machine:	**CME 85, buggy**		
Project Location:	**Barrie, Ontario**	Logged By:	**SP**	Northing:	**4913227**	Date Started:	**Feb 4/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By:	**AB**	Easting:	**606789**	Date Completed:	**Feb 4/22**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	Local 99.38 m						
	0.0 99.2 PAVEMENT: 50mm asphalt, 100mm granular 0.4 98.9	SS	1	100	48	0	99
	TOPSOIL: 300 mm						
	EARTH FILL: sandy silt, trace to some clay, trace gravel, trace organics, dark brown to brown, moist, loose 1.5 97.9	SS	2	100	8	1.5	97.5
	SANDY SILT to SAND & SILT GLACIAL TILL: trace to some clay, trace gravel, brown, moist to wet, compact	SS	3	100	21		
	- - - very dense, moist - - -	SS	4	45	54	3	96
		SS	5	50	52		
		SS	6	100	100+	4.5	94.5
		SS	7	100	100+	6	93
		SS	8	100	100+	7.5	91.5
	- - - grey - - -	SS	9	100	100+	9	90
	10.7 88.6 Borehole terminated at 10.7 m	SS	10	100	100+	10.5	

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test; + Pocket Penetrometer; ▲ Field Vane (Intact); △ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
✳ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ○ Water Content (%) LL
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
13	43	35	9

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T : (705) 719-7994
www.geiconsultants.com

Groundwater depth encountered on completion of drilling:

Cave depth after auger removal:

Groundwater depth observed on **Feb 18/22** at a depth of: **2.71m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 203

Project Number:	**2200334**				
Project Client:	**Barrie Yonge Developments GP Inc.**				
Project Name:	**447 - 455 Yonge Street**	Drilling Method: **Solid Stems**		Drilling Machine:	**CME 85, buggy**
Project Location:	**Barrie, Ontario**	Logged By: **SP**	Northing: **4913248**	Date Started:	**Feb 3/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By: **AB**	Easting: **606840**	Date Completed:	**Feb 3/22**

Depth (m)	Elevation (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Field Testing (SPT / DCPT)	Lab Testing (Combustible Organic Vapour (ppm) / Water Content (%))	GR	SA	SI	CL
0	97.5	Local 97.57 m										
0.2	97.4	TOPSOIL: 200 mm										
		SILTY SAND to SAND & SILT GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist, loose to compact	SS	1	100	5	5	18				
			SS	2	100	13	13	13				
1.5	96	- - - wet - - -	SS	3	100	9	9	13				
2.6	95.0		SS	4	100	28	28	15				
3.1	94.5	SAND: some silt, trace gravel, brown, wet, compact										
3	94.5	SANDY SILT to SILT & SAND GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist to wet, very dense	SS	5	90	69	69 →	14				
4.5	93	- - - grey, moist - - -	SS	6	100	50	50	7				
6	91.5		SS	7	100	100+	100+ →	7				
7.5	90		SS	8	100	100+	100+ →	8				
9	88.5		SS	9	100	100+	100+ →	8	8	49	34	9
10.5	87		SS	10	100	100+	100+ →	8				
10.7	86.8	Borehole terminated at 10.7 m										

Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160

Penetration Testing: SPT ○ DCPT ● 10 20 30 40

Combustible Organic Vapour (ppm) △; Combustible Organic Vapour (%LEL) ▲; Total Organic Vapour (ppm) ✳; 100 200 300 400

Atterberg Limits: PL — LL; Water Content (%) ○ 10 20 30 40

Instrumentation Installation: Groundwater depth observed on Feb 18/22 at a depth of: 1.83m

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Barrie, Ontario L4N 0B8
T : (705) 719-7994
www.geiconsultants.com

Groundwater depth encountered on completion of drilling:

Cave depth after auger removal:

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 204

Project Number:	**2200334**						
Project Client:	**Barrie Yonge Developments GP Inc.**						
Project Name:	**447 - 455 Yonge Street**	Drilling Method:	**Solid stems**	Drilling Machine:	**CME85, buggy**		
Project Location:	**Barrie, Ontario**	Logged By:	**SP**	Northing:	**4913207**	Date Started:	**Feb 4/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By:	**AB**	Easting:	**606813**	Date Completed:	**Feb 4/22**

GEI Consultants

Lithology Plot	DESCRIPTION (Local 98.63 m)	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing SPT/DCPT)	LAB TESTING (Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits PL–LL; Water Content (%))	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	TOPSOIL: 450 mm (0.4 / 98.2)	SS	1	80	6	0								
	EARTH FILL: silty sand, trace to some clay, trace organics, brown, moist to wet, loose (1.5 / 97.1)	SS	2	100	5	1.5	97.5							
	SILTY SAND to SAND & SILT GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist to wet, compact	SS	3	75	13									
	- - - dense - - -	SS	4	100	36	3	96							
	- - - very dense - - -	SS	5	100	58		94.5							
	(4.6 / 94.1) SAND: trace silt, brown, wet, very dense	SS	6	100	100+	4.5	93							
	(6.1 / 92.5) SANDY SILT to SILT & SAND GLACIAL TILL: trace to some clay, trace to some gravel, grey, moist to wet, very dense	SS	7	100	100+	6	91.5							
		SS	8	90	100+	7.5	90				4	44	39	13
	- - - moist - - -	SS	9	100	100+	9	88.5							
	(10.8 / 87.9) Borehole terminated at 10.8 m	SS	10	100	100+	10.5								

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Barrie, Ontario L4N 0B8
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Groundwater depth encountered on completion of drilling:

Cave depth after auger removal:

Groundwater depth observed on **Feb 18/22** at a depth of: **2.32m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

RECORD OF BOREHOLE No. 205

GEI Consultants

Project Number:	**2200334**				
Project Client:	**Barrie Yonge Developments GP Inc.**				
Project Name:	**447 - 455 Yonge Street**	Drilling Method: **Solid Stems**		Drilling Machine:	**CME 85, Buggy**
Project Location:	**Barrie, Ontario**	Logged By: **SP**	Northing: **4913215**	Date Started:	**Feb 2/22**
Drilling Location:	**Refer to borehole location plan**	Reviewed By: **AB**	Easting: **606871**	Date Completed:	**Feb 2/22**

Lithology Plot	DESCRIPTION (Local 97.29 m)	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	GR	SA	SI	CL	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	TOPSOIL: 450 mm (0.4 / 96.9)	SS	1	100	11	0						
	EARTH FILL: sand and silt, trace to some clay, trace to some gravel, trace organics, brown, moist, compact	SS	2	90	14	1.5	96	11	44	37	8	
	(2.3 / 95.0)	SS	3	100	14							
	SILTY SAND to SAND AND SILT GLACIAL TILL: trace to some clay, trace to some gravel, brown, moist, dense	SS	4	100	49	3	94.5					
	- - - very dense - - -	SS	5	100	79	4.5	93					
		SS	6	100	100+	6	91.5					
	- - - grey - - -	SS	7	100	100+	7.5	90					Auger grinding
		SS	8	100	100+	9	88.5					
		SS	9	100	100+	10.5	87					
	(10.7 / 86.6)	SS	10	100	100+							
	Borehole terminated at 10.7 m											

FIELD TESTING — Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160. Penetration Testing: SPT, DCPT; 10 20 30 40.

LAB TESTING — Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL, LL, Water Content (%); 10 20 30 40.

Instrumentation Installation

GEI CONSULTANTS

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T : (705) 719-7994
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Groundwater depth encountered on completion of drilling: **5.2 m**

Cave depth after auger removal: **7.6 m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

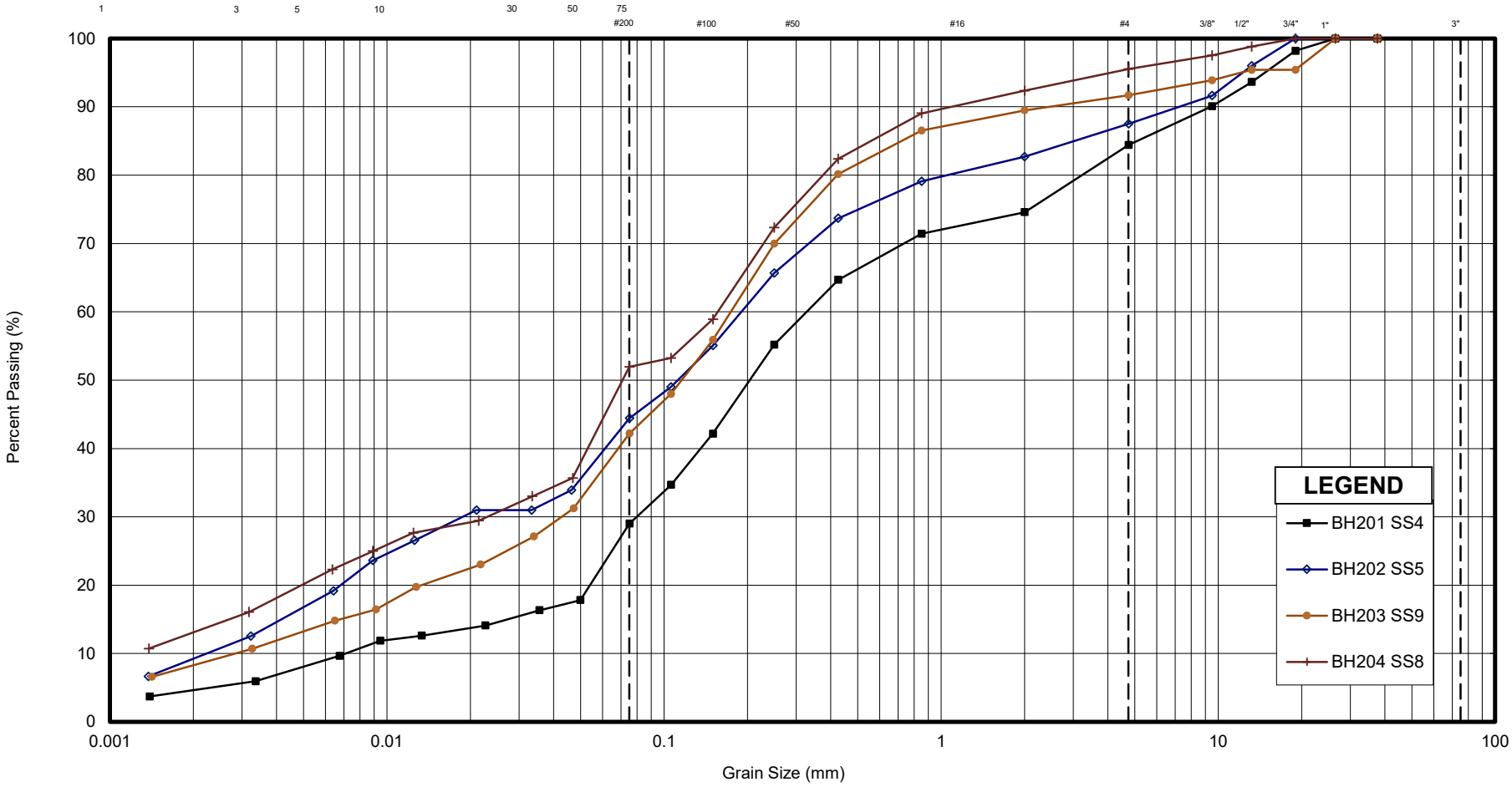
Appendix C

Geotechnical Laboratory Results

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS — SIEVE DESIGNATION (IMPERIAL)



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH201 SS4	SILTY SAND GLACIAL TILL, Some Gravel, Trace Clay	16	55	24	5	0.007	0.080	0.327	46.7	2.8
BH202 SS5	SAND AND SILT GLACIAL TILL, Some Gravel, Trace Clay	13	43	35	9	0.002	0.019	0.190	95.0	1.0
BH203 SS9	SILTY SAND GLACIAL TILL, Trace Clay, Trace Gravel	8	49	34	9	0.003	0.043	0.174	58.0	3.5
BH204 SS8	SAND AND SILT GLACIAL TILL, Some Clay, Trace Gravel	4	44	39	13	-	0.023	0.156	-	-

GEI Consultants

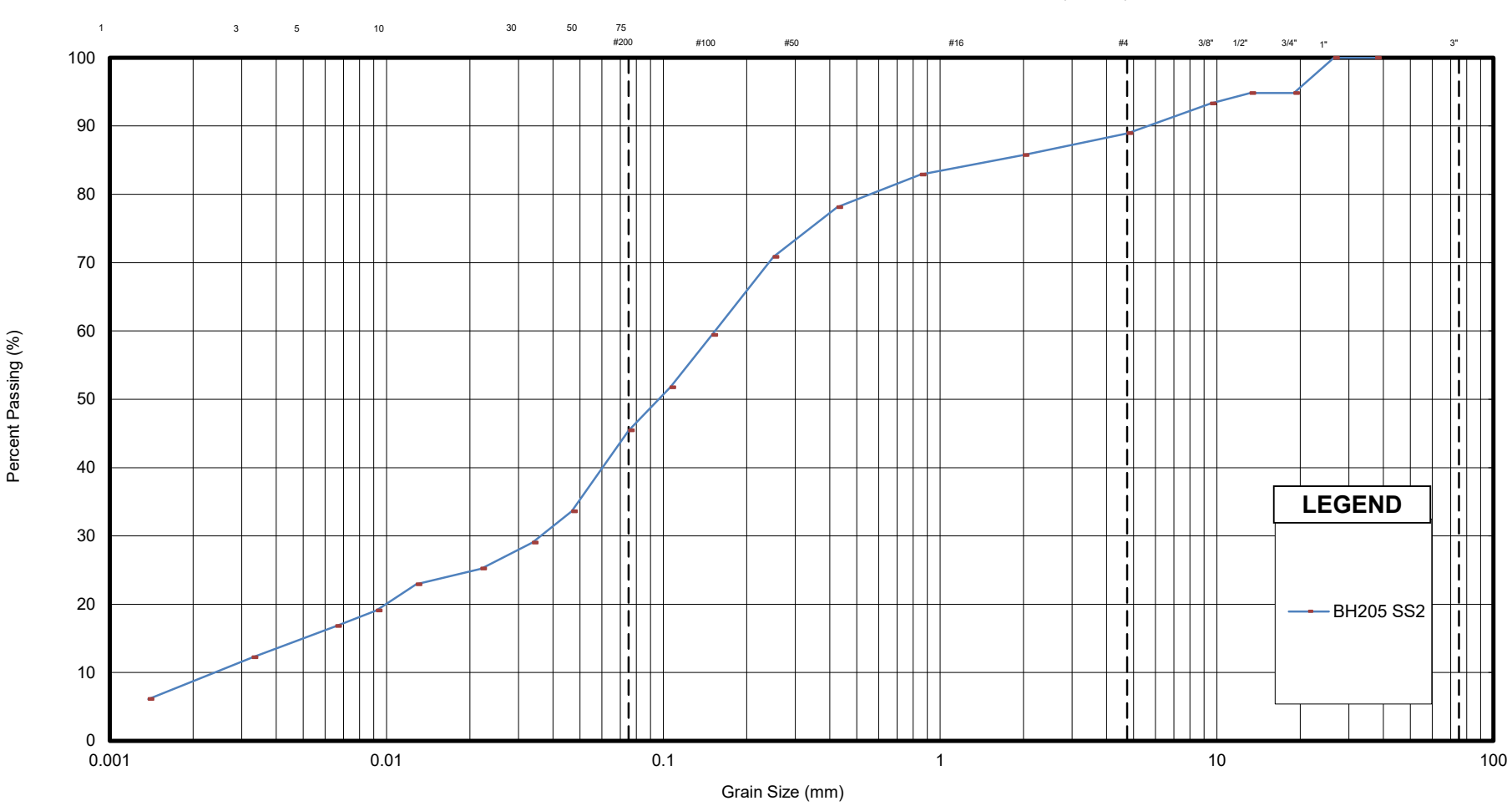
GRAIN SIZE DISTRIBUTION - 447 to 455 Yonge Street, Barrie

SILTY SAND TO SAND AND SILT GLACIAL TILL

FIGURE No.	BH 201-204 Graph
REF. No.	2200334
DATE	April 2022

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH205 SS2	EARTH FILL: Sand and Silt, Some Gravel, Trace Clay	11	44	37	8	0.002	0.036	0.154	77.0	4.2

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GRAIN SIZE DISTRIBUTION - 447 to 455 Yonge Street, Barrie

EARTH FILL (RE-WORKED GLACIAL TILL)

FIGURE No.	BH 205 Graph
REF. No.	2200334
DATE	April 2022

Appendix D

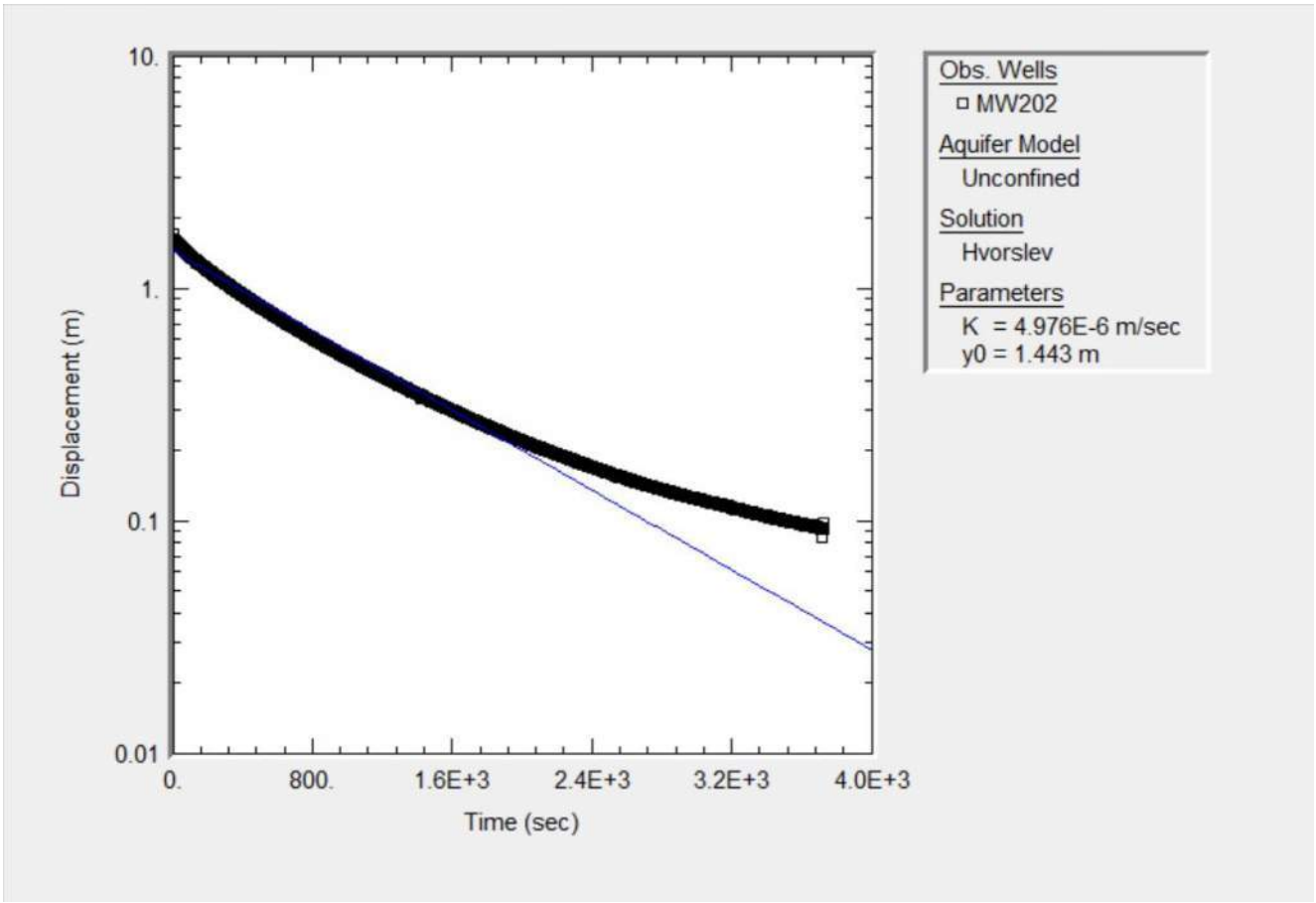
Rising Head Test Results

GEI Consultants

Estimation of K by Slug Test, based on Horslev equation

Date:	February 18, 2022
Conducted by:	S. Patrick

Well Number:	BH/MW202	
Well Screen Bottom:	10.60	mbgs
Top of Pipe:	0.10	mbgs
Well Casing Diameter:	5.08	cm
Well Elevation:	99.38	mbgs
Static Water Level:	2.62	mbgs
$K = r^2\ln(L/R)/(2LTo)$ =	**$5.0x10^{-6}$**	m/s

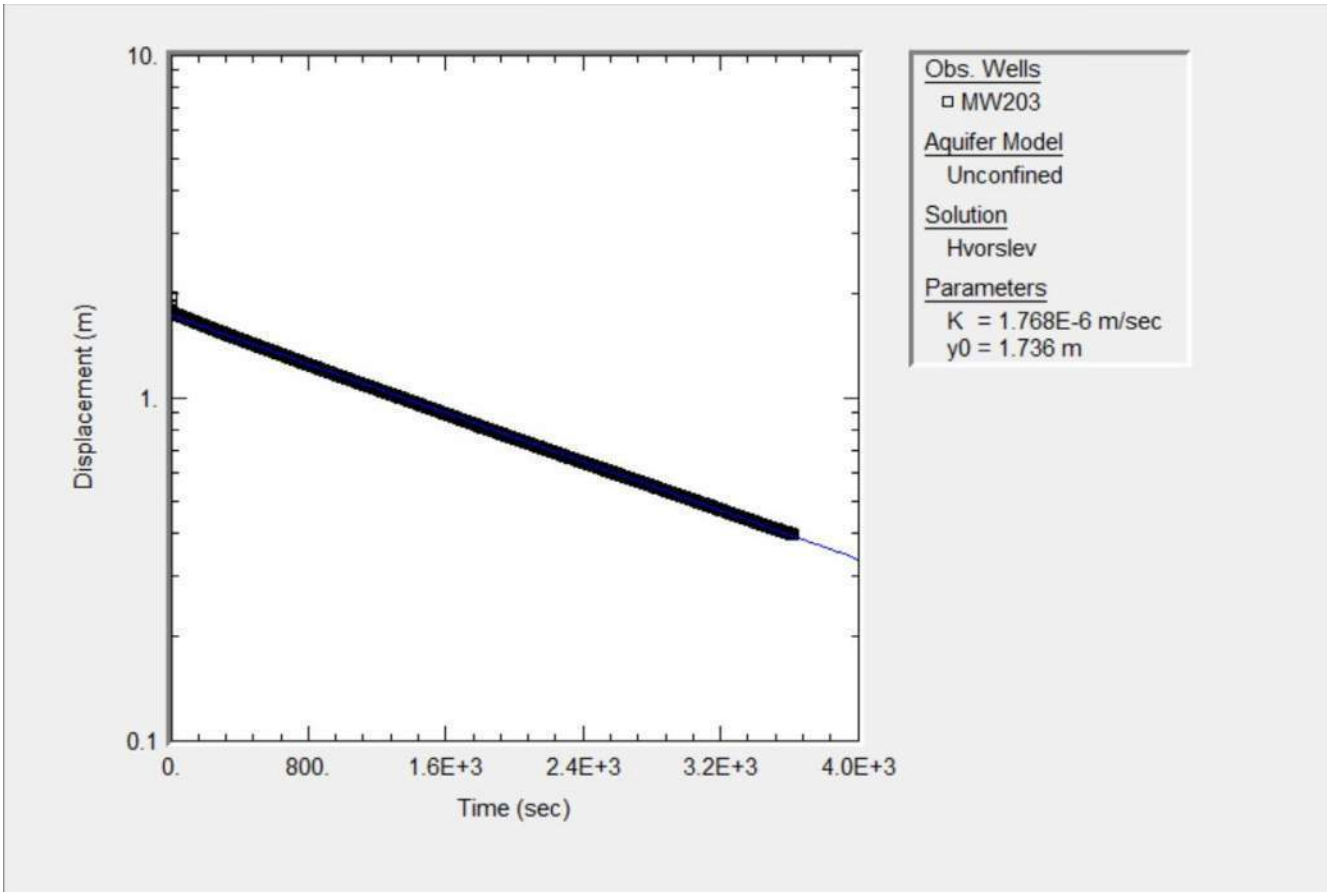


GEI Consultants

Estimation of K by Slug Test, based on Horslev equation

Date:	February 18, 2022
Conducted by:	S. Patrick

Well Number:	BH/MW203	
Well Screen Bottom:	10.60	mbgs
Top of Pipe:	0.86	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	97.57	mbgs
Static Water Level:	2.69	mbgs
$K = r^2\ln(L/R)/(2LTo)$ =	**$1.8x10^{-6}$**	m/s

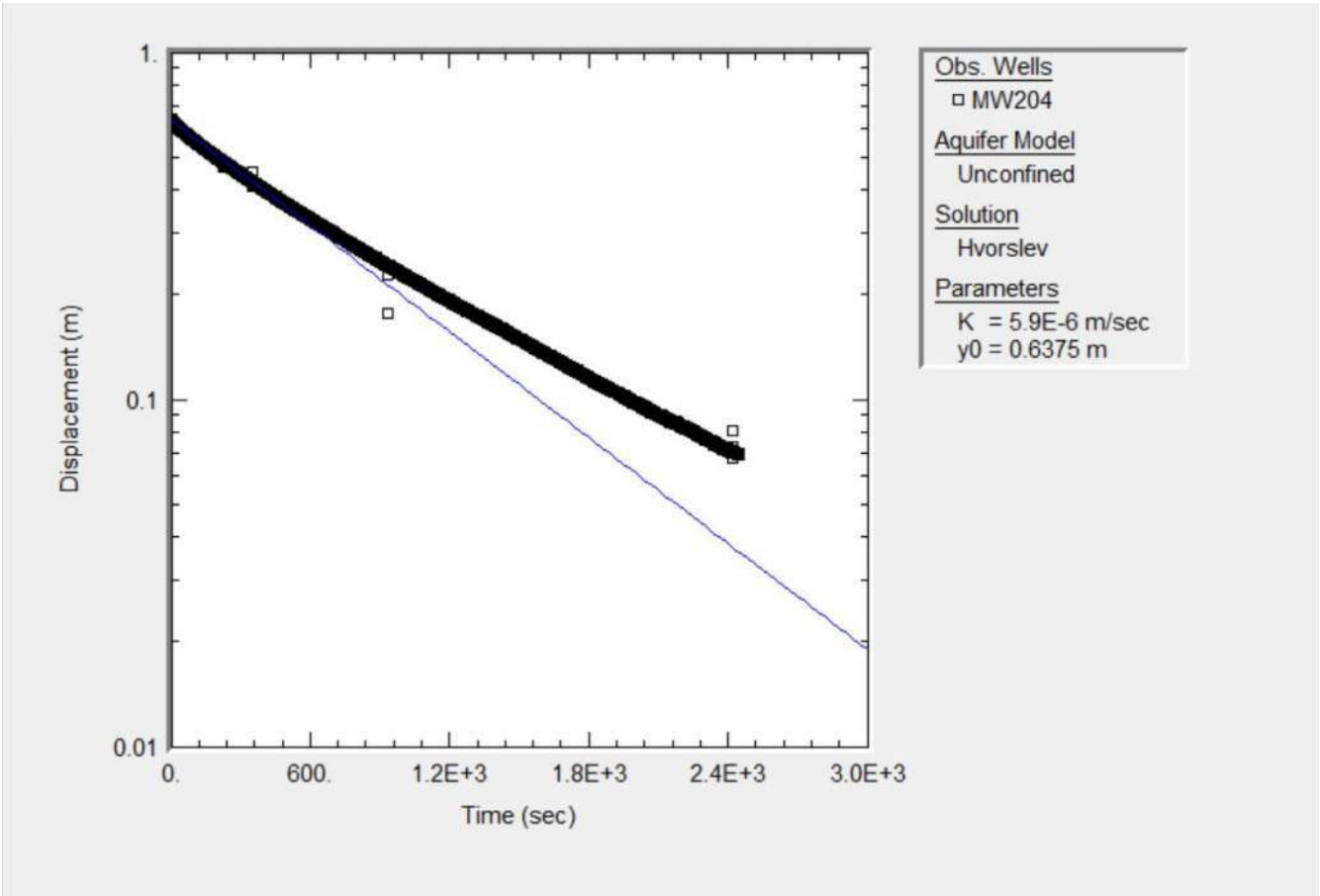


GEI Consultants

Estimation of K by Slug Test, based on Horslev equation

Date:	February 18, 2022
Conducted by:	S. Patrick

Well Number:	BH/MW204	
Well Screen Bottom:	10.60	mbgs
Top of Pipe:	0.88	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	98.63	mbgs
Static Water Level:	3.20	mbgs
$K = r^2\ln(L/R)/(2LTo)$ =	**$5.9x10^{-6}$**	m/s



Appendix E

Groundwater Chemistry Certificates of Analysis

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G104295 **REPORT No. B22-04523 (i)**

Report To:

GEI Consultants
647 Welham Rd, Unit 14,
Barrie ON L4N 0B7 Canada
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 16-Feb-22
DATE REPORTED: 23-Feb-22
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:

P.O. NUMBER: 2200334
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
Cyanide	1	Kingston	kwe	23-Feb-22	A-CN-001 (k)	SM 4500CN
A - Wet Chem	1	Kingston	TK	17-Feb-22	A-COD K	SM5220C
Anions	1	Holly Lane	pcu	18-Feb-22	A-IC-01 (o)	SM4110C
pH	1	Holly Lane	SYL	17-Feb-22	A-PH-01 (o)	SM 4500H
Sulphide	1	Kingston	TK	17-Feb-22	A-S2	SM4500-S2
A - Wet Chem	1	Kingston	ach	17-Feb-22	A-TPTKN-001 (N)(k)	E3516.2
A - Wet Chem	1	Kingston	ach	17-Feb-22	A-TPTKN-001 (P)(k)	E3516.2
Total Suspended Solids	2	Kingston	bbr	17-Feb-22	A-TSS-001 (k)	SM2540D
BOD	1	Kingston	JWF	17-Feb-22	C-BOD-001 (k)	SM 5210B
SVOC	1	Kingston	sge	22-Feb-22	C-NAB-W-001 (k)	EPA 8270
Oil & Grease	1	Kingston	aso	18-Feb-22	C-O&G-001 (k)	SM 5520
Phenolics (4-aap)	1	Kingston	kwe	18-Feb-22	C-PHEN-01 (k)	MOEE 3179
Chromium (VI)	2	Holly Lane	ST	22-Feb-22	D-CRVI-01 (o)	MOE E3056
Mercury	2	Holly Lane	PBK	22-Feb-22	D-HG-02 (o)	SM 3112 B
Metals - ICP-OES	2	Holly Lane	AHM	18-Feb-22	D-ICP-01 (o)	SM 3120
Metals-ICP-MS	2	Holly Lane	TPR	23-Feb-22	D-ICPMS Dissolved 7800	EPA 200.8
Metals - ICP-MS	2	Holly Lane	TPR	18-Feb-22	D-ICPMS-01 (o)	EPA 200.8

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines



Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G104295 **REPORT No. B22-04523 (i)**

Report To:

GEI Consultants
647 Welham Rd, Unit 14,
Barrie ON L4N 0B7 Canada
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 16-Feb-22
DATE REPORTED: 23-Feb-22
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.		MW202	MW202 - F			Barrie Sanitary	
	Sample I.D.		B22-04523-1	B22-04523-2			Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		15-Feb-22	15-Feb-22				
Parameter	**Units**	**R.L.**						
pH @25°C	pH Units		7.77				9.5	9.5
BOD(5 day)	mg/L	3	< 3				300	15
COD	mg/L	5	< 5				600	
Total Kjeldahl Nitrogen	mg/L	0.1	0.3				100	
Total Suspended Solids	mg/L	3	120	4			350	15
Oil and Grease-Mineral	mg/L	1.0	< 1.0				15	
Oil and Grease-Anim/Veg.	mg/L	1.0	< 1.0				150	
Phosphorus-Total	mg/L	0.01	0.10				10	
Cyanide (Total)	mg/L	0.005	< 0.005				1.2	
Chloride	mg/L	0.5	114				1500	
Fluoride	mg/L	0.1	< 0.1				10	
Sulphate	mg/L	1	50				1500	
Aluminum (total)	mg/L	0.01	0.61	0.07			50	
Antimony	mg/L	0.0001	0.0003	0.0004			5.0	
Arsenic	mg/L	0.0001	0.0002	0.0002			1.0	
Barium	mg/L	0.001	0.124	0.116			5.0	
Beryllium	mg/L	0.002	< 0.002	< 0.002				
Boron	mg/L	0.005	0.059	0.062				
Bismuth	mg/L	0.02	< 0.02	< 0.02			5.0	
Cadmium	mg/L	0.000015	< 0.000015	< 0.000015			0.7	0.001
Chromium	mg/L	0.001	0.001	< 0.001			2.0	0.08
Chromium (VI)	mg/L	0.001	< 0.001	< 0.001 [1]				
Cobalt	mg/L	0.0001	0.0007	0.0005			5.0	
Copper	mg/L	0.0001	0.0022	0.0017			2.0	0.01

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G104295 **REPORT No. B22-04523 (i)**

Report To:

GEI Consultants
647 Welham Rd, Unit 14,
Barrie ON L4N 0B7 Canada
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 16-Feb-22
DATE REPORTED: 23-Feb-22
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.		MW202	MW202 - F			Barrie Sanitary	
	Sample I.D.		B22-04523-1	B22-04523-2			Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		15-Feb-22	15-Feb-22				
Parameter	**Units**	**R.L.**						
Gold	mg/L	0.0007	< 0.0007	< 0.0007			5.0	
Hexachlorobenzene	mg/L	0.0001	< 0.0001				0.0001	
Iron	mg/L	0.005	0.989	0.102			50	
Lead	mg/L	0.00002	0.00034	0.00005			0.7	0.05
Manganese (Total)	mg/L	0.001	0.073	0.056			5.0	
Mercury	mg/L	0.00002	0.00003	< 0.00002			0.01	
Molybdenum	mg/L	0.01	< 0.01	< 0.01			5.0	
Nickel	mg/L	0.0002	0.0035	0.0040			2.0	0.05
Total PAH	mg/L	0.0001	< 0.0001				0.005	
Acenaphthene	µg/L	0.05	< 0.05					
Acenaphthylene	µg/L	0.05	< 0.05					
Anthracene	µg/L	0.05	< 0.05					
Benzo(a)anthracene	µg/L	0.05	< 0.05					
Benzo(a)pyrene	µg/L	0.01	< 0.01					
Benzo(b+k)fluoranthene	µg/L	0.1	< 0.1					
Benzo(g,h,i)perylene	µg/L	0.05	< 0.05					
Dibenzo(a,h)anthracene	µg/L	0.05	< 0.05					
Chrysene	µg/L	0.05	< 0.05					
Fluoranthene	µg/L	0.05	< 0.05					
Fluorene	µg/L	0.05	< 0.05					
Indeno(1,2,3,-cd)pyrene	µg/L	0.05	< 0.05					
Methylnaphthalene,1-	µg/L	0.05	< 0.05					
Methylnaphthalene,2-	µg/L	0.05	< 0.05					
Naphthalene	µg/L	0.05	< 0.05					

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines



Christine Burke
Lab Manager

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G104295 **REPORT No. B22-04523 (i)**

Report To:

GEI Consultants
647 Welham Rd, Unit 14,
Barrie ON L4N 0B7 Canada
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 16-Feb-22
DATE REPORTED: 23-Feb-22
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.		MW202	MW202 - F			Barrie Sanitary	
	Sample I.D.		B22-04523-1	B22-04523-2			Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected		15-Feb-22	15-Feb-22				
Parameter	**Units**	**R.L.**						
Phenanthrene	µg/L	0.05	< 0.05					
Pyrene	µg/L	0.05	< 0.05					
Phenolics	mg/L	0.001	< 0.001				0.1	
Platinum	mg/L	0.00004	< 0.00004	< 0.00004			5.0	
Rhodium	mg/L	0.00002	< 0.00002	< 0.00002			5.0	
Selenium	mg/L	0.001	< 0.001	< 0.001			1.0	
Silver	mg/L	0.0001	< 0.0001	< 0.0001			0.4	
Strontium	mg/L	0.001	0.266	0.277				
Sulphide	mg/L	0.01	0.07				1.0	
Thallium	mg/L	0.00005	< 0.00005	< 0.00005				
Tin	mg/L	0.05	< 0.05	< 0.05			5.0	
Titanium	mg/L	0.005	0.050	< 0.005				
Tungsten	mg/L	0.01	< 0.01	< 0.01				
Uranium	mg/L	0.00005	0.00093	0.00085				
Vanadium	mg/L	0.005	< 0.005	< 0.005			5.0	
Zinc	mg/L	0.005	0.007	< 0.005			2.0	0.04
Zirconium	mg/L	0.003	< 0.003	< 0.003				

1 . Chromium (VI)result is based on total Chromium

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines



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Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

Summary of Exceedances

Storm Sewer Guidelines		
MW202	Found Value	Limit
Total Suspended Solids (mg/L)	120	15

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

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JOB/PROJECT NO.:

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WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
Chromium (VI)	2	Holly Lane	ST	22-Feb-22	D-CRVI-01 (o)	MOE E3056
Mercury	2	Holly Lane	PBK	22-Feb-22	D-HG-02 (o)	SM 3112 B
Metals - ICP-OES	2	Holly Lane	AHM	18-Feb-22	D-ICP-01 (o)	SM 3120
Metals - ICP-MS	2	Holly Lane	TPR	18-Feb-22	D-ICPMS-01 (o)	EPA 200.8

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives



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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.		MW202	MW202 - F			PWQO	
	Sample I.D.		B22-04523-1	B22-04523-2			Interim PWQO	PWQO
	Date Collected		15-Feb-22	15-Feb-22				
Parameter	**Units**	**R.L.**						
Aluminum	µg/L	10	**610**	70			75	
Antimony	µg/L	0.1	0.3	0.4			20	
Arsenic	µg/L	0.1	0.2	0.2			5	5
Barium	µg/L	1	124	116				
Beryllium	µg/L	2	< 2	< 2				11
Boron	µg/L	5	59	62			200	
Bismuth	µg/L	20	< 20	< 20				
Cadmium	µg/L	0.015	< 0.015	< 0.015			0.1	0.2
Chromium	µg/L	1	1	< 1				
Chromium (VI)	µg/L	1	< 1	< 1 [1]				1
Cobalt	µg/L	0.1	0.7	0.5			0.9	
Copper	µg/L	0.1	2.2	1.7			5	
Iron	µg/L	5	**989**	102				300
Lead	µg/L	0.02	0.34	0.05			1	5
Manganese (Total)	µg/L	1	73	56				
Mercury	µg/L	0.02	0.03	< 0.02				0.2
Molybdenum	µg/L	10	< 10	< 10			40	
Nickel	µg/L	0.2	3.5	4.0				25
Selenium	µg/L	1	< 1	< 1				100
Silver	µg/L	0.1	< 0.1	< 0.1				0.1
Strontium	µg/L	1	266	277				
Thallium	µg/L	0.05	< 0.05	< 0.05			0.3	0.3
Tin	µg/L	50	< 50	< 50				
Titanium	µg/L	5	50	< 5				

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives



Christine Burke
Lab Manager

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DATE RECEIVED: 16-Feb-22
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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.		MW202	MW202 - F			PWQO	
	Sample I.D.		B22-04523-1	B22-04523-2			Interim PWQO	PWQO
	Date Collected		15-Feb-22	15-Feb-22				
Parameter	**Units**	**R.L.**						
Tungsten	µg/L	10	< 10	< 10			30	
Uranium	µg/L	0.05	0.93	0.85			5	
Vanadium	µg/L	5	< 5	< 5			6	
Zinc	µg/L	5	7	< 5			20	30
Zirconium	µg/L	3	< 3	< 3			4	

1 . Chromium (VI)result is based on total Chromium

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives

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Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

Summary of Exceedances

Interim PWQO

MW202	Found Value	Limit
Aluminum (µg/L)	610	75

Provincial Water Quality Objectives

MW202	Found Value	Limit
Iron (µg/L)	989	300

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives



Christine Burke
Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:

P.O. NUMBER: 2200334
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
PHC(F2-F4)	1	Kingston	KPR	17-Feb-22	C-PHC-W-001 (k)	MOE E3421
VOC's	1	Richmond Hill	JE	17-Feb-22	C-VOC-02 (rh)	EPA 8260
PHC(F1)	1	Richmond Hill	JE	17-Feb-22	C-VPHW-01 (rh)	MOE E3421

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water

Christine Burke
Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.	MW202				O. Reg. 153	
	Sample I.D.	B22-04523-1				Tbl. 1 - GW (µg/L)	
	Date Collected	15-Feb-22					
Parameter	**Units**	**R.L.**					
Acetone	µg/L	30	< 30			2700	
Benzene	µg/L	0.5	< 0.5			0.5	
Bromodichloromethane	µg/L	2	< 2			2	
Bromoform	µg/L	5	< 5			5	
Bromomethane	µg/L	0.5	< 0.5			0.89	
Carbon Tetrachloride	µg/L	0.2	< 0.2			0.2	
Monochlorobenzene (Chlorobenzene)	µg/L	0.5	< 0.5			0.5	
Chloroform	µg/L	1	< 1			2	
Dibromochloromethane	µg/L	2	< 2			2	
Dichlorobenzene,1,2-	µg/L	0.5	< 0.5			0.5	
Dichlorobenzene,1,3-	µg/L	0.5	< 0.5			0.5	
Dichlorobenzene,1,4-	µg/L	0.5	< 0.5			0.5	
Dichlorodifluoromethane	µg/L	2	< 2			590	
Dichloroethane,1,1-	µg/L	0.5	< 0.5			0.5	
Dichloroethane,1,2-	µg/L	0.5	< 0.5			0.5	
Dichloroethylene,1,1-	µg/L	0.5	< 0.5			0.5	
Dichloroethene, cis-1,2-	µg/L	0.5	< 0.5			1.6	
Dichloroethene, trans-1,2-	µg/L	0.5	< 0.5			1.6	
Dichloropropane,1,2-	µg/L	0.5	< 0.5			0.5	
Dichloropropene, cis-1,3-	µg/L	0.5	< 0.5				
Dichloropropene, trans-1,3-	µg/L	0.5	< 0.5				

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water



Christine Burke
Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D.		MW202				O. Reg. 153	
	Sample I.D.		B22-04523-1				Tbl. 1 - GW (µg/L)	
	Date Collected		15-Feb-22					
Parameter	**Units**	**R.L.**						
Dichloropropene 1,3-cis+trans	µg/L	0.5	< 0.5				0.5	
Ethylbenzene	µg/L	0.5	< 0.5				0.5	
Dibromoethane,1,2-(Ethylene Dibromide)	µg/L	0.2	< 0.2				0.2	
Hexane	µg/L	5	< 5				5	
Methyl Ethyl Ketone	µg/L	20	< 20				400	
Methyl Isobutyl Ketone	µg/L	20	< 20				640	
Methyl-t-butyl Ether	µg/L	2	< 2				15	
Dichloromethane (Methylene Chloride)	µg/L	5	< 5				5	
Styrene	µg/L	0.5	< 0.5				0.5	
Tetrachloroethane,1,1,1,2-	µg/L	0.5	< 0.5				1.1	
Tetrachloroethane,1,1,2,2-	µg/L	0.5	< 0.5				0.5	
Tetrachloroethylene	µg/L	0.5	< 0.5				0.5	
Toluene	µg/L	0.5	< 0.5				0.8	
Trichloroethane,1,1,1-	µg/L	0.5	< 0.5				0.5	
Trichloroethane,1,1,2-	µg/L	0.5	< 0.5				0.5	
Trichloroethylene	µg/L	0.5	< 0.5				0.5	
Trichlorofluoromethane	µg/L	5	< 5				150	
Vinyl Chloride	µg/L	0.2	< 0.2				0.5	
Xylene, m,p-	µg/L	1.0	< 1.0					
Xylene, o-	µg/L	0.5	< 0.5					

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water

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Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D. / Sample I.D. / Date Collected		MW202 B22-04523-1 15-Feb-22				O. Reg. 153 Tbl. 1 - GW (µg/L)	
Parameter	**Units**	**R.L.**						
Xylene, m,p,o-	µg/L	1.1	< 1.1				72	
PHC F1 (C6-C10)	µg/L	25	< 25				420	
PHC F2 (>C10-C16)	µg/L	50	< 50				150	
PHC F3 (>C16-C34)	µg/L	400	< 400				500	
PHC F4 (>C34-C50)	µg/L	400	< 400				500	

O. Reg. 153 - Soil, Ground Water and Sediment Standards
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P.O. NUMBER: 2200334
WATERWORKS NO.

Summary of Exceedances

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:

P.O. NUMBER: 2200334
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
SVOC	1	Kingston	sge	22-Feb-22	C-NAB-W-001 (k)	EPA 8270

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water



Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G104295

REPORT No. B22-04523 (ii)

Rev. 2

Report To:

GEI Consultants
647 Welham Rd, Unit 14,
Barrie ON L4N 0B7 Canada
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 16-Feb-22
DATE REPORTED: 23-Feb-22
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

	Client I.D. / Sample I.D. / Date Collected		MW202 B22-04523-1 15-Feb-22				O. Reg. 153 Tbl. 1 - GW (µg/L)	
Parameter	**Units**	**R.L.**						
Acenaphthene	µg/L	0.05	< 0.05				4.1	
Acenaphthylene	µg/L	0.05	< 0.05				1	
Anthracene	µg/L	0.05	< 0.05				0.1	
Benzo(a)anthracene	µg/L	0.05	< 0.05				0.2	
Benzo(a)pyrene	µg/L	0.01	< 0.01				0.01	
Benzo(b+k)fluoranthene	µg/L	0.1	< 0.1					
Benzo(g,h,i)perylene	µg/L	0.05	< 0.05				0.2	
Dibenzo(a,h)anthracene	µg/L	0.05	< 0.05				0.2	
Chrysene	µg/L	0.05	< 0.05				0.1	
Fluoranthene	µg/L	0.05	< 0.05				0.4	
Fluorene	µg/L	0.05	< 0.05				120	
Indeno(1,2,3,-cd)pyrene	µg/L	0.05	< 0.05				0.2	
Methylnaphthalene,1-	µg/L	0.05	< 0.05				2	
Methylnaphthalene,2-	µg/L	0.05	< 0.05				2	
Naphthalene	µg/L	0.05	< 0.05				7	
Phenanthrene	µg/L	0.05	< 0.05				0.1	
Pyrene	µg/L	0.05	< 0.05				0.2	

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water

Christine Burke
Lab Manager

R.L. = Reporting Limit
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Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 16-Feb-22
DATE REPORTED: 23-Feb-22
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 2200334
WATERWORKS NO.

Summary of Exceedances

O. Reg. 153 - Soil, Ground Water and Sediment Standards
Tbl. 1 - GW (µg/L) - Table 1 - Ground Water

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

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GENERAL SAMPLE SUBMISSION FORM

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Proudly Canadian.

SAMPLES SUBMITTED TO: Kingston ☐ Ottawa ☐ Richmond Hill ☐ Barrie ✓ London ☐ Windsor ☐

TESTING REQUIREMENTS

☒ O'Reg 153/04	☒ Table (1 - 9)	☐ Record of Site
☐ O'Reg 406/19	☐ Table (1 - 9.1)	☐ SPLP Table (1 - 9.1)
☐ RPI	☐ ICC	☐ Agricultural
☐ Coarse	☐ Medium/Fine	☐ O'Reg 558 TCLP
☐ MISA	☒ PWQO	☐ Landfill Monitoring
☐ Other:		

REPORT NUMBER (Lab Use): B22-04523

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? ☐ Yes ☒ No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Organization: GEI Consultants	Address: 647 Welham Rd, Barrie, ON L4N 9A1	Invoicing Address (if different):
Contact: Alicia Kimberley		
Tel: 705 795 Fax: 9351		
Email: Akimberley@geiconsultants.com	Quote #:	Project Name/#: [redacted] ZZ00334
Additional Info (email, cell, etc): Spatrick@geiconsultants.com	P.O. #:	Additional Info:

ANALYSES REQUESTED

Lab No.	Sample Source and/or Sample Identification	S.P.L.	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Barrie Storm suite 1	Metals (PWQO)	PHC (153/04)	VOC (153/04)	PAH (153/04)	Metals/TSS filtered	Suspected Highly Contaminated	X	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered Y/N
1	MW 202		GW	15-Feb-22		X	X	X	X	X						14	N
2	MW202-F		GW	↓							X					4	Y
	#1																
	1L Lead (HNO_3) + 3 1L Ambers (2 preserved, 1 unpreserved) + Gen Chem + nutrients + #1 phenols (Split in lab) JE JE																
	→ S^2 + ~~Chromium~~ + CN → K																
	#1+2 Gen chem + #1+2 mercury + metals + chromium + (filtered metals + chromium) → O																
	→ (1 filtered)																
	Vials → RH																

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	SCOTT PATRICK	SCOTT PATRICK
Sign:		
Date (yy-mm-dd)/Time:	~~15~~ 15-Feb-22	15-Feb-22

SHIPPING INFORMATION

Courier (Client account)	☐
Courier (Caduceon account)	☐
Drop Off	AH ☒
Caduceon (Pick-up)	☐

Invoice: # of Pieces:

REPORTING / INVOICING

Report by Fax	☐
Report by Email	☒
Invoice by Email	☒
Invoice by Mail	☐

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

Received By (print):	Elle	Signature:	ES
Date Received (yy-mm-dd):	22-02-16	Time Received:	8:00
Laboratory Prepared Bottles:	✓ Yes ☐ No		
Sample Temperature °C:	7.4	Labeled by:	JE

TURNAROUND SERVICE REQUESTED (see back page)
*Must be arranged in advance

☐	Platinum*	200% Surcharge
☐	Gold*	100% Surcharge
☐	Silver	50% Surcharge
☐	Bronze	25% Surcharge
☒	Standard	5-7 days
☐	Specific Date:	

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Comments: Some bottles are silty.

Page of

G 104295

Appendix F

Water Taking Estimates

GEI Consultants

Construction Dewatering Rate Estimate

447-455 Yonge Street, Barrie, Ontario - Site Servicing

Temporary Construction Dewatering Rate Estimates

Description	Symbol	Values	Unit	Explanation
Input Data				
Lowest Ground Elevation		98.6	m bgs	Bh/MW204
Highest Groundwater Elevation		96.7	m bgs	BH/MW202 groundwater elevation taken on February 18, 2022
Lowest Proposed Excavation		95.6	m bgs	Assume 3.0 m trench
Aquifer Bottom		93.6	m bgs	Assume 2.0 m below excavation
Hydraulic Conductivity	K	6.00E-06	m/s	Geometric mean K
Length of Excavation	x	150.0	m	Based on site plan
Width of Excavation	a	3.0	m	Based on site plan
Output				
Top of Aquifer		96.7	m asl	Average measured groundwater level
Target Water Level		94.6	m asl	Assume 1.0 m below lowest proposed excavation
Water Level above aquifer bottom before dewatering	H	3.1	m	
target water level above above aquifer bottom	h	1.0	m	
Radius of Influence	L (R_0)	15.43	m	Sichardt Equation
Precipitation		4500	L/day	10 mm rain event
Construction Dewatering Flow Rate - Steady State	Q	88.5	m^3/day	Construction Dewatering Flow - Dupuit Equation
Maximum Construction Flow Rate (safety factor of 2)	2Q	177.0	m^3/day	

Construction Dewatering Flow Rate - Steady State	Q	**88,500**	L/day
Maximum Construction Flow Rate (safety factor of 2)	2Q	**177,000**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q	**181,500**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event Per 50 m	2Q	**60,500**	L/day/50 m

Hydrogeological Investigation
447-455 Yonge Street, Barrie, Ontario
Project No.: 2200334

Equivalent Well Radius Method

447 to 455 Yonge Street, Barrie, Ontario - Underground Parking

Inputs

Rs (m)	Ro (m)	H (m)	h (m)	k (m/s)	Trench Length, x (m)	Trench Width, b (m)
39.7	15.4	2.1	0.0	6.00E-06	90	55

Elevations (m)

Ground Surface	98.6
Highest Water Level	96.7
Base of Excavation	95.6
Drawdown Target	94.6
Aquifer Bottom	94.6

Groundwater Flows		
Flow Rate, Q=	0.0004	m3/s
Q=	35,202	L/day
Safety Factor	2	
Q factored =	**70,404**	L/day

Precipitation		
Rainfall Event	10	mm
Excavation Area	4950	m2
Rainfall Q =	**49,500**	L/day

TOTAL Factored Q =	**119,904**	**L/day**

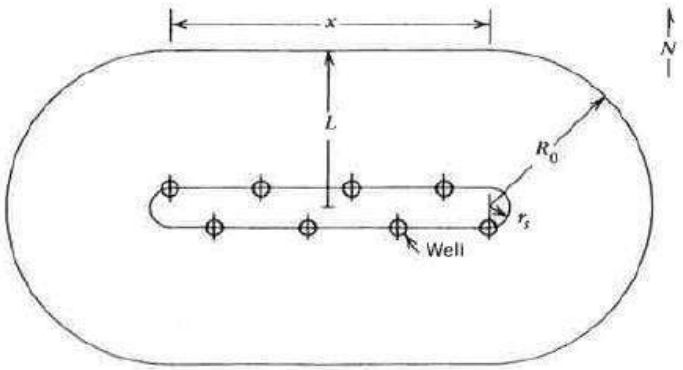


Figure 6.8 Approximate analysis of long, narrow systems.

of the actual system is finite, the end effects must be considered. This can be done by assuming that at each end of the system there is a flow equal to one half the flow to a circular well of radius r_s. The total flow to the system may be approximated by adding Eqs. 6.1 and 6.6 for a confined aquifer, or Eqs. 6.3 and 6.7 for a water table aquifer:

$$Q = \frac{2\pi KB(H - h)}{\ln R_0/r_s} + 2\left[\frac{xKB(H - h)}{L}\right] \qquad (6.10a)$$

$$Q = \frac{\pi K(H^2 - h^2)}{\ln R_0/r_s} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right] \qquad (6.10b)$$

Appendix G

Water Taking Plan

Construction Dewatering Discharge Rate and Zone of Influence

The Radius of Influence and temporary dewatering discharge rate were estimated in Section 5.1 and the details are summarized below.

Location	Radius Of Influence (ROI) (m)	Construction Dewatering Flow Rate Without Safety Factor (L/day)	Construction Dewatering Flow Rate Including Safety Factor of 2 (L/day)	Construction Dewatering Flow Rate Including Safety Factor of 2 (L/day) Including a 10 mm Rain Event
Site servicing	15.43	88,500	177,000	181,500 (60,500*)
Seven Storey Residential Building	15.43	39,671	79,342	90,542

**Construction Dewatering Flow Rate (L/day) Including Safety Factor of 2 and a 10 mm Rain Event per 50 m for site servicing.*

Potential Settlement and Monitoring

Settlement Estimate

The potential settlement was estimated by a qualified professional engineer as described below.

For the assumed maximum groundwater drawdowns of 2.1 to 2.2 m in the vicinity of the proposed building and/or serving, settlement of the soil within the radius of influence must be calculated based on the increase in effective stress (10 kPa per metre of drawdown) from reducing the pore water pressures. Settlement has the potential to damage buried utilities, building foundations, or cause subsidence in adjacent lands. The amount of settlement will decrease exponentially to zero towards the radius of influence limit.

The drawdown will occur within the generally dense to very dense glacial till. The maximum estimated settlement to occur adjacent to the dewatering system is approximately 2 mm or less, and negligible impacts are anticipated to the roadways or residential properties near the site.

Another cause of significant dewatering related settlement is due to pumping of fines through the system. It is imperative that any dewatering systems shall be designed and installed adequately to ensure no soil is conveyed through the system. Sufficient filtering techniques are incorporated at the entry point to avoid migration fines in the pumping/dewatering system.

Potential Impact on Other Water Users

Since the proposed development consist of shallow works and the site is located within an area that is municipally serviced it is not anticipated that the temporary dewatering activities will impact any water well users.

Reduction of Ground Water Flow to Waterbodies

Given the short duration of the proposed construction dewatering and that the water removed will ultimately be returned back to the Barrie Creeks watershed, it is not anticipated that the proposed construction dewatering activity will negatively impact the groundwater flow to Lovers Creek.

Water Quantity, Quality and Ground Water Level Monitoring Program

If the dewatering discharge water is treated by filtration (a silt bag at a minimum) to remove sediment and fines, the water quality is expected to improve to meet the Barrie Storm Sewer Use By-Law Criteria.

Discharge Options

Based on the groundwater quality analysis to date dewatering discharge will be directed to surface and/or existing municipal storm sewers along Yonge Street provided groundwater quality during dewatering activities continues to comply the Barrie Storm Sewer Use By-Law Criteria and/or Provincial Water Quality Objectives (PWQO) for select paraments.

If the groundwater quality of the construction dewatering discharge does not meet the applicable standards treatment options should be evaluated and/or the system should be shut down.

Water Quality Monitoring and Potential Treatment Plan

The monitoring plan for discharge to storm sewer system is outlined on Table G-1.

Ground Water Level Monitoring Program

The ground water level monitoring program is outlined on Table G-1.

Discharge Rate Monitoring

In accordance with O.Reg.63/16 daily ground water takings are to be measured and recorded by the dewatering contractor using a flow measuring device.

For each day of water taking a total daily water taking volume must be recorded. All water taking volumes for the duration of the EASR must be submitted annual through the MECP online reporting system.

Summary of Qualifications

Alicia Kimberley, MSc, P.Geo.

Ms. Alicia Kimberley is a licensed professional geoscientist with a Bachelor's and Master's degree in Earth Sciences from McMaster University and the University of Waterloo, respectively. She has eight years of professional experiences with geoenvironmental and hydrogeological assessments.

Her experiences include the design and execution of aquifer testing, in-situ ground water sampling, groundwater modelling, and preparation of hydrogeological reports to support PTTW reports.

Date of Plan Preparation

This plan prepared on the date May 5, 2022.

TABLE G-1

WATER QUALITY MONITORING PLAN FOR DEWATERING DISCHARGE TO A STORM SEWER OR SURFACE[1,2]

Period	Monitoring Location	Parameters[3]	Monitoring Frequency	Trigger For Mitigation	Mitigation Measures / Comments
Trial Dewatering	Dewatering discharge	○ Barrie Storm Sewer ○ PWQO Metals ○ O.Reg. 153/04, as amended, PHCs, VOCs, and PAHs	Once during trial dewatering	Exceeds the Barrie Storm and/or PWQO	Modify treatment method and/or shut down.
	On-Site Monitoring Wells	○ Groundwater Levels		NA	Establish baseline conditions
During Construction	Dewatering discharge	○ Barrie Storm Sewer ○ PWQO MetalsO.Reg. 153/04, as amended, PHCs, VOCs, and PAHs	Weekly then every four weeks after 3 consecutive weekly compliant samples[3]	Exceeds the Barrie Storm and/or PWQO	Change treatment method and/or shut down.
		○ Turbidity	Daily until stable (minimum 5 samples) then weekly[3]	Exceeds 15 NTU.	
	Discharge point	○ Impact Assessment	At each sampling event	Sedimentation, erosion	Reduce pumping and/or improve sediment/erosion control measures
		○ Settlement/Subsidence of nearby land	Daily	Visual indication of settlement/subsidence	Reduce pumping and consult both dewatering contractor and geotechnical engineer
	On-Site Monitoring Wells	○ Groundwater Levels	Every two weeks	Groundwater level more than 3 m or less than 1 m below excavation level	Reduce pumping and consult dewatering contractor.
Post Construction	On-Site Monitoring Wells	○ Groundwater Levels	Every two weeks for four weeks, then every four weeks until 90% recovery	Water level recovery less than 90% of baseline level	Continue monitoring

Notes:
(1) It is recommended that discharge be treated by a sediment control facility such as a decantation tank or filtration bags.
(2) Parameters may be removed from future testing after three consecutive compliant results and with agreement by QP. If dewatering moves to a different location all initial parameters must be retested.
(3) If dewatering moves to a different location or a non-compliant result is detected, the sampling will return to the initial frequency.

Appendix H

Discharge Plan

Construction Dewatering Discharge Rate and Zone of Influence

The Radius of Influence and temporary dewatering discharge rate were estimated in Section 5.1 and the details are summarized below.

Location	Radius Of Influence (ROI) (m)	Construction Dewatering Flow Rate Without Safety Factor (L/day)	Construction Dewatering Flow Rate Including Safety Factor of 2 (L/day)	Construction Dewatering Flow Rate Including Safety Factor of 2 (L/day) Including a 10 mm Rain Event
Site servicing	15.43	88,500	177,000	181,500 (60,500*)
Seven Storey Residential Building	15.43	39,671	79,342	90,542

**Construction Dewatering Flow Rate (L/day) Including Safety Factor of 2 and a 10 mm Rain Event per 50 m for site servicing.*

Proposed Discharge Method and Location

It is understood that the preferred discharge location would be to the ground surface and/or existing storm sewers. Dewatering discharge will be directed to the ground surface and/or existing storm sewers by hose or pipe from the dewatering system to any pre-treatment systems (i.e. silt bag and/or sediment tank), and then by hose or pipe to the preferred discharge location.

In the event of a significant rainfall event (100-year storm event), on-site excavation will cease until the dewatering system can be re-evaluated and/or storm water flow subsides.

Erosion and Sediment Control Measures

The construction dewatering setup will include sediment and erosion control measures, and sufficient filtration to ensure removal of suspended solids prior to discharge in accordance with typical Best Management Practices.

Statements

If discharge is directed to the surface and/or existing storm sewers with adherence to the water quantity and quality monitoring program outlined in the Water Taking Plan in Appendix G, no adverse effect on the environment is expected.

The discharge water temperature was considered in determining the method of transfer and discharge and is not expected to have an adverse impact.

Summary of Qualifications

Alicia Kimberley, MSc, P.Geo.

Ms. Alicia Kimberley is a licensed professional geoscientist with a Bachelor's and Master's degree in Earth Sciences from McMaster University and the University of Waterloo, respectively. She has eight years of professional experiences with geoenvironmental and hydrogeological assessments.

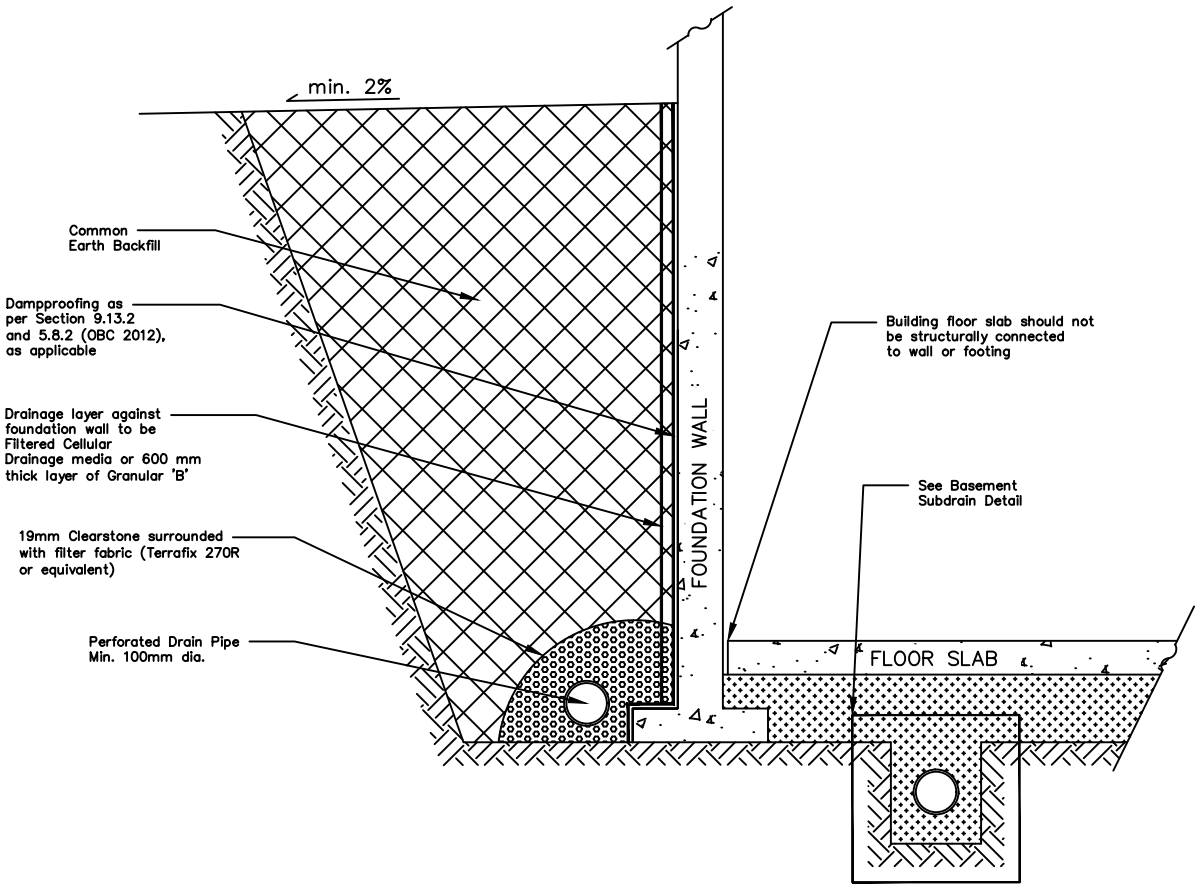
Her experiences include the design and execution of aquifer testing, in-situ ground water sampling, groundwater modelling, and preparation of hydrogeological reports to support PTTW reports.

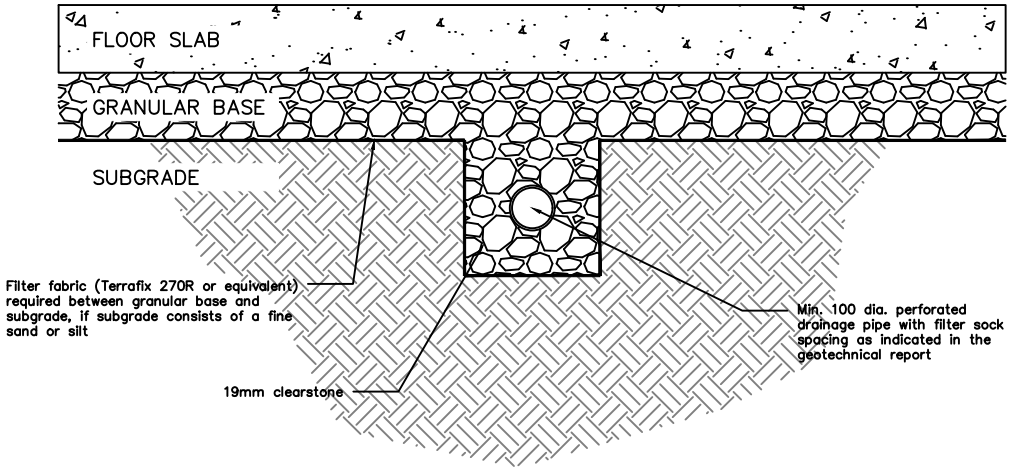
Date of Plan Preparation

This plan prepared on the date May 5, 2022.

Appendix I

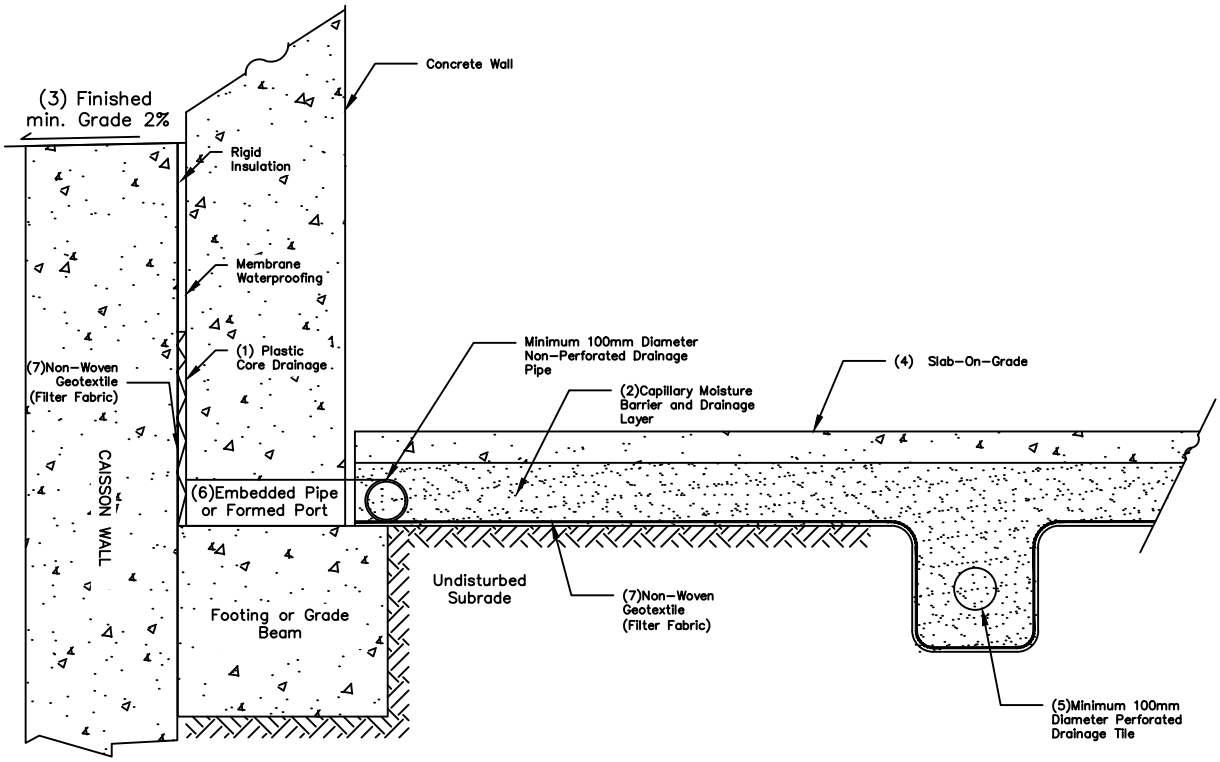
Basement Drainage Typical Details





GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7

BASEMENT FOUNDATION WALL & SUBFLOOR DRAINAGE TYPICAL DETAIL



NOTES

1) Prefabricated drainage panels to consist of Terrafix – TERRADRAIN 200, Mirafi–Miradrain 2000, or equivalent. Panels should provide continuous cover with a minimum overlap of 300mm.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS 1004) compacted to a dense state. Upper 50mm can be replaced with Granular 'A' (OPSS 1010) compacted to 98% SPMDD where vehicular traffic is required.

3) Exterior finished grade away from wall at a minimum grade of 2%.

4) Building floor slab–on–grade shall not be structurally connected to foundation wall or footing.

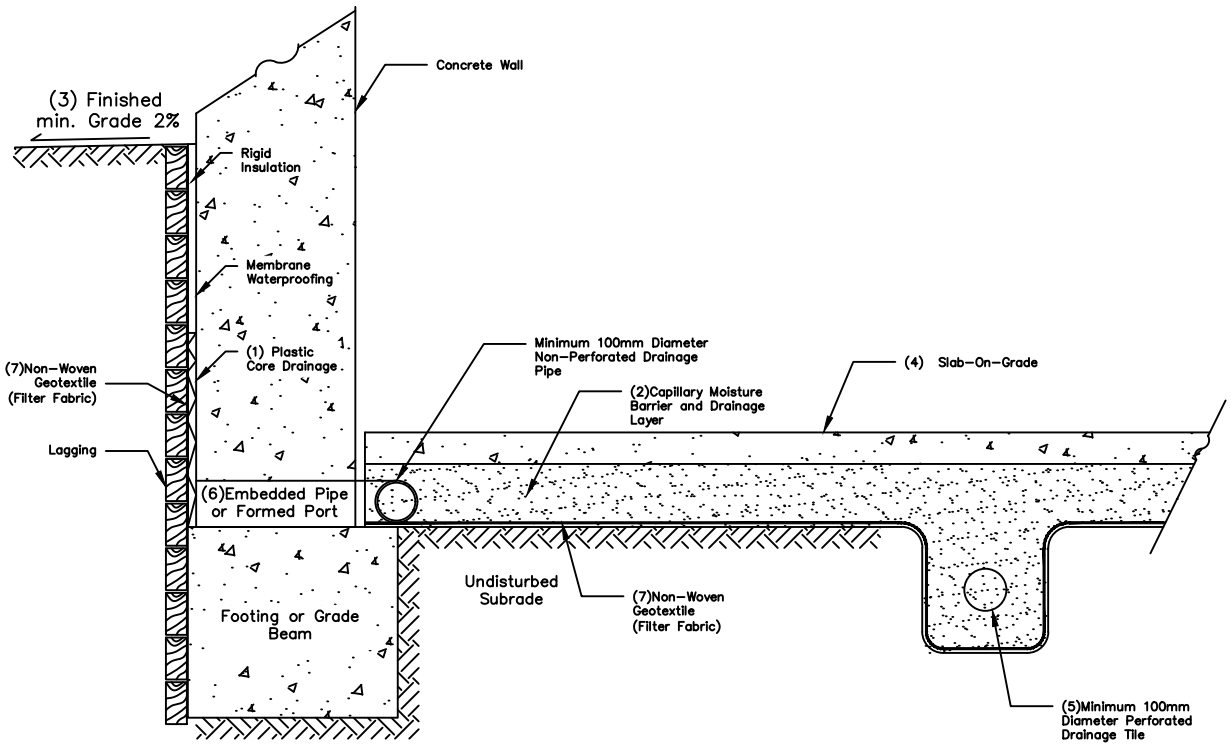
5) Drainage tile invert to be a minimum of 400mm below underside of floor slab, to be set in parallel rows, one way and at a distance of 3 to 6m on–centre, as structural foundations permit. Drainage tile should have a minimum 100mm cover (comprised of a free–draining material on all sides.)

6) Embedded pipes/formed ports to be set a distance of maximum 3m on–centre. Each part to have a minimum cross–sectional area of 1500mm^2. Do not connect the non–perforated perimeter drainage pipes to the under floor drainage tiles.

7) When the subgrade consists of a cohesionless soil, the subgrade must be seperated from the subfloor drainage layer using a non–woven geotextile (Terraflc 360R or equilvalent).

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

SCHEMATIC DRAINAGE DETAIL
CAISSON WALL SHORING SYSTEM



NOTES

1) prefabricated drainage panels to consist of Terrafix–TERRADRAIN 200, Mirafi–Miradrain 2000, or equivalent. Panels should provide continuous cover with a minimum overlap of 300mm.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS 1004) compact to a dense state. Upper 50mm can be replaced with a Granular "A" (OPSS 1010) compacted to 98% SPMDD where vehicular traffic is required.

3) Exterior finished finished grade away from wall at a minimum grade of 2%.

4) Building floor slab–on–grade shall not be structurally connected to wall or footing.

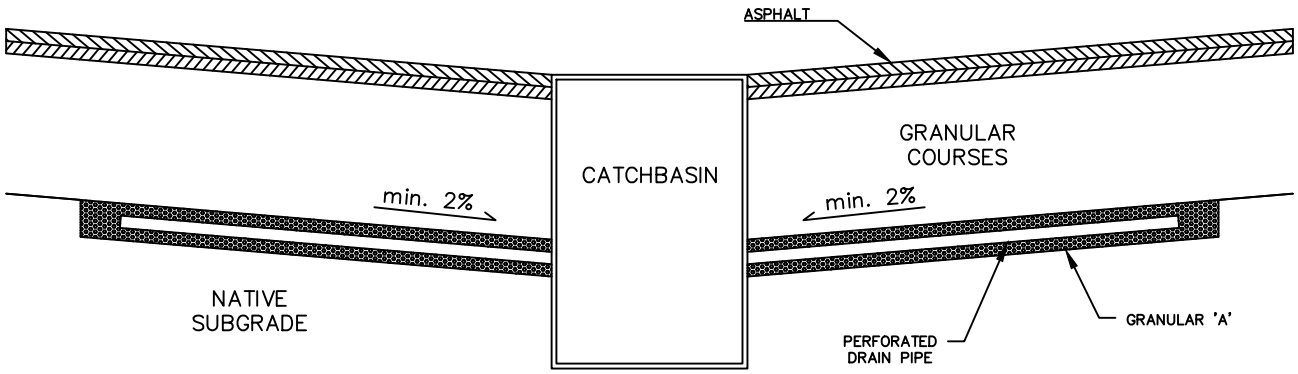
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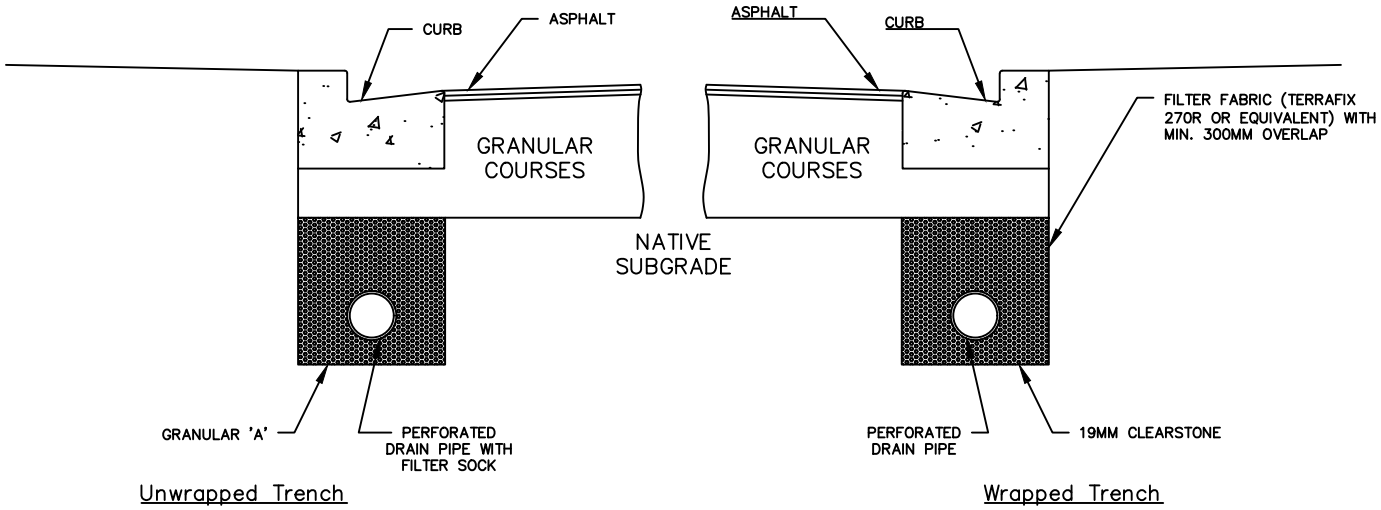
6) Embedded pipes/formed ports to be set a distance of 3m on–centre. Do not connect the non–perforated perimeter drainage pipes to the underfloor drainage tiles.

7) When the subgrade consists of a cohesionless soil, the subgrade must be seperated from the subfloor drainage layer using a non–woven geotextile (Terrafix 360R or equivalent).

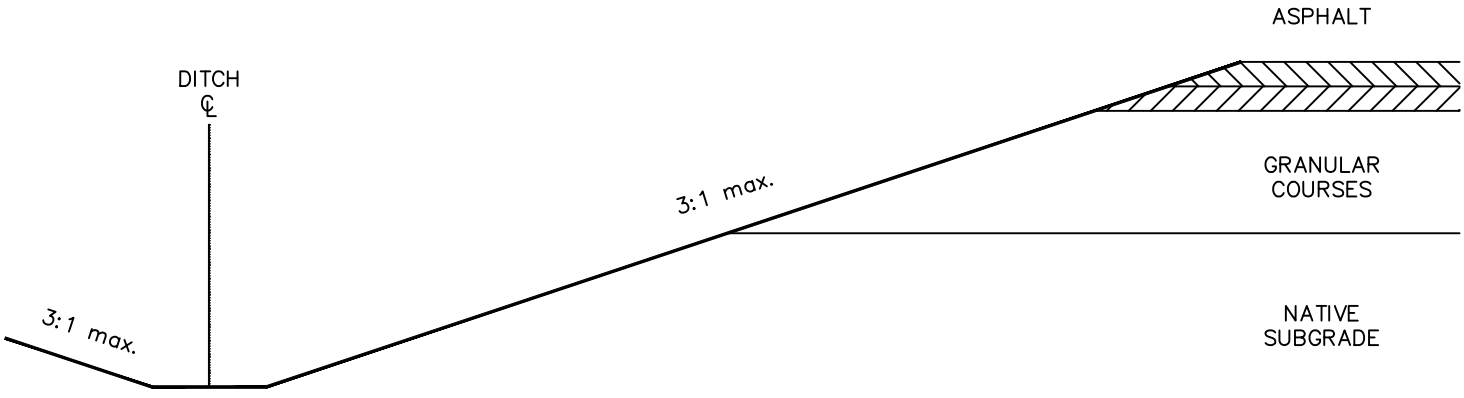
GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

SCHEMATIC DRAINAGE DETAIL
SOLDIER PILE & LAGGING SHORING SYSTEM





Urban Cross Sections



Rural Cross Section

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
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PAVEMENT DRAINAGE ALTERNATIVES TYPICAL DETAILS

Appendix J

Preliminary Water Balance

File No. 2200334

Water Balance - 447-455 Yonge Street, Barrie, Ontario

MONTHLY AND YEARLY WATER BALANCE COMPONENTS														
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Potential Evapotranspiration Calculation	Average Temperature: T (^{o}C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	6.9
	Heat Index: $i=(T/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	36.8
	Unadjusted Daily Potential Evapotranspiration: U (mm)	0.0	0.0	0.0	25.2	59.0	88.5	104.1	98.1	74.7	40.6	11.5	0.0	501.7
	Adjusting Factor for U (Latitude 44^{o})	0.81	0.81	1.02	1.13	1.27	1.28	1.30	1.20	1.04	0.94	0.80	0.76	-
	Adjusted Potential Evapotranspiration - PET (mm)	0.0	0.0	0.0	28.5	74.9	113.3	135.3	117.8	77.7	38.1	9.2	0.0	594.8
Pervious Components	Precipitation: P (mm)	82.5	61.8	58.1	62.2	82.4	84.8	77.2	89.9	94.0	77.5	88.9	73.6	932.9
	Adjusted Potential Evapotranspiration: PET (mm)	0.0	0.0	0.0	28.5	74.9	113.3	135.3	117.8	77.7	38.1	9.2	0.0	594.8
	P - PET	82.5	61.8	58.1	33.7	7.5	-28.5	-58.1	-27.9	16.3	39.4	79.7	73.6	338.1
	Change in Soil Moisture Storage (mm)	0.0	0.0	0.0	0.0	0.0	-28.5	-58.1	-27.9	16.3	39.4	0.0	0.0	-
	Water Holding Capacity (max. 75 mm)	75.0	75.0	75.0	75.0	75.0	46.5	0.0	0.0	16.3	55.7	75.0	75.0	-
	Water Surplus Available for Infiltration or Runoff	82.5	61.8	58.1	33.7	7.5	0.0	0.0	0.0	0.0	0.0	60.4	73.6	377.6
	Potential Infiltration based on MECP Infiltration Factor (mm)	41.3	30.9	29.1	16.9	3.7	0.0	0.0	0.0	0.0	0.0	30.2	36.8	188.8
	Potential Surface Water Runoff (mm)	41.3	30.9	29.1	16.9	3.7	0.0	0.0	0.0	0.0	0.0	30.2	36.8	188.8
Impervious Components	Precipitation: P (mm)	-												932.9
	Potential Evaporation: PE (mm), Assume 15%	-												139.9
	Potential Surface Water Runoff: P - PE (mm)	-												793.0

PRE- AND POST-DEVELOPMENT WATER BALANCE (NO LOW IMPACT DEVELOPMENT MEASURES IN PLACE)							
		Total Land Area (m^2)	Est. Fraction of Land	Est. Land Area (m^2)	Runoff (m^3/annum)	Infiltration (m^3/annum)	**Runoff Increase Pre to Post**
Existing Land Use (Pre-Development)	Pervious Area	5560.0	75%	4170.0	787.3	787.3	94%
	Impervious Area (house, walkway and driveway, sheds)		25%	1390.0	1102.2	0.0	**Infiltration Decrease Pre to Post**
	TOTAL	-	100%	5560.0	1889.5	787.3	-71%
Proposed Land Use (Post-Development)	Pervious Area	5560.0	22%	1223.2	230.9	230.9	**Infiltration Required to Meet Pre-Development Conditions (m^3)**
	Impervious Area (Residential apartment, roadways, townhomes, walways)		78%	4336.8	3438.9	0.0	
	TOTAL	-	100%	5560.0	3669.9	230.9	556

Notes

1. Both potential infiltration and surface water runoff are independent of temperature
2. Assumption is in January maximum soil moisture storage value is present (75mm)
3. Water Holding Capacity & Infiltration Factors taken from Table 3.1 of MOE SWMPDM, 2003
4. Average Temp. and Precip. taken from Environment Canada station "Barrie WPCC" between 1981 and 2010
5. Adjusting Factor for U based on Lorente, 1961

		1780.4	556.3
Infiltration Criteria	**Site Description**	**Infiltration Factor**	
Topography	Rolling Land - Average Slope 2.8 to 3.8 m/km	0.2	
Soils	Medium Combinations of Clay and Loam	0.2	
Cover	Cultivated Land	0.1	
	Sum of Infiltration Factors	**0.5**	

June 27, 2023 Reference No. 2200334

Barrie Yonge Developments GP Inc.
80 Maritime Ontario Blvd, Unit 239
Brampton, Ontario
L6S 0E7

Re: Monthly Groundwater Monitoring Assessment
Proposed Residential Apartment Building Development
447 to 455 Yonge Street
Barrie, Ontario

It has become more common for municipalities and conservation authorities to require potential site developments to provide evaluation of the degree of seasonal variation in groundwater elevations throughout a typical year based on site-specific measured data.

This aids in determining the seasonal high groundwater table so that basement levels and the base of LID measures can be situated above the groundwater table, and to assess potential dewatering requirements more accurately over different seasons.

GEI Consultants Inc. (GEI) was retained to conduct monthly groundwater levels within the monitoring wells previously installed on site to determine the likely seasonally high groundwater elevation for use in design. This letter summarizes the measurements of groundwater taken between February of 2022 and March of 2023 to capture the groundwater fluctuations and seasonally high groundwater table that typically occurs during the spring months.

GEI reviewed the following reports as part of the monthly groundwater level monitoring assessment:

- "*Geotechnical Investigation - Proposed Residential Apartment Building Development – 447 to 455 Yonge Street, Barrie, Ontario*", Project No. 2200334, dated September 12, 2022, by GEI Consultants Inc.
- "*Hydrogeological Investigation – Proposed Residential Apartment Building Development – 447 to 455 Yonge Street, Barrie, Ontario*", Project No. 2200334, dated September 12, 2022, by GEI Consultants Inc.

The site consists of the residential properties of 447, 449, 451, 453 and 455 Yonge Street. Each of the residential properties currently contain a single-family residential dwelling, driveway, and grassed front yards and backyards. Assuming Yonge Street runs north to south, the site is approximately 90 metres long (north to south) by 60 metres wide (east to west) and is rectangular with an area of approximately 0.54 hectares. The site is bounded by Yonge Street to the west, Maclaren Avenue to the north and residential properties to the south and east. At the time of the field work program, the residential

dwellings were vacant. The existing site is relatively flat with an approximate elevation of 254 metres. The site location is shown in Figure 1.

The purpose of the geotechnical investigation was to assess the subsurface soil conditions at the site by advancing five (5) exploratory boreholes, three (3) of these were equipped with a monitoring well, to provide geotechnical engineering recommendations in support of the proposed development. The construction details of each monitoring well is provided in the table below. The borehole and monitoring well locations are shown in Figure 2A and 2B.

Table 1: Monitoring Well Details

Monitoring Well	Ground Surface Local Elevation (m)	Top of Screen		Bottom of Screen		Strata Screened
		Depth (m)	Local Elev. (m)	Depth (m)	Local Elev. (m)	
BH/MW202	99.4	7.3	92.1	10.3	89.0	SAND & SILT GLACIAL TILL
BH/MW203	97.6	7.5	90.1	10.5	87.0	
BH/MW204	98.6	6.9	91.7	9.9	88.8	

***Note**: Benchmark used was the top of fire hydrant 1081 with local elevation of 100.00 metres.

Groundwater level measurements were taken directly using a manual water level reader in each of the three (3) monitoring wells installed on site. A minimum of four (4) months of groundwater monitoring was conducted during the expected spring freshet months (which is typically when the highest groundwater elevations occur). Direct manual groundwater readings have been measured, once in February 2022 and monthly between April 2022 and March 2023. The results of these groundwater level readings are summarized in the table below. Graphs of the groundwater elevations recorded for each monitoring well are attached to this report.

Table 2: Results of Monthly Groundwater Monitoring

Date of Groundwater Level Reading	Depth (m) / Local Elevation (m) of Groundwater Table					
	BH/MW202		BH/MW203		BH/MW204	
18-Feb-22	2.7	96.7	1.8	95.7	2.3	96.3
28-Apr-22	2.5	96.9	1.6	96.0	2.0	96.6
6-May-22	2.6	96.8	1.6	95.9	2.1	96.5
6-Jun-22	3.0	96.4	2.1	95.5	2.5	96.1
4-Jul-22	3.1	96.3	2.2	95.4	2.6	96.0
3-Aug-22	3.3	96.1	2.4	95.1	2.9	95.7
14-Sep-22	3.3	96.0	2.6	95.0	3.1	95.6
18-Oct-22	3.3	96.1	2.4	95.1	2.9	95.7
17-Nov-22	3.3	96.1	2.3	95.2	2.9	95.8
16-Dec-22	3.0	96.4	2.0	95.6	2.5	96.1
11-Jan-23	2.3	97.1	1.6	96.0	2.0	96.6
14-Feb-23	2.2	97.2	1.5	96.1	1.9	96.7
13-Mar-23	2.6	96.8	1.7	95.9	2.1	96.5
Highest Recorded	**2.2**	**97.2**	**1.5**	**96.1**	**1.9**	**96.7**

Based on the monthly groundwater level measurements recorded during this monitoring period, the highest groundwater elevation measured for each of the monitoring wells, which can be considered during design, was as follows:

- Borehole BH/MW202: Elev. 97.2 metres (depth of 2.2 metres below existing grade).
- Borehole BH/MW203: Elev. 96.1 metres (depth of 1.5 metres below existing grade).
- Borehole BH/MW204: Elev. 96.7 metres (depth of 1.9 metres below existing grade).

