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STORMWATER MANAGEMENT

AT

ELEPHANT LAKE COTTAGES
HARCOURT, DYSART ET AL, ONTARIO

PREPARED FOR:

95 DEVELOPMENTS

July 31, 2024

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1. Site Background

King EPCM (the Engineer) was retained by the Client (95 Developments) to conduct engineering investigations and services, including the creation of a Stormwater Management Plan (SWM), as part of cottage permit submissions. The property is located along the shoreline of Elephant Lake and Benoir Lake within parts or whole of Lots 32 and 33, Concession 12, Lots 27-31, Concession 11, Lots 27-31, Concession 10, Lots 27-33, Concession 9, and Lots 27-31, Concession 8, Harcourt Township, County of Haliburton, Municipality of Dysart et al. (Site).

The property has a wide variety of landscapes, including dense forests, wetlands, rocky cliff escarpments, sandy valley lands, clay slopes, and sandy beaches. The Site property is approximately 2000 Acres in size, divided into three different Blocks (phases), Eastern phase (no background color) with approximate area of 6,776,705 m², Northern phase (light gray color) with approximate area of 405,584.6 m², and finally, Southern phase (dark gray background color) with approximate area of 852,307.2 m² (Fig. 2). While Northern phase is completely located east of Benoir Lake, behind Benoir Lake Rd., the Southern phase is extended from the west-south boundary (east of Elephant Lake) to the south boundary of the Site which is located on the north of the Elephant Lake, near the shoreline. As the developments will only be executed within the Northern and Southern phases, this report covers the stormwater management plan (SWM) for these phases while the impacts of the runoffs on some parts of the Eastern phase area will be considered as an external catchments in this report as well.

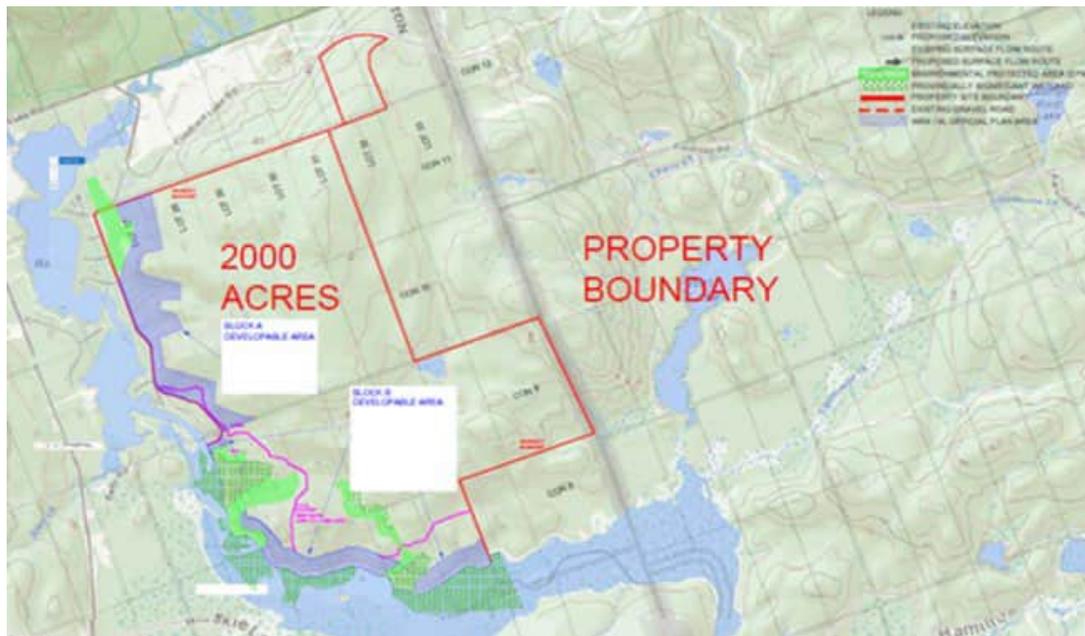


Figure 1- Topographic map of 0th Benoir Lake Rd., Dysart et al., ON

Benoir and Elephant Lakes were created by the Ontario Department of Public Works and the Ontario Hydro Electric Power Commission in 1931 at the effluence of the York River from Baptiste Lake. These lakes are located northwest of Bancroft and are part of a three-lake chain that includes Baptiste Lake. The York River is in the Saint Lawrence River drainage basin and flows from the southern extension of Algonquin Provincial Park to the Madawaska River. It spans out into Elephant, Benoir, and Baptiste Lakes and passes through Bancroft. Benoir Lake and Elephant Lake have surface areas of 92.3 and 884.6 hectares, respectively.

The Benoir Lake is approximately 228 acres in size with a maximum depth of 60 feet and a mean depth of 18.4 feet. Unlike Elephant Lake, Benoir Lake is highly developed. On the other hand, Elephant Lake is approximately 2186 acres in size with a maximum depth of about 23 feet and a mean depth of 6 feet. It is a large, picturesque shallow lake.

The Site property consists of several vacant lots abutting existing residential lots along the shore of Benoir Lake, and undeveloped lands along the shore of Elephant Lake. The study area is bounded on the west by existing residential properties along Benoir Lake Road and Benoir Lake itself, on the south by Elephant Lake, on the east by vacant undeveloped lots, and on the north by Elephant Lake Road. The project proposes initially twenty-five (25) permanent four-season single-family residential dwellings along the east side of Benoir Lake Road (Lot 1 – Lot 25) called as Northern phase; Lot 26 includes wildlife park, children park, vegetable tents, and exhibition area, 38 seasonal waterfront residences along the north shore of Elephant Lake (Lots 27 – 51 and Lots 53-63), Lot 52 includes golf practicing area, a 8 m width private condo laneway (Block A), and finally one public community boat launch area (Block B) called as Southern phase.