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

Regards,

GEI Consultants

Prepared By:

Frankie Huang, E.I.T.
Geotechnical Engineer in Training

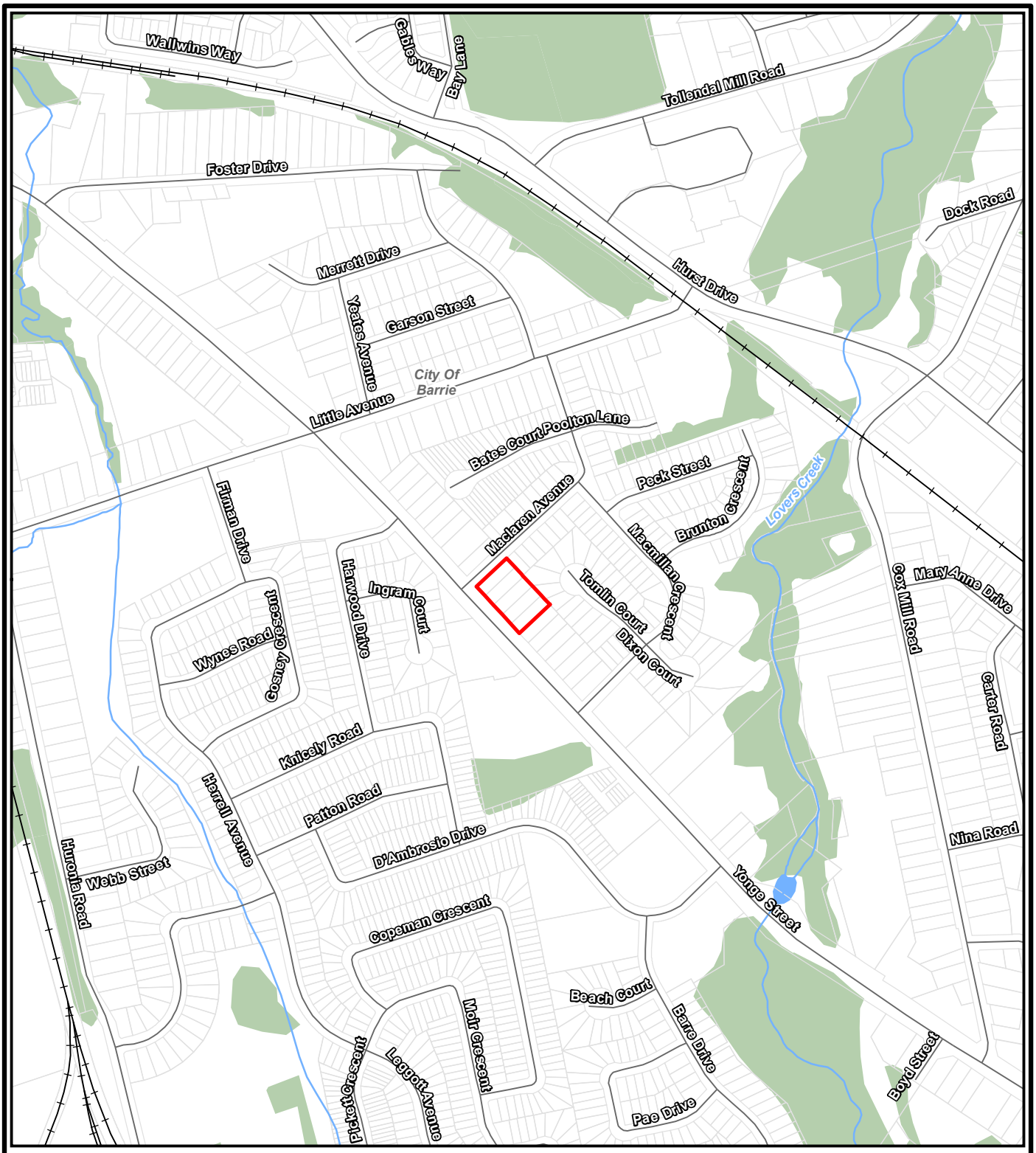
Reviewed By:

Kimberly Gilder, P.Geo.
Senior Hydrogeologist

PROFESSIONAL GEOSCIENTIST
KIMBERLY GILDER (K.G.)
PRACTISING MEMBER
2417
ONTARIO

SITE LOCATION PLAN

BOREHOLE LOCATION PLAN



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Parcels from 'Tax Parcels', City of Barrie, AGOL. Accessed March 2022.

Legend

- Site Location
- Road
- Railway
- Watercourse
- Waterbody
- Wooded Area
- Parcels

N

0 80 160 m

1:8,000

447-455 Yonge Street
Barrie, Ontario

Innovative Planning Solutions

GEI Consultants

Project 2200334

SITE LOCATION PLAN

March 2022 Fig. 1



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Orthoimagery © First Base Solutions, 2022. Imagery taken in 2020.

Legend

- Site Limit
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location

N

0 6 12 m

1:600

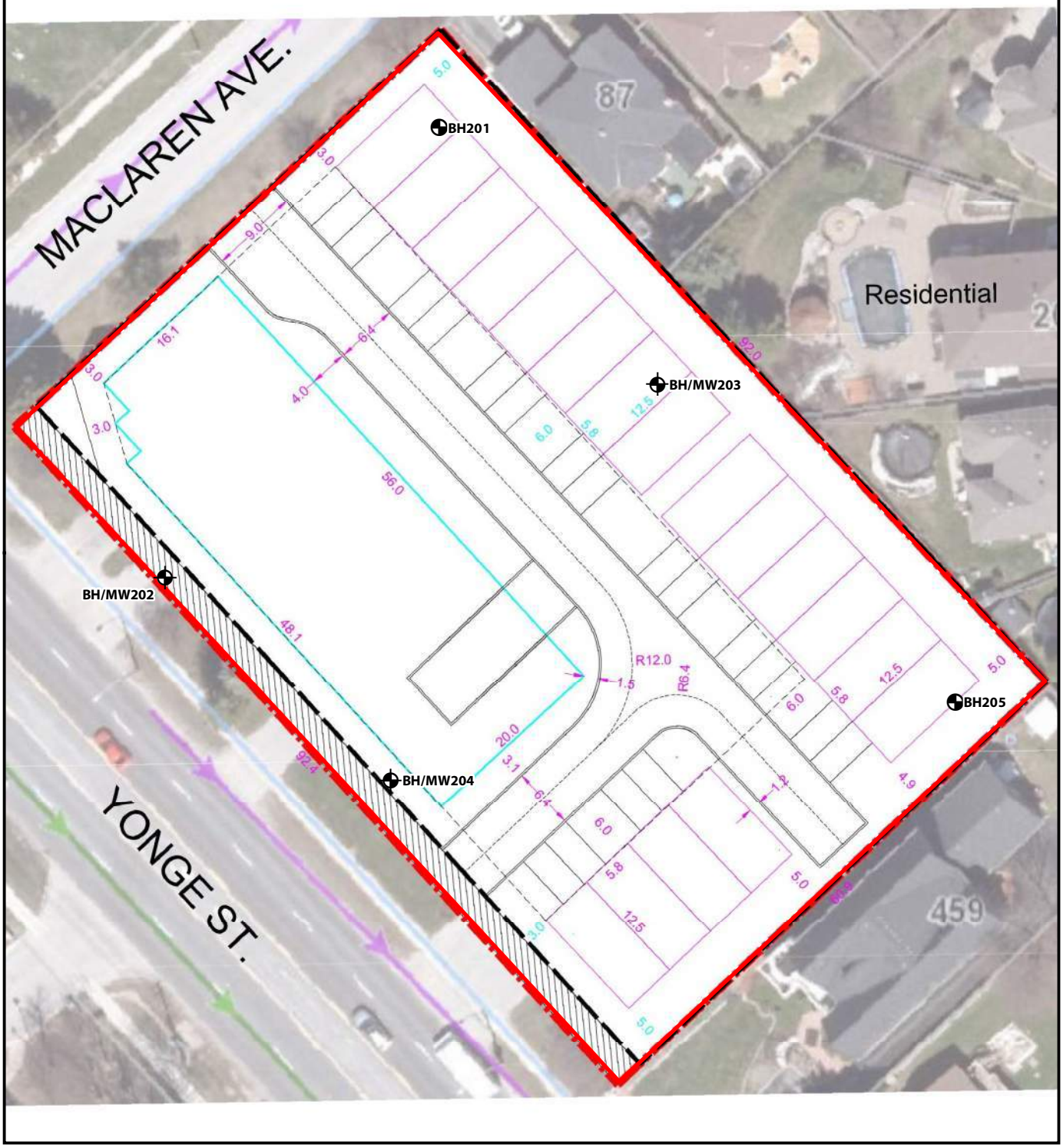
447-455 Yonge Street
Barrie, Ontario

Innovative Planning Solutions

GEI Consultants

BOREHOLE LOCATION PLAN
(AERIAL)

Project 2200334 | March 2022 | Fig. 2A



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2022.
3. Parcels from 'Tax Parcels', City of Barrie, AGOL. Accessed March 2022.

Legend

- Site Location
- Approximate Borehole/Monitoring Well Location
- Approximate Borehole Location

N

0 6 12 m

1:597

447-455 Yonge Street
Barrie, Ontario

Innovative Planning Solutions

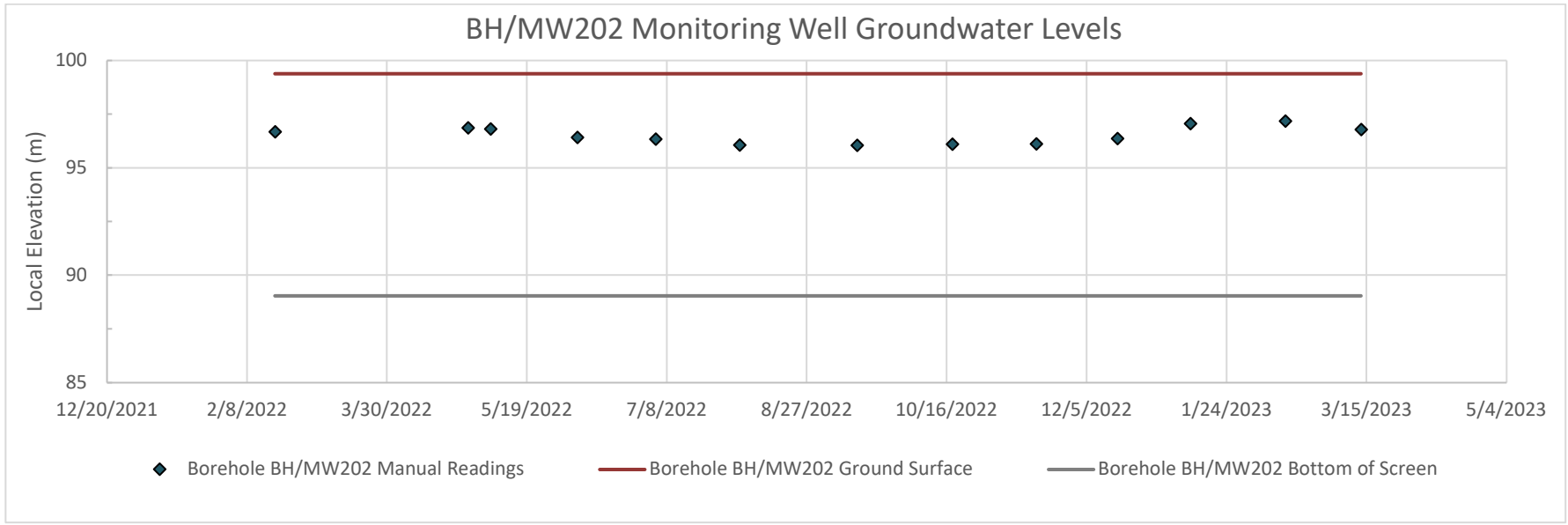
GEI Consultants

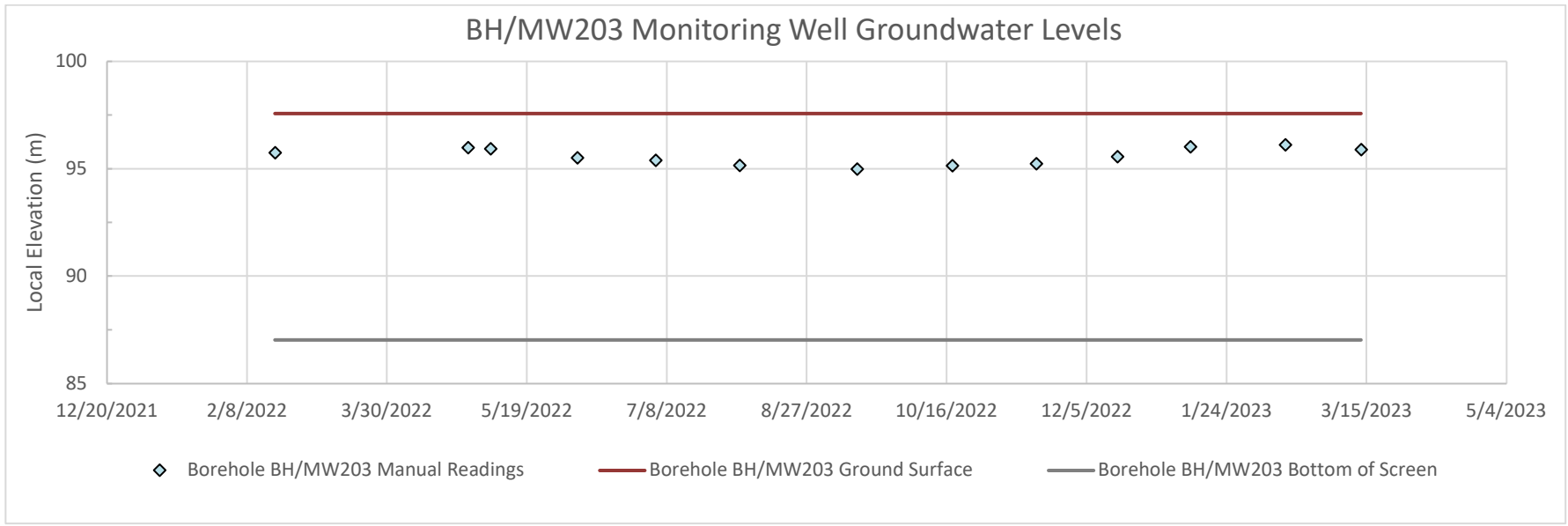
Project 2200334

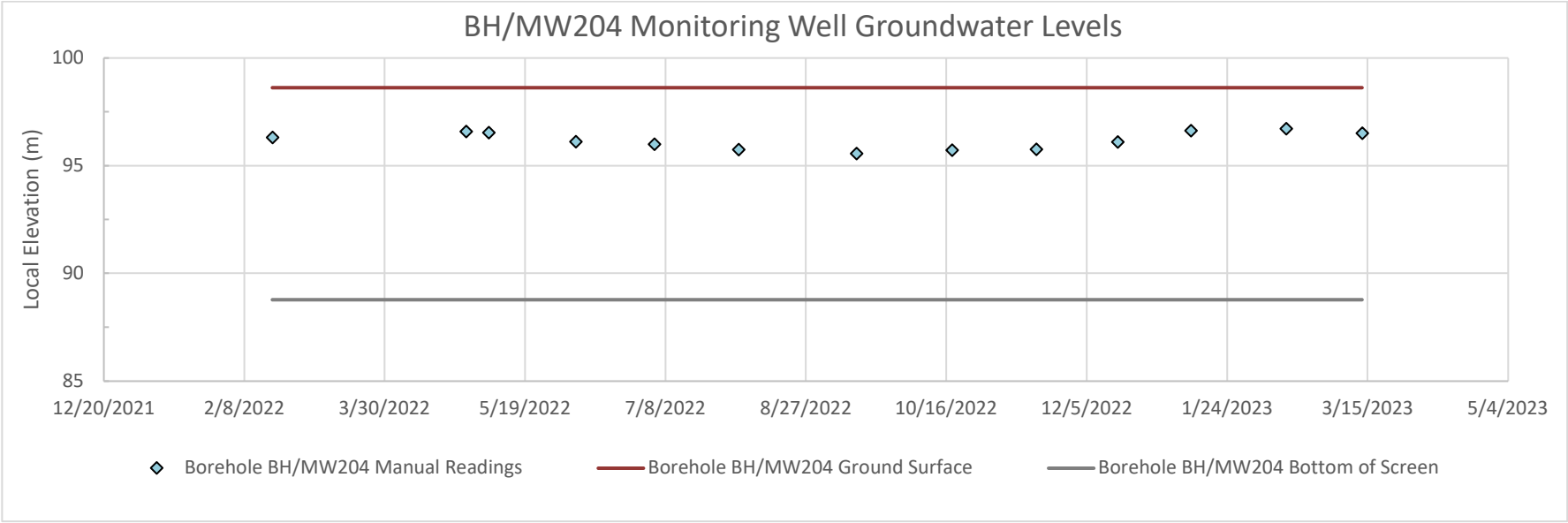
BOREHOLE LOCATION PLAN
(PROPOSED SITE PLAN)

March 2022 Fig. 2B

GRAPHS OF MEASURED WATER LEVELS


BH/MW202 Monitoring Well Groundwater Levels
Local Elevation (m)
100
95
90
85
12/20/2021
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
Borehole BH/MW202 Manual Readings
Borehole BH/MW202 Ground Surface
Borehole BH/MW202 Bottom of Screen


BH/MW203 Monitoring Well Groundwater Levels
Local Elevation (m)
100
95
90
85
12/20/2021
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
Borehole BH/MW203 Manual Readings
Borehole BH/MW203 Ground Surface
Borehole BH/MW203 Bottom of Screen


BH/MW204 Monitoring Well Groundwater Levels
Local Elevation (m)
100
95
90
85
12/20/2021
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
Borehole BH/MW204 Manual Readings
Borehole BH/MW204 Ground Surface
Borehole BH/MW204 Bottom of Screen

Design Chart 1.08: Hydrologic Soil Groups (Continued)

- Based on Soil Texture

Sands, Sandy Loams and Gravels	
- overlying sand, gravel or limestone bedrock, very well drained	A
- ditto, imperfectly drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
Medium to Coarse Loams	
- overlying sand, gravel or limestone, well drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
Medium Textured Loams	
- shallow, overlying limestone bedrock	B
- overlying medium textured subsoil	BC
Silt Loams, Some Loams	
- with good internal drainage	BC
- with slow internal drainage and good external drainage	C
Clays, Clay Loams, Silty Clay Loams	
- with good internal drainage	C
- with imperfect or poor external drainage	C
- with slow internal drainage and good external drainage	D

Source: U.S. Department of Agriculture (1972)

APPENDIX C

Water & Sanitary Servicing Calculations

PINESTONE ENGINEERING LTD.

3.2.4. Septic Systems

Development of private sewage treatment systems is not permitted. The review and approval of new private sewage treatment systems may be considered by the City only in cases where replacement or upgrading of existing systems is warranted.

3.2.5. Standard Drawings

In addition to these written guidelines, reference should also be made to the City of Barrie's Infrastructure Standard Drawings.

3.3. Design Flows

The careful determination of design flows is a crucial step in the design of an appropriate sanitary sewage collection system. The design flows for sanitary sewer design must account for flows from all sources: residential connections, commercial and institutional connections, industrial connections and extraneous flows from groundwater infiltration and surface water inflow.

In lieu of precise information on development on the whole or any part of the sanitary sewer drainage area, reference will be made to the latest zoning plan issued by the Planning Services Department.

3.3.1. Residential Flows

3.3.1.1. Design Population

Land Use or Zoning Designation Basis

When the most detailed knowledge of the ultimate land use for the tributary area consists simply of its overall proposed land use and/or zoning as determined from such sources as the governing Official Plan, Secondary Plans or Zoning By-Law, the design population can be estimated on an area basis using the following minimum design population values. When the exact land use/zoning is not confidently known, then an assessment shall be made and more restrictive values must be used. The City may alter the values associated with any particular development as determined appropriate.

Low Density	single detached, duplexes or semi-detached dwellings	25 units/hectare @ 3.13 ppu

- Typical zoning designations for Low Density Development may include RH, R1, R2, R3, R4, RM1 and RM1-SS. It should be noted that zoning designations are subject to change, and it is the responsibility of the designer to ensure that the most current zoning by-laws and designations are being used.

Medium Density	triplexes and fourplexes	26 - 35 units/hectare @ 2.34 ppu
	cluster and/or block townhouses	40 units/hectare @ 2.34 ppu
	street townhouses	47 units/hectare @ 2.34 ppu
	'walk-up' apartments	26 - 53 units/hectare @ 2.34 ppu

- Typical zoning designations for Medium Density Development may include RM2 and RM2-TH. It should be noted that zoning designations are subject to change and it is the responsibility of the designer to ensure that the most current zoning by-laws and designations are being used.

High Density	Apartment dwellings	54 - 300 units/hectare @ 1.67ppu

- Typical zoning designations for High Density Development may include RA1 and RA2. It should be noted that zoning designations are subject to change, and it is the responsibility of the designer to ensure that the most current zoning by-laws and designations are being used.

The method of determining design population for residential flows will depend upon the particular stage that is being considered and the appropriate detail required for the desired level of design accuracy. Reference shall be made to current zoning policies.

Development Details Basis

When the details regarding the proposed uses on individual lots are known, or can be assumed with reasonable certainty, a more detailed approach to design population and associated design flow estimation is required. This approach involves the determination of individual design flows for the various areas in the tributary area which will contribute to an individual sewer reach. The actual number of units shall be used and the design population estimated using the following people per unit (ppu) values.

Low Density	3.13 ppu
Medium Density	2.34 ppu
High Density	1.67 ppu

3.3.1.2. Average Daily Flow

Average daily domestic flow = 225 L/day/person (excluding extraneous flows)

3.3.1.3. Peak Flow

Peak domestic flow is to be calculated using the following formula:

$$Qp = \frac{P \times q \times M}{86.4} + I \times A$$

Where Qp = Peak residential sanitary sewage flow, including peak extraneous flows (L/s)

P = Design population in thousands (see Section 3.3.1.1)

q = Average daily domestic flow per capita (L/day/person) (see Section 3.3.1.2)

M = Peaking factor (see Section 3.3.1.3)

I = Peak extraneous flow (L/s/ha) (see Section 3.3.4)

A = Tributary area (ha) (see Section 3.2.2)

As per the MOECC Design Guidelines for Sewage Works, 2008 (MOE Guidelines), the peaking factor, M, can be calculated using the Harmon Formula or Babbit Formula. The Babbit Formula gives peaking factors that are more representative of instantaneous peaks, and the Harmon Formula gives peaking factors that are more representative of peak hour. The Babbit Formula shall only be used to assess the upstream reaches of the sewer shed where depth of flow and minimum scour is a concern for partial flow conditions where depth of flow is less than 30% of the pipe diameter.

Harmon Formula

$$M = 1 + \frac{14}{4 + P^{0.5}}$$

Babbit Formula

$$M = 5/P^{0.2}$$

Where P = Design population in thousands

The minimum permissible peaking factor M is 2.0 per the MOECC Guidelines.

3.3.2. Commercial and Institutional Flows

3.3.2.1. Average Daily Flow

Due to the high variability of sanitary flows between various commercial and institutional establishments, design flows for specific commercial and institutional uses are to be based on actual flow records for similar uses whenever possible. In the absence of historical data for estimation, the designer may refer the common commercial sewage flow rates recommended in the most current Ministry of the Environment Guidelines. For more general applications, where the specific use is not known, a minimum average design flow rate of 28 m^3/day/ha shall be used. This does not include an allowance for extraneous flows.

3.3.2.2. Peak Flow

Whenever possible, peaking factors should be based on an individual assessment of each type of use. Peak values and peak times vary greatly between various commercial and institutional establishments. so the designer must consider the intended use and design accordingly. Peak sewage flows will often correspond to water usage rates for most establishments. For more general applications, where specific information is not known, a factor of two (2) may be used.

3.3.3. Industrial Flows

3.3.3.1. Average Daily Flow

Sanitary sewage flows from industrial areas are industry/process specific and can vary greatly. Where possible, design flows should be based on an individual assessment of expected flow rates or actual flow records for each individual industrial use. In the absence of such information, the following average day design flows shall be used for industrial development:

General Industrial	= 35 m3/day/ha
Heavy or Special Industrial Use	= 55 m3/day/ha
Unknown Mix of General & Heavy	= 50 m3/day/ha

These rates do not include extraneous flows.

3.3.3.2. Peak Flow

Peak sewage flow rates vary greatly depending on the type of industry, production schedules and processes used. As such, peak sewage flow rates shall be based on an individual assessment of expected peak flow rates or actual flow records whenever possible. In the absence of such information, a peaking factor between two (2) and four (4) may be used based on the designer's best judgement. Industrial uses, which have the potential to produce higher than average sewage flow rates, may be required to provide flow monitoring devices and/or flow equalization with off-peak discharge facilities as determined by the City.

3.3.4. Extraneous Flows

When designing a sanitary sewer system, an allowance should be made for the infiltration of groundwater into the sewers and sanitary service connections (infiltration) and for other extraneous water entering the sewers from sources such as maintenance hole covers (inflow).

The amount of groundwater leakage into the sewer system will vary with the quality of construction, type of joints, ground conditions, and level of groundwater in relation to pipe. Although such infiltration can be reduced by proper design, construction, and maintenance, it cannot be completely eliminated and an allowance should be made in the design sewage flows to incorporate this flow component.

An extraneous flow rate of 0.1 L/s/ha shall be used for sanitary sewer design.

The above rate assumes strict adherence to construction standards in the installation of sanitary sewers and building connections, and does not account for any other extraneous flows such as foundation drain connections, excessive flooding through maintenance hole covers, significant groundwater problems, etc.

Where collection system infrastructure is being designed to convey flows from existing developed areas, the extraneous flow allowance used may be increased based on flow monitoring data and/or system modelling, as directed by the City of Barrie.

Where a sewer is located within the floodplain of a watercourse, maintenance hole covers are to be raised above the maximum flood elevations, or watertight maintenance hole covers with associated air vents may be required as directed by the City.

3.4. Sanitary Sewer Design

3.4.1. Hydraulic Design Sheets

The design of sanitary sewers shall be completed using the City of Barrie's Sanitary Sewer Design Sheets as provided in Appendix C, or a similar format as deemed appropriate by the City.

3.4.2. Minimum Pipe Diameter

The minimum diameter for sanitary sewers conveying raw sewage from residential areas with no potential for future intensification or sanitary sewer shall be no less than 200mm in diameter (NPS-8). Sanitary sewers located in Industrial, Commercial, Institutional, and mixed land use areas shall be no less than 250 mm in diameter (NPS-10). The downstream sanitary sewer diameter shall be no less than the upstream sanitary sewer diameter.

3.4.3. Minimum and Maximum Velocities

Sanitary sewers shall be designed such that a minimum sewage flow velocity of 0.60 m/s is achieved without including inflow and infiltration flows. The actual velocity at peak flow conditions should be calculated and slope increased to ensure adequate flushing velocities are maintained. A sample spreadsheet is available on City of Barrie website, and can be reviewed in Appendix C.

In order to reduce pipe scour, the maximum flow velocity shall be 3 m/s. Velocities in excess of 3 m/s may be permitted in special situations, provided that slope anchors are used to prevent pipe separation, and measures are taken to protect against scour. If velocities above 3 m/s are proposed, documentation must be submitted to the City for approval, indicating potential risks and mitigative measures required to ensure the long term integrity of the collection system. Minimum calculated velocities shall not exceed full flow velocities.

Figure ES-1
City of Barrie
Existing Wastewater Collection System

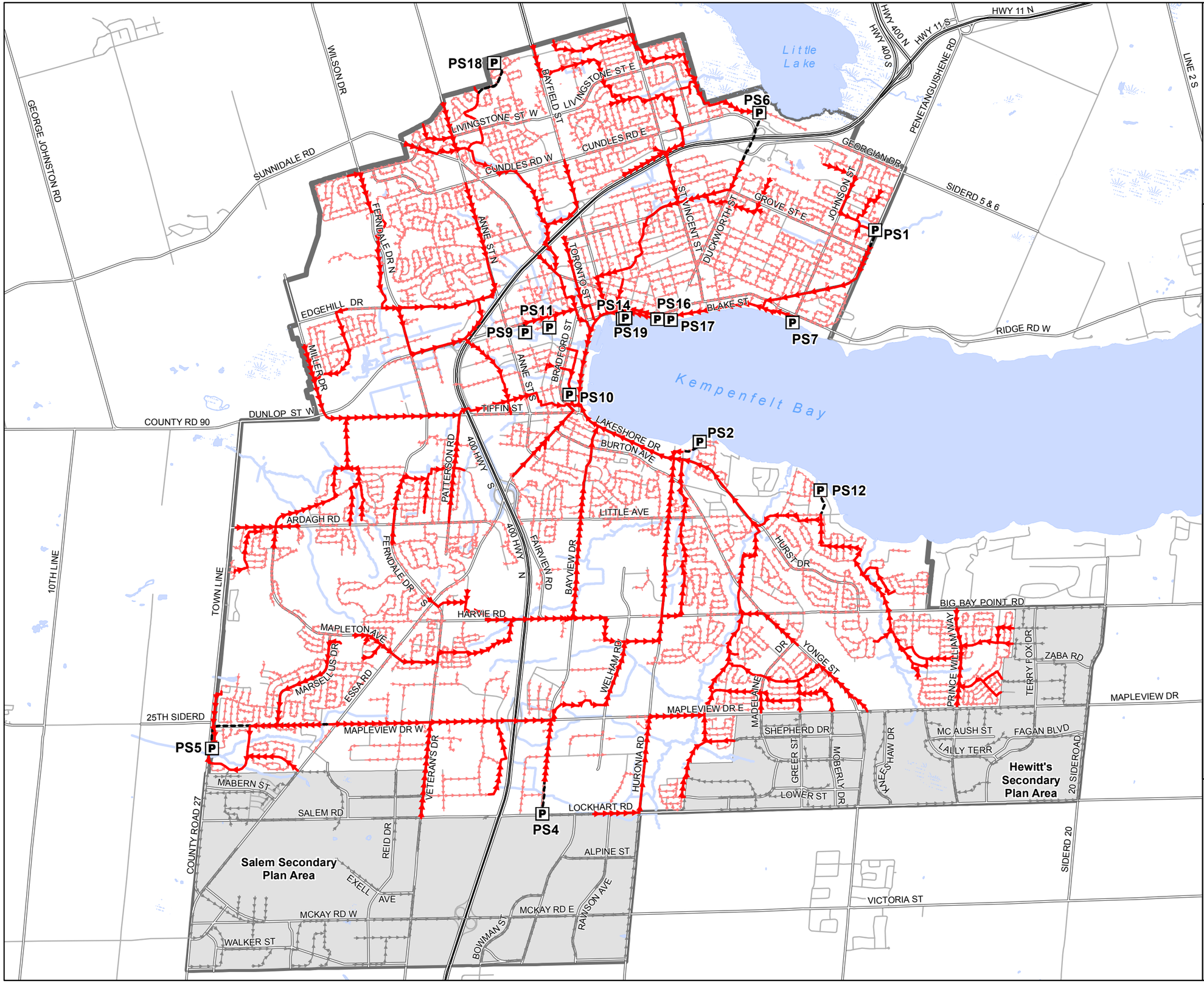
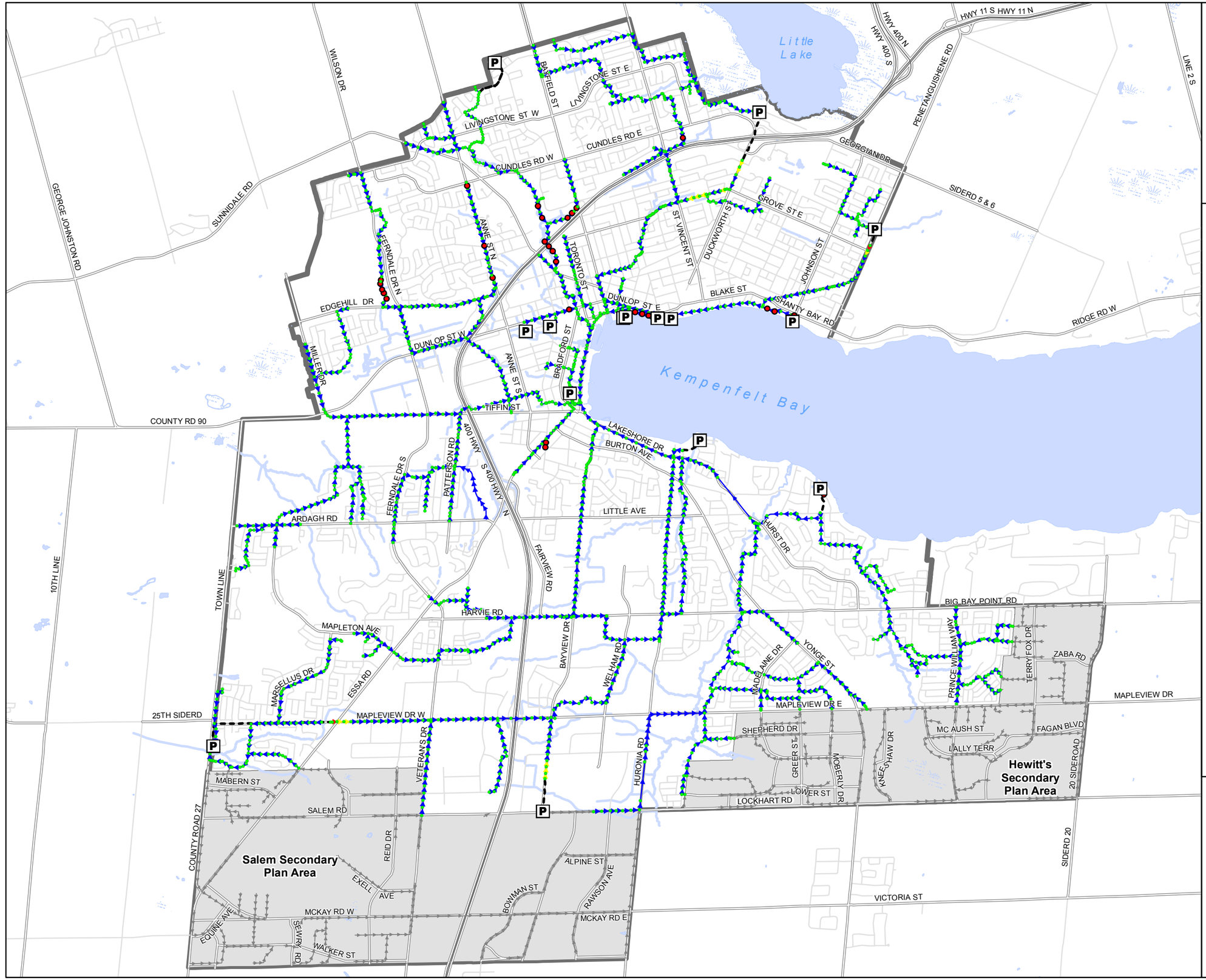


Figure 6-2
City of Barrie
Existing Wastewater Collection System Performance
Peak Dry Weather Flow Conditions



- Pumping Stations
- Secondary Plan Boundaries
- City of Barrie Limits
- Forcemain
- Future Annexed Lands Sewers

Freeboard (m)

- <= 1.8m
- > 1.8m

Peak Conduit Depth Ratio (d/D)

- < 0.5
- 0.5 - 0.7
- > 0.7

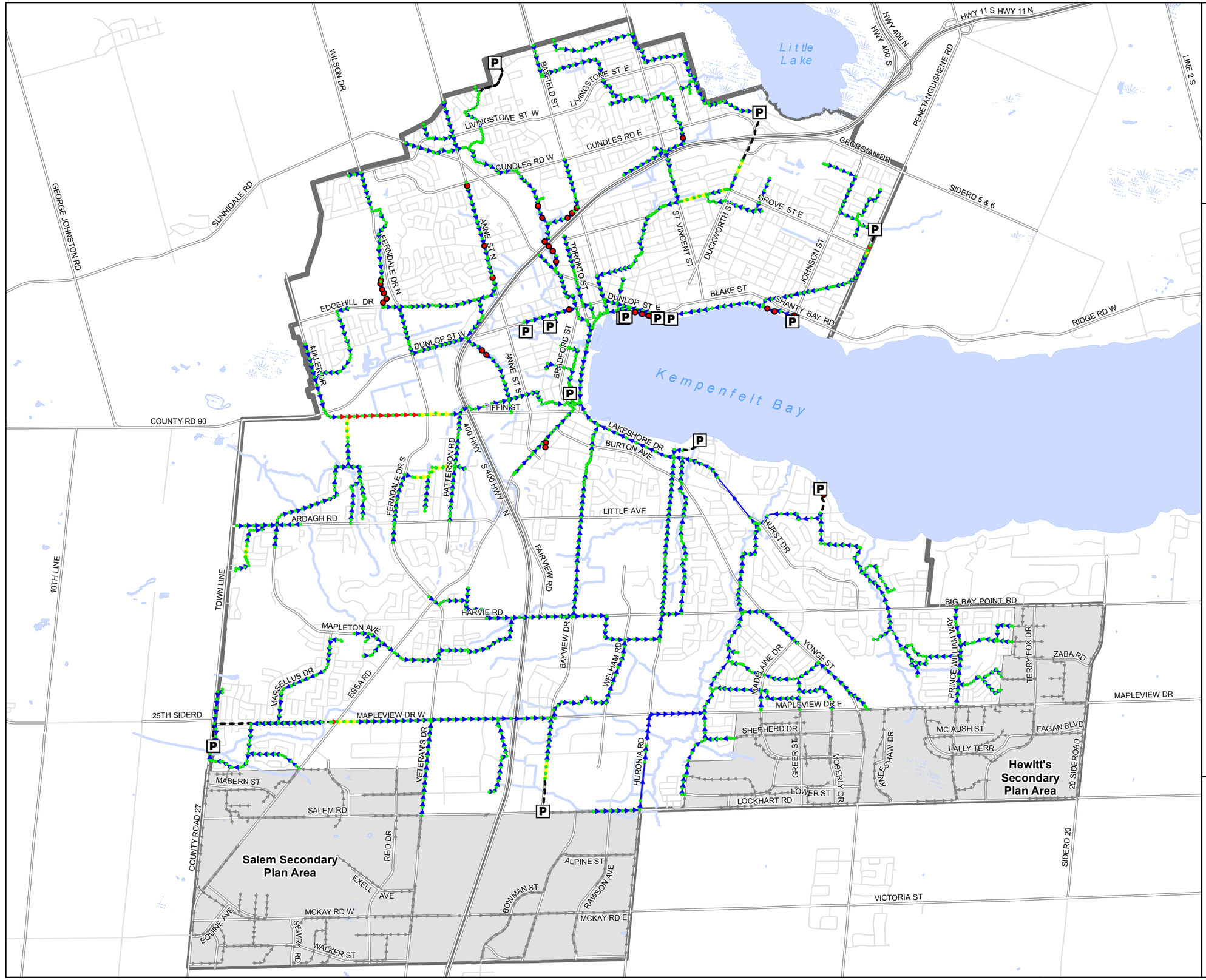
COLE

N

0 0.25 0.5 1 1.5 2
Kilometers

Updated: 4/5/2019

Figure 6-3
City of Barrie
Existing Wastewater Collection System Performance
Wet Weather Flow Conditions
(2 Year Storm Event)



- Pumping Stations
- Secondary Plan Boundaries
- Forcemain
- Future Annexed Lands Sewers
- City of Barrie Limits

Freeboard (m)

- <= 1.8m
- > 1.8m

Peak Conduit Depth Ratio (d/D)

- < 0.5
- 0.5 - 0.7
- > 0.7

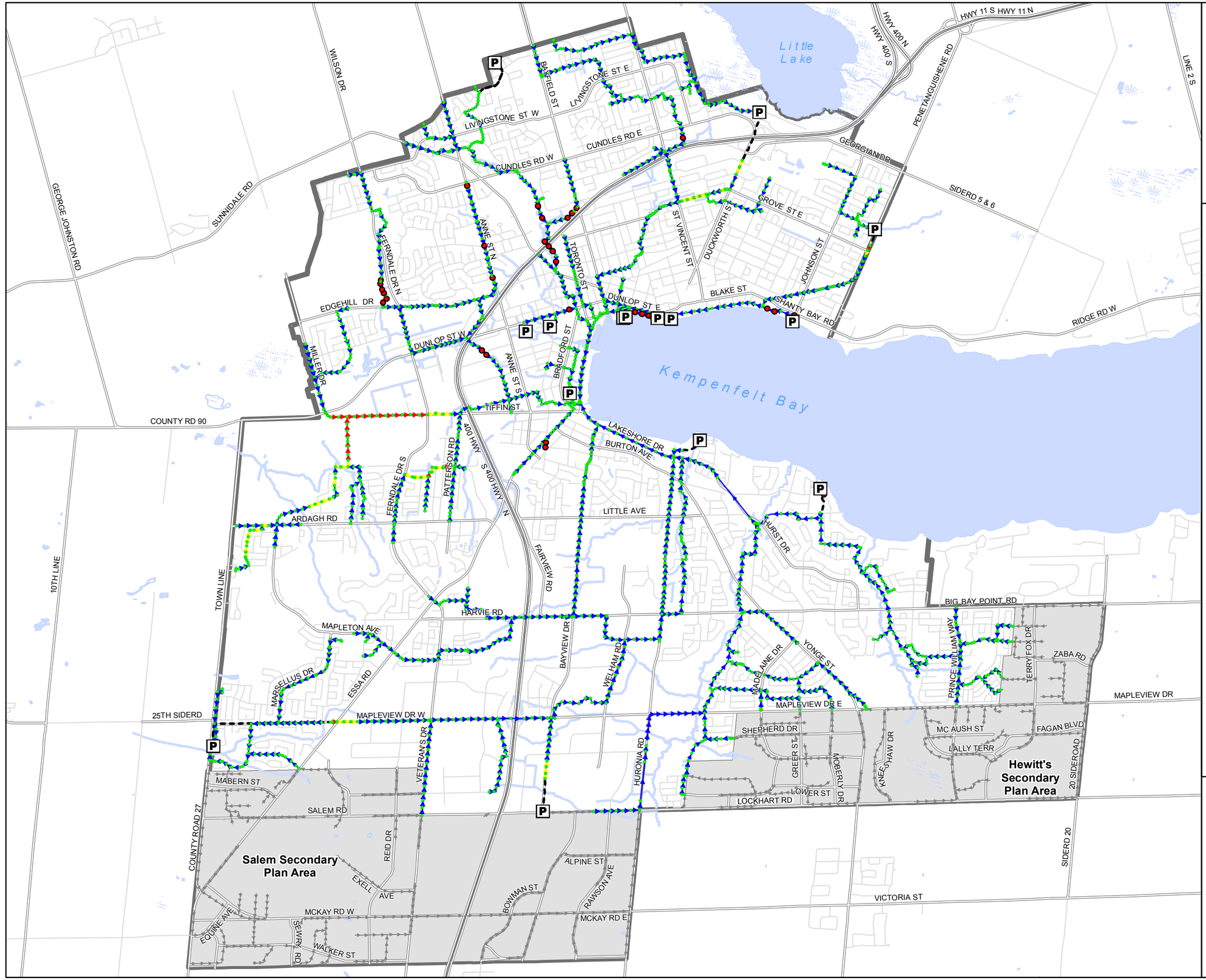
COLE

N

0 0.25 0.5 1 1.5 2
Kilometers

Updated: 4/5/2019

Figure 6-4
City of Barrie
Existing Wastewater Collection System Performance
Wet Weather Flow Conditions
(5 Year Storm Event)



- Pumping Stations
- Secondary Plan Boundaries
- City of Barrie Limits

Sanitary Collection System

- Forcemain
- Future Annexed Lands Sewers

Freeboard (m)

- <= 1.8m
- > 1.8m

Peak Conduit Depth Ratio (d/D)

- < 0.5
- 0.5 - 0.7
- > 0.7

COLE

N

0 0.25 0.5 1 1.5 2
Kilometers

Updated: 4/5/2019

Figure 6-5
City of Barrie
Existing Wastewater Collection System Performance
Wet Weather Flow Conditions
(10 Year Storm Event)

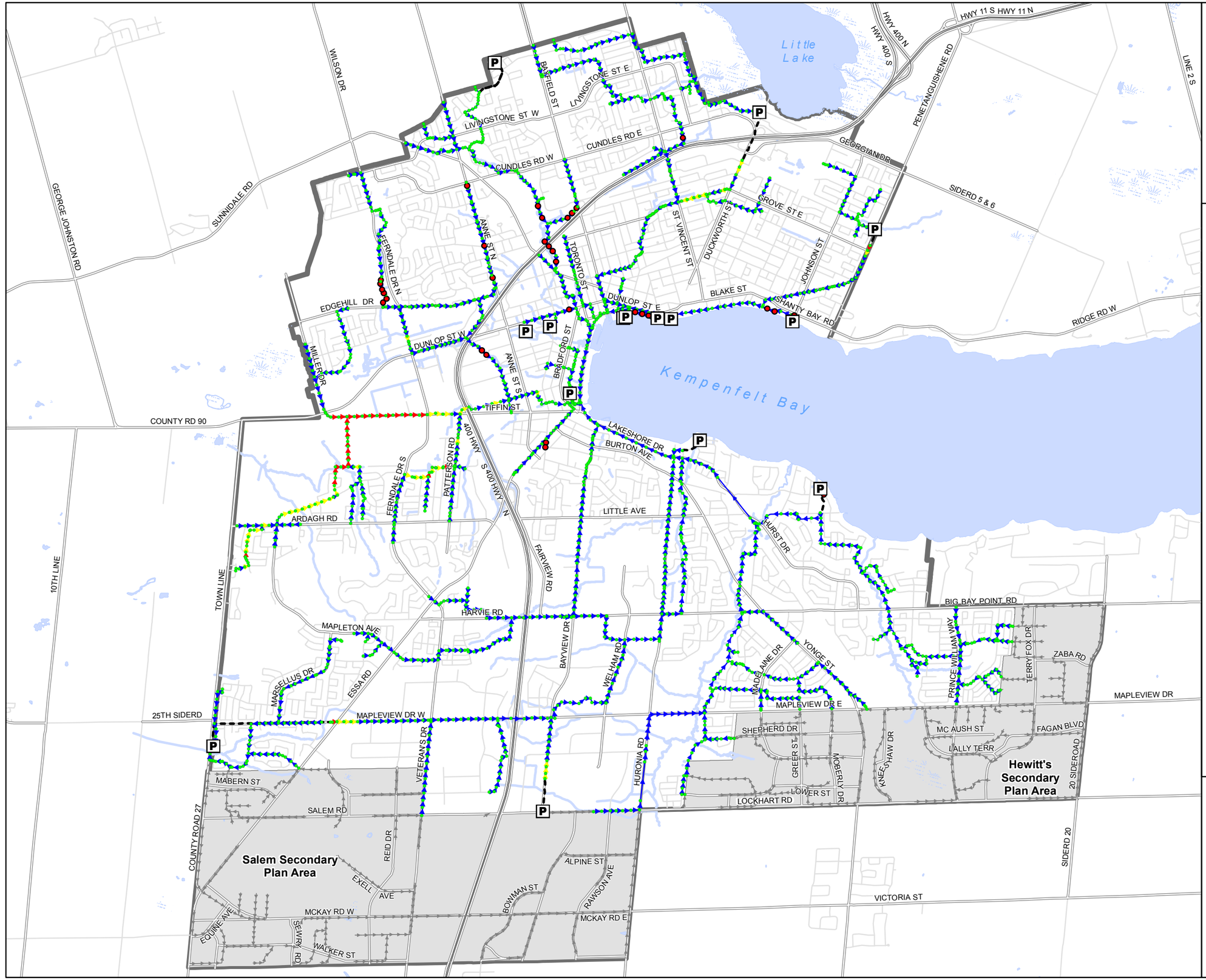
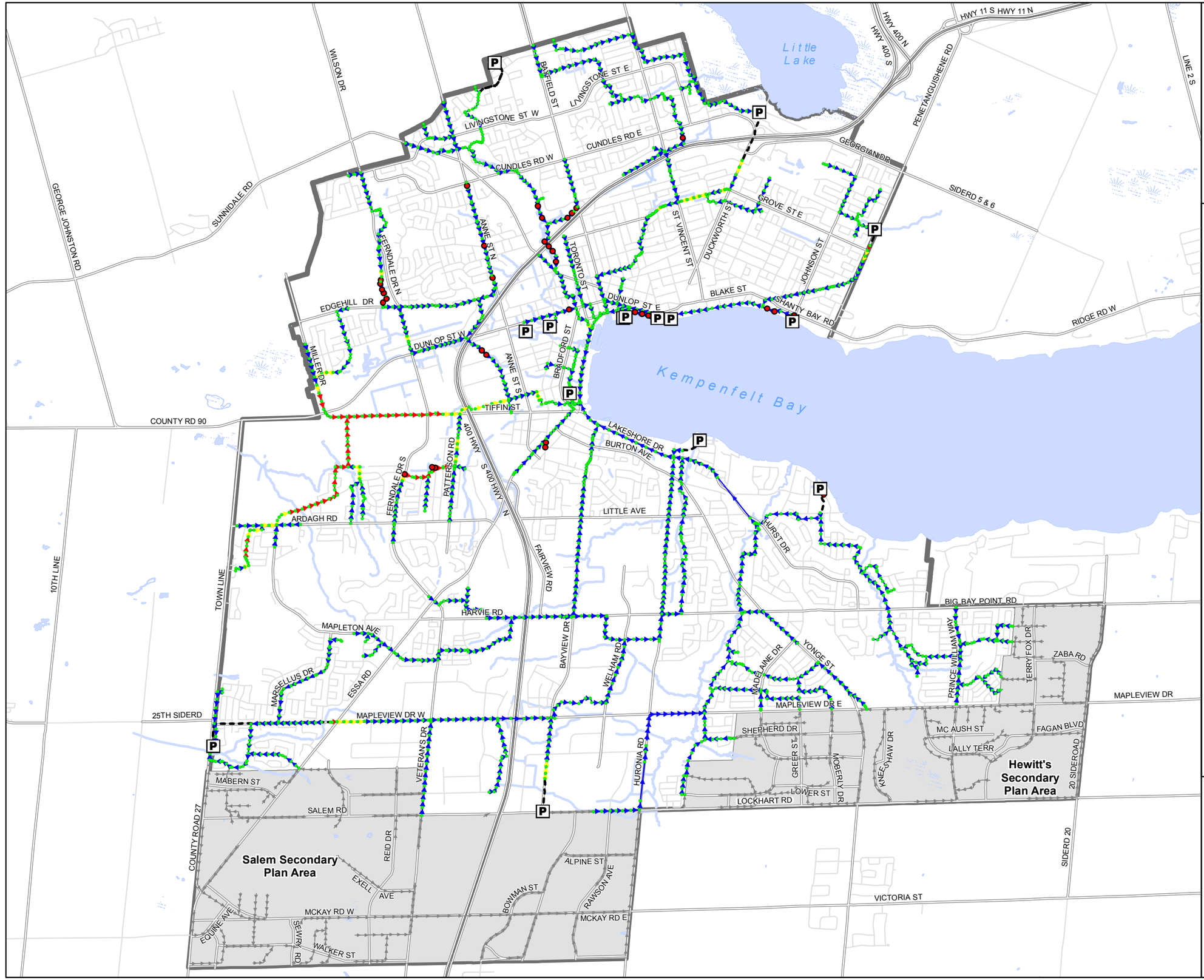


Figure 6-6
City of Barrie
Existing Wastewater Collection System Performance
Wet Weather Flow Conditions
(25 Year Storm Event)



- Pumping Stations
- Forcemain
- Secondary Plan Boundaries
- City of Barrie Limits
- Future Annexed Lands Sewers

NewFreebrd25yr

- <= 1.8m
- > 1.8m

NewMaxFullDpth25yr

- < 0.5
- 0.5 - 0.7
- > 0.7

COLE

N

0 0.25 0.5 1 1.5 2
Kilometers

Updated: 4/5/2019

8.2.2 Evaluation of Existing Pumping Stations

The capacity of existing pump stations to convey future flows was also evaluated for the various planning horizons. For this analysis, peak modelled flows corresponding to the 25-year design event were compared against the firm capacity of each station. **Table 8.3** presents the results. The station firm capacity represents the current available capacity at each station while the 2017 Existing, 2021, 2026, 2031, 2036 and 2041 values represent the required capacity in the time period. It is noted that the Huronia PS has already been decommissioned and the Lockhart PS is planned to be decommissioned. In addition, the Holly PS is currently being expanded and the station firm capacity is being increased. The values shown in **Table 8.3** correspond to the post-construction firm capacity.

Table 8.3 Pumping Station Capacity Assessment (2017-2041)

Modelled Pumping Station	Station Firm Capacity (L/s)	2017 Existing Peak Flow Entering Station (L/s)	2021 Peak Flow Entering Station (L/s)	2026 Peak Flow Entering Station (L/s)	2031 Peak Flow Entering Station (L/s)	2036 Peak Flow Entering Station (L/s)	2041 Peak Flow Entering Station (L/s)
Barrie WwTF (PS10)	2,205	1,736	1,910	1,963	2,057	2,061	2,109
Grove Street (PS1)	158	53	52	54	54	57	63
Minets Point (PS2)	61.3	22.1	22.2	22.3	22.6	22.9	23.6
Huronia (PS3)	91	Decommissioned					
Lockhart (PS4)	51	5	Planned to Be Decommissioned				
Holly (PS5)	200.9	67	81	95	108	120	130
Little Lake (PS6)	110	37	37	40	40	41	42
Tynedale (PS12)	11	10	**15**	**15**	**16**	**16**	**16**
Mooregate (PS18)	21	8	8.5	8.5	8.7	8.9	9.1

It is noted that the influent flow to PS10 does not include any recycle streams. For PS10, the Wastewater Treatment Master Plan contains a detailed examination of future needs.

The results presented above indicated that all SPSs, with the exception of Tynedale SPS (PS12), have sufficient firm capacity to convey peak flows associated with the 25-year design event through to the year 2041. PS12 will require a pump capacity increase in the planning phase 2021.

447-455 YONGE STREET DEVELOPMENT

City of Barrie

SANITARY SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Project Number:	22-11672B
Date:	April 10, 2024
Design By:	DH
Checked By:	JHV
File:	Z:\Project Documents\11672B Barrie Yonge Street Developments GP Inc\SPA Work\447-455 Barrie Yonge Street Dev\Working Files\Sanitary Sewer Design Sheet 2.xls
Drainage Area Plan No:	2000-007-002

Design Parameters

Average Daily Flow
Residential 0.0026 L/s/c
Commercial 0.324 L/s/ha

Mannings "*n*" 0.0130
Min. Velocity 0.60 m/sec
Max. Velocity 3.0 m/sec
Residential Harmon Peaking Factor (F)
Infiltration 0.10 L/s/ha

PEL PINESTONE ENGINEERING LTD.

LOCATION				RESIDENTIAL AREAS and POPULATION						SCHOOL, INSTITUTIONAL			COMMERCIAL			INDUSTRIAL				INFILTRATION			DESIGN							
										HECTARES AND FLOW OF EACH ZONING																			
										0.00 *L/s/ha*			0.324 *L/s/ha*			0.00 *L/s/ha*												
STREET	AREA NO.	MANHOLE LOCATION FROM MH	MANHOLE LOCATION TO MH	AREA	UNITS	POPUL.	CUMUL POPUL.	PEAK FACTOR "F"	PEAK RES. FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	TOTALS-C-I FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY	ACTUAL VELOCITY
				ha		*1000s*	*1000s*		*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*m*	*%*	*mm*	*L/sec.*	*m/s*	*m/s*
Proposed Apartment Building (176 Units + 572m2 commercial space)	1	SANMH1A	SAP13089	0.53	176.00	0.294	0.294	4.082245	3.1246				0.0572	0.057	0.0371				3.1617	0.53	0.53	0.0528	3.2145	7.8	2.00	200	46.3604	1.476	0.847
																								78.0	1.41	250	70.5779	1.439	

Capacity of Immediate Downstream Reach of 250mm dia. Sanitary Sewer =

physical disconnection from any piping or plumbing that is to be connected to the municipal water supply.

4.2.3. Infrastructure Standard Drawings

In addition to these written guidelines, reference should also be made to the City's Infrastructure Standard Drawings.

4.2.4. Approved Products for Drinking Water Systems

In addition to these written guidelines, reference should also be made to the approved products list for drinking water systems.

4.3. Watermain Design Criteria

4.3.1. Flow Calculations

The Developer/Owner and his Consultant shall propose the size of the watermain to accommodate the development.

The watermain shall be sized to meet the greater of either:

- Maximum day demand plus fire flow or
- Peak hour demand.

DENSITIES – the following densities shall be used for population:

Residential P.P.U.

Low Density (single detached, duplexes or semi-detached dwellings)	3.25 ppu
Medium Density (triplexes and fourplexes, cluster and/or block townhouses, street townhouses, walk-up apartments)	2.57 ppu
High Density (apartment dwellings)	1.67 ppu

Adopted from "Development Charges Background Study City of Barrie", Watson & Associates, April 2019

AVERAGE DAY DEMANDS – the following minimum average consumption rates shall be used in average demand calculation:

Average Water Consumption Rate

Residential	225 Litres/Capita/Day
Commercial/Institutional	28 m^3/ha/Day
Industrial	35 m^3/ha/Day

Note: Industrial consumption rate is for light industrial use. Heavy industrial use could have significantly higher water consumptions.

PEAKING FACTORS – peaking factors shall be based on MECP Design Guidelines for Drinking – Water Systems, 2008 (Table 3-1 and Table 3-3).

HAZEN-WILLIAMS "C" FACTORS – the following "C-Factors", as recommended by MECP, shall be used, based on inside diameter of the pipe/ regardless of material:

Watermain Pipe C-Factors

Pipe Diameter (mm)	"C" Factor
150	100
200-250	110
300-600	120
Over 600	130

According to MECP Design Guidelines for Drinking – Water Systems (2008), a minimum operations pressure of 275 kPa (40 psi) and a maximum operating pressure of 700 kPa (100 psi) shall be maintained through the system. Preferred operating pressure shall generally be in the range of 350 to 485 kPa (50 to 70 psi) under maximum daily flow. Pressures outside of this range can be accepted; however, where the maximum pressures exceed 550 kPa (80 psi), PRVs are required inside the building after the meter that is supplied and installed by the contractor/homeowner. Pressure during maximum day demand plus fire flow shall not fall below 140 kPa (20 psi).

The developer's consulting engineer shall contact the Corporate Asset Management Branch of the Infrastructure and Growth Management Division to determine if the development site is in an area experiencing problematic static and residual pressures along with any deficiencies in meeting fire flow requirements.

Fire flows shall meet the following criteria:

FIRE FLOW DEMAND – the following minimum fire flow demands shall be used in hydraulic network analysis unless FUS calculations require a higher fire flow:

Fire Flow Requirements

Description	**Minimum Required Fire Flow (L/s)[1]**
Large Residential Lots [2]	70
Residential	100
Townhouse	155
Apartment	200
High Rise Residential / Downtown / Mixed Use	- [3]
Institutional	200
Commercial	283
Industrial	333

Note 1: Subject to requirements of the Ontario Building Code
2: Refers to Buildings having a minimum of 3.0 meters of separation between buildings
3: Applicant will need to provide their own calculations

Specific fire flow demand shall be calculated according to the latest published requirements of the Water Supply for Public Fire Protection; Fire Underwriters Survey (as amended). Proposed Fire Flows less than minimums indicated would be subject to recommendation by a qualified Professional Engineer and approval by the City on a case by case basis.

Table 3-5 Maximum Day Factor and Average Daily Demand Per Capita Per Zone

	ZONE 1	ZONE 2N	ZONE 3N	ZONE 2S	ZONE 3S
Maximum Day Factor from 2015 to 2017 [1]	2.30	1.66	2.41	2.32	1.63
Maximum Day Factor for Established Population	2.30	1.80	2.41	2.32	1.80
Maximum Day Factor for Future Population [2]					
2021	1.90	1.80	2.00	1.75	1.80
2026	1.80	1.80	2.00	1.75	1.80
2031	1.80	1.75	2.00	1.75	1.80
2036	1.80	1.75	2.00	1.65	1.80
2041	1.80	1.75	2.00	1.65	1.80
2071	1.75	1.75	1.90	1.65	1.75
Average Daily Demand Per Capita (Lpcd) for Established and Future Population [3]	174	162	210	129	224

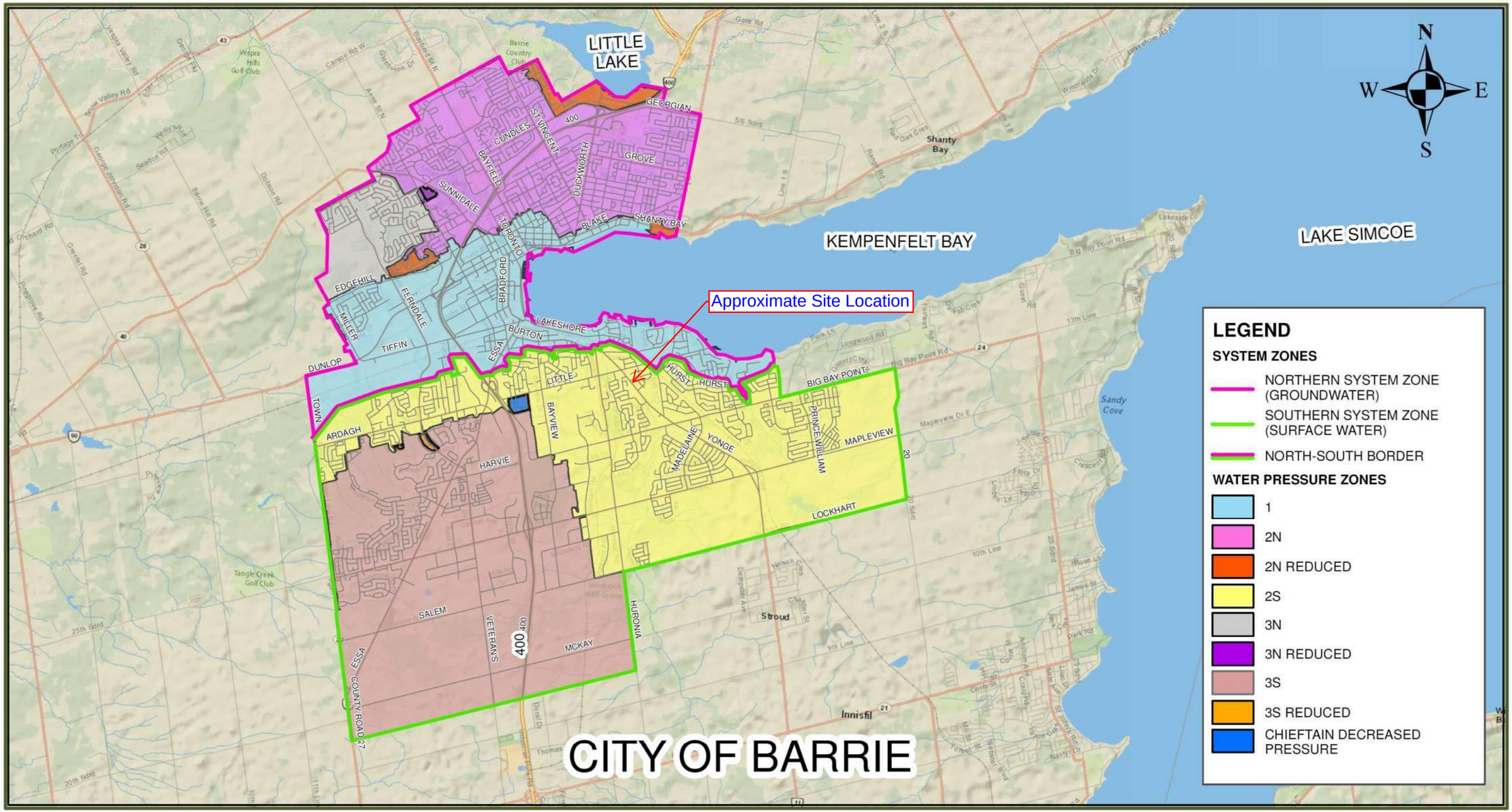
[1] Based on the maximum day factor of each zone found in Table 3-2, Table 3-3 and Table 3-4.

[2] The maximum day factors for the future population were based on Table 3-1: Peaking factors of *Design Guidelines For-Drinking Water Systems, 2008* from MECP, according to the total equivalent population of each projected year.

[3] The average daily demand each zone was calculated based on the average daily demand per capita found in Table 3-2, Table 3-3 and Table 3-4.

The combined population projections, average day demand and maximum day demand projections to ultimate buildout are summarized in Table 3-6. The demands associated with growth in the Salem and Hewitts Secondary Plan Areas have been included in Zones 2S and 3S.

WATER SERVICE AREAS



FLOW TEST RESULTS

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

DATE : MARCH 17, 2022

TIME VALVE OPENED : 11:50 AM

TIME LAST VALVE CLOSED : 12:00 PM

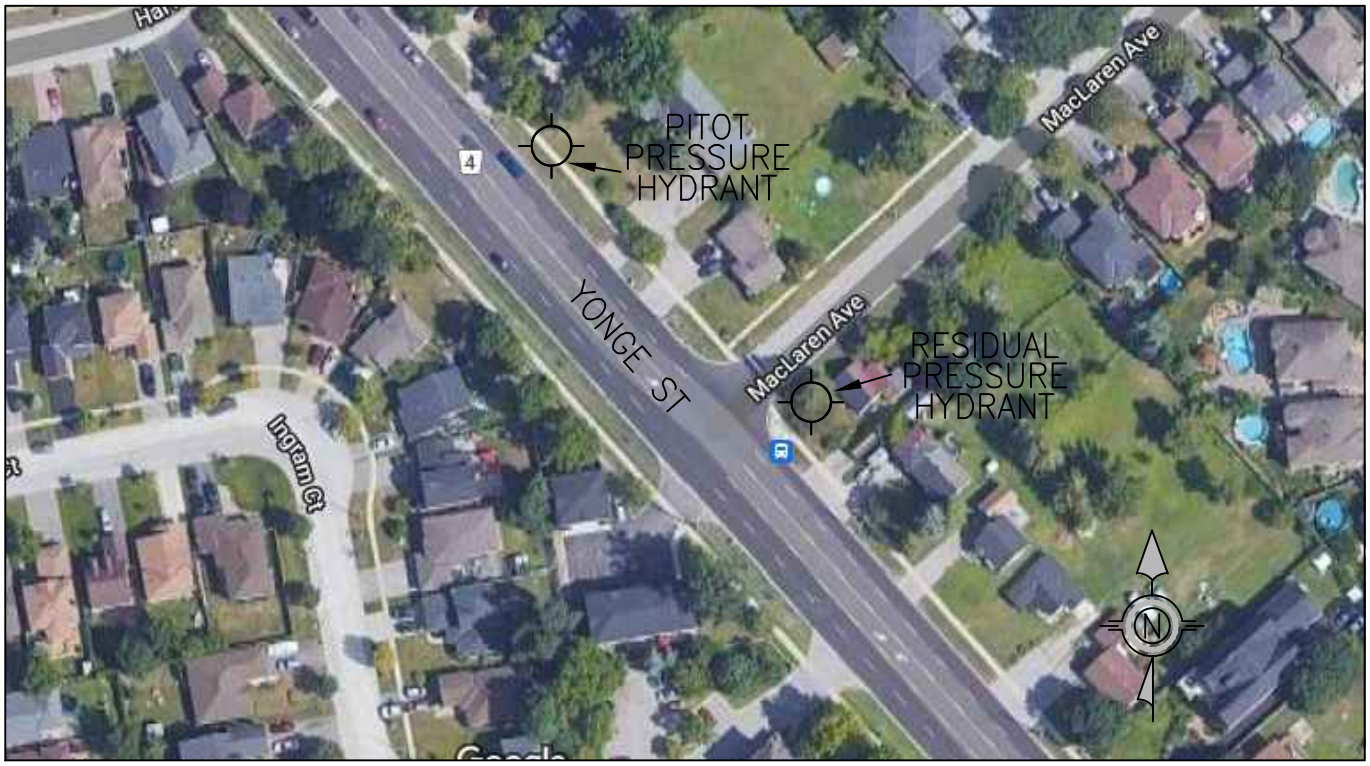
LOCATION : 447 YONGE ST

BARRIE

ONTARIO

TEST BY : LEN.K–ETHAN.B

NAME OF CITY OPERATOR : REBECCA LYNN



STATIC PRESSURE : 85 PSI

SIZE OF UNDERGROUND MAIN : 300MM

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO–EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1–3/4	0.995	83	54	654
2	1	2–1/2	0.90	82	30	924
3	2	2–1/2	0.90	80	22	1582

FIRST FOR FIRE, LIFE SAFETY & SECURITY

VIPOND INC

est. 1945

447 YONGE ST	BY : LEN.K/ETHAN.B
BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : MARCH 17, 2022

STATIC:		RESIDUAL:		FLOW:
85 PSI	TEST#1	83 PSI	@	654 GPM
	TEST#2	82 PSI	@	924 GPM
	TEST#3	80 PSI	@	1582 GPM

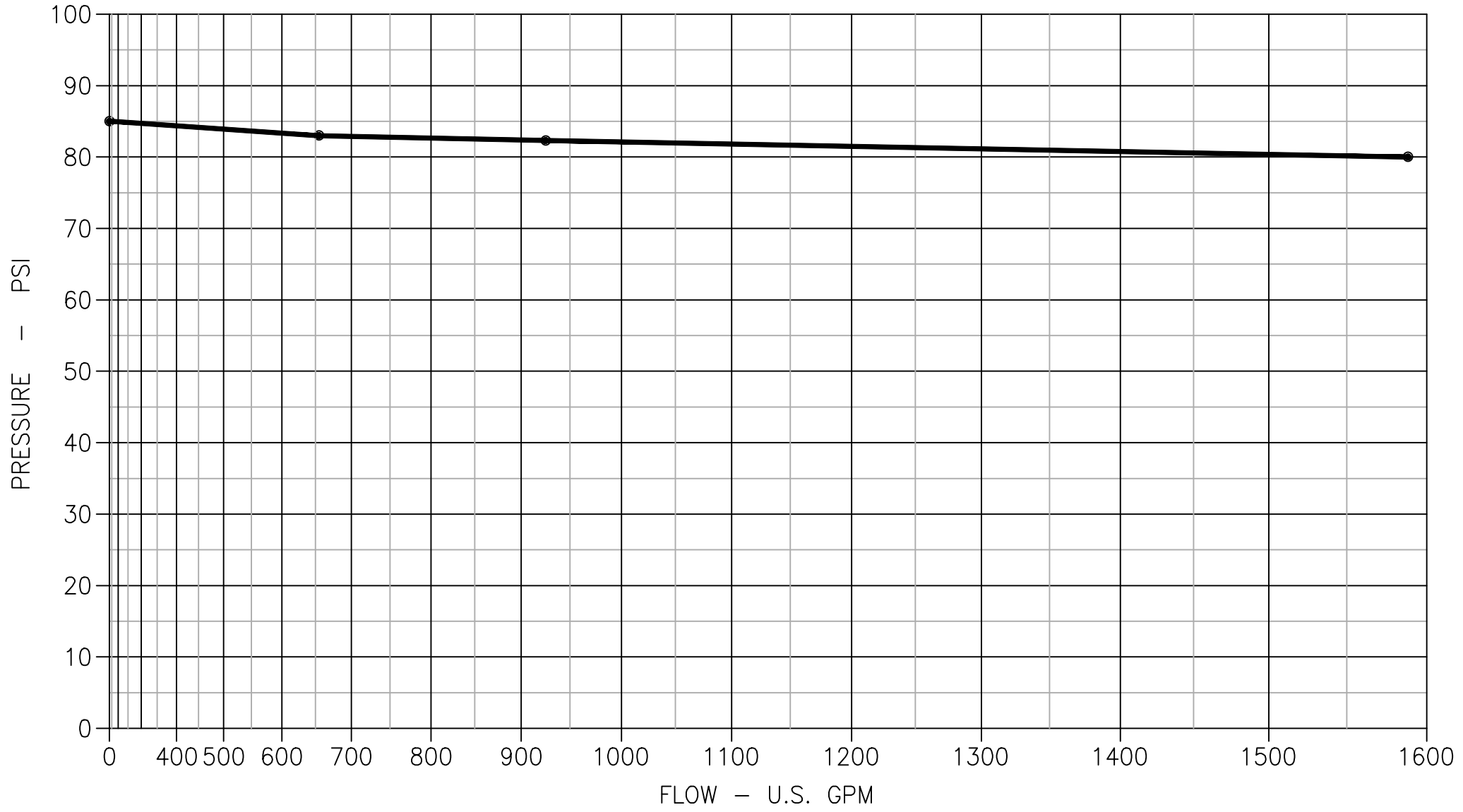


Table 3-1: Peaking Factors

POPULATION	MINIMUM RATE FACTOR (MINIMUM HOUR)	MAXIMUM DAY FACTOR	PEAK RATE FACTOR (PEAK HOUR)
500 - 1 000	0.40	2.75	4.13
1 001 - 2 000	0.45	2.50	3.75
2 001 - 3 000	0.45	2.25	3.38
3 001 - 10 000	0.50	2.00	3.00
10 001 - 25 000	0.60	1.90	2.85
25 001 - 50 000	0.65	1.80	2.70
50 001 - 75 000	0.65	1.75	2.62
75 001 -150 000	0.70	1.65	2.48
greater than 150 000	0.80	1.50	2.25

3.4.3 Commercial and Institutional Water Demands

Institutional and commercial flows should be determined by using historical records, where available. Where no records are available, the values in Table 3.2 should be used. For other commercial and tourist-commercial areas, an allowance of 28 m^3/(ha·d) [3000 USgal/(acre·d)] average flow should be used in the absence of reliable flow data.

When using the above unit demands, maximum day and peak rate factors should be developed. For establishments in operation for only a portion of the day such as schools and shopping plazas, the water usage should also be factored accordingly. For instance, with schools operating for 8 hours per day, the water use rate would be at an average rate of 70 L/(student·day) [19 USgal/(student·day)] x 24/8 or 210 L/student (55 USgal/student) over the 8-hour period of operation. The water use will drop to a residual amount during the remainder of the day. Schools generally do not exhibit large maximum day to average day ratios and a factor of 1.5 will generally cover this variation. For estimation of ***peak demand*** rates, an assessment of the water-using fixtures is generally necessary and a fixture-unit approach should be used.

Fire Flow Calculations – Fire Underwriters Survey 2020

447-455 Yonge Street, City of Barrie

Fire demands for the proposed development were calculated in accordance with the Fire Underwriters Survey (FUS) as follows:

$$\mathbf{RFF = 220C(A)^{0.5}}$$

Where,

RFF = the required fire flow in litres per minute.

C = coefficient related to the type of construction.

A = total floor area of building (excluding basements) calculated as per FUS

Construction Coefficient (C)

C = 1.0 for Type III Ordinary Construction

Total Effective Area (A)

Residential & Commercial Units: 13,609m^2

Total Effective Area: 13,609m^2

Base Required Fire Flow (RFF)

RFF = 220 * 1.0 * (13,609) ^ 0.5
RFF = 25,665 L/min ~ 26,000 L/min

Occupancy and Contents Adjustment Factor

Residential and Commercial Units (Group C & D): -15%

RFF Reduction = 26,000L/min * 0.15 = 3,900L/min

RFF = 26,000L/min – 3,900L/min = 22,100L/min

Automatic Sprinkler Protection Credit

Automatic Sprinkler System Designed and Installed in Accordance with NFPA 13: -30%

RFF Reduction = 22,100L/min * 0.3 = 6,630L/min

Exposure Adjustment Charge

Exposure charge for existing building to the north (~21.6 m) (+2%)

Exposure charge for proposed sprinklered building to the west (~26.0 m) (+0%)

Exposure charge for existing building to the east (~8.0 m) (+17%)

Total Exposure Charge: 19%

RFF Increase = 22,100L/min * 0.19 = 4,199L/min

Design Required Fire Flow (RFF)

Design RFF (FUS 2020) = 22,100L/min – 6,630L/min + 4,199L/min
Design RFF (FUS 2020) = 19,669L/min = 20,000L/min = 333.3L/sec

447 - 455 YONGE STREET DEVELOPMENT
FIRE FLOW ANALYSIS
Barrie, Ontario

Project Number: 22-11672B
Date: April 10, 2024
Design By: DPH
File: Z:\Project Documents\11672B Barrie Yonge Street Developments GP Inc\SPA Work\447-455 Barrie Yonge Street Dev\Working Files\Site Fire Flow Analysis.xls

CALCULATION OF RESIDUAL PRESSURE AT EXISTING WATERMAIN

1. Boundary Conditions (Based on Fire Flow Test Results):					
	Metric		**Imperial**		
P0 - Starting Pressure	59.78	*m*	85	*psi*	
P1 - Pressure at Q1	56.26	*m*	80	*psi*	
Q1 - From Fire Flow Test	5989	*L/min*	1582	*U.S. gal/min*	
Q2 - Required Flow	20046	*L/min*	5296	*U.S. gal/min*	From FUS
P-loss 1	3.52	*m*	5	*psi*	
P-loss 2	32.95	*m*	47	*psi*	
P2 - Residual Pressure	**26.83**	***m***	**38.1**	***psi***	Extrapolated from Fire Flow Test Results

ANALYSIS SUMMARY					
Residual Pressure after Losses	**26.83**	**m**			
	263	**kPa**	**38.2**	**psi**	**PASS**
Allowable Residual Pressure	*140*	*kPa*	*20.3*	*psi*	

APPENDIX D

SWM Design Calculations

PINESTONE ENGINEERING LTD.

where,

Q = the design flow in (m^3/s)

C = the site specific runoff coefficient

A = the drainage area (ha)

i = rainfall intensity (mm/hr)

The rainfall intensity shall be calculated in accordance with the following table and equation:

Table 3.1: Barrie WPCC IDF Curve Parameters - Adjusted to Account for Climate Change

Parameter	Return Period					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
A	675.586	843.019	976.898	1133.123	1251.473	1383.628
B	4.681	4.582	4.745	4.734	4.847	4.905
C	0.780	0.763	0.760	0.756	0.753	0.754

Rainfall Intensity, I (mm/hr) = $A/(t+B)^C$, where t is time duration in minutes

Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557

Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a, b, c values to account for climate change.

$$i = \frac{A}{(t_d + B)^C}$$

where,

i = the rainfall intensity (mm/hr)

t_d = the storm duration (minutes)

A, B, C = a function of the local intensity-duration data.

The storm duration is set to the time of concentration (i.e. the sewer inlet time plus the time of travel in the pipe or channel) for the total cumulative drainage area to the node of interest. The maximum inlet time for the first pipe of a storm sewer system is 10 minutes.

7.2.5 Calculation of Model Parameters

Model parameters shall be site specific, area weighted if required, and provided with the design documents. Soils information shall be obtained from on-site soil testing (*e.g.* borehole data) or soil survey mapping (*e.g. Soil Survey of Simcoe County*).

Table 7.4: Curve Numbers for Selected Land Uses

Land Use Description	Hydrologic Soil Group (AMC II)						
	A	AB	B	BC	C	CD	D
Cultivated Land (Fallow)	77	82	86	89	91	93	94
[2]**Cultivated Land** (Row Crops)							
---- without agricultural BMPs	72	77	81	85	88	90	91
---- [3]with agricultural BMPs	62	67	71	75	78	80	81
[4]**Cultivated Land (Small Grain)**							
---- without agricultural BMPs	65	71	76	80	84	86	88
---- with agricultural BMPs	59	65	70	74	78	80	81
[5]**Cultivated Land** (Close-seeded Legumes or Rotation Meadow)							
---- without agricultural BMPs	66	72	77	81	85	87	89
---- with agricultural BMPs	51	59	67	72	76	78	80
Pasture or Range Land							
---- [6]poor condition	68	74	79	83	86	88	89
---- [7]good condition	39	50	61	68	74	77	80
Meadow							
---- good condition	30	44	58	65	71	75	78
Wooded or Forest Land							
---- [8]poor cover	45	56	66	72	77	80	83
---- [9]good cover	25	40	55	63	70	74	77
Open Spaces, Lawns, Parks, Golf Courses, Cemeteries							
---- good condition (≥75% grass coverage)	39	50	61	68	74	77	80

---- fair condition (50% - 75% grass coverage)	49	59	69	74	79	82	84
Commercial and Business Areas (~85% impervious)	89	91	92	93	94	95	95
Industrial Areas (~72% impervious)	81	85	88	90	91	92	93
[10]**Residential Areas**							
---- ≤ 1/8 acre lot size (~65% impervious)	77	81	85	88	90	91	92
---- 1/4 acre lot size (~38% impervious)	61	68	75	79	83	85	87
---- 1/3 acre lot size (~30% impervious)	57	65	72	77	81	84	86
---- ½ acre lot size (~25% impervious)	54	62	70	75	80	83	85
---- 1 acre lot size (~20% impervious)	51	60	68	74	79	82	84
Paved Parking Lots, Roofs, Driveways	98	98	98	98	98	98	98
Streets and Roads							
---- paved with curb and storm sewer connection	98	98	98	98	98	98	98
---- gravel	76	81	85	87	89	90	91
---- dirt	72	77	82	85	87	88	89
[11]**Open Water Bodies** (Lakes, Wetlands, Ponds)	100	100	100	100	100	100	100

1 -- Adapted from U.S. Soil Conservation Service National Engineering Handbook (1972), MTC Drainage Manual Chapter B (1984), MTO Drainage Management Manual (1997).
2 -- Includes row crops such as soybeans, corn, sorghum hay, peanut, potato, etc.
3 -- Includes agricultural best management practices (BMPs) such as contouring and terracing.
4 -- Includes small grain crops such as winter wheat, spring wheat, durham wheat, barley, oats, rye, etc.
5 -- Includes close-seeded legumes such as alfalfa, timothy grass, grass hay, etc.
6 -- Poor condition is defined as heavily grazed, no mulch, or has plant cover on less than 50% of the area.
7 -- Good condition is defined as lightly grazed, more than 75% of the area has plant cover.
8 -- Poor cover is defined as heavily grazed or regularly burned so that litter, small trees and brush are regularly destroyed.
9 -- Good cover is defined as protected from grazing so that litter and shrubs cover the soil.
10 -- Curve numbers are calculated assuming that roof leaders are connected to the driveway and/or road with a minimum of additional infiltration.
11 – When a number of water bodies within a large multi-land use catchment is modeled, a CN value of 50 may be applied to the water bodies in calculating the area-weighted CN value. When isolating a water body and modeling as a separate catchment, then a CN value of 100 should be used and the catchment is typically routed through a reservoir.

The runoff coefficient shall be calculated in accordance with the following table:

Table 3.2: Runoff Coefficients (Rational C) (5-yr to 10-yr) Based on Hydrologic Soil Group

Land Use	Runoff Coefficient "C"		
	A-AB	B-BC	C-D
Cultivated Land, 0 - 5% grade	0.22	0.35	0.55
Cultivated Land, 5 - 10% grade	0.30	0.45	0.60
Cultivated Land, 10 - 30% grade	0.40	0.65	0.70
Pasture Land, 0 - 5% grade	0.10	0.28	0.40
Pasture Land, 5 - 10% grade	0.15	0.35	0.45
Pasture Land, 10 - 30% grade	0.22	0.40	0.55
Woodlot or Cutover, 0 – 5% grade	0.08	0.25	0.35
Woodlot or Cutover, 5 - 10% grade	0.12	0.30	0.42
Woodlot or Cutover, 10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands	0.05	0.05	0.05
Impervious Area (i.e., buildings, roads, parking lots, etc.)	0.95	0.95	0.95
Gravel (not to be used for proposed parking or storage areas)	0.40	0.50	0.60
Residential – Single Family	0.30	0.40	0.50
Residential – Multiple (i.e., semi, townhouse, apartment)	0.50	0.60	0.70
Industrial – light	0.55	0.65	0.75
Industrial – heavy	0.65	0.75	0.85
Commercial	0.60	0.70	0.80
Unimproved Areas	0.10	0.20	0.30
Lawn, < 2% grade	0.05	0.11	0.17
Lawn, 2 - 7% grade	0.10	0.16	0.22
Lawn, > 7% grade	0.15	0.25	0.35

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997)

An approximation of the runoff coefficient can be calculated based on the following relationship with: $c=(0.7)(TIMP)+0.2$

where,

c = the runoff coefficient

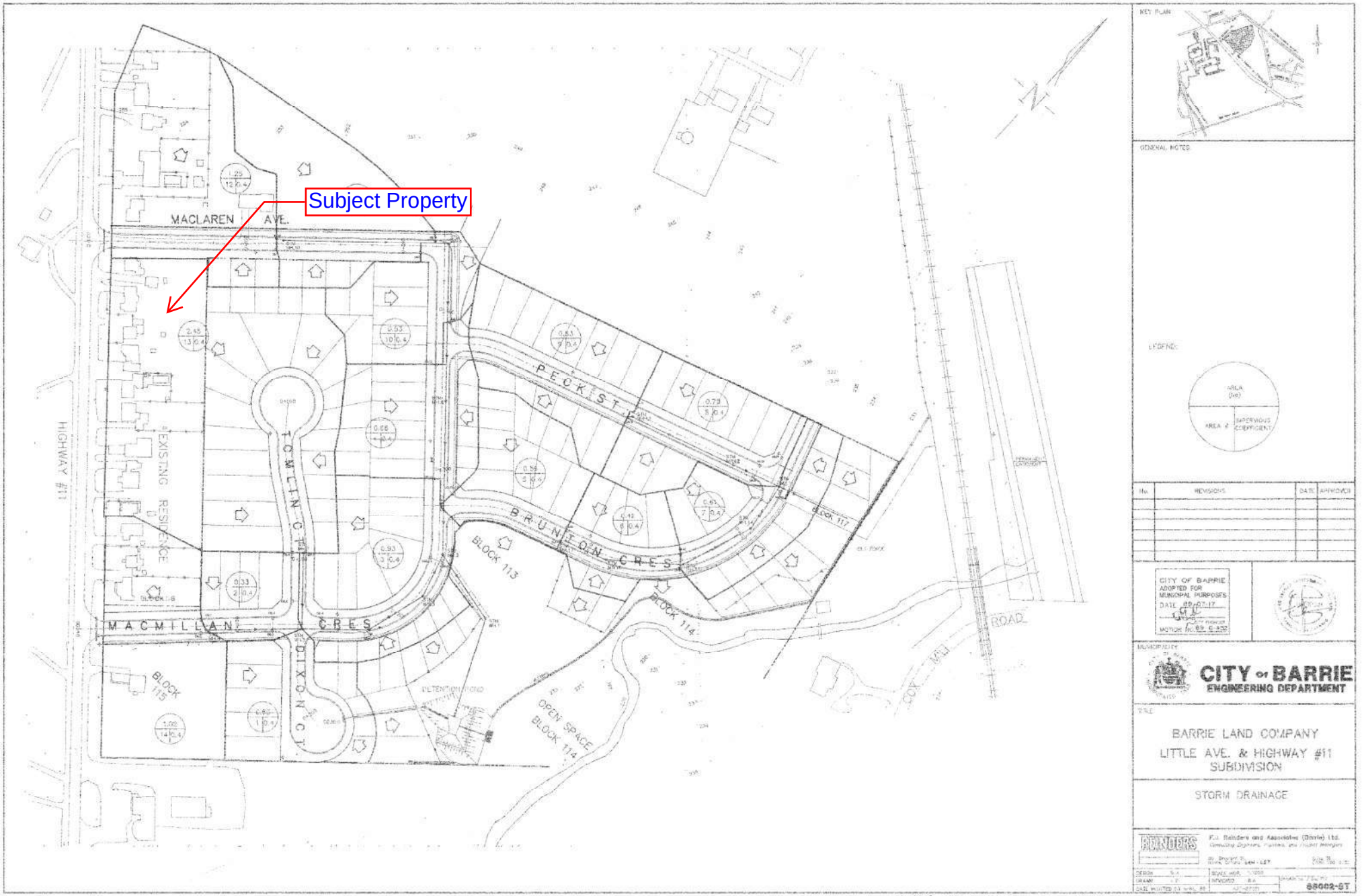
TIMP = total impervious fraction (dimensionless)

The runoff coefficient shall be adjusted for return period events greater than the 10-yr storm per the following table:

Table 3.3: Runoff Coefficient Adjustment for 25-yr to 100-yr Storms

Return Period	Runoff Coefficient "C"
25 years	$C_{25} = 1.1*C_5$
50 years	$C_{50} = 1.2*C_5$
100 years	$C_{100} = 1.25*C_5$

Adapted from Design Chart 1.07, Ontario Ministry of Transportation,"MTO Drainage Management Manual," MTO. (1997).



1995-067-007 95-57 STM2 SUB 171

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

PRE DEVELOPMENT SWM INPUT PARAMETERS

Barrie, Ontario

Project Number: 22-11672B
Date: April 9, 2024
Design By: DH
File: Z:\Project Documents\11672B Barrie Yonge Street Developments GP Inc\SPA Work\447-455 Barrie Yonge Street Dev\Working Files\HYMO SWM Calculations.xls

Time of Concentration Calculations:

Catchment Parameters			
Catchment ID	=	101	
Catchment Area	=	0.5580	ha
Flow Length	=	75	m
Slope	=	0.025	m/m
Weighted Runoff Coefficient*	=	0.40	
Time of Concentration Results			
Bransby Williams Formula (use for C>0.4)	=	3.8	min.
Airport Formula (use for C<=0.4)	=	14.6	min.
Time to Peak			
2/3 of Time of Concentration	=	0.16	hr

* Runoff Coefficient Taken From Little Avenue & Highway #11 Subdivision Storm Drainage Plan; City of Barrie Engineering Record File No. 1995-057-007

Pre Development Curve Number (CN):

Catchment	Hydrologic Soil Group	Soil Texture	Total Area (m^2)	Impervious Area (m^2)	Rooftop Area (m^2)	Meadow / Field Area (m^2)	Open Space Area (m^2)	Crop Area (m^2)	Weighted CN
101	B	Sand & Silt	5,580	540	500		4,540		74.4

Pre Development Initial Abstraction (IA):

Catchment	Total Area (m^2)	Open Space Area (m^2)	Impervious Area (m^2)	Rooftop Area (m^2)	Meadow/Field Area (m^2)	Pasture/Range Area (m^2)	Weighted IA
101	5,580	4,540	540	500			4

SCS Curve Numbers							
Cover	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Wetlands / Lakes/ SWMF's	100	100	100	100	100	100	100
Forest/Woodlot	25	40	55	63	70	74	77
Meadow/Field	30	44	58	65	71	75	78
Open Space	49	59	69	74	79	82	84
Pasture/Range	39	50	61	68	74	77	80
Impervious Areas	98	98	98	98	98	98	98

* Values taken from the City of Barrie Stormwater Infrastructure Design Standard (2023)

Initial Abstraction / Depression Storage	
Cover	Depth (mm)
Wetlands / Lakes/ SWMF	0
Forest/Woodlot	10
Meadow/Field	8
Open Space	5
Pasture/Range	7
Impervious Areas	2

* Values taken from the City of Barrie Stormwater Infrastructure Design Standard (2023)

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

POST DEVELOPMENT SWM INPUT PARAMETERS

Barrie, Ontario

Project Number: 22-11672B
Date: April 9, 2024
Design By: DH
File: Z:\Project Documents\11672B Barrie Yonge Street Developments GP Inc\SPA Work\447-455 Barrie Yonge Street Dev\Working Files\HYMO SWM Calculations.xls

Runoff Coefficients	
Land Use	**"C"**
Lawn (<2%)	0.11
Lawn (2-7%)	0.16
Residential Rooftop Area	0.95
Semi-detached Rooftop Area	0.95
Townhouse Rooftop Area	0.95
Medium/High Density Impervious Area	0.60
Industrial	0.65
Commercial	0.70
Paved areas	0.95

* Values taken from the City of Barrie Stormwater Infrastructure Design Standard (2023)

Post Development Runoff Coefficients:

Catchment	Total Area (m^2)	Lawn (<2%) (m^2)	Lawn (2-7%) (m^2)	Residential Rooftop Area (m^2)	Semi-detached Rooftop Area (m^2)	Townhouse Rooftop Area (m^2)	Medium/High Density Impervious Area (m^2)	Industrial Area (m^2)	Commercial Area (m^2)	Paved Area (m^2)	Weighted C
201	4,250			2,190						2,060	0.95
202	560		370							190	0.43
203	770		770								0.16

Time of Concentration Calculations:

Catchment Parameters			
Catchment ID	=	201	
Catchment Area	=	0.4250	ha
Pervious Flow Length	=	N/A	m
Pervious Slope	=	N/A	m/m
Impervious Slope	=	0.015	m/m
Weighted Runoff Coefficient	=	0.95	

Catchment Parameters			
Catchment ID	=	202	
Catchment Area	=	0.0560	ha
Pervious Flow Length	=	10	m
Pervious Slope	=	0.05	m/m
Impervious Slope	=	0.04	m/m
Weighted Runoff Coefficient	=	0.43	

Catchment Parameters			
Catchment ID	=	203	
Catchment Area	=	0.0770	ha
Flow Length	=	50	m
Slope	=	0.02	m/m
Weighted Runoff Coefficient*	=	0.16	

Time of Concentration Results			
Bransby Williams Formula (use for C>0.4)	=	3.2	min.
Airport Formula (use for C<=0.4)	=	17.2	min.
Time to Peak			
2/3 of Time of Concentration	=	0.19	hr

Post Development Pervious Curve Number (CN):

Catchment	Hydrologic Soil Group	Soil Texture	Total Area (m^2)	Lakes / Wetlands / SWMF's (m^2)	Forest / Woodlot Area (m^2)	Meadow / Field Area (m^2)	Lawn / Grass Area (m^2)	Impervious Area (m^2)	Weighted CN
202	B	Sand & Silt	370				370		61.0
203	B	Sand & Silt	770				770	0	61.0

SCS Curve Numbers							
Cover	**Hydrologic Soil Group**						
	A	**AB**	**B**	**BC**	**C**	**CD**	**D**
Wetlands / Lakes/ SWMF's	100	100	100	100	100	100	100
Forest/Woodlot	25	40	55	63	70	74	77
Meadow/Field	30	44	58	65	71	75	78
Lawn/Grass	39	50	61	68	74	77	80
Pasture/Range	39	50	61	68	74	77	80
Impervious Areas	98	98	98	98	98	98	98

* Values taken from the City of Barrie Stormwater Infrastructure Design Standard (2023)

Post Development Pervious Initial Abstraction (IA):

Catchment	Total Area (m^2)	Lawn/Grass Area (m^2)	Forest/Woodlot Area (m^2)	Lakes / Wetlands SWMF (m^2)	Meadow/Field Area (m^2)	Impervious Area (m^2)	Weighted IA
202	370	370					5
203	770	770				0	5

Initial Abstraction / Depression Storage	
Cover	**Depth (mm)**
Wetlands / Lakes/ SWMF	0
Forest/Woodlot	10
Meadow/Field	8
Lawn/Grass	5
Cultivated	7
Impervious Areas	2

* Values taken from the City of Barrie Stormwater Infrastructure Design Standard (2023)

For STANDHYD Command in Otthymo:

Pervious Area Calculations:	Catchment	Total Pervious Area (m2)
	201	0

Impervious Area Calulations:	Catchment	Total Directly Connected Area (m2)	Total Indirectly Connected Area (m2)	Total Impervious Area (m2)	% Ximp	% Timp
	201	4,250	0	4,250	100.0	100.0

Pervious Area Calculations:	Catchment	Total Pervious Area (m2)
	202	370

Impervious Area Calulations:	Catchment	Total Directly Connected Area (m2)	Total Indirectly Connected Area (m2)	Total Impervious Area (m2)	% Ximp	% Timp
	202	152	38	190	27.1	33.9

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

Stormwater Management Facility Storage Volumes

City of Barrie, Ontario

Project Number: 22-11672B
Date: April 9, 2024

STAGE-STORAGE RELATIONSHIP - PONDING VOLUMES

Elevation	Depth	Surface Pond Areas						Comments
		Area	Avg. Area	Pipes & Structures	SWM Tank	Surface Cells	Accum. Live	
m	*m*	m^2	*m2*	m^3	m^3	m^3	m^3	*m*
251.00	0.00				0.00		0.00	Invert of Orifice / SWM Tank
251.20	0.20				13.62		13.62	Contour
251.40	0.40				13.62		27.25	Contour
251.60	0.60				13.62		40.87	Contour
251.80	0.80				13.62		54.50	Contour
252.00	1.00				13.62		68.12	Contour
252.20	1.20				13.62		81.74	Contour
252.40	1.40				13.62		95.37	Contour
252.60	1.60				13.62		108.99	Contour
252.80	1.80				13.62		122.62	Underside of SWM Tank Lid
253.00	2.00						122.62	Contour
253.20	2.20						122.62	Contour
253.40	2.40						122.62	Contour
253.55	2.55	0.00				0.00	122.62	Top of CB Grates
253.60	2.60	62.50	31.25			1.56	124.18	Contour
253.65	2.65	125.00	93.75			4.69	128.87	Contour
253.70	2.70	526.25	325.63			16.28	145.15	Contour
253.75	2.75	927.50	726.88			36.34	181.49	Contour
253.80	2.80	1328.75	1128.13			56.41	237.90	Overflow Spillway
253.85	2.85	1730.00	1529.38			76.47	314.37	Contour

Storage Tank Size: Cast-In-Place Concrete Stormwater Management Tank (5.2m W x 13.1m L x 1.8m H)
Total Active Storage Capacity: 122.616 m^3
Volume per 1m: 68.120 m^3
Tank Height: 1.8 m

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT
Stormwater Management Facility Storage Volumes
City of Barrie, Ontario

Project Number: 22-11672B
Date: April 9, 2024

Orifice Calculations $Q_o=C_d*A_o*(2*g*H_o)^{0.5}$			
	Orifice 1		
C_d	0.63		
Invert (m)	251.00		
Width (m)	0.000		
Diameter/Height (m)	0.080		
Type (H/V)	V		

Cd	**Description**
0.63	Orifice Plate
0.8	Orifice Tube

Weir Calculations $Q_w=C_w*(H_w)^{1.5}*((L-0.2*H_w)+(0.8*TAN(THETA)*H_w))$	
Cw	1.70
Invert (m)	253.8
Length (m)	6.4
Side Slope (H:V)	0
Side Slope (rad)	0.000

Stage Discharge Relationship for Stormwater Management Facility:

Stage	**Active Volume**	**Orifice 1**			**Orifice 2**			**Weir Flow**	**Total Flow**	**Comments**
		Area	**H_o**	**Flow**	**Area**	**H_o**	**Flow**			
m	m^3	m^2	*m*	m^3/s	m^2	*m*	m^3/s	m^3/s	m^3/s	
251.00	0.00	0.0050	0.00	0.0000					0.0000	Invert of Orifice / SWM Tank
251.20	13.62	0.0050	0.16	0.0056					0.0056	Contour
251.40	27.25	0.0050	0.36	0.0084					0.0084	Contour
251.60	40.87	0.0050	0.56	0.0105					0.0105	Contour
251.80	54.50	0.0050	0.76	0.0122					0.0122	Contour
252.00	68.12	0.0050	0.96	0.0137					0.0137	Contour
252.20	81.74	0.0050	1.16	0.0151					0.0151	Contour
252.40	95.37	0.0050	1.36	0.0164					0.0164	Contour
252.60	108.99	0.0050	1.56	0.0175					0.0175	Contour
252.80	122.62	0.0050	1.76	0.0186					0.0186	Underside of SWM Tank Lid
253.00	122.62	0.0050	1.96	0.0196					0.0196	Contour
253.20	122.62	0.0050	2.16	0.0206					0.0206	Contour
253.40	122.62	0.0050	2.36	0.0215					0.0215	Contour
253.55	122.62	0.0050	2.51	0.0222					0.0222	Top of CB Grates
253.60	124.18	0.0050	2.56	0.0224					0.0224	Contour
253.65	128.87	0.0050	2.61	0.0227					0.0227	Contour
253.70	145.15	0.0050	2.66	0.0229					0.0229	Contour
253.75	181.49	0.0050	2.71	0.0231					0.0231	Contour
253.80	237.90	0.0050	2.76	0.0233				0.0000	0.0233	Overflow Spillway
253.85	314.37	0.0050	2.81	0.0235				0.1215	0.1450	Contour

PRE-DEVELOPMENT



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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                    *****  D E T A I L E D   O U T P U T *****

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  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\fe791d26-ca
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DATE: 04-23-2024                          TIME: 09:36:58

USER:


COMMENTS: _____________________________________________________

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  ************************************************
  ** SIMULATION : 100yr 24hr 5min SCS Type II   **
  ************************************************


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|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              afdc7a59-d0f2-4256-855c-a216e393ad95\c8503f19
| Ptotal=137.63 mm |    Comments: 100yr 24hr 5min SCS Type II
-------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    0.00 |  6.08    2.48 | 12.17   19.82 | 18.25    2.48
                0.08    1.51 |  6.17    2.48 | 12.25   19.82 | 18.33    2.48
                0.17    1.51 |  6.25    2.48 | 12.33   19.82 | 18.42    2.48
                0.25    1.51 |  6.33    2.48 | 12.42   19.82 | 18.50    2.48
                0.33    1.51 |  6.42    2.48 | 12.50   19.82 | 18.58    2.48
                0.42    1.51 |  6.50    2.48 | 12.58   10.18 | 18.67    2.48
                0.50    1.51 |  6.58    2.48 | 12.67   10.18 | 18.75    2.48
                0.58    1.51 |  6.67    2.48 | 12.75   10.18 | 18.83    2.48
                0.67    1.51 |  6.75    2.48 | 12.83   10.18 | 18.92    2.48
                0.75    1.51 |  6.83    2.48 | 12.92   10.18 | 19.00    2.48
                0.83    1.51 |  6.92    2.48 | 13.00   10.18 | 19.08    2.48
                0.92    1.51 |  7.00    2.48 | 13.08    7.43 | 19.17    2.48
                1.00    1.51 |  7.08    3.03 | 13.17    7.43 | 19.25    2.48
                1.08    1.51 |  7.17    3.03 | 13.25    7.43 | 19.33    2.48
                1.17    1.51 |  7.25    3.03 | 13.33    7.43 | 19.42    2.48
                1.25    1.51 |  7.33    3.03 | 13.42    7.43 | 19.50    2.48
                1.33    1.51 |  7.42    3.03 | 13.50    7.43 | 19.58    2.48
                1.42    1.51 |  7.50    3.03 | 13.58    5.78 | 19.67    2.48
                1.50    1.51 |  7.58    3.03 | 13.67    5.78 | 19.75    2.48
                1.58    1.51 |  7.67    3.03 | 13.75    5.78 | 19.83    2.48
                1.67    1.51 |  7.75    3.03 | 13.83    5.78 | 19.92    2.48
                1.75    1.51 |  7.83    3.03 | 13.92    5.78 | 20.00    2.48
                1.83    1.51 |  7.92    3.03 | 14.00    5.78 | 20.08    1.65
                1.92    1.51 |  8.00    3.03 | 14.08    4.13 | 20.17    1.65
                2.00    1.51 |  8.08    3.58 | 14.17    4.13 | 20.25    1.65
                2.08    1.79 |  8.17    3.58 | 14.25    4.13 | 20.33    1.65
                2.17    1.79 |  8.25    3.58 | 14.33    4.13 | 20.42    1.65
                2.25    1.79 |  8.33    3.58 | 14.42    4.13 | 20.50    1.65
                2.33    1.79 |  8.42    3.58 | 14.50    4.13 | 20.58    1.65
                2.42    1.79 |  8.50    3.58 | 14.58    4.13 | 20.67    1.65
                2.50    1.79 |  8.58    3.85 | 14.67    4.13 | 20.75    1.65
                2.58    1.79 |  8.67    3.85 | 14.75    4.13 | 20.83    1.65
                2.67    1.79 |  8.75    3.85 | 14.83    4.13 | 20.92    1.65
                2.75    1.79 |  8.83    3.85 | 14.92    4.13 | 21.00    1.65
                2.83    1.79 |  8.92    3.85 | 15.00    4.13 | 21.08    1.65
                2.92    1.79 |  9.00    3.85 | 15.08    4.13 | 21.17    1.65
                3.00    1.79 |  9.08    4.40 | 15.17    4.13 | 21.25    1.65
                3.08    1.79 |  9.17    4.40 | 15.25    4.13 | 21.33    1.65
                3.17    1.79 |  9.25    4.40 | 15.33    4.13 | 21.42    1.65
                3.25    1.79 |  9.33    4.40 | 15.42    4.13 | 21.50    1.65
                3.33    1.79 |  9.42    4.40 | 15.50    4.13 | 21.58    1.65
                3.42    1.79 |  9.50    4.40 | 15.58    4.13 | 21.67    1.65
                3.50    1.79 |  9.58    4.95 | 15.67    4.13 | 21.75    1.65
                3.58    1.79 |  9.67    4.95 | 15.75    4.13 | 21.83    1.65
                3.67    1.79 |  9.75    4.95 | 15.83    4.13 | 21.92    1.65
                3.75    1.79 |  9.83    4.95 | 15.92    4.13 | 22.00    1.65
                3.83    1.79 |  9.92    4.95 | 16.00    4.13 | 22.08    1.65
                3.92    1.79 | 10.00    4.95 | 16.08    2.48 | 22.17    1.65
                4.00    1.79 | 10.08    6.33 | 16.17    2.48 | 22.25    1.65
                4.08    2.20 | 10.17    6.33 | 16.25    2.48 | 22.33    1.65
                4.17    2.20 | 10.25    6.33 | 16.33    2.48 | 22.42    1.65
                4.25    2.20 | 10.33    6.33 | 16.42    2.48 | 22.50    1.65
                4.33    2.20 | 10.42    6.33 | 16.50    2.48 | 22.58    1.65
                4.42    2.20 | 10.50    6.33 | 16.58    2.48 | 22.67    1.65
                4.50    2.20 | 10.58    8.53 | 16.67    2.48 | 22.75    1.65
                4.58    2.20 | 10.67    8.53 | 16.75    2.48 | 22.83    1.65
                4.67    2.20 | 10.75    8.53 | 16.83    2.48 | 22.92    1.65
                4.75    2.20 | 10.83    8.53 | 16.92    2.48 | 23.00    1.65
                4.83    2.20 | 10.92    8.53 | 17.00    2.48 | 23.08    1.65
                4.92    2.20 | 11.00    8.53 | 17.08    2.48 | 23.17    1.65
                5.00    2.20 | 11.08   13.21 | 17.17    2.48 | 23.25    1.65
                5.08    2.20 | 11.17   13.21 | 17.25    2.48 | 23.33    1.65
                5.17    2.20 | 11.25   13.21 | 17.33    2.48 | 23.42    1.65
                5.25    2.20 | 11.33   13.21 | 17.42    2.48 | 23.50    1.65
                5.33    2.20 | 11.42   13.21 | 17.50    2.48 | 23.58    1.65
                5.42    2.20 | 11.50   13.21 | 17.58    2.48 | 23.67    1.65
                5.50    2.20 | 11.58   40.74 | 17.67    2.48 | 23.75    1.65
                5.58    2.20 | 11.67   40.74 | 17.75    2.48 | 23.83    1.65
                5.67    2.20 | 11.75   40.74 | 17.83    2.48 | 23.92    1.65
                5.75    2.20 | 11.83  168.46 | 17.92    2.48 | 24.00    1.65
                5.83    2.20 | 11.92  168.46 | 18.00    2.48 |
                5.92    2.20 | 12.00  168.46 | 18.08    2.48 |
                6.00    2.20 | 12.08   19.82 | 18.17    2.48 |

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| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=   0.56   Curve Number   (CN)= 74.4
|ID= 1 DT= 5.0 min |   Ia      (mm)=   4.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.16

     Unit Hyd Qpeak  (cms)=   0.133

     PEAK FLOW       (cms)=   0.132 (i)
     TIME TO PEAK    (hrs)=   12.083
     RUNOFF VOLUME    (mm)=  80.426
     TOTAL RAINFALL   (mm)= 137.630
     RUNOFF COEFFICIENT   =   0.584

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

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 FINISH
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================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                    *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\4daa4e83-b4
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\4daa4e83-b4

DATE: 04-23-2024                          TIME: 09:36:58

USER:


COMMENTS: _____________________________________________________

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  ************************************************
  ** SIMULATION : 100yr 4hr 5min Chicago        **
  ************************************************


-------------------
| CHICAGO STORM    |    IDF curve parameters: A=1383.628
| Ptotal= 87.45 mm |                          B=   4.905
-------------------                          C=   0.754
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    6.06 |  1.00   24.64 |  2.00   16.04 |  3.00    7.96
                0.08    6.41 |  1.08   36.97 |  2.08   14.68 |  3.08    7.67
                0.17    6.81 |  1.17   81.48 |  2.17   13.55 |  3.17    7.40
                0.25    7.27 |  1.25  245.55 |  2.25   12.60 |  3.25    7.15
                0.33    7.81 |  1.33  103.86 |  2.33   11.79 |  3.33    6.92
                0.42    8.45 |  1.42   59.20 |  2.42   11.08 |  3.42    6.71
                0.50    9.23 |  1.50   41.66 |  2.50   10.47 |  3.50    6.51
                0.58   10.19 |  1.58   32.37 |  2.58    9.93 |  3.58    6.32
                0.67   11.42 |  1.67   26.62 |  2.67    9.45 |  3.67    6.15
                0.75   13.06 |  1.75   22.72 |  2.75    9.02 |  3.75    5.99
                0.83   15.34 |  1.83   19.89 |  2.83    8.63 |  3.83    5.83
                0.92   18.79 |  1.92   17.73 |  2.92    8.28 |  3.92    5.69

--------------------------------------------------------------------------------------------------------------------
-------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=   0.56   Curve Number   (CN)= 74.4
|ID= 1 DT= 5.0 min |   Ia      (mm)=   4.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.16

     Unit Hyd Qpeak  (cms)=   0.133

     PEAK FLOW       (cms)=   0.078 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  40.573
     TOTAL RAINFALL   (mm)=  87.445
     RUNOFF COEFFICIENT   =   0.464

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

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================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                    *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\8ce311ac-3d
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\8ce311ac-3d

DATE: 04-23-2024                          TIME: 09:36:58

USER:


COMMENTS: _____________________________________________________

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  ************************************************
  ** SIMULATION : 10yr 24hr 5min SCS Type II    **
  ************************************************


-------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              afdc7a59-d0f2-4256-855c-a216e393ad95\a4746fd7
| Ptotal= 93.03 mm |    Comments: 10yr 24hr 5min SCS Type II
-------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    0.00 |  6.08    1.67 | 12.17   13.40 | 18.25    1.67
                0.08    1.02 |  6.17    1.67 | 12.25   13.40 | 18.33    1.67
                0.17    1.02 |  6.25    1.67 | 12.33   13.40 | 18.42    1.67
                0.25    1.02 |  6.33    1.67 | 12.42   13.40 | 18.50    1.67
                0.33    1.02 |  6.42    1.67 | 12.50   13.40 | 18.58    1.67
                0.42    1.02 |  6.50    1.67 | 12.58    6.88 | 18.67    1.67
                0.50    1.02 |  6.58    1.67 | 12.67    6.88 | 18.75    1.67
                0.58    1.02 |  6.67    1.67 | 12.75    6.88 | 18.83    1.67
                0.67    1.02 |  6.75    1.67 | 12.83    6.88 | 18.92    1.67
                0.75    1.02 |  6.83    1.67 | 12.92    6.88 | 19.00    1.67
                0.83    1.02 |  6.92    1.67 | 13.00    6.88 | 19.08    1.67
                0.92    1.02 |  7.00    1.67 | 13.08    5.02 | 19.17    1.67
                1.00    1.02 |  7.08    2.05 | 13.17    5.02 | 19.25    1.67
                1.08    1.02 |  7.17    2.05 | 13.25    5.02 | 19.33    1.67
                1.17    1.02 |  7.25    2.05 | 13.33    5.02 | 19.42    1.67
                1.25    1.02 |  7.33    2.05 | 13.42    5.02 | 19.50    1.67
                1.33    1.02 |  7.42    2.05 | 13.50    5.02 | 19.58    1.67
                1.42    1.02 |  7.50    2.05 | 13.58    3.91 | 19.67    1.67
                1.50    1.02 |  7.58    2.05 | 13.67    3.91 | 19.75    1.67
                1.58    1.02 |  7.67    2.05 | 13.75    3.91 | 19.83    1.67
                1.67    1.02 |  7.75    2.05 | 13.83    3.91 | 19.92    1.67
                1.75    1.02 |  7.83    2.05 | 13.92    3.91 | 20.00    1.67
                1.83    1.02 |  7.92    2.05 | 14.00    3.91 | 20.08    1.12
                1.92    1.02 |  8.00    2.05 | 14.08    2.79 | 20.17    1.12
                2.00    1.02 |  8.08    2.42 | 14.17    2.79 | 20.25    1.12
                2.08    1.21 |  8.17    2.42 | 14.25    2.79 | 20.33    1.12
                2.17    1.21 |  8.25    2.42 | 14.33    2.79 | 20.42    1.12
                2.25    1.21 |  8.33    2.42 | 14.42    2.79 | 20.50    1.12
                2.33    1.21 |  8.42    2.42 | 14.50    2.79 | 20.58    1.12
                2.42    1.21 |  8.50    2.42 | 14.58    2.79 | 20.67    1.12
                2.50    1.21 |  8.58    2.60 | 14.67    2.79 | 20.75    1.12
                2.58    1.21 |  8.67    2.60 | 14.75    2.79 | 20.83    1.12
                2.67    1.21 |  8.75    2.60 | 14.83    2.79 | 20.92    1.12
                2.75    1.21 |  8.83    2.60 | 14.92    2.79 | 21.00    1.12
                2.83    1.21 |  8.92    2.60 | 15.00    2.79 | 21.08    1.12
                2.92    1.21 |  9.00    2.60 | 15.08    2.79 | 21.17    1.12
                3.00    1.21 |  9.08    2.98 | 15.17    2.79 | 21.25    1.12
                3.08    1.21 |  9.17    2.98 | 15.25    2.79 | 21.33    1.12
                3.17    1.21 |  9.25    2.98 | 15.33    2.79 | 21.42    1.12
                3.25    1.21 |  9.33    2.98 | 15.42    2.79 | 21.50    1.12
                3.33    1.21 |  9.42    2.98 | 15.50    2.79 | 21.58    1.12
                3.42    1.21 |  9.50    2.98 | 15.58    2.79 | 21.67    1.12
                3.50    1.21 |  9.58    3.35 | 15.67    2.79 | 21.75    1.12
                3.58    1.21 |  9.67    3.35 | 15.75    2.79 | 21.83    1.12
                3.67    1.21 |  9.75    3.35 | 15.83    2.79 | 21.92    1.12
                3.75    1.21 |  9.83    3.35 | 15.92    2.79 | 22.00    1.12
                3.83    1.21 |  9.92    3.35 | 16.00    2.79 | 22.08    1.12
                3.92    1.21 | 10.00    3.35 | 16.08    1.67 | 22.17    1.12
                4.00    1.21 | 10.08    4.28 | 16.17    1.67 | 22.25    1.12
                4.08    1.49 | 10.17    4.28 | 16.25    1.67 | 22.33    1.12
                4.17    1.49 | 10.25    4.28 | 16.33    1.67 | 22.42    1.12
                4.25    1.49 | 10.33    4.28 | 16.42    1.67 | 22.50    1.12
                4.33    1.49 | 10.42    4.28 | 16.50    1.67 | 22.58    1.12
                4.42    1.49 | 10.50    4.28 | 16.58    1.67 | 22.67    1.12
                4.50    1.49 | 10.58    5.77 | 16.67    1.67 | 22.75    1.12
                4.58    1.49 | 10.67    5.77 | 16.75    1.67 | 22.83    1.12
                4.67    1.49 | 10.75    5.77 | 16.83    1.67 | 22.92    1.12
                4.75    1.49 | 10.83    5.77 | 16.92    1.67 | 23.00    1.12
                4.83    1.49 | 10.92    5.77 | 17.00    1.67 | 23.08    1.12
                4.92    1.49 | 11.00    5.77 | 17.08    1.67 | 23.17    1.12
```

5.00	1.49	11.08	8.93	17.17	1.67	23.25	1.12
5.08	1.49	11.17	8.93	17.25	1.67	23.33	1.12
5.17	1.49	11.25	8.93	17.33	1.67	23.42	1.12
5.25	1.49	11.33	8.93	17.42	1.67	23.50	1.12
5.33	1.49	11.42	8.93	17.50	1.67	23.58	1.12
5.42	1.49	11.50	8.93	17.58	1.67	23.67	1.12
5.50	1.49	11.58	27.54	17.67	1.67	23.75	1.12
5.58	1.49	11.67	27.54	17.75	1.67	23.83	1.12
5.67	1.49	11.75	27.54	17.83	1.67	23.92	1.12
5.75	1.49	11.83	113.87	17.92	1.67	24.00	1.12
5.83	1.49	11.92	113.87	18.00	1.67		
5.92	1.49	12.00	113.87	18.08	1.67		
6.00	1.49	12.08	13.40	18.17	1.67		

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.073 (i)
TIME TO PEAK (hrs)= 12.083
RUNOFF VOLUME (mm)= 44.723
TOTAL RAINFALL (mm)= 93.030
RUNOFF COEFFICIENT = 0.481

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

V V I SSSSS U U A L (v 6.2.2017)
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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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\2087f8ba-46
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\2087f8ba-46

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

** SIMULATION : 10yr 4hr 5min Chicago **

CHICAGO STORM	IDF curve parameters: A= 976.898
Ptotal= 59.77 mm	B= 4.745
	C= 0.760
	used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.04	1.00	16.64	2.00	10.79	3.00	5.32
0.08	4.28	1.08	25.08	2.08	9.86	3.08	5.13
0.17	4.55	1.17	55.96	2.17	9.10	3.17	4.94
0.25	4.86	1.25	173.13	2.25	8.45	3.25	4.78
0.33	5.22	1.33	71.59	2.33	7.91	3.33	4.62
0.42	5.65	1.42	40.40	2.42	7.43	3.42	4.48
0.50	6.18	1.50	28.30	2.50	7.02	3.50	4.34
0.58	6.83	1.58	21.92	2.58	6.65	3.58	4.22
0.67	7.66	1.67	17.99	2.67	6.33	3.67	4.10
0.75	8.77	1.75	15.33	2.75	6.04	3.75	3.99
0.83	10.31	1.83	13.40	2.83	5.78	3.83	3.89
0.92	12.65	1.92	11.94	2.92	5.54	3.92	3.79

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.040 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 21.624
TOTAL RAINFALL (mm)= 59.765
RUNOFF COEFFICIENT = 0.362

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

V V I SSSSS U U A L (v 6.2.2017)
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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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\756582e0-12
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\756582e0-12

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

** SIMULATION : 25yr 24hr 5min SCS Type II **

READ STORM	Filename: C:\Users\dhordyk\AppD
	ata\Local\Temp\
	afdc7a59-d0f2-4256-855c-a216e393ad95\89586bd0
Ptotal=111.09 mm	Comments: 25yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	2.00	12.17	16.00	18.25	2.00
0.08	1.22	6.17	2.00	12.25	16.00	18.33	2.00
0.17	1.22	6.25	2.00	12.33	16.00	18.42	2.00
0.25	1.22	6.33	2.00	12.42	16.00	18.50	2.00
0.33	1.22	6.42	2.00	12.50	16.00	18.58	2.00
0.42	1.22	6.50	2.00	12.58	8.22	18.67	2.00
0.50	1.22	6.58	2.00	12.67	8.22	18.75	2.00
0.58	1.22	6.67	2.00	12.75	8.22	18.83	2.00
0.67	1.22	6.75	2.00	12.83	8.22	18.92	2.00
0.75	1.22	6.83	2.00	12.92	8.22	19.00	2.00
0.83	1.22	6.92	2.00	13.00	8.22	19.08	2.00
0.92	1.22	7.00	2.00	13.08	6.00	19.17	2.00
1.00	1.22	7.08	2.44	13.17	6.00	19.25	2.00
1.08	1.22	7.17	2.44	13.25	6.00	19.33	2.00
1.17	1.22	7.25	2.44	13.33	6.00	19.42	2.00
1.25	1.22	7.33	2.44	13.42	6.00	19.50	2.00
1.33	1.22	7.42	2.44	13.50	6.00	19.58	2.00
1.42	1.22	7.50	2.44	13.58	4.67	19.67	2.00
1.50	1.22	7.58	2.44	13.67	4.67	19.75	2.00
1.58	1.22	7.67	2.44	13.75	4.67	19.83	2.00
1.67	1.22	7.75	2.44	13.83	4.67	19.92	2.00
1.75	1.22	7.83	2.44	13.92	4.67	20.00	2.00
1.83	1.22	7.92	2.44	14.00	4.67	20.08	1.33
1.92	1.22	8.00	2.44	14.08	3.33	20.17	1.33
2.00	1.22	8.08	2.89	14.17	3.33	20.25	1.33
2.08	1.44	8.17	2.89	14.25	3.33	20.33	1.33
2.17	1.44	8.25	2.89	14.33	3.33	20.42	1.33
2.25	1.44	8.33	2.89	14.42	3.33	20.50	1.33
2.33	1.44	8.42	2.89	14.50	3.33	20.58	1.33
2.42	1.44	8.50	2.89	14.58	3.33	20.67	1.33
2.50	1.44	8.58	3.11	14.67	3.33	20.75	1.33
2.58	1.44	8.67	3.11	14.75	3.33	20.83	1.33
2.67	1.44	8.75	3.11	14.83	3.33	20.92	1.33
2.75	1.44	8.83	3.11	14.92	3.33	21.00	1.33
2.83	1.44	8.92	3.11	15.00	3.33	21.08	1.33
2.92	1.44	9.00	3.11	15.08	3.33	21.17	1.33
3.00	1.44	9.08	3.55	15.17	3.33	21.25	1.33
3.08	1.44	9.17	3.55	15.25	3.33	21.33	1.33
3.17	1.44	9.25	3.55	15.33	3.33	21.42	1.33
3.25	1.44	9.33	3.55	15.42	3.33	21.50	1.33
3.33	1.44	9.42	3.55	15.50	3.33	21.58	1.33
3.42	1.44	9.50	3.55	15.58	3.33	21.67	1.33
3.50	1.44	9.58	4.00	15.67	3.33	21.75	1.33
3.58	1.44	9.67	4.00	15.75	3.33	21.83	1.33
3.67	1.44	9.75	4.00	15.83	3.33	21.92	1.33
3.75	1.44	9.83	4.00	15.92	3.33	22.00	1.33
3.83	1.44	9.92	4.00	16.00	3.33	22.08	1.33
3.92	1.44	10.00	4.00	16.08	2.00	22.17	1.33
4.00	1.44	10.08	5.11	16.17	2.00	22.25	1.33
4.08	1.78	10.17	5.11	16.25	2.00	22.33	1.33
4.17	1.78	10.25	5.11	16.33	2.00	22.42	1.33
4.25	1.78	10.33	5.11	16.42	2.00	22.50	1.33
4.33	1.78	10.42	5.11	16.50	2.00	22.58	1.33
4.42	1.78	10.50	5.11	16.58	2.00	22.67	1.33
4.50	1.78	10.58	6.89	16.67	2.00	22.75	1.33
4.58	1.78	10.67	6.89	16.75	2.00	22.83	1.33
4.67	1.78	10.75	6.89	16.83	2.00	22.92	1.33
4.75	1.78	10.83	6.89	16.92	2.00	23.00	1.33
4.83	1.78	10.92	6.89	17.00	2.00	23.08	1.33
4.92	1.78	11.00	6.89	17.08	2.00	23.17	1.33
5.00	1.78	11.08	10.66	17.17	2.00	23.25	1.33
5.08	1.78	11.17	10.66	17.25	2.00	23.33	1.33
5.17	1.78	11.25	10.66	17.33	2.00	23.42	1.33
5.25	1.78	11.33	10.66	17.42	2.00	23.50	1.33
5.33	1.78	11.42	10.66	17.50	2.00	23.58	1.33
5.42	1.78	11.50	10.66	17.58	2.00	23.67	1.33
5.50	1.78	11.58	32.88	17.67	2.00	23.75	1.33
5.58	1.78	11.67	32.88	17.75	2.00	23.83	1.33
5.67	1.78	11.75	32.88	17.83	2.00	23.92	1.33
5.75	1.78	11.83	135.97	17.92	2.00	24.00	1.33
5.83	1.78	11.92	135.97	18.00	2.00		
5.92	1.78	12.00	135.97	18.08	2.00		
6.00	1.78	12.08	16.00	18.17	2.00		

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.096 (i)
TIME TO PEAK (hrs)= 12.083
RUNOFF VOLUME (mm)= 58.700
TOTAL RAINFALL (mm)= 111.090

RUNOFF COEFFICIENT = 0.528

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

V V I SSSSS U U A L (v 6.2.2017)
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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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\e45e9c43-29
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\e45e9c43-29

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

** SIMULATION : 25yr 4hr 5min Chicago **

CHICAGO STORM	IDF curve parameters: A=1133.123
Ptotal= 70.87 mm	B= 4.734
	C= 0.756
	used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.87	1.00	19.82	2.00	12.89	3.00	6.39
0.08	5.15	1.08	29.77	2.08	11.79	3.08	6.16
0.17	5.47	1.17	65.99	2.17	10.89	3.17	5.94
0.25	5.84	1.25	202.83	2.25	10.12	3.25	5.74
0.33	6.27	1.33	84.29	2.33	9.47	3.33	5.56
0.42	6.79	1.42	47.77	2.42	8.91	3.42	5.39
0.50	7.41	1.50	33.55	2.50	8.41	3.50	5.23
0.58	8.19	1.58	26.05	2.58	7.98	3.58	5.08
0.67	9.18	1.67	21.41	2.67	7.59	3.67	4.94
0.75	10.49	1.75	18.27	2.75	7.25	3.75	4.81
0.83	12.33	1.83	15.99	2.83	6.93	3.83	4.68
0.92	15.10	1.92	14.26	2.92	6.65	3.92	4.57

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.054 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 28.853
TOTAL RAINFALL (mm)= 70.867
RUNOFF COEFFICIENT = 0.407

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

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\34cad80d-8f
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\34cad80d-8f

DATE: 04-23-2024                          TIME: 09:36:58

USER:


COMMENTS: _____________________________________________________
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```
  ************************************************
  ** SIMULATION : 2yr 24hr 5min SCS Type II     **
  ************************************************
```

READ STORM	Filename: C:\Users\dhordyk\AppData\Local\Temp\afdc7a59-d0f2-4256-855c-a216e393ad95\918ff4f0
Ptotal= 55.62 mm	Comments: 2yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	1.00	12.17	8.01	18.25	1.00
0.08	0.61	6.17	1.00	12.25	8.01	18.33	1.00
0.17	0.61	6.25	1.00	12.33	8.01	18.42	1.00
0.25	0.61	6.33	1.00	12.42	8.01	18.50	1.00
0.33	0.61	6.42	1.00	12.50	8.01	18.58	1.00
0.42	0.61	6.50	1.00	12.58	4.12	18.67	1.00
0.50	0.61	6.58	1.00	12.67	4.12	18.75	1.00
0.58	0.61	6.67	1.00	12.75	4.12	18.83	1.00
0.67	0.61	6.75	1.00	12.83	4.12	18.92	1.00
0.75	0.61	6.83	1.00	12.92	4.12	19.00	1.00
0.83	0.61	6.92	1.00	13.00	4.12	19.08	1.00
0.92	0.61	7.00	1.00	13.08	3.00	19.17	1.00
1.00	0.61	7.08	1.22	13.17	3.00	19.25	1.00
1.08	0.61	7.17	1.22	13.25	3.00	19.33	1.00
1.17	0.61	7.25	1.22	13.33	3.00	19.42	1.00
1.25	0.61	7.33	1.22	13.42	3.00	19.50	1.00
1.33	0.61	7.42	1.22	13.50	3.00	19.58	1.00
1.42	0.61	7.50	1.22	13.58	2.34	19.67	1.00
1.50	0.61	7.58	1.22	13.67	2.34	19.75	1.00
1.58	0.61	7.67	1.22	13.75	2.34	19.83	1.00
1.67	0.61	7.75	1.22	13.83	2.34	19.92	1.00
1.75	0.61	7.83	1.22	13.92	2.34	20.00	1.00
1.83	0.61	7.92	1.22	14.00	2.34	20.08	0.67
1.92	0.61	8.00	1.22	14.08	1.67	20.17	0.67
2.00	0.61	8.08	1.45	14.17	1.67	20.25	0.67
2.08	0.72	8.17	1.45	14.25	1.67	20.33	0.67
2.17	0.72	8.25	1.45	14.33	1.67	20.42	0.67
2.25	0.72	8.33	1.45	14.42	1.67	20.50	0.67
2.33	0.72	8.42	1.45	14.50	1.67	20.58	0.67
2.42	0.72	8.50	1.45	14.58	1.67	20.67	0.67
2.50	0.72	8.58	1.56	14.67	1.67	20.75	0.67
2.58	0.72	8.67	1.56	14.75	1.67	20.83	0.67
2.67	0.72	8.75	1.56	14.83	1.67	20.92	0.67
2.75	0.72	8.83	1.56	14.92	1.67	21.00	0.67
2.83	0.72	8.92	1.56	15.00	1.67	21.08	0.67
2.92	0.72	9.00	1.56	15.08	1.67	21.17	0.67
3.00	0.72	9.08	1.78	15.17	1.67	21.25	0.67
3.08	0.72	9.17	1.78	15.25	1.67	21.33	0.67
3.17	0.72	9.25	1.78	15.33	1.67	21.42	0.67
3.25	0.72	9.33	1.78	15.42	1.67	21.50	0.67
3.33	0.72	9.42	1.78	15.50	1.67	21.58	0.67
3.42	0.72	9.50	1.78	15.58	1.67	21.67	0.67
3.50	0.72	9.58	2.00	15.67	1.67	21.75	0.67
3.58	0.72	9.67	2.00	15.75	1.67	21.83	0.67
3.67	0.72	9.75	2.00	15.83	1.67	21.92	0.67
3.75	0.72	9.83	2.00	15.92	1.67	22.00	0.67
3.83	0.72	9.92	2.00	16.00	1.67	22.08	0.67
3.92	0.72	10.00	2.00	16.08	1.00	22.17	0.67
4.00	0.72	10.08	2.56	16.17	1.00	22.25	0.67
4.08	0.89	10.17	2.56	16.25	1.00	22.33	0.67
4.17	0.89	10.25	2.56	16.33	1.00	22.42	0.67
4.25	0.89	10.33	2.56	16.42	1.00	22.50	0.67
4.33	0.89	10.42	2.56	16.50	1.00	22.58	0.67
4.42	0.89	10.50	2.56	16.58	1.00	22.67	0.67
4.50	0.89	10.58	3.45	16.67	1.00	22.75	0.67
4.58	0.89	10.67	3.45	16.75	1.00	22.83	0.67
4.67	0.89	10.75	3.45	16.83	1.00	22.92	0.67
4.75	0.89	10.83	3.45	16.92	1.00	23.00	0.67
4.83	0.89	10.92	3.45	17.00	1.00	23.08	0.67
4.92	0.89	11.00	3.45	17.08	1.00	23.17	0.67
5.00	0.89	11.08	5.34	17.17	1.00	23.25	0.67
5.08	0.89	11.17	5.34	17.25	1.00	23.33	0.67
5.17	0.89	11.25	5.34	17.33	1.00	23.42	0.67
5.25	0.89	11.33	5.34	17.42	1.00	23.50	0.67
5.33	0.89	11.42	5.34	17.50	1.00	23.58	0.67
5.42	0.89	11.50	5.34	17.58	1.00	23.67	0.67
5.50	0.89	11.58	16.46	17.67	1.00	23.75	0.67
5.58	0.89	11.67	16.46	17.75	1.00	23.83	0.67
5.67	0.89	11.75	16.46	17.83	1.00	23.92	0.67
5.75	0.89	11.83	68.08	17.92	1.00	24.00	0.67
5.83	0.89	11.92	68.08	18.00	1.00		
5.92	0.89	12.00	68.08	18.08	1.00		
6.00	0.89	12.08	8.01	18.17	1.00		

CALIB NASHYD (0101) ID= 1 DT= 5.0 min	Area (ha)= 0.56 Ia (mm)= 4.00 U.H. Tp(hrs)= 0.16	Curve Number (CN)= 74.4 # of Linear Res.(N)= 3.00

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW	(cms)=	0.030 (i)
TIME TO PEAK	(hrs)=	12.083
RUNOFF VOLUME	(mm)=	19.080
TOTAL RAINFALL	(mm)=	55.620
RUNOFF COEFFICIENT	=	0.343

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

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\2d61c22a-2f
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\2d61c22a-2f

DATE: 04-23-2024                          TIME: 09:36:58

USER:


COMMENTS: _____________________________________________________
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  ************************************************
  ** SIMULATION : 2yr 4hr 5min Chicago          **
  ************************************************
```

CHICAGO STORM	IDF curve parameters: A= 675.586 B= 4.681 C= 0.780
Ptotal= 37.03 mm	used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	2.31	1.00	10.03	2.00	6.39	3.00	3.08
0.08	2.45	1.08	15.38	2.08	5.82	3.08	2.96
0.17	2.61	1.17	35.54	2.17	5.36	3.17	2.85
0.25	2.80	1.25	114.99	2.25	4.96	3.25	2.75
0.33	3.01	1.33	45.86	2.33	4.63	3.33	2.66
0.42	3.27	1.42	25.27	2.42	4.34	3.42	2.57
0.50	3.59	1.50	17.44	2.50	4.09	3.50	2.49
0.58	3.98	1.58	13.36	2.58	3.87	3.58	2.42
0.67	4.48	1.67	10.88	2.67	3.68	3.67	2.35
0.75	5.15	1.75	9.21	2.75	3.50	3.75	2.29
0.83	6.10	1.83	8.01	2.83	3.35	3.83	2.22
0.92	7.55	1.92	7.10	2.92	3.20	3.92	2.17

CALIB NASHYD (0101) ID= 1 DT= 5.0 min	Area (ha)= 0.56 Ia (mm)= 4.00 U.H. Tp(hrs)= 0.16	Curve Number (CN)= 74.4 # of Linear Res.(N)= 3.00

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW	(cms)=	0.017 (i)
TIME TO PEAK	(hrs)=	1.500
RUNOFF VOLUME	(mm)=	9.020
TOTAL RAINFALL	(mm)=	37.034
RUNOFF COEFFICIENT	=	0.244

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

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\c499c70b-b5
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```

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

```
  ************************************************
  ** SIMULATION : 50yr 24hr 5min SCS Type II    **
  ************************************************
```

READ STORM	Filename: C:\Users\dhordyk\AppData\Local\Temp\afdc7a59-d0f2-4256-855c-a216e393ad95\05c15ad9
Ptotal=125.40 mm	Comments: 50yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	2.26	12.17	18.06	18.25	2.26
0.08	1.38	6.17	2.26	12.25	18.06	18.33	2.26
0.17	1.38	6.25	2.26	12.33	18.06	18.42	2.26
0.25	1.38	6.33	2.26	12.42	18.06	18.50	2.26
0.33	1.38	6.42	2.26	12.50	18.06	18.58	2.26
0.42	1.38	6.50	2.26	12.58	9.28	18.67	2.26
0.50	1.38	6.58	2.26	12.67	9.28	18.75	2.26
0.58	1.38	6.67	2.26	12.75	9.28	18.83	2.26
0.67	1.38	6.75	2.26	12.83	9.28	18.92	2.26
0.75	1.38	6.83	2.26	12.92	9.28	19.00	2.26
0.83	1.38	6.92	2.26	13.00	9.28	19.08	2.26
0.92	1.38	7.00	2.26	13.08	6.77	19.17	2.26
1.00	1.38	7.08	2.76	13.17	6.77	19.25	2.26
1.08	1.38	7.17	2.76	13.25	6.77	19.33	2.26
1.17	1.38	7.25	2.76	13.33	6.77	19.42	2.26
1.25	1.38	7.33	2.76	13.42	6.77	19.50	2.26
1.33	1.38	7.42	2.76	13.50	6.77	19.58	2.26
1.42	1.38	7.50	2.76	13.58	5.27	19.67	2.26
1.50	1.38	7.58	2.76	13.67	5.27	19.75	2.26
1.58	1.38	7.67	2.76	13.75	5.27	19.83	2.26
1.67	1.38	7.75	2.76	13.83	5.27	19.92	2.26
1.75	1.38	7.83	2.76	13.92	5.27	20.00	2.26
1.83	1.38	7.92	2.76	14.00	5.27	20.08	1.50
1.92	1.38	8.00	2.76	14.08	3.76	20.17	1.50
2.00	1.38	8.08	3.26	14.17	3.76	20.25	1.50
2.08	1.63	8.17	3.26	14.25	3.76	20.33	1.50
2.17	1.63	8.25	3.26	14.33	3.76	20.42	1.50
2.25	1.63	8.33	3.26	14.42	3.76	20.50	1.50
2.33	1.63	8.42	3.26	14.50	3.76	20.58	1.50
2.42	1.63	8.50	3.26	14.58	3.76	20.67	1.50
2.50	1.63	8.58	3.51	14.67	3.76	20.75	1.50
2.58	1.63	8.67	3.51	14.75	3.76	20.83	1.50
2.67	1.63	8.75	3.51	14.83	3.76	20.92	1.50
2.75	1.63	8.83	3.51	14.92	3.76	21.00	1.50
2.83	1.63	8.92	3.51	15.00	3.76	21.08	1.50
2.92	1.63	9.00	3.51	15.08	3.76	21.17	1.50
3.00	1.63	9.08	4.01	15.17	3.76	21.25	1.50
3.08	1.63	9.17	4.01	15.25	3.76	21.33	1.50
3.17	1.63	9.25	4.01	15.33	3.76	21.42	1.50
3.25	1.63	9.33	4.01	15.42	3.76	21.50	1.50
3.33	1.63	9.42	4.01	15.50	3.76	21.58	1.50
3.42	1.63	9.50	4.01	15.58	3.76	21.67	1.50
3.50	1.63	9.58	4.51	15.67	3.76	21.75	1.50
3.58	1.63	9.67	4.51	15.75	3.76	21.83	1.50
3.67	1.63	9.75	4.51	15.83	3.76	21.92	1.50
3.75	1.63	9.83	4.51	15.92	3.76	22.00	1.50
3.83	1.63	9.92	4.51	16.00	3.76	22.08	1.50
3.92	1.63	10.00	4.51	16.08	2.26	22.17	1.50
4.00	1.63	10.08	5.77	16.17	2.26	22.25	1.50
4.08	2.01	10.17	5.77	16.25	2.26	22.33	1.50
4.17	2.01	10.25	5.77	16.33	2.26	22.42	1.50
4.25	2.01	10.33	5.77	16.42	2.26	22.50	1.50
4.33	2.01	10.42	5.77	16.50	2.26	22.58	1.50
4.42	2.01	10.50	5.77	16.58	2.26	22.67	1.50
4.50	2.01	10.58	7.77	16.67	2.26	22.75	1.50
4.58	2.01	10.67	7.77	16.75	2.26	22.83	1.50
4.67	2.01	10.75	7.77	16.83	2.26	22.92	1.50
4.75	2.01	10.83	7.77	16.92	2.26	23.00	1.50
4.83	2.01	10.92	7.77	17.00	2.26	23.08	1.50
4.92	2.01	11.00	7.77	17.08	2.26	23.17	1.50

5.00	2.01	11.08	12.04	17.17	2.26	23.25	1.50
5.08	2.01	11.17	12.04	17.25	2.26	23.33	1.50
5.17	2.01	11.25	12.04	17.33	2.26	23.42	1.50
5.25	2.01	11.33	12.04	17.42	2.26	23.50	1.50
5.33	2.01	11.42	12.04	17.50	2.26	23.58	1.50
5.42	2.01	11.50	12.04	17.58	2.26	23.67	1.50
5.50	2.01	11.58	37.12	17.67	2.26	23.75	1.50
5.58	2.01	11.67	37.12	17.75	2.26	23.83	1.50
5.67	2.01	11.75	37.12	17.83	2.26	23.92	1.50
5.75	2.01	11.83	153.49	17.92	2.26	24.00	1.50
5.83	2.01	11.92	153.49	18.00	2.26		
5.92	2.01	12.00	153.49	18.08	2.26		
6.00	2.01	12.08	18.06	18.17	2.26		

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.115 (i)
TIME TO PEAK (hrs)= 12.083
RUNOFF VOLUME (mm)= 70.266
TOTAL RAINFALL (mm)= 125.400
RUNOFF COEFFICIENT = 0.560

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

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```

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

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\6bc4abbb-8d
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\6bc4abbb-8d

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

** SIMULATION : 50yr 4hr 5min Chicago **

CHICAGO STORM	IDF curve parameters: A=1251.473
Ptotal= 79.54 mm	B= 4.847
	C= 0.753
	used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	5.53	1.00	22.40	2.00	14.60	3.00	7.26
0.08	5.85	1.08	33.57	2.08	13.36	3.08	6.99
0.17	6.21	1.17	73.94	2.17	12.33	3.17	6.75
0.25	6.63	1.25	223.60	2.25	11.47	3.25	6.52
0.33	7.12	1.33	94.25	2.33	10.74	3.33	6.31
0.42	7.70	1.42	53.72	2.42	10.10	3.42	6.12
0.50	8.41	1.50	37.82	2.50	9.54	3.50	5.94
0.58	9.29	1.58	29.40	2.58	9.05	3.58	5.77
0.67	10.40	1.67	24.19	2.67	8.61	3.67	5.61
0.75	11.89	1.75	20.65	2.75	8.22	3.75	5.46
0.83	13.96	1.83	18.09	2.83	7.87	3.83	5.32
0.92	17.09	1.92	16.14	2.92	7.55	3.92	5.19

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.066 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 34.865
TOTAL RAINFALL (mm)= 79.544
RUNOFF COEFFICIENT = 0.438

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

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\bf23b558-f6
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\bf23b558-f6

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

** SIMULATION : 5yr 24hr 5min SCS Type II **

READ STORM	Filename: C:\Users\dhordyk\AppD
	ata\Local\Temp\
	afdc7a59-d0f2-4256-855c-a216e393ad95\23cbacd2
Ptotal= 78.55 mm	Comments: 5yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	1.41	12.17	11.31	18.25	1.41
0.08	0.86	6.17	1.41	12.25	11.31	18.33	1.41
0.17	0.86	6.25	1.41	12.33	11.31	18.42	1.41
0.25	0.86	6.33	1.41	12.42	11.31	18.50	1.41
0.33	0.86	6.42	1.41	12.50	11.31	18.58	1.41
0.42	0.86	6.50	1.41	12.58	5.81	18.67	1.41
0.50	0.86	6.58	1.41	12.67	5.81	18.75	1.41
0.58	0.86	6.67	1.41	12.75	5.81	18.83	1.41
0.67	0.86	6.75	1.41	12.83	5.81	18.92	1.41
0.75	0.86	6.83	1.41	12.92	5.81	19.00	1.41
0.83	0.86	6.92	1.41	13.00	5.81	19.08	1.41
0.92	0.86	7.00	1.41	13.08	4.24	19.17	1.41
1.00	0.86	7.08	1.73	13.17	4.24	19.25	1.41
1.08	0.86	7.17	1.73	13.25	4.24	19.33	1.41
1.17	0.86	7.25	1.73	13.33	4.24	19.42	1.41
1.25	0.86	7.33	1.73	13.42	4.24	19.50	1.41
1.33	0.86	7.42	1.73	13.50	4.24	19.58	1.41
1.42	0.86	7.50	1.73	13.58	3.30	19.67	1.41
1.50	0.86	7.58	1.73	13.67	3.30	19.75	1.41
1.58	0.86	7.67	1.73	13.75	3.30	19.83	1.41
1.67	0.86	7.75	1.73	13.83	3.30	19.92	1.41
1.75	0.86	7.83	1.73	13.92	3.30	20.00	1.41
1.83	0.86	7.92	1.73	14.00	3.30	20.08	0.94
1.92	0.86	8.00	1.73	14.08	2.36	20.17	0.94
2.00	0.86	8.08	2.04	14.17	2.36	20.25	0.94
2.08	1.02	8.17	2.04	14.25	2.36	20.33	0.94
2.17	1.02	8.25	2.04	14.33	2.36	20.42	0.94
2.25	1.02	8.33	2.04	14.42	2.36	20.50	0.94
2.33	1.02	8.42	2.04	14.50	2.36	20.58	0.94
2.42	1.02	8.50	2.04	14.58	2.36	20.67	0.94
2.50	1.02	8.58	2.20	14.67	2.36	20.75	0.94
2.58	1.02	8.67	2.20	14.75	2.36	20.83	0.94
2.67	1.02	8.75	2.20	14.83	2.36	20.92	0.94
2.75	1.02	8.83	2.20	14.92	2.36	21.00	0.94
2.83	1.02	8.92	2.20	15.00	2.36	21.08	0.94
2.92	1.02	9.00	2.20	15.08	2.36	21.17	0.94
3.00	1.02	9.08	2.51	15.17	2.36	21.25	0.94
3.08	1.02	9.17	2.51	15.25	2.36	21.33	0.94
3.17	1.02	9.25	2.51	15.33	2.36	21.42	0.94
3.25	1.02	9.33	2.51	15.42	2.36	21.50	0.94
3.33	1.02	9.42	2.51	15.50	2.36	21.58	0.94
3.42	1.02	9.50	2.51	15.58	2.36	21.67	0.94
3.50	1.02	9.58	2.83	15.67	2.36	21.75	0.94
3.58	1.02	9.67	2.83	15.75	2.36	21.83	0.94
3.67	1.02	9.75	2.83	15.83	2.36	21.92	0.94
3.75	1.02	9.83	2.83	15.92	2.36	22.00	0.94
3.83	1.02	9.92	2.83	16.00	2.36	22.08	0.94
3.92	1.02	10.00	2.83	16.08	1.41	22.17	0.94
4.00	1.02	10.08	3.61	16.17	1.41	22.25	0.94
4.08	1.26	10.17	3.61	16.25	1.41	22.33	0.94
4.17	1.26	10.25	3.61	16.33	1.41	22.42	0.94
4.25	1.26	10.33	3.61	16.42	1.41	22.50	0.94
4.33	1.26	10.42	3.61	16.50	1.41	22.58	0.94
4.42	1.26	10.50	3.61	16.58	1.41	22.67	0.94
4.50	1.26	10.58	4.87	16.67	1.41	22.75	0.94
4.58	1.26	10.67	4.87	16.75	1.41	22.83	0.94
4.67	1.26	10.75	4.87	16.83	1.41	22.92	0.94
4.75	1.26	10.83	4.87	16.92	1.41	23.00	0.94
4.83	1.26	10.92	4.87	17.00	1.41	23.08	0.94
4.92	1.26	11.00	4.87	17.08	1.41	23.17	0.94
5.00	1.26	11.08	7.54	17.17	1.41	23.25	0.94
5.08	1.26	11.17	7.54	17.25	1.41	23.33	0.94
5.17	1.26	11.25	7.54	17.33	1.41	23.42	0.94
5.25	1.26	11.33	7.54	17.42	1.41	23.50	0.94
5.33	1.26	11.42	7.54	17.50	1.41	23.58	0.94
5.42	1.26	11.50	7.54	17.58	1.41	23.67	0.94
5.50	1.26	11.58	23.25	17.67	1.41	23.75	0.94
5.58	1.26	11.67	23.25	17.75	1.41	23.83	0.94
5.67	1.26	11.75	23.25	17.83	1.41	23.92	0.94
5.75	1.26	11.83	96.15	17.92	1.41	24.00	0.94
5.83	1.26	11.92	96.15	18.00	1.41		
5.92	1.26	12.00	96.15	18.08	1.41		
6.00	1.26	12.08	11.31	18.17	1.41		

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.055 (i)
TIME TO PEAK (hrs)= 12.083
RUNOFF VOLUME (mm)= 34.162
TOTAL RAINFALL (mm)= 78.550

RUNOFF COEFFICIENT = 0.435

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

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```

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

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\281d5ed0-3e
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\281d5ed0-3e

DATE: 04-23-2024 TIME: 09:36:58

USER:

COMMENTS: _____

** SIMULATION : 5yr 4hr 5min Chicago **

CHICAGO STORM	IDF curve parameters: A= 843.019
Ptotal= 50.76 mm	B= 4.582
	C= 0.763
	used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	3.39	1.00	14.01	2.00	9.07	3.00	4.46
0.08	3.58	1.08	21.15	2.08	8.29	3.08	4.30
0.17	3.81	1.17	47.54	2.17	7.64	3.17	4.15
0.25	4.07	1.25	150.31	2.25	7.10	3.25	4.01
0.33	4.38	1.33	60.96	2.33	6.64	3.33	3.88
0.42	4.74	1.42	34.18	2.42	6.24	3.42	3.75
0.50	5.18	1.50	23.88	2.50	5.89	3.50	3.64
0.58	5.73	1.58	18.47	2.58	5.58	3.58	3.54
0.67	6.43	1.67	15.15	2.67	5.31	3.67	3.44
0.75	7.36	1.75	12.90	2.75	5.07	3.75	3.35
0.83	8.67	1.83	11.27	2.83	4.85	3.83	3.26
0.92	10.64	1.92	10.04	2.92	4.65	3.92	3.18

CALIB	
NASHYD (0101)	Area (ha)= 0.56 Curve Number (CN)= 74.4
ID= 1 DT= 5.0 min	Ia (mm)= 4.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.16

Unit Hyd Qpeak (cms)= 0.133

PEAK FLOW (cms)= 0.030 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 16.222
TOTAL RAINFALL (mm)= 50.757
RUNOFF COEFFICIENT = 0.320

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

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\3d0a49b0-c2
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\3d0a49b0-c2


DATE: 04-23-2024                          TIME: 09:39:30

USER:


COMMENTS: _____________________________________________________________


-------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : HAZEL                         **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              fae66489-818a-4d8f-bfcd-c5d55cf44e2c\6894cbd9
| Ptotal=212.00 mm |    Comments: HAZEL
--------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.00    6.00 |  3.00   13.00 |  6.00   23.00 |  9.00   53.00
               0.20    6.00 |  3.20   13.00 |  6.20   23.00 |  9.20   53.00
               0.40    6.00 |  3.40   13.00 |  6.40   23.00 |  9.40   53.00
               0.60    6.00 |  3.60   13.00 |  6.60   23.00 |  9.60   53.00
               0.80    6.00 |  3.80   13.00 |  6.80   23.00 |  9.80   53.00
               1.00    4.00 |  4.00   17.00 |  7.00   13.00 | 10.00   38.00
               1.20    4.00 |  4.20   17.00 |  7.20   13.00 | 10.20   38.00
               1.40    4.00 |  4.40   17.00 |  7.40   13.00 | 10.40   38.00
               1.60    4.00 |  4.60   17.00 |  7.60   13.00 | 10.60   38.00
               1.80    4.00 |  4.80   17.00 |  7.80   13.00 | 10.80   38.00
               2.00    6.00 |  5.00   13.00 |  8.00   13.00 | 11.00   13.00
               2.20    6.00 |  5.20   13.00 |  8.20   13.00 | 11.20   13.00
               2.40    6.00 |  5.40   13.00 |  8.40   13.00 | 11.40   13.00
               2.60    6.00 |  5.60   13.00 |  8.60   13.00 | 11.60   13.00
               2.80    6.00 |  5.80   13.00 |  8.80   13.00 | 11.80   13.00

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

--------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=   0.56   Curve Number   (CN)= 87.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   4.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.16

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


                        ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
              0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
              0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
              0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
              0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
              0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
              0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
              0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
              0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
              0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
              0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
              1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
              1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
              1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
              1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
              1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
              1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
              1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
              1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
              1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
              1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
              1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
              1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
              2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
              2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
              2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
              2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
              2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
              2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
              2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
              2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
              2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
              2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
              2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
              2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
              3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Unit Hyd Qpeak  (cms)=   0.133

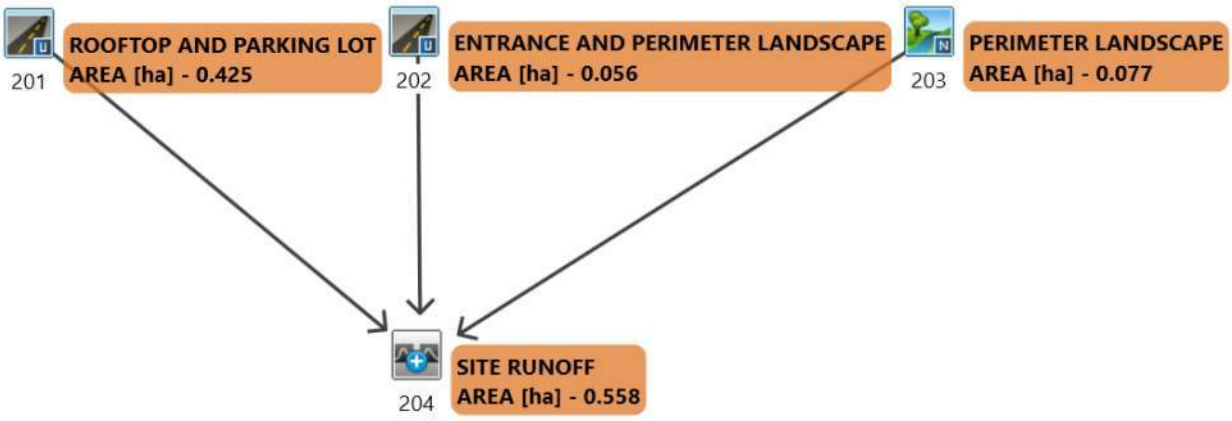
     PEAK FLOW       (cms)=   0.078 (i)
     TIME TO PEAK    (hrs)=  10.000
     RUNOFF VOLUME    (mm)= 175.110
     TOTAL RAINFALL   (mm)= 212.000
     RUNOFF COEFFICIENT    =   0.826

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

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

 FINISH
=============================================================================================================
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POST-DEVELOPMENT



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================================================================================================================

       V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\f28e22ff-4e
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\f28e22ff-4e


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____________________________________________________


--------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 100yr 24hr 5min SCS Type II   **
  ************************************************


-------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              f3913089-0d82-44ff-bd71-c0a13997982d\c8503f19
| Ptotal=137.63 mm |    Comments: 100yr 24hr 5min SCS Type II
-------------------

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    0.00 |  6.08    2.48 | 12.17   19.82 | 18.25    2.48
                0.08    1.51 |  6.17    2.48 | 12.25   19.82 | 18.33    2.48
                0.17    1.51 |  6.25    2.48 | 12.33   19.82 | 18.42    2.48
                0.25    1.51 |  6.33    2.48 | 12.42   19.82 | 18.50    2.48
                0.33    1.51 |  6.42    2.48 | 12.50   19.82 | 18.58    2.48
                0.42    1.51 |  6.50    2.48 | 12.58   10.18 | 18.67    2.48
                0.50    1.51 |  6.58    2.48 | 12.67   10.18 | 18.75    2.48
                0.58    1.51 |  6.67    2.48 | 12.75   10.18 | 18.83    2.48
                0.67    1.51 |  6.75    2.48 | 12.83   10.18 | 18.92    2.48
                0.75    1.51 |  6.83    2.48 | 12.92   10.18 | 19.00    2.48
                0.83    1.51 |  6.92    2.48 | 13.00   10.18 | 19.08    2.48
                0.92    1.51 |  7.00    2.48 | 13.08    7.43 | 19.17    2.48
                1.00    1.51 |  7.08    3.03 | 13.17    7.43 | 19.25    2.48
                1.08    1.51 |  7.17    3.03 | 13.25    7.43 | 19.33    2.48
                1.17    1.51 |  7.25    3.03 | 13.33    7.43 | 19.42    2.48
                1.25    1.51 |  7.33    3.03 | 13.42    7.43 | 19.50    2.48
                1.33    1.51 |  7.42    3.03 | 13.50    7.43 | 19.58    2.48
                1.42    1.51 |  7.50    3.03 | 13.58    5.78 | 19.67    2.48
                1.50    1.51 |  7.58    3.03 | 13.67    5.78 | 19.75    2.48
                1.58    1.51 |  7.67    3.03 | 13.75    5.78 | 19.83    2.48
                1.67    1.51 |  7.75    3.03 | 13.83    5.78 | 19.92    2.48
                1.75    1.51 |  7.83    3.03 | 13.92    5.78 | 20.00    2.48
                1.83    1.51 |  7.92    3.03 | 14.00    5.78 | 20.08    1.65
                1.92    1.51 |  8.00    3.03 | 14.08    4.13 | 20.17    1.65
                2.00    1.51 |  8.08    3.58 | 14.17    4.13 | 20.25    1.65
                2.08    1.79 |  8.17    3.58 | 14.25    4.13 | 20.33    1.65
                2.17    1.79 |  8.25    3.58 | 14.33    4.13 | 20.42    1.65
                2.25    1.79 |  8.33    3.58 | 14.42    4.13 | 20.50    1.65
                2.33    1.79 |  8.42    3.58 | 14.50    4.13 | 20.58    1.65
                2.42    1.79 |  8.50    3.58 | 14.58    4.13 | 20.67    1.65
                2.50    1.79 |  8.58    3.85 | 14.67    4.13 | 20.75    1.65
                2.58    1.79 |  8.67    3.85 | 14.75    4.13 | 20.83    1.65
                2.67    1.79 |  8.75    3.85 | 14.83    4.13 | 20.92    1.65
                2.75    1.79 |  8.83    3.85 | 14.92    4.13 | 21.00    1.65
                2.83    1.79 |  8.92    3.85 | 15.00    4.13 | 21.08    1.65
                2.92    1.79 |  9.00    3.85 | 15.08    4.13 | 21.17    1.65
                3.00    1.79 |  9.08    4.40 | 15.17    4.13 | 21.25    1.65
                3.08    1.79 |  9.17    4.40 | 15.25    4.13 | 21.33    1.65
                3.17    1.79 |  9.25    4.40 | 15.33    4.13 | 21.42    1.65
                3.25    1.79 |  9.33    4.40 | 15.42    4.13 | 21.50    1.65
                3.33    1.79 |  9.42    4.40 | 15.50    4.13 | 21.58    1.65
                3.42    1.79 |  9.50    4.40 | 15.58    4.13 | 21.67    1.65
                3.50    1.79 |  9.58    4.95 | 15.67    4.13 | 21.75    1.65
                3.58    1.79 |  9.67    4.95 | 15.75    4.13 | 21.83    1.65
                3.67    1.79 |  9.75    4.95 | 15.83    4.13 | 21.92    1.65
                3.75    1.79 |  9.83    4.95 | 15.92    4.13 | 22.00    1.65
                3.83    1.79 |  9.92    4.95 | 16.00    4.13 | 22.08    1.65
                3.92    1.79 | 10.00    4.95 | 16.08    2.48 | 22.17    1.65
                4.00    1.79 | 10.08    6.33 | 16.17    2.48 | 22.25    1.65
                4.08    2.20 | 10.17    6.33 | 16.25    2.48 | 22.33    1.65
                4.17    2.20 | 10.25    6.33 | 16.33    2.48 | 22.42    1.65
                4.25    2.20 | 10.33    6.33 | 16.42    2.48 | 22.50    1.65
                4.33    2.20 | 10.42    6.33 | 16.50    2.48 | 22.58    1.65
                4.42    2.20 | 10.50    6.33 | 16.58    2.48 | 22.67    1.65
                4.50    2.20 | 10.58    8.53 | 16.67    2.48 | 22.75    1.65
                4.58    2.20 | 10.67    8.53 | 16.75    2.48 | 22.83    1.65
                4.67    2.20 | 10.75    8.53 | 16.83    2.48 | 22.92    1.65
                4.75    2.20 | 10.83    8.53 | 16.92    2.48 | 23.00    1.65
                4.83    2.20 | 10.92    8.53 | 17.00    2.48 | 23.08    1.65
                4.92    2.20 | 11.00    8.53 | 17.08    2.48 | 23.17    1.65
                5.00    2.20 | 11.08   13.21 | 17.17    2.48 | 23.25    1.65
                5.08    2.20 | 11.17   13.21 | 17.25    2.48 | 23.33    1.65
                5.17    2.20 | 11.25   13.21 | 17.33    2.48 | 23.42    1.65
                5.25    2.20 | 11.33   13.21 | 17.42    2.48 | 23.50    1.65
                5.33    2.20 | 11.42   13.21 | 17.50    2.48 | 23.58    1.65
                5.42    2.20 | 11.50   13.21 | 17.58    2.48 | 23.67    1.65
                5.50    2.20 | 11.58   40.74 | 17.67    2.48 | 23.75    1.65
                5.58    2.20 | 11.67   40.74 | 17.75    2.48 | 23.83    1.65
                5.67    2.20 | 11.75   40.74 | 17.83    2.48 | 23.92    1.65
                5.75    2.20 | 11.83  168.46 | 17.92    2.48 | 24.00    1.65
                5.83    2.20 | 11.92  168.46 | 18.00    2.48 |
                5.92    2.20 | 12.00  168.46 | 18.08    2.48 |
                6.00    2.20 | 12.08   19.82 | 18.17    2.48 |

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-------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.012 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  59.478
     TOTAL RAINFALL   (mm)= 137.630
     RUNOFF COEFFICIENT   =   0.432

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

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-------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     168.46        167.74
               over (min)        5.00          5.00
     Storage Coeff.  (min)=       1.26 (ii)     1.63 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.33          0.32
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.20          0.00          0.199 (iii)
     TIME TO PEAK    (hrs)=      12.08         12.08           12.08
     RUNOFF VOLUME    (mm)=     135.63        130.64          135.62
     TOTAL RAINFALL   (mm)=     137.63        137.63          137.63
     RUNOFF COEFFICIENT   =       0.99          0.95            0.99

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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-------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
-------------------

                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02          0.04
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       4.00          5.00
     Length            (m)=      19.32         10.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     168.46        102.16
               over (min)        5.00          5.00
     Storage Coeff.  (min)=       0.51 (ii)     3.22 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.34          0.27
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.01          0.01          0.018 (iii)
     TIME TO PEAK    (hrs)=      12.00         12.08           12.08
     RUNOFF VOLUME    (mm)=     135.63         63.19           82.80
     TOTAL RAINFALL   (mm)=     137.63        137.63          137.63
     RUNOFF COEFFICIENT   =       0.99          0.46            0.60

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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-------------------
| ADD HYD  (  0204)|
|  1 +   2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------             (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):      0.42   0.199    12.08    135.62
     + ID2= 2 (  0202):      0.06   0.018    12.08     82.80
       ==================================================
       ID = 3 (  0204):      0.48   0.217    12.08    129.47

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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-------------------
| ADD HYD  (  0204)|
|  3 +   2 =  1    |          AREA    QPEAK    TPEAK     R.V.
-------------------             (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):      0.48   0.217    12.08    129.47
     + ID2= 2 (  0203):      0.08   0.012    12.17     59.48
       ==================================================
       ID = 1 (  0204):      0.56   0.228    12.08    119.81

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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 FINISH

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       V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\1d91fbad-64
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\1d91fbad-64


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____________________________________


--------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 100yr 4hr 5min Chicago        **
  ************************************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1383.628
| Ptotal= 87.45 mm |                          B=   4.905
--------------------                          C=   0.754
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    =  5.00 min
                         Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    6.06 |  1.00   24.64 |  2.00   16.04 |  3.00    7.96
                0.08    6.41 |  1.08   36.97 |  2.08   14.68 |  3.08    7.67
                0.17    6.81 |  1.17   81.48 |  2.17   13.55 |  3.17    7.40
                0.25    7.27 |  1.25  245.55 |  2.25   12.60 |  3.25    7.15
                0.33    7.81 |  1.33  103.86 |  2.33   11.79 |  3.33    6.92
                0.42    8.45 |  1.42   59.20 |  2.42   11.08 |  3.42    6.71
                0.50    9.23 |  1.50   41.66 |  2.50   10.47 |  3.50    6.51
                0.58   10.19 |  1.58   32.37 |  2.58    9.93 |  3.58    6.32
                0.67   11.42 |  1.67   26.62 |  2.67    9.45 |  3.67    6.15
                0.75   13.06 |  1.75   22.72 |  2.75    9.02 |  3.75    5.99
                0.83   15.34 |  1.83   19.89 |  2.83    8.63 |  3.83    5.83
                0.92   18.79 |  1.92   17.73 |  2.92    8.28 |  3.92    5.69

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-------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.006 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  27.691
     TOTAL RAINFALL   (mm)=  87.445
     RUNOFF COEFFICIENT   =   0.317

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

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-------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     245.55        171.27
               over (min)        5.00          5.00
     Storage Coeff.  (min)=       1.08 (ii)     1.40 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.34          0.33
                                                      *TOTALS*
```

```
     PEAK FLOW       (cms)=       0.29         0.00          0.288 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      85.45        80.56          85.44
     TOTAL RAINFALL   (mm)=      87.45        87.45          87.45
     RUNOFF COEFFICIENT   =       0.98         0.92           0.98

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0     Ia = Dep. Storage   (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02         0.04
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       4.00         5.00
     Length            (m)=      19.32        10.00
     Mannings n            =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     245.55        61.82
               over (min)          5.00         5.00
     Storage Coeff.  (min)=       0.44 (ii)    2.77 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.28
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.01         0.01          0.017 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      85.45        29.87          44.89
     TOTAL RAINFALL   (mm)=      87.45        87.45          87.45
     RUNOFF COEFFICIENT   =       0.98         0.34           0.51

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0     Ia = Dep. Storage   (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42   0.288     1.33    85.44
     + ID2= 2 (  0202):     0.06   0.017     1.33    44.89
       ====================================================
       ID = 3 (  0204):     0.48   0.305     1.33    80.72

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

--------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.305     1.33    80.72
     + ID2= 2 (  0203):     0.08   0.006     1.50    27.69
       ====================================================
       ID = 1 (  0204):     0.56   0.308     1.33    73.40

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

       V     V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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
```

```
               4.00    1.21 | 10.08    4.28 | 16.17    1.67 | 22.25    1.12
               4.08    1.49 | 10.17    4.28 | 16.25    1.67 | 22.33    1.12
               4.17    1.49 | 10.25    4.28 | 16.33    1.67 | 22.42    1.12
               4.25    1.49 | 10.33    4.28 | 16.42    1.67 | 22.50    1.12
               4.33    1.49 | 10.42    4.28 | 16.50    1.67 | 22.58    1.12
               4.42    1.49 | 10.50    4.28 | 16.58    1.67 | 22.67    1.12
               4.50    1.49 | 10.58    5.77 | 16.67    1.67 | 22.75    1.12
               4.58    1.49 | 10.67    5.77 | 16.75    1.67 | 22.83    1.12
               4.67    1.49 | 10.75    5.77 | 16.83    1.67 | 22.92    1.12
               4.75    1.49 | 10.83    5.77 | 16.92    1.67 | 23.00    1.12
               4.83    1.49 | 10.92    5.77 | 17.00    1.67 | 23.08    1.12
               4.92    1.49 | 11.00    5.77 | 17.08    1.67 | 23.17    1.12
               5.00    1.49 | 11.08    8.93 | 17.17    1.67 | 23.25    1.12
               5.08    1.49 | 11.17    8.93 | 17.25    1.67 | 23.33    1.12
               5.17    1.49 | 11.25    8.93 | 17.33    1.67 | 23.42    1.12
               5.25    1.49 | 11.33    8.93 | 17.42    1.67 | 23.50    1.12
               5.33    1.49 | 11.42    8.93 | 17.50    1.67 | 23.58    1.12
               5.42    1.49 | 11.50    8.93 | 17.58    1.67 | 23.67    1.12
               5.50    1.49 | 11.58   27.54 | 17.67    1.67 | 23.75    1.12
               5.58    1.49 | 11.67   27.54 | 17.75    1.67 | 23.83    1.12
               5.67    1.49 | 11.75   27.54 | 17.83    1.67 | 23.92    1.12
               5.75    1.49 | 11.83  113.87 | 17.92    1.67 | 24.00    1.12
               5.83    1.49 | 11.92  113.87 | 18.00    1.67 |
               5.92    1.49 | 12.00  113.87 | 18.08    1.67 |
               6.00    1.49 | 12.08   13.40 | 18.17    1.67 |

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

--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.006 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  30.868
     TOTAL RAINFALL   (mm)=  93.030
     RUNOFF COEFFICIENT   =   0.332

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------

                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42         0.00
     Dep. Storage     (mm)=       2.00         2.00
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      53.23        36.00
     Mannings n            =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     113.87       112.84
               over (min)          5.00         5.00
     Storage Coeff.  (min)=       1.47 (ii)    1.90 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.33         0.32
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.13         0.00          0.134 (iii)
     TIME TO PEAK    (hrs)=      12.08        12.08          12.08
     RUNOFF VOLUME    (mm)=      91.03        86.13          91.02
     TOTAL RAINFALL   (mm)=      93.03        93.03          93.03
     RUNOFF COEFFICIENT   =       0.98         0.93           0.98

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0     Ia = Dep. Storage   (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                        IMPERVIOUS    PERVIOUS (i)
```

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

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\ddd9df73-43
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\ddd9df73-43

DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____________________________________________________


--------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 10yr 24hr 5min SCS Type II    **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              f3913089-0d82-44ff-bd71-c0a13997982d\a4746fd7
| Ptotal= 93.03 mm |    Comments: 10yr 24hr 5min SCS Type II
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	1.67	12.17	13.40	18.25	1.67
0.08	1.02	6.17	1.67	12.25	13.40	18.33	1.67
0.17	1.02	6.25	1.67	12.33	13.40	18.42	1.67
0.25	1.02	6.33	1.67	12.42	13.40	18.50	1.67
0.33	1.02	6.42	1.67	12.50	13.40	18.58	1.67
0.42	1.02	6.50	1.67	12.58	6.88	18.67	1.67
0.50	1.02	6.58	1.67	12.67	6.88	18.75	1.67
0.58	1.02	6.67	1.67	12.75	6.88	18.83	1.67
0.67	1.02	6.75	1.67	12.83	6.88	18.92	1.67
0.75	1.02	6.83	1.67	12.92	6.88	19.00	1.67
0.83	1.02	6.92	1.67	13.00	6.88	19.08	1.67
0.92	1.02	7.00	1.67	13.08	5.02	19.17	1.67
1.00	1.02	7.08	2.05	13.17	5.02	19.25	1.67
1.08	1.02	7.17	2.05	13.25	5.02	19.33	1.67
1.17	1.02	7.25	2.05	13.33	5.02	19.42	1.67
1.25	1.02	7.33	2.05	13.42	5.02	19.50	1.67
1.33	1.02	7.42	2.05	13.50	5.02	19.58	1.67
1.42	1.02	7.50	2.05	13.58	3.91	19.67	1.67
1.50	1.02	7.58	2.05	13.67	3.91	19.75	1.67
1.58	1.02	7.67	2.05	13.75	3.91	19.83	1.67
1.67	1.02	7.75	2.05	13.83	3.91	19.92	1.67
1.75	1.02	7.83	2.05	13.92	3.91	20.00	1.67
1.83	1.02	7.92	2.05	14.00	3.91	20.08	1.12
1.92	1.02	8.00	2.05	14.08	2.79	20.17	1.12
2.00	1.02	8.08	2.42	14.17	2.79	20.25	1.12
2.08	1.21	8.17	2.42	14.25	2.79	20.33	1.12
2.17	1.21	8.25	2.42	14.33	2.79	20.42	1.12
2.25	1.21	8.33	2.42	14.42	2.79	20.50	1.12
2.33	1.21	8.42	2.42	14.50	2.79	20.58	1.12
2.42	1.21	8.50	2.42	14.58	2.79	20.67	1.12
2.50	1.21	8.58	2.60	14.67	2.79	20.75	1.12
2.58	1.21	8.67	2.60	14.75	2.79	20.83	1.12
2.67	1.21	8.75	2.60	14.83	2.79	20.92	1.12
2.75	1.21	8.83	2.60	14.92	2.79	21.00	1.12
2.83	1.21	8.92	2.60	15.00	2.79	21.08	1.12
2.92	1.21	9.00	2.60	15.08	2.79	21.17	1.12
3.00	1.21	9.08	2.98	15.17	2.79	21.25	1.12
3.08	1.21	9.17	2.98	15.25	2.79	21.33	1.12
3.17	1.21	9.25	2.98	15.33	2.79	21.42	1.12
3.25	1.21	9.33	2.98	15.42	2.79	21.50	1.12
3.33	1.21	9.42	2.98	15.50	2.79	21.58	1.12
3.42	1.21	9.50	2.98	15.58	2.79	21.67	1.12
3.50	1.21	9.58	3.35	15.67	2.79	21.75	1.12
3.58	1.21	9.67	3.35	15.75	2.79	21.83	1.12
3.67	1.21	9.75	3.35	15.83	2.79	21.92	1.12
3.75	1.21	9.83	3.35	15.92	2.79	22.00	1.12
3.83	1.21	9.92	3.35	16.00	2.79	22.08	1.12
3.92	1.21	10.00	3.35	16.08	1.67	22.17	1.12

```
     Surface Area     (ha)=       0.02         0.04
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       4.00         5.00
     Length            (m)=      19.32        10.00
     Mannings n            =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     113.87        53.74
               over (min)          5.00         5.00
     Storage Coeff.  (min)=       0.60 (ii)    3.76 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.25
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.01          0.010 (iii)
     TIME TO PEAK    (hrs)=      12.08        12.08          12.08
     RUNOFF VOLUME    (mm)=      91.03        33.22          48.87
     TOTAL RAINFALL   (mm)=      93.03        93.03          93.03
     RUNOFF COEFFICIENT   =       0.98         0.36           0.53

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0     Ia = Dep. Storage   (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42   0.134     12.08    91.02
     + ID2= 2 (  0202):     0.06   0.010     12.08    48.87
       ====================================================
       ID = 3 (  0204):     0.48   0.145     12.08    86.11

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

--------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.145     12.08    86.11
     + ID2= 2 (  0203):     0.08   0.006     12.17    30.87
       ====================================================
       ID = 1 (  0204):     0.56   0.151     12.08    78.49

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

       V     V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\d15b5ed4-be
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\d15b5ed4-be

DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____________________________________________________
```

```
  ************************************************
  ** SIMULATION : 10yr 4hr 5min Chicago         **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 976.898
| Ptotal= 59.77 mm |                          B=   4.745
--------------------                          C=   0.760
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    4.04 |  1.00   16.64 |   2.00   10.79 |  3.00    5.32
                0.08    4.28 |  1.08   25.08 |   2.08    9.86 |  3.08    5.13
                0.17    4.55 |  1.17   55.96 |   2.17    9.10 |  3.17    4.94
                0.25    4.86 |  1.25  173.13 |   2.25    8.45 |  3.25    4.78
                0.33    5.22 |  1.33   71.59 |   2.33    7.91 |  3.33    4.62
                0.42    5.65 |  1.42   40.40 |   2.42    7.43 |  3.42    4.48
                0.50    6.18 |  1.50   28.30 |   2.50    7.02 |  3.50    4.34
                0.58    6.83 |  1.58   21.92 |   2.58    6.65 |  3.58    4.22
                0.67    7.66 |  1.67   17.99 |   2.67    6.33 |  3.67    4.10
                0.75    8.77 |  1.75   15.33 |   2.75    6.04 |  3.75    3.99
                0.83   10.31 |  1.83   13.40 |   2.83    5.78 |  3.83    3.89
                0.92   12.65 |  1.92   11.94 |   2.92    5.54 |  3.92    3.79


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.003 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=  13.772
     TOTAL RAINFALL   (mm)=  59.765
     RUNOFF COEFFICIENT   =   0.230

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     173.13        117.63
               over (min)          5.00          5.00
     Storage Coeff.  (min)=       1.24 (ii)     1.61 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.33          0.32
                                                     *TOTALS*
     PEAK FLOW       (cms)=       0.20          0.00          0.202 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.33           1.33
     RUNOFF VOLUME    (mm)=      57.77         53.01          57.75
     TOTAL RAINFALL   (mm)=      59.77         59.77          59.77
     RUNOFF COEFFICIENT   =       0.97          0.89           0.97

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
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```
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02          0.04
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       4.00          5.00
     Length            (m)=      19.32         10.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     173.13        30.65
               over (min)          5.00         5.00
     Storage Coeff.  (min)=       0.50 (ii)    3.18 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.27
                                                     *TOTALS*
     PEAK FLOW       (cms)=       0.01         0.00          0.011 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      57.77        15.07          26.61
     TOTAL RAINFALL   (mm)=      59.77        59.77          59.77
     RUNOFF COEFFICIENT   =       0.97         0.25           0.45

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42    0.202    1.33     57.75
     + ID2= 2 (  0202):     0.06    0.011    1.33     26.61
       ================================================
       ID = 3 (  0204):     0.48    0.212    1.33     54.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48    0.212    1.33     54.13
     + ID2= 2 (  0203):     0.08    0.003    1.58     13.77
       ================================================
       ID = 1 (  0204):     0.56    0.214    1.33     48.56

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\vO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\31a2a024-76
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\31a2a024-76

DATE: 04-23-2024                          TIME: 09:40:01

USER:
```