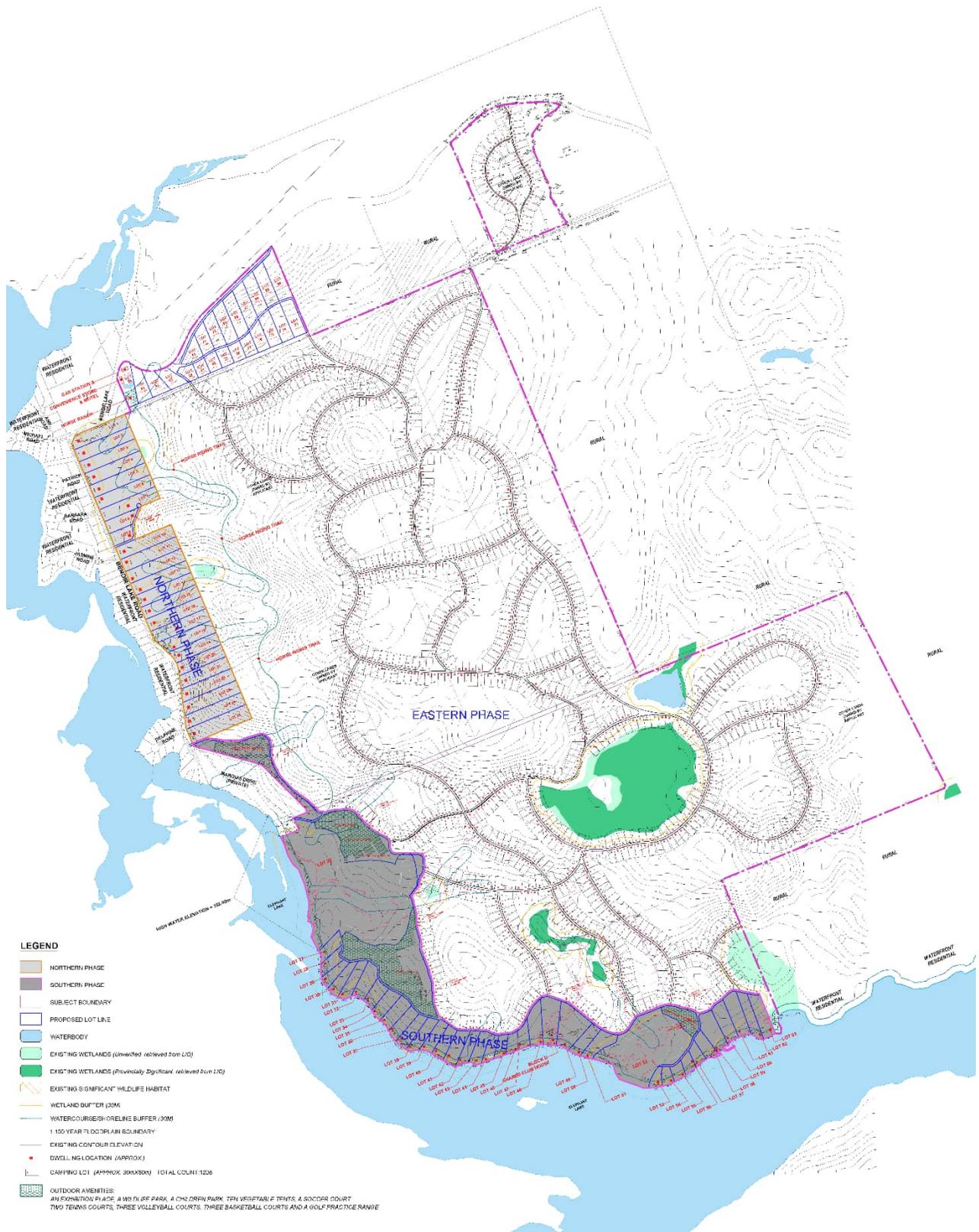


Figure 2- The site plan and construction phases

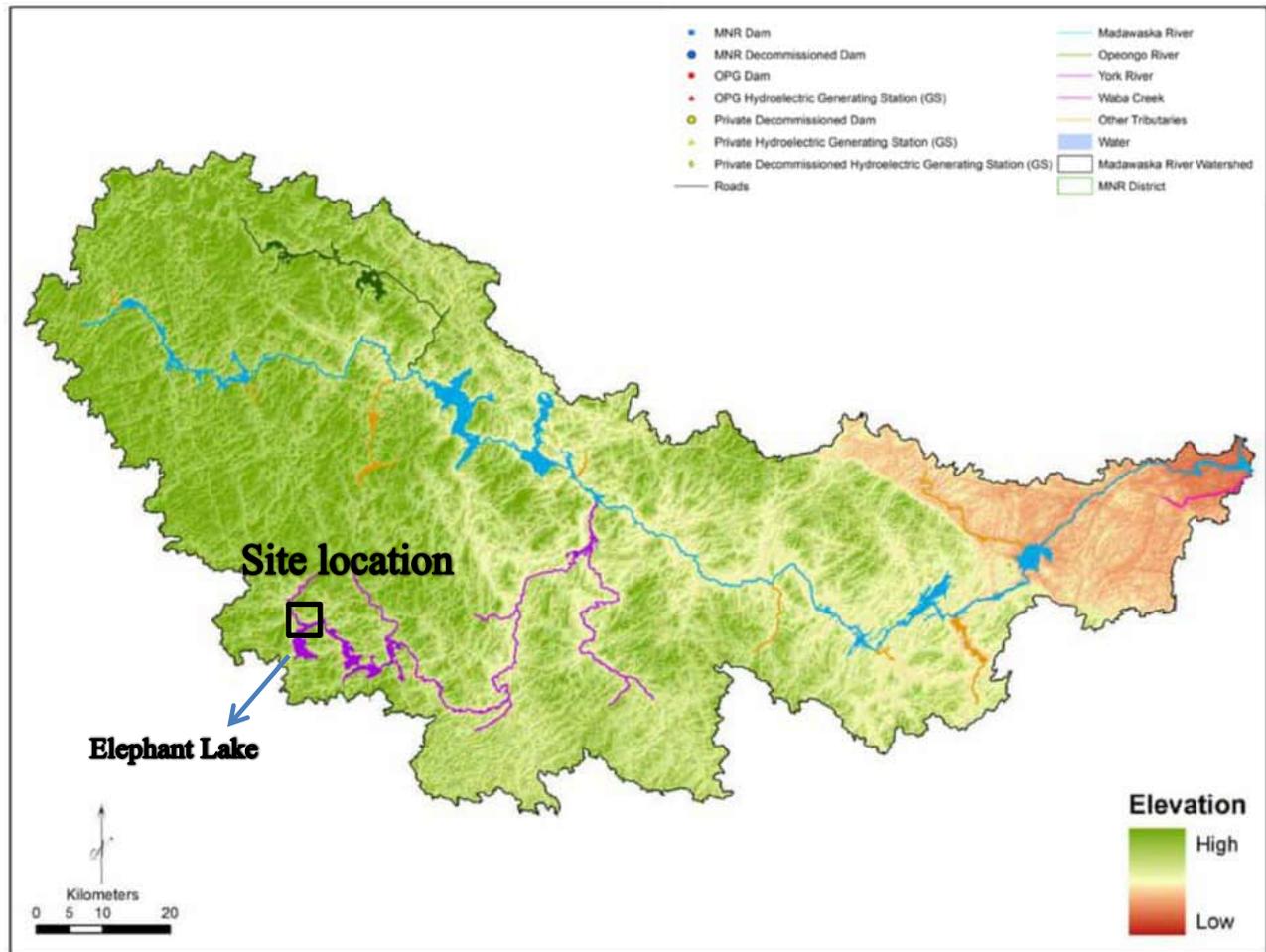


Figure 3- Site location within the Madawaska (main) watershed

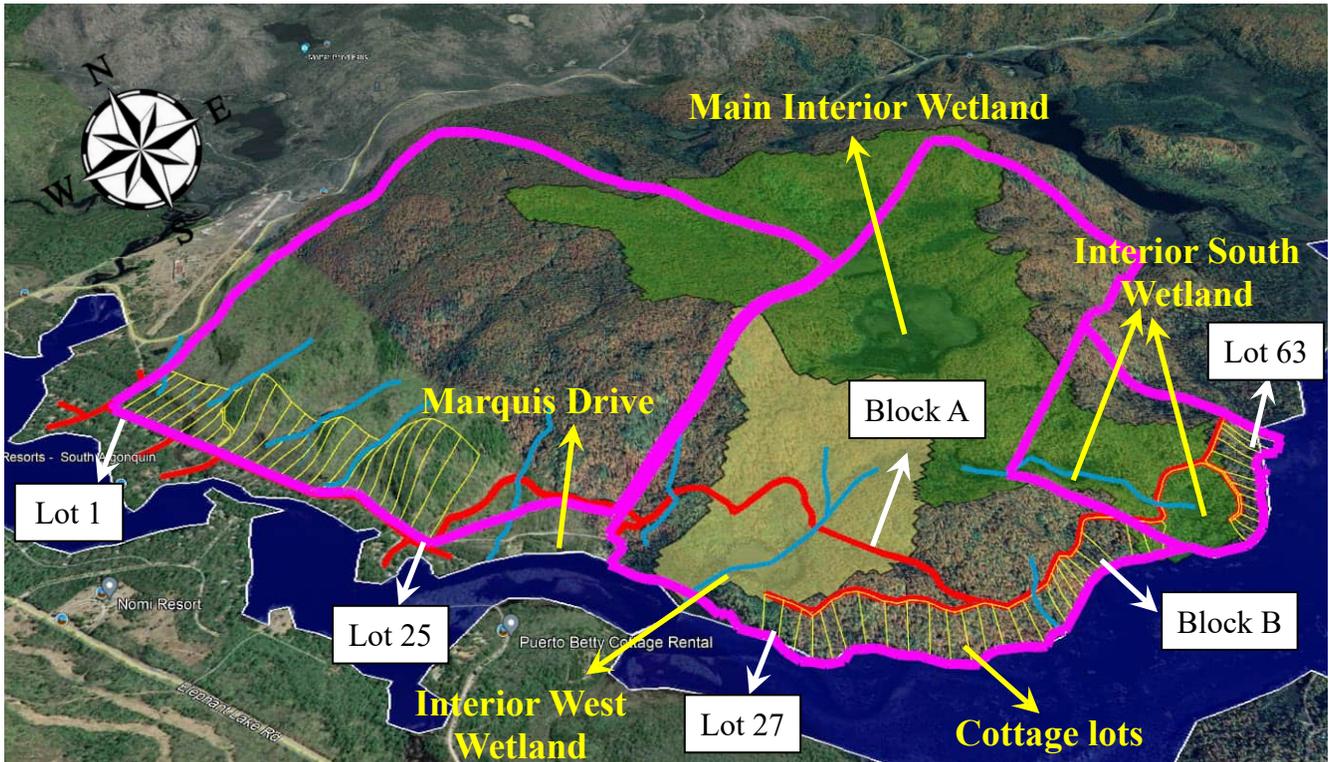


Figure 4 –Overview of subwatersheds, wetlands, roadways, and cottage lots

2. Site Investigation- MECP Wells, Boreholes & In-Situ Permeameter Testing

2.1. MECP Wells & Boreholes

Five (5) separate well records were found near and within the site property boundary, where one of them located at the eastern end of the site (Appendix III). Furthermore, eight (8) geotechnical boreholes and two (2) private water wells were drilled at the site property by King EPCM (O.Reg 903 License C-7691). Detailed borehole drill logs are in Appendix IV, while Table 1 below shows the summary. Groundwater has also been observed only in four boreholes since drilling.

Table 1 - Borehole Summary

Borehole Name	Located in Lot #	Easting	Northing	Depth	Groundwater m below grade	Description
BH101	Lot 3	724,148	5,007,290	4.6m	2.1m	Upland
BH102	Lot 32	725,656	5,004,632	3.7m	-	Upland
BH201	Lot 43	726,516	5,004,449	1.5m	1.1m	Detailed Lot Drilling
BH202	Lot 50	726,860	5,004,672	1.2m	-	Detailed Lot Drilling
BH203	Lot 39	726,115	5,004,615	1.5m	-	Detailed Lot Drilling
BH204	Lot 24	725,227	5,004,773	1.5m	-	Detailed Lot Drilling
BH205	Lot 6	724,070	5,006,939	1.5m	-	Detailed Lot Drilling
BH206	Lot 4	723,950	5,007,155	1.5m	-	Detailed Lot Drilling
BH301	Lot 6	724,091	5,006,934	79.86m	various	Potable Water Well, Well Tag A348258
BH302	Lot 43	726,537	5,004,485	36.82m	various	Potable Water Well, Well Tag A339195

2.2. In-Situ Permeameter Testing

Based on the field visit dated November 15, 2021, "field-saturated" hydraulic conductivity, K_{fs} , was achieved using the "Constant Head Well Permeameter" (CHWP) method. K_{fs201} was conducted at BH201 while K_{fs206} at BH206, and K_{fs203} at BH203 using ETC Standard Soils Pask Permeameter Apparatus. The "Constant Head Well Permeameter" (CHWP) method was described in Appendix V in detail.

The ETC Pask Permeameter is a convenient and easy-to-use apparatus for ponding a constant head of water in a well, and simultaneously measuring the flow into the soil. The K_{fs} was calculated as:

$$K_{fs201} = 4.8E-6 \text{ m/sec} = 4.8E-4 \text{ cm/sec}$$

$$K_{fs206} = 1.1E-5 \text{ m/sec} = 1.1E-3 \text{ cm/sec}$$

$$K_{fs203} = 2.7E-5 \text{ m/sec} = 2.7E-3 \text{ cm/sec}$$

And then the temperature-corrected permeability would be calculated using equation 2 as follows:

$$K_a = K_{fs} \times \mu_k / \mu_a \quad (\text{Eq. 1})$$

In which:

K_a = corrected permeability adjusted for design temperature conditions

Assuming a system design temperature of 4°C based on manual, the effect of temperature on coefficient estimation is negligible in these tests and the amounts do not change.

Correlations between Perc Time (PT) and field-saturated hydraulic conductivity (K_{fs}) are often used in the development of on-site water recycling and treatment facilities that operate by infiltration into unsaturated soil. Based on OMMAH (1997) interpolation, the measured infiltration rate may be interpolated as:

$$PT_{201} = 8.5 \text{ min / cm} \quad (\text{Infiltration Rate} = 70.4 \text{ mm/hour})$$

$$PT_{206} = 6.8 \text{ min / cm} \quad (\text{Infiltration Rate} = 88 \text{ mm/hour})$$

$$PT_{203} = 5.4 \text{ min / cm} \quad (\text{Infiltration Rate} = 112 \text{ mm/hour})$$

It is in the Engineer's opinion to trust the values obtained from the OMMAH (1997), with an average unfactored infiltration rate of 90.1 mm/hour.

For a conservative approach to infiltration speeds, the Wisconsin Department of Natural Resources (2004) method shall be used for the calculation of a factored design infiltration rate and the Engineer's opinion is that the factored engineering design infiltration rate is 36.1 mm/hour, with a safety factor of 2.5. See Appendix V for more details, the calculations, and the graphs provided.

3. Pre-development site conditions

The condition of the site prior to development can be broken down into several groups of information:

3.1. Topographic Elevation & Base Precipitation

- This site was located within the physiographic region of the Algonquin Dome (Highlands), which is characterized by rolling topography, and within the York River Subwatershed, with Sand Hydrologic Soil Group B.
- Slopes of 25% or more, measured over a horizontal distance inland of 45 meters (148 feet) from the high water mark, along a continuous shoreline frontage of 25 meters (82 feet).
- Elephant Lake is located approximately 20-30 minutes northwest of Bancroft in Harcourt, Ontario. This lake of approximately 2186 acres in size and is part of the 36-mile, 3-lake chain of Benoir and Baptiste Lakes. Elephant Lake consists of approximately 22 miles of shoreline and is 1,157 feet above sea level. The maximum depth is about 23 feet with a mean depth of 6 feet.
- The site survey & topographic information are in Appendix I, and the site plan is in Appendix II.
- Average annual precipitation reported 979mm at Bancroft station, the nearest station located southwest of the site. The least amount of rainfall occurs in February. The average in this month is 57 mm. The greatest amount of precipitation occurs in June, with an average of 99 mm. Base yearly precipitation of the site was also estimated at 983mm/year by OFAT (Ontario Flow Assessment Tool), for the sub-watersheds within the site boundary while the LID TTT estimated 945 mm/hour using its default stations (Appendix XI). This last value is used in the following calculations.
- This area is naturally a densely forested wetland that has the possibility of flooding and it is also the headwater source of the York River which is finally connected to the Madawaska River.
- The Madawaska River flows 270 km from its headwaters in Algonquin Provincial Park to the Ottawa River at Arnprior (Figure 2). This river is organized by tributary and further divided into a series of reaches or sections. The York River (120 km) is one of the main tributaries located in the southern part of the main watershed. It spans out into Elephant, Benoir, and Baptiste Lakes and passes through Bancroft. This river is in the Saint Lawrence River drainage basin and flows from the southern extension of Algonquin Provincial Park to the Madawaska River.

3.2. Vegetation & Evapotranspiration

- The site soil is mostly sand, and the Hydrologic Soil Group should be group B.

- The subject property consists of several vacant lots abutting existing residential lots along the Shore of Benoir Lake, and undeveloped lands along the Shore of Elephant Lake with a gravel road with less than 0.1% TIMP which is negligible.
- The predominant land cover types in this site were different types of Sparse Treed (<2%), Deciduous Treed (~75%), and Mixed Treed (~23%)
- Averaged site evapotranspiration was 606mm/year based on LID TTT estimation (Appendix XI).

3.3. Precipitation Surplus (Recharge + Runoff)

- Using LID TTT with average annual rainfall data (Appendix XI):
 - Total area-weighted average precipitation surplus (recharge + runoff) = 338mm/year.
 - Total area-weighted average storm runoff = 98mm/year
 - Total area-weighted average recharge = 240mm/year

3.4. Stormwater Run-off

- There are no city-maintained stormwater sewers, with stormwater generally flowing into the Lakes based on the topography. In the Northern Phase, runoff generally drains from north to west into Benoir Lake while in the Southern Phase from north to south into Elephant Lake as shown in Figure 4.
- The Site was delineated into two main subwatersheds which are known for different creeks (Appendix VI).
- There is a headwater wetland on the site property, at the highest end of the subwatershed which overflowed through two main creeks within the site (Appendix VI shows the catchment area of two main creeks passing through the site).
- Culverts and swales are designed to convey the 100-year design storm runoff.
- All stormwater in ditches is generally infiltrated or moved downstream to the Lakes.
- Based on in-situ infiltration tests using ETC Pask Permeameter Apparatus, the average unfactored infiltration rate was 6.9 min/cm = 90.1mm/hour. Three permeability tests have been performed at this site as mentioned in Section 2.2.
- Based on the Municipality of Dysart et al. requirements, Stormwater management and erosion control plans will be undertaken according to the requirements of the Ministry of Environment and Climate Change Guidelines "Storm Water Management Planning and Design Manual, 2003". In this manual, the Rational Method is suggested as the most commonly used method to determine peak flow rates to be conveyed by the storm sewer system, with data from Bancroft station, with A, B, to values of 3-parameter Chicago distribution design storm as $Intensity = A \cdot (t+t_0)^B$.
- See Table 2: Chicago Distribution Design Storm Parameters and Rainfall Amounts cited in the Simonovic et al. (2015) showing the IDF under climate change* values for Bancroft station (ID: 616I001, Latitude: 45.07, Longitude: -77.88).
* These IDF curves are calculated using provided historical observed data combined with data from Global Circulation Models (GCMs) for future scenarios. **RCP8.5:** Representative Concentration Pathway resulting in radiative forcing of 8.5 W/m² by 2100, and where radiative forcing continues to rise beyond 2100. This RCP provides a future concentration

scenario that would lead to the most severe climate change impacts when compared to all other RCPs. See User and Technical manuals for more details.

Table 2 – Bancroft Station Chicago Distribution Storm Parameters under Climate Change

Return Period	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A	30.2	41.2	87.7	55.5	60.5	64.9
B	-0.819	-0.840	-1.087	-0.807	-0.776	-0.748
t ₀	0.092	0.118	0.586	0.117	0.106	0.096

IDF Parameters	Return Period (year)					
	2	5	10	25	50	100
A	30.2	41.2	87.7	55.5	60.5	64.9
B	-0.819	-0.84	-1.087	-0.807	-0.776	-0.748
t ₀	0.092	0.118	0.586	0.117	0.106	0.096
Duration						
5 min	124.56	156.89	175.75	199.65	216.26	229.66
10 min	91.99	120.98	138.56	161.2	177.34	190.93
15 min	72.79	95.15	107.96	123.86	134.59	143.64
30 min	47.21	61.1	68.83	78.18	84.33	89.52
1 hr	29.22	38.98	44.42	50.91	55.16	58.84
2 hr	16.25	21.91	25.46	30.1	33.43	36.4
4 hr	11.32	15.27	17.96	21.82	24.96	28.09
6 hr	6.39	8.62	10.45	13.53	16.48	19.78
12 hr	3.94	5.03	5.93	7.55	9.2	10.86
24 hr	2.33	2.93	3.39	4.11	4.77	5.44

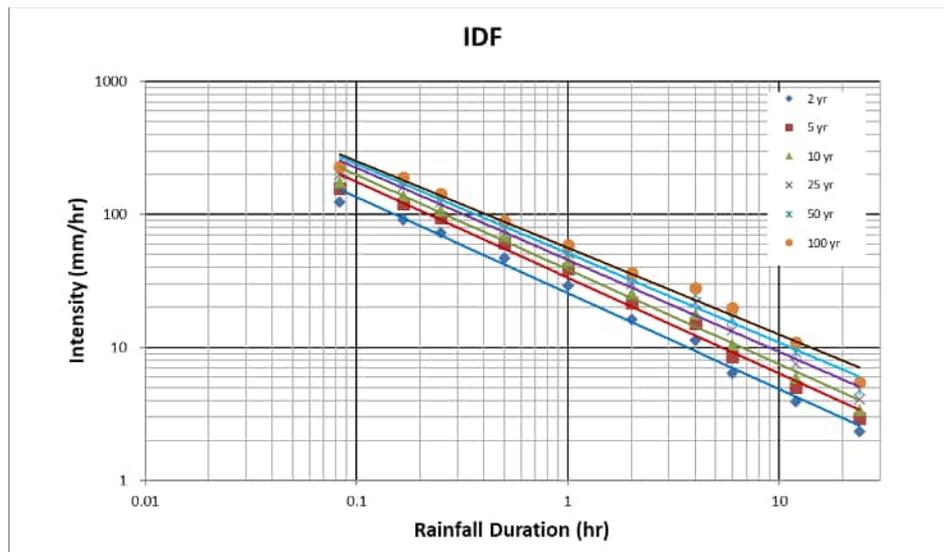


Figure 5- Intensity-Frequency-Duration (IDF) Curves calculated from Table 2 above

Table 3 – Pre-development storm event calculations

Storm Duration (hr)		2 yr Return Period	5 yr Return Period	10 yr Return Period	25 yr Return Period	50 yr Return Period	100 yr Return Period
4 hour	Intensity (mm/hour)	11.32	15.27	17.96	21.82	24.96	28.09
	Rainfall (mm)	45.28	61.08	71.84	87.28	99.84	112.36
12 hour	Intensity (mm/hour)	3.94	5.03	5.93	7.55	9.20	10.86
	Rainfall (mm)	47.28	60.36	71.16	90.60	110.40	130.32
24 hour	Intensity (mm/hour)	2.33	2.93	3.39	4.11	4.77	5.44
	Rainfall (mm)	55.92	70.32	81.36	98.64	114.48	130.56

The modified rational method is based on a simple empirical formula used to determine flow that results from a rainfall of specific intensity applied to an area based on an average catchment land use condition.