COMMENTS: _____

```
--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 25yr 24hr 5min SCS Type II    **
  ************************************************

--------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              f3913089-0d82-44ff-bd71-c0a13997982d\89586bd0
| Ptotal=111.09 mm |    Comments: 25yr 24hr 5min SCS Type II
--------------------

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    0.00 |  6.08    2.00 |  12.17   16.00 |  18.25    2.00
                0.08    1.22 |  6.17    2.00 |  12.25   16.00 |  18.33    2.00
                0.17    1.22 |  6.25    2.00 |  12.33   16.00 |  18.42    2.00
                0.25    1.22 |  6.33    2.00 |  12.42   16.00 |  18.50    2.00
                0.33    1.22 |  6.42    2.00 |  12.50   16.00 |  18.58    2.00
                0.42    1.22 |  6.50    2.00 |  12.58    8.22 |  18.67    2.00
                0.50    1.22 |  6.58    2.00 |  12.67    8.22 |  18.75    2.00
                0.58    1.22 |  6.67    2.00 |  12.75    8.22 |  18.83    2.00
                0.67    1.22 |  6.75    2.00 |  12.83    8.22 |  18.92    2.00
                0.75    1.22 |  6.83    2.00 |  12.92    8.22 |  19.00    2.00
                0.83    1.22 |  6.92    2.00 |  13.00    8.22 |  19.08    2.00
                0.92    1.22 |  7.00    2.00 |  13.08    6.00 |  19.17    2.00
                1.00    1.22 |  7.08    2.44 |  13.17    6.00 |  19.25    2.00
                1.08    1.22 |  7.17    2.44 |  13.25    6.00 |  19.33    2.00
                1.17    1.22 |  7.25    2.44 |  13.33    6.00 |  19.42    2.00
                1.25    1.22 |  7.33    2.44 |  13.42    6.00 |  19.50    2.00
                1.33    1.22 |  7.42    2.44 |  13.50    6.00 |  19.58    2.00
                1.42    1.22 |  7.50    2.44 |  13.58    4.67 |  19.67    2.00
                1.50    1.22 |  7.58    2.44 |  13.67    4.67 |  19.75    2.00
                1.58    1.22 |  7.67    2.44 |  13.75    4.67 |  19.83    2.00
                1.67    1.22 |  7.75    2.44 |  13.83    4.67 |  19.92    2.00
                1.75    1.22 |  7.83    2.44 |  13.92    4.67 |  20.00    2.00
                1.83    1.22 |  7.92    2.44 |  14.00    4.67 |  20.08    1.33
                1.92    1.22 |  8.00    2.44 |  14.08    3.33 |  20.17    1.33
                2.00    1.22 |  8.08    2.89 |  14.17    3.33 |  20.25    1.33
                2.08    1.44 |  8.17    2.89 |  14.25    3.33 |  20.33    1.33
                2.17    1.44 |  8.25    2.89 |  14.33    3.33 |  20.42    1.33
                2.25    1.44 |  8.33    2.89 |  14.42    3.33 |  20.50    1.33
                2.33    1.44 |  8.42    2.89 |  14.50    3.33 |  20.58    1.33
                2.42    1.44 |  8.50    2.89 |  14.58    3.33 |  20.67    1.33
                2.50    1.44 |  8.58    3.11 |  14.67    3.33 |  20.75    1.33
                2.58    1.44 |  8.67    3.11 |  14.75    3.33 |  20.83    1.33
                2.67    1.44 |  8.75    3.11 |  14.83    3.33 |  20.92    1.33
                2.75    1.44 |  8.83    3.11 |  14.92    3.33 |  21.00    1.33
                2.83    1.44 |  8.92    3.11 |  15.00    3.33 |  21.08    1.33
                2.92    1.44 |  9.00    3.11 |  15.08    3.33 |  21.17    1.33
                3.00    1.44 |  9.08    3.55 |  15.17    3.33 |  21.25    1.33
                3.08    1.44 |  9.17    3.55 |  15.25    3.33 |  21.33    1.33
                3.17    1.44 |  9.25    3.55 |  15.33    3.33 |  21.42    1.33
                3.25    1.44 |  9.33    3.55 |  15.42    3.33 |  21.50    1.33
                3.33    1.44 |  9.42    3.55 |  15.50    3.33 |  21.58    1.33
                3.42    1.44 |  9.50    3.55 |  15.58    3.33 |  21.67    1.33
                3.50    1.44 |  9.58    4.00 |  15.67    3.33 |  21.75    1.33
                3.58    1.44 |  9.67    4.00 |  15.75    3.33 |  21.83    1.33
                3.67    1.44 |  9.75    4.00 |  15.83    3.33 |  21.92    1.33
                3.75    1.44 |  9.83    4.00 |  15.92    3.33 |  22.00    1.33
                3.83    1.44 |  9.92    4.00 |  16.00    3.33 |  22.08    1.33
                3.92    1.44 | 10.00    4.00 |  16.08    2.00 |  22.17    1.33
                4.00    1.44 | 10.08    5.11 |  16.17    2.00 |  22.25    1.33
                4.08    1.78 | 10.17    5.11 |  16.25    2.00 |  22.33    1.33
                4.17    1.78 | 10.25    5.11 |  16.33    2.00 |  22.42    1.33
                4.25    1.78 | 10.33    5.11 |  16.42    2.00 |  22.50    1.33
                4.33    1.78 | 10.42    5.11 |  16.50    2.00 |  22.58    1.33
                4.42    1.78 | 10.50    5.11 |  16.58    2.00 |  22.67    1.33
                4.50    1.78 | 10.58    6.89 |  16.67    2.00 |  22.75    1.33
                4.58    1.78 | 10.67    6.89 |  16.75    2.00 |  22.83    1.33
                4.67    1.78 | 10.75    6.89 |  16.83    2.00 |  22.92    1.33
                4.75    1.78 | 10.83    6.89 |  16.92    2.00 |  23.00    1.33
                4.83    1.78 | 10.92    6.89 |  17.00    2.00 |  23.08    1.33
                4.92    1.78 | 11.00    6.89 |  17.08    2.00 |  23.17    1.33
                5.00    1.78 | 11.08   10.66 |  17.17    2.00 |  23.25    1.33
                5.08    1.78 | 11.17   10.66 |  17.25    2.00 |  23.33    1.33
                5.17    1.78 | 11.25   10.66 |  17.33    2.00 |  23.42    1.33
                5.25    1.78 | 11.33   10.66 |  17.42    2.00 |  23.50    1.33
                5.33    1.78 | 11.42   10.66 |  17.50    2.00 |  23.58    1.33
                5.42    1.78 | 11.50   10.66 |  17.58    2.00 |  23.67    1.33
                5.50    1.78 | 11.58   32.88 |  17.67    2.00 |  23.75    1.33
                5.58    1.78 | 11.67   32.88 |  17.75    2.00 |  23.83    1.33
                5.67    1.78 | 11.75   32.88 |  17.83    2.00 |  23.92    1.33
                5.75    1.78 | 11.83  135.97 |  17.92    2.00 |  24.00    1.33
                5.83    1.78 | 11.92  135.97 |  18.00    2.00 |
                5.92    1.78 | 12.00  135.97 |  18.08    2.00 |
                6.00    1.78 | 12.08   16.00 |  18.17    2.00 |

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.008 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  41.818
     TOTAL RAINFALL   (mm)= 111.090
     RUNOFF COEFFICIENT   =   0.376

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     135.97        135.10
               over (min)          5.00          5.00
     Storage Coeff.  (min)=       1.37 (ii)     1.77 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.33          0.32
                                                     *TOTALS*
     PEAK FLOW       (cms)=       0.16          0.00          0.161 (iii)
     TIME TO PEAK    (hrs)=      12.08         12.08          12.08
     RUNOFF VOLUME    (mm)=     109.09        104.14         109.08
     TOTAL RAINFALL   (mm)=     111.09        111.09         111.09
     RUNOFF COEFFICIENT   =       0.98          0.94           0.98

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02          0.04
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       4.00          5.00
     Length            (m)=      19.32         10.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     135.97        72.38
               over (min)          5.00         5.00
     Storage Coeff.  (min)=       0.56 (ii)    3.50 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.26
                                                     *TOTALS*
     PEAK FLOW       (cms)=       0.01         0.01          0.013 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08          12.08
     RUNOFF VOLUME    (mm)=     109.09        44.74          62.16
     TOTAL RAINFALL   (mm)=     111.09        111.09         111.09
```

```
     RUNOFF COEFFICIENT   =       0.98         0.40          0.56

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD (  0204)|
|   1 +   2 =  3  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42   0.161    12.08   109.08
     + ID2= 2 (  0202):     0.06   0.013    12.08    62.16
       ==========================================
       ID = 3 (  0204):     0.48   0.174    12.08   103.62

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

--------------------
| ADD HYD (  0204)|
|   3 +   2 =  1  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.174    12.08   103.62
     + ID2= 2 (  0203):     0.08   0.008    12.17    41.82
       ==========================================
       ID = 1 (  0204):     0.56   0.182    12.08    95.09

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

       V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
       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 M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\5c290430-82
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\5c290430-82


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____________________________________________________

--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 25yr 4hr 5min Chicago         **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1133.123
| Ptotal= 70.87 mm |                          B=   4.734
--------------------                          C=   0.756
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.33

                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.01         0.00          0.013 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      68.87        20.60         33.65
     TOTAL RAINFALL   (mm)=      70.87        70.87         70.87
     RUNOFF COEFFICIENT   =       0.97         0.29          0.47

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD (  0204)|
|   1 +   2 =  3  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42   0.237     1.33    68.86
     + ID2= 2 (  0202):     0.06   0.013     1.33    33.65
       ==========================================
       ID = 3 (  0204):     0.48   0.250     1.33    64.76

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

--------------------
| ADD HYD (  0204)|
|   3 +   2 =  1  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.250     1.33    64.76
     + ID2= 2 (  0203):     0.08   0.004     1.50    18.96
       ==========================================
       ID = 1 (  0204):     0.56   0.252     1.33    58.44

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

       V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
       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 M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\2aa2993a-bd
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\2aa2993a-bd


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____________________________________________________

--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 2yr 24hr 5min SCS Type II     **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              f3913089-0d82-44ff-bd71-c0a13997982d\918ff4f0
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.87	1.00	19.82	2.00	12.89	3.00	6.39
0.08	5.15	1.08	29.77	2.08	11.79	3.08	6.16
0.17	5.47	1.17	65.99	2.17	10.89	3.17	5.94
0.25	5.84	1.25	202.83	2.25	10.12	3.25	5.74
0.33	6.27	1.33	84.29	2.33	9.47	3.33	5.56
0.42	6.79	1.42	47.77	2.42	8.91	3.42	5.39
0.50	7.41	1.50	33.55	2.50	8.41	3.50	5.23
0.58	8.19	1.58	26.05	2.58	7.98	3.58	5.08
0.67	9.18	1.67	21.41	2.67	7.59	3.67	4.94
0.75	10.49	1.75	18.27	2.75	7.25	3.75	4.81
0.83	12.33	1.83	15.99	2.83	6.93	3.83	4.68
0.92	15.10	1.92	14.26	2.92	6.65	3.92	4.57

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD  (  0203)|   Area    (ha)=   0.08   Curve Number    (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.004 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  18.958
     TOTAL RAINFALL   (mm)=  70.867
     RUNOFF COEFFICIENT   =   0.268

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42         0.00
     Dep. Storage     (mm)=       2.00         2.00
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      53.23        36.00
     Mannings n             =    0.013        0.250

     Max.Eff.Inten.(mm/hr)=     202.83       139.44
                   over (min)       5.00         5.00
     Storage Coeff.  (min)=       1.17 (ii)    1.51 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.33
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.24         0.00          0.237 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33          1.33
     RUNOFF VOLUME    (mm)=      68.87        64.05         68.86
     TOTAL RAINFALL   (mm)=      70.87        70.87         70.87
     RUNOFF COEFFICIENT   =       0.97         0.90          0.97

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02         0.04
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       4.00         5.00
     Length            (m)=      19.32        10.00
     Mannings n             =    0.013        0.250

     Max.Eff.Inten.(mm/hr)=     202.83       42.27
                   over (min)       5.00         5.00
     Storage Coeff.  (min)=       0.47 (ii)    2.99 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.28
```

```
| Ptotal= 55.62 mm |    Comments: 2yr 24hr 5min SCS Type II
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	1.00	12.17	8.01	18.25	1.00
0.08	0.61	6.17	1.00	12.25	8.01	18.33	1.00
0.17	0.61	6.25	1.00	12.33	8.01	18.42	1.00
0.25	0.61	6.33	1.00	12.42	8.01	18.50	1.00
0.33	0.61	6.42	1.00	12.50	8.01	18.58	1.00
0.42	0.61	6.50	1.00	12.58	4.12	18.67	1.00
0.50	0.61	6.58	1.00	12.67	4.12	18.75	1.00
0.58	0.61	6.67	1.00	12.75	4.12	18.83	1.00
0.67	0.61	6.75	1.00	12.83	4.12	18.92	1.00
0.75	0.61	6.83	1.00	12.92	4.12	19.00	1.00
0.83	0.61	6.92	1.00	13.00	4.12	19.08	1.00
0.92	0.61	7.00	1.00	13.08	3.00	19.17	1.00
1.00	0.61	7.08	1.22	13.17	3.00	19.25	1.00
1.08	0.61	7.17	1.22	13.25	3.00	19.33	1.00
1.17	0.61	7.25	1.22	13.33	3.00	19.42	1.00
1.25	0.61	7.33	1.22	13.42	3.00	19.50	1.00
1.33	0.61	7.42	1.22	13.50	3.00	19.58	1.00
1.42	0.61	7.50	1.22	13.58	2.34	19.67	1.00
1.50	0.61	7.58	1.22	13.67	2.34	19.75	1.00
1.58	0.61	7.67	1.22	13.75	2.34	19.83	1.00
1.67	0.61	7.75	1.22	13.83	2.34	19.92	1.00
1.75	0.61	7.83	1.22	13.92	2.34	20.00	0.00
1.83	0.61	7.92	1.22	14.00	2.34	20.08	0.67
1.92	0.61	8.00	1.22	14.08	1.67	20.17	0.67
2.00	0.61	8.08	1.45	14.17	1.67	20.25	0.67
2.08	0.72	8.17	1.45	14.25	1.67	20.33	0.67
2.17	0.72	8.25	1.45	14.33	1.67	20.42	0.67
2.25	0.72	8.33	1.45	14.42	1.67	20.50	0.67
2.33	0.72	8.42	1.45	14.50	1.67	20.58	0.67
2.42	0.72	8.50	1.45	14.58	1.67	20.67	0.67
2.50	0.72	8.58	1.56	14.67	1.67	20.75	0.67
2.58	0.72	8.67	1.56	14.75	1.67	20.83	0.67
2.67	0.72	8.75	1.56	14.83	1.67	20.92	0.67
2.75	0.72	8.83	1.56	14.92	1.67	21.00	0.67
2.83	0.72	8.92	1.56	15.00	1.67	21.08	0.67
2.92	0.72	9.00	1.56	15.08	1.67	21.17	0.67
3.00	0.72	9.08	1.78	15.17	1.67	21.25	0.67
3.08	0.72	9.17	1.78	15.25	1.67	21.33	0.67
3.17	0.72	9.25	1.78	15.33	1.67	21.42	0.67
3.25	0.72	9.33	1.78	15.42	1.67	21.50	0.67
3.33	0.72	9.42	1.78	15.50	1.67	21.58	0.67
3.42	0.72	9.50	1.78	15.58	1.67	21.67	0.67
3.50	0.72	9.58	2.00	15.67	1.67	21.75	0.67
3.58	0.72	9.67	2.00	15.75	1.67	21.83	0.67
3.67	0.72	9.75	2.00	15.83	1.67	21.92	0.67
3.75	0.72	9.83	2.00	15.92	1.67	22.00	0.67
3.83	0.72	9.92	2.00	16.00	1.67	22.08	0.67
3.92	0.72	10.00	2.00	16.08	1.00	22.17	0.67
4.00	0.72	10.08	2.56	16.17	1.00	22.25	0.67
4.08	0.89	10.17	2.56	16.25	1.00	22.33	0.67
4.17	0.89	10.25	2.56	16.33	1.00	22.42	0.67
4.25	0.89	10.33	2.56	16.42	1.00	22.50	0.67
4.33	0.89	10.42	2.56	16.50	1.00	22.58	0.67
4.42	0.89	10.50	2.56	16.58	1.00	22.67	0.67
4.50	0.89	10.58	3.45	16.67	1.00	22.75	0.67
4.58	0.89	10.67	3.45	16.75	1.00	22.83	0.67
4.67	0.89	10.75	3.45	16.83	1.00	22.92	0.67
4.75	0.89	10.83	3.45	16.92	1.00	23.00	0.67
4.83	0.89	10.92	3.45	17.00	1.00	23.08	0.67
4.92	0.89	11.00	3.45	17.08	1.00	23.17	0.67
5.00	0.89	11.08	5.34	17.17	1.00	23.25	0.67
5.08	0.89	11.17	5.34	17.25	1.00	23.33	0.67
5.17	0.89	11.25	5.34	17.33	1.00	23.42	0.67
5.25	0.89	11.33	5.34	17.42	1.00	23.50	0.67
5.33	0.89	11.42	5.34	17.50	1.00	23.58	0.67
5.42	0.89	11.50	5.34	17.58	1.00	23.67	0.67
5.50	0.89	11.58	16.46	17.67	1.00	23.75	0.67
5.58	0.89	11.67	16.46	17.75	1.00	23.83	0.67
5.67	0.89	11.75	16.46	17.83	1.00	23.92	0.67
5.75	0.89	11.83	68.08	17.92	1.00	24.00	0.67
5.83	0.89	11.92	68.08	18.00	1.00		
5.92	0.89	12.00	68.08	18.08	1.00		
6.00	0.89	12.08	8.01	18.17	1.00		

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD  (  0203)|   Area    (ha)=   0.08   Curve Number    (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
```

```
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.002 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  11.994
     TOTAL RAINFALL   (mm)=  55.620
     RUNOFF COEFFICIENT   =   0.216

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      0.42         0.00
     Dep. Storage     (mm)=      2.00         2.00
     Average Slope     (%)=      1.50         1.50
     Length            (m)=     53.23        36.00
     Mannings n            =    0.013        0.250

     Max.Eff.Inten.(mm/hr)=     68.08        66.49
           over (min)           5.00         5.00
     Storage Coeff.  (min)=     1.81 (ii)    2.34 (ii)
     Unit Hyd. Tpeak (min)=     5.00         5.00
     Unit Hyd. peak  (cms)=     0.32         0.30
                                                      *TOTALS*
     PEAK FLOW       (cms)=     0.08         0.00        0.080 (iii)
     TIME TO PEAK    (hrs)=    12.08        12.08       12.08
     RUNOFF VOLUME    (mm)=    53.62        48.89       53.61
     TOTAL RAINFALL   (mm)=    55.62        55.62       55.62
     RUNOFF COEFFICIENT   =     0.96         0.88        0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      0.02         0.04
     Dep. Storage     (mm)=      2.00         5.00
     Average Slope     (%)=      4.00         5.00
     Length            (m)=     19.32        10.00
     Mannings n            =    0.013        0.250

     Max.Eff.Inten.(mm/hr)=     68.08        21.20
           over (min)           5.00         5.00
     Storage Coeff.  (min)=     0.73 (ii)    4.62 (ii)
     Unit Hyd. Tpeak (min)=     5.00         5.00
     Unit Hyd. peak  (cms)=     0.34         0.22
                                                      *TOTALS*
     PEAK FLOW       (cms)=     0.00         0.00        0.005 (iii)
     TIME TO PEAK    (hrs)=    12.08        12.08       12.08
     RUNOFF VOLUME    (mm)=    53.62        13.16       20.20
     TOTAL RAINFALL   (mm)=    55.62        55.62       55.62
     RUNOFF COEFFICIENT   =     0.96         0.24        0.36

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  61.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
```

```
       ID1= 1 (  0201):     0.42   0.080    12.08    53.61
     + ID2= 2 (  0202):     0.06   0.005    12.08    20.20
       ========================================================
       ID = 3 (  0204):     0.48   0.085    12.08    49.72

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

--------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.085    12.08    49.72
     + ID2= 2 (  0203):     0.08   0.002    12.17    11.99
       ========================================================
       ID = 1 (  0204):     0.56   0.088    12.08    44.52

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\7c7671bc-5b
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\7c7671bc-5b


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____

--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 2yr 4hr 5min Chicago           **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 675.586
| Ptotal= 37.03 mm |                          B=   4.681
--------------------                          C=   0.780
                          used in:   INTENSITY =  A / (t + B)^C

                          Duration of storm  =  4.00 hrs
                          Storm time step    =  5.00 min
                          Time to peak ratio =  0.33

      TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
       hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
      0.00    2.31 |  1.00   10.03 |  2.00    6.39 |  3.00    3.08
      0.08    2.45 |  1.08   15.38 |  2.08    5.82 |  3.08    2.96
      0.17    2.61 |  1.17   35.54 |  2.17    5.36 |  3.17    2.85
      0.25    2.80 |  1.25  114.99 |  2.25    4.96 |  3.25    2.75
      0.33    3.01 |  1.33   45.86 |  2.33    4.63 |  3.33    2.66
      0.42    3.27 |  1.42   25.27 |  2.42    4.34 |  3.42    2.57
      0.50    3.59 |  1.50   17.44 |  2.50    4.09 |  3.50    2.49
      0.58    3.98 |  1.58   13.36 |  2.58    3.87 |  3.58    2.42
      0.67    4.48 |  1.67   10.88 |  2.67    3.68 |  3.67    2.35
      0.75    5.15 |  1.75    9.21 |  2.75    3.50 |  3.75    2.29
      0.83    6.10 |  1.83    8.01 |  2.83    3.35 |  3.83    2.22
      0.92    7.55 |  1.92    7.10 |  2.92    3.20 |  3.92    2.17
```

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.001 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=   5.260
     TOTAL RAINFALL   (mm)=  37.034
     RUNOFF COEFFICIENT   =   0.142

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      0.42         0.00
     Dep. Storage     (mm)=      2.00         2.00
     Average Slope     (%)=      1.50         1.50
     Length            (m)=     53.23        36.00
     Mannings n            =    0.013        0.250

     Max.Eff.Inten.(mm/hr)=    114.99        73.51
           over (min)           5.00         5.00
     Storage Coeff.  (min)=     1.47 (ii)    1.90 (ii)
     Unit Hyd. Tpeak (min)=     5.00         5.00
     Unit Hyd. peak  (cms)=     0.33         0.32
                                                      *TOTALS*
     PEAK FLOW       (cms)=     0.13         0.00        0.133 (iii)
     TIME TO PEAK    (hrs)=     1.33         1.33        1.33
     RUNOFF VOLUME    (mm)=    35.03        30.52       35.02
     TOTAL RAINFALL   (mm)=    37.03        37.03       37.03
     RUNOFF COEFFICIENT   =     0.95         0.82        0.95

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      0.02         0.04
     Dep. Storage     (mm)=      2.00         5.00
     Average Slope     (%)=      4.00         5.00
     Length            (m)=     19.32        10.00
     Mannings n            =    0.013        0.250

     Max.Eff.Inten.(mm/hr)=    114.99        11.95
           over (min)           5.00         5.00
     Storage Coeff.  (min)=     0.59 (ii)    3.75 (ii)
     Unit Hyd. Tpeak (min)=     5.00         5.00
     Unit Hyd. peak  (cms)=     0.34         0.25
                                                      *TOTALS*
     PEAK FLOW       (cms)=     0.00         0.00        0.006 (iii)
     TIME TO PEAK    (hrs)=     1.33         1.33        1.33
     RUNOFF VOLUME    (mm)=    35.03         5.88       13.76
     TOTAL RAINFALL   (mm)=    37.03        37.03       37.03
     RUNOFF COEFFICIENT   =     0.95         0.16        0.37

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  61.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
```

```
--------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42   0.133     1.33    35.02
     + ID2= 2 (  0202):     0.06   0.006     1.33    13.76
       ========================================================
       ID = 3 (  0204):     0.48   0.139     1.33    32.55

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

--------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.139     1.33    32.55
     + ID2= 2 (  0203):     0.08   0.001     1.58     5.26
       ========================================================
       ID = 1 (  0204):     0.56   0.139     1.33    28.78

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\431037f8-70
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\431037f8-70


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____

--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 50yr 24hr 5min SCS Type II    **
  ************************************************

--------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              f3913089-0d82-44ff-bd71-c0a13997982d\05c15ad9
| Ptotal=125.40 mm |    Comments: 50yr 24hr 5min SCS Type II
--------------------

      TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
       hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
      0.00    0.00 |  6.08    2.26 | 12.17   18.06 | 18.25    2.26
      0.08    1.38 |  6.17    2.26 | 12.25   18.06 | 18.33    2.26
      0.17    1.38 |  6.25    2.26 | 12.33   18.06 | 18.42    2.26
      0.25    1.38 |  6.33    2.26 | 12.42   18.06 | 18.50    2.26
      0.33    1.38 |  6.42    2.26 | 12.50   18.06 | 18.58    2.26
      0.42    1.38 |  6.50    2.26 | 12.58    9.28 | 18.67    2.26
      0.50    1.38 |  6.58    2.26 | 12.67    9.28 | 18.75    2.26
      0.58    1.38 |  6.67    2.26 | 12.75    9.28 | 18.83    2.26
      0.67    1.38 |  6.75    2.26 | 12.83    9.28 | 18.92    2.26
      0.75    1.38 |  6.83    2.26 | 12.92    9.28 | 19.00    2.26
      0.83    1.38 |  6.92    2.26 | 13.00    9.28 | 19.08    2.26
      0.92    1.38 |  7.00    2.26 | 13.08    6.77 | 19.17    2.26
```

1.00	1.38	7.08	2.76	13.17	6.77	19.25	2.26
1.08	1.38	7.17	2.76	13.25	6.77	19.33	2.26
1.17	1.38	7.25	2.76	13.33	6.77	19.42	2.26
1.25	1.38	7.33	2.76	13.42	6.77	19.50	2.26
1.33	1.38	7.42	2.76	13.50	6.77	19.58	2.26
1.42	1.38	7.50	2.76	13.58	5.27	19.67	2.26
1.50	1.38	7.58	2.76	13.67	5.27	19.75	2.26
1.58	1.38	7.67	2.76	13.75	5.27	19.83	2.26
1.67	1.38	7.75	2.76	13.83	5.27	19.92	2.26
1.75	1.38	7.83	2.76	13.92	5.27	20.00	2.26
1.83	1.38	7.92	2.76	14.00	5.27	20.08	1.50
1.92	1.38	8.00	2.76	14.08	3.76	20.17	1.50
2.00	1.38	8.08	3.26	14.17	3.76	20.25	1.50
2.08	1.63	8.17	3.26	14.25	3.76	20.33	1.50
2.17	1.63	8.25	3.26	14.33	3.76	20.42	1.50
2.25	1.63	8.33	3.26	14.42	3.76	20.50	1.50
2.33	1.63	8.42	3.26	14.50	3.76	20.58	1.50
2.42	1.63	8.50	3.26	14.58	3.76	20.67	1.50
2.50	1.63	8.58	3.51	14.67	3.76	20.75	1.50
2.58	1.63	8.67	3.51	14.75	3.76	20.83	1.50
2.67	1.63	8.75	3.51	14.83	3.76	20.92	1.50
2.75	1.63	8.83	3.51	14.92	3.76	21.00	1.50
2.83	1.63	8.92	3.51	15.00	3.76	21.08	1.50
2.92	1.63	9.00	3.51	15.08	3.76	21.17	1.50
3.00	1.63	9.08	4.01	15.17	3.76	21.25	1.50
3.08	1.63	9.17	4.01	15.25	3.76	21.33	1.50
3.17	1.63	9.25	4.01	15.33	3.76	21.42	1.50
3.25	1.63	9.33	4.01	15.42	3.76	21.50	1.50
3.33	1.63	9.42	4.01	15.50	3.76	21.58	1.50
3.42	1.63	9.50	4.01	15.58	3.76	21.67	1.50
3.50	1.63	9.58	4.51	15.67	3.76	21.75	1.50
3.58	1.63	9.67	4.51	15.75	3.76	21.83	1.50
3.67	1.63	9.75	4.51	15.83	3.76	21.92	1.50
3.75	1.63	9.83	4.51	15.92	3.76	22.00	1.50
3.83	1.63	9.92	4.51	16.00	3.76	22.08	1.50
3.92	1.63	10.00	4.51	16.08	2.26	22.17	1.50
4.00	1.63	10.08	5.77	16.17	2.26	22.25	1.50
4.08	2.01	10.17	5.77	16.25	2.26	22.33	1.50
4.17	2.01	10.25	5.77	16.33	2.26	22.42	1.50
4.25	2.01	10.33	5.77	16.42	2.26	22.50	1.50
4.33	2.01	10.42	5.77	16.50	2.26	22.58	1.50
4.42	2.01	10.50	5.77	16.58	2.26	22.67	1.50
4.50	2.01	10.58	7.77	16.67	2.26	22.75	1.50
4.58	2.01	10.67	7.77	16.75	2.26	22.83	1.50
4.67	2.01	10.75	7.77	16.83	2.26	22.92	1.50
4.75	2.01	10.83	7.77	16.92	2.26	23.00	1.50
4.83	2.01	10.92	7.77	17.00	2.26	23.08	1.50
4.92	2.01	11.00	7.77	17.08	2.26	23.17	1.50
5.00	2.01	11.08	12.04	17.17	2.26	23.25	1.50
5.08	2.01	11.17	12.04	17.25	2.26	23.33	1.50
5.17	2.01	11.25	12.04	17.33	2.26	23.42	1.50
5.25	2.01	11.33	12.04	17.42	2.26	23.50	1.50
5.33	2.01	11.42	12.04	17.50	2.26	23.58	1.50
5.42	2.01	11.50	12.04	17.58	2.26	23.67	1.50
5.50	2.01	11.58	37.12	17.67	2.26	23.75	1.50
5.58	2.01	11.67	37.12	17.75	2.26	23.83	1.50
5.67	2.01	11.75	37.12	17.83	2.26	23.92	1.50
5.75	2.01	11.83	153.49	17.92	2.26	24.00	1.50
5.83	2.01	11.92	153.49	18.00	2.26		
5.92	2.01	12.00	153.49	18.08	2.26		
6.00	2.01	12.08	18.06	18.17	2.26		

CALIB
NASHYD (0203)
ID= 1 DT= 5.0 min

Area (ha)= 0.08 Curve Number (CN)= 61.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.19

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.010 (i)
TIME TO PEAK (hrs)= 12.167
RUNOFF VOLUME (mm)= 51.134
TOTAL RAINFALL (mm)= 125.400
RUNOFF COEFFICIENT = 0.408

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

CALIB
STANDHYD (0201)

Area (ha)= 0.42

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\71df7708-ab
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\71df7708-ab

DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____
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  **********************************************
  ** SIMULATION : 50yr 4hr 5min Chicago        **
  **********************************************
```

CHICAGO STORM
Ptotal= 79.54 mm

IDF curve parameters: A=1251.473
B= 4.847
C= 0.753
used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	5.53	1.00	22.40	2.00	14.60	3.00	7.26
0.08	5.85	1.08	33.57	2.08	13.36	3.08	6.99
0.17	6.21	1.17	73.94	2.17	12.33	3.17	6.75
0.25	6.63	1.25	223.60	2.25	11.47	3.25	6.52
0.33	7.12	1.33	94.25	2.33	10.74	3.33	6.31
0.42	7.70	1.42	53.72	2.42	10.10	3.42	6.12
0.50	8.41	1.50	37.82	2.50	9.54	3.50	5.94
0.58	9.29	1.58	29.40	2.58	9.05	3.58	5.77
0.67	10.40	1.67	24.19	2.67	8.61	3.67	5.61
0.75	11.89	1.75	20.65	2.75	8.22	3.75	5.46
0.83	13.96	1.83	18.09	2.83	7.87	3.83	5.32
0.92	17.09	1.92	16.14	2.92	7.55	3.92	5.19

CALIB
NASHYD (0203)
ID= 1 DT= 5.0 min

Area (ha)= 0.08 Curve Number (CN)= 61.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.19

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.005 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 23.392
TOTAL RAINFALL (mm)= 79.544
RUNOFF COEFFICIENT = 0.294

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

|ID= 1 DT= 5.0 min | Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	153.49	152.70
over (min)	5.00	5.00
Storage Coeff. (min)=	1.31 (ii)	1.69 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.33	0.32

		TOTALS
PEAK FLOW (cms)=	0.18	0.00	0.181 (iii)
TIME TO PEAK (hrs)=	12.08	12.08	12.08
RUNOFF VOLUME (mm)=	123.40	118.43	123.39
TOTAL RAINFALL (mm)=	125.40	125.40	125.40
RUNOFF COEFFICIENT =	0.98	0.94	0.98

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0202)
ID= 1 DT= 5.0 min

Area (ha)= 0.06
Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	153.49	88.14
over (min)	5.00	5.00
Storage Coeff. (min)=	0.53 (ii)	3.34 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.26

		TOTALS
PEAK FLOW (cms)=	0.01	0.01	0.016 (iii)
TIME TO PEAK (hrs)=	12.00	12.08	12.08
RUNOFF VOLUME (mm)=	123.40	54.49	73.14
TOTAL RAINFALL (mm)=	125.40	125.40	125.40
RUNOFF COEFFICIENT =	0.98	0.43	0.58

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0204)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0201):	0.42	0.181	12.08	123.39
+ ID2= 2 (0202):	0.06	0.016	12.08	73.14
ID = 3 (0204):	0.48	0.197	12.08	117.54

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0204)
3 + 1 =

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0204):	0.48	0.197	12.08	117.54
+ ID2= 2 (0203):	0.08	0.010	12.17	51.13
ID = 1 (0204):	0.56	0.207	12.08	108.38

CALIB
STANDHYD (0201)
ID= 1 DT= 5.0 min

Area (ha)= 0.42
Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	223.60	155.21
over (min)	5.00	5.00
Storage Coeff. (min)=	1.12 (ii)	1.45 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.33

		TOTALS
PEAK FLOW (cms)=	0.26	0.00	0.262 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	77.54	72.68	77.53
TOTAL RAINFALL (mm)=	79.54	79.54	79.54
RUNOFF COEFFICIENT =	0.97	0.91	0.97

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0202)
ID= 1 DT= 5.0 min

Area (ha)= 0.06
Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	223.60	51.83
over (min)	5.00	5.00
Storage Coeff. (min)=	0.46 (ii)	2.87 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.28

		TOTALS
PEAK FLOW (cms)=	0.01	0.01	0.015 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	77.54	25.32	39.43
TOTAL RAINFALL (mm)=	79.54	79.54	79.54
RUNOFF COEFFICIENT =	0.97	0.32	0.50

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0204)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0201):	0.42	0.262	1.33	77.53
+ ID2= 2 (0202):	0.06	0.015	1.33	39.43
ID = 3 (0204):	0.48	0.277	1.33	73.10

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0204)
3 + 2 = 1

	AREA	QPEAK	TPEAK	R.V.

```
                    (ha)    (cms)    (hrs)     (mm)
      ID1= 3 (  0204):     0.48   0.277     1.33    73.10
    + ID2= 2 (  0203):     0.08   0.005     1.50    23.39
      ========================================================
      ID = 1 (  0204):     0.56   0.279     1.33    66.24

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\ebe9d971-2e
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\ebe9d971-2e


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____


------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 5yr 24hr 5min SCS Type II     **
  ************************************************


-------------------
|     READ STORM    |     Filename: C:\Users\dhordyk\AppD
|                   |               ata\Local\Temp\
|                   |               f3913089-0d82-44ff-bd71-c0a13997982d\23cbacd2
| Ptotal= 78.55 mm  |    Comments: 5yr 24hr 5min SCS Type II
-------------------
                TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
                 hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
                0.00     0.00 |  6.08     1.41 |  12.17   11.31 | 18.25     1.41
                0.08     0.86 |  6.17     1.41 |  12.25   11.31 | 18.33     1.41
                0.17     0.86 |  6.25     1.41 |  12.33   11.31 | 18.42     1.41
                0.25     0.86 |  6.33     1.41 |  12.42   11.31 | 18.50     1.41
                0.33     0.86 |  6.42     1.41 |  12.50   11.31 | 18.58     1.41
                0.42     0.86 |  6.50     1.41 |  12.58    5.81 | 18.67     1.41
                0.50     0.86 |  6.58     1.41 |  12.67    5.81 | 18.75     1.41
                0.58     0.86 |  6.67     1.41 |  12.75    5.81 | 18.83     1.41
                0.67     0.86 |  6.75     1.41 |  12.83    5.81 | 18.92     1.41
                0.75     0.86 |  6.83     1.41 |  12.92    5.81 | 19.00     1.41
                0.83     0.86 |  6.92     1.41 |  13.00    5.81 | 19.08     1.41
                0.92     0.86 |  7.00     1.41 |  13.08    4.24 | 19.17     1.41
                1.00     0.86 |  7.08     1.73 |  13.17    4.24 | 19.25     1.41
                1.08     0.86 |  7.17     1.73 |  13.25    4.24 | 19.33     1.41
                1.17     0.86 |  7.25     1.73 |  13.33    4.24 | 19.42     1.41
                1.25     0.86 |  7.33     1.73 |  13.42    4.24 | 19.50     1.41
                1.33     0.86 |  7.42     1.73 |  13.50    4.24 | 19.58     1.41
                1.42     0.86 |  7.50     1.73 |  13.58    3.30 | 19.67     1.41
                1.50     0.86 |  7.58     1.73 |  13.67    3.30 | 19.75     1.41
                1.58     0.86 |  7.67     1.73 |  13.75    3.30 | 19.83     1.41
                1.67     0.86 |  7.75     1.73 |  13.83    3.30 | 19.92     1.41
                1.75     0.86 |  7.83     1.73 |  13.92    3.30 | 20.00     1.41
                1.83     0.86 |  7.92     1.73 |  14.00    3.30 | 20.08     0.94
                1.92     0.86 |  8.00     1.73 |  14.08    2.36 | 20.17     0.94
                2.00     0.86 |  8.08     2.04 |  14.17    2.36 | 20.25     0.94
                2.08     1.02 |  8.17     2.04 |  14.25    2.36 | 20.33     0.94
                2.17     1.02 |  8.25     2.04 |  14.33    2.36 | 20.42     0.94
                2.25     1.02 |  8.33     2.04 |  14.42    2.36 | 20.50     0.94
                2.33     1.02 |  8.42     2.04 |  14.50    2.36 | 20.58     0.94
                2.42     1.02 |  8.50     2.04 |  14.58    2.36 | 20.67     0.94
                2.50     1.02 |  8.58     2.20 |  14.67    2.36 | 20.75     0.94
                2.58     1.02 |  8.67     2.20 |  14.75    2.36 | 20.83     0.94
                2.67     1.02 |  8.75     2.20 |  14.83    2.36 | 20.92     0.94
                2.75     1.02 |  8.83     2.20 |  14.92    2.36 | 21.00     0.94
                2.83     1.02 |  8.92     2.20 |  15.00    2.36 | 21.08     0.94
                2.92     1.02 |  9.00     2.20 |  15.08    2.36 | 21.17     0.94
                3.00     1.02 |  9.08     2.51 |  15.17    2.36 | 21.25     0.94
                3.08     1.02 |  9.17     2.51 |  15.25    2.36 | 21.33     0.94
                3.17     1.02 |  9.25     2.51 |  15.33    2.36 | 21.42     0.94
                3.25     1.02 |  9.33     2.51 |  15.42    2.36 | 21.50     0.94
                3.33     1.02 |  9.42     2.51 |  15.50    2.36 | 21.58     0.94
                3.42     1.02 |  9.50     2.51 |  15.58    2.36 | 21.67     0.94
                3.50     1.02 |  9.58     2.83 |  15.67    2.36 | 21.75     0.94
                3.58     1.02 |  9.67     2.83 |  15.75    2.36 | 21.83     0.94
                3.67     1.02 |  9.75     2.83 |  15.83    2.36 | 21.92     0.94
                3.75     1.02 |  9.83     2.83 |  15.92    2.36 | 22.00     0.94
                3.83     1.02 |  9.92     2.83 |  16.00    2.36 | 22.08     0.94
                3.92     1.02 | 10.00     2.83 |  16.08    1.41 | 22.17     0.94
                4.00     1.02 | 10.08     3.61 |  16.17    1.41 | 22.25     0.94
                4.08     1.26 | 10.17     3.61 |  16.25    1.41 | 22.33     0.94
                4.17     1.26 | 10.25     3.61 |  16.33    1.41 | 22.42     0.94
                4.25     1.26 | 10.33     3.61 |  16.42    1.41 | 22.50     0.94
                4.33     1.26 | 10.42     3.61 |  16.50    1.41 | 22.58     0.94
                4.42     1.26 | 10.50     3.61 |  16.58    1.41 | 22.67     0.94
                4.50     1.26 | 10.58     4.87 |  16.67    1.41 | 22.75     0.94
                4.58     1.26 | 10.67     4.87 |  16.75    1.41 | 22.83     0.94
                4.67     1.26 | 10.75     4.87 |  16.83    1.41 | 22.92     0.94
                4.75     1.26 | 10.83     4.87 |  16.92    1.41 | 23.00     0.94
                4.83     1.26 | 10.92     4.87 |  17.00    1.41 | 23.08     0.94
                4.92     1.26 | 11.00     4.87 |  17.08    1.41 | 23.17     0.94
                5.00     1.26 | 11.08     7.54 |  17.17    1.41 | 23.25     0.94
                5.08     1.26 | 11.17     7.54 |  17.25    1.41 | 23.33     0.94
                5.17     1.26 | 11.25     7.54 |  17.33    1.41 | 23.42     0.94
                5.25     1.26 | 11.33     7.54 |  17.42    1.41 | 23.50     0.94
                5.33     1.26 | 11.42     7.54 |  17.50    1.41 | 23.58     0.94
                5.42     1.26 | 11.50     7.54 |  17.58    1.41 | 23.67     0.94
                5.50     1.26 | 11.58    23.25 |  17.67    1.41 | 23.75     0.94
                5.58     1.26 | 11.67    23.25 |  17.75    1.41 | 23.83     0.94
                5.67     1.26 | 11.75    23.25 |  17.83    1.41 | 23.92     0.94
                5.75     1.26 | 11.83    96.15 |  17.92    1.41 | 24.00     0.94
                5.83     1.26 | 11.92    96.15 |  18.00    1.41 |
                5.92     1.26 | 12.00    96.15 |  18.08    1.41 |
                6.00     1.26 | 12.08    11.31 |  18.17    1.41 |

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

-------------------
| CALIB             |
| NASHYD   (  0203) |   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min  |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.004 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  22.867
     TOTAL RAINFALL   (mm)=  78.550
     RUNOFF COEFFICIENT   =   0.291

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

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

-------------------
| CALIB             |
| STANDHYD (  0201) |   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      96.15         94.95
               over (min)        5.00          5.00
     Storage Coeff.  (min)=      1.57 (ii)     2.04 (ii)
     Unit Hyd. Tpeak (min)=      5.00          5.00
     Unit Hyd. peak  (cms)=      0.33          0.31
                                                         *TOTALS*
     PEAK FLOW       (cms)=      0.11          0.00          0.113 (iii)
```

```
     TIME TO PEAK    (hrs)=      12.08         12.08         12.08
     RUNOFF VOLUME    (mm)=      76.55         71.69         76.54
     TOTAL RAINFALL   (mm)=      78.55         78.55         78.55
     RUNOFF COEFFICIENT   =       0.97          0.91          0.97

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

-------------------
| CALIB             |
| STANDHYD (  0202) |   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
-------------------

                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02          0.04
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       4.00          5.00
     Length            (m)=      19.32         10.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      96.15         40.01
               over (min)        5.00          5.00
     Storage Coeff.  (min)=      0.64 (ii)     4.03 (ii)
     Unit Hyd. Tpeak (min)=      5.00          5.00
     Unit Hyd. peak  (cms)=      0.34          0.24
                                                         *TOTALS*
     PEAK FLOW       (cms)=      0.00          0.00          0.008 (iii)
     TIME TO PEAK    (hrs)=      12.08         12.08         12.08
     RUNOFF VOLUME    (mm)=      76.55         24.76         36.35
     TOTAL RAINFALL   (mm)=      78.55         78.55         78.55
     RUNOFF COEFFICIENT   =       0.97          0.32          0.46

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

-------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
      ID1= 1 (  0201):      0.42   0.113    12.08    76.54
    + ID2= 2 (  0202):      0.06   0.008    12.08    36.35
      ========================================================
      ID = 3 (  0204):      0.48   0.122    12.08    71.86

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

-------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
      ID1= 3 (  0204):      0.48   0.122    12.08    71.86
    + ID2= 2 (  0203):      0.08   0.004    12.17    22.87
      ========================================================
      ID = 1 (  0204):      0.56   0.126    12.08    65.10

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\61e0532O-13
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\61e0532O-13


DATE: 04-23-2024                          TIME: 09:40:01

USER:


COMMENTS: _____


------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 5yr 4hr 5min Chicago          **
  ************************************************


-------------------
| CHICAGO STORM     |    IDF curve parameters: A= 843.019
| Ptotal= 50.76 mm  |                          B=   4.582
-------------------                           C=   0.763
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    =  5.00 min
                         Time to peak ratio =  0.33

                TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
                 hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
                0.00     3.39 |  1.00    14.01 |  2.00     9.07 |  3.00     4.46
                0.08     3.58 |  1.08    21.15 |  2.08     8.29 |  3.08     4.30
                0.17     3.81 |  1.17    47.54 |  2.17     7.64 |  3.17     4.15
                0.25     4.07 |  1.25   150.31 |  2.25     7.10 |  3.25     4.01
                0.33     4.38 |  1.33    60.96 |  2.33     6.64 |  3.33     3.88
                0.42     4.74 |  1.42    34.18 |  2.42     6.24 |  3.42     3.75
                0.50     5.18 |  1.50    23.88 |  2.50     5.89 |  3.50     3.64
                0.58     5.73 |  1.58    18.47 |  2.58     5.58 |  3.58     3.54
                0.67     6.43 |  1.67    15.15 |  2.67     5.31 |  3.67     3.44
                0.75     7.36 |  1.75    12.90 |  2.75     5.07 |  3.75     3.35
                0.83     8.67 |  1.83    11.27 |  2.83     4.85 |  3.83     3.26
                0.92    10.64 |  1.92    10.04 |  2.92     4.65 |  3.92     3.18

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

-------------------
| CALIB             |
| NASHYD   (  0203) |   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min  |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.002 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=  10.030
     TOTAL RAINFALL   (mm)=  50.757
     RUNOFF COEFFICIENT   =   0.198

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

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

-------------------
| CALIB             |
| STANDHYD (  0201) |   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     150.31        100.23
               over (min)        5.00          5.00
```

```
     Storage Coeff.  (min)=       1.32 (ii)    1.70 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.33         0.32
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.17         0.00          0.175 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      48.76        44.07          48.75
     TOTAL RAINFALL   (mm)=      50.76        50.76          50.76
     RUNOFF COEFFICIENT   =       0.96         0.87           0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02         0.04
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       4.00         5.00
     Length            (m)=      19.32        10.00
     Mannings n            =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     150.31        22.40
           over (min)           5.00         5.00
     Storage Coeff.  (min)=       0.53 (ii)    3.37 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.26
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.01         0.00          0.009 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      48.76        11.04          21.24
     TOTAL RAINFALL   (mm)=      50.76        50.76          50.76
     RUNOFF COEFFICIENT   =       0.96         0.22           0.42

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0204)|
|   1 +   2 =  3   |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0201):     0.42   0.175     1.33    48.75
     + ID2= 2 (  0202):     0.06   0.009     1.33    21.24
       ==========================================================
       ID = 3 (  0204):     0.48   0.183     1.33    45.54

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

--------------------
| ADD HYD  (  0204)|
|   3 +   2 =  1   |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0204):     0.48   0.183     1.33    45.54
     + ID2= 2 (  0203):     0.08   0.002     1.58    10.03
       ==========================================================
       ID = 1 (  0204):     0.56   0.184     1.33    40.64

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

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================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\55bce6fd-30
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\55bce6fd-30


DATE: 04-23-2024                          TIME: 09:40:55

USER:


COMMENTS: _____________________________________________________


----------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : HAZEL                         **
  ************************************************


-------------------
|    READ STORM     |    Filename: C:\Users\dhordyk\AppD
|                   |              ata\Local\Temp\
|                   |              8f2f9O8e-3931-4389-a856-bc6b7b9bda52\6894cbd9
| Ptotal=212.00 mm  |    Comments: HAZEL
-------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.00    6.00 |  3.00   13.00 |   6.00   23.00 |  9.00   53.00
               0.20    6.00 |  3.20   13.00 |   6.20   23.00 |  9.20   53.00
               0.40    6.00 |  3.40   13.00 |   6.40   23.00 |  9.40   53.00
               0.60    6.00 |  3.60   13.00 |   6.60   23.00 |  9.60   53.00
               0.80    6.00 |  3.80   13.00 |   6.80   23.00 |  9.80   53.00
               1.00    4.00 |  4.00   17.00 |   7.00   13.00 | 10.00   38.00
               1.20    4.00 |  4.20   17.00 |   7.20   13.00 | 10.20   38.00
               1.40    4.00 |  4.40   17.00 |   7.40   13.00 | 10.40   38.00
               1.60    4.00 |  4.60   17.00 |   7.60   13.00 | 10.60   38.00
               1.80    4.00 |  4.80   17.00 |   7.80   13.00 | 10.80   38.00
               2.00    6.00 |  5.00   13.00 |   8.00   13.00 | 11.00   13.00
               2.20    6.00 |  5.20   13.00 |   8.20   13.00 | 11.20   13.00
               2.40    6.00 |  5.40   13.00 |   8.40   13.00 | 11.40   13.00
               2.60    6.00 |  5.60   13.00 |   8.60   13.00 | 11.60   13.00
               2.80    6.00 |  5.80   13.00 |   8.80   13.00 | 11.80   13.00

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

-------------------
| CALIB             |
| NASHYD  (  0203)  |   Area    (ha)=   0.08   Curve Number   (CN)= 78.0
|ID= 1 DT= 5.0 min  |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

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

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    6.00 |  3.083   13.00 |  6.083   23.00 |  9.08   53.00
               0.167    6.00 |  3.167   13.00 |  6.167   23.00 |  9.17   53.00
               0.250    6.00 |  3.250   13.00 |  6.250   23.00 |  9.25   53.00
               0.333    6.00 |  3.333   13.00 |  6.333   23.00 |  9.33   53.00
               0.417    6.00 |  3.417   13.00 |  6.417   23.00 |  9.42   53.00
               0.500    6.00 |  3.500   13.00 |  6.500   23.00 |  9.50   53.00
               0.583    6.00 |  3.583   13.00 |  6.583   23.00 |  9.58   53.00
               0.667    6.00 |  3.667   13.00 |  6.667   23.00 |  9.67   53.00
               0.750    6.00 |  3.750   13.00 |  6.750   23.00 |  9.75   53.00
               0.833    6.00 |  3.833   13.00 |  6.833   23.00 |  9.83   53.00
               0.917    6.00 |  3.917   13.00 |  6.917   23.00 |  9.92   53.00
               1.000    6.00 |  4.000   13.00 |  7.000   23.00 | 10.00   53.00
               1.083    4.00 |  4.083   17.00 |  7.083   13.00 | 10.08   38.00
               1.167    4.00 |  4.167   17.00 |  7.167   13.00 | 10.17   38.00
               1.250    4.00 |  4.250   17.00 |  7.250   13.00 | 10.25   38.00
               1.333    4.00 |  4.333   17.00 |  7.333   13.00 | 10.33   38.00
               1.417    4.00 |  4.417   17.00 |  7.417   13.00 | 10.42   38.00
               1.500    4.00 |  4.500   17.00 |  7.500   13.00 | 10.50   38.00
               1.583    4.00 |  4.583   17.00 |  7.583   13.00 | 10.58   38.00
               1.667    4.00 |  4.667   17.00 |  7.667   13.00 | 10.67   38.00
               1.750    4.00 |  4.750   17.00 |  7.750   13.00 | 10.75   38.00
               1.833    4.00 |  4.833   17.00 |  7.833   13.00 | 10.83   38.00
               1.917    4.00 |  4.917   17.00 |  7.917   13.00 | 10.92   38.00
               2.000    4.00 |  5.000   17.00 |  8.000   13.00 | 11.00   38.00
               2.083    6.00 |  5.083   13.00 |  8.083   13.00 | 11.08   13.00
               2.167    6.00 |  5.167   13.00 |  8.167   13.00 | 11.17   13.00
               2.250    6.00 |  5.250   13.00 |  8.250   13.00 | 11.25   13.00
               2.333    6.00 |  5.333   13.00 |  8.333   13.00 | 11.33   13.00
               2.417    6.00 |  5.417   13.00 |  8.417   13.00 | 11.42   13.00
               2.500    6.00 |  5.500   13.00 |  8.500   13.00 | 11.50   13.00
               2.583    6.00 |  5.583   13.00 |  8.583   13.00 | 11.58   13.00
               2.667    6.00 |  5.667   13.00 |  8.667   13.00 | 11.67   13.00
               2.750    6.00 |  5.750   13.00 |  8.750   13.00 | 11.75   13.00
               2.833    6.00 |  5.833   13.00 |  8.833   13.00 | 11.83   13.00
               2.917    6.00 |  5.917   13.00 |  8.917   13.00 | 11.92   13.00
               3.000    6.00 |  6.000   13.00 |  9.000   13.00 | 12.00   13.00

    Max.Eff.Inten.(mm/hr)=      53.00        52.99
          over (min)            5.00         5.00
    Storage Coeff.  (min)=      2.00 (ii)    2.59 (ii)
    Unit Hyd. Tpeak (min)=      5.00         5.00
    Unit Hyd. peak  (cms)=      0.31         0.29
                                                    *TOTALS*
    PEAK FLOW       (cms)=      0.06         0.00      0.063 (iii)
    TIME TO PEAK    (hrs)=      9.58        10.00        10.00
    RUNOFF VOLUME    (mm)=    210.00       207.47       210.00
    TOTAL RAINFALL   (mm)=    212.00       212.00       212.00
    RUNOFF COEFFICIENT   =      0.99         0.98         0.99

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  99.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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-------------------
| CALIB             |
| STANDHYD (  0202) |   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
-------------------

                        IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=      0.02         0.04
    Dep. Storage     (mm)=      2.00         5.00
    Average Slope     (%)=      4.00         5.00
    Length            (m)=     19.32        10.00
    Mannings n            =     0.013        0.250

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

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    6.00 |  3.083   13.00 |  6.083   23.00 |  9.08   53.00
               0.167    6.00 |  3.167   13.00 |  6.167   23.00 |  9.17   53.00
               0.250    6.00 |  3.250   13.00 |  6.250   23.00 |  9.25   53.00
               0.333    6.00 |  3.333   13.00 |  6.333   23.00 |  9.33   53.00
               0.417    6.00 |  3.417   13.00 |  6.417   23.00 |  9.42   53.00
               0.500    6.00 |  3.500   13.00 |  6.500   23.00 |  9.50   53.00
               0.583    6.00 |  3.583   13.00 |  6.583   23.00 |  9.58   53.00
               0.667    6.00 |  3.667   13.00 |  6.667   23.00 |  9.67   53.00
               0.750    6.00 |  3.750   13.00 |  6.750   23.00 |  9.75   53.00
               0.833    6.00 |  3.833   13.00 |  6.833   23.00 |  9.83   53.00
               0.917    6.00 |  3.917   13.00 |  6.917   23.00 |  9.92   53.00
               1.000    6.00 |  4.000   13.00 |  7.000   23.00 | 10.00   53.00
               1.083    4.00 |  4.083   17.00 |  7.083   13.00 | 10.08   38.00
               1.167    4.00 |  4.167   17.00 |  7.167   13.00 | 10.17   38.00
               1.250    4.00 |  4.250   17.00 |  7.250   13.00 | 10.25   38.00
               1.333    4.00 |  4.333   17.00 |  7.333   13.00 | 10.33   38.00
               1.417    4.00 |  4.417   17.00 |  7.417   13.00 | 10.42   38.00
               1.500    4.00 |  4.500   17.00 |  7.500   13.00 | 10.50   38.00
               1.583    4.00 |  4.583   17.00 |  7.583   13.00 | 10.58   38.00
               1.667    4.00 |  4.667   17.00 |  7.667   13.00 | 10.67   38.00
               1.750    4.00 |  4.750   17.00 |  7.750   13.00 | 10.75   38.00
               1.833    4.00 |  4.833   17.00 |  7.833   13.00 | 10.83   38.00
               1.917    4.00 |  4.917   17.00 |  7.917   13.00 | 10.92   38.00
               2.000    4.00 |  5.000   17.00 |  8.000   13.00 | 11.00   38.00
               2.083    6.00 |  5.083   13.00 |  8.083   13.00 | 11.08   13.00
               2.167    6.00 |  5.167   13.00 |  8.167   13.00 | 11.17   13.00
               2.250    6.00 |  5.250   13.00 |  8.250   13.00 | 11.25   13.00
               2.333    6.00 |  5.333   13.00 |  8.333   13.00 | 11.33   13.00
               2.417    6.00 |  5.417   13.00 |  8.417   13.00 | 11.42   13.00
               2.500    6.00 |  5.500   13.00 |  8.500   13.00 | 11.50   13.00
               2.583    6.00 |  5.583   13.00 |  8.583   13.00 | 11.58   13.00
               2.667    6.00 |  5.667   13.00 |  8.667   13.00 | 11.67   13.00
               2.750    6.00 |  5.750   13.00 |  8.750   13.00 | 11.75   13.00
               2.833    6.00 |  5.833   13.00 |  8.833   13.00 | 11.83   13.00
               2.917    6.00 |  5.917   13.00 |  8.917   13.00 | 11.92   13.00
               3.000    6.00 |  6.000   13.00 |  9.000   13.00 | 12.00   13.00

    Unit Hyd Qpeak  (cms)=   0.015

    PEAK FLOW       (cms)=   0.010 (i)
    TIME TO PEAK    (hrs)=  10.000
    RUNOFF VOLUME    (mm)= 153.412
    TOTAL RAINFALL   (mm)= 212.000
    RUNOFF COEFFICIENT   =   0.724

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

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-------------------
| CALIB             |
| STANDHYD (  0201) |   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                        IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=      0.42         0.00
    Dep. Storage     (mm)=      2.00         2.00
    Average Slope     (%)=      1.50         1.50
    Length            (m)=     53.23        36.00
    Mannings n            =     0.013        0.250

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

                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    6.00 |  3.083   13.00 |  6.083   23.00 |  9.08   53.00
               0.167    6.00 |  3.167   13.00 |  6.167   23.00 |  9.17   53.00
               0.250    6.00 |  3.250   13.00 |  6.250   23.00 |  9.25   53.00
               0.333    6.00 |  3.333   13.00 |  6.333   23.00 |  9.33   53.00
               0.417    6.00 |  3.417   13.00 |  6.417   23.00 |  9.42   53.00
               0.500    6.00 |  3.500   13.00 |  6.500   23.00 |  9.50   53.00
               0.583    6.00 |  3.583   13.00 |  6.583   23.00 |  9.58   53.00
               0.667    6.00 |  3.667   13.00 |  6.667   23.00 |  9.67   53.00
               0.750    6.00 |  3.750   13.00 |  6.750   23.00 |  9.75   53.00
               0.833    6.00 |  3.833   13.00 |  6.833   23.00 |  9.83   53.00
               0.917    6.00 |  3.917   13.00 |  6.917   23.00 |  9.92   53.00
               1.000    6.00 |  4.000   13.00 |  7.000   23.00 | 10.00   53.00
               1.083    4.00 |  4.083   17.00 |  7.083   13.00 | 10.08   38.00
               1.167    4.00 |  4.167   17.00 |  7.167   13.00 | 10.17   38.00
               1.250    4.00 |  4.250   17.00 |  7.250   13.00 | 10.25   38.00
               1.333    4.00 |  4.333   17.00 |  7.333   13.00 | 10.33   38.00
               1.417    4.00 |  4.417   17.00 |  7.417   13.00 | 10.42   38.00
               1.500    4.00 |  4.500   17.00 |  7.500   13.00 | 10.50   38.00
               1.583    4.00 |  4.583   17.00 |  7.583   13.00 | 10.58   38.00
               1.667    4.00 |  4.667   17.00 |  7.667   13.00 | 10.67   38.00
               1.750    4.00 |  4.750   17.00 |  7.750   13.00 | 10.75   38.00
               1.833    4.00 |  4.833   17.00 |  7.833   13.00 | 10.83   38.00
               1.917    4.00 |  4.917   17.00 |  7.917   13.00 | 10.92   38.00
               2.000    4.00 |  5.000   17.00 |  8.000   13.00 | 11.00   38.00
               2.083    6.00 |  5.083   13.00 |  8.083   13.00 | 11.08   13.00
               2.167    6.00 |  5.167   13.00 |  8.167   13.00 | 11.17   13.00
               2.250    6.00 |  5.250   13.00 |  8.250   13.00 | 11.25   13.00
               2.333    6.00 |  5.333   13.00 |  8.333   13.00 | 11.33   13.00
               2.417    6.00 |  5.417   13.00 |  8.417   13.00 | 11.42   13.00
               2.500    6.00 |  5.500   13.00 |  8.500   13.00 | 11.50   13.00
               2.583    6.00 |  5.583   13.00 |  8.583   13.00 | 11.58   13.00
               2.667    6.00 |  5.667   13.00 |  8.667   13.00 | 11.67   13.00
               2.750    6.00 |  5.750   13.00 |  8.750   13.00 | 11.75   13.00
               2.833    6.00 |  5.833   13.00 |  8.833   13.00 | 11.83   13.00
               2.917    6.00 |  5.917   13.00 |  8.917   13.00 | 11.92   13.00
               3.000    6.00 |  6.000   13.00 |  9.000   13.00 | 12.00   13.00

    Max.Eff.Inten.(mm/hr)=      53.00        53.21
          over (min)            5.00        10.00
    Storage Coeff.  (min)=      0.81 (ii)    5.11 (ii)
    Unit Hyd. Tpeak (min)=      5.00        10.00
    Unit Hyd. peak  (cms)=      0.34         0.16
                                                    *TOTALS*
    PEAK FLOW       (cms)=      0.00         0.01      0.008 (iii)
    TIME TO PEAK    (hrs)=      9.33        10.00        10.00
    RUNOFF VOLUME    (mm)=    210.00       158.00       172.04
    TOTAL RAINFALL   (mm)=    212.00       212.00       212.00
    RUNOFF COEFFICIENT   =      0.99         0.75         0.81

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  78.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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-------------------
| ADD HYD  (  0204)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)     (cms)    (hrs)     (mm)
      ID1= 1 (  0201):      0.42    0.063    10.00   210.00
    + ID2= 2 (  0202):      0.06    0.008    10.00   172.04
      ==========================================================
      ID = 3 (  0204):      0.48    0.070    10.00   205.58

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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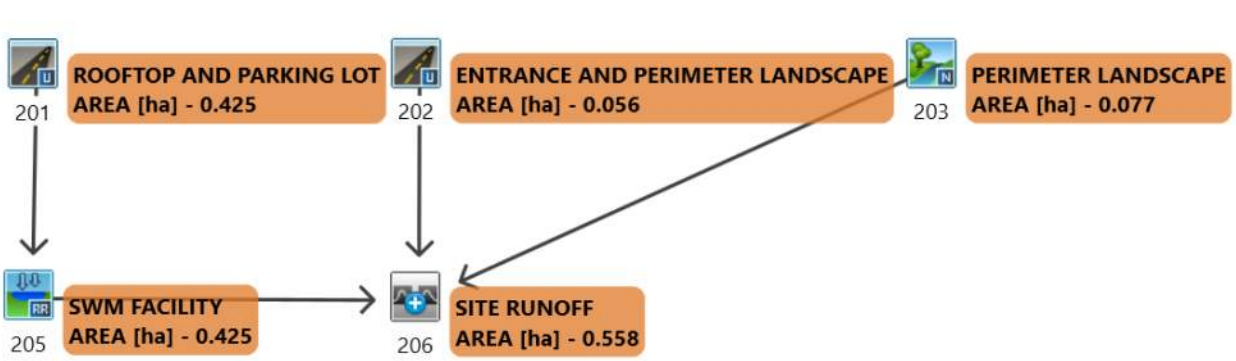
-------------------
| ADD HYD  (  0204)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)     (cms)    (hrs)     (mm)
      ID1= 3 (  0204):      0.48    0.070    10.00   205.58
    + ID2= 2 (  0203):      0.08    0.010    10.00   153.41
      ==========================================================
      ID = 1 (  0204):      0.56    0.080    10.00   198.38

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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 FINISH
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POST-DEVELOPMENT WITH SWM



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==============================================================================================

       V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\e1b4f2eb-09
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\e1b4f2eb-09


DATE: 04-23-2024                          TIME: 09:41:32

USER:


COMMENTS: _____________________________________________________


----------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 100yr 24hr 5min SCS Type II   **
  ************************************************


-------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              5d2fae5e-3df1-4d84-8e6d-36dc0a390706\c8503f19
| Ptotal=137.63 mm |    Comments: 100yr 24hr 5min SCS Type II
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```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	2.48	12.17	19.82	18.25	2.48
0.08	1.51	6.17	2.48	12.25	19.82	18.33	2.48
0.17	1.51	6.25	2.48	12.33	19.82	18.42	2.48
0.25	1.51	6.33	2.48	12.42	19.82	18.50	2.48
0.33	1.51	6.42	2.48	12.50	19.82	18.58	2.48
0.42	1.51	6.50	2.48	12.58	10.18	18.67	2.48
0.50	1.51	6.58	2.48	12.67	10.18	18.75	2.48
0.58	1.51	6.67	2.48	12.75	10.18	18.83	2.48
0.67	1.51	6.75	2.48	12.83	10.18	18.92	2.48
0.75	1.51	6.83	2.48	12.92	10.18	19.00	2.48
0.83	1.51	6.92	2.48	13.00	10.18	19.08	2.48
0.92	1.51	7.00	2.48	13.08	7.43	19.17	2.48
1.00	1.51	7.08	3.03	13.17	7.43	19.25	2.48
1.08	1.51	7.17	3.03	13.25	7.43	19.33	2.48
1.17	1.51	7.25	3.03	13.33	7.43	19.42	2.48
1.25	1.51	7.33	3.03	13.42	7.43	19.50	2.48
1.33	1.51	7.42	3.03	13.50	7.43	19.58	2.48
1.42	1.51	7.50	3.03	13.58	5.78	19.67	2.48
1.50	1.51	7.58	3.03	13.67	5.78	19.75	2.48
1.58	1.51	7.67	3.03	13.75	5.78	19.83	2.48
1.67	1.51	7.75	3.03	13.83	5.78	19.92	2.48
1.75	1.51	7.83	3.03	13.92	5.78	20.00	2.48
1.83	1.51	7.92	3.03	14.00	5.78	20.08	1.65
1.92	1.51	8.00	3.03	14.08	4.13	20.17	1.65
2.00	1.51	8.08	3.58	14.17	4.13	20.25	1.65
2.08	1.79	8.17	3.58	14.25	4.13	20.33	1.65
2.17	1.79	8.25	3.58	14.33	4.13	20.42	1.65
2.25	1.79	8.33	3.58	14.42	4.13	20.50	1.65
2.33	1.79	8.42	3.58	14.50	4.13	20.58	1.65
2.42	1.79	8.50	3.58	14.58	4.13	20.67	1.65
2.50	1.79	8.58	3.85	14.67	4.13	20.75	1.65
2.58	1.79	8.67	3.85	14.75	4.13	20.83	1.65
2.67	1.79	8.75	3.85	14.83	4.13	20.92	1.65
2.75	1.79	8.83	3.85	14.92	4.13	21.00	1.65
2.83	1.79	8.92	3.85	15.00	4.13	21.08	1.65
2.92	1.79	9.00	3.85	15.08	4.13	21.17	1.65
3.00	1.79	9.08	4.40	15.17	4.13	21.25	1.65
3.08	1.79	9.17	4.40	15.25	4.13	21.33	1.65
3.17	1.79	9.25	4.40	15.33	4.13	21.42	1.65
3.25	1.79	9.33	4.40	15.42	4.13	21.50	1.65
3.33	1.79	9.42	4.40	15.50	4.13	21.58	1.65
3.42	1.79	9.50	4.40	15.58	4.13	21.67	1.65
3.50	1.79	9.58	4.95	15.67	4.13	21.75	1.65
3.58	1.79	9.67	4.95	15.75	4.13	21.83	1.65
3.67	1.79	9.75	4.95	15.83	4.13	21.92	1.65
3.75	1.79	9.83	4.95	15.92	4.13	22.00	1.65
3.83	1.79	9.92	4.95	16.00	4.13	22.08	1.65
3.92	1.79	10.00	4.95	16.08	2.48	22.17	1.65
4.00	1.79	10.08	6.33	16.17	2.48	22.25	1.65
4.08	2.20	10.17	6.33	16.25	2.48	22.33	1.65
4.17	2.20	10.25	6.33	16.33	2.48	22.42	1.65
4.25	2.20	10.33	6.33	16.42	2.48	22.50	1.65
4.33	2.20	10.42	6.33	16.50	2.48	22.58	1.65
4.42	2.20	10.50	6.33	16.58	2.48	22.67	1.65
4.50	2.20	10.58	8.53	16.67	2.48	22.75	1.65
4.58	2.20	10.67	8.53	16.75	2.48	22.83	1.65
4.67	2.20	10.75	8.53	16.83	2.48	22.92	1.65
4.75	2.20	10.83	8.53	16.92	2.48	23.00	1.65
4.83	2.20	10.92	8.53	17.00	2.48	23.08	1.65
4.92	2.20	11.00	8.53	17.08	2.48	23.17	1.65
5.00	2.20	11.08	13.21	17.17	2.48	23.25	1.65
5.08	2.20	11.17	13.21	17.25	2.48	23.33	1.65
5.17	2.20	11.25	13.21	17.33	2.48	23.42	1.65
5.25	2.20	11.33	13.21	17.42	2.48	23.50	1.65
5.33	2.20	11.42	13.21	17.50	2.48	23.58	1.65
5.42	2.20	11.50	13.21	17.58	2.48	23.67	1.65
5.50	2.20	11.58	40.74	17.67	2.48	23.75	1.65
5.58	2.20	11.67	40.74	17.75	2.48	23.83	1.65
5.67	2.20	11.75	40.74	17.83	2.48	23.92	1.65
5.75	2.20	11.83	168.46	17.92	2.48	24.00	1.65
5.83	2.20	11.92	168.46	18.00	2.48		
5.92	2.20	12.00	168.46	18.08	2.48		
6.00	2.20	12.08	19.82	18.17	2.48		

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| CALIB             |
| NASHYD  (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.012 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  59.478
     TOTAL RAINFALL   (mm)= 137.630
     RUNOFF COEFFICIENT   =   0.432

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

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-------------------
| CALIB             |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
-------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02          0.04
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       4.00          5.00
     Length            (m)=      19.32         10.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     168.46        102.16
               over (min)          5.00          5.00
     Storage Coeff.  (min)=       0.51 (ii)     3.22 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.34          0.27
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.01          0.01      0.018 (iii)
     TIME TO PEAK    (hrs)=      12.00         12.08        12.08
     RUNOFF VOLUME    (mm)=     135.63         63.19        82.80
     TOTAL RAINFALL   (mm)=     137.63        137.63       137.63
     RUNOFF COEFFICIENT   =       0.99          0.46         0.60

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  61.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------------------------------------
-------------------
| CALIB             |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n            =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     168.46        167.74
               over (min)          5.00          5.00
     Storage Coeff.  (min)=       1.26 (ii)     1.63 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.33          0.32
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.20          0.00        0.199 (iii)
     TIME TO PEAK    (hrs)=      12.08         12.08         12.08
     RUNOFF VOLUME    (mm)=     135.63        130.64        135.62
     TOTAL RAINFALL   (mm)=     137.63        137.63        137.63
     RUNOFF COEFFICIENT   =       0.99          0.95          0.99

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  98.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------------------------------------
-------------------
| RESERVOIR(  0205)|    OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
-------------------     (cms)     (ha.m.)   |   (cms)     (ha.m.)
                        0.0000      0.0000  |    0.0196      0.0123
                        0.0056      0.0014  |    0.0206      0.0123
                        0.0084      0.0027  |    0.0215      0.0123
                        0.0105      0.0041  |    0.0222      0.0123
                        0.0122      0.0054  |    0.0224      0.0124
                        0.0137      0.0068  |    0.0227      0.0129
                        0.0151      0.0082  |    0.0229      0.0145
                        0.0164      0.0095  |    0.0231      0.0181
                        0.0175      0.0109  |    0.0233      0.0238
                        0.0186      0.0123  |    0.1450      0.0314

                           AREA      QPEAK     TPEAK       R.V.
                           (ha)      (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)      0.425      0.199     12.08     135.62
   OUTFLOW: ID= 1 (  0205)      0.425      0.023     12.58     135.50

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.70
                TIME SHIFT OF PEAK FLOW       (min)= 30.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.0228

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-------------------
| ADD HYD  (  0206)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0202):     0.06   0.018    12.08    82.80
     + ID2= 2 (  0203):     0.08   0.012    12.17    59.48
       ========================================================
       ID = 3 (  0206):     0.13   0.029    12.08    69.30

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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-------------------
| ADD HYD  (  0206)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0206):     0.13   0.029    12.08    69.30
     + ID2= 2 (  0205):     0.42   0.023    12.58   135.50
       ========================================================
       ID = 1 (  0206):     0.56   0.052    12.08   119.72

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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================================================================================================

       V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
       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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\4fd01fbe-49
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\4fd01fbe-49


DATE: 04-23-2024                          TIME: 09:41:32

USER:


COMMENTS: _____________________________________________________


----------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 100yr 4hr 5min Chicago      **
  ************************************************


-------------------
| CHICAGO STORM    |    IDF curve parameters: A=1383.628
| Ptotal= 87.45 mm |                          B=   4.905
-------------------                          C=   0.754
                          used in:   INTENSITY =  A / (t + B)^C

                          Duration of storm  =  4.00 hrs
                          Storm time step    =  5.00 min
                          Time to peak ratio =  0.33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	6.06	1.00	24.64	2.00	16.04	3.00	7.96
0.08	6.41	1.08	36.97	2.08	14.68	3.08	7.67
0.17	6.81	1.17	81.48	2.17	13.55	3.17	7.40
0.25	7.27	1.25	245.55	2.25	12.60	3.25	7.15
0.33	7.81	1.33	103.86	2.33	11.79	3.33	6.92
0.42	8.45	1.42	59.20	2.42	11.08	3.42	6.71
0.50	9.23	1.50	41.66	2.50	10.47	3.50	6.51
0.58	10.19	1.58	32.37	2.58	9.93	3.58	6.32
0.67	11.42	1.67	26.62	2.67	9.45	3.67	6.15
0.75	13.06	1.75	22.72	2.75	9.02	3.75	5.99
0.83	15.34	1.83	19.89	2.83	8.63	3.83	5.83
0.92	18.79	1.92	17.73	2.92	8.28	3.92	5.69

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-------------------
| CALIB             |
| NASHYD  (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.006 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  27.691
     TOTAL RAINFALL   (mm)=  87.445
     RUNOFF COEFFICIENT   =   0.317
```

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

CALIB	
STANDHYD (0202)	Area (ha)= 0.06
ID= 1 DT= 5.0 min	Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	245.55	61.82
over (min)	5.00	5.00
Storage Coeff. (min)=	0.44 (ii)	2.77 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.28

		TOTALS
PEAK FLOW (cms)=	0.01	0.01	0.017 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	85.45	29.87	44.89
TOTAL RAINFALL (mm)=	87.45	87.45	87.45
RUNOFF COEFFICIENT =	0.98	0.34	0.51

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
STANDHYD (0201)	Area (ha)= 0.42
ID= 1 DT= 5.0 min	Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	245.55	171.27
over (min)	5.00	5.00
Storage Coeff. (min)=	1.08 (ii)	1.40 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.33

		TOTALS
PEAK FLOW (cms)=	0.29	0.00	0.288 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	85.45	80.56	85.44
TOTAL RAINFALL (mm)=	87.45	87.45	87.45
RUNOFF COEFFICIENT =	0.98	0.92	0.98

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0196	0.0123
0.0056	0.0014	0.0206	0.0123
0.0084	0.0027	0.0215	0.0123
0.0105	0.0041	0.0222	0.0123
0.0122	0.0054	0.0224	0.0124
0.0137	0.0068	0.0227	0.0129
0.0151	0.0082	0.0229	0.0145
0.0164	0.0095	0.0231	0.0181
0.0175	0.0109	0.0233	0.0238

0.0186	0.0123	0.1450	0.0314

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)	0.425	0.288	1.33	85.44
OUTFLOW: ID= 1 (0205)	0.425	0.023	1.92	85.31

PEAK FLOW REDUCTION [Qout/Qin](%)= 8.05
TIME SHIFT OF PEAK FLOW (min)= 35.00
MAXIMUM STORAGE USED (ha.m.)= 0.0207

ADD HYD (0206)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.06	0.017	1.33	44.89
+ ID2= 2 (0203):	0.08	0.006	1.50	27.69
ID = 3 (0206):	0.13	0.020	1.33	34.93

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0206)				
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0206):	0.13	0.020	1.33	34.93
+ ID2= 2 (0205):	0.42	0.023	1.92	85.31
ID = 1 (0206):	0.56	0.038	1.42	73.31

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
      V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
      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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```

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

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\4e21e0d1-70
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\4e21e0d1-70

DATE: 04-23-2024 TIME: 09:41:32

USER:

COMMENTS: _____

```
  ************************************************
  ** SIMULATION : 10yr 24hr 5min SCS Type II    **
  ************************************************
```

READ STORM	Filename: C:\Users\dhordyk\AppD ata\Local\Temp\ 5d2fae5e-3df1-4d84-8e6d-36dc0a390706\a4746fd7
Ptotal= 93.03 mm	Comments: 10yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	1.67	12.17	13.40	18.25	1.67
0.08	1.02	6.17	1.67	12.25	13.40	18.33	1.67
0.17	1.02	6.25	1.67	12.33	13.40	18.42	1.67
0.25	1.02	6.33	1.67	12.42	13.40	18.50	1.67
0.33	1.02	6.42	1.67	12.50	13.40	18.58	1.67
0.42	1.02	6.50	1.67	12.58	6.88	18.67	1.67
0.50	1.02	6.58	1.67	12.67	6.88	18.75	1.67
0.58	1.02	6.67	1.67	12.75	6.88	18.83	1.67
0.67	1.02	6.75	1.67	12.83	6.88	18.92	1.67
0.75	1.02	6.83	1.67	12.92	6.88	19.00	1.67
0.83	1.02	6.92	1.67	13.00	6.88	19.08	1.67
0.92	1.02	7.00	1.67	13.08	5.02	19.17	1.67
1.00	1.02	7.08	2.05	13.17	5.02	19.25	1.67
1.08	1.02	7.17	2.05	13.25	5.02	19.33	1.67
1.17	1.02	7.25	2.05	13.33	5.02	19.42	1.67
1.25	1.02	7.33	2.05	13.42	5.02	19.50	1.67
1.33	1.02	7.42	2.05	13.50	5.02	19.58	1.67
1.42	1.02	7.50	2.05	13.58	3.91	19.67	1.67
1.50	1.02	7.58	2.05	13.67	3.91	19.75	1.67
1.58	1.02	7.67	2.05	13.75	3.91	19.83	1.67
1.67	1.02	7.75	2.05	13.83	3.91	19.92	1.67
1.75	1.02	7.83	2.05	13.92	3.91	20.00	1.67
1.83	1.02	7.92	2.05	14.00	3.91	20.08	1.12
1.92	1.02	8.00	2.05	14.08	2.79	20.17	1.12
2.00	1.02	8.08	2.42	14.17	2.79	20.25	1.12
2.08	1.21	8.17	2.42	14.25	2.79	20.33	1.12
2.17	1.21	8.25	2.42	14.33	2.79	20.42	1.12
2.25	1.21	8.33	2.42	14.42	2.79	20.50	1.12
2.33	1.21	8.42	2.42	14.50	2.79	20.58	1.12
2.42	1.21	8.50	2.42	14.58	2.79	20.67	1.12
2.50	1.21	8.58	2.60	14.67	2.79	20.75	1.12
2.58	1.21	8.67	2.60	14.75	2.79	20.83	1.12
2.67	1.21	8.75	2.60	14.83	2.79	20.92	1.12
2.75	1.21	8.83	2.60	14.92	2.79	21.00	1.12
2.83	1.21	8.92	2.60	15.00	2.79	21.08	1.12
2.92	1.21	9.00	2.60	15.08	2.79	21.17	1.12
3.00	1.21	9.08	2.98	15.17	2.79	21.25	1.12
3.08	1.21	9.17	2.98	15.25	2.79	21.33	1.12
3.17	1.21	9.25	2.98	15.33	2.79	21.42	1.12
3.25	1.21	9.33	2.98	15.42	2.79	21.50	1.12
3.33	1.21	9.42	2.98	15.50	2.79	21.58	1.12
3.42	1.21	9.50	2.98	15.58	2.79	21.67	1.12
3.50	1.21	9.58	3.35	15.67	2.79	21.75	1.12
3.58	1.21	9.67	3.35	15.75	2.79	21.83	1.12
3.67	1.21	9.75	3.35	15.83	2.79	21.92	1.12
3.75	1.21	9.83	3.35	15.92	2.79	22.00	1.12
3.83	1.21	9.92	3.35	16.00	2.79	22.08	1.12
3.92	1.21	10.00	3.35	16.08	1.67	22.17	1.12
4.00	1.21	10.08	4.28	16.17	1.67	22.25	1.12
4.08	1.49	10.17	4.28	16.25	1.67	22.33	1.12
4.17	1.49	10.25	4.28	16.33	1.67	22.42	1.12
4.25	1.49	10.33	4.28	16.42	1.67	22.50	1.12
4.33	1.49	10.42	4.28	16.50	1.67	22.58	1.12
4.42	1.49	10.50	4.28	16.58	1.67	22.67	1.12
4.50	1.49	10.58	5.77	16.67	1.67	22.75	1.12
4.58	1.49	10.67	5.77	16.75	1.67	22.83	1.12
4.67	1.49	10.75	5.77	16.83	1.67	22.92	1.12
4.75	1.49	10.83	5.77	16.92	1.67	23.00	1.12
4.83	1.49	10.92	5.77	17.00	1.67	23.08	1.12
4.92	1.49	11.00	5.77	17.08	1.67	23.17	1.12
5.00	1.49	11.08	8.93	17.17	1.67	23.25	1.12
5.08	1.49	11.17	8.93	17.25	1.67	23.33	1.12
5.17	1.49	11.25	8.93	17.33	1.67	23.42	1.12
5.25	1.49	11.33	8.93	17.42	1.67	23.50	1.12
5.33	1.49	11.42	8.93	17.50	1.67	23.58	1.12
5.42	1.49	11.50	8.93	17.58	1.67	23.67	1.12
5.50	1.49	11.58	27.54	17.67	1.67	23.75	1.12
5.58	1.49	11.67	27.54	17.75	1.67	23.83	1.12
5.67	1.49	11.75	27.54	17.83	1.67	23.92	1.12
5.75	1.49	11.83	113.87	17.92	1.67	24.00	1.12
5.83	1.49	11.92	113.87	18.00	1.67		
5.92	1.49	12.00	113.87	18.08	1.67		
6.00	1.49	12.08	13.40	18.17	1.67		

CALIB	
NASHYD (0203)	Area (ha)= 0.08 Curve Number (CN)= 61.0
ID= 1 DT= 5.0 min	Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.19

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.006 (i)
TIME TO PEAK (hrs)= 12.167
RUNOFF VOLUME (mm)= 30.868
TOTAL RAINFALL (mm)= 93.030
RUNOFF COEFFICIENT = 0.332

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

CALIB	
STANDHYD (0202)	Area (ha)= 0.06
ID= 1 DT= 5.0 min	Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	113.87	53.74
over (min)	5.00	5.00
Storage Coeff. (min)=	0.60 (ii)	3.76 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.25

			TOTALS
PEAK FLOW (cms)=	0.00	0.01	0.010 (iii)
TIME TO PEAK (hrs)=	12.08	12.08	12.08
RUNOFF VOLUME (mm)=	91.03	33.22	48.87
TOTAL RAINFALL (mm)=	93.03	93.03	93.03
RUNOFF COEFFICIENT =	0.98	0.36	0.53

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
STANDHYD (0201)	Area (ha)= 0.42
ID= 1 DT= 5.0 min	Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	113.87	112.84
over (min)	5.00	5.00
Storage Coeff. (min)=	1.47 (ii)	1.90 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.33	0.32

			TOTALS
PEAK FLOW (cms)=	0.13	0.00	0.134 (iii)
TIME TO PEAK (hrs)=	12.08	12.08	12.08
RUNOFF VOLUME (mm)=	91.03	86.13	91.02
TOTAL RAINFALL (mm)=	93.03	93.03	93.03
RUNOFF COEFFICIENT =	0.98	0.93	0.98

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0196	0.0123
0.0056	0.0014	0.0206	0.0123
0.0084	0.0027	0.0215	0.0123
0.0105	0.0041	0.0222	0.0123

	0.0122	0.0054	|	0.0224	0.0124
	0.0137	0.0068	|	0.0227	0.0129
	0.0151	0.0082	|	0.0229	0.0145
	0.0164	0.0095	|	0.0231	0.0181
	0.0175	0.0109	|	0.0233	0.0238
	0.0186	0.0123	|	0.1450	0.0314

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)	0.425	0.134	12.08	91.02
OUTFLOW: ID= 1 (0205)	0.425	0.023	12.17	90.89

PEAK FLOW REDUCTION [Qout/Qin](%)= 17.04
TIME SHIFT OF PEAK FLOW (min)= 5.00
MAXIMUM STORAGE USED (ha.m.)= 0.0146

ADD HYD (0206)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.06	0.010	12.08	48.87
+ ID2= 2 (0203):	0.08	0.006	12.17	30.87
ID = 3 (0206):	0.13	0.016	12.08	38.45

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0206)
3 + 2 = 1

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0206):	0.13	0.016	12.08	38.45
+ ID2= 2 (0205):	0.42	0.023	12.17	90.89
ID = 1 (0206):	0.56	0.039	12.08	78.39

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
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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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\1a50e3f6-ed
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\1a50e3f6-ed

DATE: 04-23-2024 TIME: 09:41:32

USER:

COMMENTS: _____

** SIMULATION : 10yr 4hr 5min Chicago **

CHICAGO STORM | Ptotal= 59.77 mm |

IDF curve parameters: A= 976.898
B= 4.745
C= 0.760

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.04	1.00	16.64	2.00	10.79	3.00	5.32
0.08	4.28	1.08	25.08	2.08	9.86	3.08	5.13
0.17	4.55	1.17	55.96	2.17	9.10	3.17	4.94
0.25	4.86	1.25	173.13	2.25	8.45	3.25	4.78
0.33	5.22	1.33	71.59	2.33	7.91	3.33	4.62
0.42	5.65	1.42	40.40	2.42	7.43	3.42	4.48
0.50	6.18	1.50	28.30	2.50	7.02	3.50	4.34
0.58	6.83	1.58	21.92	2.58	6.65	3.58	4.22
0.67	7.66	1.67	17.99	2.67	6.33	3.67	4.10
0.75	8.77	1.75	15.33	2.75	6.04	3.75	3.99
0.83	10.31	1.83	13.40	2.83	5.78	3.83	3.89
0.92	12.65	1.92	11.94	2.92	5.54	3.92	3.79

CALIB
NASHYD (0203) | ID= 1 DT= 5.0 min |

Area (ha)= 0.08 Curve Number (CN)= 61.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.19

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.003 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 13.772
TOTAL RAINFALL (mm)= 59.765
RUNOFF COEFFICIENT = 0.230

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

CALIB
STANDHYD (0202) | ID= 1 DT= 5.0 min |

Area (ha)= 0.06
Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.02	0.04
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	4.00	5.00
Length	(m)=	19.32	10.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		173.13	30.65
over (min)		5.00	5.00
Storage Coeff. (min)=		0.50 (ii)	3.18 (ii)
Unit Hyd. Tpeak (min)=		5.00	5.00
Unit Hyd. peak (cms)=		0.34	0.27

		TOTALS
PEAK FLOW	(cms)=	0.011 (iii)
TIME TO PEAK	(hrs)=	1.33
RUNOFF VOLUME	(mm)=	26.61
TOTAL RAINFALL	(mm)=	59.77
RUNOFF COEFFICIENT	=	0.45

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0201) | ID= 1 DT= 5.0 min |

Area (ha)= 0.42
Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.42	0.00
Dep. Storage	(mm)=	2.00	2.00
Average Slope	(%)=	1.50	1.50
Length	(m)=	53.23	36.00
Mannings n	=	0.013	0.250

	0.0122	0.0054	|	0.0224	0.0124
	0.0137	0.0068	|	0.0227	0.0129
	0.0151	0.0082	|	0.0229	0.0145
	0.0164	0.0095	|	0.0231	0.0181
	0.0175	0.0109	|	0.0233	0.0238
	0.0186	0.0123	|	0.1450	0.0314

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)	0.425	0.202	1.33	57.75
OUTFLOW: ID= 1 (0205)	0.425	0.023	1.75	57.63

PEAK FLOW REDUCTION [Qout/Qin](%)= 11.26
TIME SHIFT OF PEAK FLOW (min)= 25.00
MAXIMUM STORAGE USED (ha.m.)= 0.0131

ADD HYD (0206)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.06	0.011	1.33	26.61
+ ID2= 2 (0203):	0.08	0.003	1.58	13.77
ID = 3 (0206):	0.13	0.012	1.33	19.18

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0206)
3 + 2 = 1

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0206):	0.13	0.012	1.33	19.18
+ ID2= 2 (0205):	0.42	0.023	1.75	57.63
ID = 1 (0206):	0.56	0.029	1.50	48.46

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
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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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\6955846a-66
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\6955846a-66

DATE: 04-23-2024 TIME: 09:41:32

USER:

COMMENTS: _____

** SIMULATION : 25yr 24hr 5min SCS Type II **

READ STORM | Ptotal=111.09 mm |

Filename: C:\Users\dhordyk\AppD
ata\Local\Temp\
5d2fae5e-3df1-4d84-8e6d-36dc0a390706\89586bd0
Comments: 25yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	2.00	12.17	16.00	18.25	2.00
0.08	1.22	6.17	2.00	12.25	16.00	18.33	2.00
0.17	1.22	6.25	2.00	12.33	16.00	18.42	2.00
0.25	1.22	6.33	2.00	12.42	16.00	18.50	2.00
0.33	1.22	6.42	2.00	12.50	16.00	18.58	2.00
0.42	1.22	6.50	2.00	12.58	8.22	18.67	2.00
0.50	1.22	6.58	2.00	12.67	8.22	18.75	2.00
0.58	1.22	6.67	2.00	12.75	8.22	18.83	2.00
0.67	1.22	6.75	2.00	12.83	8.22	18.92	2.00
0.75	1.22	6.83	2.00	12.92	8.22	19.00	2.00
0.83	1.22	6.92	2.00	13.00	8.22	19.08	2.00
0.92	1.22	7.00	2.00	13.08	6.00	19.17	2.00
1.00	1.22	7.08	2.44	13.17	6.00	19.25	2.00
1.08	1.22	7.17	2.44	13.25	6.00	19.33	2.00
1.17	1.22	7.25	2.44	13.33	6.00	19.42	2.00
1.25	1.22	7.33	2.44	13.42	6.00	19.50	2.00
1.33	1.22	7.42	2.44	13.50	6.00	19.58	2.00
1.42	1.22	7.50	2.44	13.58	4.67	19.67	2.00
1.50	1.22	7.58	2.44	13.67	4.67	19.75	2.00
1.58	1.22	7.67	2.44	13.75	4.67	19.83	2.00
1.67	1.22	7.75	2.44	13.83	4.67	19.92	2.00
1.75	1.22	7.83	2.44	13.92	4.67	20.00	2.00
1.83	1.22	7.92	2.44	14.00	4.67	20.08	1.33
1.92	1.22	8.00	2.44	14.08	3.33	20.17	1.33
2.00	1.22	8.08	2.89	14.17	3.33	20.25	1.33
2.08	1.44	8.17	2.89	14.25	3.33	20.33	1.33
2.17	1.44	8.25	2.89	14.33	3.33	20.42	1.33
2.25	1.44	8.33	2.89	14.42	3.33	20.50	1.33
2.33	1.44	8.42	2.89	14.50	3.33	20.58	1.33
2.42	1.44	8.50	2.89	14.58	3.33	20.67	1.33
2.50	1.44	8.58	3.11	14.67	3.33	20.75	1.33
2.58	1.44	8.67	3.11	14.75	3.33	20.83	1.33
2.67	1.44	8.75	3.11	14.83	3.33	20.92	1.33
2.75	1.44	8.83	3.11	14.92	3.33	21.00	1.33
2.83	1.44	8.92	3.11	15.00	3.33	21.08	1.33
2.92	1.44	9.00	3.11	15.08	3.33	21.17	1.33
3.00	1.44	9.08	3.55	15.17	3.33	21.25	1.33
3.08	1.44	9.17	3.55	15.25	3.33	21.33	1.33
3.17	1.44	9.25	3.55	15.33	3.33	21.42	1.33
3.25	1.44	9.33	3.55	15.42	3.33	21.50	1.33
3.33	1.44	9.42	3.55	15.50	3.33	21.58	1.33
3.42	1.44	9.50	3.55	15.58	3.33	21.67	1.33
3.50	1.44	9.58	4.00	15.67	3.33	21.75	1.33
3.58	1.44	9.67	4.00	15.75	3.33	21.83	1.33
3.67	1.44	9.75	4.00	15.83	3.33	21.92	1.33
3.75	1.44	9.83	4.00	15.92	3.33	22.00	1.33
3.83	1.44	9.92	4.00	16.00	3.33	22.08	1.33
3.92	1.44	10.00	4.00	16.08	2.00	22.17	1.33

4.00	1.44	10.08	5.11	16.17	2.00	22.25	1.33
4.08	1.78	10.17	5.11	16.25	2.00	22.33	1.33
4.17	1.78	10.25	5.11	16.33	2.00	22.42	1.33
4.25	1.78	10.33	5.11	16.42	2.00	22.50	1.33
4.33	1.78	10.42	5.11	16.50	2.00	22.58	1.33
4.42	1.78	10.50	5.11	16.58	2.00	22.67	1.33
4.50	1.78	10.58	6.89	16.67	2.00	22.75	1.33
4.58	1.78	10.67	6.89	16.75	2.00	22.83	1.33
4.67	1.78	10.75	6.89	16.83	2.00	22.92	1.33
4.75	1.78	10.83	6.89	16.92	2.00	23.00	1.33
4.83	1.78	10.92	6.89	17.00	2.00	23.08	1.33
4.92	1.78	11.00	6.89	17.08	2.00	23.17	1.33
5.00	1.78	11.08	10.66	17.17	2.00	23.25	1.33
5.08	1.78	11.17	10.66	17.25	2.00	23.33	1.33
5.17	1.78	11.25	10.66	17.33	2.00	23.42	1.33
5.25	1.78	11.33	10.66	17.42	2.00	23.50	1.33
5.33	1.78	11.42	10.66	17.50	2.00	23.58	1.33
5.42	1.78	11.50	10.66	17.58	2.00	23.67	1.33
5.50	1.78	11.58	32.88	17.67	2.00	23.75	1.33
5.58	1.78	11.67	32.88	17.75	2.00	23.83	1.33
5.67	1.78	11.75	32.88	17.83	2.00	23.92	1.33
5.75	1.78	11.83	135.97	17.92	2.00	24.00	1.33
5.83	1.78	11.92	135.97	18.00	2.00		
5.92	1.78	12.00	135.97	18.08	2.00		
6.00	1.78	12.08	16.00	18.17	2.00		

CALIB				
NASHYD (0203)	Area (ha)= 0.08	Curve Number (CN)= 61.0		
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00		
	U.H. Tp(hrs)= 0.19			

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW	(cms)=	0.008 (i)
TIME TO PEAK	(hrs)=	12.167
RUNOFF VOLUME	(mm)=	41.818
TOTAL RAINFALL	(mm)=	111.090
RUNOFF COEFFICIENT	=	0.376

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

CALIB			
STANDHYD (0202)	Area (ha)= 0.06		
ID= 1 DT= 5.0 min	Total Imp(%)= 33.90	Dir. Conn.(%)= 27.10	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.02	0.04
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	4.00	5.00
Length	(m)=	19.32	10.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		135.97	72.38
over (min)		5.00	5.00
Storage Coeff. (min)=		0.56 (ii)	3.50 (ii)
Unit Hyd. Tpeak (min)=		5.00	5.00
Unit Hyd. peak (cms)=		0.34	0.26

		TOTALS
PEAK FLOW	(cms)=	0.01 0.01 0.013 (iii)
TIME TO PEAK	(hrs)=	12.00 12.08 12.08
RUNOFF VOLUME	(mm)=	109.09 44.74 62.16
TOTAL RAINFALL	(mm)=	111.09 111.09 111.09
RUNOFF COEFFICIENT	=	0.98 0.40 0.56

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0201)	Area (ha)= 0.42		
ID= 1 DT= 5.0 min	Total Imp(%)= 99.90	Dir. Conn.(%)= 99.90	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.42	0.00
Dep. Storage	(mm)=	2.00	2.00
Average Slope	(%)=	1.50	1.50
Length	(m)=	53.23	36.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		135.97	135.10
over (min)		5.00	5.00
Storage Coeff. (min)=		1.37 (ii)	1.77 (ii)
Unit Hyd. Tpeak (min)=		5.00	5.00
Unit Hyd. peak (cms)=		0.33	0.32

		TOTALS
PEAK FLOW	(cms)=	0.16 0.00 0.161 (iii)
TIME TO PEAK	(hrs)=	12.08 12.08 12.08
RUNOFF VOLUME	(mm)=	109.09 104.14 109.08
TOTAL RAINFALL	(mm)=	111.09 111.09 111.09
RUNOFF COEFFICIENT	=	0.98 0.94 0.98

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0196	0.0123
	0.0056	0.0014	0.0206	0.0123
	0.0084	0.0027	0.0215	0.0123
	0.0105	0.0041	0.0222	0.0123
	0.0122	0.0054	0.0224	0.0124
	0.0137	0.0068	0.0227	0.0129
	0.0151	0.0082	0.0229	0.0145
	0.0164	0.0095	0.0231	0.0181
	0.0175	0.0109	0.0233	0.0238
	0.0186	0.0123	0.1450	0.0314

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)		0.425	0.161	12.08	109.08
OUTFLOW: ID= 1 (0205)		0.425	0.023	12.17	108.96
PEAK FLOW REDUCTION [Qout/Qin](%)=					14.38
TIME SHIFT OF PEAK FLOW				(min)=	5.00
MAXIMUM STORAGE USED				(ha.m.)=	0.0179

ADD HYD (0206)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.06	0.013	12.08	62.16
+ ID2= 2 (0203):	0.08	0.008	12.17	41.82
ID = 3 (0206):	0.13	0.021	12.08	50.38

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0206)				
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0206):	0.13	0.021	12.08	50.38
+ ID2= 2 (0205):	0.42	0.023	12.17	108.96
ID = 1 (0206):	0.56	0.044	12.08	95.00

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

==========

```
      V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
      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 M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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```

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

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\c7c56f5e-4f
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\c7c56f5e-4f

DATE: 04-23-2024 TIME: 09:41:32

USER:

COMMENTS: _____

** SIMULATION : 25yr 4hr 5min Chicago **

CHICAGO STORM	IDF curve parameters: A=1133.123
Ptotal= 70.87 mm	B= 4.734
	C= 0.756

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.87	1.00	19.82	2.00	12.89	3.00	6.39
0.08	5.15	1.08	29.77	2.08	11.79	3.08	6.16
0.17	5.47	1.17	65.99	2.17	10.89	3.17	5.94
0.25	5.84	1.25	202.83	2.25	10.12	3.25	5.74
0.33	6.27	1.33	84.29	2.33	9.47	3.33	5.56
0.42	6.79	1.42	47.77	2.42	8.91	3.42	5.39
0.50	7.41	1.50	33.55	2.50	8.41	3.50	5.23
0.58	8.19	1.58	26.05	2.58	7.98	3.58	5.08
0.67	9.18	1.67	21.41	2.67	7.59	3.67	4.94
0.75	10.49	1.75	18.27	2.75	7.25	3.75	4.81
0.83	12.33	1.83	15.99	2.83	6.93	3.83	4.68
0.92	15.10	1.92	14.26	2.92	6.65	3.92	4.57

CALIB				
NASHYD (0203)	Area (ha)= 0.08	Curve Number (CN)= 61.0		
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00		
	U.H. Tp(hrs)= 0.19			

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW	(cms)=	0.004 (i)
TIME TO PEAK	(hrs)=	1.500
RUNOFF VOLUME	(mm)=	18.958
TOTAL RAINFALL	(mm)=	70.867
RUNOFF COEFFICIENT	=	0.268

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

CALIB			
STANDHYD (0202)	Area (ha)= 0.06		
ID= 1 DT= 5.0 min	Total Imp(%)= 33.90	Dir. Conn.(%)= 27.10	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.02	0.04
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	4.00	5.00
Length	(m)=	19.32	10.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		202.83	42.27
over (min)		5.00	5.00
Storage Coeff. (min)=		0.47 (ii)	2.99 (ii)
Unit Hyd. Tpeak (min)=		5.00	5.00
Unit Hyd. peak (cms)=		0.34	0.28

		TOTALS
PEAK FLOW	(cms)=	0.01 0.00 0.013 (iii)
TIME TO PEAK	(hrs)=	1.33 1.33 1.33
RUNOFF VOLUME	(mm)=	68.87 20.60 33.65
TOTAL RAINFALL	(mm)=	70.87 70.87 70.87
RUNOFF COEFFICIENT	=	0.97 0.29 0.47

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0201)	Area (ha)= 0.42		
ID= 1 DT= 5.0 min	Total Imp(%)= 99.90	Dir. Conn.(%)= 99.90	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.42	0.00
Dep. Storage	(mm)=	2.00	2.00
Average Slope	(%)=	1.50	1.50
Length	(m)=	53.23	36.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		202.83	139.44
over (min)		5.00	5.00
Storage Coeff. (min)=		1.17 (ii)	1.51 (ii)
Unit Hyd. Tpeak (min)=		5.00	5.00
Unit Hyd. peak (cms)=		0.34	0.33

		TOTALS
PEAK FLOW	(cms)=	0.24 0.00 0.237 (iii)
TIME TO PEAK	(hrs)=	1.33 1.33 1.33
RUNOFF VOLUME	(mm)=	68.87 64.05 68.86
TOTAL RAINFALL	(mm)=	70.87 70.87 70.87
RUNOFF COEFFICIENT	=	0.97 0.90 0.97

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0196	0.0123
	0.0056	0.0014	0.0206	0.0123
	0.0084	0.0027	0.0215	0.0123
	0.0105	0.0041	0.0222	0.0123
	0.0122	0.0054	0.0224	0.0124
	0.0137	0.0068	0.0227	0.0129
	0.0151	0.0082	0.0229	0.0145
	0.0164	0.0095	0.0231	0.0181
	0.0175	0.0109	0.0233	0.0238
	0.0186	0.0123	0.1450	0.0314

		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)		0.425	0.237	1.33	68.86
OUTFLOW: ID= 1 (0205)		0.425	0.023	1.83	68.72
PEAK FLOW REDUCTION [Qout/Qin](%)=					9.69
TIME SHIFT OF PEAK FLOW				(min)=	30.00
MAXIMUM STORAGE USED				(ha.m.)=	0.0160

```
--------------------
| ADD HYD  (  0206)|
|   1 +   2 =   3  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0202):     0.06   0.013     1.33    33.65
     + ID2= 2 (  0203):     0.08   0.004     1.50    18.96
       ================================================
       ID = 3 (  0206):     0.13   0.015     1.33    25.14

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

--------------------
| ADD HYD  (  0206)|
|   3 +   2 =   1  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0206):     0.13   0.015     1.33    25.14
     + ID2= 2 (  0205):     0.42   0.023     1.83    68.72
       ================================================
       ID = 1 (  0206):     0.56   0.033     1.42    58.33

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

      V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
      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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\6d90f314-13
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\6d90f314-13


DATE: 04-23-2024                          TIME: 09:41:32

USER:


COMMENTS: _____________________________________________________


-------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 2yr 24hr 5min SCS Type II     **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\dhordyk\AppD
|                  |              ata\Local\Temp\
|                  |              5d2fae5e-3df1-4d84-8e6d-36dc0a390706\918ff4f0
| Ptotal= 55.62 mm |    Comments: 2yr 24hr 5min SCS Type II
--------------------

 TIME   RAIN |  TIME   RAIN |'  TIME   RAIN |  TIME   RAIN
  hrs  mm/hr |   hrs  mm/hr |'   hrs  mm/hr |   hrs  mm/hr
 0.00   0.00 |  6.08   1.00 | 12.17   8.01 | 18.25   1.00
 0.08   0.61 |  6.17   1.00 | 12.25   8.01 | 18.33   1.00
 0.17   0.61 |  6.25   1.00 | 12.33   8.01 | 18.42   1.00
 0.25   0.61 |  6.33   1.00 | 12.42   8.01 | 18.50   1.00
 0.33   0.61 |  6.42   1.00 | 12.50   8.01 | 18.58   1.00
 0.42   0.61 |  6.50   1.00 | 12.58   4.12 | 18.67   1.00
 0.50   0.61 |  6.58   1.00 | 12.67   4.12 | 18.75   1.00
 0.58   0.61 |  6.67   1.00 | 12.75   4.12 | 18.83   1.00
 0.67   0.61 |  6.75   1.00 | 12.83   4.12 | 18.92   1.00
 0.75   0.61 |  6.83   1.00 | 12.92   4.12 | 19.00   1.00
 0.83   0.61 |  6.92   1.00 | 13.00   4.12 | 19.08   1.00
 0.92   0.61 |  7.00   1.00 | 13.08   3.00 | 19.17   1.00
 1.00   0.61 |  7.08   1.22 | 13.17   3.00 | 19.25   1.00
 1.08   0.61 |  7.17   1.22 | 13.25   3.00 | 19.33   1.00
 1.17   0.61 |  7.25   1.22 | 13.33   3.00 | 19.42   1.00
 1.25   0.61 |  7.33   1.22 | 13.42   3.00 | 19.50   1.00
 1.33   0.61 |  7.42   1.22 | 13.50   3.00 | 19.58   1.00
 1.42   0.61 |  7.50   1.22 | 13.58   2.34 | 19.67   1.00
 1.50   0.61 |  7.58   1.22 | 13.67   2.34 | 19.75   1.00
 1.58   0.61 |  7.67   1.22 | 13.75   2.34 | 19.83   1.00
 1.67   0.61 |  7.75   1.22 | 13.83   2.34 | 19.92   1.00
 1.75   0.61 |  7.83   1.22 | 13.92   2.34 | 20.00   1.00
 1.83   0.61 |  7.92   1.22 | 14.00   2.34 | 20.08   0.67
 1.92   0.61 |  8.00   1.22 | 14.08   1.67 | 20.17   0.67
 2.00   0.61 |  8.08   1.45 | 14.17   1.67 | 20.25   0.67
 2.08   0.72 |  8.17   1.45 | 14.25   1.67 | 20.33   0.67
 2.17   0.72 |  8.25   1.45 | 14.33   1.67 | 20.42   0.67
 2.25   0.72 |  8.33   1.45 | 14.42   1.67 | 20.50   0.67
 2.33   0.72 |  8.42   1.45 | 14.50   1.67 | 20.58   0.67
 2.42   0.72 |  8.50   1.45 | 14.58   1.67 | 20.67   0.67
 2.50   0.72 |  8.58   1.56 | 14.67   1.67 | 20.75   0.67
 2.58   0.72 |  8.67   1.56 | 14.75   1.67 | 20.83   0.67
 2.67   0.72 |  8.75   1.56 | 14.83   1.67 | 20.92   0.67
 2.75   0.72 |  8.83   1.56 | 14.92   1.67 | 21.00   0.67
 2.83   0.72 |  8.92   1.56 | 15.00   1.67 | 21.08   0.67
 2.92   0.72 |  9.00   1.56 | 15.08   1.67 | 21.17   0.67
 3.00   0.72 |  9.08   1.78 | 15.17   1.67 | 21.25   0.67
 3.08   0.72 |  9.17   1.78 | 15.25   1.67 | 21.33   0.67
 3.17   0.72 |  9.25   1.78 | 15.33   1.67 | 21.42   0.67
 3.25   0.72 |  9.33   1.78 | 15.42   1.67 | 21.50   0.67
 3.33   0.72 |  9.42   1.78 | 15.50   1.67 | 21.58   0.67
 3.42   0.72 |  9.50   1.78 | 15.58   1.67 | 21.67   0.67
 3.50   0.72 |  9.58   2.00 | 15.67   1.67 | 21.75   0.67
 3.58   0.72 |  9.67   2.00 | 15.75   1.67 | 21.83   0.67
 3.67   0.72 |  9.75   2.00 | 15.83   1.67 | 21.92   0.67
 3.75   0.72 |  9.83   2.00 | 15.92   1.67 | 22.00   0.67
 3.83   0.72 |  9.92   2.00 | 16.00   1.67 | 22.08   0.67
 3.92   0.72 | 10.00   2.00 | 16.08   1.00 | 22.17   0.67
 4.00   0.72 | 10.08   2.56 | 16.17   1.00 | 22.25   0.67
 4.08   0.89 | 10.17   2.56 | 16.25   1.00 | 22.33   0.67
 4.17   0.89 | 10.25   2.56 | 16.33   1.00 | 22.42   0.67
 4.25   0.89 | 10.33   2.56 | 16.42   1.00 | 22.50   0.67
 4.33   0.89 | 10.42   2.56 | 16.50   1.00 | 22.58   0.67
 4.42   0.89 | 10.50   2.56 | 16.58   1.00 | 22.67   0.67
 4.50   0.89 | 10.58   3.45 | 16.67   1.00 | 22.75   0.67
 4.58   0.89 | 10.67   3.45 | 16.75   1.00 | 22.83   0.67
 4.67   0.89 | 10.75   3.45 | 16.83   1.00 | 22.92   0.67
 4.75   0.89 | 10.83   3.45 | 16.92   1.00 | 23.00   0.67
 4.83   0.89 | 10.92   3.45 | 17.00   1.00 | 23.08   0.67
 4.92   0.89 | 11.00   3.45 | 17.08   1.00 | 23.17   0.67
 5.00   0.89 | 11.08   5.34 | 17.17   1.00 | 23.25   0.67
 5.08   0.89 | 11.17   5.34 | 17.25   1.00 | 23.33   0.67
 5.17   0.89 | 11.25   5.34 | 17.33   1.00 | 23.42   0.67
 5.25   0.89 | 11.33   5.34 | 17.42   1.00 | 23.50   0.67
 5.33   0.89 | 11.42   5.34 | 17.50   1.00 | 23.58   0.67
 5.42   0.89 | 11.50   5.34 | 17.58   1.00 | 23.67   0.67
 5.50   0.89 | 11.58  16.46 | 17.67   1.00 | 23.75   0.67
 5.58   0.89 | 11.67  16.46 | 17.75   1.00 | 23.83   0.67
 5.67   0.89 | 11.75  16.46 | 17.83   1.00 | 23.92   0.67
 5.75   0.89 | 11.83  68.08 | 17.92   1.00 | 24.00   0.67
 5.83   0.89 | 11.92  68.08 | 18.00   1.00 |
 5.92   0.89 | 12.00  68.08 | 18.08   1.00 |
 6.00   0.89 | 12.08   8.01 | 18.17   1.00 |

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

--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.002 (i)
     TIME TO PEAK    (hrs)=  12.167
     RUNOFF VOLUME    (mm)=  11.994
     TOTAL RAINFALL   (mm)=  55.620
     RUNOFF COEFFICIENT   =   0.216

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

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

--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=    0.02          0.04
     Dep. Storage     (mm)=    2.00          5.00
     Average Slope     (%)=    4.00          5.00
     Length            (m)=   19.32         10.00
     Mannings n             =  0.013         0.250

     Max.Eff.Inten.(mm/hr)=   68.08         21.20
               over (min)     5.00          5.00
     Storage Coeff.  (min)=  0.73 (ii)    4.62 (ii)
     Unit Hyd. Tpeak (min)=   5.00          5.00
     Unit Hyd. peak  (cms)=   0.34          0.22
                                                  *TOTALS*
     PEAK FLOW       (cms)=   0.00          0.00     0.005 (iii)
     TIME TO PEAK    (hrs)=  12.08         12.08      12.08
     RUNOFF VOLUME    (mm)=  53.62         13.16      20.20
     TOTAL RAINFALL   (mm)=  55.62         55.62      55.62
     RUNOFF COEFFICIENT   =   0.96          0.24       0.36

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  61.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------

                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=    0.42          0.00
     Dep. Storage     (mm)=    2.00          2.00
     Average Slope     (%)=    1.50          1.50
     Length            (m)=   53.23         36.00
     Mannings n             =  0.013         0.250

     Max.Eff.Inten.(mm/hr)=   68.08         66.49
               over (min)     5.00          5.00
     Storage Coeff.  (min)=  1.81 (ii)    2.34 (ii)
     Unit Hyd. Tpeak (min)=   5.00          5.00
     Unit Hyd. peak  (cms)=   0.32          0.30
                                                  *TOTALS*
     PEAK FLOW       (cms)=   0.08          0.00     0.080 (iii)
     TIME TO PEAK    (hrs)=  12.08         12.08      12.08
     RUNOFF VOLUME    (mm)=  53.62         48.89      53.61
     TOTAL RAINFALL   (mm)=  55.62         55.62      55.62
     RUNOFF COEFFICIENT   =   0.96          0.88       0.96

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| RESERVOIR(  0205)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |    (cms)     (ha.m.)
                          0.0000      0.0000    |    0.0196      0.0123
                          0.0056      0.0014    |    0.0206      0.0123
                          0.0084      0.0027    |    0.0215      0.0123
                          0.0105      0.0041    |    0.0222      0.0123
                          0.0122      0.0054    |    0.0224      0.0124
                          0.0137      0.0068    |    0.0227      0.0129
                          0.0151      0.0082    |    0.0229      0.0145
                          0.0164      0.0095    |    0.0231      0.0181
                          0.0175      0.0109    |    0.0233      0.0238
                          0.0186      0.0123    |    0.1450      0.0314

                             AREA     QPEAK     TPEAK       R.V.
                             (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)    0.425     0.080     12.08      53.61
   OUTFLOW: ID= 1 (  0205)    0.425     0.015     12.17      53.48

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 19.00
                  TIME SHIFT OF PEAK FLOW          (min)=  5.00
                  MAXIMUM  STORAGE   USED        (ha.m.)=  0.0084

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

--------------------
| ADD HYD  (  0206)|
|   1 +   2 =   3  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0202):     0.06   0.005    12.08    20.20
     + ID2= 2 (  0203):     0.08   0.002    12.17    11.99
       ================================================
       ID = 3 (  0206):     0.13   0.007    12.08    15.45

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

--------------------
| ADD HYD  (  0206)|
|   3 +   2 =   1  |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0206):     0.13   0.007    12.08    15.45
     + ID2= 2 (  0205):     0.42   0.015    12.17    53.48
       ================================================
       ID = 1 (  0206):     0.56   0.021    12.08    44.42

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

      V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
      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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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\a1735fc9-69
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\a1735fc9-69


DATE: 04-23-2024                          TIME: 09:41:32

USER:


COMMENTS: _____________________________________


-------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 2yr 4hr 5min Chicago          **
  ************************************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 675.586
| Ptotal= 37.03 mm |                          B=   4.681
--------------------                          C=   0.780
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    =  5.00 min
                         Time to peak ratio =  0.33

 TIME   RAIN |  TIME   RAIN |'  TIME   RAIN |  TIME   RAIN
  hrs  mm/hr |   hrs  mm/hr |'   hrs  mm/hr |   hrs  mm/hr
 0.00   2.31 |  1.00  10.03 |  2.00   6.39 |  3.00   3.08
 0.08   2.45 |  1.08  15.38 |  2.08   5.82 |  3.08   2.96
 0.17   2.61 |  1.17  35.54 |  2.17   5.36 |  3.17   2.85
 0.25   2.80 |  1.25 114.99 |  2.25   4.96 |  3.25   2.75
```

0.33	3.01	1.33	45.86	2.33	4.63	3.33	2.66
0.42	3.27	1.42	25.27	2.42	4.34	3.42	2.57
0.50	3.59	1.50	17.44	2.50	4.09	3.50	2.49
0.58	3.98	1.58	13.36	2.58	3.87	3.58	2.42
0.67	4.48	1.67	10.88	2.67	3.68	3.67	2.35
0.75	5.15	1.75	9.21	2.75	3.50	3.75	2.29
0.83	6.10	1.83	8.01	2.83	3.35	3.83	2.22
0.92	7.55	1.92	7.10	2.92	3.20	3.92	2.17

CALIB					
NASHYD (0203)	Area (ha)= 0.08	Curve Number (CN)= 61.0			
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00			
	U.H. Tp(hrs)= 0.19				

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.001 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 5.260
TOTAL RAINFALL (mm)= 37.034
RUNOFF COEFFICIENT = 0.142

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

CALIB		
STANDHYD (0202)	Area (ha)= 0.06	
ID= 1 DT= 5.0 min	Total Imp(%)= 33.90	Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	114.99	11.95
over (min)	5.00	5.00
Storage Coeff. (min)=	0.59 (ii)	3.75 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.25

			TOTALS
PEAK FLOW (cms)=	0.00	0.00	0.006 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	35.03	5.88	13.76
TOTAL RAINFALL (mm)=	37.03	37.03	37.03
RUNOFF COEFFICIENT =	0.95	0.16	0.37

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
STANDHYD (0201)	Area (ha)= 0.42				
ID= 1 DT= 5.0 min	Total Imp(%)= 99.90	Dir. Conn.(%)= 99.90			

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	114.99	73.51
over (min)	5.00	5.00
Storage Coeff. (min)=	1.47 (ii)	1.90 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.33	0.32

			TOTALS
PEAK FLOW (cms)=	0.13	0.00	0.133 (iii)
TIME TO PEAK (hrs)=	1.33	1.33	1.33
RUNOFF VOLUME (mm)=	35.03	30.52	35.02
TOTAL RAINFALL (mm)=	37.03	37.03	37.03
RUNOFF COEFFICIENT =	0.95	0.82	0.95

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0196	0.0123
	0.0056	0.0014	0.0206	0.0123
	0.0084	0.0027	0.0215	0.0123
	0.0105	0.0041	0.0222	0.0123
	0.0122	0.0054	0.0224	0.0124
	0.0137	0.0068	0.0227	0.0129
	0.0151	0.0082	0.0229	0.0145
	0.0164	0.0095	0.0231	0.0181
	0.0175	0.0109	0.0233	0.0238
	0.0186	0.0123	0.1450	0.0314

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)	0.425	0.133	1.33	35.02
OUTFLOW: ID= 1 (0205)	0.425	0.015	1.67	34.89

PEAK FLOW REDUCTION [Qout/Qin](%)= 11.25
TIME SHIFT OF PEAK FLOW (min)= 20.00
MAXIMUM STORAGE USED (ha.m.)= 0.0080

ADD HYD (0206)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.06	0.006	1.33	13.76
+ ID2= 2 (0203):	0.08	0.001	1.58	5.26
ID = 3 (0206):	0.13	0.006	1.33	8.84

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0206)				
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0206):	0.13	0.006	1.33	8.84
+ ID2= 2 (0205):	0.42	0.015	1.67	34.89
ID = 1 (0206):	0.56	0.017	1.50	28.68

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
      V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
      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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```

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

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\636efe75-13
Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\636efe75-13

DATE: 04-23-2024 TIME: 09:41:32

USER:

COMMENTS: _____

** SIMULATION : 50yr 24hr 5min SCS Type II **

READ STORM	Filename: C:\Users\dhordyk\AppData\Local\Temp\5d2fae5e-3df1-4d84-8e6d-36dc0a390706\05c15ad9
Ptotal=125.40 mm	Comments: 50yr 24hr 5min SCS Type II

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	6.08	2.26	12.17	18.06	18.25	2.26
0.08	1.38	6.17	2.26	12.25	18.06	18.33	2.26
0.17	1.38	6.25	2.26	12.33	18.06	18.42	2.26
0.25	1.38	6.33	2.26	12.42	18.06	18.50	2.26
0.33	1.38	6.42	2.26	12.50	18.06	18.58	2.26
0.42	1.38	6.50	2.26	12.58	9.28	18.67	2.26
0.50	1.38	6.58	2.26	12.67	9.28	18.75	2.26
0.58	1.38	6.67	2.26	12.75	9.28	18.83	2.26
0.67	1.38	6.75	2.26	12.83	9.28	18.92	2.26
0.75	1.38	6.83	2.26	12.92	9.28	19.00	2.26
0.83	1.38	6.92	2.26	13.00	9.28	19.08	2.26
0.92	1.38	7.00	2.26	13.08	6.77	19.17	2.26
1.00	1.38	7.08	2.76	13.17	6.77	19.25	2.26
1.08	1.38	7.17	2.76	13.25	6.77	19.33	2.26
1.17	1.38	7.25	2.76	13.33	6.77	19.42	2.26
1.25	1.38	7.33	2.76	13.42	6.77	19.50	2.26
1.33	1.38	7.42	2.76	13.50	6.77	19.58	2.26
1.42	1.38	7.50	2.76	13.58	5.27	19.67	2.26
1.50	1.38	7.58	2.76	13.67	5.27	19.75	2.26
1.58	1.38	7.67	2.76	13.75	5.27	19.83	2.26
1.67	1.38	7.75	2.76	13.83	5.27	19.92	2.26
1.75	1.38	7.83	2.76	13.92	5.27	20.00	2.26
1.83	1.38	7.92	2.76	14.00	5.27	20.08	1.50
1.92	1.38	8.00	2.76	14.08	3.76	20.17	1.50
2.00	1.38	8.08	3.26	14.17	3.76	20.25	1.50
2.08	1.63	8.17	3.26	14.25	3.76	20.33	1.50
2.17	1.63	8.25	3.26	14.33	3.76	20.42	1.50
2.25	1.63	8.33	3.26	14.42	3.76	20.50	1.50
2.33	1.63	8.42	3.26	14.50	3.76	20.58	1.50
2.42	1.63	8.50	3.26	14.58	3.76	20.67	1.50
2.50	1.63	8.58	3.51	14.67	3.76	20.75	1.50
2.58	1.63	8.67	3.51	14.75	3.76	20.83	1.50
2.67	1.63	8.75	3.51	14.83	3.76	20.92	1.50
2.75	1.63	8.83	3.51	14.92	3.76	21.00	1.50
2.83	1.63	8.92	3.51	15.00	3.76	21.08	1.50
2.92	1.63	9.00	3.51	15.08	3.76	21.17	1.50
3.00	1.63	9.08	4.01	15.17	3.76	21.25	1.50
3.08	1.63	9.17	4.01	15.25	3.76	21.33	1.50
3.17	1.63	9.25	4.01	15.33	3.76	21.42	1.50
3.25	1.63	9.33	4.01	15.42	3.76	21.50	1.50
3.33	1.63	9.42	4.01	15.50	3.76	21.58	1.50
3.42	1.63	9.50	4.01	15.58	3.76	21.67	1.50
3.50	1.63	9.58	4.51	15.67	3.76	21.75	1.50
3.58	1.63	9.67	4.51	15.75	3.76	21.83	1.50
3.67	1.63	9.75	4.51	15.83	3.76	21.92	1.50
3.75	1.63	9.83	4.51	15.92	3.76	22.00	1.50
3.83	1.63	9.92	4.51	16.00	3.76	22.08	1.50
3.92	1.63	10.00	4.51	16.08	2.26	22.17	1.50
4.00	1.63	10.08	5.77	16.17	2.26	22.25	1.50
4.08	2.01	10.17	5.77	16.25	2.26	22.33	1.50
4.17	2.01	10.25	5.77	16.33	2.26	22.42	1.50
4.25	2.01	10.33	5.77	16.42	2.26	22.50	1.50
4.33	2.01	10.42	5.77	16.50	2.26	22.58	1.50
4.42	2.01	10.50	5.77	16.58	2.26	22.67	1.50
4.50	2.01	10.58	7.77	16.67	2.26	22.75	1.50
4.58	2.01	10.67	7.77	16.75	2.26	22.83	1.50
4.67	2.01	10.75	7.77	16.83	2.26	22.92	1.50
4.75	2.01	10.83	7.77	16.92	2.26	23.00	1.50
4.83	2.01	10.92	7.77	17.00	2.26	23.08	1.50
4.92	2.01	11.00	7.77	17.08	2.26	23.17	1.50
5.00	2.01	11.08	12.04	17.17	2.26	23.25	1.50
5.08	2.01	11.17	12.04	17.25	2.26	23.33	1.50
5.17	2.01	11.25	12.04	17.33	2.26	23.42	1.50
5.25	2.01	11.33	12.04	17.42	2.26	23.50	1.50
5.33	2.01	11.42	12.04	17.50	2.26	23.58	1.50
5.42	2.01	11.50	12.04	17.58	2.26	23.67	1.50
5.50	2.01	11.58	37.12	17.67	2.26	23.75	1.50
5.58	2.01	11.67	37.12	17.75	2.26	23.83	1.50
5.67	2.01	11.75	37.12	17.83	2.26	23.92	1.50
5.75	2.01	11.83	153.49	17.92	2.26	24.00	1.50
5.83	2.01	11.92	153.49	18.00	2.26		
5.92	2.01	12.00	153.49	18.08	2.26		
6.00	2.01	12.08	18.06	18.17	2.26		

CALIB					
NASHYD (0203)	Area (ha)= 0.08	Curve Number (CN)= 61.0			
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00			
	U.H. Tp(hrs)= 0.19				

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.010 (i)
TIME TO PEAK (hrs)= 12.167
RUNOFF VOLUME (mm)= 51.134
TOTAL RAINFALL (mm)= 125.400
RUNOFF COEFFICIENT = 0.408

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

CALIB		
STANDHYD (0202)	Area (ha)= 0.06	
ID= 1 DT= 5.0 min	Total Imp(%)= 33.90	Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	153.49	88.14
over (min)	5.00	5.00
Storage Coeff. (min)=	0.53 (ii)	3.34 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.26

			TOTALS
PEAK FLOW (cms)=	0.01	0.01	0.016 (iii)
TIME TO PEAK (hrs)=	12.00	12.08	12.08
RUNOFF VOLUME (mm)=	123.40	54.49	73.14
TOTAL RAINFALL (mm)=	125.40	125.40	125.40
RUNOFF COEFFICIENT =	0.98	0.43	0.58

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
STANDHYD (0201)	Area (ha)= 0.42				
ID= 1 DT= 5.0 min	Total Imp(%)= 99.90	Dir. Conn.(%)= 99.90			

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	153.49	152.70
over (min)	5.00	5.00
Storage Coeff. (min)=	1.31 (ii)	1.69 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.33	0.32

TOTALS

```
      PEAK FLOW       (cms)=       0.18         0.00          0.181 (iii)
      TIME TO PEAK    (hrs)=      12.08        12.08          12.08
      RUNOFF VOLUME    (mm)=     123.40       118.43         123.39
      TOTAL RAINFALL   (mm)=     125.40       125.40         125.40
      RUNOFF COEFFICIENT   =       0.98         0.94           0.98

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0205)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |    0.0196      0.0123
                          0.0056      0.0014   |    0.0206      0.0123
                          0.0084      0.0027   |    0.0215      0.0123
                          0.0105      0.0041   |    0.0222      0.0123
                          0.0122      0.0054   |    0.0224      0.0124
                          0.0137      0.0068   |    0.0227      0.0129
                          0.0151      0.0082   |    0.0229      0.0145
                          0.0164      0.0095   |    0.0231      0.0181
                          0.0175      0.0109   |    0.0233      0.0238
                          0.0186      0.0123   |    0.1450      0.0314

                              AREA      QPEAK     TPEAK       R.V.
                              (ha)      (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     0.425     0.181     12.08     123.39
   OUTFLOW: ID= 1 (  0205)     0.425     0.023     12.17     123.27

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 12.79
                  TIME SHIFT OF PEAK FLOW          (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0204

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

--------------------
| ADD HYD  (  0206)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0202):     0.06   0.016    12.08    73.14
     + ID2= 2 (  0203):     0.08   0.010    12.17    51.13
       ================================================
       ID = 3 (  0206):     0.13   0.025    12.08    60.40

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

--------------------
| ADD HYD  (  0206)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0206):     0.13   0.025    12.08    60.40
     + ID2= 2 (  0205):     0.42   0.023    12.17   123.27
       ================================================
       ID = 1 (  0206):     0.56   0.048    12.08   108.28

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

      V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
      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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                  *****  D E T A I L E D   O U T P U T *****
```

```
  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\bf1e5e73-d6
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\bf1e5e73-d6

DATE: 04-23-2024                          TIME: 09:41:32

USER:


COMMENTS: _____

--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 50yr 4hr 5min Chicago         **
  ************************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1251.473
| Ptotal= 79.54 mm |                           B=   4.847
--------------------                           C=   0.753
                              used in:   INTENSITY =  A / (t + B)^C

                              Duration of storm  =  4.00 hrs
                              Storm time step    =  5.00 min
                              Time to peak ratio =  0.33

               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.00    5.53 |  1.00   22.40 |'  2.00   14.60 |  3.00    7.26
               0.08    5.85 |  1.08   33.57 |'  2.08   13.36 |  3.08    6.99
               0.17    6.21 |  1.17   73.94 |'  2.17   12.33 |  3.17    6.75
               0.25    6.63 |  1.25  223.60 |'  2.25   11.47 |  3.25    6.52
               0.33    7.12 |  1.33   94.25 |'  2.33   10.74 |  3.33    6.31
               0.42    7.70 |  1.42   53.72 |'  2.42   10.10 |  3.42    6.12
               0.50    8.41 |  1.50   37.82 |'  2.50    9.54 |  3.50    5.94
               0.58    9.29 |  1.58   29.40 |'  2.58    9.05 |  3.58    5.77
               0.67   10.40 |  1.67   24.19 |'  2.67    8.61 |  3.67    5.61
               0.75   11.89 |  1.75   20.65 |'  2.75    8.22 |  3.75    5.46
               0.83   13.96 |  1.83   18.09 |'  2.83    7.87 |  3.83    5.32
               0.92   17.09 |  1.92   16.14 |'  2.92    7.55 |  3.92    5.19

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.08   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.19

     Unit Hyd Qpeak  (cms)=   0.015

     PEAK FLOW       (cms)=   0.005 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  23.392
     TOTAL RAINFALL   (mm)=  79.544
     RUNOFF COEFFICIENT   =   0.294

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
--------------------

                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02          0.04
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       4.00          5.00
     Length            (m)=      19.32         10.00
     Mannings n             =    0.013         0.250

     Max.Eff.Inten.(mm/hr)=     223.60         51.83
               over (min)          5.00          5.00
     Storage Coeff.  (min)=        0.46 (ii)     2.87 (ii)
     Unit Hyd. Tpeak (min)=        5.00          5.00
     Unit Hyd. peak  (cms)=        0.34          0.28
                                                          *TOTALS*
     PEAK FLOW       (cms)=        0.01          0.01          0.015 (iii)
     TIME TO PEAK    (hrs)=        1.33          1.33          1.33
```

```
     RUNOFF VOLUME    (mm)=      77.54         25.32          39.43
     TOTAL RAINFALL   (mm)=      79.54         79.54          79.54
     RUNOFF COEFFICIENT   =       0.97          0.32           0.50

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  61.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
--------------------

                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.42          0.00
     Dep. Storage     (mm)=       2.00          2.00
     Average Slope     (%)=       1.50          1.50
     Length            (m)=      53.23         36.00
     Mannings n             =    0.013         0.250

     Max.Eff.Inten.(mm/hr)=     223.60        155.21
               over (min)          5.00          5.00
     Storage Coeff.  (min)=        1.12 (ii)     1.45 (ii)
     Unit Hyd. Tpeak (min)=        5.00          5.00
     Unit Hyd. peak  (cms)=        0.34          0.33
                                                          *TOTALS*
     PEAK FLOW       (cms)=        0.26          0.00          0.262 (iii)
     TIME TO PEAK    (hrs)=        1.33          1.33          1.33
     RUNOFF VOLUME    (mm)=      77.54         72.68          77.53
     TOTAL RAINFALL   (mm)=      79.54         79.54          79.54
     RUNOFF COEFFICIENT   =       0.97          0.91           0.97

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  98.0     Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0205)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |    0.0196      0.0123
                          0.0056      0.0014   |    0.0206      0.0123
                          0.0084      0.0027   |    0.0215      0.0123
                          0.0105      0.0041   |    0.0222      0.0123
                          0.0122      0.0054   |    0.0224      0.0124
                          0.0137      0.0068   |    0.0227      0.0129
                          0.0151      0.0082   |    0.0229      0.0145
                          0.0164      0.0095   |    0.0231      0.0181
                          0.0175      0.0109   |    0.0233      0.0238
                          0.0186      0.0123   |    0.1450      0.0314

                              AREA      QPEAK     TPEAK       R.V.
                              (ha)      (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     0.425     0.262      1.33      77.53
   OUTFLOW: ID= 1 (  0205)     0.425     0.023      1.83      77.41

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.82
                  TIME SHIFT OF PEAK FLOW          (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0184

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

--------------------
| ADD HYD  (  0206)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0202):     0.06   0.015     1.33    39.43
     + ID2= 2 (  0203):     0.08   0.005     1.50    23.39
       ================================================
       ID = 3 (  0206):     0.13   0.017     1.33    30.15

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

```
--------------------
| ADD HYD  (  0206)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0206):     0.13   0.017     1.33    30.15
     + ID2= 2 (  0205):     0.42   0.023     1.83    77.41
       ================================================
       ID = 1 (  0206):     0.56   0.035     1.42    66.15

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

      V    V   I    SSSSS  U   U    A    L                (v 6.2.2017)
      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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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\184fad66-e5
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\184fad66-e5

DATE: 04-23-2024                          TIME: 09:41:32

USER:


COMMENTS: _____

--------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 5yr 24hr 5min SCS Type II     **
  ************************************************

--------------------
| READ STORM       |     Filename: C:\Users\dhordyk\AppD
|                  |               ata\Local\Temp\
|                  |               5d2fae5e-3df1-4d84-8e6d-36dc0a390706\23cbacd2
| Ptotal= 78.55 mm |     Comments: 5yr 24hr 5min SCS Type II
--------------------

               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.00    0.00 |  6.08    1.41 |'  12.17   11.31 |  18.25    1.41
               0.08    0.86 |  6.17    1.41 |'  12.25   11.31 |  18.33    1.41
               0.17    0.86 |  6.25    1.41 |'  12.33   11.31 |  18.42    1.41
               0.25    0.86 |  6.33    1.41 |'  12.42   11.31 |  18.50    1.41
               0.33    0.86 |  6.42    1.41 |'  12.50   11.31 |  18.58    1.41
               0.42    0.86 |  6.50    1.41 |'  12.58    5.81 |  18.67    1.41
               0.50    0.86 |  6.58    1.41 |'  12.67    5.81 |  18.75    1.41
               0.58    0.86 |  6.67    1.41 |'  12.75    5.81 |  18.83    1.41
               0.67    0.86 |  6.75    1.41 |'  12.83    5.81 |  18.92    1.41
               0.75    0.86 |  6.83    1.41 |'  12.92    5.81 |  19.00    1.41
               0.83    0.86 |  6.92    1.41 |'  13.00    5.81 |  19.08    1.41
               0.92    0.86 |  7.00    1.41 |'  13.08    4.24 |  19.17    1.41
               1.00    0.86 |  7.08    1.73 |'  13.17    4.24 |  19.25    1.41
               1.08    0.86 |  7.17    1.73 |'  13.25    4.24 |  19.33    1.41
               1.17    0.86 |  7.25    1.73 |'  13.33    4.24 |  19.42    1.41
               1.25    0.86 |  7.33    1.73 |'  13.42    4.24 |  19.50    1.41
               1.33    0.86 |  7.42    1.73 |'  13.50    4.24 |  19.58    1.41
               1.42    0.86 |  7.50    1.73 |'  13.58    3.30 |  19.67    1.41
               1.50    0.86 |  7.58    1.73 |'  13.67    3.30 |  19.75    1.41
               1.58    0.86 |  7.67    1.73 |'  13.75    3.30 |  19.83    1.41
               1.67    0.86 |  7.75    1.73 |'  13.83    3.30 |  19.92    1.41
               1.75    0.86 |  7.83    1.73 |'  13.92    3.30 |  20.00    1.41
               1.83    0.86 |  7.92    1.73 |'  14.00    3.30 |  20.08    0.94
               1.92    0.86 |  8.00    1.73 |'  14.08    2.36 |  20.17    0.94
```

2.00	0.86	8.08	2.04	14.17	2.36	20.25	0.94
2.08	1.02	8.17	2.04	14.25	2.36	20.33	0.94
2.17	1.02	8.25	2.04	14.33	2.36	20.42	0.94
2.25	1.02	8.33	2.04	14.42	2.36	20.50	0.94
2.33	1.02	8.42	2.04	14.50	2.36	20.58	0.94
2.42	1.02	8.50	2.04	14.58	2.36	20.67	0.94
2.50	1.02	8.58	2.20	14.67	2.36	20.75	0.94
2.58	1.02	8.67	2.20	14.75	2.36	20.83	0.94
2.67	1.02	8.75	2.20	14.83	2.36	20.92	0.94
2.75	1.02	8.83	2.20	14.92	2.36	21.00	0.94
2.83	1.02	8.92	2.20	15.00	2.36	21.08	0.94
2.92	1.02	9.00	2.20	15.08	2.36	21.17	0.94
3.00	1.02	9.08	2.51	15.17	2.36	21.25	0.94
3.08	1.02	9.17	2.51	15.25	2.36	21.33	0.94
3.17	1.02	9.25	2.51	15.33	2.36	21.42	0.94
3.25	1.02	9.33	2.51	15.42	2.36	21.50	0.94
3.33	1.02	9.42	2.51	15.50	2.36	21.58	0.94
3.42	1.02	9.50	2.51	15.58	2.36	21.67	0.94
3.50	1.02	9.58	2.83	15.67	2.36	21.75	0.94
3.58	1.02	9.67	2.83	15.75	2.36	21.83	0.94
3.67	1.02	9.75	2.83	15.83	2.36	21.92	0.94
3.75	1.02	9.83	2.83	15.92	2.36	22.00	0.94
3.83	1.02	9.92	2.83	16.00	2.36	22.08	0.94
3.92	1.02	10.00	2.83	16.08	1.41	22.17	0.94
4.00	1.02	10.08	3.61	16.17	1.41	22.25	0.94
4.08	1.26	10.17	3.61	16.25	1.41	22.33	0.94
4.17	1.26	10.25	3.61	16.33	1.41	22.42	0.94
4.25	1.26	10.33	3.61	16.42	1.41	22.50	0.94
4.33	1.26	10.42	3.61	16.50	1.41	22.58	0.94
4.42	1.26	10.50	3.61	16.58	1.41	22.67	0.94
4.50	1.26	10.58	4.87	16.67	1.41	22.75	0.94
4.58	1.26	10.67	4.87	16.75	1.41	22.83	0.94
4.67	1.26	10.75	4.87	16.83	1.41	22.92	0.94
4.75	1.26	10.83	4.87	16.92	1.41	23.00	0.94
4.83	1.26	10.92	4.87	17.00	1.41	23.08	0.94
4.92	1.26	11.00	4.87	17.08	1.41	23.17	0.94
5.00	1.26	11.08	7.54	17.17	1.41	23.25	0.94
5.08	1.26	11.17	7.54	17.25	1.41	23.33	0.94
5.17	1.26	11.25	7.54	17.33	1.41	23.42	0.94
5.25	1.26	11.33	7.54	17.42	1.41	23.50	0.94
5.33	1.26	11.42	7.54	17.50	1.41	23.58	0.94
5.42	1.26	11.50	7.54	17.58	1.41	23.67	0.94
5.50	1.26	11.58	23.25	17.67	1.41	23.75	0.94
5.58	1.26	11.67	23.25	17.75	1.41	23.83	0.94
5.67	1.26	11.75	23.25	17.83	1.41	23.92	0.94
5.75	1.26	11.83	96.15	17.92	1.41	24.00	0.94
5.83	1.26	11.92	96.15	18.00	1.41		
5.92	1.26	12.00	96.15	18.08	1.41		
6.00	1.26	12.08	11.31	18.17	1.41		

CALIB
NASHYD (0203)
ID= 1 DT= 5.0 min

Area (ha)= 0.08 Curve Number (CN)= 61.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.19

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.004 (i)
TIME TO PEAK (hrs)= 12.167
RUNOFF VOLUME (mm)= 22.867
TOTAL RAINFALL (mm)= 78.550
RUNOFF COEFFICIENT = 0.291

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

CALIB
STANDHYD (0202)
ID= 1 DT= 5.0 min

Area (ha)= 0.06
Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	96.15	40.01
over (min)	5.00	5.00
Storage Coeff. (min)=	0.64 (ii)	4.03 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.24
		TOTALS
PEAK FLOW (cms)=	0.00	0.00 0.008 (iii)
TIME TO PEAK (hrs)=	12.08	12.08 12.08
RUNOFF VOLUME (mm)=	76.55	24.76 36.35
TOTAL RAINFALL (mm)=	78.55	78.55 78.55
RUNOFF COEFFICIENT =	0.97	0.32 0.46

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0201)
ID= 1 DT= 5.0 min

Area (ha)= 0.42
Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	96.15	94.95
over (min)	5.00	5.00
Storage Coeff. (min)=	1.57 (ii)	2.04 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.33	0.31
		TOTALS
PEAK FLOW (cms)=	0.11	0.00 0.113 (iii)
TIME TO PEAK (hrs)=	12.08	12.08 12.08
RUNOFF VOLUME (mm)=	76.55	78.55 76.54
TOTAL RAINFALL (mm)=	78.55	78.55 78.55
RUNOFF COEFFICIENT =	0.97	0.91 0.97

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF
IN= 2---> OUT= 1	
DT= 5.0 min	

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0196	0.0123
0.0056	0.0014	0.0206	0.0123
0.0084	0.0027	0.0215	0.0123
0.0105	0.0041	0.0222	0.0123
0.0122	0.0054	0.0224	0.0124
0.0137	0.0068	0.0227	0.0129
0.0151	0.0082	0.0229	0.0145
0.0164	0.0095	0.0231	0.0181
0.0175	0.0109	0.0233	0.0238
0.0186	0.0123	0.1450	0.0314

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)	0.425	0.113	12.08	76.54
OUTFLOW: ID= 1 (0205)	0.425	0.019	12.17	76.41

PEAK FLOW REDUCTION [Qout/Qin](%)= 16.36
TIME SHIFT OF PEAK FLOW (min)= 5.00
MAXIMUM STORAGE USED (ha.m.)= 0.0122

ADD HYD (0206)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0202):	0.06	0.008	12.08	36.35
+ ID2= 2 (0203):	0.08	0.004	12.17	22.87
ID = 3 (0206):	0.13	0.012	12.08	28.55

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0206)
3 + 2 = 1

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0206):	0.13	0.012	12.08	28.55
+ ID2= 2 (0205):	0.42	0.019	12.17	76.41
ID = 1 (0206):	0.56	0.030	12.08	65.00

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input  filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\fd8ee926-ec
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\fd8ee926-ec

DATE: 04-23-2024                          TIME: 09:41:33

USER:


COMMENTS: _____
```

****
** SIMULATION : 5yr 4hr 5min Chicago **
****

CHICAGO STORM
Ptotal= 50.76 mm

IDF curve parameters: A= 843.019
B= 4.582
C= 0.763
used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	3.39	1.00	14.01	2.00	9.07	3.00	4.46
0.08	3.58	1.08	21.15	2.08	8.29	3.08	4.30
0.17	3.81	1.17	47.54	2.17	7.64	3.17	4.15
0.25	4.07	1.25	150.31	2.25	7.10	3.25	4.01
0.33	4.38	1.33	60.96	2.33	6.64	3.33	3.88
0.42	4.74	1.42	34.18	2.42	6.24	3.42	3.75
0.50	5.18	1.50	23.88	2.50	5.89	3.50	3.64
0.58	5.73	1.58	18.47	2.58	5.58	3.58	3.54
0.67	6.43	1.67	15.15	2.67	5.31	3.67	3.44
0.75	7.36	1.75	12.90	2.75	5.07	3.75	3.35
0.83	8.67	1.83	11.27	2.83	4.85	3.83	3.26
0.92	10.64	1.92	10.04	2.92	4.65	3.92	3.18

CALIB
NASHYD (0203)
ID= 1 DT= 5.0 min

Area (ha)= 0.08 Curve Number (CN)= 61.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.19

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.002 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 10.030
TOTAL RAINFALL (mm)= 50.757
RUNOFF COEFFICIENT = 0.198

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

CALIB
STANDHYD (0202)
ID= 1 DT= 5.0 min

Area (ha)= 0.06
Total Imp(%)= 33.90 Dir. Conn.(%)= 27.10

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.02	0.04
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	4.00	5.00
Length (m)=	19.32	10.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	150.31	22.40
over (min)	5.00	5.00
Storage Coeff. (min)=	0.53 (ii)	3.37 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.34	0.26
		TOTALS
PEAK FLOW (cms)=	0.01	0.00 0.009 (iii)
TIME TO PEAK (hrs)=	1.33	1.33 1.33
RUNOFF VOLUME (mm)=	48.76	11.04 21.24
TOTAL RAINFALL (mm)=	50.76	50.76 50.76
RUNOFF COEFFICIENT =	0.96	0.22 0.42

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 61.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0201)
ID= 1 DT= 5.0 min

Area (ha)= 0.42
Total Imp(%)= 99.90 Dir. Conn.(%)= 99.90

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.42	0.00
Dep. Storage (mm)=	2.00	2.00
Average Slope (%)=	1.50	1.50
Length (m)=	53.23	36.00
Mannings n =	0.013	0.250
Max.Eff.Inten.(mm/hr)=	150.31	100.23
over (min)	5.00	5.00
Storage Coeff. (min)=	1.32 (ii)	1.70 (ii)
Unit Hyd. Tpeak (min)=	5.00	5.00
Unit Hyd. peak (cms)=	0.33	0.32
		TOTALS
PEAK FLOW (cms)=	0.17	0.00 0.175 (iii)
TIME TO PEAK (hrs)=	1.33	1.33 1.33
RUNOFF VOLUME (mm)=	48.76	44.07 48.75
TOTAL RAINFALL (mm)=	50.76	50.76 50.76
RUNOFF COEFFICIENT =	0.96	0.87 0.96

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0205)	OVERFLOW IS OFF

```
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)      (ha.m.)  |   (cms)      (ha.m.)
                           0.0000      0.0000  |   0.0196      0.0123
                           0.0056      0.0014  |   0.0206      0.0123
                           0.0084      0.0027  |   0.0215      0.0123
                           0.0105      0.0041  |   0.0222      0.0123
                           0.0122      0.0054  |   0.0224      0.0124
                           0.0137      0.0068  |   0.0227      0.0129
                           0.0151      0.0082  |   0.0229      0.0145
                           0.0164      0.0095  |   0.0231      0.0181
                           0.0175      0.0109  |   0.0233      0.0238
                           0.0186      0.0123  |   0.1450      0.0314

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)      0.425     0.175      1.33       48.75
   OUTFLOW: ID= 1 (  0205)      0.425     0.018      1.75       48.61

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.17
                  TIME SHIFT OF PEAK FLOW          (min)= 25.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0112

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

--------------------
| ADD HYD  (  0206)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0202):     0.06   0.009     1.33    21.24
      + ID2= 2 (  0203):     0.08   0.002     1.58    10.03
        ==============================================
        ID = 3 (  0206):     0.13   0.009     1.33    14.75

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

--------------------
| ADD HYD  (  0206)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0206):     0.13   0.009     1.33    14.75
      + ID2= 2 (  0205):     0.42   0.018     1.75    48.61
        ==============================================
        ID = 1 (  0206):     0.56   0.022     1.42    40.54

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

 FINISH
================================================================================================================
```

```
 V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
 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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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\c15001d2-26
  Summary filename: C:\Users\dhordyk\AppData\Local\Civica\VH5\8b5ebd9d-0756-4ee3-8eaf-d1b88eca86b8\c15001d2-26

DATE: 04-23-2024                          TIME: 09:42:26

USER:


COMMENTS: _____________________________________________________

--------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : HAZEL                         **
  ************************************************


-------------------
|    READ STORM     |    Filename: C:\Users\dhordyk\AppD
|                   |              ata\Local\Temp\
|                   |              5c225d7f-b500-47a9-93d0-8a01717e2533\6894cbd9
| Ptotal=212.00 mm  |    Comments: HAZEL
-------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	6.00	3.00	13.00	6.00	23.00	9.00	53.00
0.20	6.00	3.20	13.00	6.20	23.00	9.20	53.00
0.40	6.00	3.40	13.00	6.40	23.00	9.40	53.00
0.60	6.00	3.60	13.00	6.60	23.00	9.60	53.00
0.80	6.00	3.80	13.00	6.80	23.00	9.80	53.00
1.00	4.00	4.00	17.00	7.00	13.00	10.00	38.00
1.20	4.00	4.20	17.00	7.20	13.00	10.20	38.00
1.40	4.00	4.40	17.00	7.40	13.00	10.40	38.00
1.60	4.00	4.60	17.00	7.60	13.00	10.60	38.00
1.80	4.00	4.80	17.00	7.80	13.00	10.80	38.00
2.00	6.00	5.00	13.00	8.00	13.00	11.00	13.00
2.20	6.00	5.20	13.00	8.20	13.00	11.20	13.00
2.40	6.00	5.40	13.00	8.40	13.00	11.40	13.00
2.60	6.00	5.60	13.00	8.60	13.00	11.60	13.00
2.80	6.00	5.80	13.00	8.80	13.00	11.80	13.00

```
--------------------------------------------------------------------------------

-------------------
| CALIB             |
| NASHYD  (  0203)  |   Area    (ha)=   0.08   Curve Number   (CN)= 78.0
|ID= 1 DT= 5.0 min  |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.19

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

                        ---- TRANSFORMED HYETOGRAPH ----
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00

```
    Max.Eff.Inten.(mm/hr)=      53.00        53.21
          over (min)            5.00        10.00
    Storage Coeff.  (min)=      0.81 (ii)    5.11 (ii)
    Unit Hyd. Tpeak (min)=      5.00        10.00
    Unit Hyd. peak  (cms)=      0.34         0.16
                                                    *TOTALS*
    PEAK FLOW       (cms)=      0.00         0.01      0.008 (iii)
    TIME TO PEAK    (hrs)=      9.33        10.00       10.00
    RUNOFF VOLUME    (mm)=    210.00       158.00      172.04
    TOTAL RAINFALL   (mm)=    212.00       212.00      212.00
    RUNOFF COEFFICIENT   =      0.99         0.75        0.81

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  78.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| CALIB             |
| STANDHYD (  0201) |   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  99.90   Dir. Conn.(%)=  99.90
-------------------

                        IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=    0.42          0.00
    Dep. Storage     (mm)=    2.00          2.00
    Average Slope     (%)=    1.50          1.50
    Length            (m)=   53.23         36.00
    Mannings n            =   0.013         0.250

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

                        ---- TRANSFORMED HYETOGRAPH ----
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00

```
    Unit Hyd Qpeak  (cms)=   0.015

    PEAK FLOW       (cms)=   0.010 (i)
    TIME TO PEAK    (hrs)=  10.000
    RUNOFF VOLUME    (mm)= 153.412
    TOTAL RAINFALL   (mm)= 212.000
    RUNOFF COEFFICIENT   =   0.724

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

--------------------------------------------------------------------------------
-------------------
| CALIB             |
| STANDHYD (  0202) |   Area    (ha)=   0.06
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  33.90   Dir. Conn.(%)=  27.10
-------------------

                        IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=    0.02          0.04
    Dep. Storage     (mm)=    2.00          5.00
    Average Slope     (%)=    4.00          5.00
    Length            (m)=   19.32         10.00
    Mannings n            =   0.013         0.250

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

                        ---- TRANSFORMED HYETOGRAPH ----
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.00	3.083	13.00	6.083	23.00	9.08	53.00
0.167	6.00	3.167	13.00	6.167	23.00	9.17	53.00
0.250	6.00	3.250	13.00	6.250	23.00	9.25	53.00
0.333	6.00	3.333	13.00	6.333	23.00	9.33	53.00
0.417	6.00	3.417	13.00	6.417	23.00	9.42	53.00
0.500	6.00	3.500	13.00	6.500	23.00	9.50	53.00
0.583	6.00	3.583	13.00	6.583	23.00	9.58	53.00
0.667	6.00	3.667	13.00	6.667	23.00	9.67	53.00
0.750	6.00	3.750	13.00	6.750	23.00	9.75	53.00
0.833	6.00	3.833	13.00	6.833	23.00	9.83	53.00
0.917	6.00	3.917	13.00	6.917	23.00	9.92	53.00
1.000	6.00	4.000	13.00	7.000	23.00	10.00	53.00
1.083	4.00	4.083	17.00	7.083	13.00	10.08	38.00
1.167	4.00	4.167	17.00	7.167	13.00	10.17	38.00
1.250	4.00	4.250	17.00	7.250	13.00	10.25	38.00
1.333	4.00	4.333	17.00	7.333	13.00	10.33	38.00
1.417	4.00	4.417	17.00	7.417	13.00	10.42	38.00
1.500	4.00	4.500	17.00	7.500	13.00	10.50	38.00
1.583	4.00	4.583	17.00	7.583	13.00	10.58	38.00
1.667	4.00	4.667	17.00	7.667	13.00	10.67	38.00
1.750	4.00	4.750	17.00	7.750	13.00	10.75	38.00
1.833	4.00	4.833	17.00	7.833	13.00	10.83	38.00
1.917	4.00	4.917	17.00	7.917	13.00	10.92	38.00
2.000	4.00	5.000	17.00	8.000	13.00	11.00	38.00
2.083	6.00	5.083	13.00	8.083	13.00	11.08	13.00
2.167	6.00	5.167	13.00	8.167	13.00	11.17	13.00
2.250	6.00	5.250	13.00	8.250	13.00	11.25	13.00
2.333	6.00	5.333	13.00	8.333	13.00	11.33	13.00
2.417	6.00	5.417	13.00	8.417	13.00	11.42	13.00
2.500	6.00	5.500	13.00	8.500	13.00	11.50	13.00
2.583	6.00	5.583	13.00	8.583	13.00	11.58	13.00
2.667	6.00	5.667	13.00	8.667	13.00	11.67	13.00
2.750	6.00	5.750	13.00	8.750	13.00	11.75	13.00
2.833	6.00	5.833	13.00	8.833	13.00	11.83	13.00
2.917	6.00	5.917	13.00	8.917	13.00	11.92	13.00
3.000	6.00	6.000	13.00	9.000	13.00	12.00	13.00

```
    Max.Eff.Inten.(mm/hr)=      53.00        52.99
          over (min)            5.00         5.00
    Storage Coeff.  (min)=      2.00 (ii)    2.59 (ii)
    Unit Hyd. Tpeak (min)=      5.00         5.00
    Unit Hyd. peak  (cms)=      0.31         0.29
                                                    *TOTALS*
    PEAK FLOW       (cms)=      0.06         0.00      0.063 (iii)
    TIME TO PEAK    (hrs)=      9.58        10.00       10.00
    RUNOFF VOLUME    (mm)=    210.00       207.47      210.00
    TOTAL RAINFALL   (mm)=    212.00       212.00      212.00
    RUNOFF COEFFICIENT   =      0.99         0.98        0.99

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

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  99.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| RESERVOIR(  0205) |     OVERFLOW IS OFF
| IN= 2---> OUT= 1  |
| DT=  5.0 min      |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
-------------------      (cms)      (ha.m.)    |   (cms)     (ha.m.)
                          0.0000      0.0000    |    0.0196      0.0123
                          0.0056      0.0014    |    0.0206      0.0123
                          0.0084      0.0027    |    0.0215      0.0123
                          0.0105      0.0041    |    0.0222      0.0123
                          0.0122      0.0054    |    0.0224      0.0124
                          0.0137      0.0068    |    0.0227      0.0129
                          0.0151      0.0082    |    0.0229      0.0145
                          0.0164      0.0095    |    0.0231      0.0181
                          0.0175      0.0109    |    0.0233      0.0238
                          0.0186      0.0123    |    0.1450      0.0314

                             AREA     QPEAK     TPEAK      R.V.
                             (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)    0.425     0.063     10.00     210.00
   OUTFLOW: ID= 1 (  0205)    0.425     0.045     11.00     209.87

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 71.63
                  TIME SHIFT OF PEAK FLOW          (min)= 60.00
                  MAXIMUM  STORAGE   USED        (ha.m.)=  0.0251

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

-------------------
| ADD HYD  (  0206)|
|  1 +  2 =  3     |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)      (mm)
       ID1= 1 (  0202):      0.06    0.008    10.00    172.04
     + ID2= 2 (  0203):      0.08    0.010    10.00    153.41
       ================================================
       ID = 3 (  0206):      0.13    0.018    10.00    161.26

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

-------------------
| ADD HYD  (  0206)|
|  3 +  2 =  1     |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)      (mm)
       ID1= 3 (  0206):      0.13    0.018    10.00    161.26
     + ID2= 2 (  0205):      0.42    0.045    11.00    209.87
       ================================================
       ID = 1 (  0206):      0.56    0.058    11.00    198.28