- Pre-development 1 in 2 years, 1 in 5 years, 1 in 10 years, 1 in 25 years, 1 in 50 years, and the 1 in 100 years design storm events, peak flow conditions are calculated as follows:
- Peak flow rate Modified Rational Formula: $Q_p = (0.001/3600) * A * C * C_a * i$
 - Total site area in ha = 781.4 (~2000 acre)
 - A = Developed area within the site boundary (INTERNAL) = 40.6 ha or 405,584.7 m² (Northern Phase/Catchment #101), and 85.2 ha or 852,307.2 m² (Southern Phase/Catchment #102)
 - C = runoff coefficient = 0.18 (Northern Phase) and 0.15 (Southern Phase) (Sand & 0.0% TIMP (#101) and 1.9% TIMP (#102), MTO 1997 design chart 1.07 for rural, See Appendix IX for more details.)
 - A' = Total catchment area (EXTERNAL) flows through the developed site = 781.8 ha = 7,817,508.13 m² including (Appendix VII):
 - EXT 1 = 2,993,639.3 m² (C= 0.16),
 - EXT 2 = 424,014.03 m² (C= 0.17),
 - EXT 3 = 2,612,713.5 m² (C= 0.16),
 - EXT 6 = 177,393.3 m² (C= 0.18),
 - EXT 7 = 351,856.16 m² (C= 0.16).
 - C_a = Antecedent Precipitation Factor = 1.0 for 2, 5, and 10 years, 1.10 for 25 years, 1.20 for 50 years, and 1.25 for 100 years.
 - i = average rainfall intensity in mm/hour (4, 12 & 24 hour IDF under climate change conditions for Bancroft, Table 2 above)

The computed peak flow for various return periods for the entire area of the site is indicated in Table 4.

*Table 4 –Peak Flow Rate Calculations (Qp) using Modified Rational Method
(Pre-Development Scenario)*

Catchment	Duration Storm	2 yr Return Period (m ³ /s)	5 yr Return Period (m ³ /s)	10 yr Return Period (m ³ /s)	25 yr Return Period (m ³ /s)	50 yr Return Period (m ³ /s)	100 yr Return Period (m ³ /s)
Internal (101+102)	4 hour	0.632	0.852	1.002	1.339	1.671	1.959
	12 hour	0.220	0.281	0.331	0.463	0.616	0.757
	24 hour	0.130	0.163	0.189	0.252	0.319	0.379
External (EXT1+ EXT2+ EXT3+EXT6+EXT7)	4 hour	3.325	4.485	5.275	7.049	8.797	10.313
	12 hour	1.157	1.477	1.742	2.439	3.242	3.987
	24 hour	0.684	0.861	0.996	1.328	1.681	1.997
Total (All Catchments Area)	4 hour	3.956	5.337	6.277	8.389	10.468	12.272
	12 hour	1.377	1.758	2.072	2.903	3.858	4.744
	24 hour	0.814	1.024	1.185	1.580	2.001	2.377

4. Post-development site conditions

The Client has proposed to construct twenty-five (25) permanent four-season single-family residential dwellings along the east side of Benoir Lake Road (Lots 1 – 25), 37 seasonal waterfront residences along the north shore of Elephant Lake (Lots 27-51 and Lots 53 – 63), one private condo laneway 8m width (Block A), one public community boat launch area (Block B), Golf practicing range in Lot 52, Wildlife park, Children park, Exhibition area, and Vegdttable tents in Lot 26. Below is a summary of the proposed site conditons (Southern and Northern Phases):

- Total site surface area = 781.4 ha (~2000 acre)
- A = Developed area (INTERNAL) = 40.6 ha or 405,584.7 m² (Northern Phase/Catchment #101), and 85.2 ha or 852,307.2 m² (Southern Phase/Catchment #102)
- Total pervious surface area (woodland/wetland/grass) = 114.9 Ha (91.4%)
- Total impervious surface area (TIMP) = 1.0 ha or 2.5% (Northern Phase) and 9.9 ha or 11.6%.
 - 1.05Ha – new building & garage (building rooftop area)

4.05Ha – new driveway (roadway)
1.25Ha – existing roadway
4.56Ha – Amenity Area (imp.)

- Rooftop downspouts are connected directly to an internal ditch (LID) which also captures runoff from the covered driveway and then it is drained to the lake in each block.
- Swale along both sides of the new roadway (LID)
- Post-development peak flow conditions are calculated as follows:
- Peak flow rate Modified Rational Formula: $Q_p = (0.001/3600) * A * C * C_a * i$
 - A = Developed area within the site boundary = 40.6 ha or 405,584.7 m² (Northern Phase/Catchment #101), and 85.2 ha or 852,307.2 m² (Southern Phase/Catchment #102)
 - C = runoff coefficient = 0.19 (Northern Phase) and 0.17 (Southern Phase) (Sand & 2.5% TIMP (#101) and 11.6% TIMP (#102), MTO 1997 design chart 1.07 for rural, See Appendix IX for more details.)
 - A' = Total catchment area (external) flows through the developed site = 781.8 ha = 7,817,508.13 m² including (Appendix VII):

EXT 1 = 2,993,639.3 m² (C= 0.16),
EXT 2 = 424,014.03 m² (C= 0.17),
EXT 3 = 2,612,713.5 m² (C= 0.16),
EXT 6 = 177,393.3 m² (C= 0.18),
EXT 7 = 351,856.16 m² (C= 0.16).

- C_a = Antecedent Precipitation Factor = 1.0 for 2, 5, and 10 years, 1.10 for 25 years, 1.20 for 50 years, and 1.25 for 100 years.
- i = average rainfall intensity in mm/hour (4, 12 & 24 hour IDF for Bancroft, Table 2 above)

*Table 5 –Peak Flow Rate Calculations (Qp) using Modified Rational Method
(Post-Development Scenario without Mitigation)*

Catchment	Duration Storm	2 yr Return Period (m ³ /s)	5 yr Return Period (m ³ /s)	10 yr Return Period (m ³ /s)	25 yr Return Period (m ³ /s)	50 yr Return Period (m ³ /s)	100 yr Return Period (m ³ /s)
Internal (101+102)	4 hour	0.698	0.941	1.107	1.480	1.847	2.165
	12 hour	0.243	0.310	0.366	0.512	0.681	0.837
	24 hour	0.144	0.181	0.209	0.279	0.353	0.419
External (EXT1+ EXT2+ EXT3+EXT6+EXT7)	4 hour	3.325	4.485	5.275	7.049	8.797	10.313
	12 hour	1.157	1.477	1.742	2.439	3.242	3.987
	24 hour	0.684	0.861	0.996	1.328	1.681	1.997
Total (All Catchments Area)	4 hour	4.023	5.426	6.382	8.529	10.644	12.477
	12 hour	1.400	1.787	2.107	2.951	3.923	4.824
	24 hour	0.828	1.041	1.205	1.607	2.034	2.416

Note: One of the most commonly used procedures for calculating peak flows is the Rational Method. A limitation of this method is that it is applicable only to small drainage areas, typically ranging from less than 8 hectares (20 acres) to 2500 hectares (6175 acres), depending on various references. For instance, less than 20 acres (Poertner, 1974), less than 200 acres or 80 ha (Oregon.gov, 2024), less than 500 ha (Viesman and Hammer, 1993), up to 2500 ha (Ministry of Transportation of Quebec, 1993), and so on. So, as the total area of the northern and southern phases was 125.8 ha, the Engineer decided to use this method to estimate the peak flow for different return periods.

According to Tables 4-5 above, the results showed that the total runoff from a 100-yr 4-hour storm event is equal to 2.377 cms (pre-dev) and 2.416 cms (post-dev) indicating an 1.6% increase in the 100-year 4 hours runoff due to the new development.

To compare the accuracy of the Rational Method with another hydrological method for large watersheds, the Engineer decided to compare the results of the Rational method for the worst-case scenario (i.e., 100-year storm event) with the SCS Type II 12-hour 100-year storm event. The SCS curve number method is a simple, widely used, and efficient method for determining the runoff from a rainfall event in a particular area. The SCS developed the Type I, Type II, and Type III design storms, and the Type II distribution applies to most parts of Canada. The Type II distribution is a mass curve for the percent of

accumulated rainfall depth over a duration of 6, 12, or 24 hours. The 12-hour SCS storm is derived from the steepest 12 hours of the 24-hour SCS curve.

For this comparison, we divided the entire site area into seven separate sub-catchments with different outlets and times of concentration. Then, we performed a new set of calculations to check the peak runoff produced by each sub-catchment based on the Modified SCS Curve Number Method (CN*). Please refer to Appendix XII for details of the SCS method and a comparison of both methods.

Our results showed that the total runoff generated by five independent sub-catchments which are diverted towards the developed area, i.e., Catchments 1, 2, 3, 6 & 7 (area = 781.9 ha; Legal site area plus external sub-catchment area) using a Type II, 100-yr 12-hour storm event is equal to 4.40 cms (post-dev) and 4.02 cms (pre-dev) while the values based on the simple Rational method for this area were 4.82 cms (post-dev) and 4.74 cms (pre-dev). In other words, we can expect a 10-18% increase in the 100-year runoff estimation by the Rational method.

This is even though the 100-year 12-hour peak discharge difference (post – pre) in both methods is 3438 m³ (Rational Method) and 16,416 m³ (SCS Method), respectively, which are equivalent to 0.4 and 1.9 mm of the water level of the Elephant Lake, respectively; which is negligible.

5. Water Quantity

5.1. Peak flow control

Prior to development, the site property is considered near-vacant with a Total Impervious Surface Area of 1.3% within the developed area as an existing old road, with trees, grasses & wetlands for the remaining 98.7%. The property has an average grade of 25% towards the lakes, with sand-primary soil having high infiltration rates.

Post-development has a TIMP = 8.6%, and combined with the proposed swale along the roadways and within each proposed lot, there does not expect to be changed in peak runoff flow rates or total volumes due to the insignificance of the TIMP compared to the entire site, which has a negligible effect on the runoff coefficient. As can be seen in Table 6, it is concluded that the proposed development will result in an increase in surface runoff to the lakes of 3438 m³ from the proposed development during the worst-case scenario, i.e., 24-hour 100-year storm event. This represents an increase of 8.7 percent from the Site under existing conditions during a similar storm event. When compared to the storage capacity of Elephant Lake and Benoir Lake with a total surface of 10 square kilometers, this will result in an increase in lake level of 0.32 mm over existing conditions (For an area of 121.1 ha). This represents a limited impact on both lakes.

Table 6 – Peak Flow Volume Calculations using Modified Rational Method

Duration Storm		2 yr Return Period (m ³)	5 yr Return Period (m ³)	10 yr Return Period (m ³)	25 yr Return Period (m ³)	50 yr Return Period (m ³)	100 yr Return Period (m ³)
4 hour	Pre	56970.3	76849.5	90387.5	120795.1	150739.8	176711.1
	Post	57925.8	78138.4	91903.5	122821.1	153268.0	179674.9
	Diff.	955.5	1288.9	1516.0	2026.0	2528.2	2963.8
12 hour	Pre	59486.7	75943.6	89531.9	125390.0	166683.4	204957.2
	Post	60484.4	77217.3	91033.6	127493.0	169479.0	208394.7
	Diff.	997.7	1273.7	1501.6	2103.0	2795.6	3437.5
24 hour	Pre	70357.3	88475.1	102365.4	136517.3	172843.5	205334.6
	Post	71537.3	89959.0	104082.2	138807.0	175742.4	208778.5
	Diff.	1180.0	1483.9	1716.9	2289.7	2898.9	3443.8

5.2. Volume control

The proposed site will have a total impervious surface area of 10.9 Hectares (8.6% of the total area of the Northern and Southern phases), which is above the standard stormwater volume control requirement of 0.5 Hectares by most conservation authorities. The total volume of stormwater runoff produced due to a 25 mm rainfall event from the total impervious area of the study site is 2,719 m³, which is equal to a 0.3 mm increase in the water level of the Elephant Lake and it is really negligible, as discussed above in Section 5.1.

5.3. Major-minor system conveyance

The shoreline of the subject property is classified as a high infiltration area (with some inland areas having exposed bedrock), with a dense forest tree cover, which increases the initial detention and reduces runoff rates in most parts of the developed area, 90.1mm/hr unfactored infiltration rate vs 1:100 year 4-hour event of 28.1mm/hr precipitation under climate change condition.

The minor system conveyance is for flows below a 5-year storm event (i.e., 15.3mm/hr precipitation in 4 hours) while the major system conveyance is for flows between 5 and 100-year storm events, and is the same for pre-development and post-development, generally flowing to the lakes.

Similarly, all precipitation on impermeable surfaces of the developed area will be drained to the respective swale LID for infiltration and discharging to the wetland or lake.

5.4. Hydraulic Assessment for Roadway Culverts

A hydraulic assessment was performed for the stormwater drainage system such as main creeks and culverts within the study limits (Northern and Southern phases). Hydraulic computer programs have distinct advantages over hand calculations or nomographs for determining normal depth, culvert velocity, hydraulic radius, and area of flow for partially full flow conditions. Hydraulic assessments of Culverts 2

and 6 were analyzed using the Hydraulic Engineering Center's River Analysis System modeling software, HEC-RAS, v6.0 Beta 3.

Under post-dev conditions, there are 61 new waterfront residential lots (cottages) with exclusive LID septic which are infiltrated to the ground, around 2 km of roadside grassed swales discharged to the wetlands/lakes, and 7 different small circular culverts (d=12 in) across small streams with 2 crossing main culverts (2 & 6 with d = 30-59 in), located within the study limits (Appendix X). There are only two main creeks in this area where culverts 2 and 6 will be installed in their crossing with the roadway, and hydraulic simulation has been carried out for further investigation in this section.

The HEC-RAS 1D hydraulic analysis applies a standard step or step-backwater analysis to the input data. The key information that HEC-RAS calculates is a water surface elevation based on the various input parameters (Geometry data, Flow data, Plan data, etc.) and that the water surface is level at the cross-section under analysis. Within the one-dimensional hydraulic analysis, there are two modeling categories including steady flow and unsteady flow discharges. Steady flow hydraulic models include analysis that is based on constant flow discharge along the channel. In general, steady state is based on a hydraulic engine calculation that applies Manning's equation and step/backwater solution. In this simulation, this type of modeling was used based on the rational method discharges as an upstream input flow.

Due to the hydraulic analysis, the main parameters of the elements are predefined, so the accuracy and operation of the system are ascertained by defining the catchment areas. The rainfall is governed by the intensity of the rain (IDF-curves), with a note that a bigger catchment area generates a greater amount of flow (rainfall concentration), and vice versa smaller catchment areas less amount of flow. For this study, the index Flood Method (Moin & Shaw, 1985) and Multiple Regression Method (Moin & Shaw 1985) have been used through OFAT (Ontario Flow Assessment Tool). OFAT contains a series of regional hydrologic models and empirical relationships that generate water flow information. Flow regimes can be determined for a watershed after the watershed has been generated and the required characterizations computed. Rather than this model, the SCS Method is another useful method for a drainage area greater than 20 acres. Some of the common hydrological modeling tools, e.g., VO, used the SCS Method (CN) for modeling the ungauged rural catchments. In this project, we performed a new set of calculations to check the peak runoff produced by each sub-catchment based on the Modified SCS Curve Number Method (CN*), see more details in Appendix XII.

In the Index Flood Method, the Ontario province was divided into 12 regions based on the study conducted by Sangal and Kallio (1977), and a homogeneity test was conducted. The variable used for single station analysis is annual peak instantaneous flow. Where this value is not available, the analysis uses the hydrograph method described by Sangal (1981). The Multiple Regression Method was also included for the flood mapping studies along with the Index Method. The main feature of this method is the delineation of homogenous regions within Ontario using the standardized residuals from the 100-year return level. The parameters significant in the regression equations in the order of importance are: Drainage Area, Base Flow Index, Slope of the Main Channel, Area Controlled by Lakes and Swamps, Mean Annual Runoff, Mean Annual Precipitation, and Shape Factor.

The flood flow model "Index Flood Method With Expected Probability Adjustment (Moin & Shaw, 1985)" has estimated parameters of: Q1.25, Q2, Q5, Q10, Q20, Q50, Q100, Q200, Q500 and Maximum probable flow (Table 7 below)

Based on the Municipality of Dysart et al. requirements, Stormwater management and erosion control plans will be undertaken according to the requirements of the Ministry of Environment and Climate Change Guidelines "Storm Water Management Planning and Design Manual, 2003". So, the proposed roadway drainage infrastructure shall be designed to meet the following criteria:

- Minor system: 5-year
- Major System: 100-year

Based on new results, the SCS 12-hr 100-yr peak flow for catchments 1 & 2, are 1.37 & 0.45 cms, respectively. These amounts are lower than the PMF values (MAX) that were used for culvert design in both catchments, while the results showed the post-dev major storms as:

Catchment 1 (Culvert #2):

$Q_{\text{peak-100yr}} = 1.54 \text{ cms}$ & $Q_{\text{peak-PMF}} = 3.2 \text{ cms}$ (Index Flood Method) vs $Q_{\text{peak-100yr}} = 1.37 \text{ cms}$ (SCS 12 hr)

Catchment 2 (Culvert #6):

$Q_{\text{peak-100yr}} = 0.33 \text{ cms}$ & $Q_{\text{peak-PMF}} = 0.75 \text{ cms}$ (Index Flood Method) vs $Q_{\text{peak-100yr}} = 0.45 \text{ cms}$ (SCS 12 hr)

As can be seen, our design based on the PMF values produced the most conservative peak flows (LARGER) from the Index Flood Method (Moin & Shaw, 1985) compared to the SCS 12-hour 100-year storm event ($Q_{\text{peak-PMF}}$ by OFAT > $Q_{\text{peak-100yr}}$ by SCS).

As reported in Table 7, the maximum possible discharges (worst case scenario) are estimated at 3.2 cms and 0.75 cms for eastern and western subcatchments, respectively, which are obtained for the total subcatchments area of 3.8 square kilometers. In the post-development scenario, the total volume of runoff production by dwelling area would be captured by septic through infiltration while the rest of subwatersheds and roadway runoff followed the current conditions through the roadside ditch and overland flow, then discharge to the wetlands or creeks. The results of the hydraulic analysis are summarized in Appendix X.

The cross-section geometric data used in hydraulic modeling was extracted from the DEM using HEC-GeoRAS. The use of HEC-GeoRAS ensures spatial reference of geometry data when imported into HEC-RAS while the proposed swale cross-sections drew with the HEC-RAS geometry tool at desired cross-sections. As per HEC-RAS requirements, all cross-sections are oriented looking downstream. The cross-section nomenclature reflects the distance in meters relative to the initial cross-section for each river/stream. Left overbank, main channel and right overbank downstream lengths were measured from the GIS. As per HEC-RAS recommendations, the overbank distances are measured from each overbank centroid.

Manning's n values for the main channel, left and right overbanks were based on recommended values in Table 3-1 of the HEC-RAS River Analysis System Technical Manual. Regarding the digging of new swales, the Manning's n values for main channels and overbanks are set to the same value of 0.035.

The input flows to the HEC-RAS model are derived from the OFAT hydrological model for each creek. For this report, only the maximum probable flows were evaluated as the worst-case scenario.

Probably the most commonly used downstream boundary condition in both steady and unsteady RAS is the Normal Depth assumption, however, in this modeling with a steep sloping creek (>10%), the critical boundary condition is more accurate. This condition requires using critical depth to reach boundary conditions and the software automatically calculates critical depth for each of the profiles and uses that as the boundary condition.

Energy losses occur due to the contraction and expansion of flow between cross-sections. This is most significant at culverts. Contraction and expansion coefficients have been set according to Table 5-2 of the HEC-RAS Reference Manual. Entrance losses for culverts have been set according to Tables 6-3 and 6-4 of the HEC-RAS Reference Manual and exit losses have been set to 1.0 which is typical for an abrupt transition.

The culvert shape, size, length, and inverts were determined from topographic survey data and hydraulic assessment using HEC-RAS. Manning’s roughness coefficient of 0.013 was used for the CSP culvert.

The proposed main culverts modeling accompanied by detailed modeling of the main creeks output and graphs are provided in Appendix X.

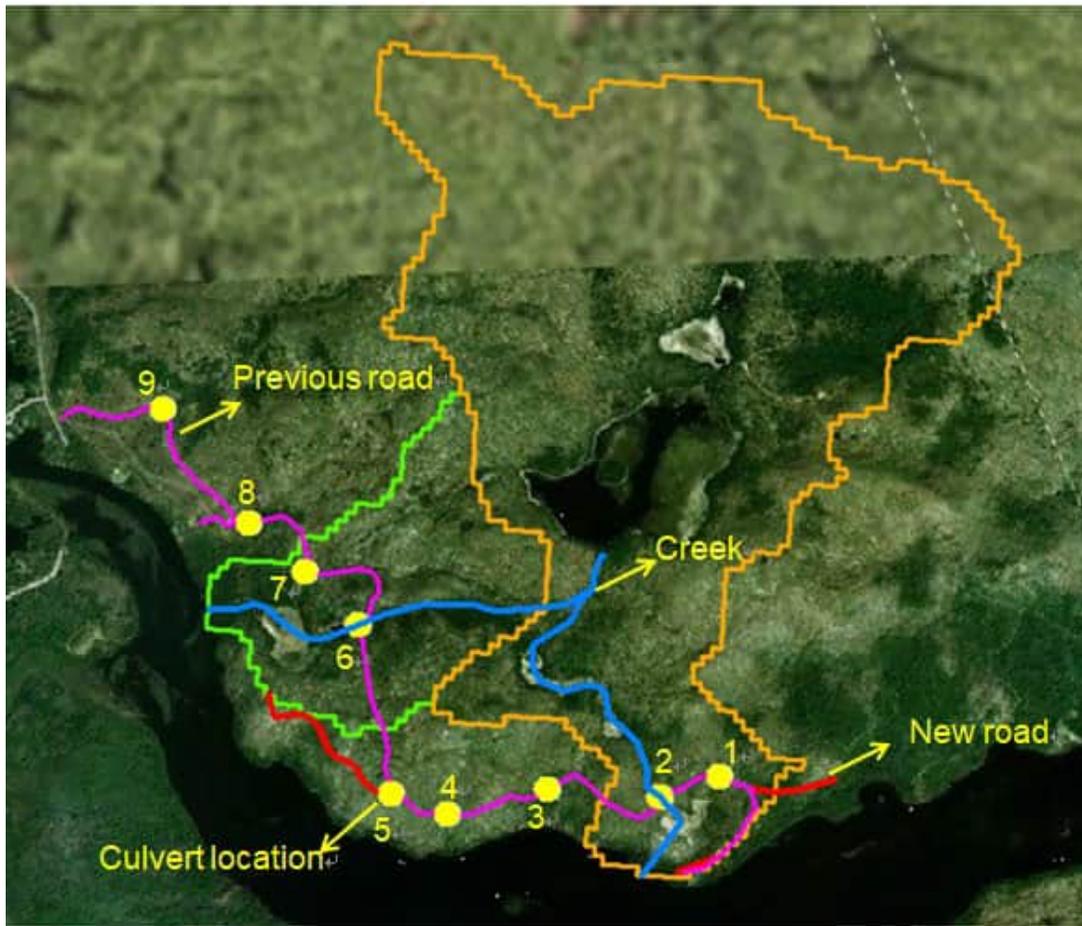


Figure 6- Overview of subwatersheds, roadways, main creeks, and culvert locations

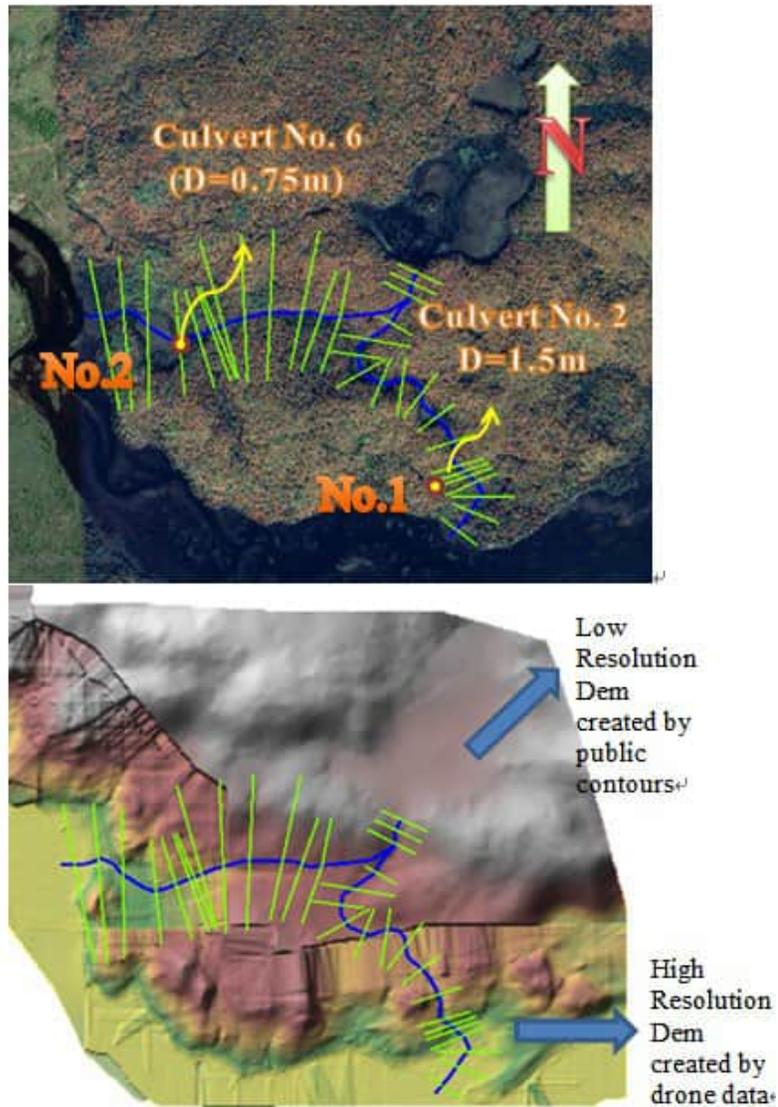


Figure 7- Main outlets of wetland (Main Creeks)

Table 7- Index flood method with EPA (Expected Probability Adjustment) (Moin & Shaw, 1985)

Catchment	Flow	Results (m ³ /s)
1	Q _{1.25}	0.66
	Q ₂	0.69
	Q ₅	0.85
	Q ₁₀	0.99
	Q ₂₀	1.15
	Q ₅₀	1.37
	Q ₁₀₀	1.54
	Q ₂₀₀	1.72
	Q ₅₀₀	1.93
	Q_{max}	3.2
2	Q _{1.25}	0.14
	Q ₂	0.15
	Q ₅	0.18
	Q ₁₀	0.21
	Q ₂₀	0.25
	Q ₅₀	0.30
	Q ₁₀₀	0.33
	Q ₂₀₀	0.38
	Q ₅₀₀	0.42
	Q_{max}	0.75

Table 8- Culvert Material Take-Off List

Culvert Name	Recommended Dia. (mm)	Recommended Dia. (in)	Minimum Dia. (mm)	Minimum Dia. (in)
Culvert #1	457	18	305	12
Culvert #2	1500	59	1500	59
Culvert #3	457	18	305	12
Culvert #4	457	18	305	12
Culvert #5	457	18	305	12
Culvert #6	750	30	750	30
Culvert #7	457	18	305	12
Culvert #8	457	18	305	12
Culvert #9	457	18	305	12

All culverts are recommended to be double-walled HDPE Culverts, corrugated outside and smooth inside
Culverts may be substituted with corrugated steel pipe where stock is not available
All culverts has a recommended length of 12.0m.
Culverts must be joined using appropriate manufacturer recommendations

6. Water Quality

6.1. Total Suspended solids

Stormwater quality controls will be required to be implemented in accordance with requirements of the Stormwater Management Planning and Design Manual (2003) with a targeted Total Suspended Solids (TSS) removal of 80% in accordance with provincial policy.

Water quality treatment is proposed through strategic placement of vegetated swales along the drainage pathways servicing the roadways and through the septic bed in each lot. These infiltration measures (grassed swale and septic) will function to settle suspended solids resulting from runoff and vehicle usage.

The proposed post-development has all impervious areas draining the entirety of 4-hour and 24-hour storm event volumes into the swales/septic and if there is any outflow, it might be discharged into the wetland or lake. Based on MOE 2003 SWM PDM Table 3.2, Enhanced 80% S.S. Removal by infiltration practice requires 25m³/Ha for 35% levels of imperviousness. Under an equivalent basis of 10.9 Ha of TIMP, there is a proposed 31.1Ha of total development area. Based on lower range values provided in MOE 2003 Table 3.2, at the required infiltration capture of 25m³/Ha, the minimum storage volume required is 778m³.