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

 FINISH
================================================================================
```

5 Year

A = 843.019
B = 4.582
C = 0.763
Runoff Coefficient Adjustment = 1

CITY of BARRIE

STORM SEWER DESIGN SHEET (D702A v1.1)

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

May 9, 2024

Acceptable
Review
Incorrect

File No: 22-11672B
Design Sheet: POST-1
Calculated By: DH
Checked By: DH

Catchment Area	Street Name	Maintenance Hole Number		Runoff Calculations									Hydraulic Calculations						
				Runoff Coefficent C	Runoff Coefficient w/ Adjustment C'	Area A	Incremental C'*A	Total C'*A	Time of Concentration		Intensity	*Total Q	Diameter	Mannings N	Length	Slope	Q_{pipe}	Velocity	Capacity Check Q / Q_{pipe}
		From	To			Ha			Total minutes	Flow Time In Pipe minutes	mm/hr	m^3/s	mm		m	%	m^3/s	m/s	%
201	447-455 YONGE STREET	TANK	HS-4	100-YEAR CONTROLLED PEAK FLOWRATE FROM VO MODELLING								0.023	250	0.013	0.700	7.100	0.158	3.228	14.5%
		HS-4	STMMH#1	100-YEAR CONTROLLED PEAK FLOWRATE FROM VO MODELLING								0.023	250	0.013	9.900	2.000	0.084	1.713	27.3%
203		CB#1	STMMH#1	100-YEAR UNCONTROLLED PEAK FLOWRATE FROM VO MODELLING								0.012	250	0.013	62.200	0.500	0.042	0.857	28.5%
201 & 203		STMMH#1	STMMH#2	100-YEAR CONTROLLED PEAK FLOWRATE FROM VO MODELLING								0.035	250	0.013	14.200	1.000	0.059	1.211	58.9%
EXT	427-437 YONGE STREET	CBMH#1	STMMH#2	100-YEAR FLOWRATE FROM STORM SEWER DESIGN SHEET								0.034	250	0.013	9.400	1.000	0.059	1.211	57.2%
EXT	MACLAREN AVENUE	STMMH#2	DDLV00520									0.069	300	0.013	48.700	1.700	0.126	1.784	54.7%
EXT*	MACLAREN AVENUE	DDLV00520	DDLV00521	0.400	0.400	0.651	0.260	0.260	10.000	0.681	109.105	0.148	300	0.013	103.100	3.400	0.178	2.523	83.0%

*Flowrate includes modifed catchment area derived from the Little Avenue & Highway #11 Subdivision Storm Drainage Plan (Drawing No. 1995-057-007) and controlled flowrates from the developments of 427-437 and 447-455 Yonge Street.

Inspection and Maintenance Checklist
Stormwater Collection and Conveyance System

Date of Inspection: _____ Inspection Area: _____

Field Inspector(s): _____ Reason for Inspection: _____

Current Weather: _____ Rain (inches): In Last 24 hrs: _____ In Last Week: _____

Facility Type	Location		Sediment Build-up		Maintenance Needed		Maintenance Follow-up	
(CB, Pond, etc)	GIS#/GPS	Description	Depth (in)	Needs Removal?	Code	Description/Action Needed	Date Completed	Initials

Maintenance Codes:

1 – Accumulated Sediment
2 – Trash & Debris
3 – Vegetation Concerns
4 – Water Quality Concerns
5 – Impeded Water Flow
6 – Erosion
7 – Structural Repairs
8 – Cover/Frame/Grate
9 – Damaged Pipes
10 – Mosquito/Vector Breeding
11 – Other
12 – Could Not Locate

See maintenance standards for detailed code descriptions for each facility type.

Make additional copies of this page as needed for field inspections.

Maintenance Standards
Catch Basins and Manholes

Maintenance Code	Type	Conditions When Maintenance Is Needed
1	Sediment	Sediment exceeds 60% of sump depth. Sediment depth within 6 inches of the invert of the lowest pipe.
2	Trash & Debris	Trash or debris in front of catch basin opening or blocking inlet by more than 10%. Trash or debris exceeds 60% of sump depth. Trash or debris within 6 inches of the invert of the lowest pipe. Trash or debris blocking more than 1/3 of any inlet or outlet pipe. Trash and debris blocking more than 20% of grate surface. Dead animals or vegetation that generate odors and cause complaints or dangerous gases (e.g., methane).
3	Vegetation	Vegetation growing across and blocking more than 10% of the grate opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall.
4	Water Quality	Any evidence of oil, gasoline, contaminants, or other pollutants. Water flowing in catch basin during dry weather – report as potential illicit discharge concern.
5	Water Flow	Impeded water flow due to vegetation or sediment (use appropriate code from above).
6	Erosion	N/A
7	Cover/Frame/ Grate	Cover is missing or only partially in place. One maintenance person cannot remove lid after applying normal lifting pressure. Frame separated by more than ¾ inch from top slab. Frame not securely attached. Locking mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread. Grate with opening wider than 7/8 inch. Grate damaged or missing.
8	Structure	Top slab with holes larger than 2 square inches or cracks wider than 1/4 inch. Fractures or cracks in basin walls or bottom. Grout at inlet/outlet pipes has separated or cracked wider than ½ inch and longer than one foot. Soil is entering the catch basin through cracks in the structure. Settlement has created a safety, function, or design problem. Field inspector judges that structure is unsound.
9	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.

Maintenance Code	Type	Conditions When Maintenance Is Needed
10	Mosquito Vector Breeding	Suitable habitat exists for mosquito production (e.g., standing water for more than 72 hours in areas accessible to mosquitoes.)
11	Other	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges. Catch basin insert requires replacement if: • Sediment, trash, or debris blocks water flow through the insert, • Effluent water from the insert has a visible sheen, or • Insert is saturated with water or oil and can no longer absorb.
12	Could Not Locate	Field inspectors are unable to locate the catch basin or manhole.

Maintenance Standards
Control Structures

Maintenance Code	Type	Conditions When Maintenance Is Needed
1	Sediment	Sediment depth exceeds 60% of sump depth. Sediment accumulated within 6 inches of the orifice plate or lowest pipe invert.
2	Trash & Debris	Trash or debris exceeds 60% of sump depth. Trash or debris within 6 inches of the orifice plate or lowest pipe invert. Trash or debris blocking openings in the control structure. Trash or debris blocking more than 1/3 of any inlet or outlet pipe. Dead animals or vegetation that generate odors and cause complaints or dangerous gases (e.g., methane).
3	Vegetation	Vegetation growing in inlet/outlet pipe joints that is more than six inches tall.
4	Water Quality	Any evidence of oil, gasoline, contaminants, or other pollutants.
5	Water Flow	Impeded water flow due to vegetation or sediment (use appropriate code from above).
6	Erosion	N/A
7	Cover/Frame/ Grate	Cover is missing or only partially in place. One maintenance person cannot remove lid after applying normal lifting pressure. Frame separated by more than ¾ inch from top slab. Frame not securely attached. Locking mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.
8	Structure	Damaged or missing orifice plate. Control structure is not securely attached to manhole wall. Control structure is not in upright position. Connection between control structure and outlet pipe is not watertight. Holes (other than design openings) in the control structure. Cleanout gate is not watertight, is missing, is rusted, or cannot be moved up and down by one maintenance person applying normal pressure. Top slab with holes larger than 2 square inches or cracks wider than 1/4 inch. Fractures or cracks in basin walls or bottom. Grout at inlet/outlet pipes has separated or cracked wider than ½ inch and longer than one foot. Soil is entering the catch basin through cracks in the structure. Settlement has created a safety, function, or design problem. Field inspector judges that structure is unsound.
9	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.

Maintenance Code	Type	Conditions When Maintenance Is Needed
10	Mosquito Vector Breeding	Suitable habitat exists for mosquito production (e.g., standing water for more than 72 hours in areas accessible to mosquitoes.)
11	Other	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.
12	Could Not Locate	Field inspectors are unable to locate the structure.

Maintenance Standards
Conveyance Systems (Pipes and Ditches)

Maintenance Code	Type	Conditions When Maintenance Is Needed
1	Sediment	Sediment or debris exceeds 20% of pipe diameter or 20% of debris barrier openings. Accumulated sediment that exceeds 20% of the design depth of the ditch.
2	Trash & Debris	Trash and debris accumulated in pipe or ditch. Visual evidence of dumping
3	Vegetation	Vegetation reduces movement of water through pipes. Excessive vegetation that reduces free movement of water through ditches.
4	Water Quality	Any evidence of oil, gasoline, contaminants, or other pollutants. Water flowing in pipes or ditch during dry weather – report as potential illicit discharge concern.
5	Water Flow	Impeded water flow due to vegetation or sediment (use appropriate code from above). Standing water in the pipe or swale between storm events.
6	Erosion	Erosion damage over 2 inches deep where cause is still present or there is potential for continued erosion. Native soil is visible beneath the rock lining of a conveyance ditch.
7	Cover/Frame/ Grate	N/A
8	Structure	Debris barrier/trash rack is missing or not attached to pipe. Debris barrier/trash rack bars are bent by more than 3 inches. Debris barrier/trash rack bars are loose, or rust is causing 50% deterioration to any part of the barrier.
9	Damaged Pipes	Protective coating is damaged, or rust is causing more than 50% deterioration to any part of pipe. Any dent that decreases the flow area by more than 20% or puncture that impacts performance.
10	Mosquito Vector Breeding	Suitable habitat exists for mosquito production (e.g., standing water for more than 72 hours in areas accessible to mosquitoes.)
11	Other	
12	Could Not Locate	Field inspectors are unable to locate the pipe or ditch.

Maintenance Standards
Vaults, Tanks, and Storage Pipes

Maintenance Code	Type	Conditions When Maintenance Is Needed
1	Sediment	Sediment depth exceeds 10% of storage depth for half-length of storage facility, or any point depth exceeds 15% of storage depth. (Example: 72-inch depth storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)
2	Trash & Debris	Trash or debris exceeds the limits for sediment described above.
3	Vegetation	N/A
4	Water Quality	Prevalent and visible oil sheen. Evidence of oil, gasoline, contaminants, or other pollutants.
5	Water Flow	First cell (if applicable) is empty, doesn't hold water.
6	Erosion	N/A
7	Cover/Frame/ Grate	Cover is missing or only partially in place. One maintenance person cannot remove lid after applying normal lifting pressure. Locking mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.
8	Structure	See Control Structures for additional maintenance standards. Openings or voids between tank or pipe sections allowing material to be transported into facility. Tank/pipe is bent more than 10% of its design shape. Cracks wider than 1/2-inch. Evidence of soil particles entering structure through cracks. The vault is not structurally sound. One-half of the cross section of an air vent is blocked or vent is damaged.
9	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.
10	Mosquito Vector Breeding	Suitable habitat exists for mosquito production (e.g., standing water for more than 72 hours in areas accessible to mosquitoes.)
11	Other	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.
12	Could Not Locate	Field inspectors are unable to locate the facility.

Worksheet for Diversion Swale (Catchment 203)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.010	m/m
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V
Discharge	12.00	L/s

Results		
Normal Depth	96.8	mm
Flow Area	0.0	m²
Wetted Perimeter	0.6	m
Hydraulic Radius	45.9	mm
Top Width	0.58	m
Critical Depth	79.9	mm
Critical Slope	0.028	m/m
Velocity	0.43	m/s
Velocity Head	0.01	m
Specific Energy	0.11	m
Froude Number	0.620	
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.0	mm
Length	0.0	m
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	mm
Profile Description	N/A	
Profile Headloss	0.00	m
Downstream Velocity	0.00	m/s
Upstream Velocity	0.00	m/s
Normal Depth	96.8	mm
Critical Depth	79.9	mm
Channel Slope	0.010	m/m
Critical Slope	0.028	m/m

Worksheet for Diversion Swale (Catchment 203)

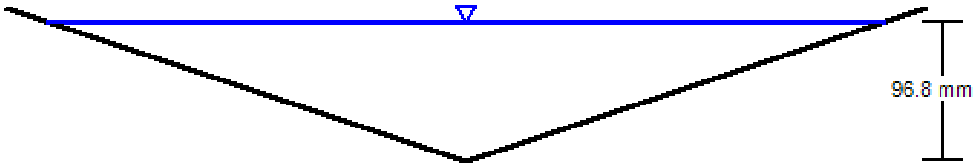
Notes:

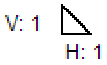
100-Year Peak Flowrate for Catchment 203 from VO Modelling.

Cross Section for Diversion Swale (Catchment 203)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.010	m/m
Normal Depth	96.8	mm
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V
Discharge	12.00	L/s





Hydroworks Sizing Summary

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

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04-11-2024

Recommended Size: HydroStorm HS 4

A HydroStorm HS 4 is recommended to provide 80 % annual TSS removal based on a drainage area of 0.425 (ha) with an imperviousness of 100 % and Barrie WPCC, Ontario rainfall for the City of Toronto particle size distribution.

The recommended HydroStorm HS 4 treats 100 % of the annual runoff and provides 82 % annual TSS removal for the Barrie WPCC rainfall records and City of Toronto particle size distribution.

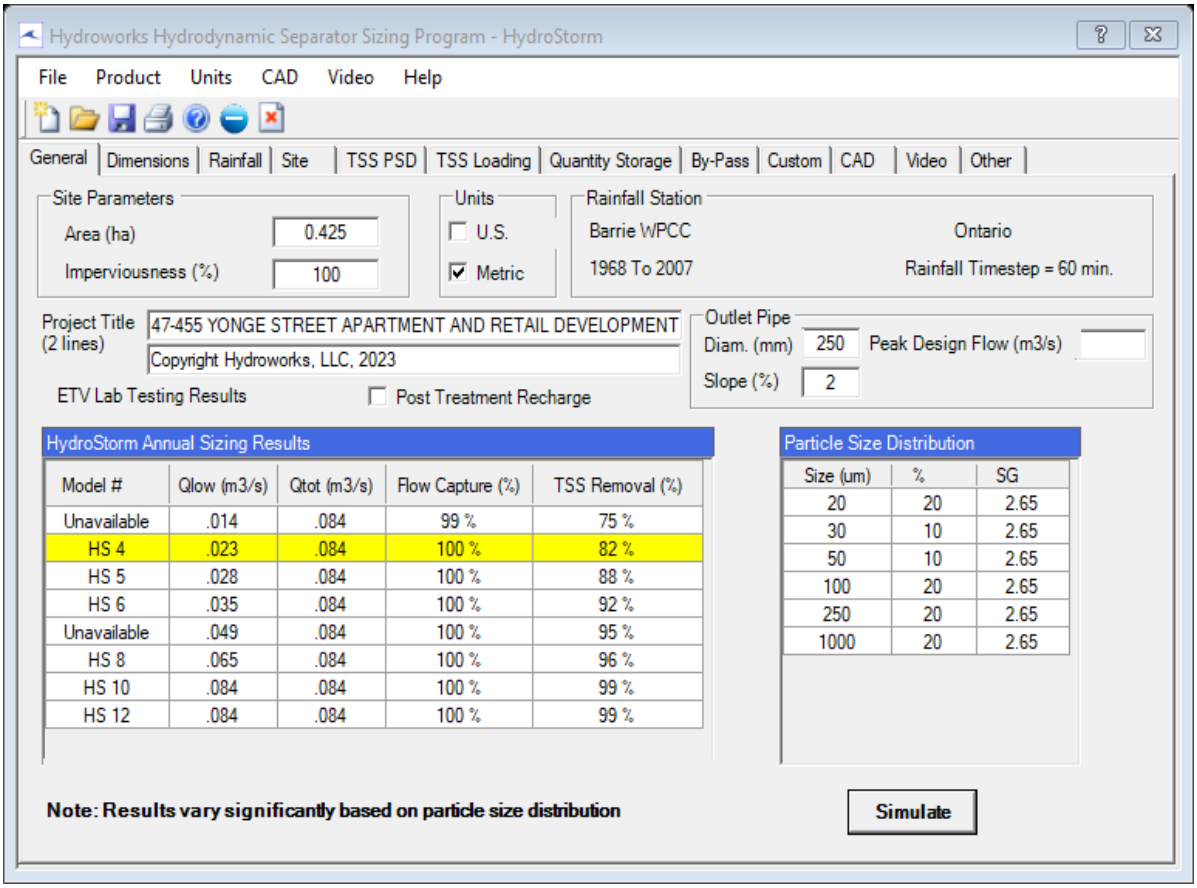
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .08 (m3/s) for the given 250 (mm) pipe diameter at 2% slope. The headloss was calculated to be 156 (mm) based on a flow depth of 250 (mm) (full pipe flow).

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

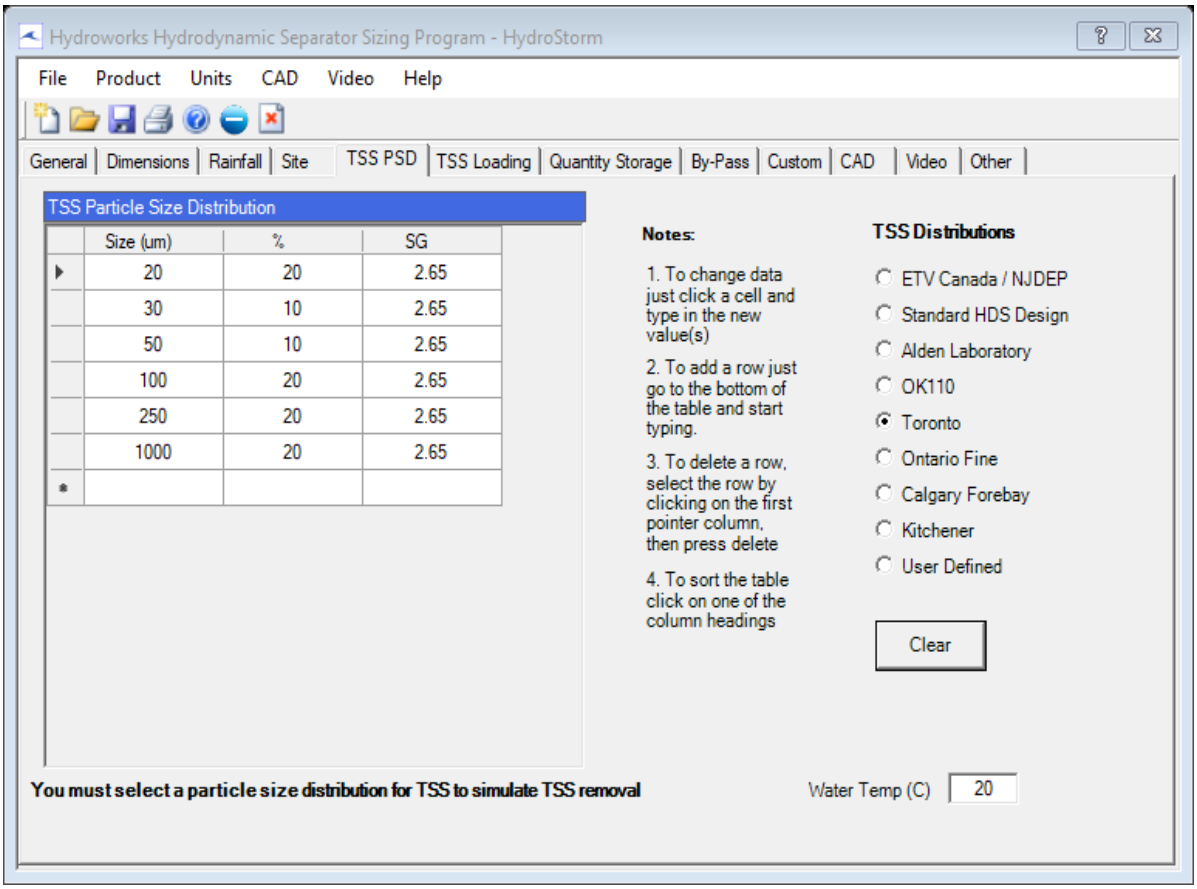
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroStorm .

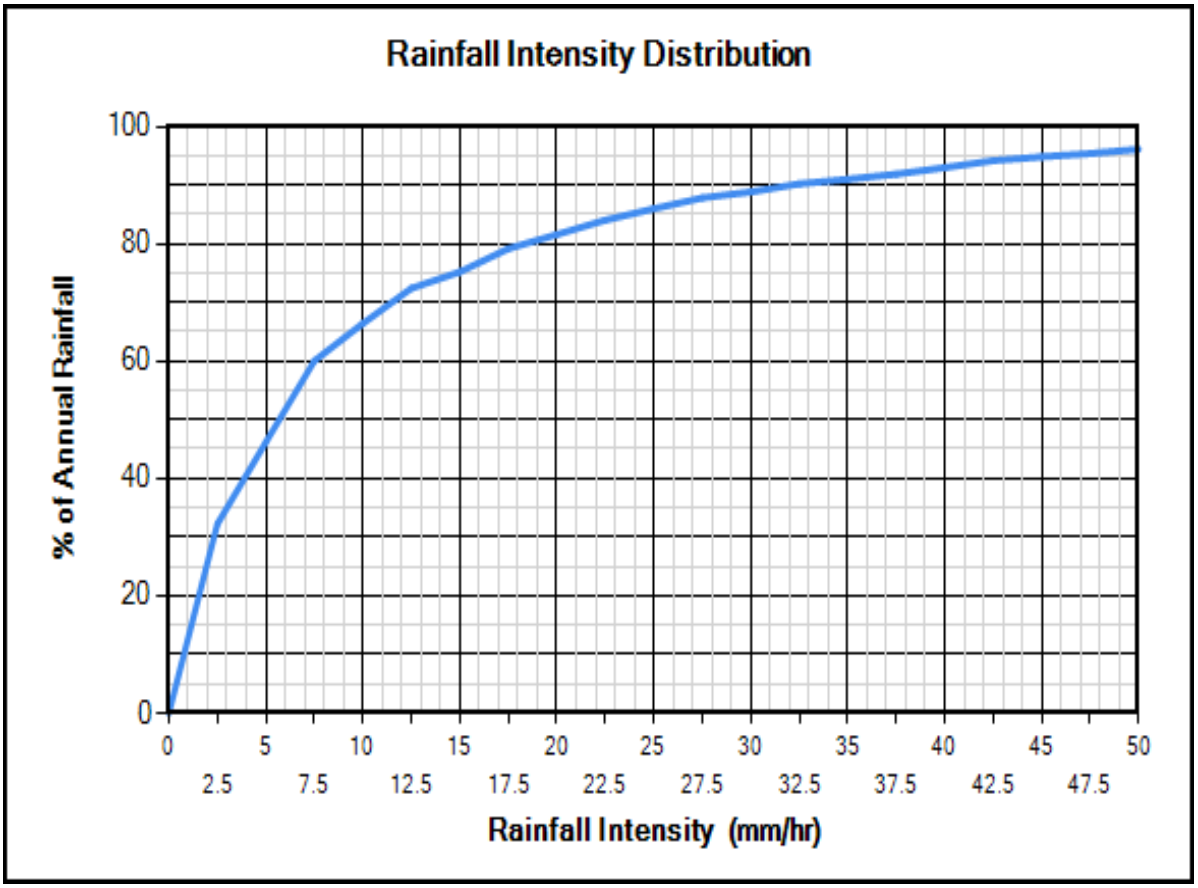
TSS Removal Sizing Summary



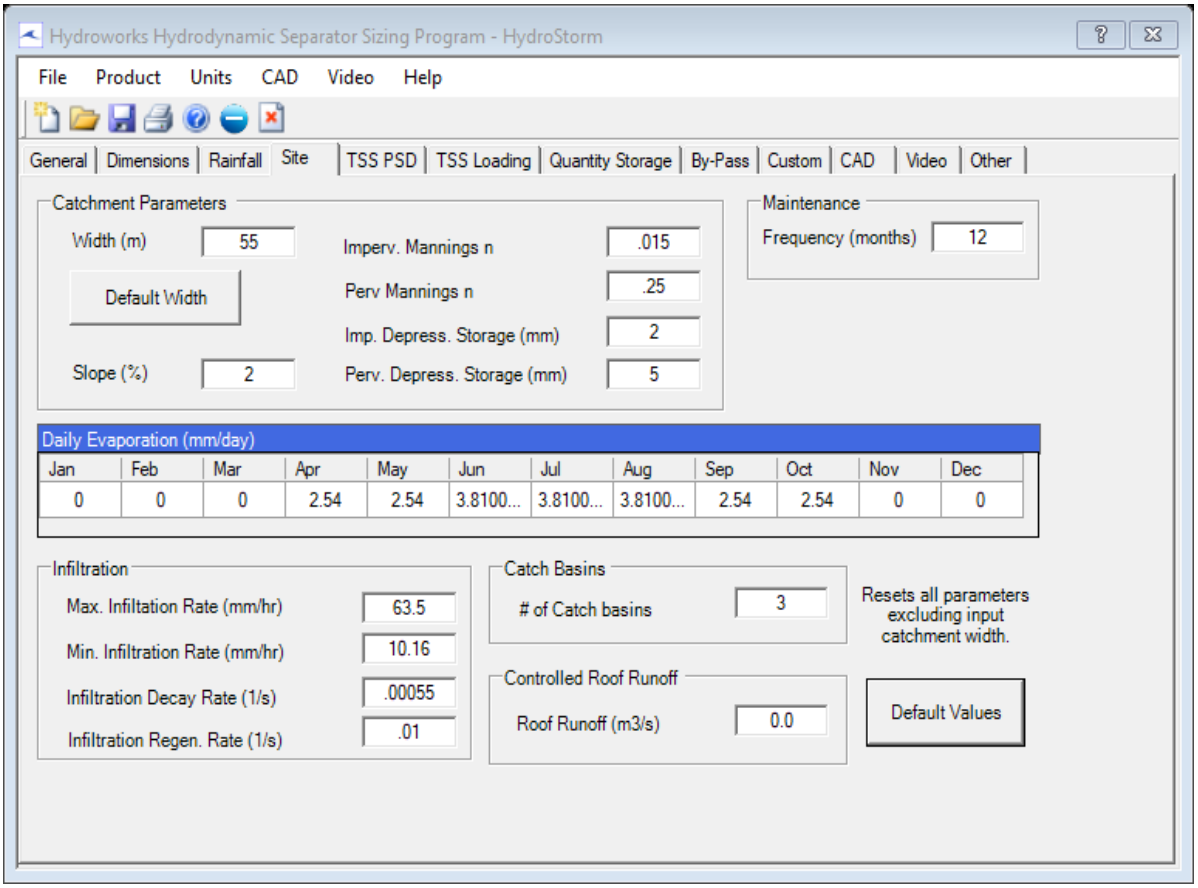
TSS Particle Size Distribution



Rainfall Station - Barrie WPCC, Ontario(1968 To 2007)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

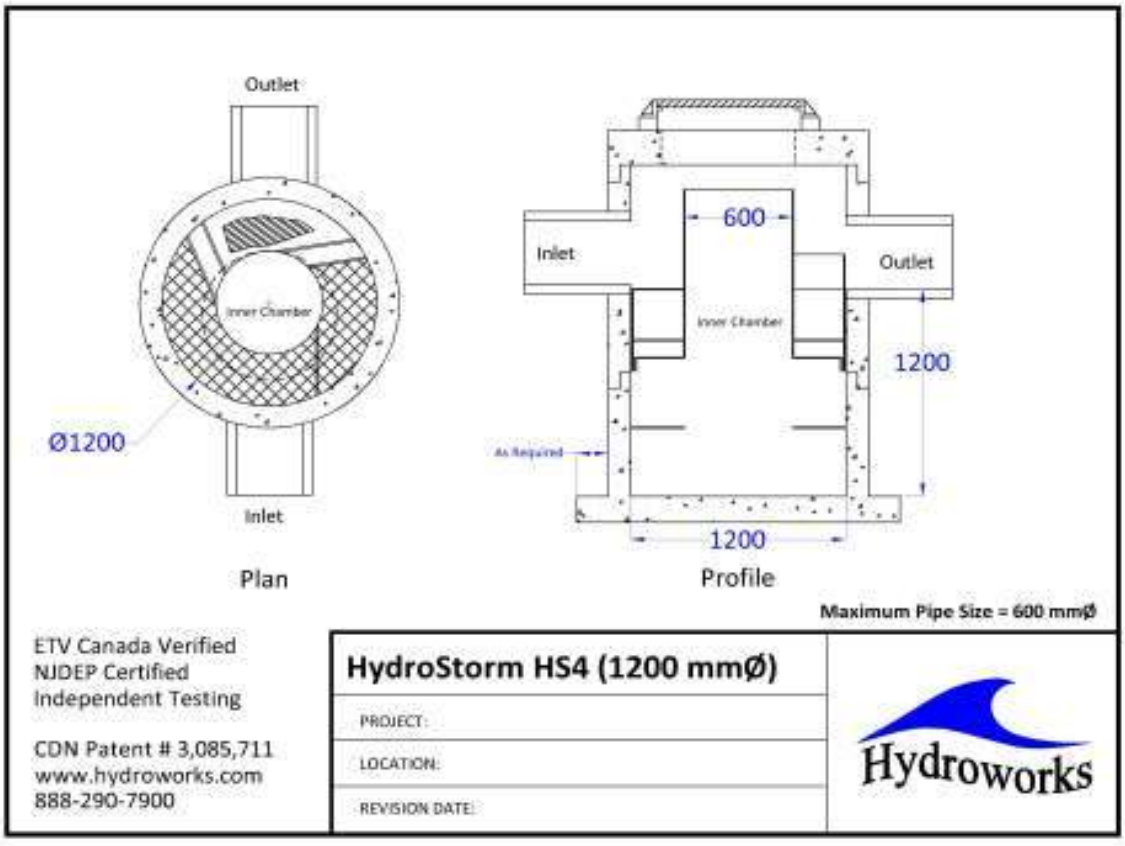
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

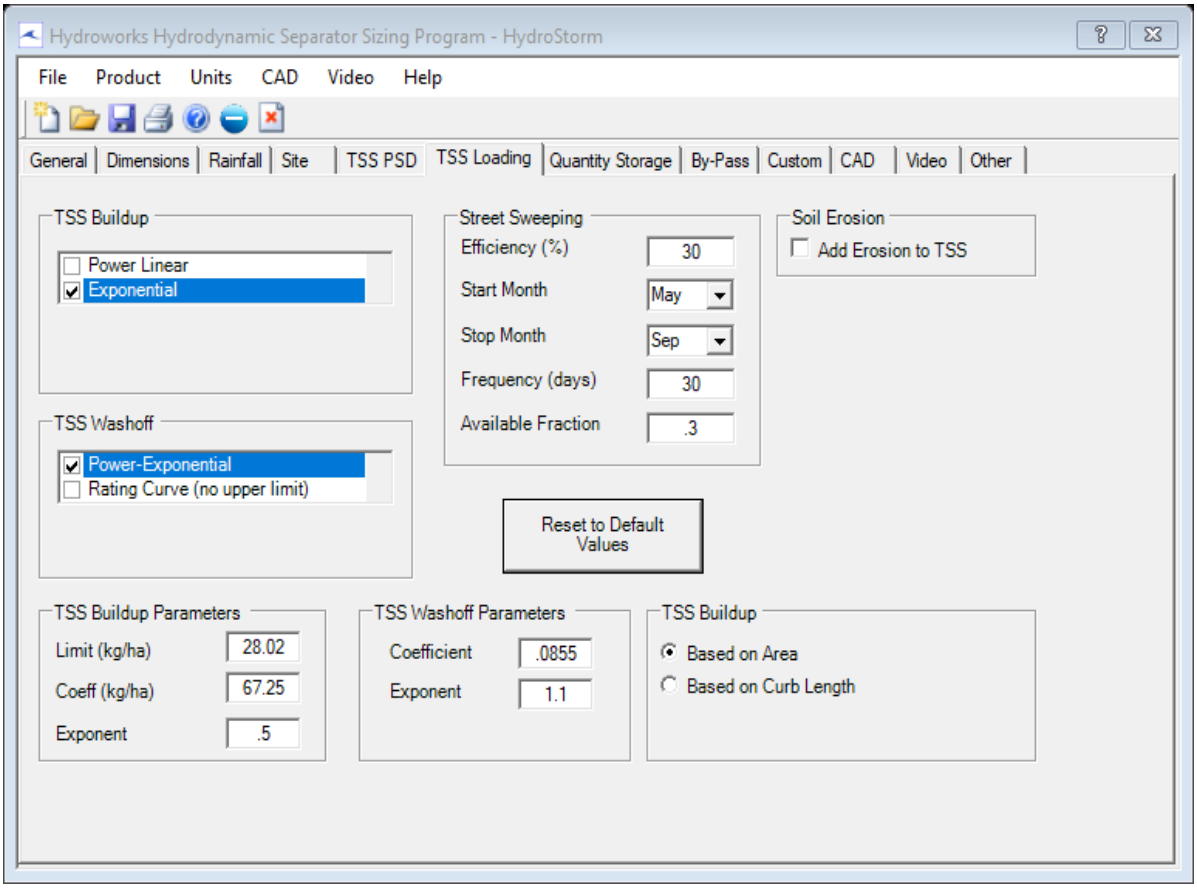
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
Unavailable	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1576	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4328	13.2	20
HS 12	3.66	3.35	7166	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

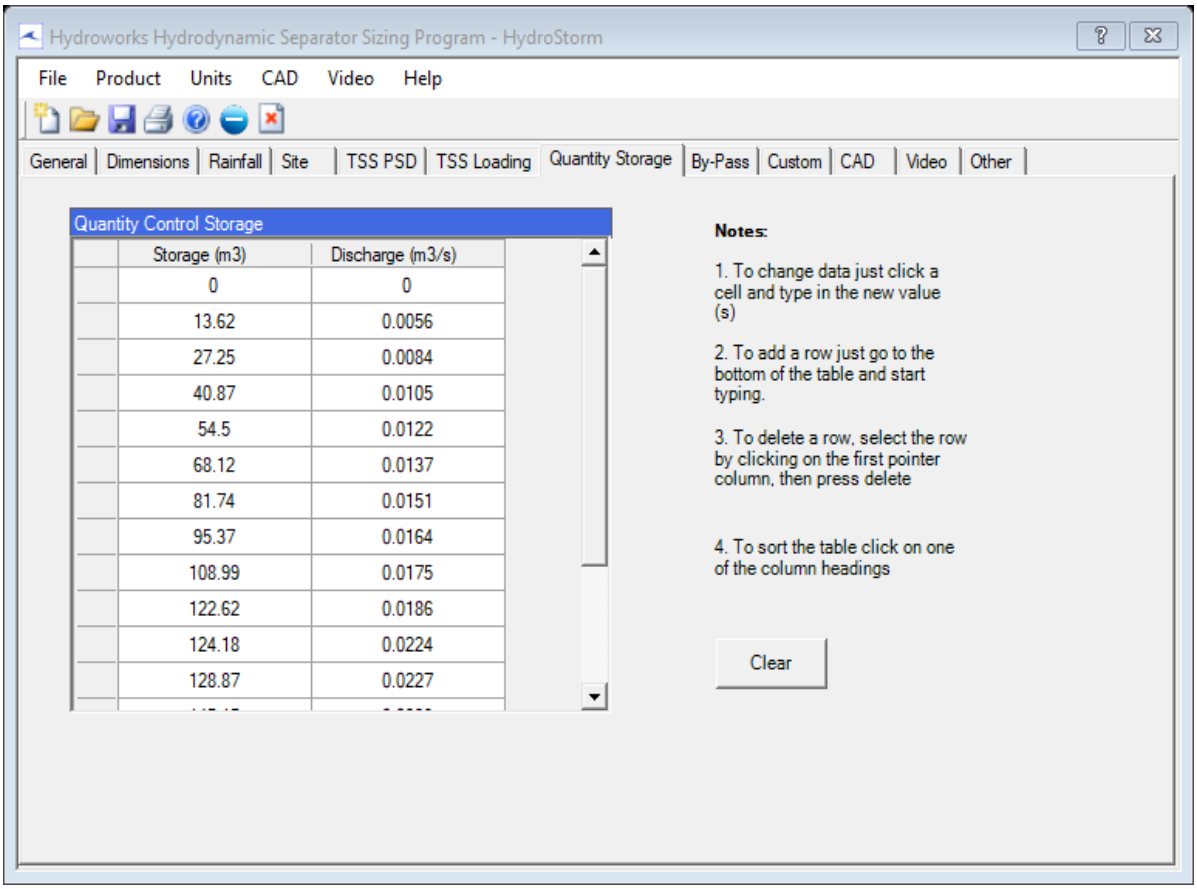
Generic HS 4 CAD Drawing



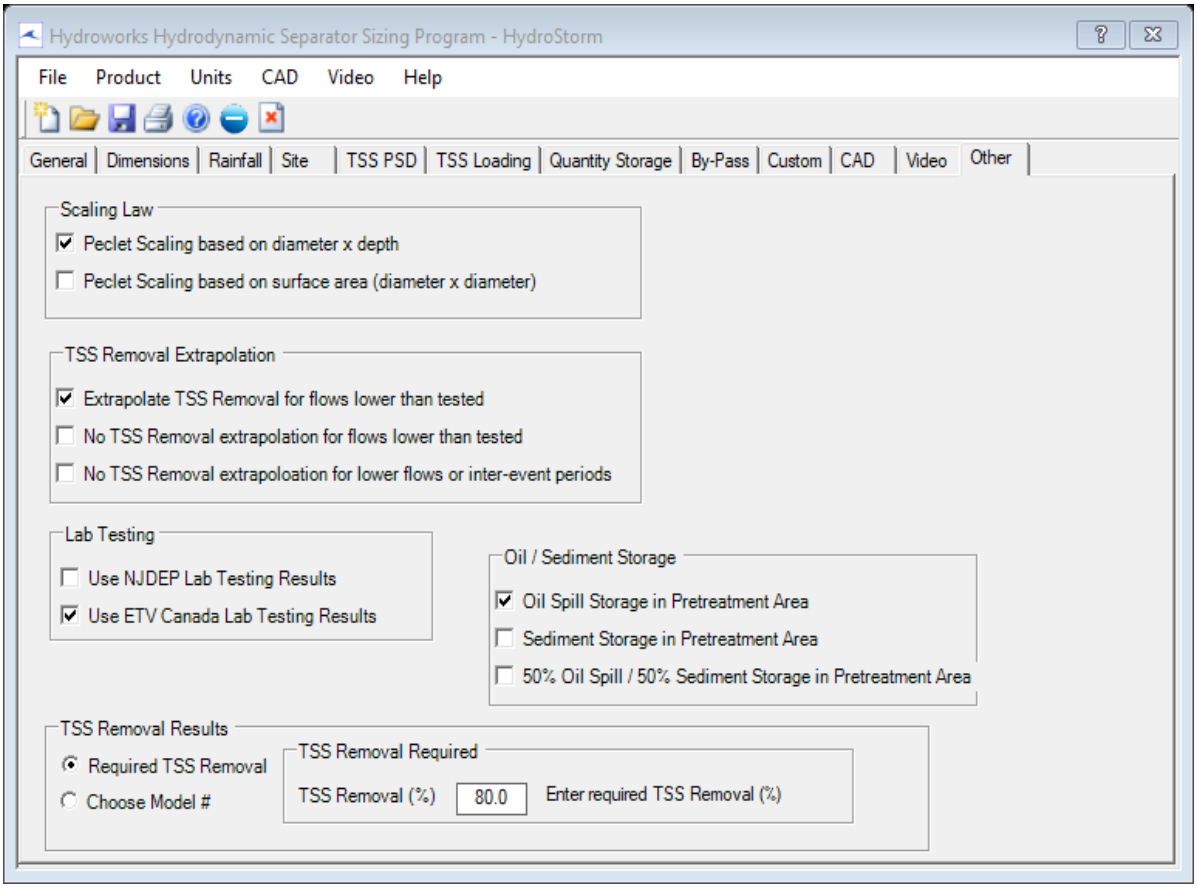
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.8
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1-800-290-7900
www.hydroworks.com

Verification Testing of the Hydroworks HS 4 Stormwater Treatment System

In Accordance with the Canadian ETV Program

"Procedure for Laboratory Testing of Oil-Grit Separators", 2014

Technical Evaluation Report

Alden Report No. : 1152HS4SVT-CETV-R1

Submitted to:

Hydroworks, LLC
Clark, NJ

Prepared by

James Mailloux
Senior Engineer
Alden Research Laboratory

February 2018

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1.0 Introduction

Under a contract from Hydroworks, LLC, verification testing of a Hydroworks HydroStorm 4-ft diameter Hydrodynamic Separator (HS 4), was conducted at Alden Research Laboratory, Inc. (Alden) in Holden, Massachusetts. The purpose of the testing was to define the performance characteristics of the HS 4 treatment unit under controlled laboratory conditions, utilizing established standard testing methodologies. The testing was conducted in accordance with the Canadian Environmental Technology Verification (CETV) Program "Procedure for Laboratory Testing of Oil-Grit Separators 2014", to establish the following parameters:

a) Hydraulic Characteristics Curves:
Define the flow capacity and system losses

b) Sediment Scour Testing:
Quantify the sediment mass by particle size fractions that are washed out of the unit at defined flows.

c) Sediment Removal Efficiency Curve:
Quantify the sediment removal characteristics at various surface loading rates, including particle size fractions, using a mass balance methodology.

d) Light liquid Re-entrainment:
Perform testing to qualitatively assess the unit's ability to retain light liquid at defined flows using a plastic bead surrogate.

e) Particle Size Distribution (PSD):
At a minimum, the particle size distribution of the influent, effluent and/or captured material for all sediment test conditions.

2.0 Test Unit Description

The HS 4 test unit was a concrete cylindrical device measuring 1.22 m in diameter with a sump depth of 1.2 m and a collection sump area of 1.17 m^2. Aluminum inlet and outlet pipes, 0.35 m in diameter, were oriented along the centerline of the unit, with the inverts located 1.24 m and 1.19 m above the sump floor, respectively. The pipes were set with 0.25% slopes. The internal geometry was divided into an annular pretreatment channel, 0.61 m diameter inner chamber, and lower collection sump. The pretreatment channel extended 0.305 m below the outlet pipe invert and contained three (3) intermediate low-flow weirs, 0.305 m high (flush with the outlet invert), and two (2) downstream bypass weirs, 0.508 m high (0.203 m above the outlet invert). Grating was positioned over the channel to help displace the inflow turbulence and protect the captured sediment from scour. Openings were located upstream of each weir to allow the flow to be conveyed into the inner chamber and lower sump. The flow passed along the outside of a lower outlet disk and through an opening in the pretreatment disk, downstream of the bypass weirs, where it was conveyed into the outlet pipe. An annular secondary horizontal plate was located within the lower sump to protect the collected sediment from scour. Initial testing was performed using a solid plate. After the completion of testing, the plate was replaced with a perforated plate and a test was repeated to demonstrate that the treatment was not sensitive to the plate geometry. Drawings of the HS 4 test unit are shown on **Figure 1.** A photograph showing the unit installed in the test loop is shown on **Figure 2.**

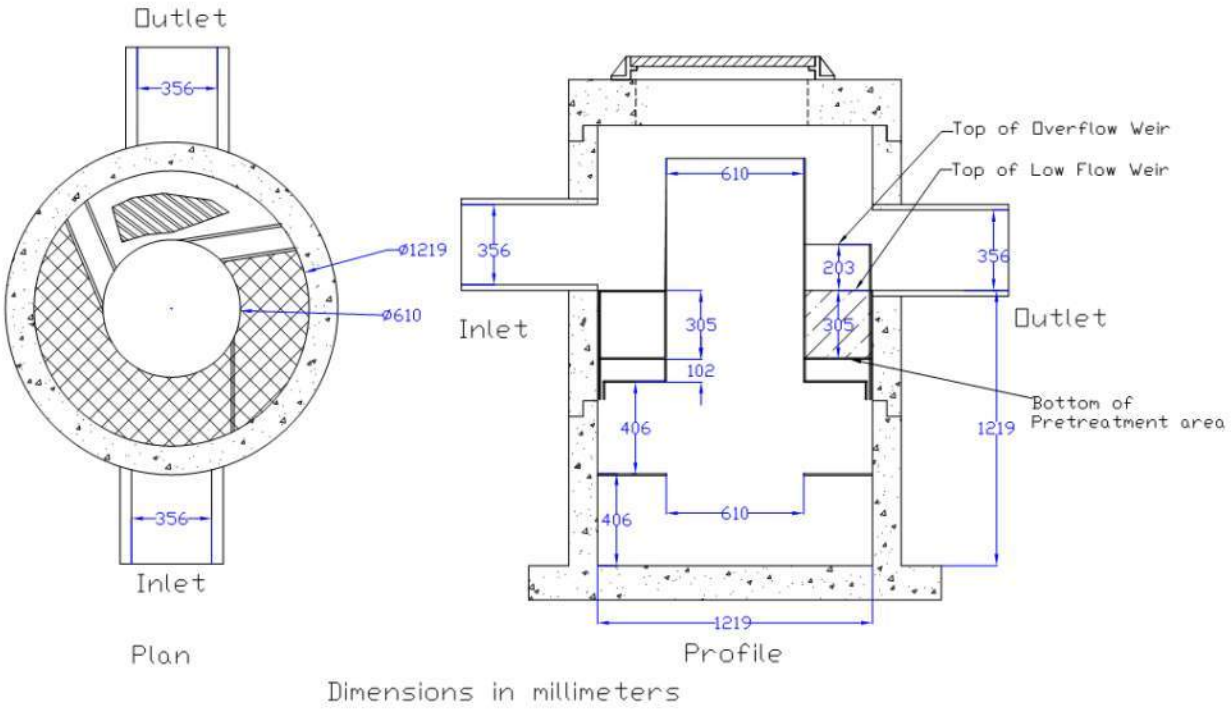


Figure 1: Drawing of the HS 4 Treatment Unit



Figure 2: HS 4 Test Unit Installed in Alden Flow Loop

3.0 Materials and Methods

3.1 Experimental Design

The HS 4 test unit was installed in the Alden test loop, shown on **Figure 3,** which was set up as a recirculation system. The loop was designed to provide metered flow up to approximately 17 cfs (481 L/s). Flow was supplied to the unit using either a 20HP or 50HP laboratory pump (flow dependent), drawing water from a 50,000-gallon (190,000 L) supply sump. Thirty feet (9.1m) of straight 14-inch (0.35m) pipe conveyed the metered flow to the unit. The influent and effluent pipes were set at 0.25% slopes. A 14-inch (0.35m) tee was located 4 pipe-diameters upstream of the test unit for injecting sediment into the crown of the influent pipe. This location deviated from the recommended distance of 5 pipe-diameters. However, the shorter distance was considered conservative for collecting sediment in the influent pipe and provided a better assessment of the unit's ability to capture sediment. Filtration of the test-loop flow, to reduce background concentration, was performed with an inline filter wall containing 1-micron filter bags.

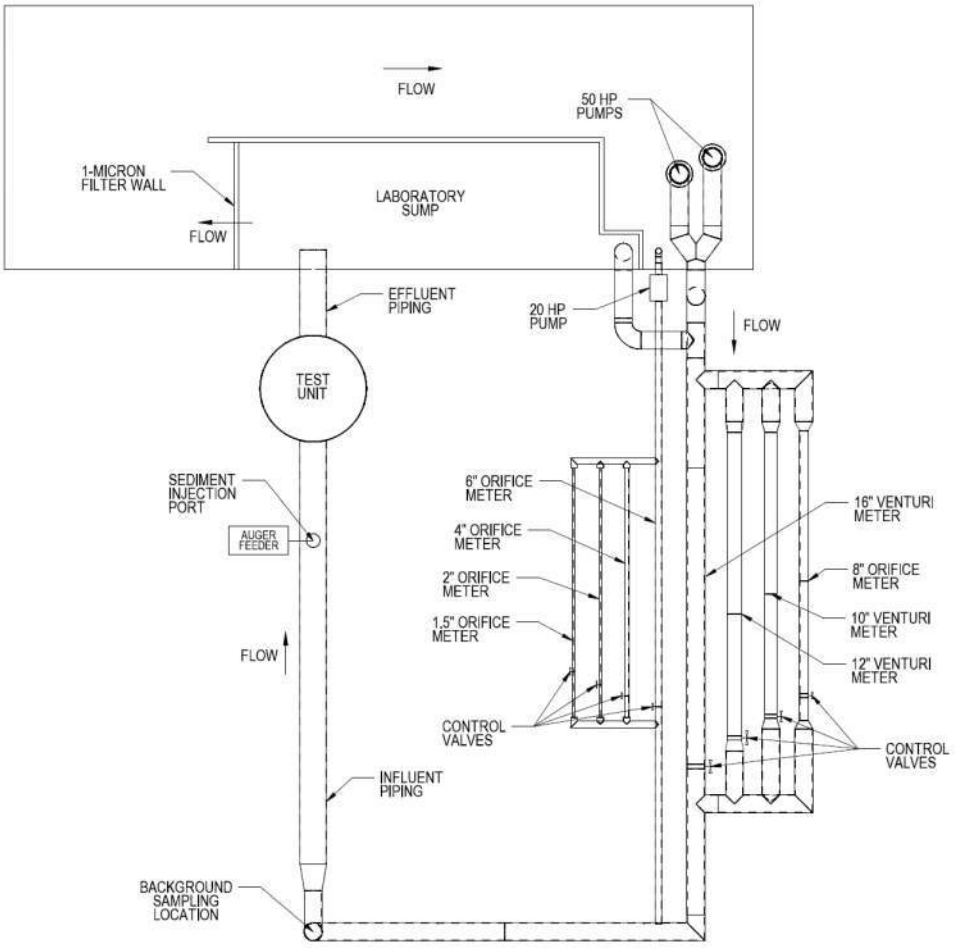


Figure 3: Plan View of Alden Flow Loop

3.2 Testing

3.2.1 Hydraulic Testing

The HS 4 unit was tested with clean water to determine its hydraulic characteristics, including loss coefficients (Cd's) and/or K factors, as well as the maximum flow prior to bypass. Flow and water level measurements were recorded for fifteen steady-state flow conditions using a computer Data-Acquisition (DA) system, which included a data collect program, a 0-250" Rosemount Differential Pressure (DP) cell, and a Druck 0-2 psi Absolute Pressure (AP) cell. Flows were set and measured using calibrated differential-pressure flow meters and control valves. Each test flow was set and operated at steady state for approximately 10 minutes, after which time a minimum of 60 seconds of flow and pressure data were averaged and recorded for each pressure tap location. Water elevations were measured within the treatment unit in the pretreatment channel, inner chamber and upstream of the outlet area. Measurements within the influent and effluent pipes were taken one pipe-diameter upstream and downstream of the unit.

3.2.2 Removal Efficiency Testing

Removal testing was conducted on a clean unit utilizing the mass balance methodology. A false floor was installed at the 50% collection sump sediment storage depth of 6" (0.15m), as stated by Hydroworks. All tests were run with clean water containing a sediment solids concentration (SSC) of less than 20 mg/L.

A minimum of seven sediment removal efficiency tests were conducted at loading rates corresponding to 40, 80, 200, 400, 600, 1000 and 1400 L/min/m^2 of effective treatment area. The HS 4 treatment area was 1.17 m^2, resulting in test flows of 47, 94, 234, 468, 702, 1170 and 1638 L/min.

The 600 L/min/m^2 test was repeated with a perforated secondary plate installed to determine the impact of the plate design on removal efficiency.

The test sediment was prepared by Alden to meet the PSD gradation of 1-1000 microns in accordance with the distribution shown in **Table 1.** The sediment is silica based, with a specific gravity of 2.65. Samples of each test batch were analyzed for PSD compliance by GeoTesting Express, Inc., an independent certified analytical laboratory, using the ASTM D422-63 (2007)e1 analytical method. The average of all the samples was used for compliance with the protocol specification.

The target influent sediment concentration was 200 mg/L (+/-25 mg/L) for all tests. The concentration was verified by collecting a minimum of six timed dry samples at the injector and correlating the data with the measured flow rate to produce the resulting influent concentration values for each test. The allowed Coefficient of Variance (COV) for the measured samples was 0.10.

A minimum of 11.3 kg of test sediment was introduced into the influent pipe for each test. In addition, the criteria of 25 minutes of test time, eight collection sump volume exchanges, and a supply water

temperature below 25 degrees Celsius were met for all tests conducted. The moisture content of the test sediment was determined using ASTM D4959-07 for each test conducted.

A minimum of 5 background samples of the supply water were collected at evenly-spaced intervals throughout each test. Samples were collected every hour for any test that was greater than 5 hours in duration. Collected samples were analyzed for Suspended Solids Concentration (SSC) using the ASTM D3977-97 (2013).

After completion of a selected test, the unit was decanted over a period not exceeding 30 hours. The remaining water and sediment was collected from the treatment unit and dried in designated pre-weighed nonferrous trays in compliance with ASTM D4959-07.

Table 1:
Target CETV Test Sediment Particle Size Distribution

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

3.2.3 Sediment Scour Testing

A sediment scour test was conducted on the test unit to evaluate the ability to retain captured material through a range of flows. The solids storage sump of the test unit was pre-loaded to the 50% storage capacity level of 15.2 cm with the 1-1000 micron sediment listed in **Table 1**. A false floor was installed in the sump to reduce the quantity of material required for the test. However, a minimum sediment depth of 10.2 cm was preloaded as per the protocol specification. The solid secondary plate, located just above the collection sump, was also preloaded to 10.2 cm with the 1-1000 sediment, as requested by Toronto Region Conservation Authority (TRCA). All test sediment was evenly distributed and levelled. The pretreatment channel was preloaded with a conservative blend consisting of all the material captured during the 40, 80 and 200 L/min/m^2 removal efficiency tests and an additional 30% of 1-1000 micron sediment. The material was preloaded in the areas of deposition observed during the removal testing.

The unit was filled with clean water (< 20 mg/L background) to the invert of the outlet pipe prior to testing. Testing was conducted at a temperature not exceeding 25 degrees C. The test was conducted within 96 hours of filling the unit.

The test was conducted sequentially at five surface loading rates equal to 200, 800, 1400, 2000 and 2600 L/min/m^2. Testing consisted of conveying the selected target flow through the unit and collecting 5 pairs of time-stamped effluent samples (every 1 minute) for SSC and PSD analysis, and a minimum of 5 time-stamped background samples evenly spaced throughout the test. Each target flow was reached within 1 minute of commencement of the flow change. Flow data was continuously recorded every 10 seconds throughout the test and correlated with the samples. The first target flow was reached within 1 minute of initiating the test.

It was necessary to change flow meters during the test, as the required flows exceeded the minimum and/or maximum range of any single meter, while maintaining the required COV of 0.04. When the flow capacity of the selected meter was reached, the flow was shut down over a period of approximately 10 seconds and all flow data saved. The next flow meter data-acquisition file was executed and the flow increased at a rate that corresponded to reaching each previous target flow after a period of 1-minute, thereby preventing artificially-induced scour due to flow surge.

Effluent samples for PSD and sediment concentration were collected in 1-L wide-mouth bottles from the end of the outlet pipe for all flows.

An additional scour test was conducted using the same methodology but with a perforated secondary plate installed in the sump. The lower sump was preloaded to the 50% capacity level with 1-1000 micron sediment. The pretreatment channel was preloaded with a sediment distribution that reflected the distribution captured during removal testing. This is considered a scientifically sound approach, as the channel is designed to capture the coarse particles prior to the flow entering the inner chamber.

3.2.4 Light-liquid Re-entrainment Testing

A test was conducted to assess the ability to retain light liquid within the unit. The unit was tested with a false floor installed at the 50% capture elevation, as in the sediment removal testing. The test flows were the same as in the sediment scour tests (200, 800, 1400, 2000 and 2600 L/min/m^2) and were conducted to the same time criteria (1-minute transition, 5-minute test).

The ETV protocol prescribes low-density polyethylene beads as a surrogate to represent floating liquid for a qualitative assessment of liquid behavior during operation. Dow Chemical Dowlex^{tm} 2517, with a density of 0.917 g/cm^2, has been specified as the acceptable surrogate material.

The pellets were preloaded within the inner-chamber area to a volume equal to a depth of 50.8 mm over the sedimentation area. The corresponding mass of the test material was measured and recorded prior to loading the unit.

The effluent was collected in flow-designated nets to allow for quantification of any re-entrained pellets for each flow rate. The collected pellets for each flow, as well as the interim periods, were dried and the volume and mass of collected pellets was quantified for each flow rate, as well as the overall test.

3.3 Instrumentation and Measuring Techniques

3.3.1 Flow

The inflow to the test unit was measured using one of five (5) calibrated differential-pressure flow meters (2”, 4”, 6”, 8” or 12”) [51mm, 102mm, 152mm, 203mm, 305mm]. Each meter is fabricated per ASME guidelines and calibrated in Alden’s Calibration Department. The 12” meter was used during hydraulic testing only. The high and low pressure lines from each meter were connected to manifolds containing isolation valves. Flows were set with a butterfly valve and the differential head from the meter was measured using a Rosemount® 0 to 250-inch (6.35m) Differential Pressure (DP) cell, also calibrated at Alden prior to testing. The test flow was averaged and recorded every 5-30 seconds (flow dependent) throughout the duration of the test using an in-house computer data acquisition (DA) program. The accuracy of the flow measurement is ±2%. A photograph of the flow meters is shown on **Figure 4** and the pumps on **Figure 5.**



Figure 4: Photograph Showing Laboratory Flow Meters



Figure 5: Photograph Showing Laboratory Pumps

3.3.2 Temperature

Water temperature measurements within the supply sump were obtained using a calibrated Omega® DP25 temperature probe and readout device. The calibration was performed at the laboratory prior to testing. The temperature reading was documented at the start and end of each test and/or day (for multi-day tests), to assure an acceptable testing temperature of less than 25 degrees C.

3.3.3 Pressure Head

Pressure head measurements were recorded at multiple locations using piezometer taps and a Druck®, model PTX510, 0 - 2.0 psi cell. The pressure cell was calibrated at Alden prior to testing. Accuracy of the readings is $\pm$ 0.3 mm. The cell was installed at a known datum above the unit floor, allowing for elevation readings through the full range of flows. A minimum of 60 seconds of pressure data was averaged and recorded for each pressure tap, under steady-state flow conditions, using the computer DA program. A photograph of the pressure instrumentation is shown on **Figure 6**.



Figure 6: Pressure Measurement Instrumentation

3.3.4 Sediment Injection

The test sediment was injected into the crown of the influent pipe using an Auger® volumetric screw feeder, model VF-1, shown on **Figure 7.** The feed screws used in testing ranged in size from 9.5mm to 25mm, depending on the test flow. Each auger screw, driven with a variable-speed drive, was calibrated with the test sediment prior to testing, to establish a relationship between the auger speed (0-100%) and feed rate in mg/minute. The calibration, as well as test verification of the sediment feed was accomplished by collecting 1-minute timed dry samples and weighing them on an Ohaus® 4000g x 0.1g,

model SCD-010 digital scale. The feeder has a hopper at the upper end of the auger to provide a constant supply of dry test sediment.



Figure 7: Photograph Showing Variable-speed Auger Feeder

3.3.5 Sample Collection

Scour testing effluent samples were collected in 1-L bottles from the end of the pipe for sediment concentration and PSD analyses. Background concentration samples were collected from the center of the vertical pipe upstream of the test unit with the use of a 19mm diameter isokinetic sampler, shown on **Figure 8.**



Figure 8: Photograph Showing the Background Isokinetic Sampler

3.3.6 Sample Concentration Analyses

Effluent and background concentration samples were analyzed by Alden in accordance with Method B, as described in ASTM Designation: D 3977-97 (Re-approved 2013), "Standard Test Methods for Determining Sediment Concentration in Water Samples". The required silica material used in the sediment testing did not result in any dissolved solids in the samples and therefore, simplified the ASTM testing methods for determining sediment concentration.

3.3.7 Mass Balance Analysis

A modified mass balance method, in which the influent and captured sediment mass is quantified, was used to determine the sediment removal efficiency at each designated test flow. The mass of injected sediment was determined by weighing the prepared test batch prior to testing and subtracting the mass remaining in the injection hopper at the conclusion of the test. All captured material was collected in designated pre-weighed non-ferrous trays and dried in a Binder® laboratory oven; model ED-400, in accordance with ASTM Method D 4959-07, "Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating". Depending on collected mass, each tray was weighed on either an Ohaus® 4000g x 0.1g; model SCD-010, or Ohaus® 30kg x 0.001kg; model RD-30LS digital scale.

3.4 Data Management and Acquisition

A designated Laboratory Records Book was used to document the conditions and pertinent data entries for each test conducted. All entries are initialed and dated.

A computer running an Alden in-house Labview® Data Acquisition (DA) program was used to record all data related to instrument calibration and testing. A 16-bit National Instruments® NI6212 Analog to Digital (A/D) board was used to convert the signal from the pressure cells to a voltage. Alden's in-house data collection software, by default, collects one second averages of data collected at a raw rate of 250 Hz. The system allows contiguous data collection by continuously writing the collected 1 second averages and their RMS values to disk. The data output from the program is in tab delimited text format with a user-defined number of significant figures.

Test flow and pressure data was continuously collected at a frequency of 250 Hz. The flow data was averaged and recorded to file every 5 to 30 seconds, depending on the duration of the test. Steady-state pressure data was averaged and recorded over a duration of 60 seconds for each point. The recorded data files were imported into Excel for further analysis and plotting.

Excel based data sheets were used to record all sediment related data used for quantifying injection rate, effluent and background sample concentrations, captured mass and PSD data. The data was input to the designated spreadsheet for final processing.

3.5 Preparation of Test Sediment

The sediment PSD used for scour and removal efficiency testing was comprised of 1-1000 micron silica particles with a SG of 2.65, as shown in Table 1. Sediment batches were prepared by Alden to meet the protocol specifications using commercially-available silica products. A random sample from each test batch was analyzed in accordance with ASTM D422-63 (2007)e1, by GeoTesting Express, an AALA ISO/IEC 17025 accredited independent laboratory, prior to testing. The specified less-than (%-finer) values of the sample average were within the specifications listed in **Table 1**, as defined by the protocol. The D_{50} of the sample average was 69 microns. The PSD data of the samples are shown in **Table 2** and the corresponding curves are shown on **Figure 9**.

Table 2:
PSD Analyses of the 1-1000 micron Test Batches

Particle size	40 l/m/m^2	80 l/m/m^2	200 l/m/m^2	400 l/m/m^2	600 l/m/m^2	1000 l/m/m^2	1400 l/m/m^2	Average	CETV	QA / QC Compliant
(micron)	%-Finer	%-Finer	%-Finer	%-Finer	%-Finer	%-Finer	%-Finer	%-Finer	%-Finer	
1000	100	100	100	100	100	100	100	**100**	**100**	Y
500	95	97	95	95	96	96	95	**96**	**95**	Y
250	91	93	90	90	92	92	90	**91**	**90**	Y
150	77	74	76	74	79	73	74	**75**	**75**	Y
110	65	63	64	63	65	63	63	**64**	**60**	Y
75	53	51	51	51	54	51	50	**52**	**50**	Y
53	47	47	47	45	47	47	45	**46**	**45**	Y
20	35	36	36	35	36	37	35	**36**	**35**	Y
8	22	20	22	20	18	21	21	**21**	**20**	Y
5	16	14	16	14	13	15	15	**15**	**10**	Y
2	7	6	7	7	4	6	6	**6**	**5**	Y
D50	64	69	69	71	62	69	75	**69**	**75**	Y

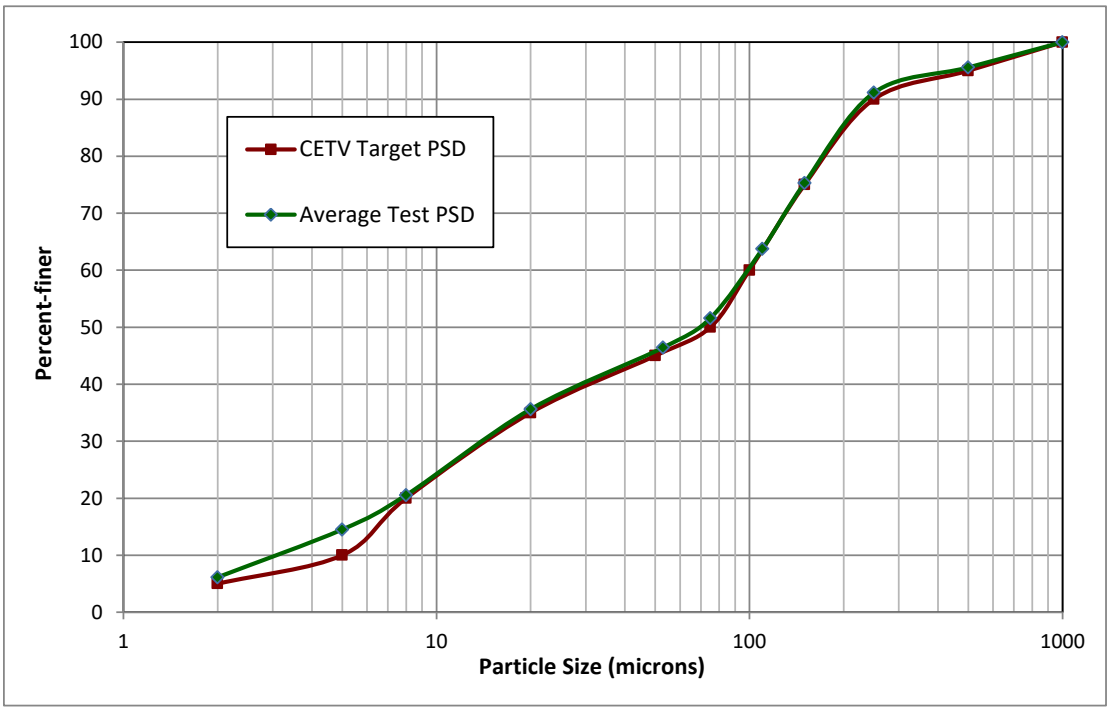


Figure 9: PSD Curves of Test Sediment Average and CETV Specifications

3.6 Data Analysis

The following equations and procedures were used in analyzing the data collected on the Hydroworks HS 4 test unit:

3.6.1 Hydraulics

The pressure cell was mounted at an elevation of 0.067m below the outlet pipe invert. This datum value was added to all measurements taken to calculate the water height above the invert. The system energy loss across the unit was determined by adding the velocity head to the elevation measurements taken in the inlet and outlet pipes.

The velocity head is defined by:

$$\mathbf{H = V^2/2g} \quad (1)$$

where,

H = velocity head (m), V = velocity (m/sec), and g = gravity (9.81 m/sec^2).

The velocity is defined by:

$$\mathbf{V = Q/A} \quad (2)$$

where,

V = velocity (m/sec), Q = flow (m^3/sec), and A = area (m^2).

The area in the partial pipe flow was calculated using:

$$\boldsymbol{A = 0.125(\theta - Sin\theta)D^2} \quad (3)$$

where,

A = area (m^2), θ = angle of inclusion (radians), and D = pipe diameter (m).

The angle of inclusion of the water surface (θ) was calculated using:

$$\boldsymbol{\theta = 2\pi - 2(ACos\left(\frac{y-\frac{D}{2}}{\frac{D}{2}}\right))} \quad (4)$$

where,

Y = measured water depth (m), and D = pipe diameter (m).

The system and pipe loss coefficient (Cd) was calculated using:

$$\boldsymbol{Cd = \frac{Q}{A(2g\Delta H)^{0.5}}} \quad (5)$$

where,

Q = flow (m^3/sec), A = area of insert outlet opening (m^2), g = gravity (9.81 m/s^2), and ΔH = energy loss across unit (m).

3.6.2 Removal Efficiency

The injected mass was calculated by:

$$\mathbf{M_{inj} = \Delta M - (\Delta M \text{ x } w)} \quad (6)$$

where,

M_{inj} = final mass of injected sediment (kg), ΔM = measured mass of injected sediment (kg), w = moisture content of sediment (%).

The sediment removal efficiency was calculated by:

$$\mathbf{\% \text{ Removal} = (M_c / M_{inj}) \text{ x } 100} \quad (7)$$

where,

M_c = captured mass (g), M_{inj} = total mass of injected sediment (g)

The background sample concentrations were calculated as follows:

$$\mathbf{BG \text{ (mg/L)} = \text{ Sediment Wt (mg) / Sample Volume (L)}} \quad (8)$$

The auger injector verification concentrations were determined by the following:

$$C_i = M_f / Q_{avg} \quad (9)$$

where,

C_i = influent concentration (mg/L), M_f = sediment mass feed (mg/min), Q_{avg} = average flow (L/min)

3.7 Laboratory Analysis

The following Test Methods were used to analyze the various dry and aqueous sediment and plastic samples:

- **Sediment Concentration**

  ASTM Designation: D 3977-97 (Re-approved 2013), "Standard Test Methods for Determining Sediment Concentration in Water Samples"

- **Sediment Moisture Content**

  ASTM Designation: D4959-07, "Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating"

- **Dry Sediment Particle Size Distribution**

  ASTM D422-63 (2007), "Standard Test Method for Particle Size Analysis of Soils"

- **Aqueous Sample Particle Size Distribution**

  ISO 13320-1 (2009) Particle Size Analysis – Laser Diffraction Methods

- **Light-Liquid Surrogate Plastic Density**

  ASTM D792-13 Method A "Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement"

3.7.1 Independent Analytical Laboratories

All dry sediment PSD analyses were performed by GeoTesting Express, Inc., Acton, Massachusetts. GeoTesting is an AALA ISO/IEC 17025 accredited independent laboratory

All aqueous PSD samples were analyzed by Microtrac, Inc. Particle Analysis Laboratory, York, Pennsylvania. Microtrac is an ISO 9001, ISO 13320 and ISO/IEC 17021 accredited laboratory.

3.8 Quality Assurance and Control

A Test Plan was submitted and approved outlining the testing methodologies and procedures used for conducting the verification tests. The Test Plan was followed throughout the testing.

All instruments were calibrated prior to testing and periodically checked throughout the test program. The instrumentation calibrations are shown in Appendix B.

3.8.1 Flow

The flow meters and Pressure Cells were calibrated in Alden's Calibration Laboratory, which is ISO 17025 accredited. A standard water manometer board and Engineers Rule were used to verify the computer measurement of each flow meter.

3.8.2 Sediment Injection

The sediment feed in g/min was verified with the use of a digital stop watch and 4000g calibrated digital scale. The tare weight of the sample container was recorded prior to collection of each sample. The final sediment concentrations were adjusted for moisture.

3.8.3 Sediment Concentration Analysis

All sediment concentration samples were processed at Alden in accordance with the ASTM D3977-97 (2013) analytical method. Gross sample weights were measured using a 4000g x 0.1g calibrated digital scale. The dried sample weights were measured with a calibrated 0.0001g analytical balance. The change in filter weight due to processing was accounted for by including three control filters with each test set. The average of the three values, which was typically (+/- 0.1mg), was used in the final concentration calculations.

Analytical accuracy was verified by preparing two blind control samples and processing using the ASTM method. The final calculated values were within 0.26% and 0.87% of the theoretical sample concentrations, with an average of 0.57% accuracy.

4.0 Results and Discussion

4.1 Sediment Removal Performance

Removal efficiency tests were conducted at the seven required flows of 40, 80, 200, 400, 600, 1000 and 1400 L/min/m^2. The target influent sediment concentration was 200 mg/l. The HS 4 treatment area was 1.17 m^2, resulting in target test flows of 47, 94, 234, 468, 702, 1170 and 1638 L/min, respectively. A summary of the calculated test parameters is shown in **Table 3**.

Table 3:
Calculated Test Parameter summary

TARGET FLOW	**L/m/m^2**	**40**	**80**	**200**	**400**	**600**	**1000**	**1400**
	L/min	**47**	**94**	**234**	**468**	**702**	**1170**	**1638**
	L/s	0.8	1.6	3.9	7.8	11.7	19.5	27.3
8X Treatment Unit Vol	**cu.m.**	10.0	10.2	10.8	11.1	11.4	12.2	13.1
Run Time	**(min)**	212.8	109.4	46.2	25.9	14.9	11.1	8.0
Sediment Quantity per Test	(Kg)	**12.0**	**12.0**	**12.0**	**12.0**	**12.0**	**12.0**	**12.0**
feed rate	(g/min)	**9.4**	**18.7**	**46.8**	**93.6**	**140.4**	**234.0**	**327.6**
Approx. Total Run Time	(min)	**1282**	**641**	**256**	**128**	**85**	**51**	**37**
	(hours)	21.4	10.7	4.3	2.1	1.4	0.9	0.6

The target and measured flow and temperature parameters are shown in **Table 4** and the injected sediment data is shown in **Table 5**.

Table 4:
Test Flow and Temperature Summary

Target Flow		**Actual Flow**	**Deviation from Target**	**Flow Measurement COV**	**Maximum Temperature**	**QA / QC Compliant**
L/min/m^2	L/min	L/min			Deg. C	
40	47	**46**	-0.7%	0.004	22.6	**Y**
80	94	**93**	-0.3%	0.002	20.1	**Y**
200	234	**233**	-0.4%	0.002	22.1	**Y**
400	468	**425**	-9.2%	0.001	18.8	**Y**
600	702	**736**	4.9%	0.002	23.8	**Y**
1000	1170	**1104**	-5.7%	0.004	19.9	**Y**
1400	1638	**1628**	-0.6%	0.002	18.8	**Y**

Table 5:
Injected Sediment Summary

Target Flow		Target Concentration	Injector Wts. Concentration	Injector Measurements	Mass/Volume Concentration	Total Injected Mass	QA / QC Compliant
L/min/m^2	L/min	mg/L	mg/L	COV	mg/L	kg	
40	47	200	202	0.01	**203**	**11.7**	**Y**
80	94	200	203	0.02	**196**	**11.9**	**Y**
200	234	200	200	0.00	**201**	**11.9**	**Y**
400	468	200	201	0.01	**194**	**12.3**	**Y**
600	702	200	199	0.00	**199**	**12.2**	**Y**
1000	1170	200	200	0.00	**197**	**12.4**	**Y**
1400	1638	200	200	0.00	**194**	**12.6**	**Y**

At the end of each test run, the captured sediment was collected and quantified from the inlet pipe and treatment unit. The calculated removal efficiencies ranged from 35.7% to 68.6% for the seven flows tested. The %-removal summary is shown in **Table 6**, with the corresponding removal curve shown on **Figure 10**. The %-removal curves for the collected regions are shown on **Figure 11**.

Table 6:
Removal Efficiency Captured Mass Summary

Flow	Tested Flow	Removal Efficiency	Inlet Pipe	Pretreatment Channel	Secondary Plate	Outlet Dispersion Plate	Collection Sump
L/min/m^2	L/min	%	%	%	%	%	%
40	**46**	**68.6**	**0.0**	**52.3**	**8.2**	**1.6**	**6.5**
80	**93**	**64.0**	**0.0**	**44.8**	**9.1**	**2.3**	**7.7**
200	**233**	**60.0**	**0.0**	**44.5**	**6.6**	**1.5**	**7.4**
400	**425**	**56.1**	**0.0**	**37.4**	**8.6**	**2.4**	**7.7**
600	**736**	**46.1**	**0.0**	**24.7**	**8.5**	**3.1**	**9.9**
1000	**1104**	**41.2**	**0.0**	**20.5**	**8.3**	**2.8**	**9.6**
1400	**1628**	**35.7**	**0.5**	**20.0**	**4.3**	**1.7**	**9.3**

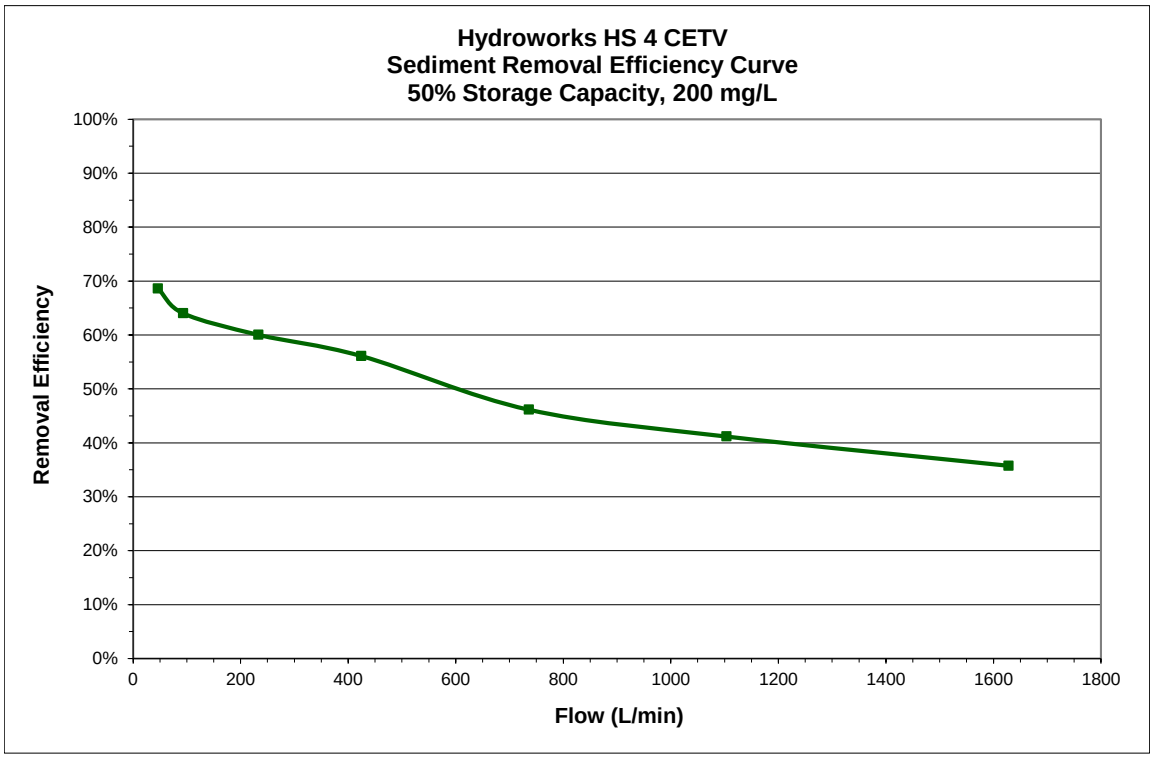


Figure 10: HS 4 Removal Efficiency Curve

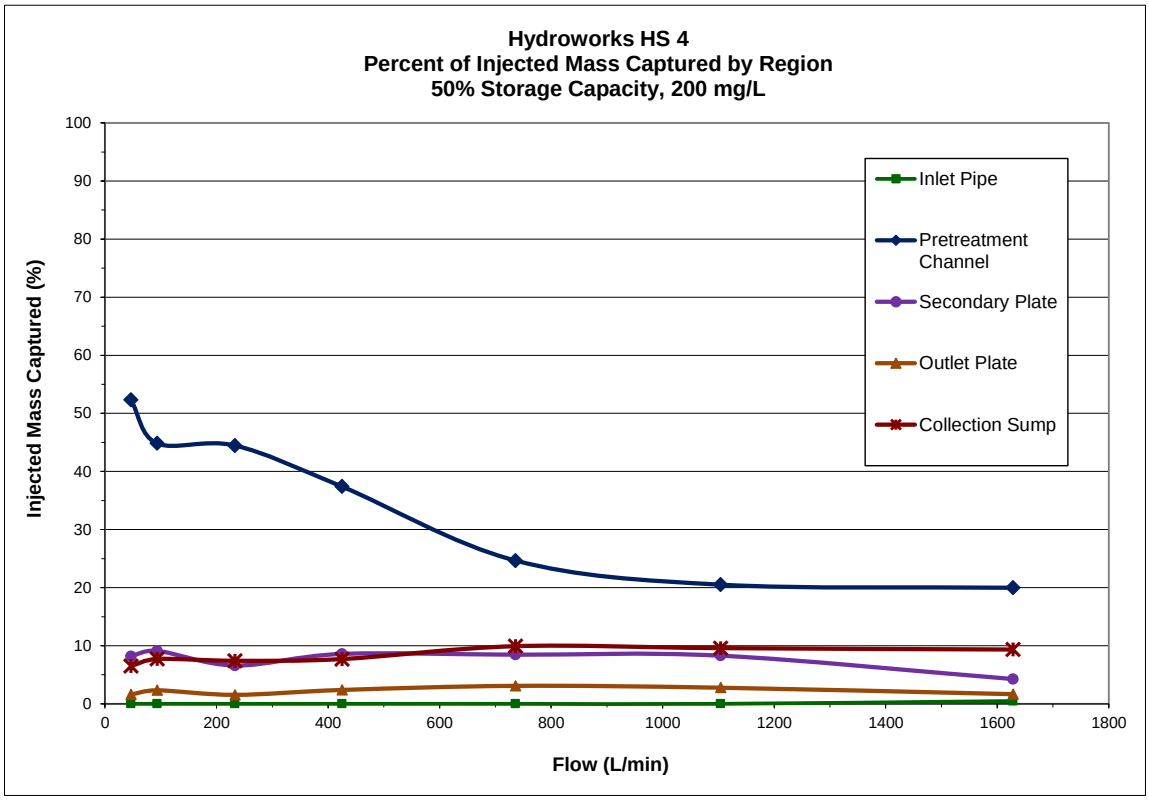


Figure 11: Captured Mass by Region

The particle size fractions of the captured sediment for all tests conducted are summarized in **Table 7.** The average test sediment data is included in column 2 as a benchmark. The percent of the size fractions of the injected sediment captured by the unit at each test flow is shown in **Table 8**. Some reported capture values are outside the absolute limit (+100%), or below the expected value. This is especially true at the larger size fractions (fewer particles) and those with small retained values. Factors that affect the accuracy of the data include how well the initial mix and collected sediment was blended and sampled, as well as accuracy and reporting of the PSD analyses. All sieve results were reported as whole numbers. Consequently, comparative values of 4.4% and 4.5% (2% difference) would be reported as 4% and 5% (25% difference).

PSD samples were analyzed for each deposition location only for the 40 L/min/m^2 test. For the remaining tests, the collected sediment from the sump, secondary plate and outlet plate were blended prior to taking a sample for analysis. A sample was collected from the pretreatment channel for each test. Details of the PSD data are presented in each removal test discussion section.

Table 7:
PSD Data Summary of Captured Sediment by Size Fraction

Particle Range (µm)	Average Test Sediment	40 L/min/m^2	80 L/min/m^2	200 L/min/m^2	400 L/min/m^2	600 L/min/m^2	1000 L/min/m^2	1400 L/min/m^2
>1000	0%	0%	0%	0%	0%	0%	0%	0%
500-1000	4%	4%	6%	5%	3%	4%	4%	1%
250-500	4%	4%	5%	5%	3%	5%	4%	2%
150-250	16%	15%	14%	12%	12%	12%	11%	11%
105-150	12%	11%	12%	13%	13%	11%	10%	10%
75-105	12%	12%	9%	10%	11%	7%	7%	6%
53-75	5%	5%	6%	7%	7%	4%	3%	3%
20-53	11%	8%	6%	5%	4%	2%	1%	1%
8-20	15%	5%	4%	2%	1%	0%	0%	0%
5-8	6%	1%	0%	0%	0%	0%	0%	0%
2-5	8%	1%	0%	0%	0%	0%	0%	0%

Table 8:
Injected Sediment Captured by Size Fraction at Each Flow

Particle Range (µm)	**40** L/min/m^2	**80** L/min/m^2	**200** L/min/m^2	**400** L/min/m^2	**600** L/min/m^2	**1000** L/min/m^2	**1400** L/min/m^2