10.9Ha of TIMP @ 31.1Ha of total dev area = 35% -> required infiltration = 25m³/ha x 31.1Ha = 778m³

The subject property has a total proposed main driveway length of 5215m, with approximately 2394m of single-sided roadside swale (from Lot 27 – 53 – 58), and 2821m that require roadside swale on both sides of the roadway (main driveway from Benoir Lake Rd down to 38, and 59-63). A total of 8036 linear meters swale along the shared driveway is proposed. To provide the required volume capacity, several

earth check dams would be constructed within the swales. The distance between check dams can be calculated based on the depth of water at the check dam and the swale channel slope (See Table 9 for volume calculations provided by check dams in each ditch and the roadside ditch divisions exhibited in Figure 8). In this project, we need 71 and 453 check dams in the single-sided and double-sided roadside swales with 2394 m and 5642 m lengths, respectively (Total number of check dams = 524).

In summary, there is 814m³ of potential storage and retention from the roadside earth dams, while the required storage is 778m³. Based on an initial review basis, 80% of TSS removal is preliminarily met.

Table 9 – Design of Check Dams for Retainment

Ditch/Swale	Length (m)	Grading (%)	Distance between check dams (m)	Number of Check Dams (#)	Water Volume Capacity* (m ³)	Infiltration Footprint Area** (m ²)	Infiltration*** (m ³ /hr)
a	339	7.15	6	121	69	5.3	23.2
b	491	2.4	17	59	99	15.8	33.6
c	172	3.5	11	30	35	10.8	11.8
d	362	3.5	11	63	73	10.8	24.8
e	195	0.6	67	6	39	63.2	13.4
f	795	0.8	50	32	161	47.4	54.5
g	341	0.84	48	7	35	45.2	11.7
h	361	0.75	53	7	37	50.6	12.4
i	802	1.1	36	22	81	34.5	27.5
j	161	8.1	5	65	33	4.7	11.0
k	611	0.9	44	14	62	42.2	20.9
l	279	3	13	21	28	12.6	9.6
m	306	5	8	77	62	7.6	21.0
Total	5215			524	814	351	275

* Water Volume Capacity or Check-dam Static Storage = $(h^2 \times (h \times z + B)) / (2S)$

** Infiltration footprint area = $(B + 2 \times h \times (1 + z^2)^{0.5}) \times Distance / 2$

*** 24 hour Dynamic Storage = $(A \times i \times 24) / 1000$

In which:

h = check dam height (m), z = horizontal component of the swale side slope (1 vertical: H horizontal)(m), S = slope (-), B = channel bottom width (m), A = Infiltration Footprint Area (m²), i = infiltration rate (mm/hr).

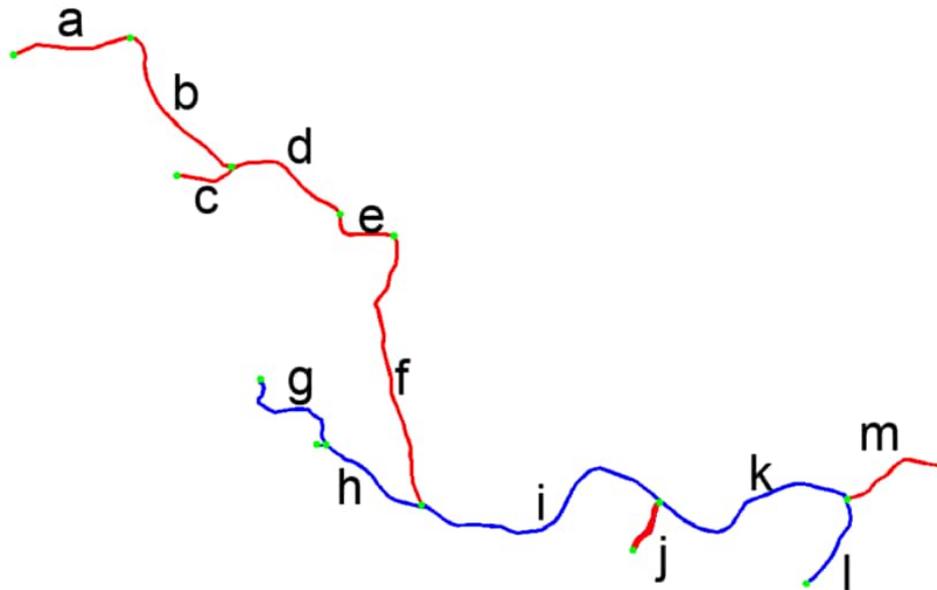


Figure 8- Division of Roadside Ditches (single-sided: blue; double-sided: red)

6.2. Total Phosphorus Budget

A refined version (v4.2, Fall 2012) of Ontario’s Lakeshore Capacity Model (LCM) was used to assess potential changes in water quality from the proposed development area within the Benoir and Elephant Lakes watershed. The LCM is a mass balance, steady-state model that quantifies the natural and human phosphorus inputs to a watershed and estimates the resulting phosphorus concentrations of the watershed’s lakes using the assumptions and recommended coefficients and constants provided by the MOE (MOE, 2010). Detailed methods and assumptions of the model are provided in MOE (2010).

The following provides a description and brief rationale for the selection of various coefficients and assumptions used in the modeling of Benoir and Elephant Lakes:

- The lakes and catchments area of Benoir and Elephant Lakes are 37,270 and 46,937 ha (3.73 and 4.69 km²), respectively.
- Total phosphorus (TP) loading from the land area in the whole watershed (Benoir Lake catchment is part of the whole Elephant Lake catchment) was determined using the following equation, because the percentage of wetland in the catchment was greater than 3.5%, and cleared or pastured land was less than 15%:

$$\text{TP (kg/yr)} = \text{catchment area (km}^2\text{)} \times (0.47 \times \% \text{ wetland area} + 3.82)$$

- A TP loading rate of 0.167 kg/ha/yr was used to calculate TP loads to the surface of the lakes from atmospheric deposition.
- Mean annual runoff values from 0.438 and 0.44 m/yr were determined from the runoff lookup table provided by the MOECC to calculate water loads from the lakes basin.

- TP loads from septic systems located within 300 m of the shoreline of the lakes were calculated assuming a loading rate of 0.66 kg/capita/yr for each septic system. For existing conditions, a septic usage rates of 1.27, 0.69, 1.18, and 0.69 capita yrs/yr for extended seasonal, seasonal, resort, and trailer parks residences were used.
- All lots included an overland runoff TP load of 0.04 kg/lot/yr.
- Model assumes that vacant lots of record will eventually be converted into extended seasonal cottages and future usage is equal to 1.27 capita years/yr. Although the shorelines of Benoir Lake were fully developed, there appeared to be about 20 vacant lots on the Elephant Lake shorelines.
- TP sampling is often best completed during spring turnover when the water column is mixed to assess whole lake conditions for studies of lake capacity. Phosphorus samples have been collected from East End of Elephant Lake, by Rock Cliff between 2002 and 2008 as part of MOECC's Lake Partner Program. Recently, four new samples were collected from central parts of Elephant Lake by King EPCM on May 25th, 2021, and were tested by TESTMARK Laboratories LTD.

The results of the LCM phosphorus model predicted that the development in the watershed without phosphorus reduction offsets would increase the phosphorus concentration in Benoir Lake and push the water quality closer to the upper mesotrophic range. There was an increase of 1.69 µg/L of TP and a decrease of 1.03 µg/L of TP between current and future conditions for Benoir and Elephant Lakes, respectively. The amount of phosphorus output in the proposed development for Benoir Lake increased to 16.69 µg/L, whereas it would be decreased to 13.33 µg/L in Elephant Lake.

By applying the over/under prediction coefficients of the model for both lakes, it can be said that both the current condition and the proposed condition would be below the average sampled total phosphorus (in that case, corrected TP_{future} would be 14.1 and 13.7 µg/L for Benoir and Elephant Lakes, respectively).

Details of the Lakeshore Capacity Model are provided in a separate LCM report.

7. Erosion and Sediment Control

In general, the guiding principles of the ESC Plan are according to the following goals and targets:

- Minimizing soil erosion at the source;
- Containing sediment on site;
- Treating sediment-laden runoff; and
- Being proactive, not reactive.

1.1. Minimizing soil erosion at the source

Based on the proposed developments, the site needs to replace the existing road with a new gravel road along with the implementation of new culverts and swales, and thus earthworks generally cause significant erosion. The main area of concern for ESC is the construction of the new road with new culverts. All temporary grading will have slopes directed into the excavated area.

1.2. Containing sediment on site

Where sediments are not directed into the excavation area of each block, it is a requirement to install Silt Fences as per LSRCA ESC-4 designs along with pinned silt socks at the site boundary with surrounding wetlands and woodlands.

1.3. Treating sediment-laden runoff

The proposed significant cut & fill plan requires careful management to prevent sediment-laden storm runoff from being conveyed off-site and into nearby lakes and streams. Assuming that Silt Fences are adequately installed and maintained, any temporary ponding of sediment-laden runoff will be infiltrated into the natural soils and runoff outflow from ditches would be captured by installing a series of straw bale check dams to slow sediment-laden water and allowing sediment to settle and clean water to flow downstream.

1.4. Being proactive, not reactive

It is acknowledged that the project proposes cut & fill operations. Topsoil stripping of the fill location must be prepared prior to the actual cut operations. This would allow the fill portion to occur as soon as feasible, with minimal stockpiling. It is also a requirement to seed the backfilled area as soon as possible.

This project can be separated into four (4) separate phases as follow:

Phase 1 –Road Construction & Driveway: Access road construction and widening the old road, implementation of 9 new proposed culverts and swales along the road requires topsoil stripping, as well as the removal of any trees along the way. In this phase, the existing corrugated metal culverts under the access road are to be replaced with new larger double-walled HDPE Culverts (corrugated outside and smooth inside) with three different sizes including 18, 30, and 59 in. diameters. All culverts have a recommended length of 12.0m. A silt fence shall be installed as per OPSD 219.110 “Light-Duty Silt Fence Barrier”, generally along both sides of the road construction (see attached site diagrams). All topsoil shall be stockpiled at the north side of the road, behind the silt fences, to act as a loose permeable filtration mound before the silt fences.

Phase 2 –Concrete Footing & Foundation Construction: Once road construction is completed, pouring the concrete foundation can begin. In this project, no excavation is done and the building is built on concrete footings. Silt fences must be installed prior to the concrete operation, along the bottom of the hill for each side based on the lot map. Mechanized tracks would not heavily impair sandy soil quality, or cause undue erosion, as long as all work area is surrounded by silt fence. After concrete forms are stripped and appropriately cured, the backfill of surrounding voids will be completed by using material from the stockpile.

Phase 3 –Actual Construction & Septic System: After the foundation is completed, the physical construction may be completed, as well as septic holding tanks are also installed and buried in this phase. Similar to previous phases, silt fences are required prior to the start of septic construction. Finally, the area around the new dwelling and its driveway should be paved with asphalt. The equipment used in this phase would be considered small, such as min-excavators, front-end loaders, and other small landscaping equipment.

Phase 4 –Landscaping, Grassing, and others: After the backfill is completed, landscaping, grassing,

and reseeded also are done during this phase. This phase of construction should not introduce significant erosions, other than where small mechanical equipment treads have disrupted native groundcover vegetation. The equipment used in this phase would be considered small, such as min-excavators, front-end loaders, and other small landscaping equipment.

Details of Erosion and Sediment Control Measures and Cut & Fill Details are provided in a separate ESC plan report.

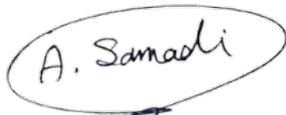
8. Reliance & Signature

This report is the intellectual property of King EPCM, and has been prepared for the sole use of 95 Developments (the Client). King EPCM accepts no liability for claims arising from the use of this report, or from actions taken or decisions made as a result of this report, by parties other than the Client. The Client may submit this report to the County of Haliburton, and Municipality of Dysart et al. in regard to the Client's residential development project at Elephant Lake, Harcourt, Dysart et al., Ontario.

Respectfully,



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APPENDIX I – SITE SURVEY PLAN