>500	73%	194%	98%	67%	111%	103%	26%
250-500	100%	135%	92%	64%	115%	98%	48%
150-250	110%	75%	89%	72%	89%	60%	69%
105-150	94%	109%	107%	119%	78%	99%	91%
75-105	96%	76%	79%	95%	68%	54%	46%
53-75	87%	142%	170%	118%	56%	69%	65%
20-53	71%	54%	46%	44%	19%	14%	10%
8-20	38%	23%	15%	8%	2%	2%	2%
5-8	13%	6%	1%	1%	0%	0%	0%
2-5	8%	0%	0%	0%	0%	0%	0%

4.1.1 40 L/min/m^2 (46.7 L/min)

The test was conducted over a period of 3 days to meet the minimum 11.3 kg feed requirement. The total test duration was 21.4 hours. The test flow was averaged and recorded every 20 seconds throughout the test. The average recorded test flow for each day was 46.3, 46.5 and 46.6 L/min, respectively. The overall average was 46.5 L/min, with a COV of 0.004. The recorded temperature for the full test ranged from 22.1 to 22.6 degrees C.

The injection feed rate of 9.3 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 197 mg/L to 206 mg/L, with a mean of 202 mg/L and COV of 0.01. The total mass injected into the unit was 11.693 kg. The calculated mass-flow concentration for the test was 203 mg/L. The measured influent concentration data for the complete test is shown on **Figure 12**.

Twenty-four (24) background concentrations samples were collected throughout the test and ranged from 0.9 to 3.0 mg/L. The background curve is shown on **Figure 13**.

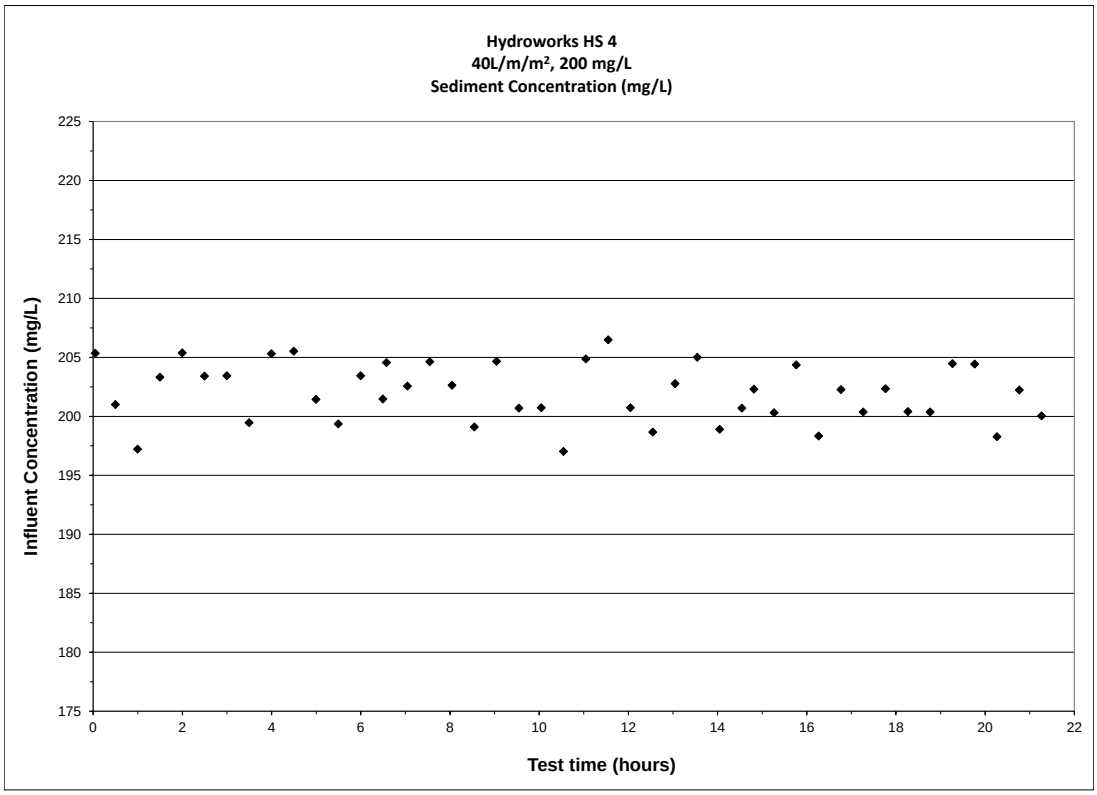


Figure 12: 40 L/min/m² Measured Influent Concentrations

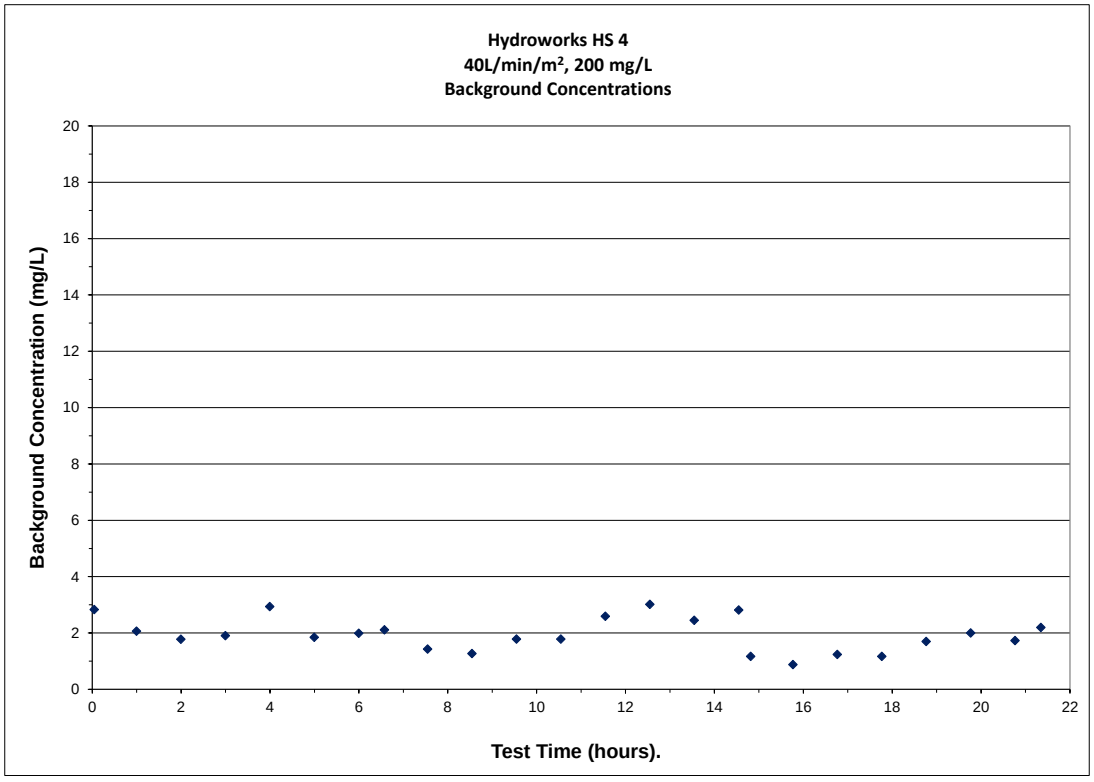


Figure 13: 40 L/min/m² Measured Background Concentrations

The total collected mass from the unit was 8.023 kg, resulting in a removal efficiency of 68.6%. The mass collected from each settling region was quantified based on the % of total captured mass, as well as % of total injected mass. The resulting data is shown in **Table 9**.

Table 9:
40 L/min/m² Breakdown of Captured Mass by Region

	Pretreatment Channel	Secondary Plate	Sump	Outlet Dispersion Plate	Total
mass (g)	6116.5	958.4	760.3	188.1	8023.3
% of captured	76.2%	11.9%	9.5%	2.3%	100.0%
% of Injected	52.3%	8.2%	6.5%	1.6%	68.6%

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 10** and the %-finer curves are shown on **Figure 14**.

Table 10:
40 L/min/m² PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Pretreatment Channel	Secondary Plate	Collection Sump	Outlet Dispersion Plate	Total Retained
500-1000	5%	4%	0%	0%	0%	4%
250-500	4%	4%	0%	0%	0%	4%
150-250	14%	15%	0%	0%	0%	15%
100-150	12%	10%	1%	1%	0%	11%
75-100	12%	9%	2%	1%	0%	12%
50-75	6%	4%	1%	0%	0%	5%
20-50	12%	3%	2%	2%	1%	8%
8-20	14%	1%	2%	2%	1%	5%
5-8	6%	0%	0%	0%	0%	1%
2-5	9%	0%	0%	0%	0%	1%

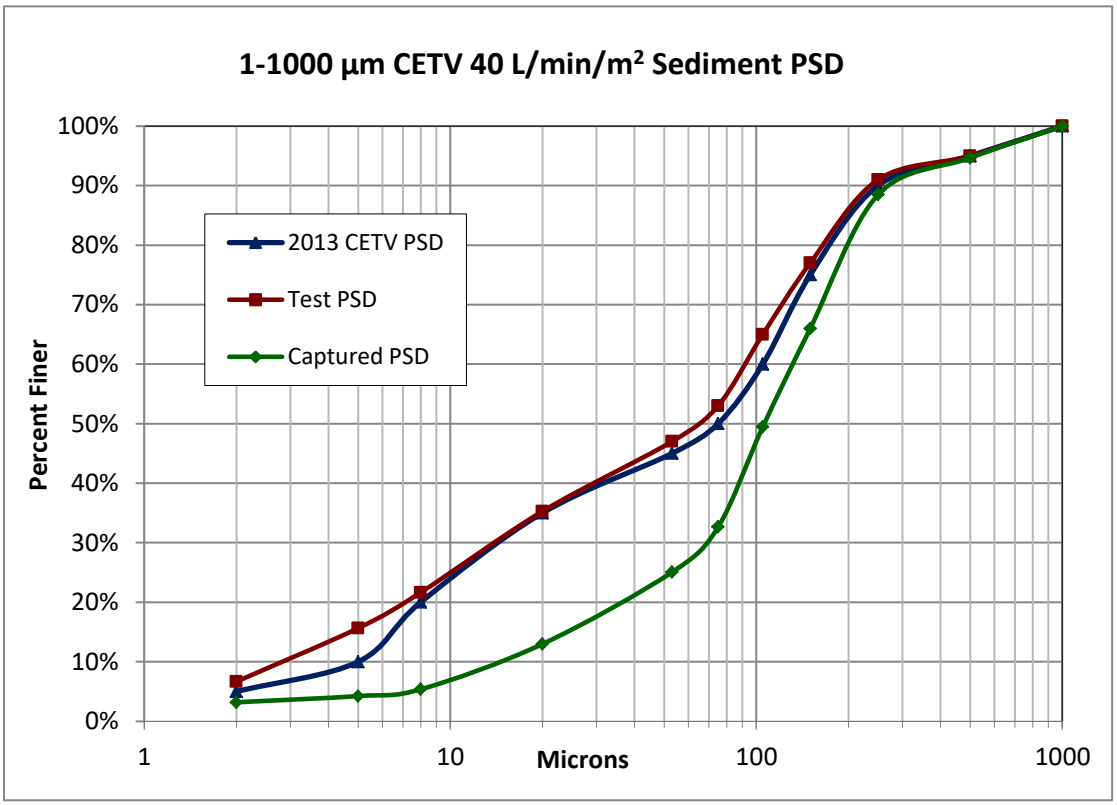


Figure 14: 40 L/min/m² %-Finer Curves of Test Sediment and Total Captured Mass

4.1.2 80 L/min/m² (93.4 L/min)

The test was conducted over a period of 2 days to meet the minimum 11.3 kg feed requirement. The total test duration was 11.1 hours. The test flow was averaged and recorded every 20 seconds throughout the test. The average recorded test flow for each day was 93.4 and 93.3 L/min, respectively. The overall average was 93.4 L/min, with a maximum COV of 0.002. The recorded temperature for the full test ranged from 19.6 to 20.1 degrees C.

The injection feed rate of 18.7 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 198 mg/L to 208 mg/L, with a mean of 203 mg/L and COV of 0.02. The total mass injected into the unit was 11.930 kg. The calculated mass-flow concentration for the test was 196 mg/L. The measured influent concentration data for the complete test is shown on **Figure 15**.

Thirteen (13) background concentrations samples were collected throughout the test and ranged from 1.3 to 5.0 mg/L. The background curve is shown on **Figure 16**.

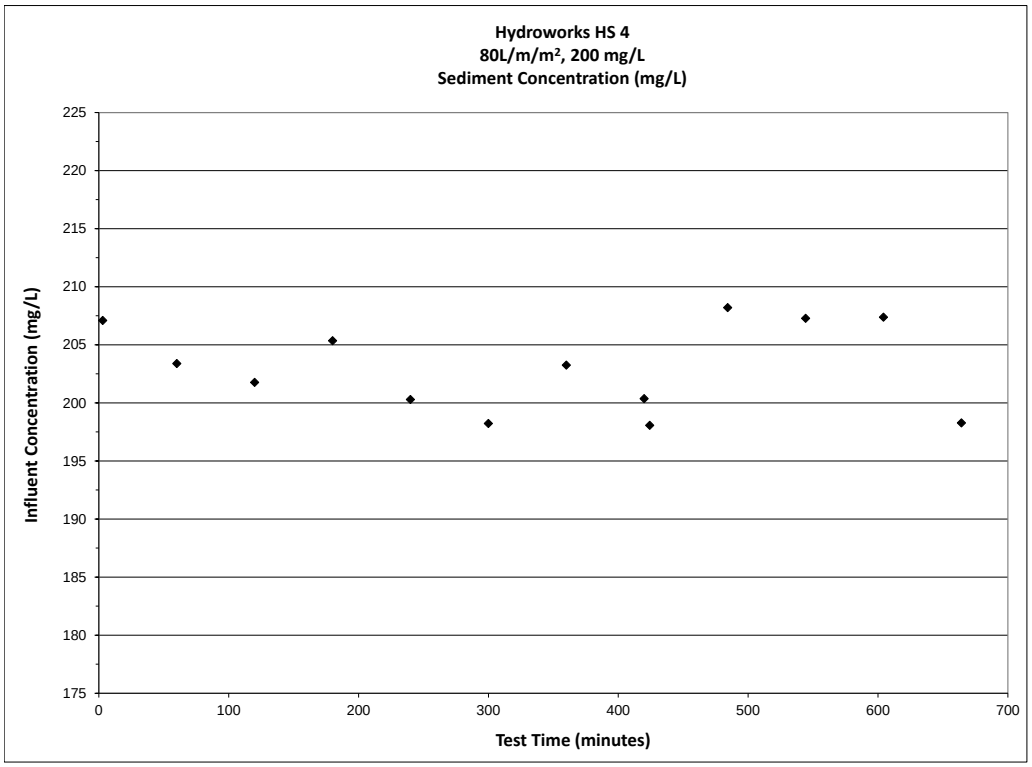


Figure 15: 80 L/min/m² Measured Influent Concentrations

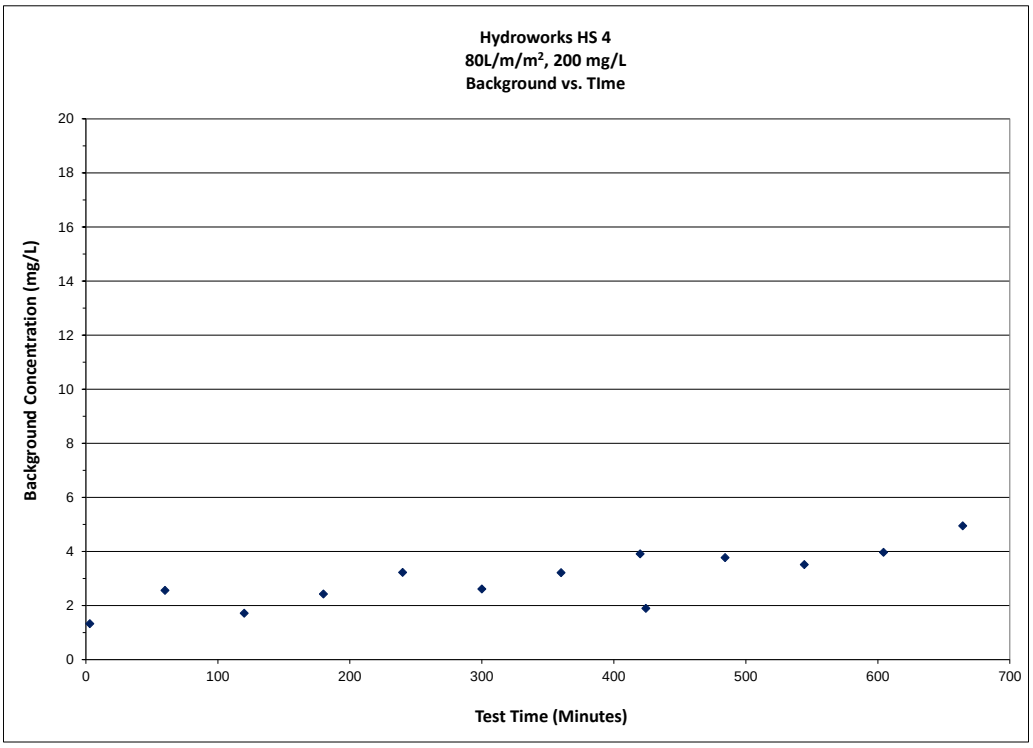


Figure 16: 80 L/min/m² Measured Background Concentrations

The total mass collected from the unit was 7.636 kg, resulting in a removal efficiency of 64.0

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 11** and the %-finer curves are shown on **Figure 17**.

Table 11:
80 L/min/m² PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Total Retained
500-1000	3%	6%
250-500	4%	5%
150-250	19%	14%
100-150	11%	12%
75-100	12%	9%
50-75	4%	6%
20-50	11%	6%
8-20	16%	4%
5-8	6%	0%
2-5	8%	0%

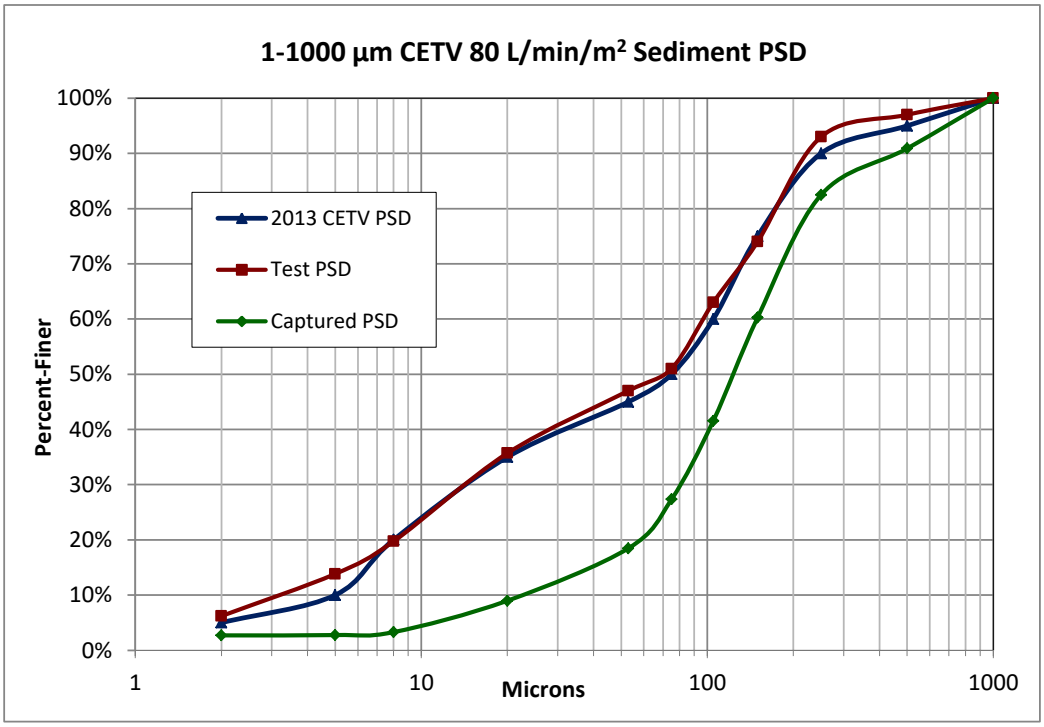


Figure 17: 80 L/min/m² Percent-Finer Curves of Test Sediment and Total Captured Mass

4.1.3 200 L/min/m^2 (233.4 L/min)

The test was conducted over a duration of 265 minutes to meet the minimum 11.3 kg feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 233.2 L/min, with a COV of 0.002. The maximum recorded temperature for the full test was 22.1 degrees C.

The injection feed rate of 46.8 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 199 mg/L to 202 mg/L, with a mean of 200 mg/L and COV of 0.00. The total mass injected into the unit was 11.946 kg. The calculated mass-flow concentration for the test was 201 mg/L. The measured influent concentration data for the complete test is shown on **Figure 18**.

Eight (8) background concentrations samples were collected throughout the test and ranged from 1.7 to8.1 mg/L. The background curve is shown on **Figure 19**.

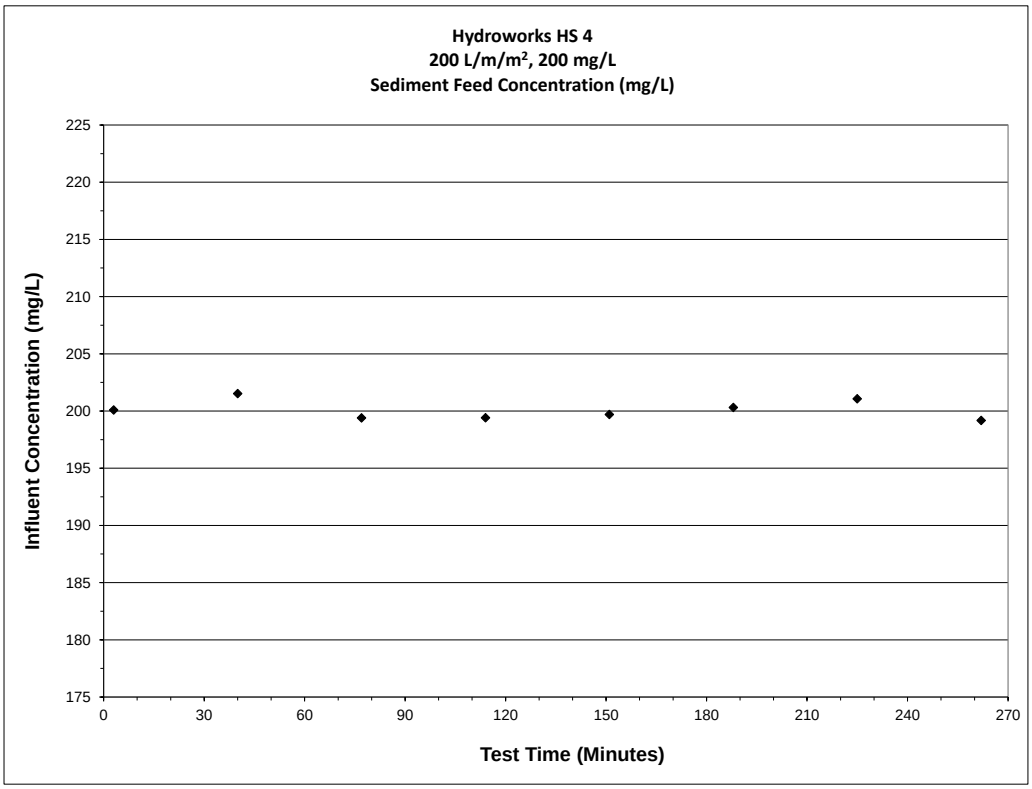


Figure 18: 200 L/min/m^2 Measured Influent Concentrations

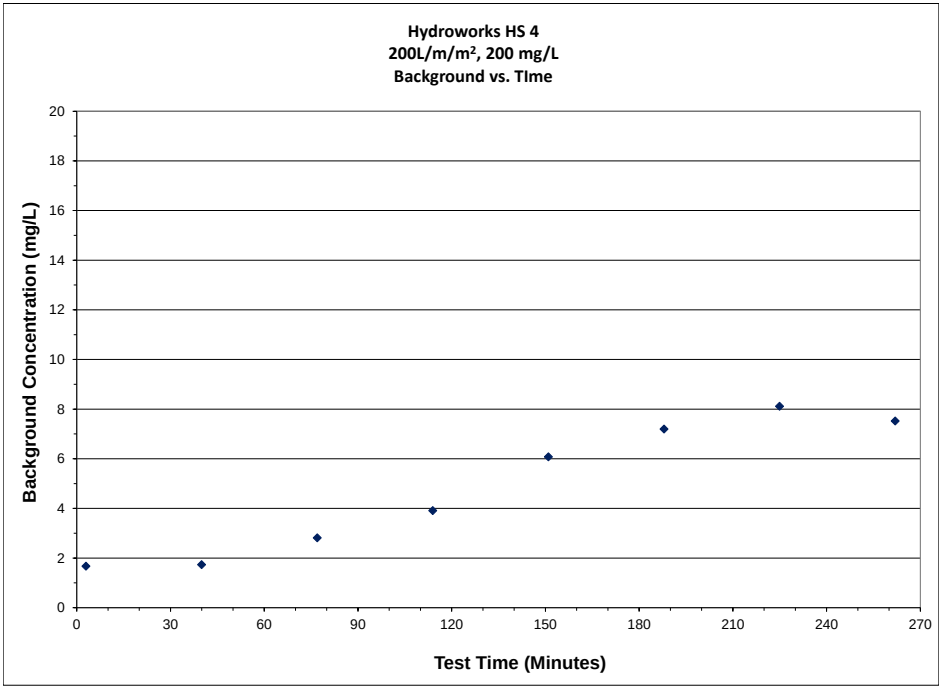


Figure 19: 200 L/min/m² Measured Background Concentrations

The total mass collected from the unit was 7.170 kg, resulting in a removal efficiency of 60.0%.

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 12** and the %-finer curves are shown on **Figure 20**.

Table 12:
200 L/min/m² PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Total Retained
500-1000	5%	5%
250-500	5%	5%
150-250	14%	12%
100-150	12%	13%
75-100	13%	10%
50-75	4%	7%
20-50	11%	5%
8-20	14%	2%
5-8	6%	0%
2-5	9%	0%

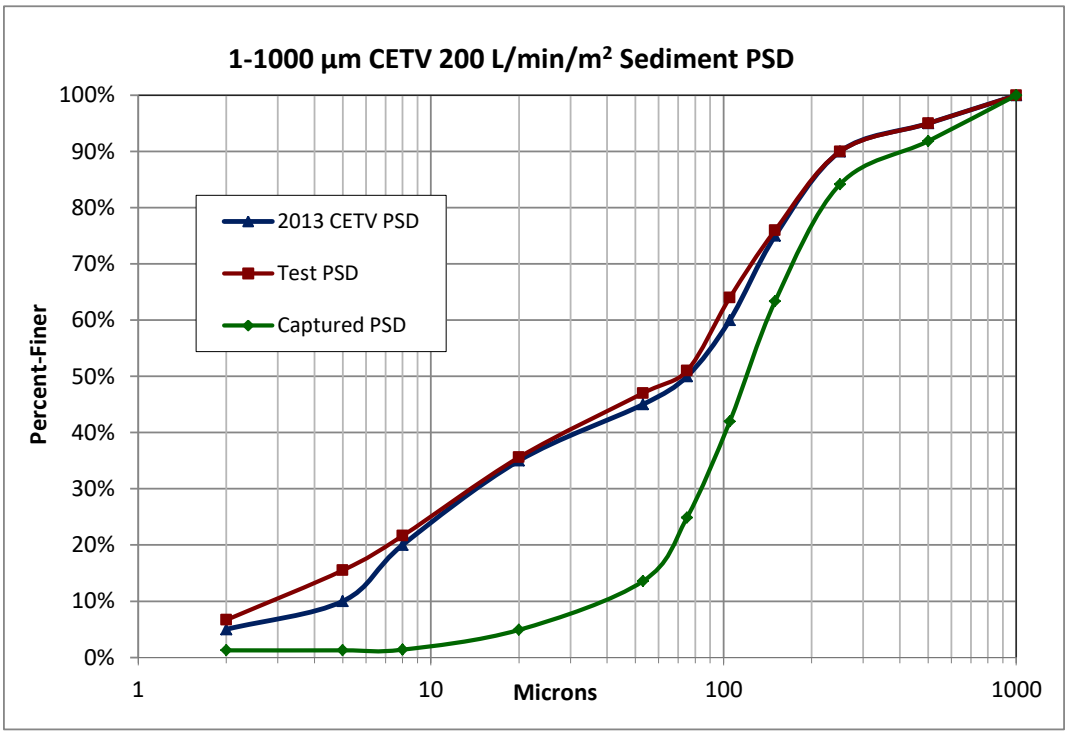


Figure 20: 200 L/min/m² Percent-Finer Curves of Test Sediment and Total Captured Mass

4.1.4 400 L/min/m² (466.8 L/min)

The test was conducted over a duration of 157 minutes to meet the minimum 11.3 kg feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 424.8 L/min, with a COV of 0.001. This flow is lower than the target of 467 L/min, but is within the 10% tolerance stated in the protocol. The maximum recorded temperature for the full test was 18.8 degrees C.

The injection feed rate of 84.8 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 199 mg/L to 202 mg/L, with a mean of 201 mg/L and COV of 0.01. The total mass injected into the unit was 12.345 kg. The calculated mass-flow concentration for the test was 194 mg/L. The measured influent concentration data for the complete test is shown on **Figure 21**.

Eight (8) background concentrations samples were collected throughout the test and ranged from 1.4 to8.9 mg/L. The background curve is shown on **Figure 22**.

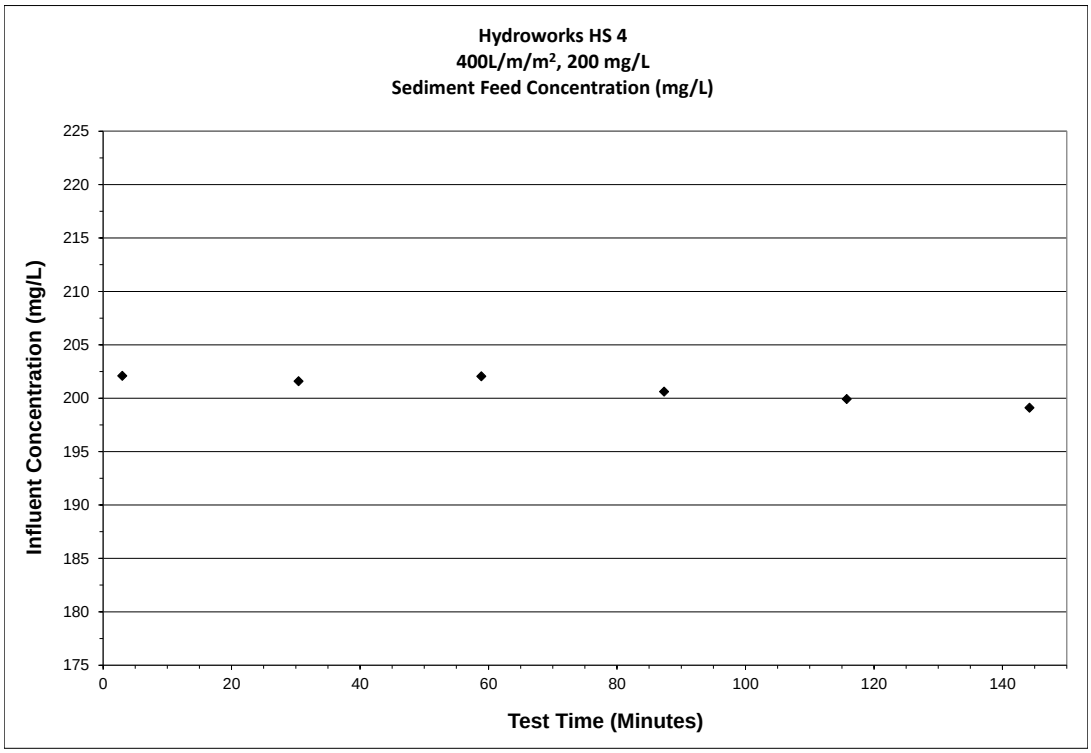


Figure 21: 400 L/min/m² Measured Influent Concentrations

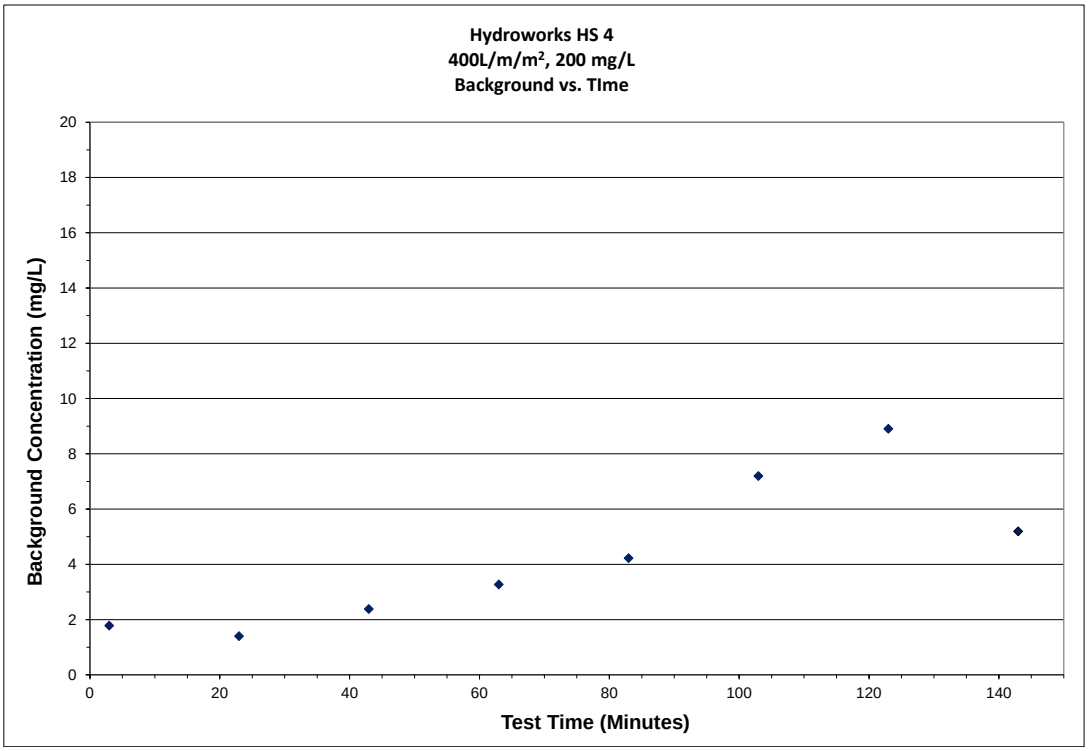


Figure 22: 400 L/min/m² Measured Background Concentrations

The total mass collected from the unit was 6.924 kg, resulting in a removal efficiency of 56.1%.

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 13** and the %-finer curves are shown on **Figure 23**.

Table 13:
400 L/min/m² PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Total Retained
500-1000	5%	3%
250-500	5%	3%
150-250	16%	12%
100-150	11%	13%
75-100	12%	11%
50-75	6%	7%
20-50	10%	4%
8-20	15%	1%
5-8	7%	0%
2-5	7%	0%

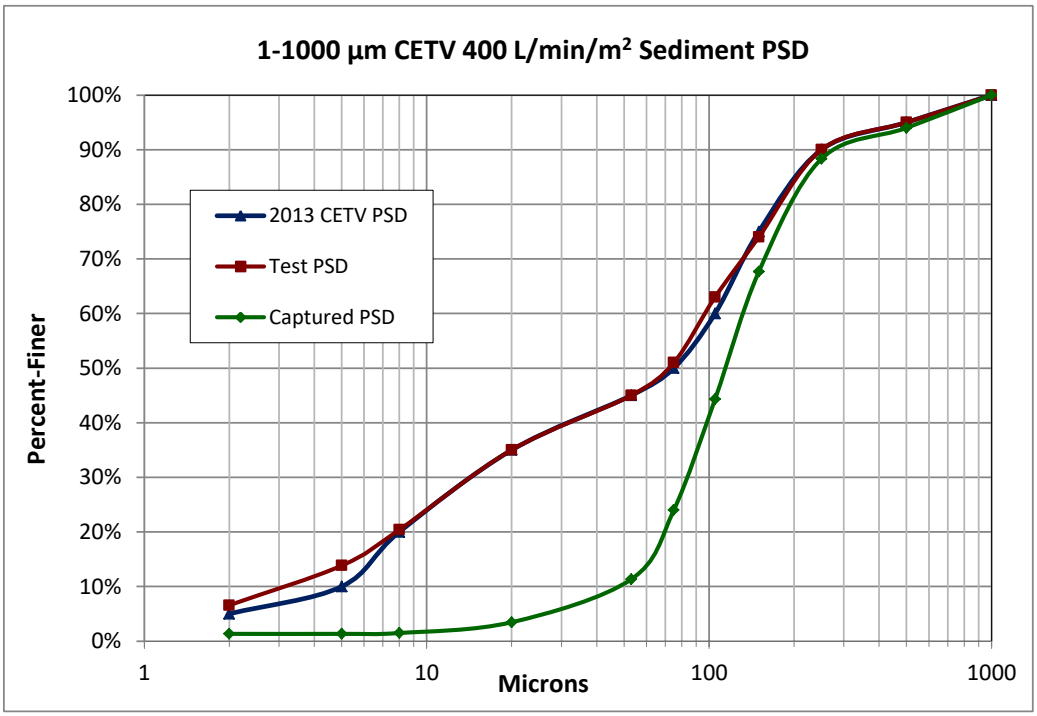


Figure 23: 400 L/min/m² Percent-Finer Curves of Test Sediment and Total Captured Mass

4.1.5 600 L/min/m² (700.1 L/min)

The test was conducted over a duration of 90 minutes to meet the minimum 11.3 kg feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 736.2 L/min, with a COV of 0.002. The maximum recorded temperature for the full test was 23.8 degrees C.

The injection feed rate of 147.6 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 199 mg/L to 200 mg/L, with a mean of 199 mg/L and COV of 0.00. The total mass injected into the unit was 12.177 kg. The calculated mass-flow concentration for the test was 199 mg/L. The measured influent concentration data for the complete test is shown on **Figure 24**.

Eight (8) background concentrations samples were collected throughout the test and ranged from 0.1 to 2.6 mg/L. The background curve is shown on **Figure 25.**

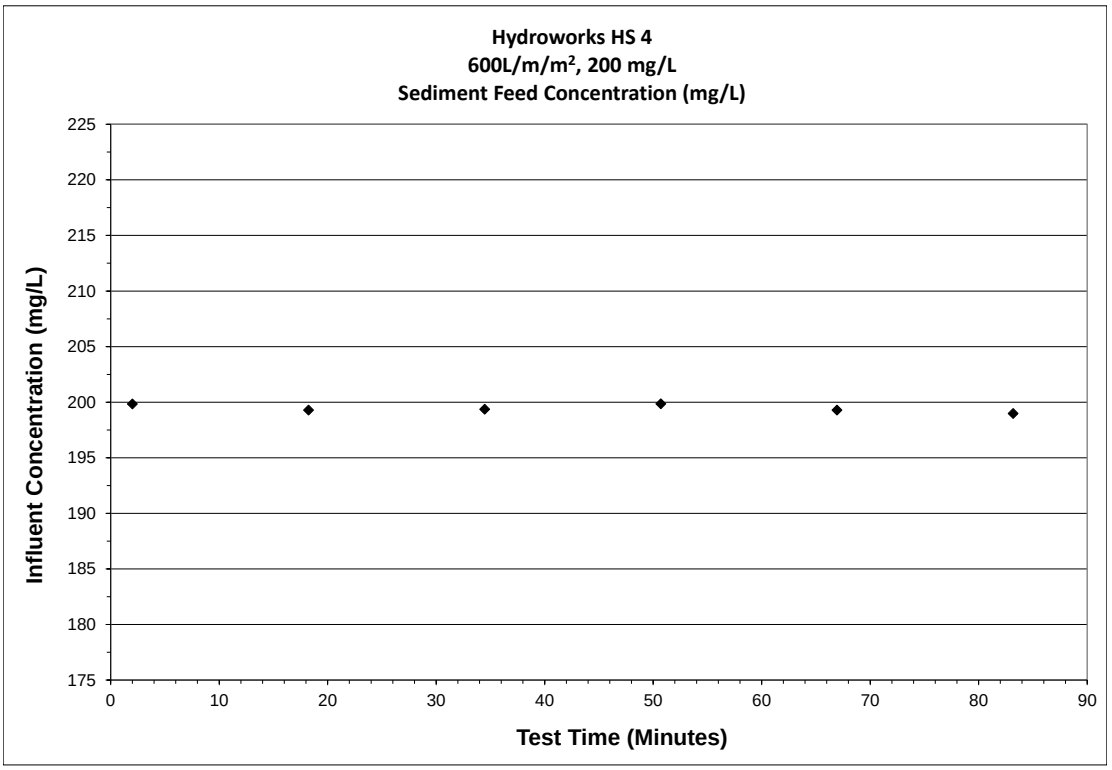


Figure 24: 600 L/min/m² Measured Influent Concentrations

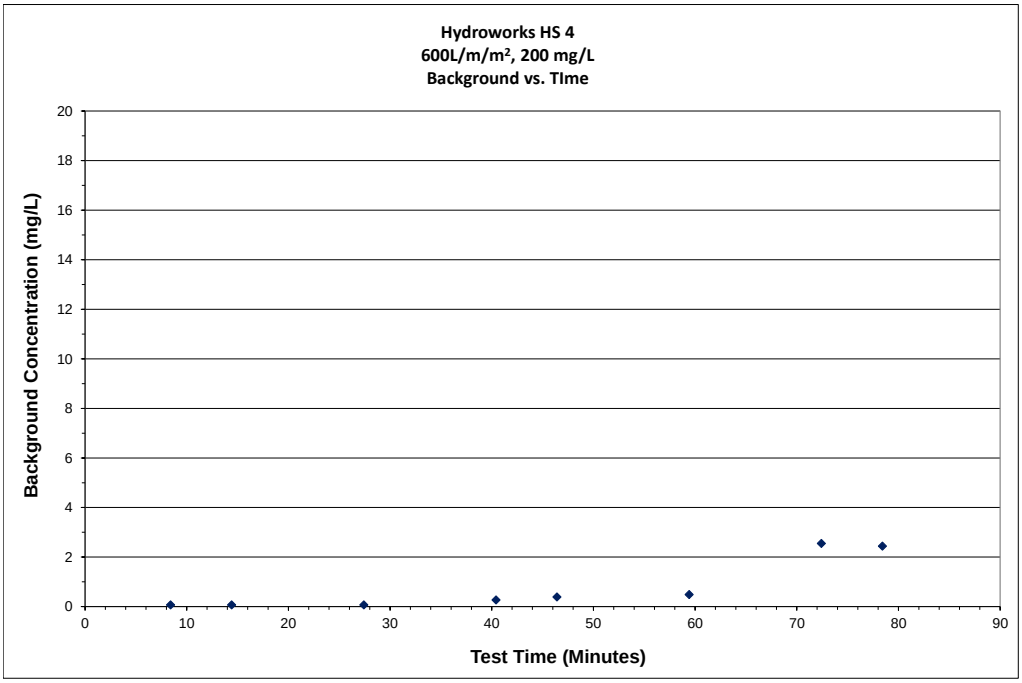


Figure 25: 600 L/min/m² Measured Background Concentrations

The total mass collected from the unit was 5.618 kg, resulting in a removal efficiency of 46.1%.

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 14** and the %-finer curves are shown on **Figure 26**.

Table 14:
600 L/min/m² PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Total Retained
500-1000	4%	4%
250-500	4%	5%
150-250	13%	12%
100-150	14%	11%
75-100	11%	7%
50-75	7%	4%
20-50	11%	2%
8-20	18%	0%
5-8	5%	0%
2-5	8%	0%

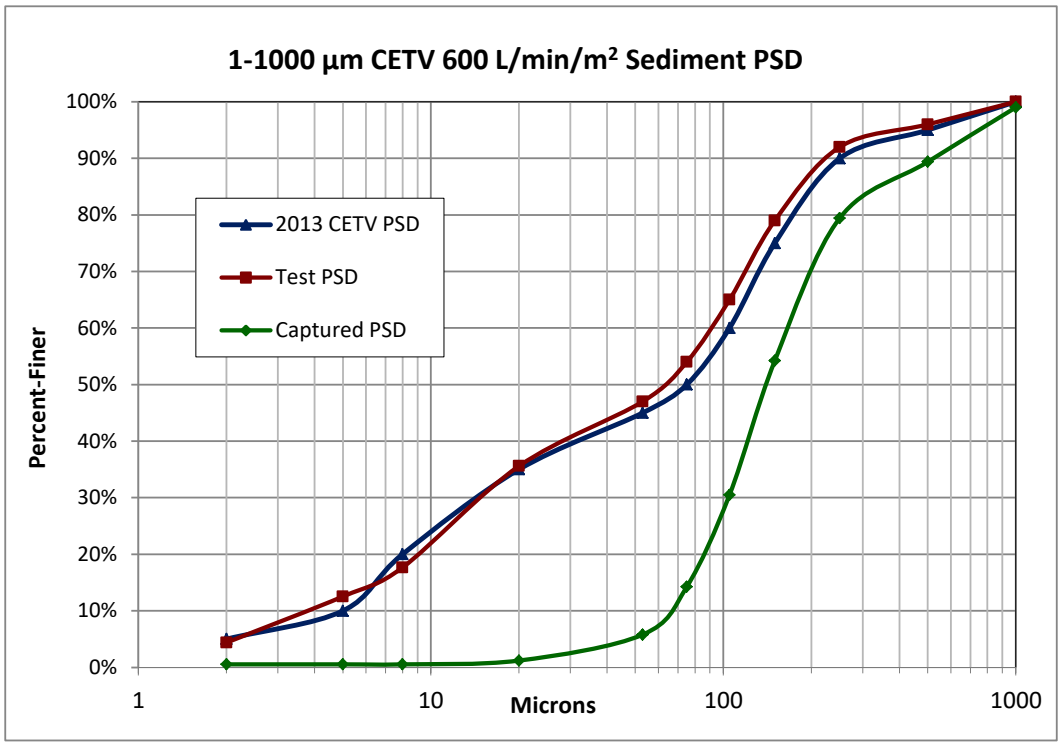


Figure 26: 600 L/min/m² Percent-Finer Curves of Test Sediment and Total Captured Mass

4.1.6 1000 L/min/m² (1167 L/min)

The test was conducted over a duration of 65 minutes to meet the minimum 11.3 kg feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 1104 L/min, with a COV of 0.004. The maximum recorded temperature for the full test was 19.9 degrees C.

The injection feed rate of 220.8 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 199 mg/L to 200 mg/L, with a mean of 200 mg/L and COV of 0.00. The total mass injected into the unit was 12.372 kg. The calculated mass-flow concentration for the test was 197 mg/L. The measured influent concentration data for the complete test is shown on **Figure 27**.

Eight (8) background concentrations samples were collected throughout the test and ranged from 1.2 to 7.6 mg/L. The background curve is shown on **Figure 28**.

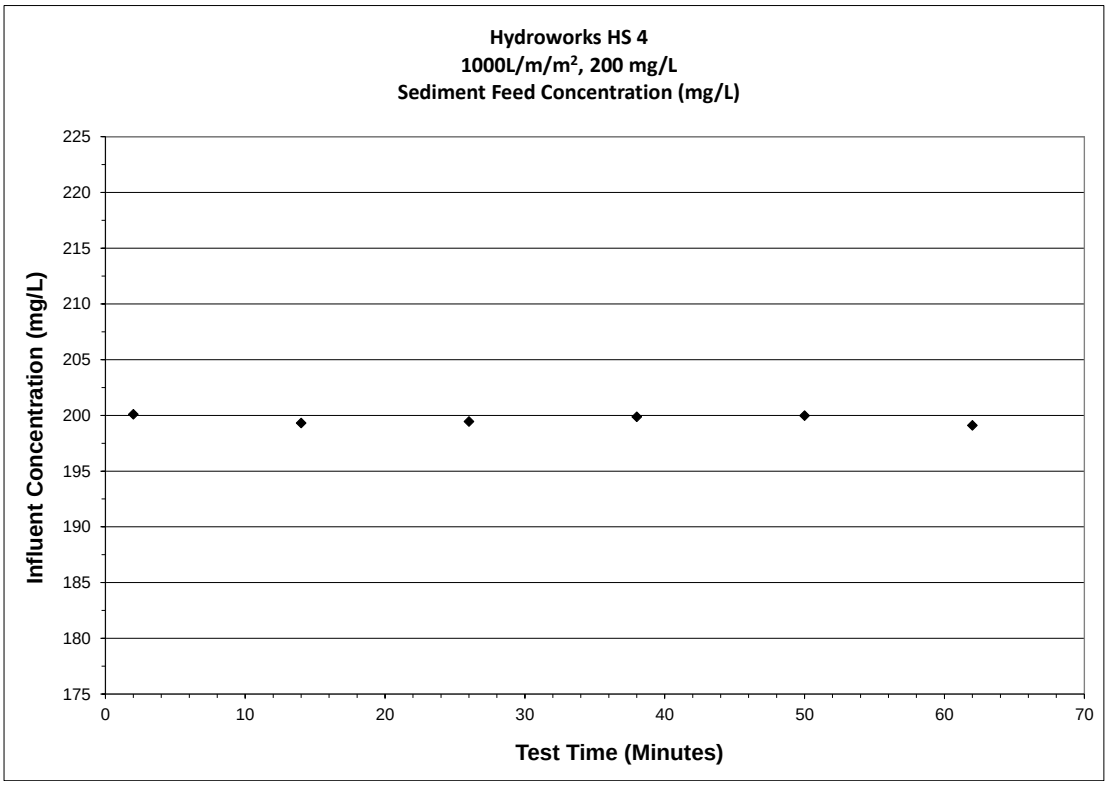


Figure 27: 1000 L/min/m² Measured Influent Concentrations

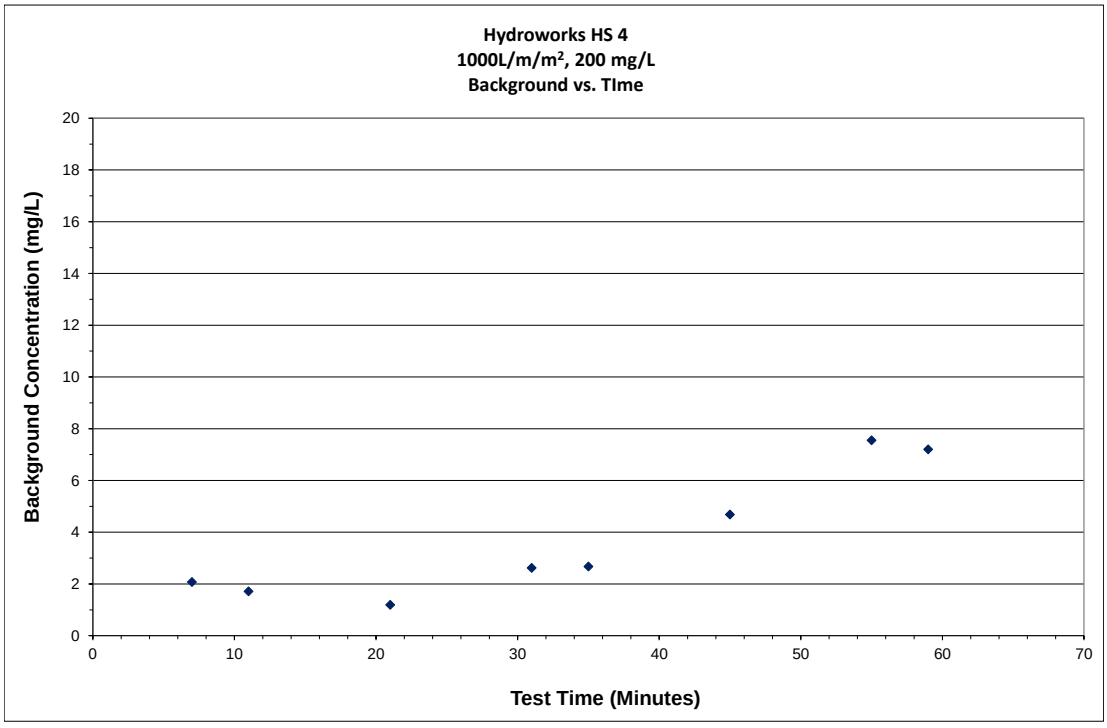


Figure 28: 1000 L/min/m² Measured Background Concentrations

The total mass collected from the unit was 5.093 kg, resulting in a removal efficiency of 41.2%.**4**

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 15** and the %-finer curves are shown on **Figure 29**.

Table 15:
1000 L/min/m² PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Total Retained
500-1000	4%	4%
250-500	4%	4%
150-250	19%	11%
100-150	10%	10%
75-100	12%	7%
50-75	4%	3%
20-50	10%	1%
8-20	16%	0%
5-8	6%	0%
2-5	9%	0%

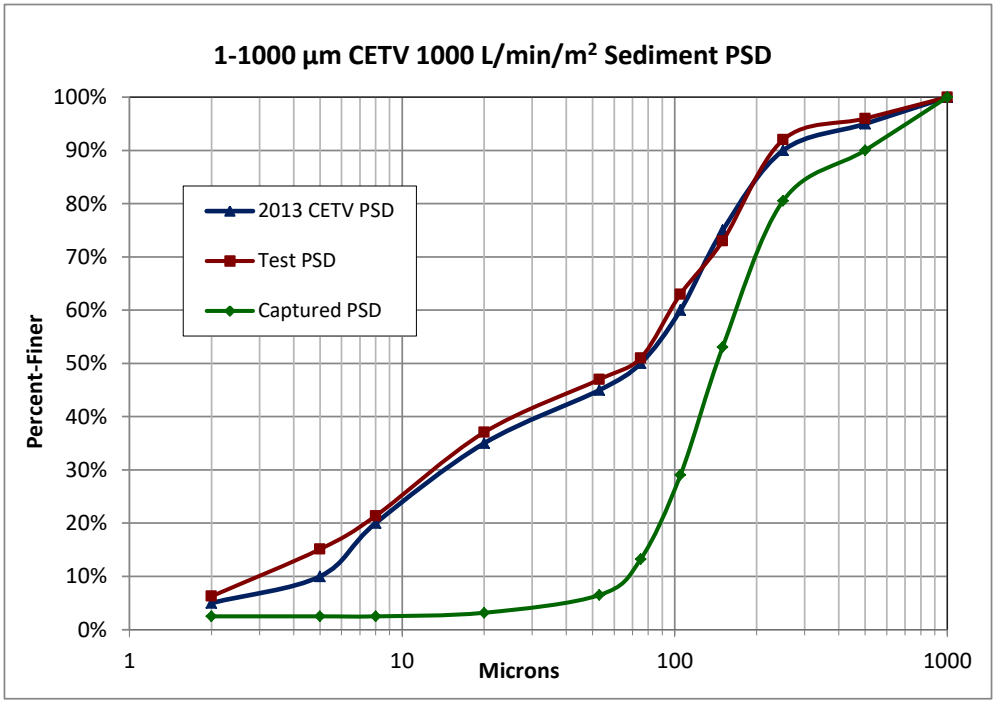


Figure 29: 1000 L/min/m² Percent-Finer Curves of Test Sediment and Total Captured Mass

4.1.7 1400 L/min/m^2 (1634 L/min)

The test was conducted over a duration of 45 minutes to meet the minimum 11.3 kg feed requirement. The test flow was averaged and recorded every 5 seconds throughout the test. The average recorded test flow was 1628 L/min, with a COV of 0.002. The maximum recorded temperature for the full test was 18.8 degrees C.

The injection feed rate of 327.6 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 199 mg/L to 200 mg/L, with a mean of 200 mg/L and COV of 0.00. The total mass injected into the unit was 12.586 kg. The calculated mass-flow concentration for the test was 194 mg/L. The measured influent concentration data for the complete test is shown on **Figure 30.**

Eight (8) background concentrations samples were collected throughout the test and ranged from 0.3 to 4.0 mg/L. The background curve is shown on **Figure 31**.

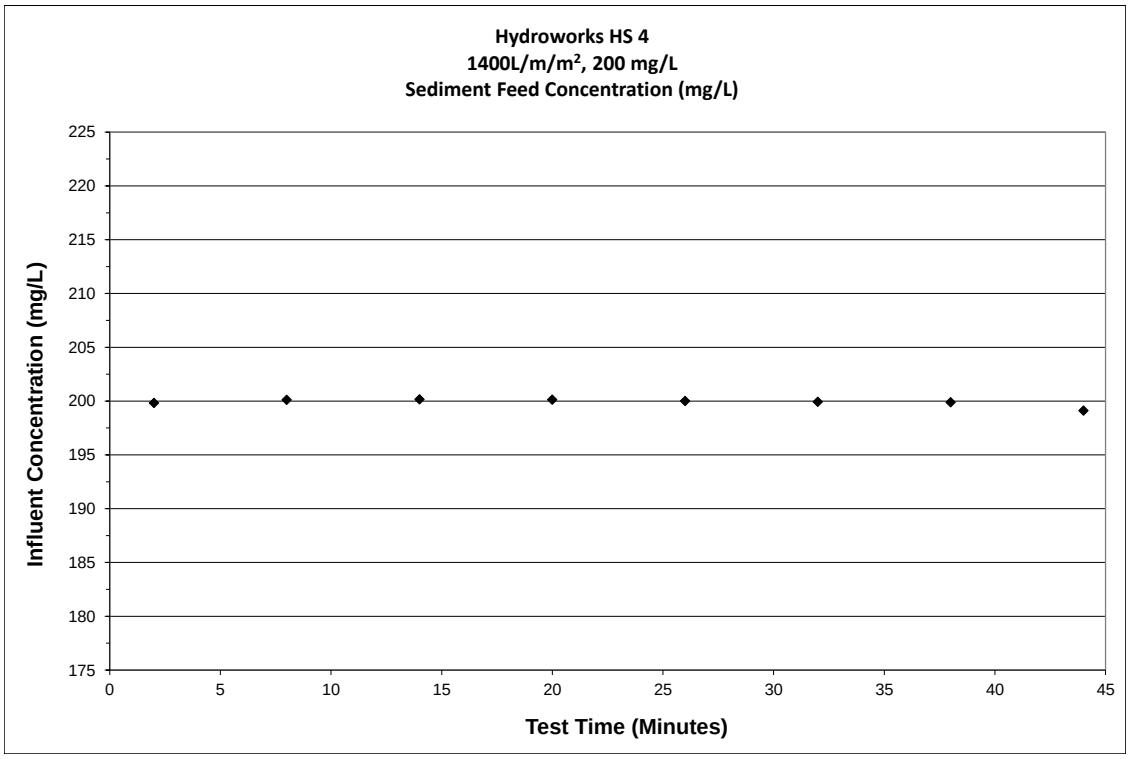


Figure 30: 1400 L/min/m^2 Measured Influent Concentrations

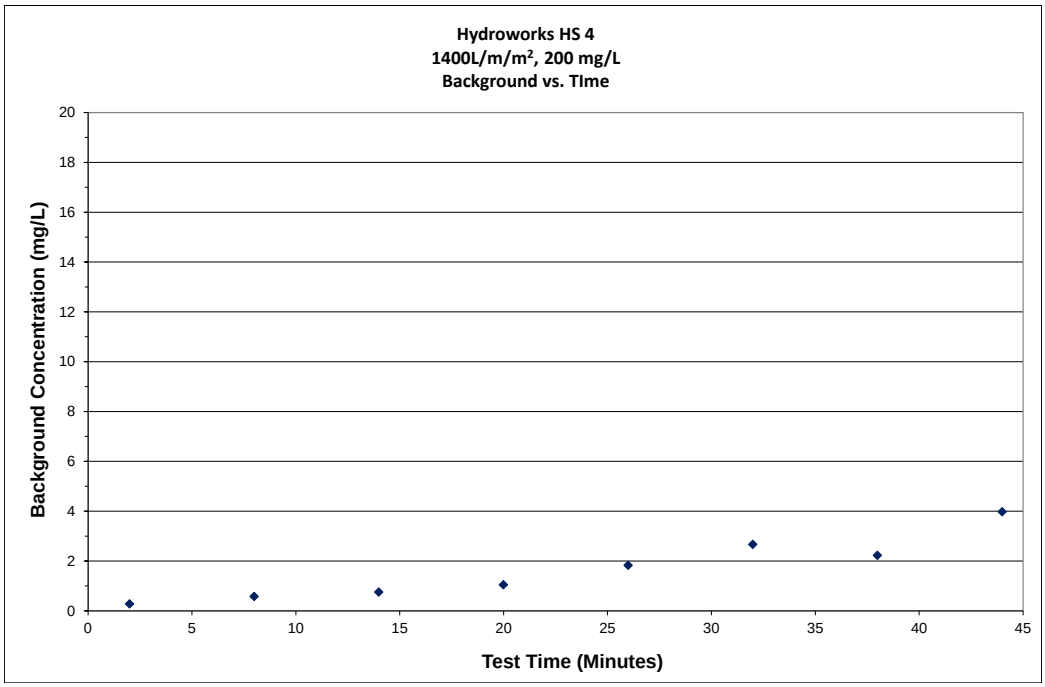


Figure 31: 1400 L/min/m^2 Measured Background Concentrations

The total mass collected from the unit was 4.498 kg, resulting in a removal efficiency of 35.7%.

Particle Size Distribution

A well-mixed random dry sample from the test batch was collected and analyzed for PSD by the independent analytical laboratory. A well-mixed dry sediment sample from each capture region was analyzed for PSD. The PSD breakdown of the percent of injected mass captured within each region is shown in **Table 16** and the %-finer curves are shown on **Figure 32**.

Table 16:
1400 L/min/m^2 PSD Breakdown of Injected Mass Captured

PSD Size Fraction microns	Test Sediment PSD	Total Retained
500-1000	5%	1%
250-500	5%	2%
150-250	16%	11%
100-150	11%	10%
75-100	13%	6%
50-75	5%	3%
20-50	10%	1%
8-20	14%	0%
5-8	6%	0%
2-5	9%	0%

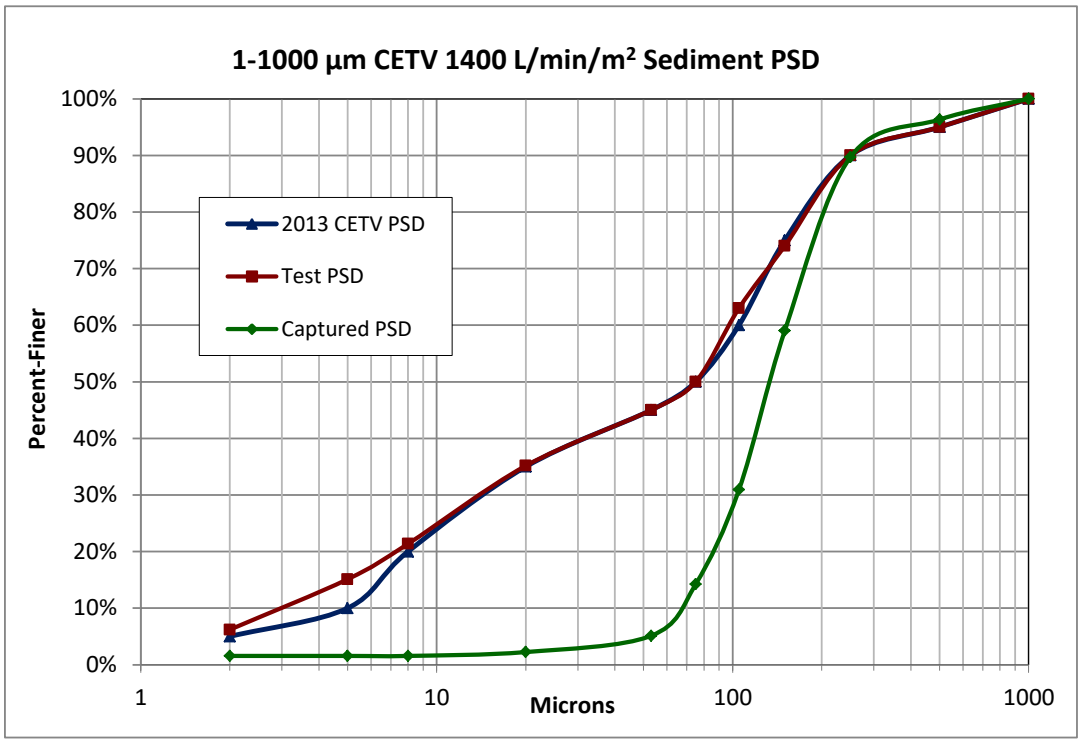


Figure 32: 1400 L/min/m² Percent-Finer Curves of Test Sediment and Total Captured Mass

4.1.8 Perforated Secondary Plate Test 600 L/min/m² (700.1 L/min)

The certification tests resulted in sediment deposition on the solid secondary plate, which consequently required the plate to be preloaded for scour testing. Taking into account the close proximity of the plate to the collection sump, as well as our knowledge of sediment transport, it is expected that the deposited sediment would have settled in the lower sump, with no impact on removal efficiency, if the plate was removed. Since the purpose of the plate is to protect the sump from potential scour, the plate was replaced with a 32% open-area perforated plate of the same geometry (size and orientation). The plate would provide a means for the sediment to deposit in the sump, while still providing a sufficient level of protection against scour. A repeat test was conducted at 600 L/min/m² to confirm that the new plate would produce the same flow and removal characteristics as the solid plate. PSD analyses were not conducted, being unnecessary to achieve the goal of the test.

The test was conducted over a duration of 90 minutes to meet the minimum 11.3 kg feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 740.9 L/min, with a COV of 0.003. The maximum recorded temperature for the full test was 16.1 degrees C.

The injection feed rate of 147.6 g/min was verified by collecting timed weight samples from the injector. The measured influent injection concentrations for the full test ranged from 199 mg/L to 200 mg/L, with a mean of 199 mg/L and COV of 0.00. The total mass injected into the unit was 12.035 kg. The

calculated mass-flow concentration for the test was 194 mg/L. The measured influent concentration data for the complete test is shown on **Figure 24**.

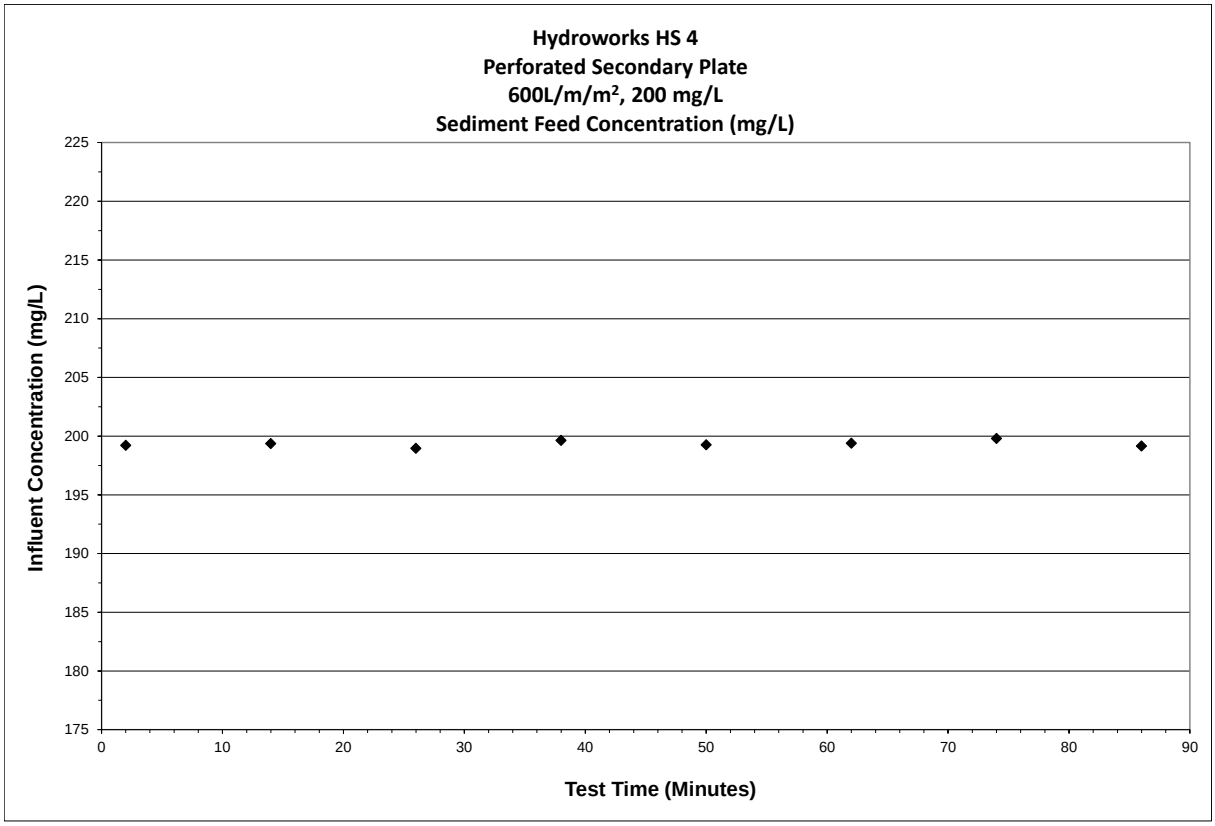


Figure 33: 600 L/min/m^2 Perforated Plate Measured Influent Concentrations

Eight (8) background concentrations samples were collected throughout the test. Approximately halfway through the test, it was observed that an internal sump wall had developed a crack, which allowed raw effluent to bypass the filtration wall. The testing was not terminated for the following reasons: 1) the impact of the breach on the background concentrations would not be known until the test was completed, and 2) being a closed-loop system, any increase in concentration is a result of the fine injected particles not being captured by the treatment system and therefore, will not skew the mass balance results. The concentration did exceed the 20 mg/L limit, with values ranging from 0.2 to 28.4 mg/L. The background curve is shown on **Figure 25.**

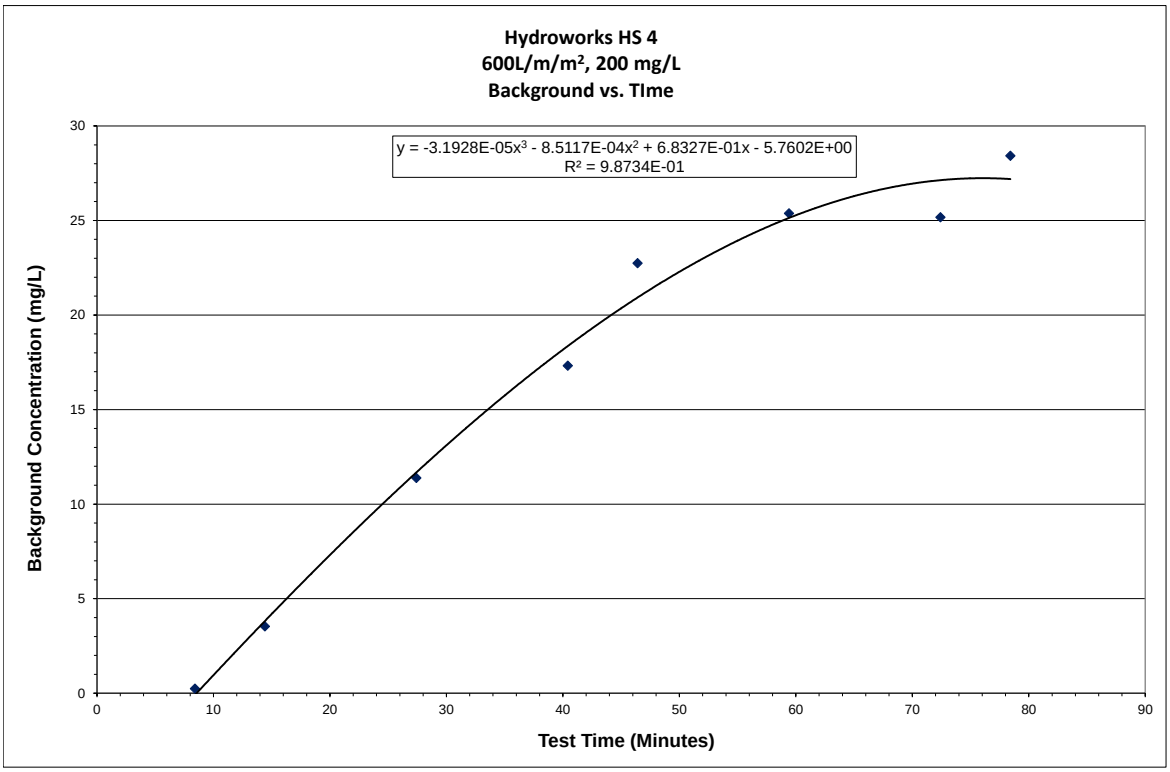


Figure 34: 600 L/min/m² Measured Background Concentrations

The total mass collected from the unit was 5.529 kg, resulting in a removal efficiency of 45.9%. This matches well with the previous test removal of 46.1%. The quantified deposition from the perforated plate was 2.7%, significantly lower than the 8.5% collected from the solid plate. This material was collected along the outer edge of the plate where it attaches to the mounting ring. The quantity of sediment collected from the sump increased by the same margin, validating the statement that the material from the solid plate would have been collected in the lower sump. The capture splits for the solid and perforated plate tests are summarized in **Table 17**.

Table 17:
600 L/min/m² Summary of Injected Mass Captured

	Flow	Tested Flow	Removal Efficiency	Pretreatment Channel	Secondary Plate	Outlet Dispersion Plate	Collection Sump
	L/min/m^2	L/min	%	%	%	%	%
Solid Plate	600	736.2	46.1	24.7	8.5	3.1	9.9
Perforated Plate	600	740.9	45.9	25.8	2.7	3.0	14.5

4.2 Sediment Re-Suspension and Washout

A false floor was installed in the collection sump to reduce the quantity of sediment required for the test. The sump was uniformly preloaded to the 50% sump capacity level (15.2 cm), with a minimum depth of 10.2 cm of 1-1000 micron sediment shown in **Table 1**.

Removal efficiency testing resulted in sediment deposition of <10% on the secondary plate at the lower flows (<5% at 1400 SLR). However, TRCA requested that the Secondary Plate surface be preloaded to a depth of 10.2 cm prior to conducting the re-suspension test. The leading edge was tapered at an angle of approximately 45 degrees to reduce slumping. The test was conducted as described in **Section 3.2.3** , with target surface loading rates of 200, 800, 1400, 2000 and 2600 L/min/m^2.

The average measured flow data recorded throughout the test is shown in Error! Reference source not found. and all recorded data on **Figure 35.** Seven (7) background samples were collected throughout the duration of the test. The measured concentrations ranged from 0.7 to 17.1 mg/L, as shown on **Figure 36**. A 3rd-order curve equation was established for adjusting the effluent concentrations.

Table 18:
Resuspension Flow Summary

Target SLR	Measured SLR	Deviation from Target	COV	QA / QC Compliant
200	204.8	2.4%	0.019	**Yes**
800	804.2	0.5%	0.004	**Yes**
1400	1407.8	0.6%	0.027	**Yes**
2000	2023.8	1.2%	0.002	**Yes**
2600	2622.7	0.9%	0.002	**Yes**

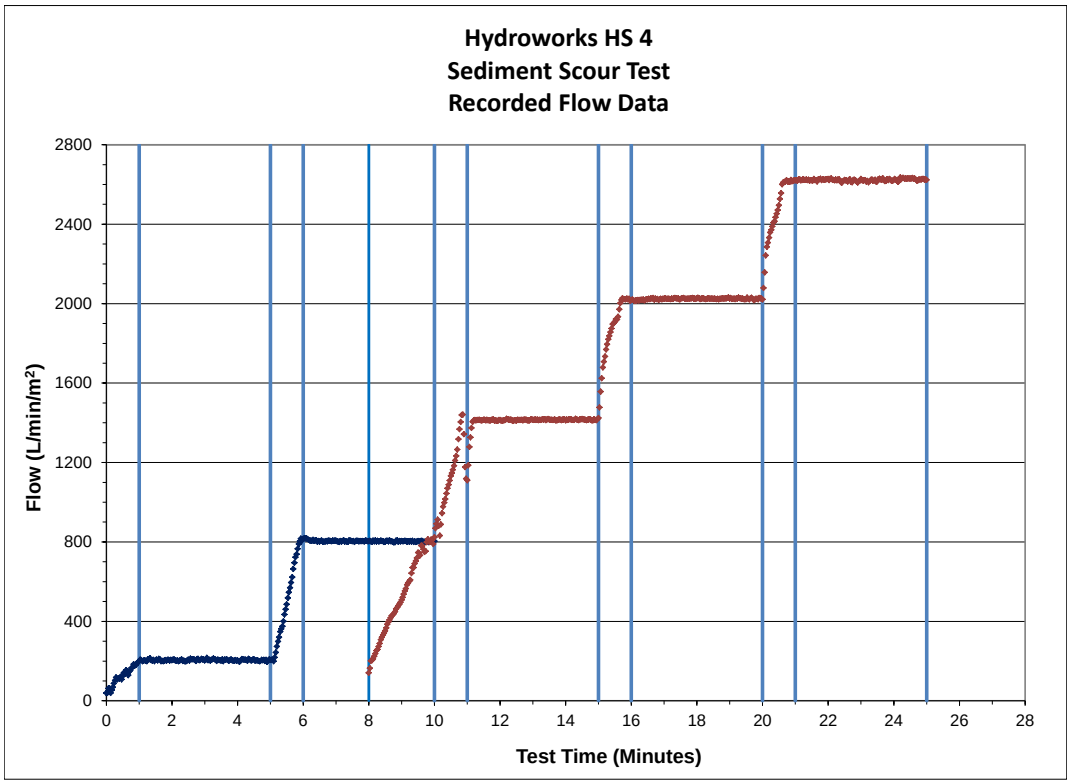


Figure 35: Scour Test Recorded Flow Data

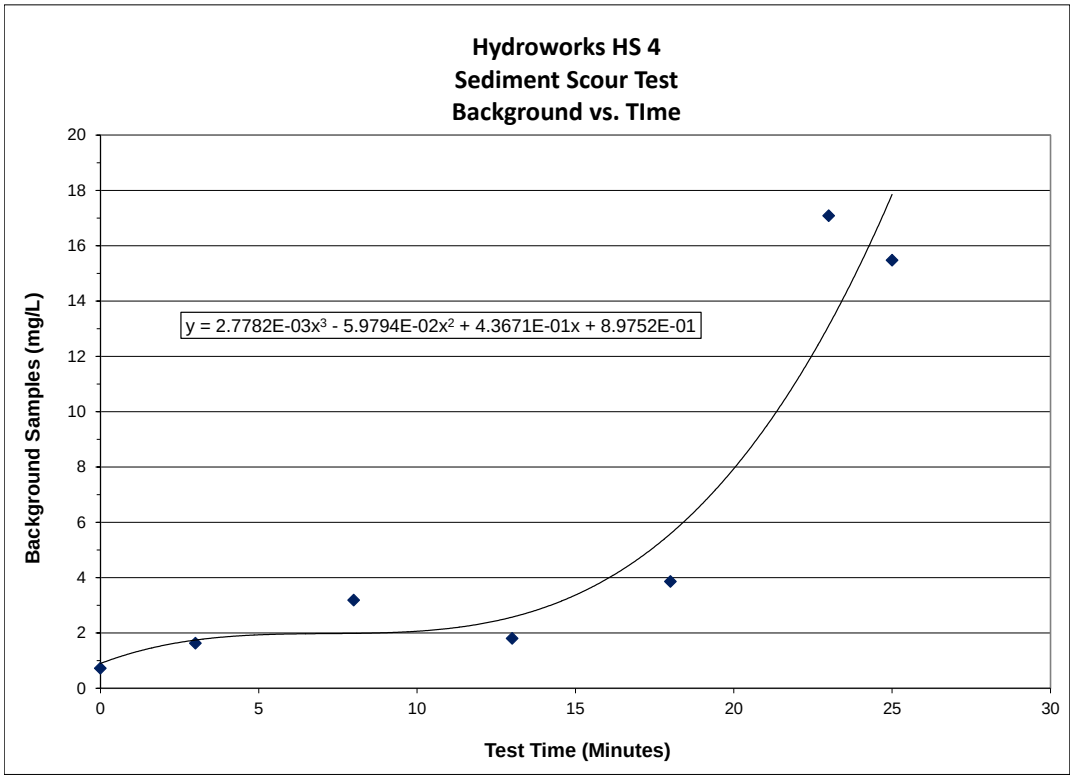


Figure 36: Measured Background Concentrations

Measured effluent sediment concentrations (adjusted for background) increased over the surface loading rates of 200, 800 and 1400 L/min/m^2, after which it decreased due to bypass flow. The average concentration for each tested SLR was 40.2, 71.0, 271.2, 227.1 and 128.5 mg/L, respectively. The concentrations were adjusted for particle size, based on a D_5 of 7.0 microns for the 40 L/min/m^2 removal efficiency test. The D_5 adjusted effluent concentrations were 11.3, 28.9, 196.7, 175.4 and 99.9 mg/L, respectively. The effluent data is shown in Error! Reference source not found. and the corresponding curves are shown on Error! Reference source not found..

The unit was slowly decanted after the completion of the test. It was observed that most of the Secondary Plate was devoid of sediment. A measurement of the sump depth revealed an increase of approximately 7 cm. This leads to a conclusion that most of the sediment from the Secondary Plate was carried into the lower sump. It can also be concluded that the fine material loaded on the Secondary Plate was re-suspended and conveyed out of the unit with the flow, as the velocity in the unit is higher than the fall velocity of the fine sediment.

Table 19
Measured Scour Effluent Concentrations (mg/L) Adjusted for Background

Measured Concentration at Each surface Loading Rate					
Effluent Sample No.	200 L/min/m^2	800 L/min/m^2	1400 L/min/m^2	2000 L/min/m^2	2600 L/min/m^2
1	32.4	58.0	68.5	255.7	138.5
2	38.8	120.7	188.1	254.8	128.6
3	37.4	75.5	329.0	238.0	113.6
4	40.1	55.8	417.5	216.7	144.7
5	52.1	44.9	352.9	170.3	117.1
Average	**40.2**	**71.0**	**271.2**	**227.1**	**128.5**
D_5 Correction	**11.3**	**28.9**	**196.7**	**175.4**	**99.9**

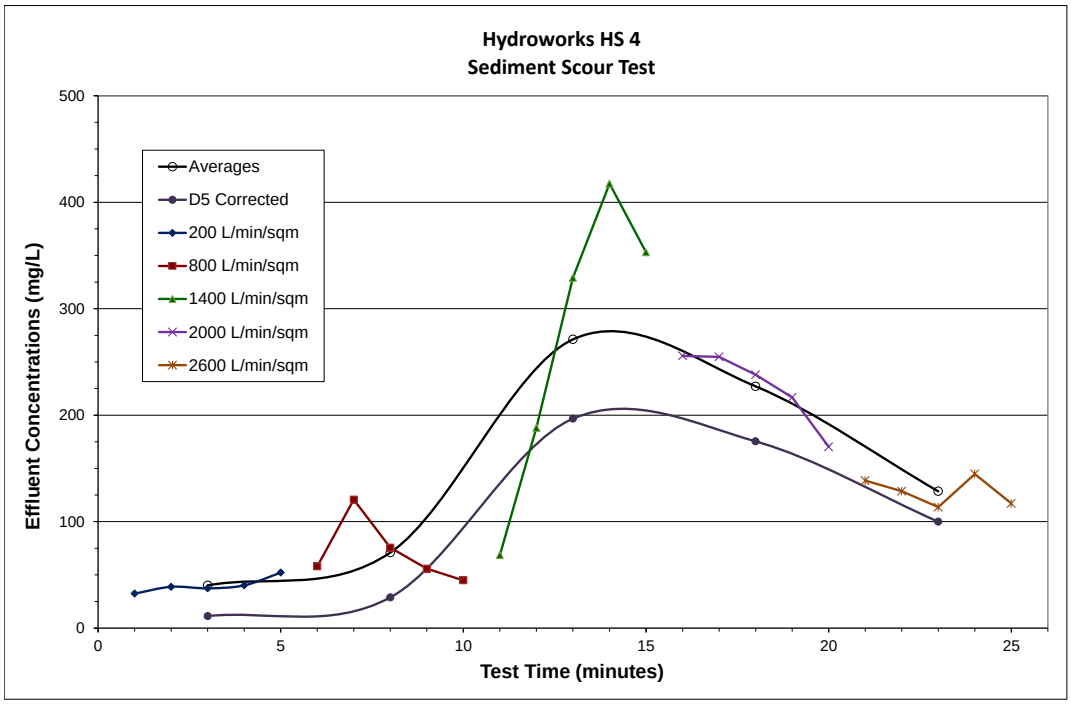


Figure 37: Scour Testing Effluent Concentrations Adjusted for Background

4.2.1 Perforated Plate Sediment Re-Suspension and Washout

A repeat scour test was conducted with the perforated secondary plate installed. The sump was uniformly preloaded to the 50% sump capacity level (15.2 cm), with a minimum depth of 10.2 cm of 1-1000 micron sediment shown in **Table 1**. The pretreatment channel was preloaded with 22 kg of sediment that was collected at the lower flows during removal testing, as shown on **Figure 38**. This is the scientifically correct approach, as the channel is designed to capture the coarse particles prior to the flow entering the inner chamber. A sieve analysis conducted on the material showed good correlation above 53 microns and a finer distribution below 53 microns. This indicates that there was still "flour" material (<53 microns) remaining from the previous adjusted scour test blend and is still conservative.

The average measured flow data recorded throughout the test is shown in Error! Reference source not found. and all recorded data on **Figure 35.** Seven (7) background samples were collected throughout the duration of the test. The measured concentrations ranged from 2.4 to 10.4 mg/L, as shown on **Figure 36**. A 3rd-order curve equation was established for adjusting the effluent concentrations.

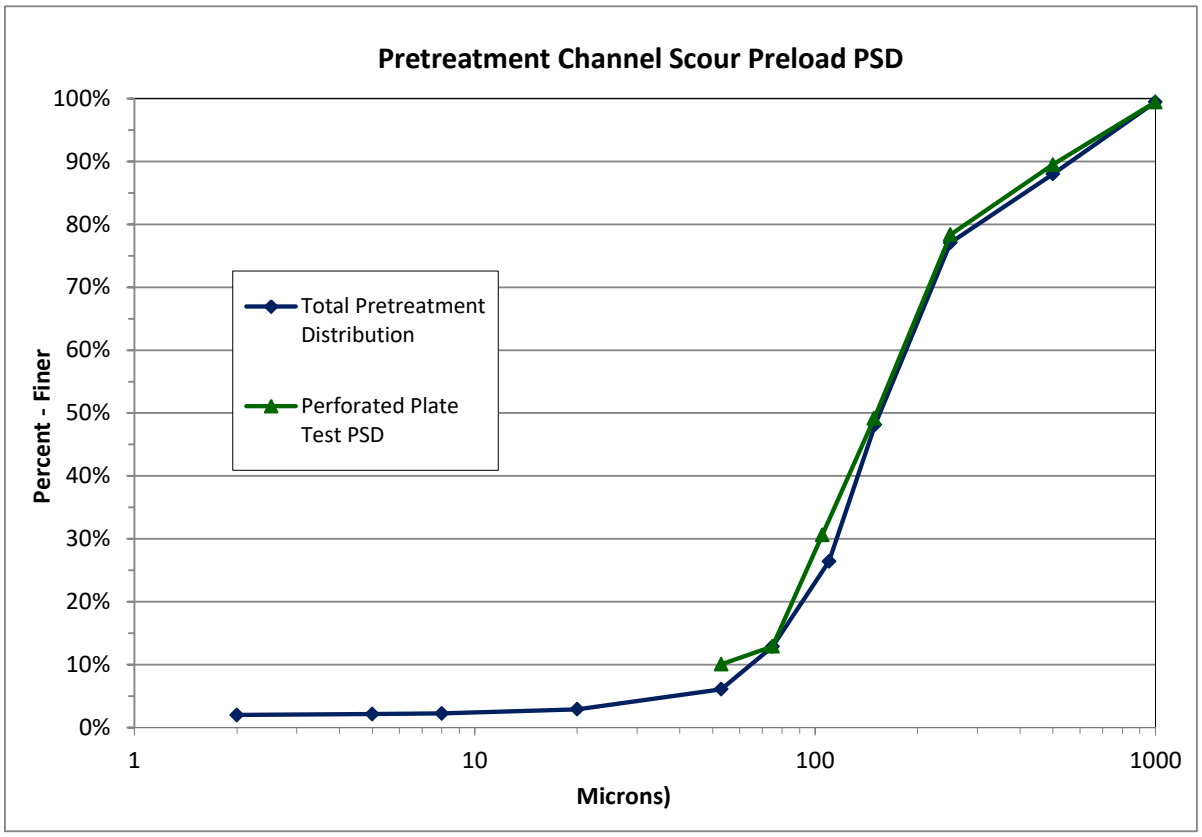


Figure 38: Repeat Scour Test Pretreatment Channel Preloaded PSD

Table 20
Repeat Scour Test Flow Summary

Target SLR	Measured SLR	Deviation from Target	COV	QA / QC Compliant
200	201.0	0.5%	0.020	**Yes**
800	805.9	0.7%	0.003	**Yes**
1400	1428.2	2.0%	0.006	**Yes**
2000	2009.9	0.5%	0.002	**Yes**
2600	2609.8	0.4%	0.002	**Yes**

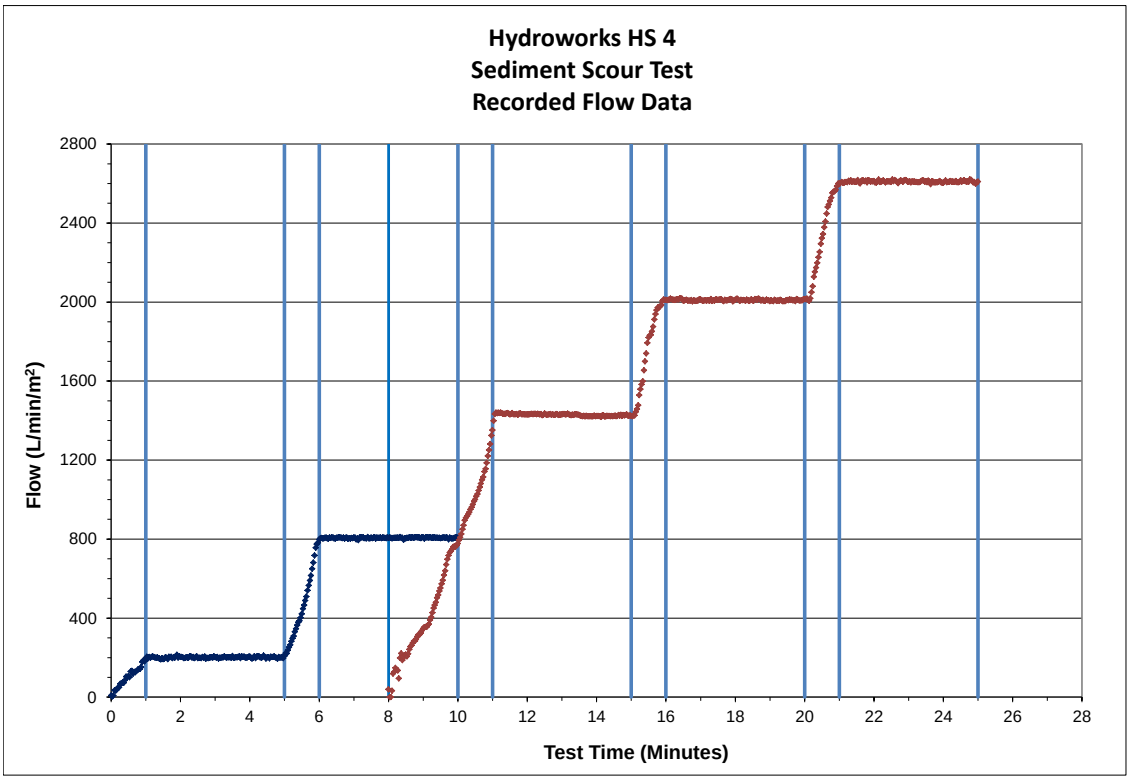


Figure 39: Repeat Scour Test Recorded Flow Data

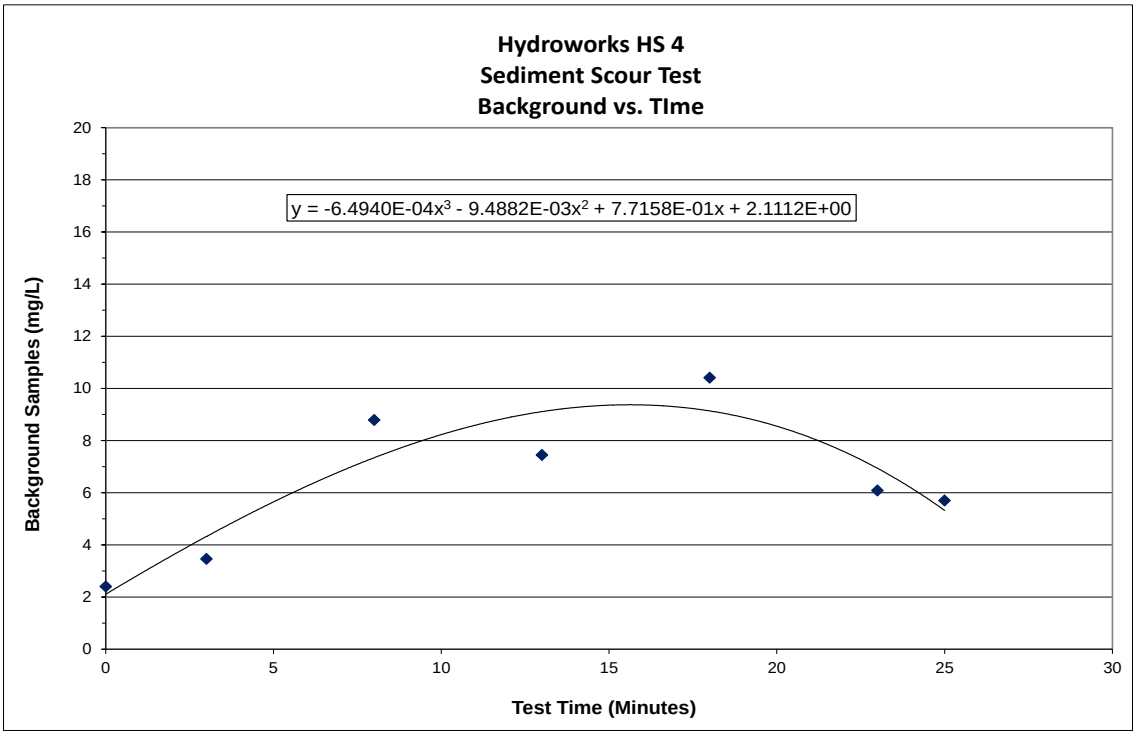


Figure 40: Measured Background Concentrations

The average concentration for each tested SLR was 37.2, 37.1, 24.1, 24.1 and 29.8 mg/L, respectively. The concentrations were adjusted for particle size, based on a D_5 of 7.0 microns for the 40 L/min/m^2 removal efficiency test. The D_5 adjusted effluent concentrations were 22.4, 28.5, 20.0, 19.1 and 24.4 mg/L, respectively. The effluent data is shown in Error! Reference source not found. and the corresponding curves are shown on Error! Reference source not found..

Table 21
Measured Scour Effluent Concentrations (mg/L) Adjusted for Background

Measured Concentration at Each surface Loading Rate					
Effluent Sample No.	200 L/min/m^2	800 L/min/m^2	1400 L/min/m^2	2000 L/min/m^2	2600 L/min/m^2
1	50.6	18.2	14.7	17.3	30.5
2	49.4	59.1	27.4	34.6	35.2
3	38.6	43.0	36.3	28.4	33.1
4	27.4	39.0	24.1	21.6	24.8
5	19.9	26.0	18.1	18.5	25.5
Average	**37.2**	**37.1**	**24.1**	**24.1**	**29.8**
D_5 Correction	**22.4**	**28.5**	**20.0**	**19.1**	**24.4**

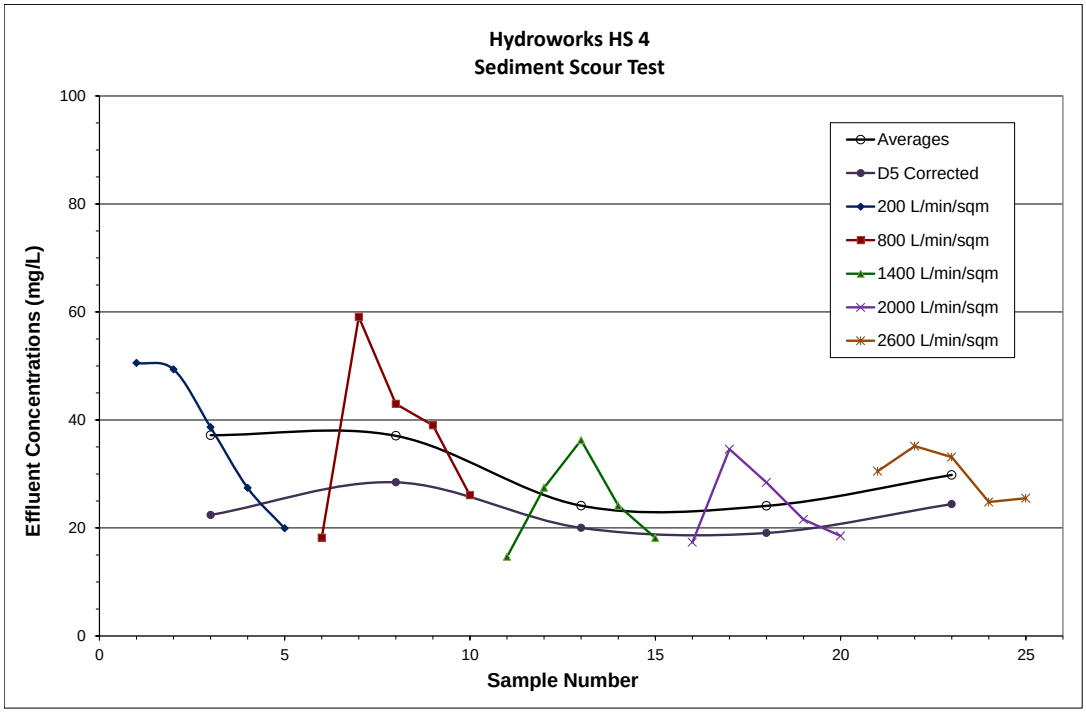


Figure 41: Scour Testing Effluent Concentrations Adjusted for Background

4.3 Light-Liquid Re-Entrainment Simulation

A light-liquid re-entrainment test was conducted using Dow Chemical Dowlex^{tm} 2517 low-density polyethylene beads. The product density of 0.917 g/cm^2 was verified by an independent analytical laboratory using ASTM D1238 and ASTM D792 methods.

The inner chamber of the HS 4 unit was filled with 58.3 liters (33.4 kg) of pellets, which corresponded to a 5cm depth over the collection sump area of 1.17m^2. The test was conducted in accordance with the procedure described in **Section 3.2.4**, at the SLR of 200, 800, 1400, 2000 and 2600 L/min/m^2.

The recorded SLR flow data for the test is graphically shown on Error! Reference source not found.. All recorded flows were within 1% of the targets, with a maximum COV of 0.011. The recorded average flow data, as well as quantified volume and mass of collected pellets for each target SLR and overall test, is shown in Error! Reference source not found.. The maximum re-entrainment of 4.6% occurred at 1400 L/min/m^2, which is the 100% treatment flow and start of bypass. The re-entrainment diminished to 4.3% and 2.5% with each subsequent flow. The total volume re-entrained from the oil collection region for the entire test was 11.7%, for a retention rate of 88.3%.

Table 22:
Light-liquid Recorded Flow and Re-entrainment Data

Light-liquid Re-Suspension Data				Starting Volume	(Liters) 58.3	Starting Mass	(grams) 33399	Hydroworks HG4	
Action	Time Stamp (minutes)	Meter	Target Flow (L/min/m^2)	Recorded Flow (L/min/m^2)	COV	Measured Collected Volume (Liters)	Measured Collected Mass (grams)	Calculated Percentages Collected Volume (Liters)	Calculated Percentages Collected Mass (grams)
Start D.A. Recording	0.0								
Flow set	1.0	4"	200	**199**	0.021	0	0	**0.0%**	**0.0%**
Stop Collection	6.0			-0.6%					
Flow set	7.0	4"	800	**807**	0.005	0.1	49	**0.1%**	**0.1%**
Stop Collection	12.0			0.9%					
Flow set	13.0	8"	1400	**1408**	0.002	2.7	1523	**4.6%**	**4.6%**
Stop Collection	18.0			0.6%					
Flow set	19.0	8"	2000	**2014**	0.002	2.5	1445	**4.3%**	**4.3%**
Stop Collection	24.0			0.7%					
Flow set	25.0	8"	2600	**2608**	0.002	1.5	847	**2.5%**	**2.5%**
Stop Collection	30.0			0.3%					
				Interim Collection Net		0.1	39	**0.1%**	**0.1%**
				Total		**6.8**	**3902**	**11.7%**	**11.7%**
						Pellets Retained		**88.3%**	**88.3%**

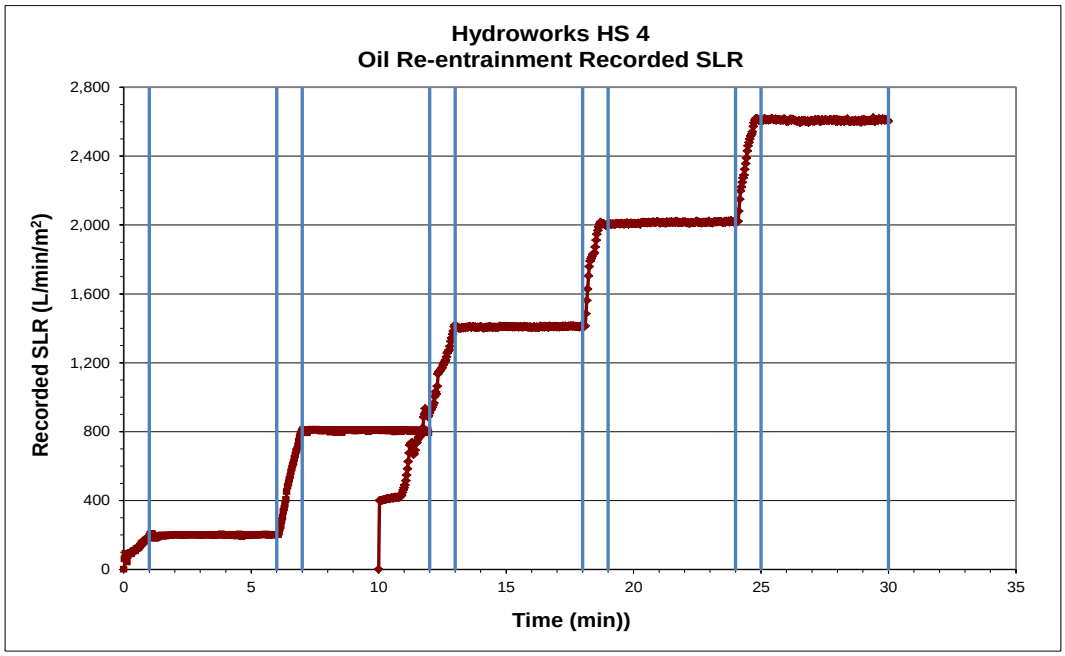


Figure 42: Recorded Light-liquid SLR Flow Data

4.4 Hydraulic Characteristics

Piezometer taps were installed in the unit as described in **Section 3.2.1**. Flow (L/min) and water level (meters) within the unit were measured for 15 flows ranging from 0 to 6606 L/min. The influent pipe was flowing full at approximately 5730 L/min. The entrance to the effluent pipe was submerged at approximately 6600 L/min. The flow reached bypass at 1630 L/min. The recorded data is shown in **Table 23** and the Elevation Curves for each pressure tap location are shown on Error! Reference source not found.**.** The pressure data for the inlet and outlet pipes were corrected for energy.

Table 23:
Recorded Flow and Elevation Data

Measured Flow	Water Elevations (adjusted to outlet invert)						Losses			
	Inlet Pipe	Inlet Area	Pretreatment Channel	Inner Chamber	Outlet Shelf	Outlet Pipe	**Inlet El. (A')**	**Outlet El. (E')**	**System Energy Loss**	**Loss Coeff.**
	A		B	C	D	E	**Corrected for Energy**	**Corrected for Energy**	**A'-E'**	Outlet Area
L/min	m	sq-m	m	m	m	m	m	m	m	Cd
0.0	0.052	0.000	0.000	0.000	0.000	-0.003	0.052	0.000	0.000	0.000
94.7	0.076	0.003	0.047	0.039	0.039	0.020	0.091	0.047	0.043	0.025
190.0	0.087	0.005	0.061	0.057	0.057	0.029	0.107	0.064	0.042	0.050
379.9	0.099	0.008	0.086	0.081	0.080	0.044	0.132	0.085	0.047	0.095
571.2	0.109	0.010	0.110	0.101	0.098	0.056	0.152	0.101	0.051	0.137
764.9	0.119	0.013	0.132	0.119	0.113	0.067	0.168	0.116	0.051	0.182
1052.7	0.158	0.025	0.166	0.143	0.132	0.081	0.183	0.135	0.048	0.260
1325.0	0.197	0.038	0.199	0.164	0.147	0.091	0.214	0.152	0.062	0.288
1631.9	0.244	0.055	0.245	0.188	0.165	0.104	0.257	0.168	0.089	0.296
1901.7	0.262	0.061	0.266	0.205	0.182	0.113	0.275	0.182	0.093	0.337
2278.9	0.279	0.067	0.283	0.222	0.195	0.127	0.296	0.199	0.096	0.397
2657.4	0.293	0.072	0.297	0.237	0.214	0.141	0.312	0.216	0.097	0.462
3783.6	0.333	0.084	0.333	0.276	0.243	0.174	0.362	0.261	0.101	0.643
5730.5	0.393	0.098	0.395	0.348	0.312	0.221	0.441	0.332	0.110	0.934
6606.4	0.428	0.099	0.429	0.387	0.365	0.222	0.491	0.367	0.123	1.016

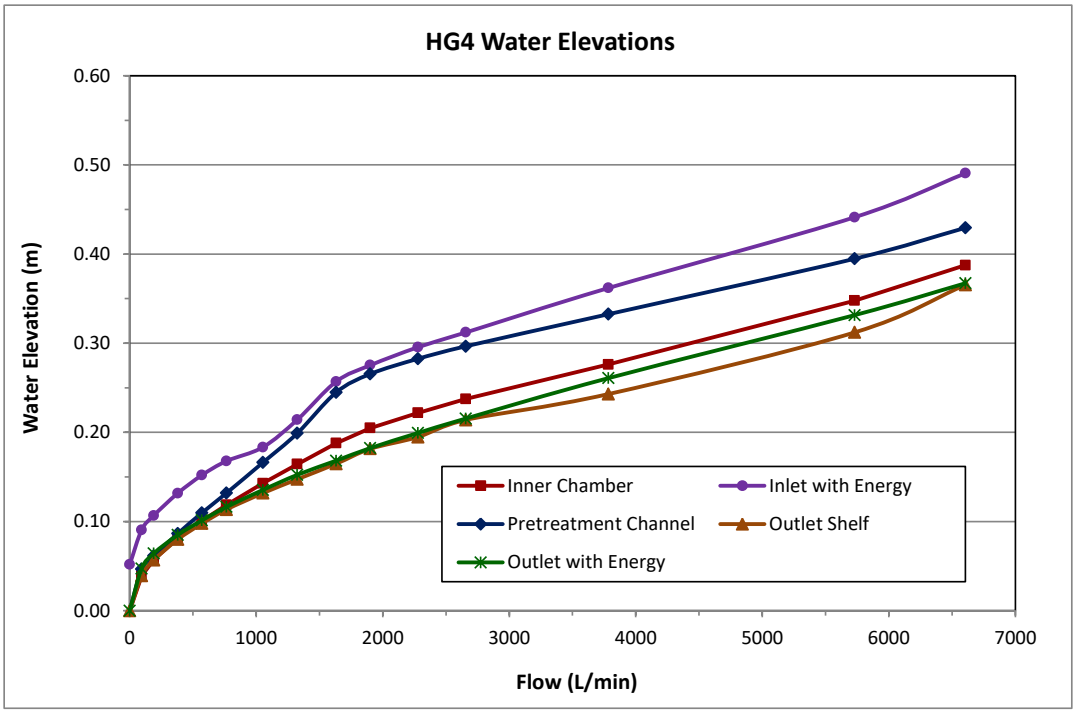


Figure 43: Measured Flow vs Water Elevations

As seen on Error! Reference source not found., the calculated system energy loss (influent to effluent) ranged from 0 to 0.089 m at the point of bypass. The loss decreased as expected due to bypass flow and

started increasing once the water elevation reached the top of the outlet pipe. The loss coefficient (Cd) for the insert was based on the area of the insert outlet (0.07 m^2). The Cd values prior to bypass ranged from 0.03 to 0.30. The calculated losses are shown in **Table 233**.

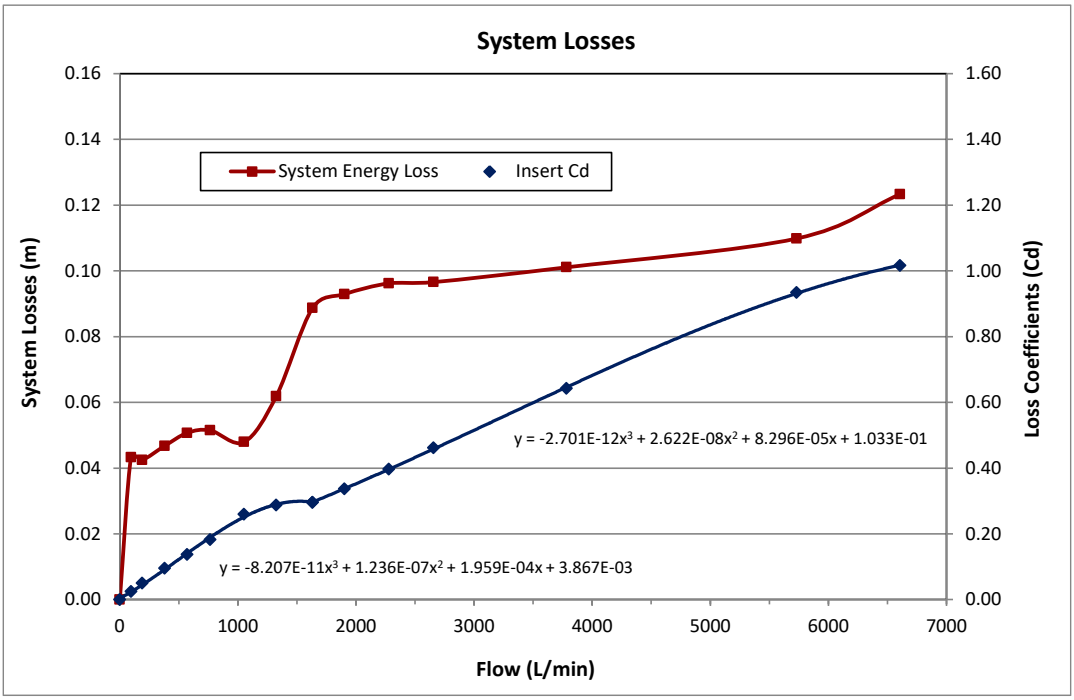


Figure 44: Calculated Losses and Insert Outlet Cd

5.0 Conclusions

The Hydroworks HS 4 Stormwater Treatment Unit achieved sediment removal efficiencies from 35.7% to 68.6% for surface loading rates ranging from 40 to 1400 L/min/m^2, respectively, using CETV specified 1-1000 micron PSD.

Light-liquid testing results showed that the unit was able to retain 88.3% of the pre-loaded pellets through the full range of SLRs from 200 to 2600 L/min/m^2.

Sediment scour testing resulted in average effluent concentrations ranging from 11 to 197 mg/L for loading rates up to 2600 L/min/m^2. This testing was conducted with the Secondary Plate preloaded to 10.2 cm.

Hydraulic testing was conducted at flows ranging from 0 to 6600 L/min. Bypass was reached at 1630 L/min. The maximum calculated system loss at 6600 L/min was 0.12 m.

The solid secondary plate was replaced with a 32% open-area plate and the 600 L/min/m2 test was repeated. The solid and perforated plate tests produced removal efficiencies of 46.1% and 45.9%, respectively. This indicates that the flow patterns and particle settling characteristics are not sensitive to the plate geometry.

A repeat scour test was conducted with the perforated plate installed. The calculated average effluent concentrations ranged from 19.1 to 28.5 mg/L. This is a significant drop from the solid plate maximum concentration of 197 mg/L and verifies that the perforated plate meets its intended purpose of protecting the sump from excessive scour.

6.0 Nomenclature and Abbreviations

A	= area	(L^2)
°C	= degree centigrade	(T)
Cd	= coefficient of discharge	
Ci	= influent sediment concentration	(M/L^3)
Cfs	= cubic feet per second	(L^3/T)
Cm^3	= cubic centimeters	(L^3)
COV	= coefficient of variance	
D	= diameter	(L)
D_{50}	= median particle size	(L)
DA	= data acquisition	
DP	= differential pressure	(ΔL)
g	= grams	(M)
g	= gravity	(L/T^2)
H	= head	(L)
Hz	= hertz	(T)
Kg	= kilogram	(M)
L	= liters	(L^3)
L/m	= liters per minute	(L^3/T)
L/s	= liters per second	(L^3/T)
m	= meter	(L)
mg/L	= milligram per liter	(M/L^3)
min	= minute	(T)
mm	= millimeters	(L)
PSD	= particle size distribution	
Q	= flow	(L^3/T)
sec	= seconds	(T)
SLR	= surface loading rate	($L^3/T/L^2$)
SSC	= suspended solids concentration	
V	= velocity	(L/T)
w	= moisture content (%)	

7.0 References

ASTM (2013), “Standard Test Methods for Determining Sediment Concentration in Water Samples”, Annual Book of ASTM Standards, D3977-97, Vol. 11.02.

ASTM (2007), “Standard Test Method for Particle Size Analysis of Soils”, Annual Book of ASTM Standards, D422-63, Vol. 04.08.

ASTM (2007), “Standard Test Methods for Determination of Water (Moisture) Content of Soil by Direct Heating”, Annual Book of ASTM Standards, D4959-07, Vol. 04.08.

ASME (1971), “Fluid Meters Their Theory and Application- Sixth Edition”.

CETV (2014), “Procedure for Laboratory Testing of Oil-Grit Separators”, The Canadian Environmental Technology Verification Program.

APPENDIX A

ALDEN QUALIFICATIONS

Founded in 1894, Alden is the oldest continuously operating hydraulic laboratory in the United States and one of the oldest in the world. From the early days of hydropower development and aviation, through World Wars I and II, and into the modern world defined by environmental needs, Alden has been a recognized leader in the field of fluid dynamics consulting, research and development. In the 21st Century, Alden is a vibrant, growing organization consisting of engineers, scientists, biologists, and support staff in five specialty areas. Much of our work supports the power generating, environmental, manufacturing, and process industries.

Alden offers a scope of specialized services including: conceptual design, detailed design, verification testing, analytical modeling, Computational Fluid Dynamics (CFD), field measurements, physical modeling, precision flow meter calibrations, and field testing. Decades of combined experience in numerical simulation techniques, physical modeling, and field studies provide the broad knowledge that is essential for recognizing which method is best suited to solving a problem.

Unusually large facilities (more than 125,000 square feet of enclosed space) and sophisticated data acquisition systems are available for each study. Approximately twenty buildings, located on thirty acres at our headquarters in Holden, MA are equipped with flow supplies and control systems for conducting hydraulic modeling, verification and equipment testing, fish testing, air/gas flow modeling, and numerous other types of flow testing. Fixed facilities providing air and water flow and an inventory of movable flow related equipment such as pumps, valves, meter devices, fish screens, etc. are located on the premises at our Massachusetts laboratory. Fully equipped and staffed carpentry, machine, and instrumentation shops provide rapid and efficient project support.

Alden has performed verification testing on approximately twenty Hydrodynamic Separator and Filtration Manufactured Treatment Devices (MTDs) for multiple manufacturers under various state and federal testing protocols. Alden's senior stormwater engineer, James Mailloux, has served on the ASTM and SWEMA Stormwater Technical committees, providing guidance in the area of testing methodologies. He has a Master's Degree in Environmental Engineering from Worcester Polytechnic Institute and has been conducting testing at Alden for more than 25 years. Mr. Mailloux has contributed to articles related to laboratory testing in Stormwater Magazine, as well as presented on multiple testing and regulatory topics at various conferences, including StormCon, WefTec and the National Precast Concrete Association training seminars.

APPENDIX B

INSTRUMENTATION CALIBRATIONS

Hydroworks® HydroStorm

Operations & Maintenance Manual

Version 1.2

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please email a copy of the completed checklist to Hydroworks at for our records.

Introduction

The HydroStorm is a state-of-the-art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroStorm is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroStorm.

Hydroworks® HydroStorm Operation

The Hydroworks HydroStorm (HS) separator is a unique hydrodynamic by-pass separator. It incorporates a protected submerged pretreatment zone to collect larger solids, a treatment tank to remove finer solids, and a dual set of weirs to create a high flow bypass. High flows are conveyed directly to the outlet and do not enter the treatment area, however, the submerged pretreatment area still allows removal of coarse solids during high flows.

Under normal or low flows, water enters an inlet area with a horizontal grate. The area underneath the grate is submerged with openings to the main treatment area of the separator. Coarse solids fall through the grate and are either trapped in the pretreatment area or conveyed into the main treatment area depending on the flow rate. Fines are transported into the main treatment area. Openings and weirs in the pretreatment area allow entry of water and solids into the main treatment area and cause water to rotate in the main treatment area creating a vortex motion. Water in the main treatment area is forced to rise along the walls of the separator to discharge from the treatment area to the downstream pipe.

The vortex motion forces solids and floatables to the middle of the inner chamber. Floatables are trapped since the inlet to the treatment area is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while water must flow up the walls of the separator to discharge into the downstream pipe.

A set of high flow weirs near the outlet pipe create a high flow bypass over both the pretreatment area and main treatment chamber. The rate of flow into the treatment area is regulated by the number and size of openings into the treatment chamber and the height of by-pass weirs. High flows flow over the weirs directly to the outlet pipe preventing the scour and resuspension of any fines collected in the treatment chamber.

A central access tube is located in the structure to provide access for cleaning. The arrangement of the inlet area and bypass weirs near the outlet pipe facilitate the use of multiple inlet pipes.

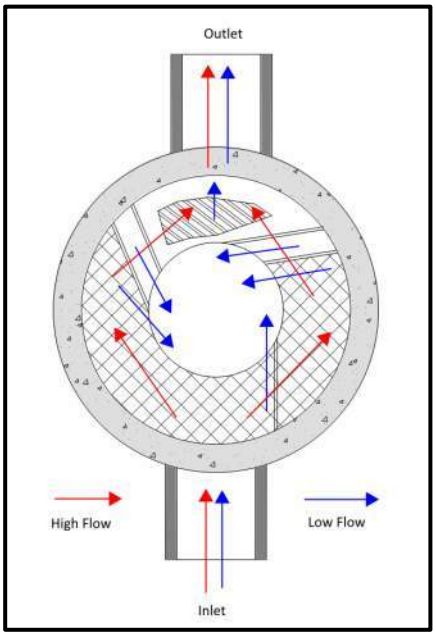


Figure 1. Hydroworks HydroStorm Operation – Plan View

Figure 2 is a profile view of the HydroStorm separator showing the flow patterns for low and high flows.

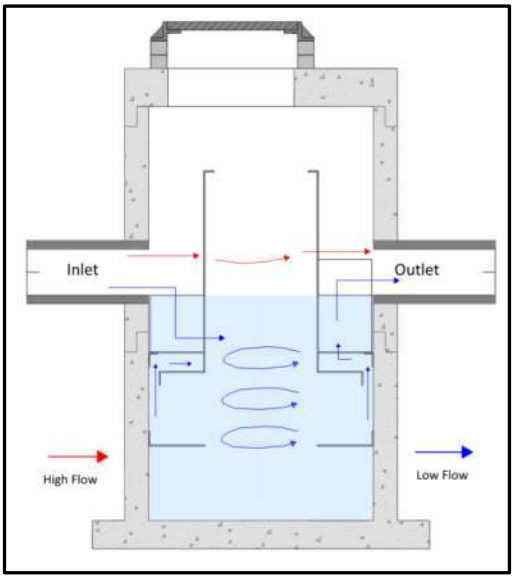


Figure 2. Hydroworks HydroStorm Operation – Profile View

Hydroworks

The HS 4i is an inlet version of the HS 4 separator. There is a catch-basin grate on top of the HS 4i. A funnel sits sits underneath the grate on the frame and directs the water to the inlet side of the separator to ensure all lows flows are properly treated. The whole funnel is removed for inspection and cleaning.

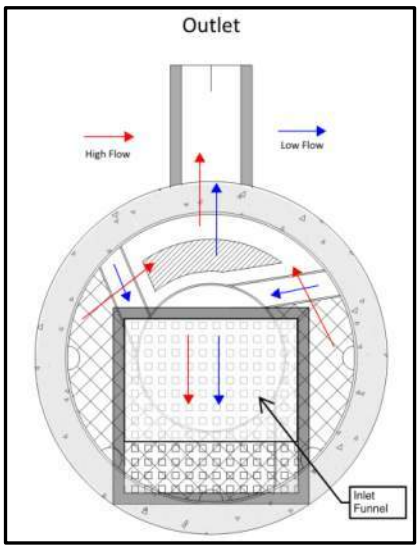


Figure 3. Hydroworks HS 4i Funnel

Construction Materials

The inner chamber and outlet baffle are made out of a copolymer plastic. The shell of the structure is pre-cast concrete. Pre-cast concrete is readily accepted by all municipalities since it has the following advantages:

- long service life
- ease of installation (less dependent on backfill (contractor proficiency) for structural integrity)
- concrete structures are designed for both anti-buoyancy and traffic loading without any field requirements (such as structural loading slabs in traffic areas and anti-buoyancy slabs to prevent groundwater uplift).
- low maintenance requirements

Hydroworks HS Separator Dimensions and Capacities

The HS separator is manufactured in a variety of sizes from 4 ft inside diameter to 12 ft inside diameter as shown in Table 1. Larger sizes may not be available in all areas. Please check with Hydroworks to ensure availability of the larger model sizes.

Table 1. Hydroworks HS Separator Dimensions*					
Model	Structure Inside Diam. (SID) (mm)	Structure Depth (mm)*	Sediment/ Sinking Trash Volume (L)	Oil/Floating Trash Volume (L)	Permanent Pool Wet Volume (L)
HS 3	900	1050	420	150	700
HS 4	1200	1200	845	355	1420
HS 5	1500	1500	1695	620	2775
HS 6	1800	1800	3110	1020	4800
HS 7	2100	1950	4530	1550	7080
HS 8	2400	2100	6225	2325	9960
HS 9	2700	2400	9200	3195	14410
HS 10	3000	2700	13025	4275	20015
HS 12	3600	3000	20525	7095	30535

*Dimensions vary with project requirements

The volumes provided in Table 1 for oil and sediment are to full capacity and not indicative of recommended depths/volumes for maintenance.

Headloss

Any water quality system implemented in a storm drain network will create headloss in the system. In general, depending on the configuration of the by-pass, systems designed to treat high flows or all of the flow will have a higher headloss impact on the storm drain network than systems that by-pass high flows.

The headloss created by the HS separator was measured in an independent laboratory (Alden Research Laboratory) for a full-scale HS 4. The K value ($h = K\ v^2/(2g)$) for headloss calculations was determined to be 1.04 as shown in Figure 3.

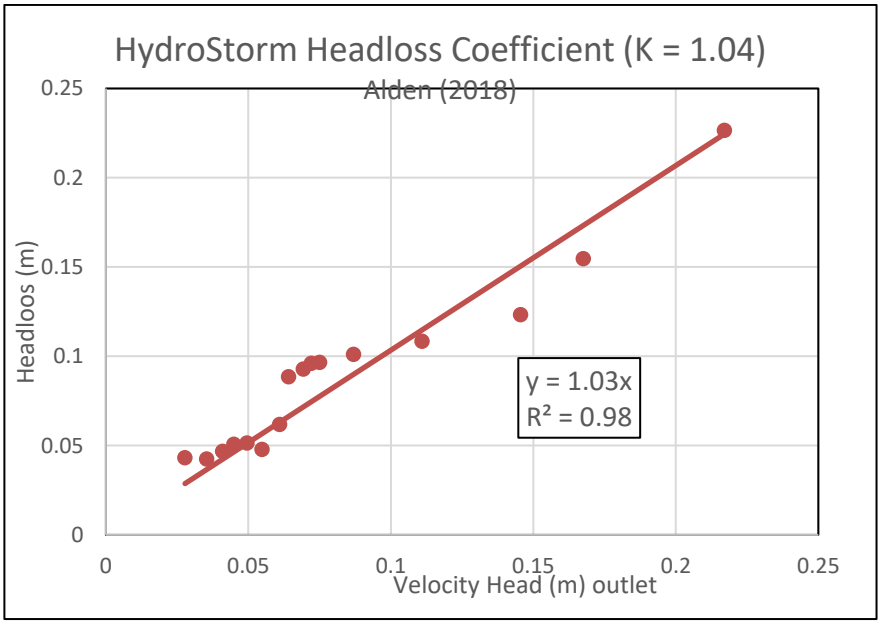


Figure 3. HydroStorm Headloss K Factor (1.04)

Hydroworks

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the center access tube of the separator. Separators with an inlet grate (HS 4i or custom separator) will have a plastic funnel located under the grate that must be removed from the frame prior to inspection or maintenance. If you are missing a funnel please contact Hydroworks at the numbers provided at the end of this document.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HydroStorm separator should be inspected every four weeks and after every large storm (over 0.5” (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroStorm separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HydroStorm separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required future frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroStorm unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroStorm separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

A central access opening (24” (600 mm) or greater) is provided to the gain access to the lower treatment tank of the unit. This is the primary location to maintain by vacuum truck. The pretreatment area can also be vacuumed and/or flushed into the lower treatment tank of the separator for cleaning via the central access once the water level is lowered below the pretreatment floor.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature.

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HydroStorm unit will typically take 1 to 2 hours based on a vacuum truck and longer for other cleaning methods (i.e. clamshell bucket).

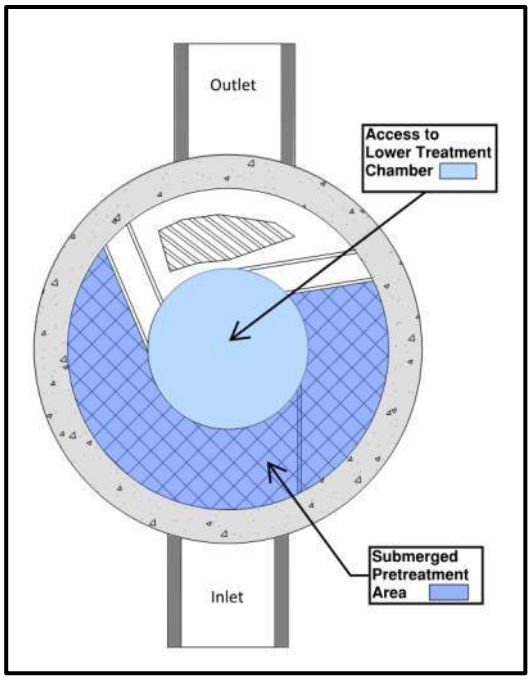


Figure 3. Maintenance Access

Frequency

Construction Period

A HydroStorm separator can fill with construction sediment quickly during the construction period. The HydroStorm must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroStorm separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The HydroStorm was independently tested by Alden Research Laboratory in 2017. A HydroStorm HS 4 was tested for scour with a 50% sediment depth of 0.5 ft.(150 mm). The sump depths given in Table 1 are scaled larger than required based on standard scaling requirements (NJDEP, ETV Canada). Accordingly maintenance depths for units larger than the HS 4 will be larger than 300 mm.

There will be designs with increased sediment storage based on specifications or site-specific criteria. A measurement of the total depth in the separator through the central access tube should be taken and compared to sump depth given in Table 1.

The standard sump depth from Table 1 should be subtracted from the measured depth and the resulting extra depth should be added to the values given in Table 2 to determine the site-specific sediment maintenance depth for that separator.

For example, if the measured sump depth in the HS-7 is 7.5 feet, then the sediment maintenance depth for that HS-7 is 2.25 ft (= 0.5 + 1.75) and the separator does not need to be cleaned for sediment accumulation until the measure sediment depth is 2.25 ft.

The HydroStorm separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the water surface of the separator.

Table 2 Standard Maintenance Depths for HydroStorm Models

Model	Diameter ft (mm)	Sediment Maintenance Depth for Total Water Depth ft (mm)*
HS-3	3 (900)	1 (300)
HS-4	4 (1200)	1 (300)
HS-5	5 (1500)	1.75 (530)
HS-6	6 (1800)	2 (610)
HS-7	7 (2100)	1.75 (535)
HS-8	8 (2400)	1.5 (465)
HS-9	9 (2700)	1.75 (540)
HS-10	10 (3000)	2 (615)
HS-12	12 (3600)	1.5 (470)

*based on standard sump depths in Table 1

HYDROSTORM INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroStorm	**Yes**	**No**
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____“

Routine Measurements

Floating debris depth	**< 0.5” (13mm)**	☐	**>0.5” 13mm)**	☐ *
Floating debris coverage	**< 50% of surface area**	☐	**> 50% surface area**	☐ *
Sludge depth	**< 12” (300mm)**	☐	**> 12” (300mm)**	☐ ****

* Maintenance required
** Repairs required
*** Further investigation is required

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroStorm

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroStorm to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroStorm are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroStorm, or the cost of other goods or services related to the purchase and installation of the HydroStorm. For this Limited Warranty to apply, the HydroStorm must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroStorm arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroStorm, whether the claim is based upon contract, tort, or other legal basis.

Specifications

1. Must be independently tested to the 2013 NJDEP Laboratory Protocol and 2013 ETV Canada protocol (ISO 14024:2016). Separator must be sized based on this data.

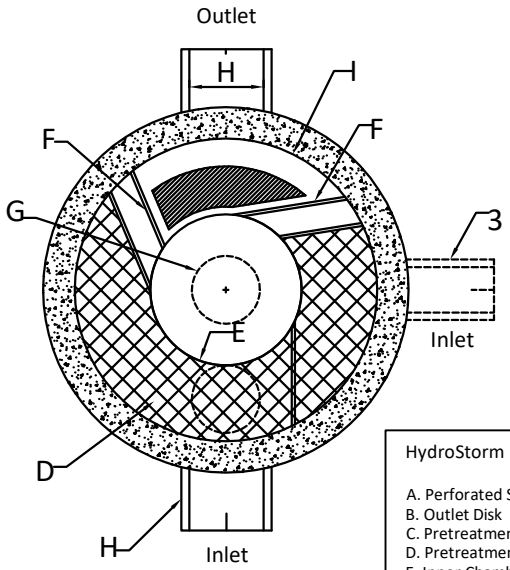
2. Any testing performed by the manufacturer is unacceptable to demonstrate an alternate equal.

3. Field Testing is unreliable, site and storm specific, and subject to compounding equipment and analytical errors and therefore is unacceptable as verification of an alternate equal. TARP verfication as per NJDEP is testing consistent with the 2013 NJDEP laboratory protocol.

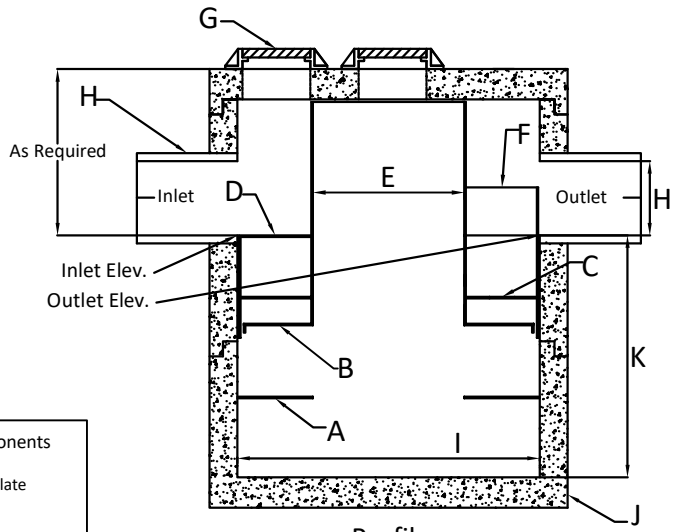
4. The separator must be designed based on the following criteria:

Flow Criteria	
Water Quality FLow Rate cfs (L/s)	
Peak Design Flow Rate cfs (L/s)	

TSS Removal Criteria	
Annual TSS Removal (%)	
NJDEP/ETV Canada TSS	
OK110 Sand	
City of Toronto	
Other	



Plan



Profile

HydroStorm Components

A. Perforated Scour Plate
B. Outlet Disk
C. Pretreatment Disk
D. Pretreatment Grate
E. Inner Chamber
F. By-Pass Weirs
G. Frame and Cover (1-2)
H. Inlet and Outlet Pipes
I. Structure Diameter
J. Base Extension (HS4 - HS6)
K. Sump Depth

HydroStorm by Hydroworks, LLC
US Patent No. 10,710,907
www.hydroworks.com
888-290-7900

HydroStorm Dimensions / Capacities

Model	Diameter ft (m) (9)	Sump Depth ft (m) (11)	Inner Chamber Diam. ft (m) (5)	Max. Pipe in (mm) (8)	Oil Spill Volume gal (L)	Sediment Volume ft3 (m3)	Total Volume gal (L)
HS 3	3 (0.9)	3 (0.9)	1.5 (0.45)	18 (450)	40 (155)	10 (0.35)	155 (600)
HS 4	4 (1.2)	4 (1.2)	2 (0.6)	24 (600)	95 (375)	30 (0.85)	375 (1420)
HS 5	5 (1.5)	5 (1.5)	2.5 (0.8)	30 (750)	165 (635)	60 (1.8)	730 (2780)
HS 6	6 (1.8)	6 (1.8)	3 (0.9)	36 (900)	270 (1030)	110 (3.2)	1265 (4800)
HS 7	7 (2.1)	6.5 (2.0)	3.5 (1.0)	42 (1050)	410 (1560)	160 (4.6)	1870 (7080)
HS 8	8 (2.4)	7 (2.1)	4 (1.2)	48 (1200)	615 (2330)	220 (6.2)	2630 (9960)
HS 10	10 (3.0)	9 (2.7)	5 (1.5)	60 (1500)	1130 (4285)	465 (13.1)	5285 (20015)
HS 12	12 (3.6)	11 (3.3)	6 (1.8)	72 (1800)	1875 (7100)	835 (23.7)	9305 (35225)

Notes:

1. Headloss K factor of 1.04 for hydraulic gradeline calculations

2. Sump depths shown are typical. Additional depth can be added as required

3. Multiple inlet pipes allowed

4. Drops allowed

5. Inlet invert elevations should be the same or higher than the outlet invert elevation. Inlet can be up to 12" (300 mm) lower than outlet if pretreatment area is omitted but 12" (300 mm) must be added to sump depth to maintain overall treatment volume.

6. Solid Cover shown. HydroStorm can be desiged with an inlet grate if required.

7. Oil capacities given are spill capacities.

8. Sediment depths are maximum holding capacities and not recommended capacities for regular maintenance.

9. Capacities are rounded down to nearest 5 gal or ft3 (1L or 0.1 m3 for metric units)

10. Base Extensions not provided on standard units larger than the HS 6. Extensions can be provided if required due to groundwater/buoyancy concerns at the request of the engineer of record.

11. HS4 to HS6 models require one frame and cover. HS7 to HS12 models require two covers

Hydroworks HydroStorm

PROJECT:

LOCATION:

REVISION DATE: 08/07/2020

Hydroworks

Lovers Creek Subwatershed

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.69	914	537	377
Fine Sandy Loam	B		914	571	343
Silt Loam	C		914	585	329
Clay	D		-	-	-
Forest					
Fine Sand	A	8.05	914	574	340
Fine Sandy Loam	B		914	557	357
Silt Loam	C		914	593	321
Clay	D		914	560	354
Pasture & Shrubs					
Fine Sand	A	1.66	914	566	348
Fine Sandy Loam	B		914	582	332
Silt Loam	C		914	658	256
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	3.89	914	571	343
Fine Sandy Loam	B		914	608	306
Silt Loam	C		914	650	264
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	16.20	914	589	325
Fine Sandy Loam	B		914	623	291
Silt Loam	C		914	646	268
Clay	D		914	523	391
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.20	914	493	421
Fine Sandy Loam	B		914	529	385
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**914**	**545**	**369**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

PRE-DEVELOPMENT WATER BALANCE

City of Barrie, Ontario

Project Number: 22-11672B

Date: April 10, 2024

Design By: DPH

LOVERS CREEK SUBWATERSHED (LSRCA Lake Simcoe Climate Data Version 1, April 2017)				
Designation	**Hydrologic Soil Group**	**Annual Precipitation (mm/yr)**	**Actual Evapotranspiration (mm/yr)**	**Precipitation Surplus (mm/yr)**
Urban Lawn	B	914	571	343

Catchment Designation	**Pre-Development Condition**				
	Forest	**Lawn**	**Building**	**Impervious**	**Totals**
Area(m2)	0	4540	500	540	5580
Pervious Area (m2)	0	4540	0	0	4540
Impervious Area (m2)	0	0	500	540	1040
Infiltration Factors					
Topography Infiltration Factor	0.11	0.11	0	0	
Soil Infiltration Factor	0.2	0.2	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	
MOE Infiltration Factor (Sum)	***0.51***	***0.41***	***0***	***0***	
Actual Infiltration Factor	0.51	0.41	0	0	
Run-off Coefficient	0.49	0.59	1	1	
Run-off from impervious surfaces*	0	0	0.8	0.8	
Inputs (per Unit Area)					
Precipitation (mm/yr)	914	914	914	914	914
Run-on (mm/yr)	0	0	0	0	0
Other inputs (mm/yr)	0	0	0	0	0
Total inputs (mm/yr)	**914**	**914**	**914**	**914**	**914**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	343	343	731	731	415
Net Surplus (mm/yr)	343	343	731	731	415
Evapotranspiration (mm/yr)	571	571	183	183	499
Infiltration (mm/yr)	175	141	0	0	114
Rooftop Infiltration (mm/yr)	0	0	0	0	0
Total Infiltration (mm/yr)	175	141	0	0	114
Runoff Pervious Areas (mm/yr)	168	202	0	0	165
Runoff Impervious Areas (mm/yr)	0	0	731	731	136
Total Runoff (mm/yr)	168	202	731	731	301
Total Outputs (mm/yr)	**914**	**914**	**914**	**914**	**914**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipitation (m3/yr)	0	4150	457	494	5100
Run-on (m3/yr)	0	0	0	0	0
Other inputs (m3/yr)	0	0	0	0	0
Total Inputs (m3/yr)	**0**	**4150**	**457**	**494**	**5100**
Outputs (Volumes)					
Precipitation Surplus (m3/yr)	0	1557	366	395	2318
Net Surplus (m3/yr)	0	1557	366	395	2318
Evapotranspiration (m3/yr)	0	2592	91	99	2782
Infiltration (m3/yr)	0	638	0	0	638
Rooftop Infiltration (m3/yr)	0	0	0	0	0
Total Infiltration (m3/yr)	0	638	0	0	638
Runoff Pervious Areas (m3/yr)	0	919	0	0	919
Runoff Impervious Areas (m3/yr)	0	0	366	395	760
Total Runoff (m3/yr)	0	919	366	395	1679
Total Outputs (m3/yr)	**0**	**4150**	**457**	**494**	**5100**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 20% of precipitation value.

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

POST DEVELOPMENT WATER BALANCE WITHOUT MITIGATION

City of Barrie, Ontario
Project Number: 22-11672B
Date: April 10, 2024
Design By: DPH

LOVERS CREEK SUBWATERSHED (LSRCA Lake Simcoe Climate Data Version 1, April 2017)				
Designation	**Hydrologic Soil Group**	**Annual Precipitation (mm/yr)**	**Actual Evapotranspiration (mm/yr)**	**Precipitation Surplus (mm/yr)**
Urban Lawn	B	914	571	343

Catchment Designation	**Post Development Condition**				
	Forest	**Lawn**	**Building**	**Impervious**	**Totals**
Area(m2)	0	1140	2190	2250	5580
Pervious Area (m2)	0	1140	0	0	1140
Impervious Area (m2)	0	0	2190	2250	4440
Infiltration Factors					
Topography Infiltration Factor	0.11	0.11	0	0	
Soil Infiltration Factor	0.2	0.2	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	
MOE Infiltration Factor (Sum)	***0.51***	***0.41***	***0***	***0***	
Actual Infiltration Factor	0.51	0.41	0	0	
Run-off Coefficient	0.49	0.59	1	1	
Run-off from impervious surfaces*	0	0	0.8	0.8	
Inputs (per Unit Area)					
Precipitation (mm/yr)	914	914	914	914	914
Run-on (mm/yr)	0	0	0	0	0
Other inputs (mm/yr)	0	0	0	0	0
Total inputs (mm/yr)	**914**	**914**	**914**	**914**	**914**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	343	343	731	731	652
Net Surplus (mm/yr)	343	343	731	731	652
Evapotranspiration (mm/yr)	571	571	183	183	262
Infiltration (mm/yr)	175	141	0	0	29
Rooftop Infiltration (mm/yr)	0	0	0	0	0
Total Infiltration (mm/yr)	175	141	0	0	29
Runoff Pervious Areas (mm/yr)	168	202	0	0	41
Runoff Impervious Areas (mm/yr)	0	0	731	731	582
Total Runoff (mm/yr)	168	202	731	731	623
Total Outputs (mm/yr)	**914**	**914**	**914**	**914**	**914**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipitation (m3/yr)	0	1042	2002	2057	5100
Run-on (m3/yr)	0	0	0	0	0
Other inputs (m3/yr)	0	0	0	0	0
Total Inputs (m3/yr)	**0**	**1042**	**2002**	**2057**	**5100**
Outputs (Volumes)					
Precipitation Surplus (m3/yr)	0	391	1601	1645	3638
Net Surplus (m3/yr)	0	391	1601	1645	3638
Evapotranspiration (m3/yr)	0	651	400	411	1463
Infiltration (m3/yr)	0	160	0	0	160
Rooftop Infiltration (m3/yr)	0	0	0	0	0
Total Infiltration (m3/yr)	0	160	0	0	160
Runoff Pervious Areas (m3/yr)	0	231	0	0	231
Runoff Impervious Areas (m3/yr)	0	0	1601	1645	3247
Total Runoff (m3/yr)	0	231	1601	1645	3477
Total Outputs (m3/yr)	**0**	**1042**	**2002**	**2057**	**5100**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 20% of precipitation value.

447-455 YONGE STREET APARTMENT AND RETAIL DEVELOPMENT

WATER BALANCE SUMMARY

City of Barrie, Ontario

Project Number: 22-11672B

Date: April 10, 2024

Design By: DPH

Characteristic	Site		
	Pre-Development	Post Development	Change (Pre to Post)
Inputs (Volumes)			
Precipitation (m3/yr)	5100	5100	0.0%
Run-on (m3/yr)	0	0	0.0%
Other Inputs (m3/yr)	0	0	0.0%
Total Inputs (m3/yr)	5100	5100	**0.0%**
Output (Volumes)			
Precipitation Surplus (m3/yr)	2318	3638	56.9%
Net Surplus (m3/yr)	2318	3638	56.9%
Evapotranspiration (m3/yr)	2782	1463	-47.4%
Infiltration (m3/yr)	638	160	-74.9%
Rooftop Infiltration (m3/yr)	0	0	0.0%
Total Infiltration (m3/yr)	638	160	-74.9%
Runoff Pervious Areas (m3/yr)	919	231	-74.9%
Runoff Impervious Areas (m3/yr)	760	3247	0.0%
Total Runoff (m3/yr)	1679	3477	107.1%
Total Outputs (m3/yr)	5100	5100	**0.0%**

Table 3.1: Hydrologic Cycle Component Values

	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

* *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

To obtain a phosphorus removal credit, a best management practice (BMP) needs to be constructed as part of the proposed development. Phosphorus removal credit(s) will not be applied to existing natural features such as wetlands or stream buffers.

Phosphorus loading and percentage removal efficiencies are to comply with the applicable phosphorus tool (Ministry of the Environment (MOE) Tool, 2012 or latest version, or the low impact development (L.I.D.) TTT Tool) and associated documentation, unless otherwise specified below.

Supported Phosphorus Percentage Removal Efficiency by Tool

Ministry of the Environment (MOE) Tool

MOE Lake Simcoe Phosphorus Loading Development Tool (2012), including the supporting report titled "Phosphorus Budget Tool in Support of Sustainable Development for the Lake Simcoe Watershed" (Hutchinson, March 2012).

Land uses are to be consistent with Table 1 in the Hutchinson report.

Subsequent versions of this tool and documentation should be used to obtain the latest Ministry of the Environment, Conservation and Parks (MECP) accepted removal rates:

- Constructed Wetlands – 77%
- Dry Detention Ponds – 10%
- Infiltration Trenches – 60%
- Perforated Pipe Infiltration / Exfiltration System (not infiltration trenches) – 87%
- Sand or Media Filters – 45%
- Sorbtive Media Interceptors – 79%
- Vegetated Filter Strips / Stream Buffers – 65%
- Wet Detention Ponds – 63%
- Enhanced swale – 25%
- Oil and Grit Separators (O.G.S.) units, Environmental Technology Verification (ETV) verified – 20% (unless otherwise stated by ETV)
- Filter units (ETV verified/ Technology Assessment Protocol-Ecology (T.A.P.E.) approved) – 40% (unless otherwise verified by ETV/ T.A.P.E.)

Note: Facilities are to be designed in accordance with the MECP and Sustainable Technologies Evaluation Program (STEP) World Internet Knowledge Index (WIKI) L.I.D. Guidelines, to achieve enhanced quality control in order to be eligible for the above phosphorus reduction credits.

L.I.D. TTT Tool

- The default rates included within the L.I.D. TTT Tool should not be altered.

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: **447-455 Yonge Street Apartment and Retail Development**
Subwatershed: **Lovers Creek**

Total Pre-Development Area (ha):	**0.5580**	Total Pre-Development Phosphorus Load (kg/yr):	**0.04**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Low Intensity Development	0.558	0.07	0.04

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.019	1.32	Dry Detention Ponds	10%	0.02

Catchment 202 (Impervious Area): 10% TP Removal Benefit from Lovers Creek SWMF LV13

High Intensity - Residential	0.425	1.32	Other	28%	0.40

Catchment 201: 20% TP Removal Benefit from Hydroworks Hydrostorm HS-4 (ETV Certified), and 10% TP Removal Benefit from Lovers Creek SWMF LV13

Low Intensity Development	0.114	0.07	Dry Detention Ponds	10%	0.01

Catchment 202 & 203 (Landscape): 10% TP Removal Benefit from Lovers Creek SWMF LV13

Post-Development Area Altered:	**0.56**
Total Pre-Development Area:	**0.56**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.04**
Post-Development:	**0.59**
Change (Pre - Post):	**-0.56**
1421% Net Increase in Load	
Post-Development (with BMPs):	**0.43**
Change (Pre - Post):	**-0.39**
1010.28% Net Increase in Load	

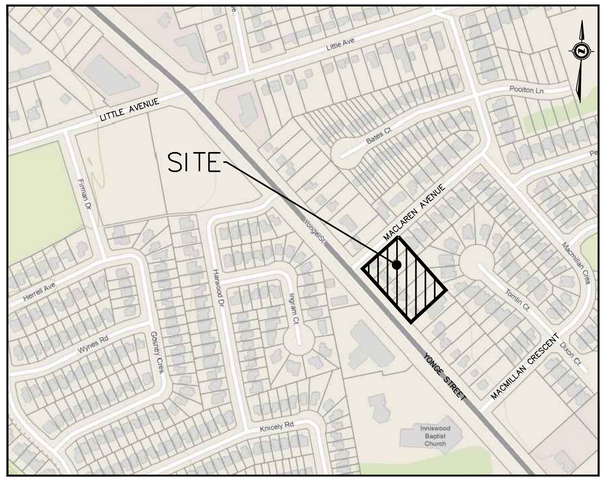
APPENDIX E

Engineering Drawings

PINESTONE ENGINEERING LTD.

PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
BARRIE, ONTARIO

Dwg.No.	Description
	TITLE PAGE
EX–1	EXISTING CONDITIONS AND PLAN
ESC–1	EROSION AND SEDIMENT CONTROL PLAN
ESC–2	EROSION AND SEDIMENT CONTROL DETAILS AND NOTES PLAN
SERV–1	SITE SERVICING PLAN
SERV–2	UNDERGROUND PARKING SERVICING PLAN
PP–1	MACLAREN AVENUE PLAN AND PROFILE – 0+000 TO 0+140
GP–1	SITE GRADING PLAN
PM–1	SITE PAVEMENT MARKINGS PLAN
PRE–1	PRE DEVELOPMENT CATCHMENT PLAN
POST–1	POST DEVELOPMENT CATCHMENT PLAN
DET–1	CONSTRUCTION NOTES AND DETAILS PLAN
DET–2	STANDARD DETAILS PLAN



SITE LOCATION

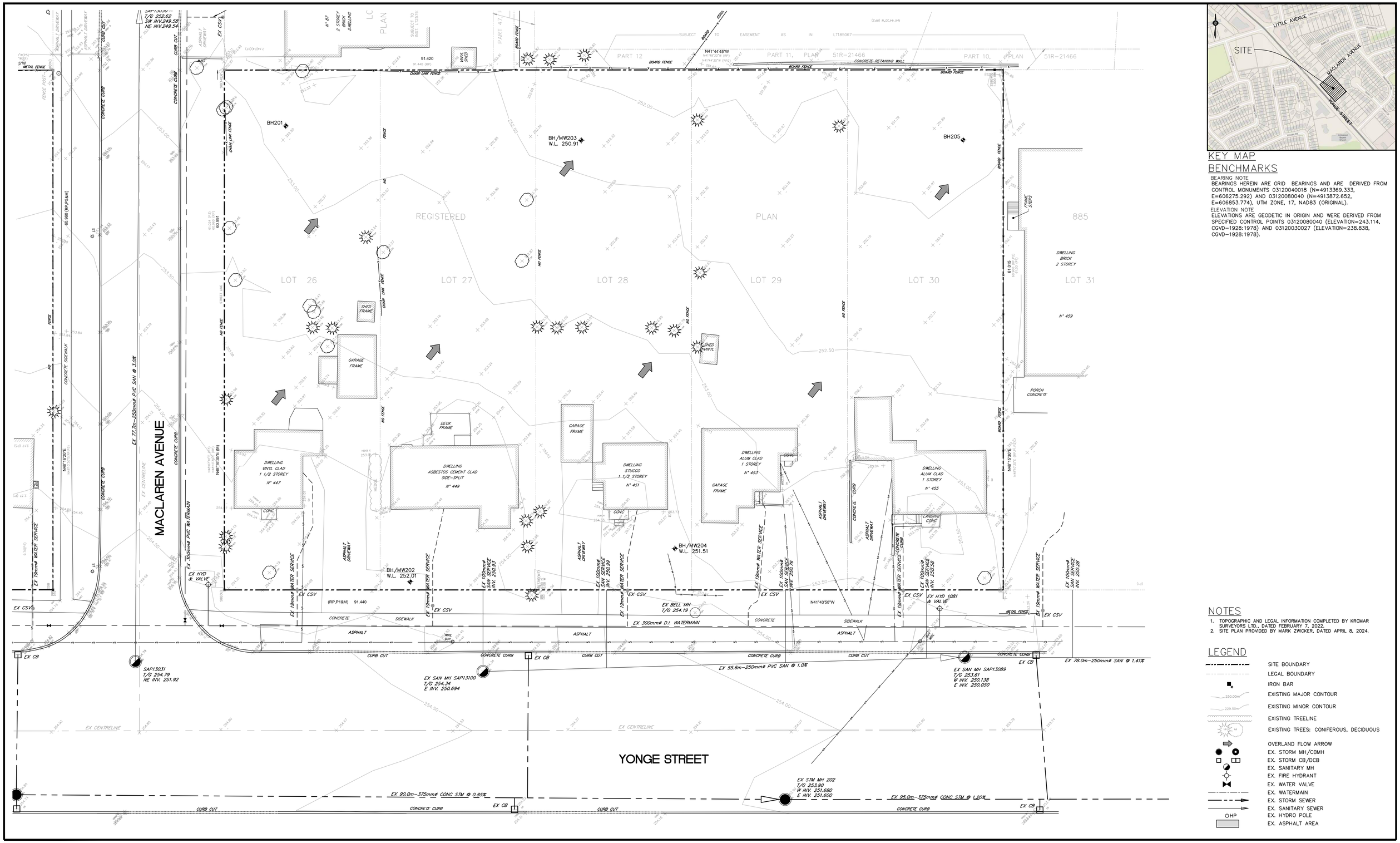
PUBLIC WORKS DEPARTMENT
CITY OF BARRIE DEVELOPMENT SERVICES
70 COLLIER STREET
BARRIE, ONTARIO
L4M 4T5

DEVELOPER
BARRIE YONGE DEVELOPMENTS GP INC.
80 MARITIME ONTARIO BLVD, UNIT 239
BRAMPTON, ONTARIO
L6S 0E7

DEVELOPER'S ENGINEER
PINESTONE ENGINEERING LTD.
20 BELL FARM ROAD, UNIT 1
BARRIE, ONTARIO
L4M 6E4

PEL
PINESTONE ENGINEERING LIMITED | www.pel.ca

1ST SPA SUBMISSION
MAY 2024
PEL Project No. 22-11672B



KEY MAP

BENCHMARKS

BEARING NOTE
BEARINGS HEREIN ARE GRID BEARINGS AND ARE DERIVED FROM CONTROL MONUMENTS 03120040018 (N=4913369.333, E=606275.292) AND 03120080040 (N=4913872.652, E=606853.774), UTM ZONE, 17, NAD83 (ORIGINAL).

ELEVATION NOTE
ELEVATIONS ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM SPECIFIED CONTROL POINTS 03120080040 (ELEVATION=243.114, CGVD-1928:1978) AND 03120030027 (ELEVATION=238.838, CGVD-1928:1978).

NOTES

1. TOPOGRAPHIC AND LEGAL INFORMATION COMPLETED BY KRCMAR SURVEYORS LTD., DATED FEBRUARY 7, 2022.
2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.

LEGEND

- SITE BOUNDARY
- LEGAL BOUNDARY
- IRON BAR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING TREELINE
- EXISTING TREES: CONIFEROUS, DECIDUOUS
- OVERLAND FLOW ARROW
- EX. STORM MH/CBMH
- EX. STORM CB/DCB
- EX. SANITARY MH
- EX. FIRE HYDRANT
- EX. WATER VALVE
- EX. WATERMAIN
- EX. STORM SEWER
- EX. SANITARY SEWER
- EX. HYDRO POLE
- EX. ASPHALT AREA

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them

Drawings shall not be used for construction unless sealed and signed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

Any errors and/or omissions shall be reported to Pinestone Engineering Ltd. without delay.

PEL
PINESTONE ENGINEERING LIMITED | www.pel.ca

SEAL
LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
100530228
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE:	DATE:
1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

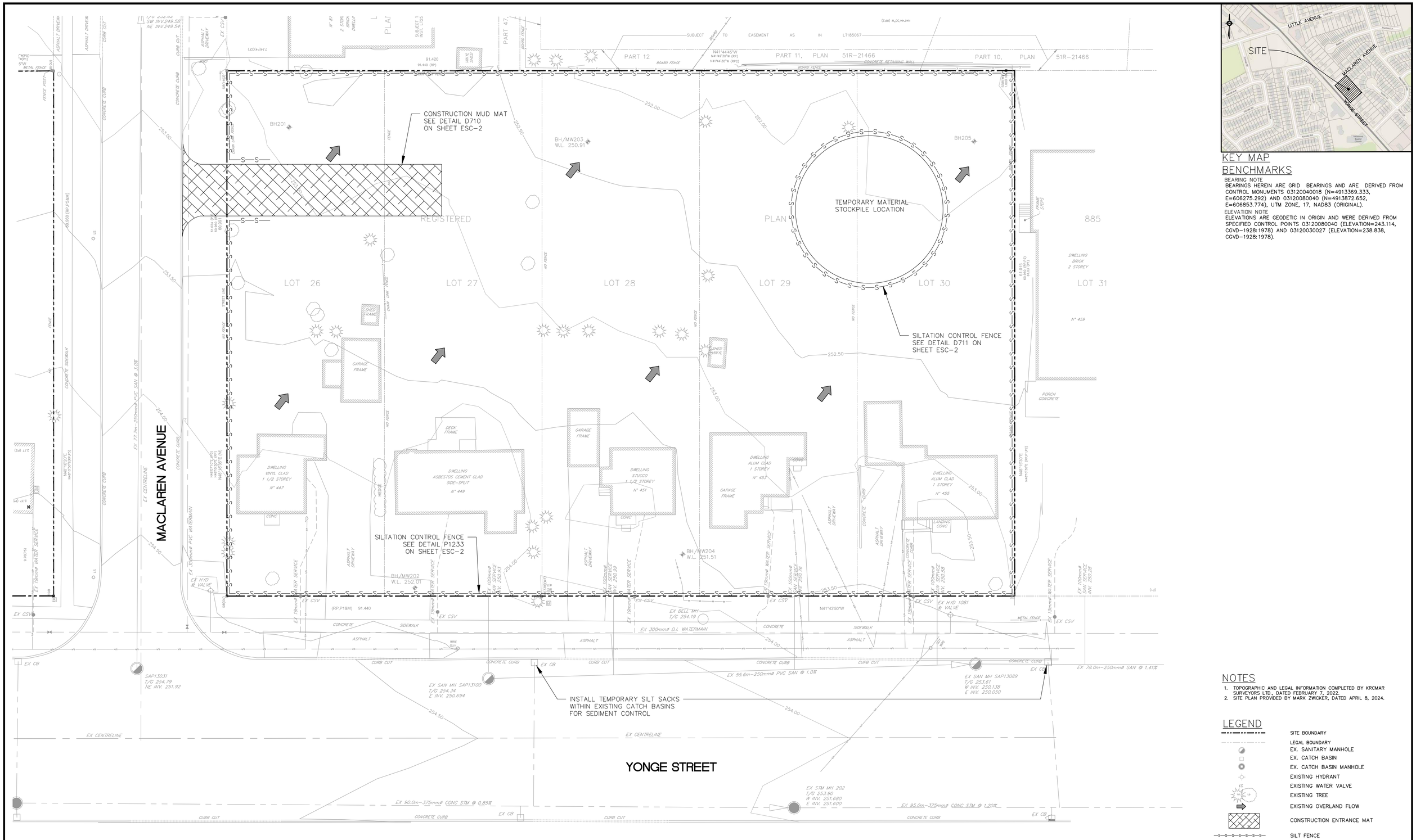
NORTH ARROW

PROJECT:
PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING:
EXISTING CONDITIONS PLAN

PROJECT No. : 22-11672B

DRAWING No. EX-1



KEY MAP

BENCHMARKS

BEARING NOTE
BEARINGS HEREIN ARE GRID BEARINGS AND ARE DERIVED FROM CONTROL MONUMENTS 03120040018 (N=4913369.333, E=606275.292) AND 03120080040 (N=4913872.652, E=606853.774), UTM ZONE, 17, NAD83 (ORIGINAL).

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NOTES

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2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.

LEGEND

- SITE BOUNDARY
- LEGAL BOUNDARY
- EX. SANITARY MANHOLE
- EX. CATCH BASIN
- EX. CATCH BASIN MANHOLE
- EXISTING HYDRANT
- EXISTING WATER VALVE
- EXISTING TREE
- EXISTING OVERLAND FLOW
- CONSTRUCTION ENTRANCE MAT
- SILT FENCE

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PEL
PINESTONE ENGINEERING LIMITED | www.pel.ca

SEAL

LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
100530228
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE:	DATE:
1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

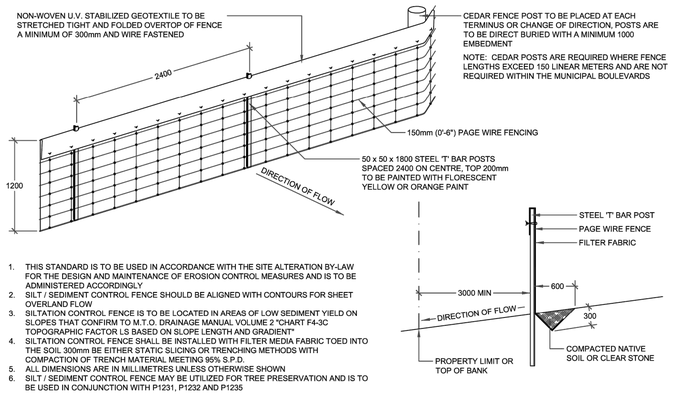
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: EROSION AND SEDIMENT CONTROL PLAN

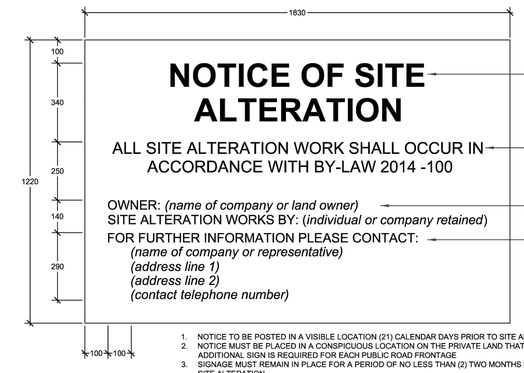
PROJECT No. : 22-11672B

DRAWING No. ESC-1



1. THIS STANDARD IS TO BE USED IN ACCORDANCE WITH THE SITE ALTERATION BY-LAW FOR THE DESIGN AND MAINTENANCE OF EROSION CONTROL MEASURES AND IS TO BE ADMINISTERED ACCORDINGLY.
2. SILT / SEDIMENT CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW
3. SILTATION CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFIRM TO M.T.O. DRAINAGE MANUAL VOLUME 2 "CHART F4-3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT"
4. SILTATION CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL 300mm BE EITHER STATIC SLICING OR TRENCHING METHODS WITH COMPACTION OF TRENCH MATERIAL MEETING 95% S.P.D.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN
6. SILT / SEDIMENT CONTROL FENCE MAY BE UTILIZED FOR TREE PRESERVATION AND IS TO BE USED IN CONJUNCTION WITH P1231, P1232 AND P1235

Barrie	FENCE SILTATION CONTROL	REV No. 3	DATE: APR 2023
			SCALE: N.T.S.
			P1233



1. NOTICE TO BE POSTED IN A VISIBLE LOCATION (21) CALENDAR DAYS PRIOR TO SITE ALTERATION ON THE PROPERTY
2. NOTICE MUST BE PLACED IN A CONSPICUOUS LOCATION ON THE PRIVATE LAND THAT IS ADJACENT TO A PUBLIC ROAD. AN ADDITIONAL SIGN IS REQUIRED FOR EACH PUBLIC ROAD FRONTAGE
3. SIGNAGE MUST REMAIN IN PLACE FOR A PERIOD OF NO LESS THAN (2) TWO MONTHS FOLLOWING THE COMMENCEMENT OF SITE ALTERATION
4. CONTACT INFORMATION TO CONTAIN THE ADDRESS AND TELEPHONE NUMBER OF A PERSON ACTING ON BEHALF OF THE COMPANY/LAND OWNER FOR WHOM FURTHER INFORMATION ON THE PROPOSED SITE ALTERATION MAY BE OBTAINED
5. COLOUR OF LETTERING TO BE BLACK ON WHITE
6. ALL DIMENSIONS ARE IN MILLIMETRES

Barrie	SIGN SITE ALTERATION NOTIFICATION	REV No. 2	DATE: APR 2023
			SCALE: N.T.S.
			P1237



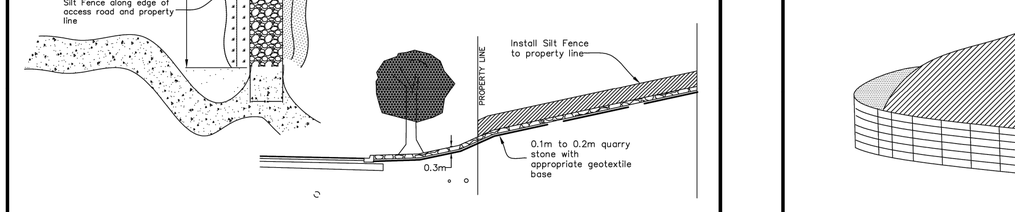
KEY MAP

NOTES

1. TOPOGRAPHIC AND LEGAL INFORMATION COMPLETED BY KRCMAR SURVEYORS LTD., DATED FEBRUARY 7, 2022.
2. SITE PLAN PROVIDED BY MARK ZWCKER, DATED APRIL 8, 2024.

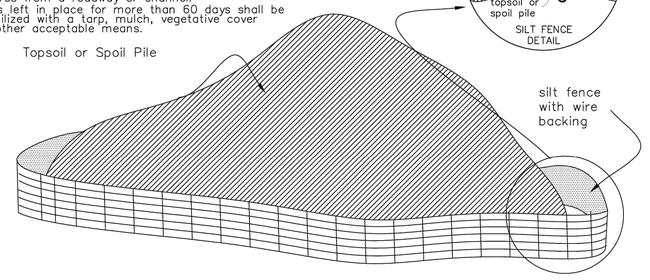
EROSION CONTROL NOTES:

1. All silt fencing to be installed prior to any grading or excavation.
2. Erosion control fencing to be installed around the base of all stockpiles.
3. Additional erosion control measures may be required as site development progresses. Contractor to provide all additional erosion control structures as directed by the engineer.
4. Pinestone Engineering Ltd. to monitor erosion control structures to ensure fencing is installed and maintenance is performed to municipal requirements.
5. Erosion control structures to be monitored regularly and after every rainfall. Any damage repaired immediately. Sediments to be removed when accumulations reach a maximum of 0.30m above the base of the fence.
6. All erosion control structures to remain in place until all disturbed ground have been re-stabilized either by paving or restoration of vegetative ground cover.
7. No alternate methods of erosion protection shall be permitted unless approved Pinestone Engineering Ltd. and the City of Barrie.
8. Install mud mat prior to any grading works onsite.
9. Contractor is responsible for municipal roadway to be cleared of all sediments from vehicular tracking etc. at the end of each day.

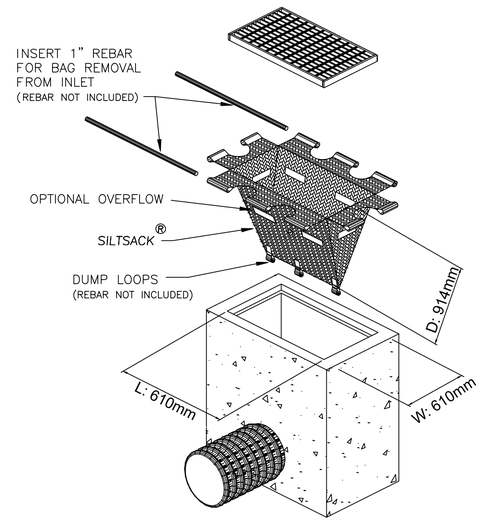


NOTES:
1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, 'CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES' AND IS TO BE ADMINISTERED ACCORDINGLY.
2. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
3. Construction mat is to be installed as the first step in the site alteration process.
4. Construction mats are required where paved roads are within 300m of the site.

Barrie	Construction Entrance	REV No. 2	DATE: APR 2023
			SCALE: N.T.S
			D710



Barrie	Siltation Control	REV No. 1	DATE: APR 2023
			SCALE: N.T.S
			D711



TYPICAL SILT SACK CONSTRUCTION TYPE B

BENCHMARKS

BEARING NOTE
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ELEVATION NOTE
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SEAL
LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
100530228
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY: C.A.	CHECKED BY: J.V.
DESIGNED BY: D.H.	
SCALE: 1:200	DATE: MAY 2024

NO.	YY.MM.DD	REVISION	BY

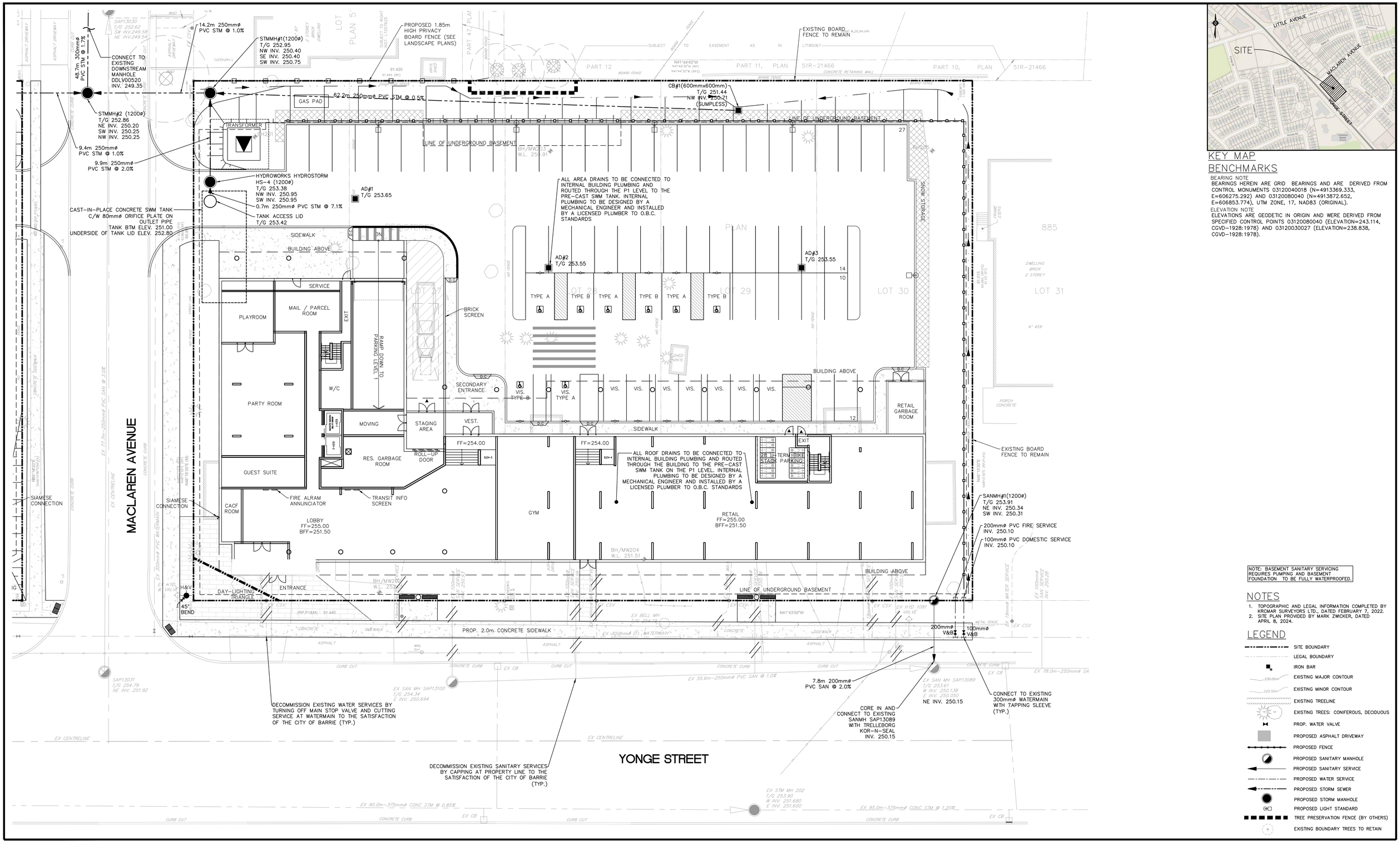
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

PROJECT No. : 22-11672B

DRAWING: EROSION AND SEDIMENT CONTROL DETAILS AND NOTES PLAN

DRAWING No. ESC-2



KEY MAP

BENCHMARKS

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NOTE: BASEMENT SANITARY SERVICING REQUIRES PUMPING AND BASEMENT FOUNDATION TO BE FULLY WATERPROOFED.

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2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.

LEGEND

- SITE BOUNDARY
- LEGAL BOUNDARY
- IRON BAR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING TREELINE
- EXISTING TREES: CONIFEROUS, DECIDUOUS
- PROP. WATER VALVE
- PROPOSED ASPHALT DRIVEWAY
- PROPOSED FENCE
- PROPOSED SANITARY MANHOLE
- PROPOSED SANITARY SERVICE
- PROPOSED WATER SERVICE
- PROPOSED STORM SEWER
- PROPOSED STORM MANHOLE
- PROPOSED LIGHT STANDARD
- TREE PRESERVATION FENCE (BY OTHERS)
- EXISTING BOUNDARY TREES TO RETAIN

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SEAL

D. P. HORDYK
100530028
2024-05-09
PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE:	DATE:
1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: SITE SERVICING PLAN

PROJECT No. : 22-11672B

DRAWING No. SERV-1



KEY MAP

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CONNECT TO EXISTING DOWNSTREAM MANHOLE DDLV00520 INV. 249.35

9.6m 250mmø PVC STM @ 1.0%

CBMH#1(1200ø) T/G 252.92 NW INV. 250.35 SE INV. 250.35

48.7m 300mmø PVC STM @ 1.7%

STMMH#2(1200ø) T/G 252.86 NE INV. 250.20 SW INV. 250.25 NW INV. 250.25

14.20m 250mmø PVC STM @ 1.0%

STMMH#1(1200ø) T/G 252.95 NW INV. 250.40 SE INV. 250.40 SW INV. 250.75

62.2m 250mmø PVC STM @ 0.5%

CB#1(600mmx600mm) T/G 251.44 NW INV. 250.71 (SUMPLESS)

9.9m 250mmø PVC STM @ 2.0%

NOTCH FOUNDATION WALL TO ACCOMODATE PROPOSED STORM SEWER

HYDROWORKS HYDROSTORM HS-4 (1200ø) T/G 253.38 NW INV. 250.95 SW INV. 250.95

0.7m 250mmø PVC STM @ 7.1%

TANK ACCESS LID T/G 253.42

CAST-IN-PLACE CONCRETE SWM TANK C/W 80mmø ORIFICE PLATE ON OUTLET PIPE TANK BTM ELEV. 251.00 UNDERSIDE OF TANK LID ELEV. 252.80

AD#1 T/G 253.65

ALL AREA DRAINS TO BE CONNECTED TO INTERNAL BUILDING PLUMBING AND ROUTED THROUGH THE P1 LEVEL TO THE PRE-CAST SWM TANK. INTERNAL PLUMBING TO BE DESIGNED BY A MECHANICAL ENGINEER AND INSTALLED BY A LICENSED PLUMBER TO O.B.C. STANDARDS

AD#2 T/G 253.55

AD#3 T/G 253.55

TRANSFORMER ABOVE

ELEC. ROOM

MECH. ROOM

LOCKERS

RAMP UP TO GROUND FLOOR

UP

134 PARKING SPACES
INCLUDING 0 ACCESSIBLE PARKING

EV PROVISION

SITE TRIANGLE

EX 77.7m-250mmø PVC SAN @ 1.0%

EX 300mmø D.I. WATERMAIN

EX HYD & VALVE

RELOCATE EXISTING HYDRANT AND VALVE PER BSD-W507

45° BEND

DECOMMISSION EXISTING WATER SERVICES BY TURNING OFF MAIN STOP VALVE AND CUTTING SERVICE AT WATERMAIN TO THE SATISFACTION OF THE CITY OF BARRIE (TYP.)

EX BELL MH T/G 254.19

EX SAN MH SAP1.3100 T/G 254.34 E INV. 250.694

SAP1.3031 T/G 254.79 NE INV. 251.92

EX 55.6m-250mmø PVC SAN @ 1.0%

DECOMMISSION EXISTING SANITARY SERVICES BY CAPPING AT PROPERTY LINE TO THE SATISFACTION OF THE CITY OF BARRIE (TYP.)

SANMH#1(1200ø) T/G 253.91 NE INV. 250.34 SW INV. 250.31

200mmø PVC FIRE SERVICE INV. 250.10

100mmø PVC DOMESTIC SERVICE INV. 250.10

EX HYD 1081

200mmø V&B 100mmø V&B

CONNECT TO EXISTING 300mmø WATERMAIN WITH TAPPING SLEEVE (TYP.)

7.8m 200mmø PVC SAN @ 2.0%

EX SAN MH SAP1.3089 T/G 253.61 W INV. 250.138 E INV. 250.050 NE INV. 250.15

CORE IN AND CONNECT TO EXISTING SANMH SAP1.3089 WITH TRELLEBORG KOR-N-SEAL INV. 250.15

EX 78.0m-250mmø SAN @

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NOTES

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LEGEND

- SITE BOUNDARY
- LEGAL BOUNDARY
- IRON BAR
- EXISTING MAJOR CONTOUR (230.00m)
- EXISTING MINOR CONTOUR (229.50m)
- EXISTING TREELINE
- EXISTING TREES: CONIFEROUS, DECIDUOUS
- PROP. WATER VALVE
- PROPOSED ASPHALT DRIVEWAY
- PROPOSED FENCE
- PROPOSED SANITARY MANHOLE
- PROPOSED SANITARY SERVICE
- PROPOSED WATER SERVICE
- PROPOSED STORM SEWER
- PROPOSED STORM MANHOLE

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PINESTONE ENGINEERING LIMITED | www.pel.ca

SEAL

LICENSED PROFESSIONAL ENGINEER D. P. HOROYK. 100530228 2024-05-08 PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE:	DATE:
1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

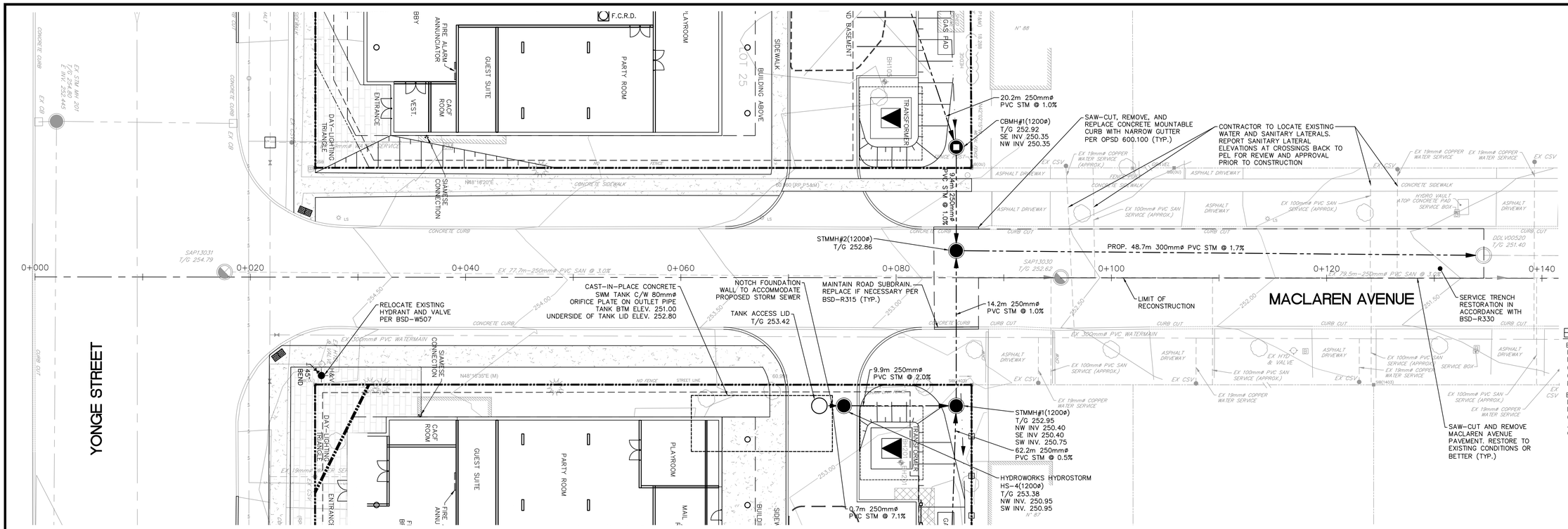
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

PROJECT No. : 22-11672B

DRAWING: UNDERGROUND PARKING SERVICING PLAN

DRAWING No. SERV-2



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SEAL

LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
100530228
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
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SCALE:	DATE:
HOR. 1:200 VERT. 1:40	MAY 2024

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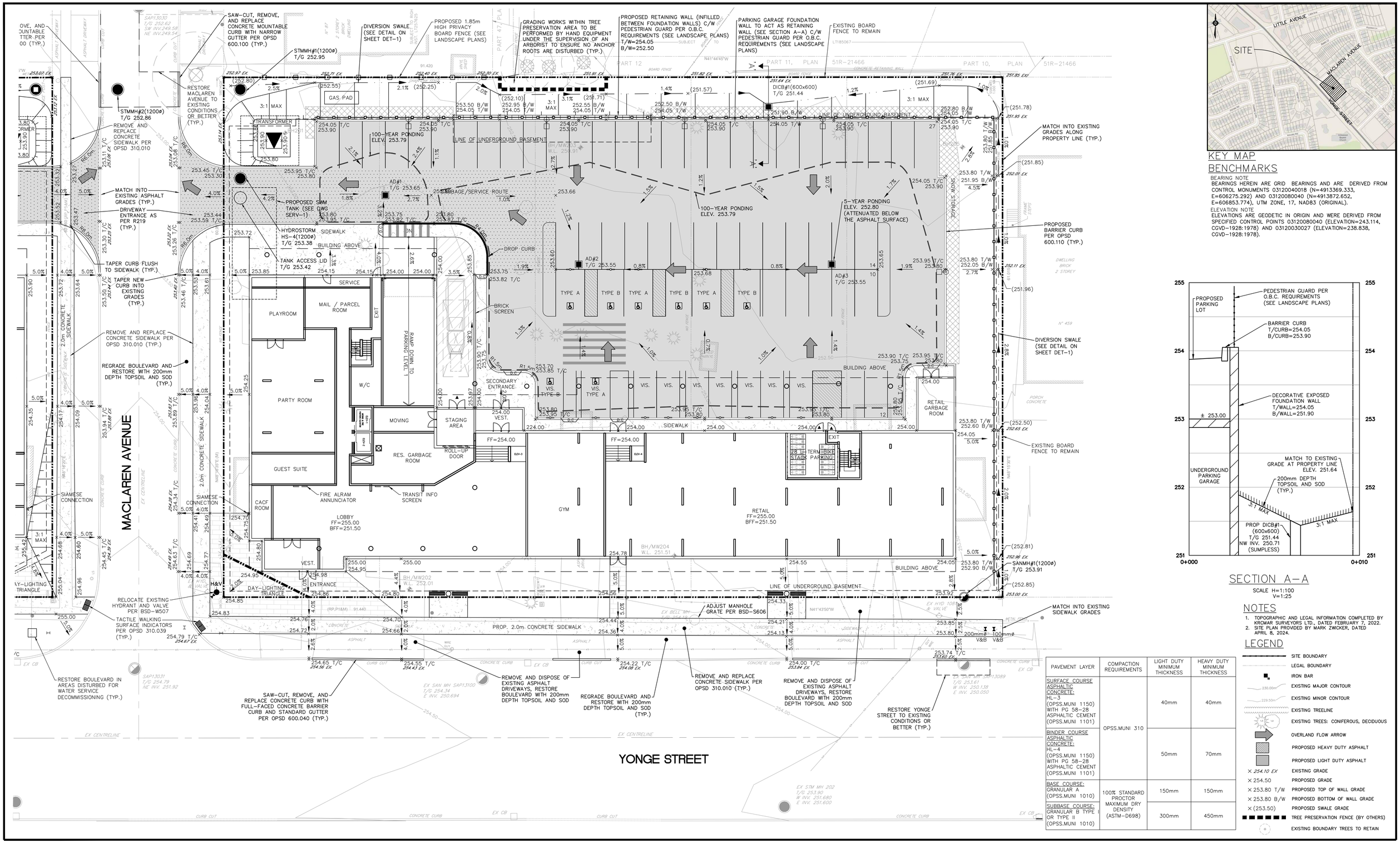
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: MACLAREN AVENUE
PLAN AND PROFILE
0+000 TO 0+140

PROJECT No. : 22-11672B

DRAWING No. PP-1



KEY MAP

BENCHMARKS

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SECTION A-A

SCALE H=1:100
V=1:25

NOTES

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2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.

LEGEND

- SITE BOUNDARY
- LEGAL BOUNDARY
- IRON BAR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING TREELINE
- EXISTING TREES: CONIFEROUS, DECIDUOUS
- OVERLAND FLOW ARROW
- PROPOSED HEAVY DUTY ASPHALT
- PROPOSED LIGHT DUTY ASPHALT
- × 254.10 EX — EXISTING GRADE
- × 254.50 — PROPOSED GRADE
- × 253.80 T/W — PROPOSED TOP OF WALL GRADE
- × 253.80 B/W — PROPOSED BOTTOM OF WALL GRADE
- × (253.50) — PROPOSED SWALE GRADE
- TREE PRESERVATION FENCE (BY OTHERS)
- EXISTING BOUNDARY TREES TO RETAIN

PAVEMENT LAYER	COMPACTION REQUIREMENTS	LIGHT DUTY MINIMUM THICKNESS	HEAVY DUTY MINIMUM THICKNESS
SURFACE COURSE ASPHALTIC CONCRETE: HL-3 (OPSS.MUNI 1150) WITH PG 58-28 ASPHALTIC CEMENT (OPSS.MUNI 1101)	OPSS.MUNI 310	40mm	40mm
BINDER COURSE ASPHALTIC CONCRETE: HL-4 (OPSS.MUNI 1150) WITH PG 58-28 ASPHALTIC CEMENT (OPSS.MUNI 1101)		50mm	70mm
BASE COURSE: GRANULAR A (OPSS.MUNI 1010)	100% STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM-D698)	150mm	150mm
SUBBASE COURSE: GRANULAR B TYPE II OR TYPE II (OPSS.MUNI 1010)		300mm	450mm

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SEAL

LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
100530228
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE:	DATE:
1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

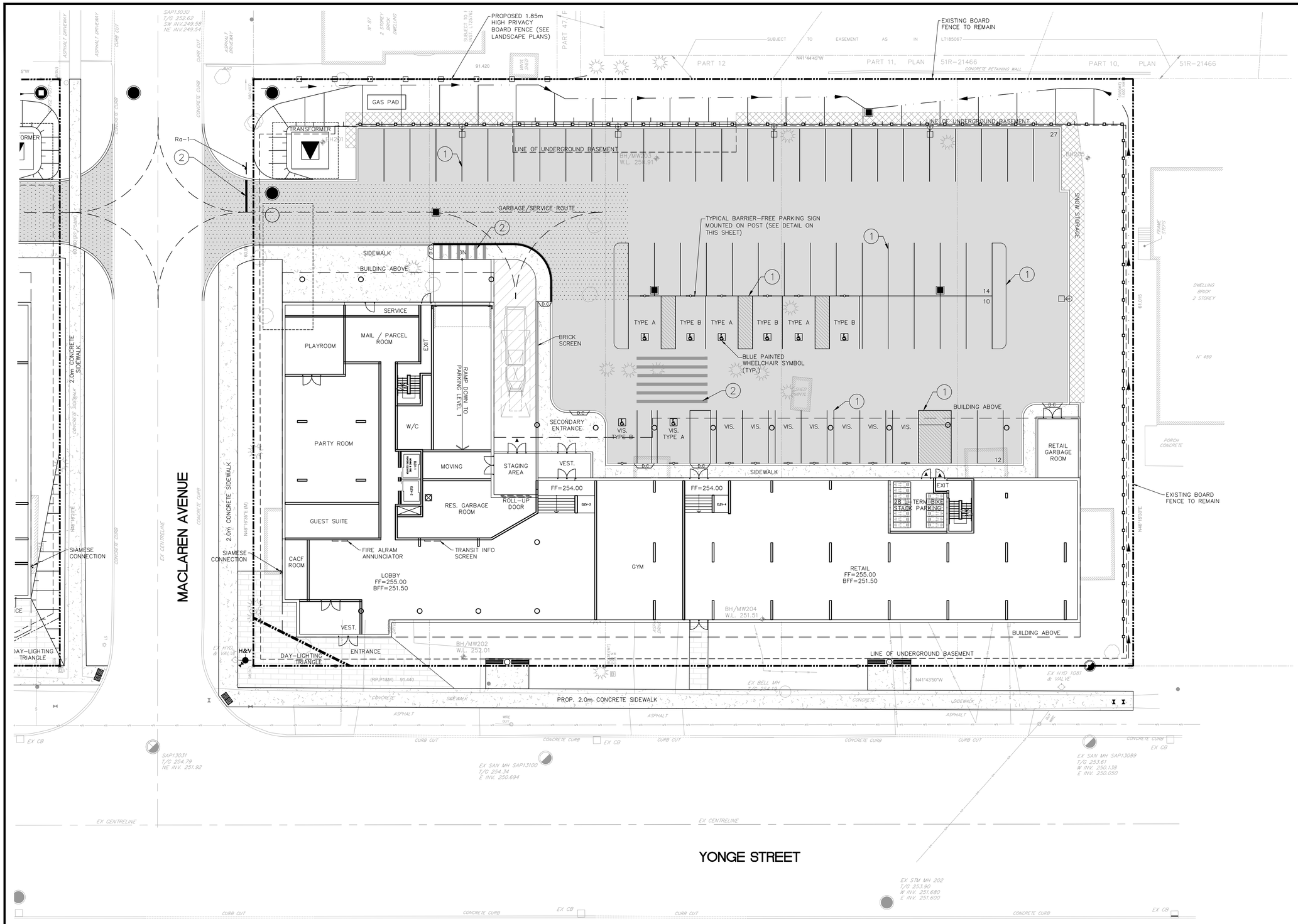
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: SITE GRADING PLAN

PROJECT No. : 22-11672B

DRAWING No. GP-1





KEY MAP

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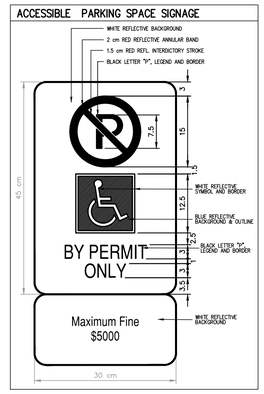
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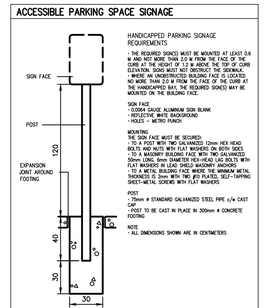
LEGEND

STOP / Ra-1	STOP SIGN (Ra-1)
1	SOLID WHITE, 10cm WIDTH
2	SOLID WHITE, 30cm WIDTH
	PROPOSED LIGHT DUTY ASPHALT AREA
	PROPOSED HEAVY DUTY ASPHALT AREA
	TACTILE PLATE PER OPSD 310.039 (TYP.)

ACCESSIBLE PARKING SPACE SIGNAGE



ACCESSIBLE PARKING SPACE SIGNAGE



HANDICAPPED PARKING SIGNAGE REQUIREMENTS

- THE REQUIRED SIGN(S) MUST BE MOUNTED AT LEAST 0.6 M AND NOT MORE THAN 2.0 M FROM THE FACE OF THE CURB, WITH A MINIMUM CLEARANCE OF 1.2 M ABOVE THE TOP OF CURB ELEVATION. THE BOTTOM OF THE SIGN SHALL BE NO LESS THAN 1.5 M ABOVE THE CURB ELEVATION.
- WHERE AN UNOBSTRUCTED WALKING FACE IS LOCATED NO MORE THAN 2.0 M FROM THE FACE OF THE CURB AT THE HANDICAPPED BAY, THE REQUIRED SIGN(S) MAY BE MOUNTED ON THE BUILDING FACE.

SIGN FACE
- 0.0064 GAUGE ALUMINUM SIGN BLANK
- REFLECTIVE WHITE BACKGROUND
- HOLES – METRO PUNCH

MOUNTING
THE SIGN FACE MUST BE SECURED:
- TO A POST WITH TWO GALVANIZED 12mm HEX HEAD BOLTS AND NUTS WITH FLAT WASHERS ON BOTH SIDES
- TO A CONCRETE BUILDING FACE WITH TWO GALVANIZED 50mm LONG, 6mm DIAMETER HEX-HEAD LAG BOLTS WITH FLAT WASHERS IN LEAD SHIELD MASONRY ANCHORS
- TO A METAL BUILDING FACE WHERE THE MINIMUM METAL THICKNESS IS 2mm WITH TWO Ø13 PLATED, SELF-TAPPING SHEET-METAL SCREWS WITH FLAT WASHERS

POST
- 75mm ø STANDARD GALVANIZED STEEL PIPE c/w CAST CAP
- POST TO BE CAST IN PLACE IN 300mm ø CONCRETE FOOTING

NOTE
- ALL DIMENSIONS SHOWN ARE IN CENTIMETERS

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Drawings shall not be used for construction unless sealed and signed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

Any errors and/or omissions shall be reported to Pinestone Engineering Ltd. without delay.

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LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
100530228
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE:	DATE:
1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

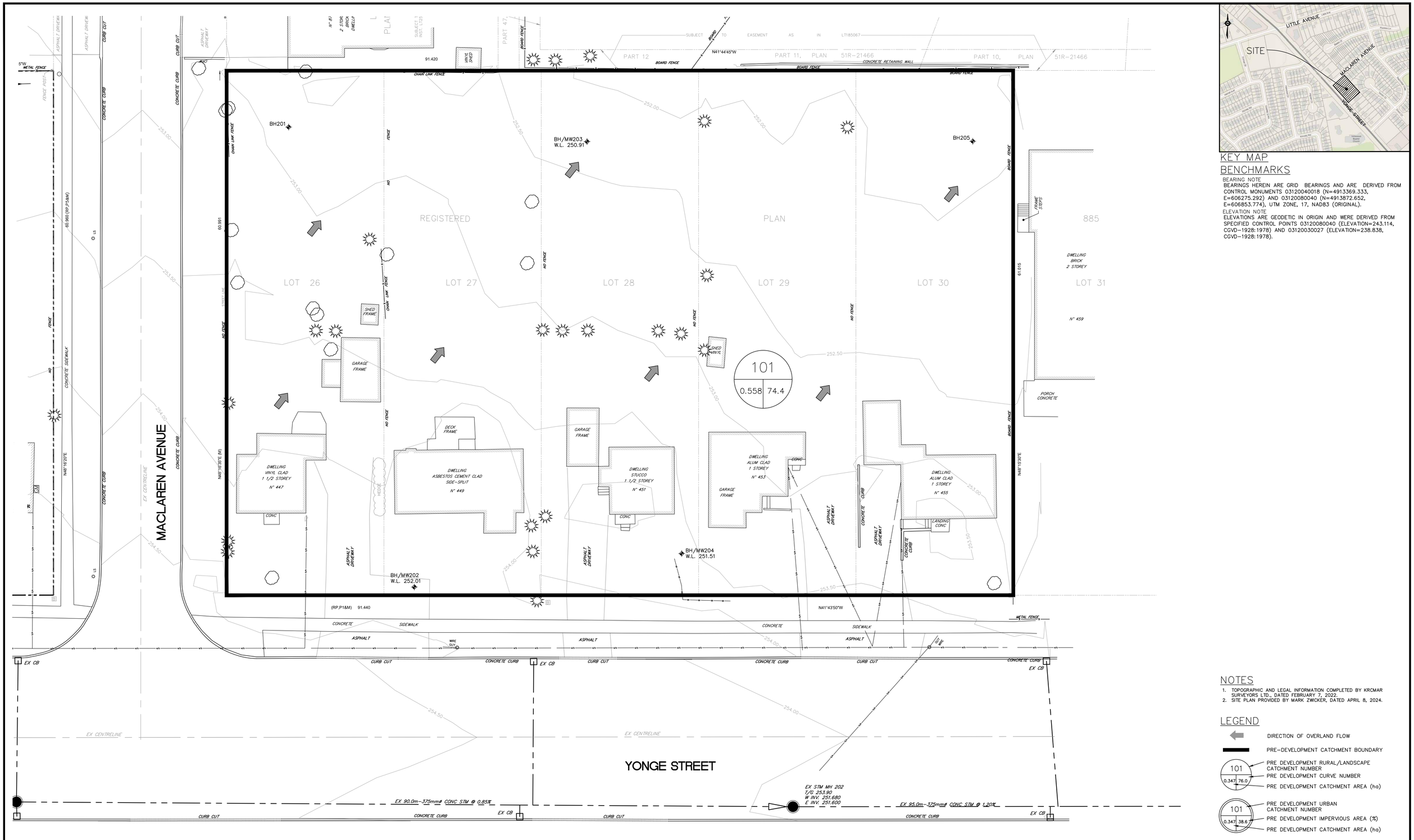
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: PAVEMENT MARKING AND SIGNAGE PLAN

PROJECT No. : 22-11672B

DRAWING No. PM-1



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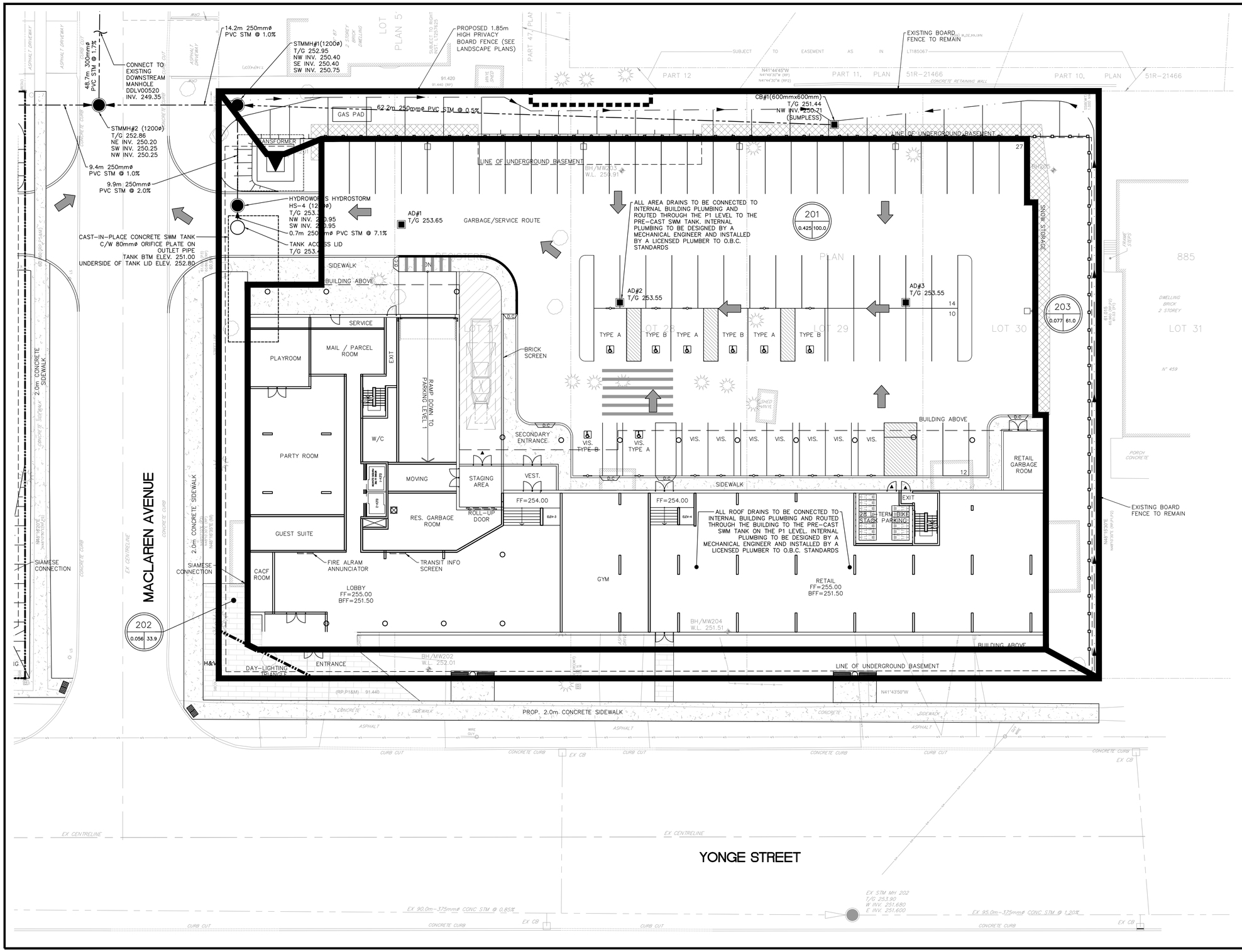
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: PRE DEVELOPMENT CATACHMENT PLAN

PROJECT No. : 22-11672B

DRAWING No. PRE-1





KEY MAP

BENCHMARKS

BEARING NOTE
BEARINGS HEREIN ARE GRID BEARINGS AND ARE DERIVED FROM CONTROL MONUMENTS 03120040018 (N=4913369.333, E=606275.292) AND 03120080040 (N=4913872.652, E=606853.774), UTM ZONE, 17, NAD83 (ORIGINAL).

ELEVATION NOTE
ELEVATIONS ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM SPECIFIED CONTROL POINTS 03120080040 (ELEVATION=243.114, CGVD-1928:1978) AND 03120030027 (ELEVATION=238.838, CGVD-1928:1978).

NOTES

1. TOPOGRAPHIC AND LEGAL INFORMATION COMPLETED BY KRCMAR SURVEYORS LTD., DATED FEBRUARY 7, 2022.
2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.

LEGEND

- DIRECTION OF OVERLAND FLOW
- POST-DEVELOPMENT CATCHMENT BOUNDARY
- 203 / 0.603 / 76.0 — POST DEVELOPMENT RURAL/LANDSCAPE CATCHMENT NUMBER; POST DEVELOPMENT CURVE NUMBER; POST DEVELOPMENT CATCHMENT AREA (ha)
- 201 / 0.313 / 62.8 — POST DEVELOPMENT URBAN CATCHMENT NUMBER; POST DEVELOPMENT IMPERVIOUS AREA (%); POST DEVELOPMENT CATCHMENT AREA (ha)

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1:200	MAY 2024

NO.	YY.MM.DD	REVISION	BY

NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

PROJECT No. : 22-11672B

DRAWING: POST DEVELOPMENT CATCHMENT PLAN

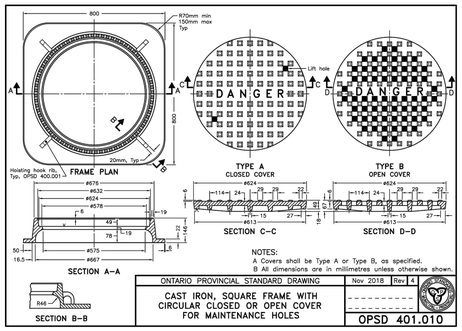
DRAWING No. POST-1

RESTORATION NOTES

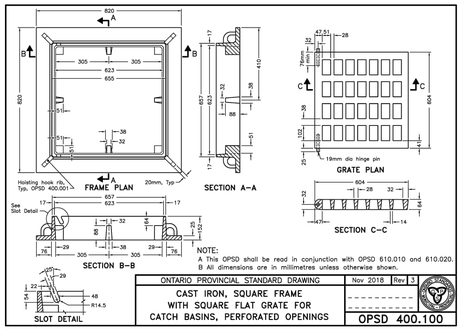
1. REINSTATE ROADS TO PREVIOUS CONDITION OR BETTER. MINIMUM PAVEMENT COMPOSITION:
   - YONGE STREET: 40mm HL1, 100mm HL4, 150mm GRANULAR 'A AND 1130mm GRANULAR 'B'.
   - MACLAREN AVENUE: 40mm HL3, 70mm HL4 OR HL8, 150mm GRANULAR 'A', AND 530mm GRANULAR 'B'.
2. CONTRACTOR TO RESTORE DRIVEWAYS AND BOULEVARD IN AREAS DISTURBED BY CONSTRUCTION TO EQUAL OR BETTER CONDITIONS.
3. MINIMUM GRAVEL DRIVEWAY RESTORATION TO BE 150mm, GRANULAR 'A'. ASPHALT DRIVEWAY RESTORATION TO BE 50mm OF HL3. AND 200mm GRANULAR 'A'
4. ALL GRASSED AREAS DISTURBED DURING CONSTRUCTION SHALL BE RESTORED WITH 200mm DEPTH TOPSOIL AND SOD. MAINTAIN UNTIL ESTABLISHED.
5. ALL RESTORATION WORK TO BE COMPLETED TO THE SATISFACTION OF THE ENGINEER.

PARKING LOT/DRIVEWAY NOTES

1. EXISTING SOILS AND GRANULAR MATERIALS TO BE REMOVED TO THE LIMITS SHOWN ON THE DRAWINGS AND ANY SURPLUS IS TO BE DISPOSED OFF-SITE AT A LOCATION CHOSEN BY, AND PAID FOR, BY THE CONTRACTOR.
2. PROPOSED SUB-GRADE TO BE INSPECTED AND PROOF-ROLLED IN THE PRESENCE OF THE GEOTECHNICAL ENGINEER AND APPROVED PRIOR TO PLACEMENT OF GRANULAR "B". DEFICIENT AREAS ARE TO BE SUB-EXCAVATED AND REPLACED WITH GRANULAR "B" AS DIRECTED BY THE GEOTECHNICAL ENGINEER.
3. THE GRANULAR SUB-BASE IS TO BE INSPECTED AND PROOF-ROLLED IN THE PRESENCE OF THE GEOTECHNICAL ENGINEER AND APPROVED PRIOR TO PLACEMENT OF THE GRANULAR "A".
4. THE GRANULAR BASE IS TO BE INSPECTED AND PROOF-ROLLED IN THE PRESENCE OF THE GEOTECHNICAL ENGINEER AND APPROVED PRIOR TO PLACEMENT OF THE ASPHALT.
5. CONTRACTOR TO PROVIDE SAMPLES OF GRANULAR MATERIALS AND THE ASPHALT MIX DESIGNS TO THE GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION.
6. GRANULAR MATERIALS TO BE UNIFORMLY COMPACTED TO MINIMUM 100% STANDARD PROCTOR MAXIMUM DRY DENSITY. HOT LAID ASPHALT TO BE ROLLED UNIFORMLY TO A MINIMUM OF 97% MARSHALL BULK DENSITY.
7. GRASSED AREAS DISTURBED DURING CONSTRUCTION TO BE RESTORED WITH MINIMUM 200mm TOPSOIL AND SOD.
8. TOPSOIL SHALL CONFORM TO OPSS 570, EXCEPT THAT TOPSOIL SHALL CONTAIN NOT LESS THAN 4% ORGANIC MATTER FOR CLAY LOAMS AND NOT LESS THAN 2% FOR SANDY LOAMS, WITH AN ACIDITY VALUE RANGING FROM P.H. 6.0 TO P.H. 7.5 AND CAPABLE OF SUSTAINING VIGOROUS PLANT GROWTH. IT SHALL BE FREE FROM ANY ADMIXTURE OF SUBSOIL, CLAY LUMPS, STONES GREATER THAN 25mm IN DIAMETER AND ANY OTHER EXTRANEOUS MATTER.
9. SOD SHALL CONFORM TO OPSS 571.



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 4
CAST IRON, SQUARE FRAME WITH CIRCULAR CLOSED OR OPEN COVER FOR MAINTENANCE HOLES		OPSD 401.010



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3
CAST IRON, SQUARE FRAME WITH SQUARE FLAT GRATE FOR CATCH BASINS, PERFORATED OPENINGS		OPSD 400.100

GENERAL NOTES

1. DRAWINGS

A. ALL DRAWINGS SHALL BE PRODUCED IN ACCORDANCE WITH CURRENT CITY OF BARRIE STANDARDS & SYMBOLS FOR PLAN & PROFILE DRAWINGS, GENERAL SERVICE PLANS AND LOT GRADING PLANS.

2. MEASUREMENTS

A. ALL DIMENSIONS ARE IN METRES, EXCEPT PIPE DIAMETERS, WHICH ARE IN MILLIMETRES, UNLESS SPECIFIED OTHERWISE.

3. GENERAL

A. ALL WORK SHALL BE IN ACCORDANCE WITH CURRENT CITY OF BARRIE STANDARD DRAWINGS (BSD) AND ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

B. ORDER OF PRECEDENCE OF STANDARD DRAWINGS IS FIRSTLY CITY OF BARRIE STANDARD DRAWINGS (BSD) AND SECONDLY ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

C. LOCATION OF EXISTING SERVICES ARE NOT GUARANTEED. THE CONTRACTOR IS REQUIRED TO NOTIFY THE VARIOUS UTILITY COMPANIES 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORK.

D. A ROAD OCCUPANCY PERMIT IS REQUIRED FROM THE ROADS AND PARKS OPERATIONS BRANCH PRIOR TO THE COMMENCEMENT OF WORK WITHIN ANY CITY RIGHT-OF-WAY.

E. A SITE ALTERATION PERMIT IS REQUIRED FROM THE ENGINEERING DEPARTMENT PRIOR TO THE COMMENCEMENT OF ANY EARTH WORKS ON THE SITE.

F. NATIVE MATERIAL, SUITABLE FOR BACKFILL, SHALL BE COMPACTED TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY.

G. GRANULAR MATERIAL , USED FOR BACKFILL , SHALL BE PLACED IN LAYERS 150mm IN DEPTH MAXIMUM AND COMPACTED TO 100% STANDARD PROCTOR MAXIMUM DRY DENSITY.

H. ALL DISTURBED AREAS ARE TO BE REINSTATED TO THEIR ORIGINAL CONDITION OR BETTER, AS DETERMINED BY THE CITY ENGINEERING DEPARTMENT.

I. ALL SILT CONTROL AND EROSION PROTECTION DEVICES ARE TO BE IN PLACE PRIOR TO THE COMMENCEMENT OF CONSTRUCTION AND SHALL REMAIN IN PLACE AND BE MAINTAINED BY THE CONTRACTOR UNTIL CONSTRUCTION IS COMPLETE AND THE GRASS HAS ESTABLISHED GROWTH, SUBJECT TO APPROVAL BY THE CITY ENGINEERING DEPARTMENT.

Barrie	Development General Notes	REV No. 5	DATE: APR 2023
			SCALE: N.T.S
			G200B

GENERAL NOTES - WATERMAIN

1. CONTRACTORS SHALL INFORM THE CITY OF BARRIE WATER OPERATIONS DEPARTMENT A MINIMUM OF 48 HOURS IN ADVANCE OF THEIR INTENTIONS TO PERFORM WORK ON WATER INFRASTRUCTURE.

2. OPERATION OF HYDRANTS AND VALVES ON THE POTABLE WATER SYSTEM BY OTHER THAN QUALIFIED WATER OPERATIONS STAFF IS PROHIBITED BY CURRENT BY-LAW. CITY SERVICE FEES ARE PER THE CURRENT FEES BY-LAW. THE CITY'S WATER OPERATIONS STAFF WILL SWAB, PRESSURE TEST, CHLORINATE AND FLUSH ALL NEW WATERMAINS.

3. MINIMUM COVER OVER WATERMAIN SHALL BE 1.7m. THE MINIMUM HORIZONTAL SEPARATION BETWEEN WATERMAIN AND SEWERS SHALL BE 2.5m. WHERE WATERMAIN CONFLICTS WITH SEWER PIPES, DEFLECT WATERMAIN HORIZONTALLY OR VERTICALLY WHILE PROVIDING A MINIMUM OF 0.5m CLEARANCE BETWEEN WATERMAIN AND SEWERS. MAINTAIN MINIMUM DEPTH OF COVER AT ALL TIMES.

4. WATERMAIN SHALL BE INSTALLED IN BEDDING AS PER OPSD 802.010 (GRANULAR 'A' EMBEDMENT MATERIAL) FOR FLEXIBLE PIPES AND OPSD 802.030 OR 802.031 CLASS 'B' (GRANULAR 'A' BEDDING MATERIAL, GRANULAR 'A' OR SELECT NATIVE COVER MATERIAL) FOR RIGID PIPE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF WATER OPERATIONS. ALTERNATIVE EMBEDMENT MATERIAL - SAND MEETING GRADATION REQUIREMENTS OF OPSS.MUNI 1004.05.07 COMPACTED TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY IS PERMISSIBLE WHERE NOTED IN STANDARD DETAILS. GEOTECHNICAL CERTIFICATION OF MATERIAL AND COMPACTION TESTING MUST BE PROVIDED EVERY 150 METRES. THE COMPACTION TESTING MUST INCLUDE THE ENTIRE EMBEDMENT ENVELOPE (HAUNCHES, BEDDING, TOP OF PIPE AND COVER).

5. COPPER WATER MAINS AND SERVICES 25mm TO 50mm IN DIAMETER SHALL BE EMBEDDED IN SAND 100mm ABOVE AND BELOW TO CONFORM TO OPSS.MUNI 1004.05.07.

6. RESTRAINING WILL BE REQUIRED ON ALL HYDRANTS. THRUST BLOCKS, AS PER OPSD 1103.010 AND 1103.020. RESTRAINING DEVICES MAY BE REQUIRED IN ADDITION TO STANDARD CONCRETE THRUST BLOCKING WHERE SOIL CONDITIONS WARRANT AT THE CITY'S DISCRETION.

7. NEW WATERMAINS TO BE PVC DR18 CL150 MINIMUM; DUCTILE IRON CL52 AS PER THE APPROVED MANUFACTURERS PRODUCTS FOR LINEAR WATER SYSTEMS LIST.

8. TRACING WIRE SHALL BE #12 AWG HIGH STRENGTH COPPER CLAD (HS-CSS) AND SHALL BE INSTALLED ON THE TOTAL LENGTH OF ALL WATERMAIN AND BROUGHT UP AT EACH HYDRANT AND TERMINATED INSIDE A HYDRANT TEST STATION. ALL SPLICES TO UTILIZE CONNECTORS AS PER THE APPROVED MANUFACTURERS PRODUCTS FOR LINEAR WATER SYSTEMS LIST.

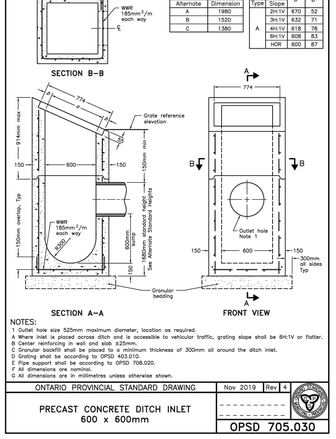
9. ALL WATER SERVICES SHALL BE MINIMUM 25mm TYPE 'K' COPPER OR 25mm CROSS-LINKED POLYETHYLENE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF WATER OPERATIONS. WATER SERVICE SADDLES SHALL BE USED WHEN TAPPING INTO PVC WATERMAIN.

10. SERVICE TAPPINGS SHALL BE PLACED AT A MINIMUM SEPARATION OF 1.0m AND A MINIMUM OF 0.6m FROM JOINTS. (ENDS OF PIPE)

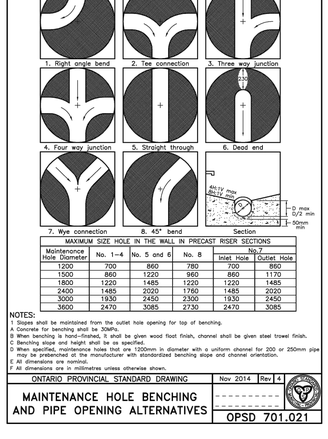
11. RISER PIPES ARE TO BE INSTALLED AS PER BSD-510, AND REMOVED AS DIRECTED. SWABBING SCHEDULE TO BE SUPPLIED BY A WATER OPERATIONS FIELD REPRESENTATIVE. ALL RISERS ARE TO BE RESTRAINED OR THRUST BLOCKED.

12. ALL NEW CURB STOPS AND BOXES TO BE LOCATED AT PROPERTY LINE AND OUT OF DRIVEWAYS AND SIDEWALKS.

Barrie	Watermain General Notes	REV No. 4	DATE: APR 2023
			SCALE: N.T.S.
			W539



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 4
PRECAST CONCRETE DITCH INLET 600 x 600mm		OPSD 705.030



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 4
MAINTENANCE HOLE BENCHING AND PIPE OPENING ALTERNATIVES		OPSD 701.021

STORM SEWER

A. STORM SEWER TO BE PROVIDED ON ALL ROADS WITH CURB AND GUTTER.

B. PLACE ALL CATCH BASIN LATERALS AT 2% GRADE UNLESS OTHERWISE NOTED. PIPE SIZE MINIMUM 250mm DIA. SINGLE , 300mm DIA. DOUBLE.

C. STORM SEWERS SHALL BE CONSTRUCTED WITH BEDDING AS PER OPSD-802.010 (GRAN. 'A' EMBEDMENT MATERIAL) FOR FLEXIBLE PIPES AND OPSD-802.030 OR 802.031 CLASS B (GRAN. 'A' BEDDING MATERIAL) FOR RIGID PIPE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF ENGINEERING.

D. MAINTENANCE HOLE TOPS (FRAMES) AND CATCH BASIN (FRAMES) ARE TO BE SET TO BASE COURSE ASPHALT GRADE AND THEN ADJUSTED TO FINAL GRADE WHEN THE TOP LIFT OF ASPHALT IS PLACED. ALL ADJUSTMENT WILL BE ACCORDANCE WITH BSD-N2.

E. STORM SEWER TO BE LOCATED OFFSET 3.0m SOUTH OR EAST OF CENTRELINE UNLESS OTHERWISE SPECIFIED.

F. ALL CONNECTIONS TO THE STORM MAIN SHALL BE MADE WITH A STORM MANHOLE OR APPROVED FACTORY TEE CONNECTION AS PER OPSD–708.01 OR 708.03.

G. PIPE MATERIAL TO BE REINFORCED CONCRETE WITH A MINIMUM STRENGTH OF 50 N/m/mm CERTIFIED TO C.S.A. STANDARD A247.2–1982, CLASS 50–D (PREVIOUSLY C.S.A. STANDARD A257.2–1974, CLASS II) OR PVC CERTIFIED TO C.S.A. STANDARDS 182.2 AND 182.4.

H. STORM SEWER TO BE MINIMUM 300mm DIAMETER WITH JOINTS CONFORMING TO C.S.A. STANDARD A257.3.

I. ALL PIPE BEDDING MUST CONFORM TO OPSD, MAXIMUM COVER TABLE. NO FLEXIBLE PIPE SEWERS WILL BE INSTALLED WITH A DEPTH OF COVER GREATER THAN 6 METRES UNLESS SPECIFICALLY APPROVED BY THE DIRECTOR OF ENGINEERING.

J. ALL PIPE HANDLING INSTALLATIONS MUST BE IN STRICT COMPLIANCE WITH MANUFACTURES INSTALLATION GUIDES AND THE O.C.P.A. OR UNIBELL GUIDELINES.

K. SUMP PUMP DISCHARGE PIPING IN BOULEVARD:
IN THE EVENT OF OVERACTIVE SUMP PUMP ACTIVITY, A 150mm DIAMETER PVC DR–28 SEWER MAY BE INSTALLED, WHEN SO DIRECTED BY THE DIRECTOR OF ENGINEERING, ALONG THE FRONTAGES OF DESIGNATED LOTS, WITH AN OFFSET OF 0.6m FROM BACK OF CURB. THIS SEWER IS TO BE CAPPED AT THE UPSTREAM END AND IS TO OUTLET INTO THE NEAREST CATCHBASIN DOWNSTREAM. DEPTH OF SEWER IS TO BE EQUAL TO SUBDRAIN DEPTH. NOT TO BE DIRECTLY CONNECTED TO FOUNDATION DRAINS.

Barrie	Storm Sewers General Notes	REV No. 5	DATE: APR 2023
			SCALE: N.T.S
			D788



KEY MAP

NOTES

1. TOPOGRAPHIC AND LEGAL INFORMATION COMPLETED BY KRCMAR SURVEYORS LTD., DATED FEBRUARY 7, 2022.
2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.

GENERAL NOTES

SANITARY SEWERS

A. SANITARY SEWER TO BE LOCATED AT THE CENTRELINE OF THE ROAD.

B. SEWERS SHALL BE CONSTRUCTED WITH BEDDINGS AS PER OPSD-1005.02, (GRAN. 'A' EMBEDMENT MATERIAL) FOR FLEXIBLE PIPES AND OPSD-1005.01 CLASS B (GRAN. 'A') FOR RIGID PIPE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF MUNICIPAL WORKS.

C. MAXIMUM DEFLECTION FROM COMBINED LIVE AND DEAD LOADING SHALL NOT EXCEED ANY C.S.A., O.P.S. OR MANUFACTURES RECOMMENDED SPECIFICATIONS.

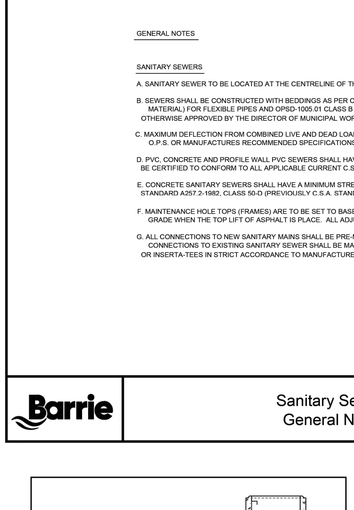
D. PVC, CONCRETE AND PROFILE WALL PVC SEWERS SHALL HAVE RUBBER GASKET TYPE JOINTS AND SHALL BE CERTIFIED TO CONFORM TO ALL APPLICABLE CURRENT C.S.A. SPECIFICATIONS.

E. CONCRETE SANITARY SEWERS SHALL HAVE A MINIMUM STRENGTH OF 50 N/m/mm CONFORMING TO CSA STANDARD A257.2-1982, CLASS 50-D (PREVIOUSLY C.S.A. STANDARD A257.2-1974, CLASS II).

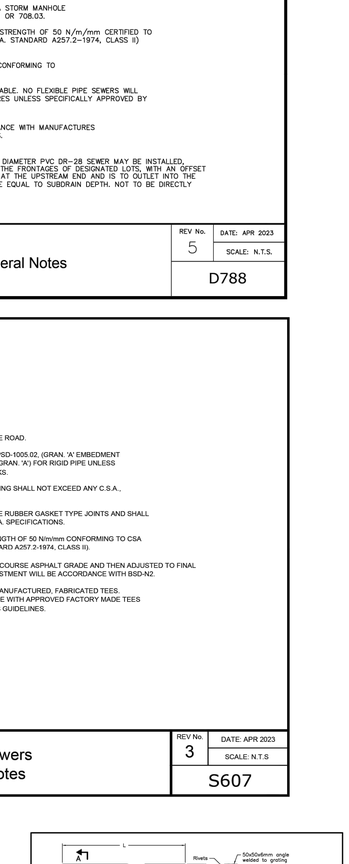
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G. ALL CONNECTIONS TO NEW SANITARY MAINS SHALL BE PRE-MANUFACTURED, FABRICATED TEES. CONNECTIONS TO EXISTING SANITARY SEWER SHALL BE MADE WITH APPROVED FACTORY MADE TEES OR INSERTA-TEES IN STRICT ACCORDANCE TO MANUFACTURES GUIDELINES.

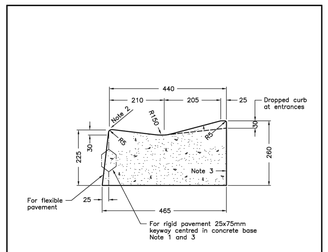
Barrie	Sanitary Sewers General Notes	REV No. 3	DATE: APR 2023
			SCALE: N.T.S
			S607



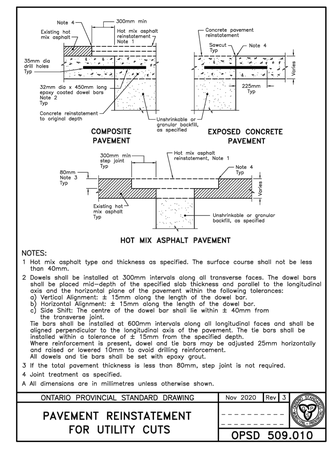
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 5
PRECAST CONCRETE MAINTENANCE HOLE 1200mm DIAMETER		OPSD 701.010



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2017	Rev 3
GALVANIZED STEEL HONEYCOMB GRATING FOR DITCH INLETS		OPSD 403.010



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2012	Rev 2
CONCRETE MOUNTABLE CURB WITH NARROW GUTTER		OPSD 600.100



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2020	Rev 3
PAVEMENT REINSTATEMENT FOR UTILITY CUTS		OPSD 509.010

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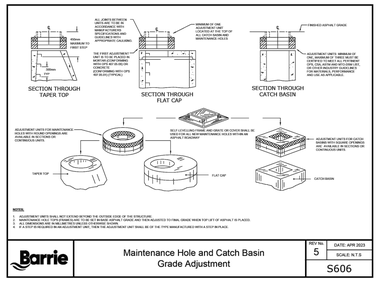
NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

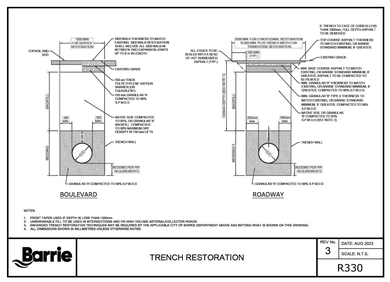
PROJECT No. : 22-11672B

DRAWING: CONSTRUCTION NOTES AND DETAILS PLAN

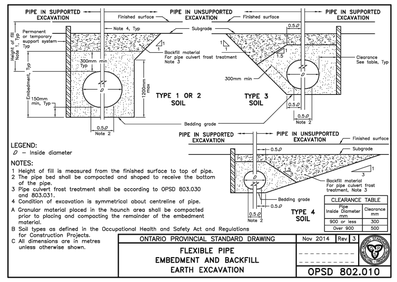
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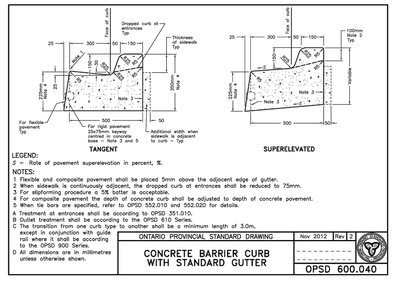
Barrie | Maintenance Hole and Catch Basin Grade Adjustment | REV No. 5 | DATE: APR 2023 | SCALE: N.T.S. | S606



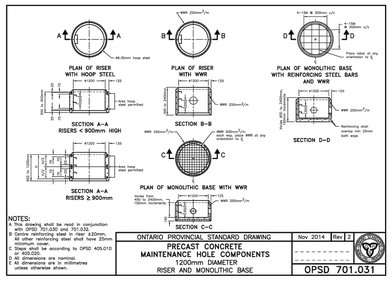
Barrie | TRENCH RESTORATION | REV No. 3 | DATE: AUG 2023 | SCALE: N.T.S. | R330



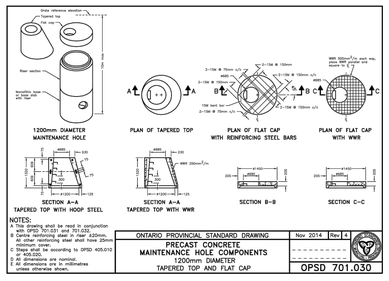
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2014 | Rev 3
FLEXIBLE PIPE EMBEDMENT AND BACKFILL EARTH EXCAVATION
OPSD 802.010



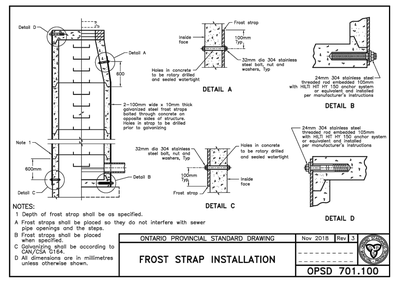
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2012 | Rev 2
CONCRETE BARRIER CURB WITH STANDARD GUTTER
OPSD 600.040



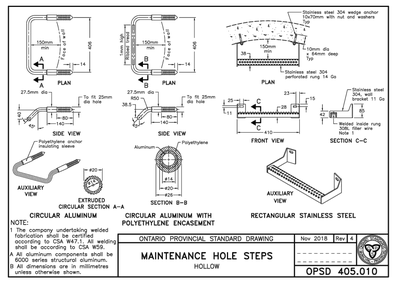
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2014 | Rev 2
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS 1200mm DIAMETER RISER AND MONOLITHIC BASE
OPSD 701.031



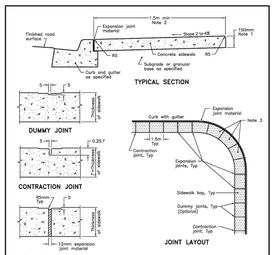
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2014 | Rev 4
PRECAST CONCRETE MAINTENANCE HOLE COMPONENTS 1200mm DIAMETER TAPERED TOP AND FLAT CAP
OPSD 701.030



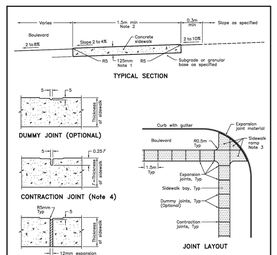
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2018 | Rev 3
FROST STRAP INSTALLATION
OPSD 701.100



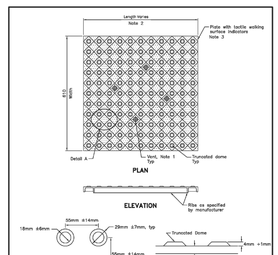
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2018 | Rev 4
MAINTENANCE HOLE STEPS HOLLOW
OPSD 405.010



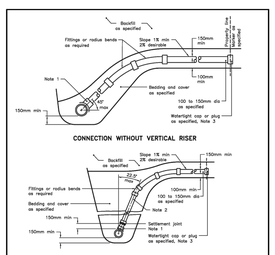
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2019 | Rev 3
CONCRETE SIDEWALK ADJACENT TO CURB WITH GUTTER
OPSD 310.020



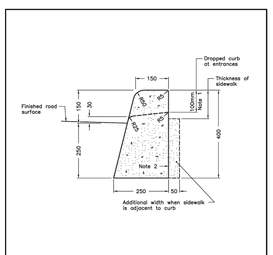
ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2019 | Rev 3
CONCRETE SIDEWALK
OPSD 310.010



ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2019 | Rev 1
CONCRETE SIDEWALK RAMPS TACTILE WALKING SURFACE INDICATORS COMPONENT
OPSD 310.039



ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2021 | Rev 4
SEWER SERVICE CONNECTIONS FOR MAIN PIPE SEWER
OPSD 1006.010

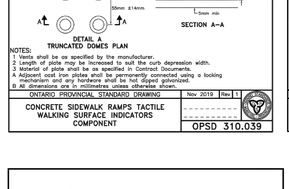


ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2012 | Rev 2
CONCRETE BARRIER CURB
OPSD 600.110

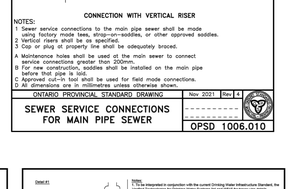
Barrie | DRIVEWAY AND ENTRANCE DETAIL | REV No. 2 | DATE: APR 2023 | SCALE: N.T.S. | R319



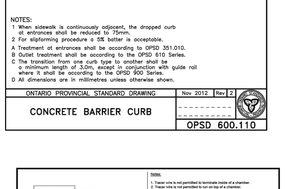
Barrie | ROAD SUBDRAIN | REV No. 2 | DATE: APR 2023 | SCALE: N.T.S. | R315



Barrie | Water Service 100mm to 300mm | REV No. 2 | DATE: APR 2020 | SCALE: N.T.S. | W505



Barrie | Hydrant and Valve | REV No. 4 | DATE: APR 2024 | SCALE: N.T.S. | W507



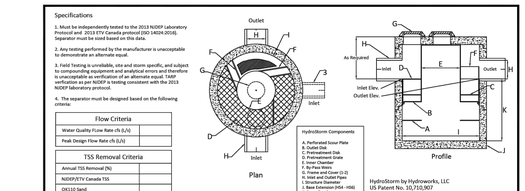
Barrie | Water Infrastructure Tracer Wire | REV No. 6 | DATE: APR 2024 | SCALE: N.T.S. | W515



KEY MAP

NOTES

1. TOPOGRAPHIC AND LEGAL INFORMATION COMPLETED BY KRCMAR SURVEYORS LTD., DATED FEBRUARY 7, 2022.
2. SITE PLAN PROVIDED BY MARK ZWICKER, DATED APRIL 8, 2024.



The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them

Drawings shall not be used for construction unless sealed and signed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

Any errors and/or omissions shall be reported to Pinestone Engineering Ltd. without delay.

PEL
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SEAL
LICENSED PROFESSIONAL ENGINEER
D. P. HORDYK
10053028
2024-05-09
PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
C.A.	J.V.
DESIGNED BY:	
D.H.	
SCALE: 1:200	DATE: MAY 2024

NO.	YY.MM.DD	REVISION	BY

NORTH ARROW

PROJECT: PROPOSED APARTMENT AND RETAIL DEVELOPMENT
447-455 YONGE STREET
CITY OF BARRIE

DRAWING: STANDARD DETAILS PLAN

PROJECT No. : 22-11672B

DRAWING No. DET-2