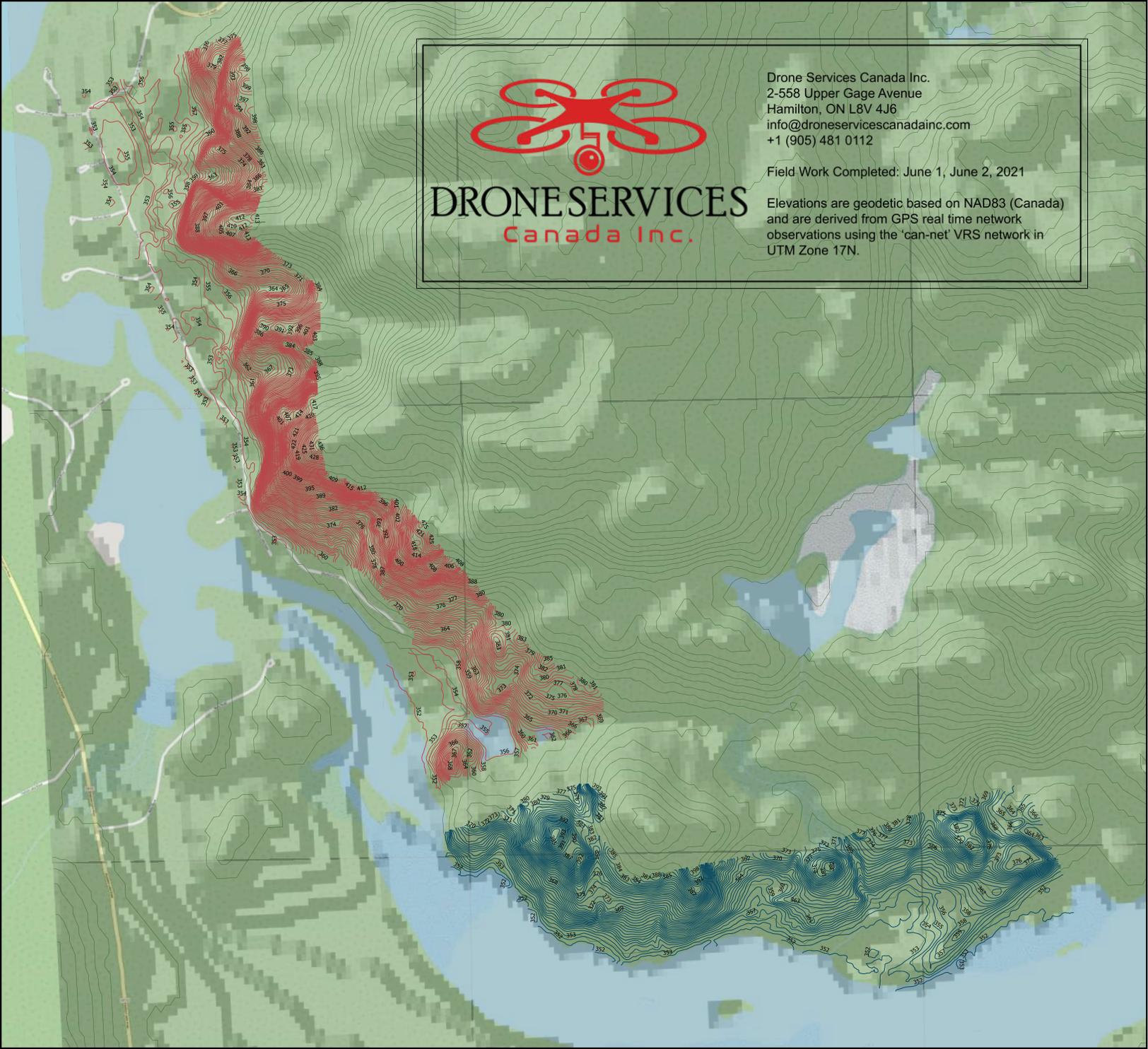


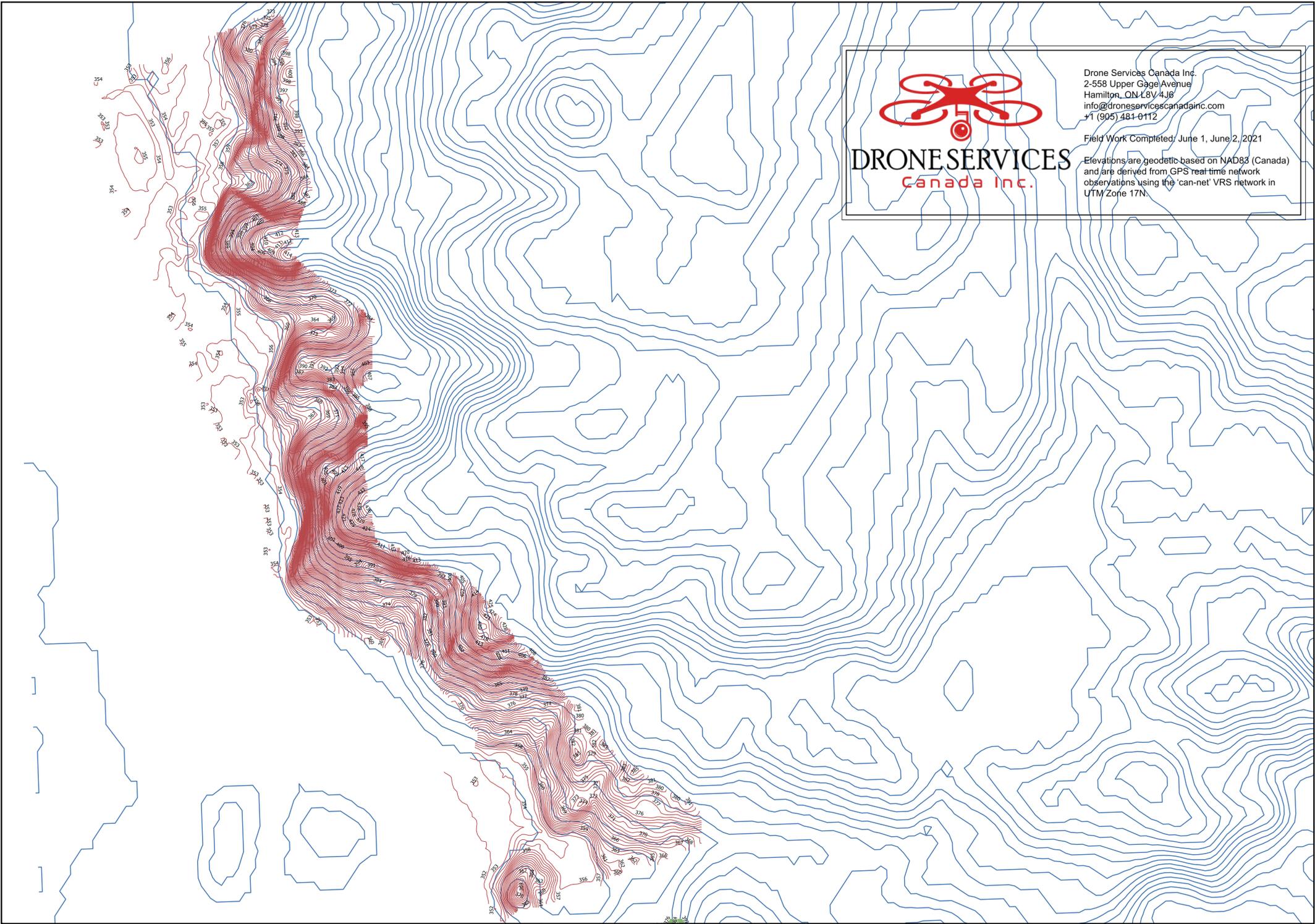
DRONE SERVICES Canada Inc.

Drone Services Canada Inc.
2-558 Upper Gage Avenue
Hamilton, ON L8V 4J6
info@droneservicescanadainc.com
+1 (905) 481 0112

Field Work Completed: June 1, June 2, 2021

Elevations are geodetic based on NAD83 (Canada)
and are derived from GPS real time network
observations using the 'can-net' VRS network in
UTM Zone 17N.





DRONE SERVICES
Canada Inc.

Drone Services Canada Inc.
2-558 Upper Gage Avenue
Hamilton, ON L8V 4J8
info@droneservicescanadainc.com
+1 (905) 481-0112

Field Work Completed: June 1, June 2, 2021

Elevations are geodetic based on NAD83 (Canada) and are derived from GPS real-time network observations using the 'can-net' VRS network in UTM Zone 17N.

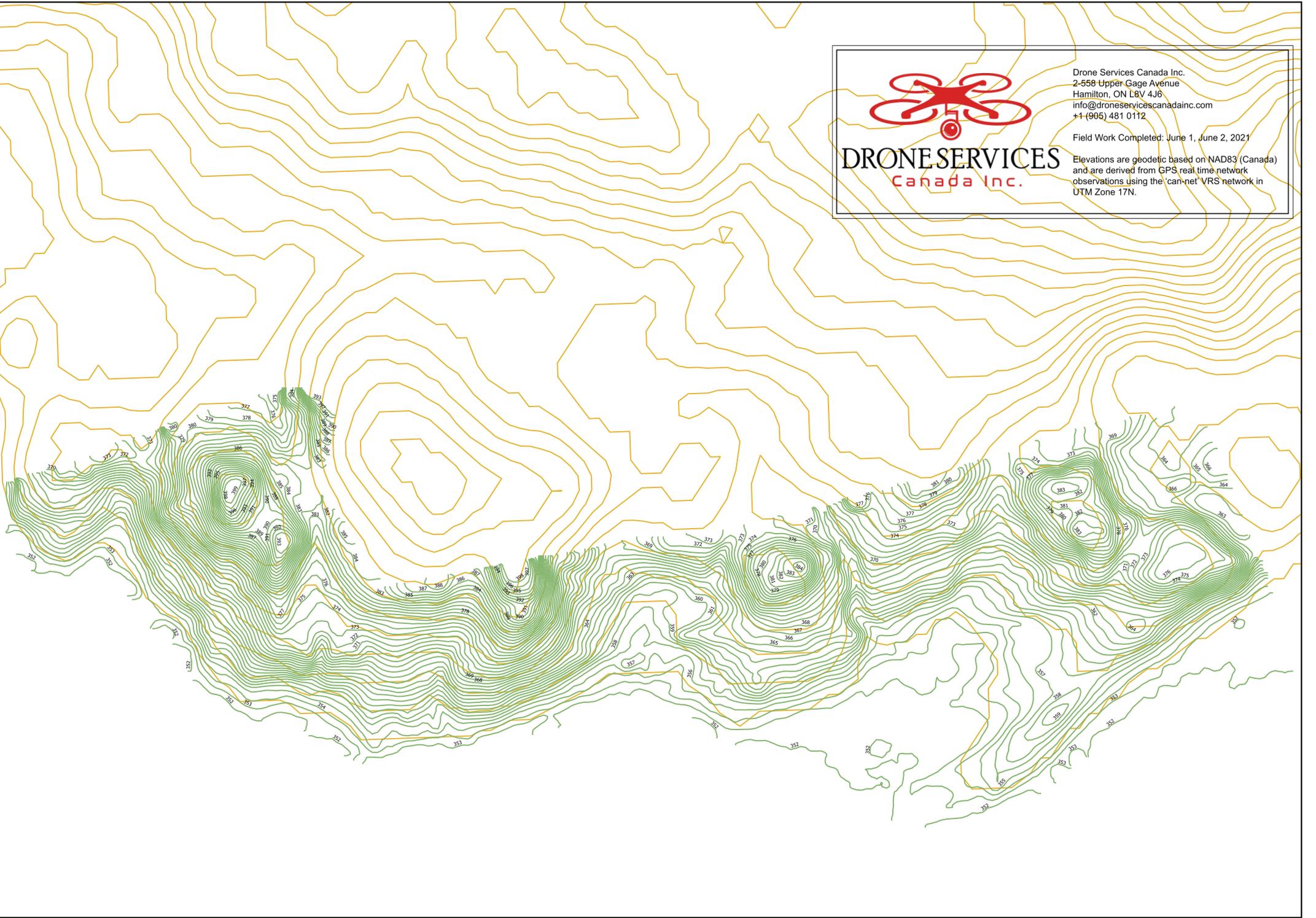


DRONE SERVICES
Canada Inc.

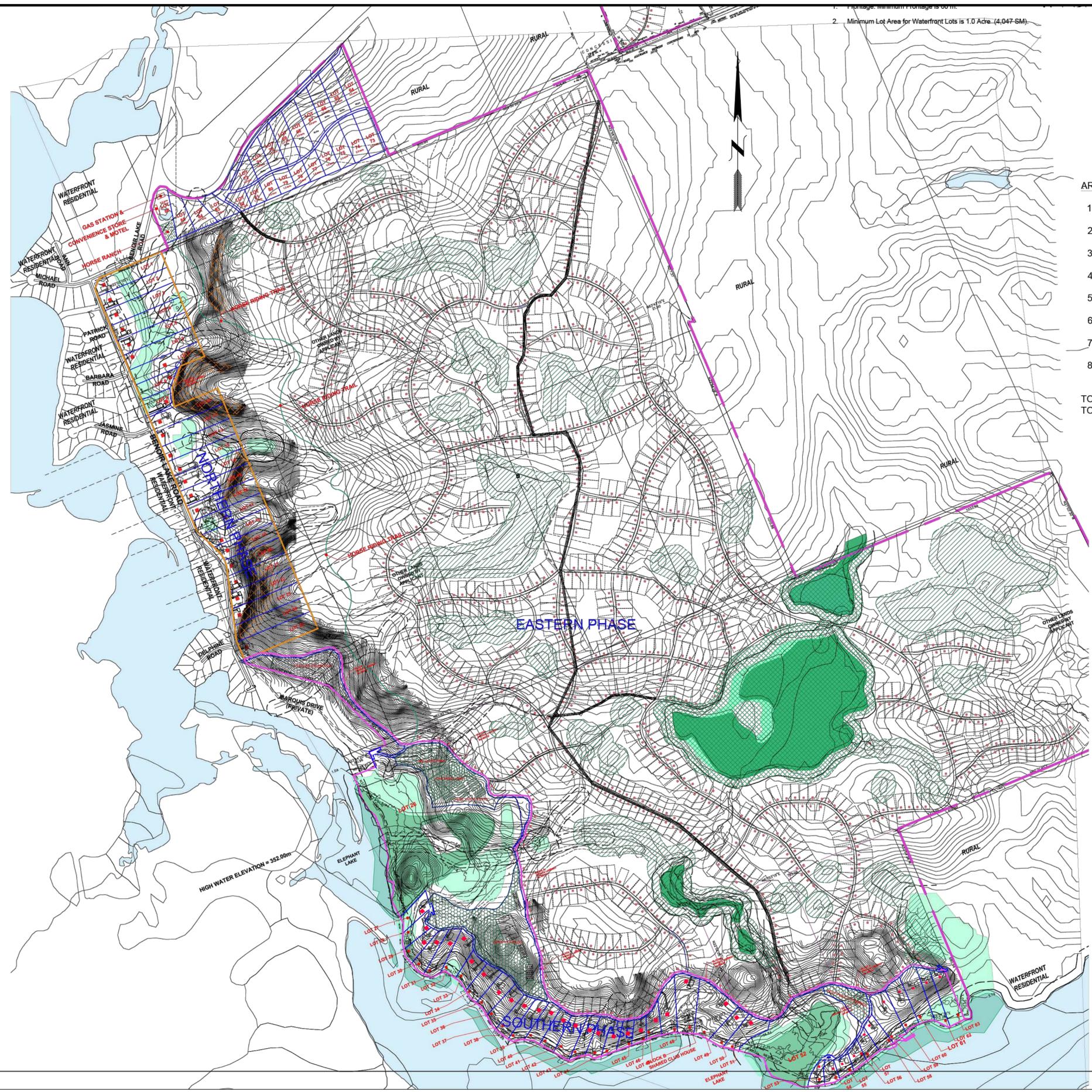
Drone Services Canada Inc.
2-558 Upper Gage Avenue
Hamilton, ON L8V 4J6
info@droneservicescanadainc.com
+1 (905) 481 0112

Field Work Completed: June 1, June 2, 2021

Elevations are geodetic based on NAD83 (Canada)
and are derived from GPS real time network
observations using the 'can-net' VRS network in
UTM Zone 17N.



APPENDIX II – SITE PLAN



1. Minimum Lot Area for Waterfront Lots is 0.6 Ha.
 2. Minimum Lot Area for Waterfront Lots is 1.0 Acre (4,047 SM).

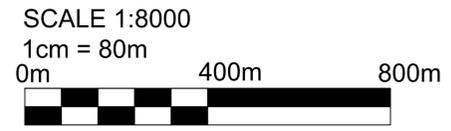
SURVEY NOTES
 BEARINGS ARE UTM GRID, DERIVED FROM OBSERVED REFERENCE POINTS A AND B, BY STATIC GNSS OBSERVATIONS, SHOWN HEREON, BEARING OF N67°45'10"E, REFERRED TO THE CENTRAL MERIDIAN OF UTM ZONE 17 (81° WEST LONGITUDE) NAD 83 (CSRS) V1.1 EPOCH 2010, GNSS BASELINE POST PROCESSED FROM LEICA REFERENCE STATION - HALIBURTON. FOR BEARING COMPARISONS, A ROTATION OF 1°59'50" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P1 THROUGH P6 AND 2°02'25" COUNTER-CLOCKWISE ON P7.
 DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 1.00017448. PROPERTY LINES ARE UNFENCED, UNLESS OTHERWISE NOTED. FENCES ARE LOCATED ON PROPERTY LINES, UNLESS OTHERWISE NOTED.
 TIES SHOWN TO THE WATER'S EDGE OF YORK RIVER ARE AT RIGHT ANGLES TO THE TRAVERSE LINE, UNLESS OTHERWISE NOTED.
 SSB'S PLANTED DUE TO INSUFFICIENT OVERBURDEN
 CONTOUR INFORMATION AND LOT CONCEPT FROM KING EPCM.
 FOR FULL SURVEY DETAILS REFER TO PLANS BY MILLER LAND SURVEYING

AREA SUMMARY OF HARD SURFACE FOR ANCILLARY FACILITY

1. FOOTBALL FIELD: 5403m² , (PERMEABLE SURFACE)
2. HORSE RANGE: 3726m² , (PERMEABLE SURFACE)
3. TENNIS COURT: 534 x 2 = 1068m² IN TOTAL, (IMPERMEABLE SURFACE)
4. BADMINTON COURT: 358 x 3 = 1074m² IN TOTAL (IMPERMEABLE SURFACE)
5. BASKET BALL FIELD: 450 x 3 = 1350m² IN TOTAL (IMPERMEABLE SURFACE)
6. GAS STATION: 450m² ,(IMPERMEABLE SURFACE)
7. CONVENIENT STORE AND MOTEL: 360m² , (IMPERMEABLE SURFACE)
8. CAR PARKING: 12000m² APPROXIMATLY, (PERMEABLE SURFACE)

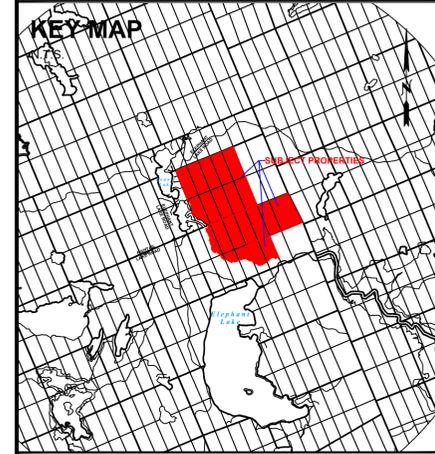
TOTAL PERMEABLE SURFACE: 21129m²
 TOTAL IMPERMEABLE SURFACE: 4320m²

- LEGEND**
- SUBJECT BOUNDARY
 - EXISTING PARCEL
 - WATERBODY
 - EXISTING WATERCOURSE
 - WATERCOURSE/SHORELINE BUFFER (30m)
 - EXISTING WETLANDS (Unverified, retrieved from LIO)
 - EXISTING WETLANDS (Provincially Significant, retrieved from LIO)
 - WETLAND BUFFER (30m)
 - EXISTING SIGNIFICANT WILDLIFE HABITAT
 - 1:100 YEAR FLOODPLAIN BOUNDARY
 - EXISTING CONTOUR ELEVATION (5m Interval)
 - EXISTING GRAVEL DRIVE
 - EXISTING MUNICIPAL ROAD
 - PROPOSED LOT/BLOCK LINE
 - PROPOSED SEPTIC SYSTEM AREA
 - PROPOSED DWELLING, DRIVEWAY AND GARAGE



Municipality Notes

DRAWN	STAMP
KL	
DATE	
JULY 29, 2024	



KING E P C M 211-3780 14th Ave
 Markham, ON, L3R 9Y5
 www.KingEPCM.com
 647-459-5647

CLIENT
2463756 ONTARIO INC.

PROJECT NAME
ALGONQUIN GARDEN

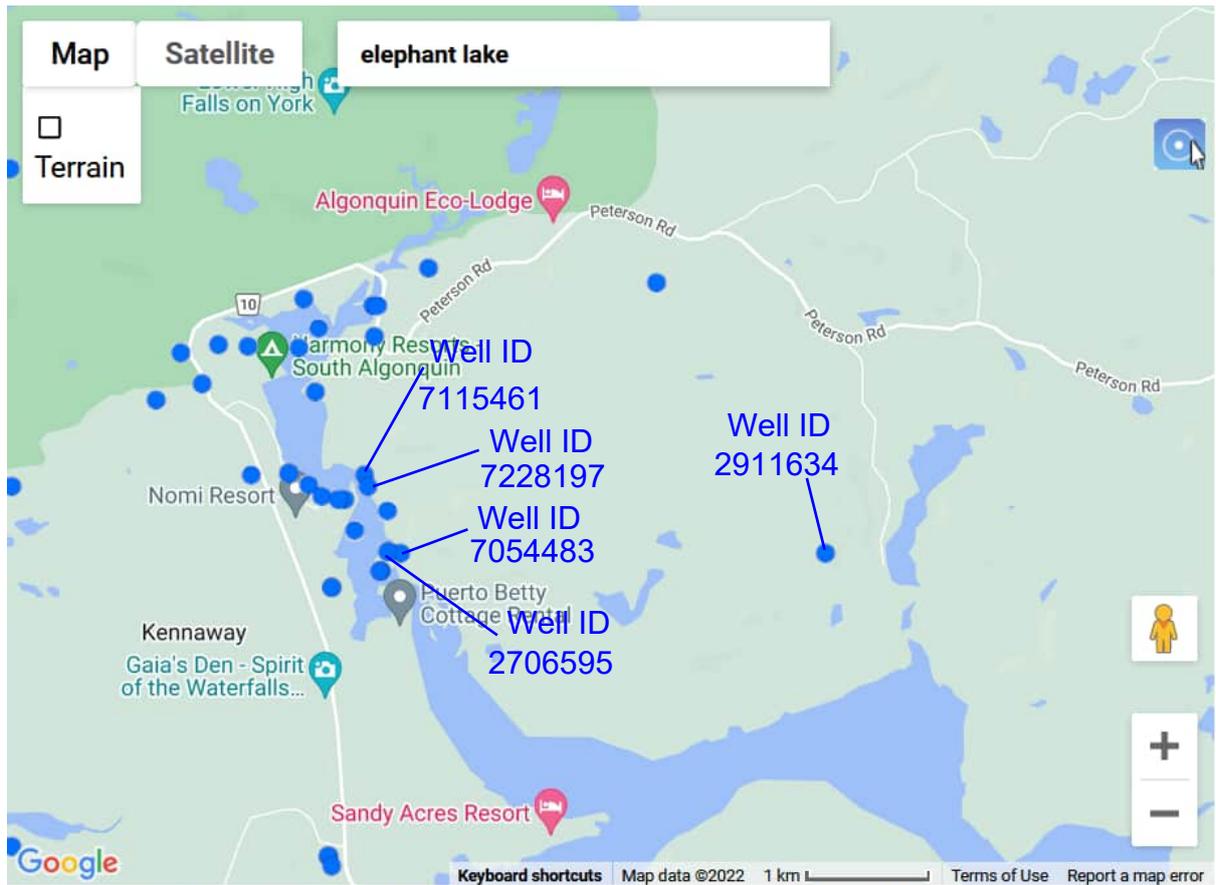
PROJECT LOCATION
 PART OF CON 11 LOT 27 - 31, CON 10 LOT 27 - 31
 CON 09 LOT 27 - 33, CON 08 LOT 27 - 31, TWP. OF
 HARCOURT, THE MUNICIPALITY OF DYSERT ET AL

PRINT TITLE
ENGINEERING SITE PLAN

FILE No.
EGR - 1.1

No.	ISSUED FOR:	DATE	DRAW BY	CHECK
V22	ISSUED FOR PERMITS	JULY 29, 2024	KL	TW

APPENDIX III – MECP WELL RECORDS



Latitude:45.21293, Longitude:-78.18468 (UTM Zone:17, Easting:721066, Northing:5010460)

2911634

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK CORRECT BOX WHERE APPLICABLE

11

MUNICIP. CON. 10 14 15 22 23 24

COUNTY OR DISTRICT: *Hastings* TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: *Merchell* CON. BLOCK, TRACT, SURVEY ETC: *15* LOT: *34*

ADDRESS: *Box 186 Bancroft, Ont.* DATE COMPLETED: DAY *26* MO *5* YR *87*

NORTHING: 21 10 12 17 18 24 25 26 30 31 BASIN CODE: I, II, III, IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)						
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION		DEPTH - FEET	
					FROM	TO
<i>Brown</i>	<i>sand</i>	<i>quicksand</i>			<i>0</i>	<i>134</i>
<i>Grey & black</i>	<i>granite</i>				<i>135</i>	<i>160</i>

31 32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
<i>146</i>	<input checked="" type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET	
			FROM	TO
<i>6 1/4</i>	<input checked="" type="checkbox"/> STEEL <input type="checkbox"/> GALVANIZED <input type="checkbox"/> CONCRETE <input type="checkbox"/> OPEN HOLE <input type="checkbox"/> PLASTIC	<i>.188</i>	<i>0</i>	<i>140</i>
<i>5 1/16</i>	<input type="checkbox"/> STEEL <input type="checkbox"/> GALVANIZED <input type="checkbox"/> CONCRETE <input checked="" type="checkbox"/> OPEN HOLE <input type="checkbox"/> PLASTIC		<i>140</i>	<i>160</i>

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
<i>10-13</i>	<i>14-17</i>
<i>18-21</i>	<i>22-25</i>
<i>26-29</i>	<i>30-33</i>

Drive shoe

71 PUMPING TEST

PUMPING TEST METHOD: PUMP BAILER

PUMPING RATE: *100* GPM DURATION OF PUMPING: *2* HOURS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING			
<i>20</i> FEET	<i>160</i> FEET	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
		<i>28-28</i>	<i>29-31</i>	<i>32-34</i>	<i>35-37</i>

RECOMMENDED PUMP TYPE: SHALLOW DEEP

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE INDICATE NORTH BY ARROW.

BIRD'S CREEK

BAPTISTE LK. RD.

CAMP PENNECA RD.

200'

COUNTY LINE of HALIBURTON & HASTINGS.

10608

FINAL STATUS OF WELL

WATER SUPPLY

WATER USE

DOMESTIC

METHOD OF CONSTRUCTION

ROTARY (AIR)

3651

CONTRACTOR

NAME OF WELL CONTRACTOR: *B. Marguardt Son Ltd.* WELL CONTRACTOR'S LICENCE NUMBER: *3651*

ADDRESS: *Palmer Rapids, Ont. K0J 2E0*

NAME OF WELL TECHNICIAN: *Wayne Marguardt* WELL TECHNICIAN'S LICENCE NUMBER: *T-0059*

SUBMISSION DATE: DAY *8* MO *9* YR *87*

OFFICE USE ONLY

DATA SOURCE: *SEP 14 1987*

DATE OF INSPECTION: _____ INSPECTOR: _____

REMARKS: _____

CSS.ES

Instructions for Completing Form

- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference. All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form. Questions regarding completing this application can be directed to the Water Well Help Desk (Toll Free) at 1-888-396-9355. All metre measurements shall be reported to 1/10th of a metre. Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

Table with columns: MUN, CON, LOT

RR#/Street Number/Name: HALLIBURTON 1388 Bendit Lk Rd, City/Town/Village: HARCOURT, Site/Compartment/Block/Tract etc.: 26 10

Log of Overburden and Bedrock Materials (see instructions)

Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From, Metres To. Includes entries for SAND, SILT, BOULDERS, GRAVEL.

AIR TEST 25 gpm

Hole Diameter, Water Record, Chlorinated sections

Construction Record, Casing, Screen, No Casing or Screen sections

Test of Well Yield section with pumping test method, draw down, and recovery data

Plugging and Sealing Record, Method of Construction, Water Use, Final Status of Well sections

Location of Well section with diagram and audit information

Well Contractor/Technician Information section

Ministry Use Only section

Measurements recorded in: Metric Imperial

Page _____ of _____

Well Owner's Information

1242 Benoit Lk Rd HARCOURT 129 11
 County/District/Municipality City/Town/Village Province Postal Code
 HALIBURTON Ontario K1J6V6
 UTM Coordinates Zone Easting Northing Municipal Plan and Sublot Number Other
 NAD 83 177240125006716

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)	
				From	To
BROWN	SAND			0	28
GREY	CLAY			28	148
GREY	BOULDERS	BROKEN ROCK		148	160
U	COARSE GRAVEL			160	161

Annular Space

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
0 140	Bentonite	55

Results of Well Yield Testing

After test of well yield, water was:	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
<input checked="" type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____				
If pumping discontinued, give reason: _____	Static Level	5.5		7.9
	1		1	5.5
Pump intake set at (m/ft)	2	7.9	2	
Pumping rate (l/min / GPM)	3		3	
Duration of pumping	4	7.9	4	
Final water level end of pumping (m/ft)	5		5	
If flowing give rate (l/min / GPM)	10		10	
	15		15	
Recommended pump depth (m/ft)	20	7.9	20	
Recommended pump rate (l/min / GPM)	25		25	
Well production (l/min / GPM)	30		30	
Disinfected?	40		40	
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	50		50	
	60	7.9	60	

Method of Construction

<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input type="checkbox"/> Public	<input type="checkbox"/> Commercial	<input type="checkbox"/> Not used
<input checked="" type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input checked="" type="checkbox"/> Domestic	<input type="checkbox"/> Municipal	<input type="checkbox"/> Dewatering
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input type="checkbox"/> Test Hole	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Cooling & Air Conditioning	
<input type="checkbox"/> Air percussion		<input type="checkbox"/> Industrial		
<input type="checkbox"/> Other, specify _____		<input type="checkbox"/> Other, specify _____		

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
6 1/4	steel	0.188	+2	161	<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

Construction Record - Screen

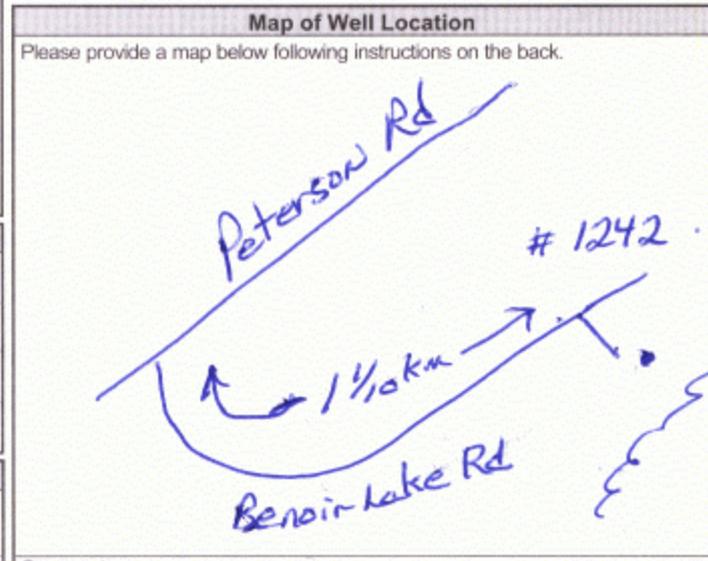
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To

Water Details

Water found at Depth (m/ft)	Kind of Water:	Fresh	Untested
161	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	<input type="checkbox"/>	<input type="checkbox"/>

Well Contractor and Well Technician Information

Business Name of Well Contractor: EARLY MARQUAROT & SON INC
 Well Contractor's Licence No.: 3611
 Business Address (Street Number/Name): RR1, 6442 Palmer Road
 Municipality: Palmer Rapids
 Province: ON Postal Code: K0J2E0
 Business E-mail Address: _____
 Bus. Telephone No. (inc. area code): 6137582200
 Name of Well Technician (Last Name, First Name): MARQUAROT TERRY
 Well Technician's Licence No.: T62
 Signature of Technician and/or Contractor: [Signature]
 Date Submitted: 20081030



Comments:

Well owner's information package delivered: Yes No

Date Package Delivered: Y Y Y Y | M M | D D

Date Work Completed: Y Y Y Y | M M | D D

Ministry Use Only

Audit No. Z 87014

NOV 19 2008

Received

A151726

Measurements recorded in: Metric Imperial

Page _____ of _____

Address of Well Location (Street Number/Name) 1268 BENDIR LAKE RD		Township HARCOURT	Lot 26 129	Concession 11
County/District/Municipality HALIBURTON		City/Town/Village	Province Ontario	Postal Code
UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number Plan 506	
NAD 83	17724046	5006628	Other River Lot # 133	

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)	
				From	To
BROWN	SAND			0	12
GREY	CLAY	grit	FIRM	12	148
REY	CLAY	cobbles	packed	148	155
Red	Rock			155	159
	gravel	Broken Rock	seams	159	161

Annular Space

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
From: 0 To: 150	Bentonite grout	65

Results of Well Yield Testing

After test of well yield, water was:	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
<input checked="" type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____	Static Level	3		3.5
If pumping discontinued, give reason: _____	1	3.1	1	3.1
Pump intake set at (m/ft) 100	2	3.2	2	3.0
Pumping rate (l/min / GPM) 10	3	3.3	3	3.0
Duration of pumping 1 hrs + min	4	3.3	4	
Final water level end of pumping (m/ft) 3.5	5	3.3	5	
If flowing give rate (l/min / GPM)	10	3.4	10	
	15	3.5	15	
	20	3.5	20	
Recommended pump depth (m/ft) 100	25	3.5	25	
Recommended pump rate (l/min / GPM) 10	30		30	
Well production (l/min / GPM) 50 gpm	40	3.5	40	
Disinfected? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	50		50	
	60	3.5	60	

Method of Construction		Well Use		
<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input type="checkbox"/> Public	<input type="checkbox"/> Commercial	<input type="checkbox"/> Not used
<input checked="" type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input checked="" type="checkbox"/> Domestic	<input type="checkbox"/> Municipal	<input type="checkbox"/> Dewatering
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input type="checkbox"/> Test Hole	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Cooling & Air Conditioning	
<input type="checkbox"/> Air percussion		<input type="checkbox"/> Industrial		
<input type="checkbox"/> Other, specify mud		<input type="checkbox"/> Other, specify		

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
6 1/4	steel	.188	+2	155.5	<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify <input type="checkbox"/> Other, specify
6	open hole		155.5	161	

Construction Record - Screen

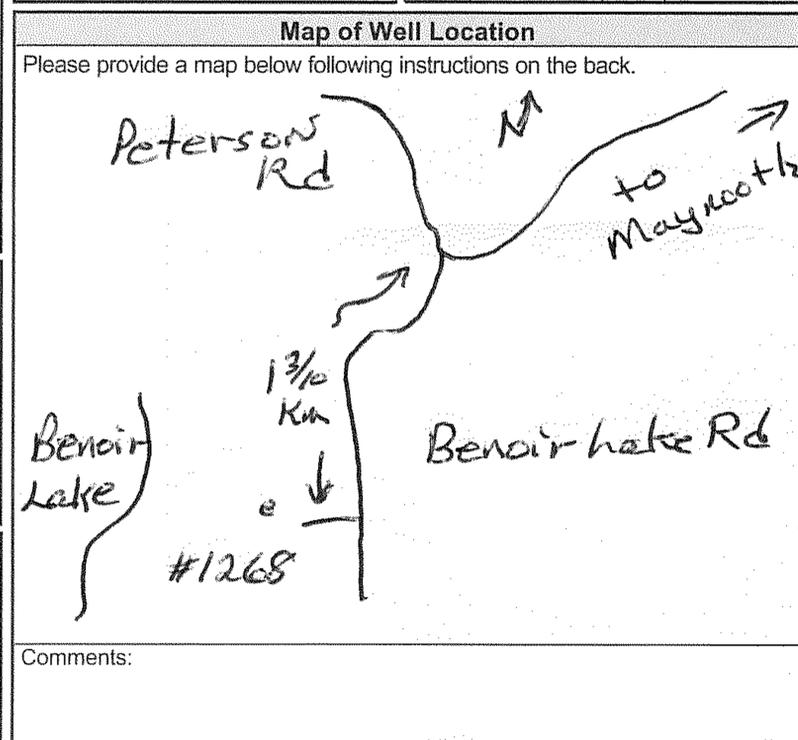
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To

Water Details		Hole Diameter		
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested	Depth (m/ft) From	To	Diameter (cm/in)
9-16 (m/ft)	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	0	155	9 1/2
		155	161	6

Well Contractor and Well Technician Information

Business Name of Well Contractor MARQUAROT WATERSPECIALISTS INC	Well Contractor's Licence No. 7422
Business Address (Street Number/Name) #1, 6442 Palmer Road	Municipality Palmer Rapids
Province ON	Postal Code K0J2E0
Business E-mail Address	

Bus. Telephone No. (inc. area code) 6137582200	Name of Well Technician (Last Name, First Name) MARQUAROT TERRY
Well Technician's Licence No. T62	Signature of Technician and/or Contractor Terry Marquardt
	Date Submitted 20140919



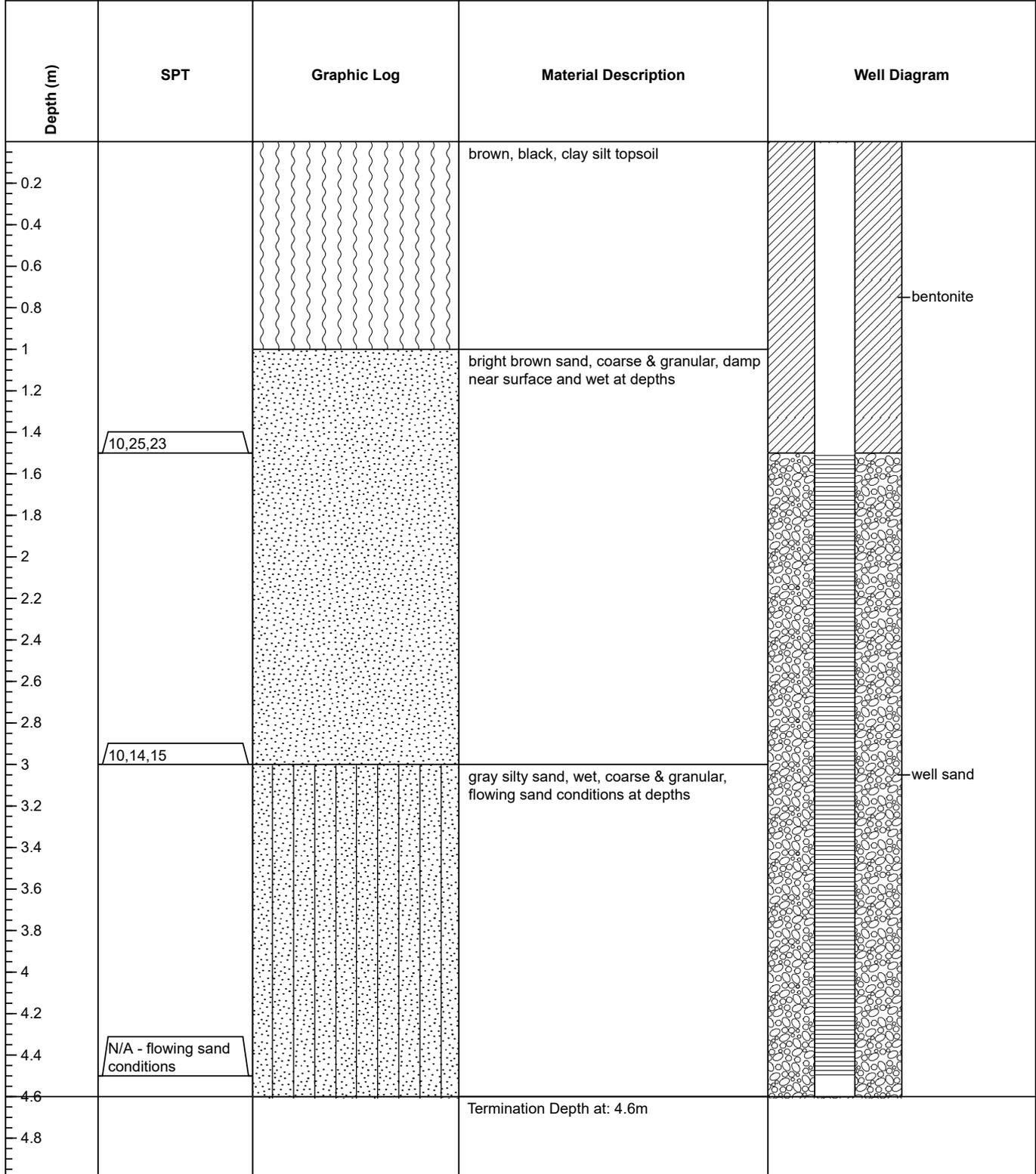
Well owner's information package delivered <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Date Package Delivered 20140917	Ministry Use Only Audit No. 2175365 SEP 26 2014
	Date Work Completed 20140917	

APPENDIX IV – BOREHOLE DRILL LOG

GROUNDWATER LOG BH101

PROJECT NUMBER	DRILLING DATE APR 12, 2021	COORDINATES 724,148N, 5,007,290E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 4.6M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 4.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING 2" PVC	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN uPVC Factory Slotted	WELL TOC

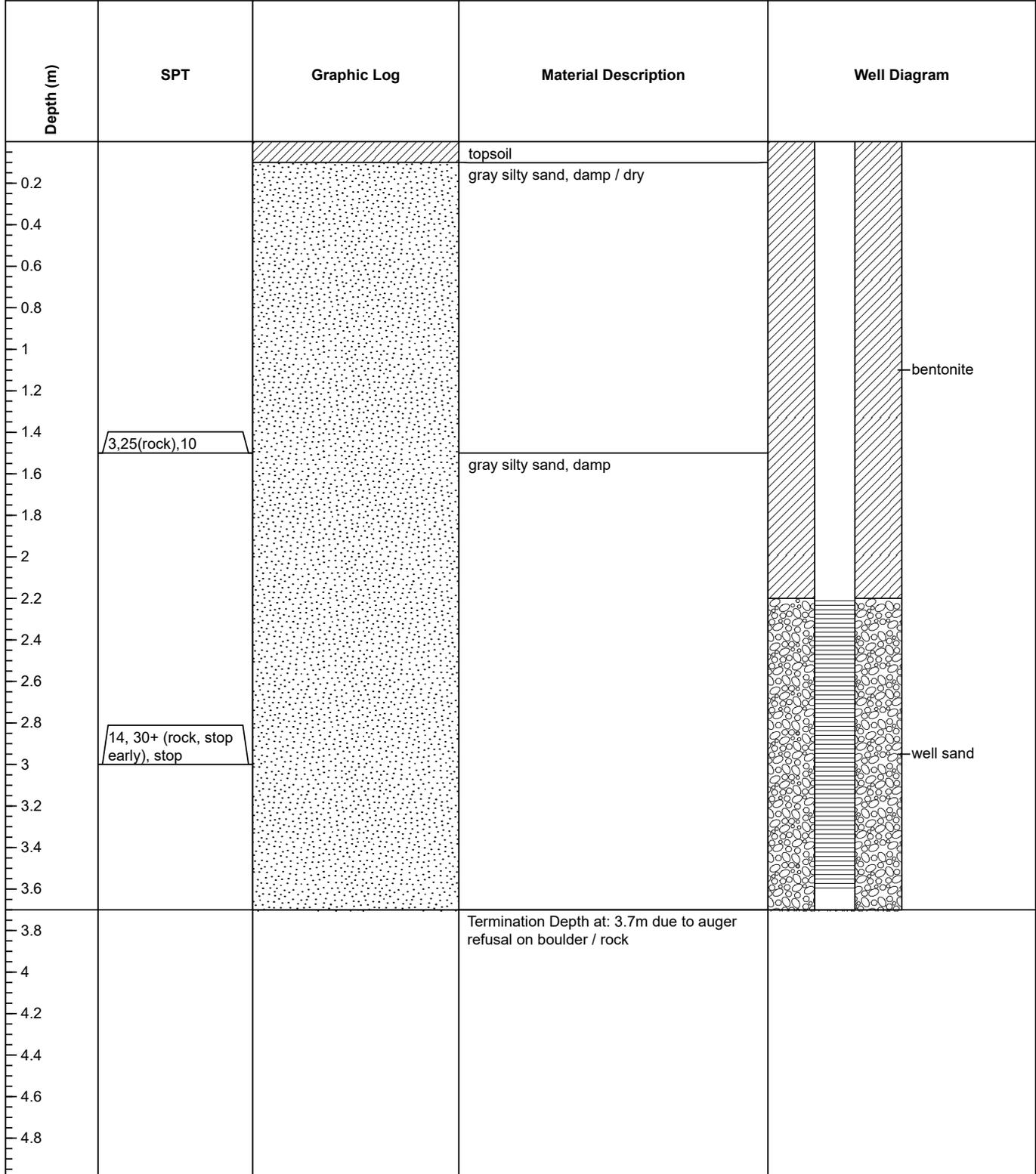
COMMENTS IN PROPOSED LOT A3	LOGGED BY TW
	CHECKED BY



GROUNDWATER LOG BH102

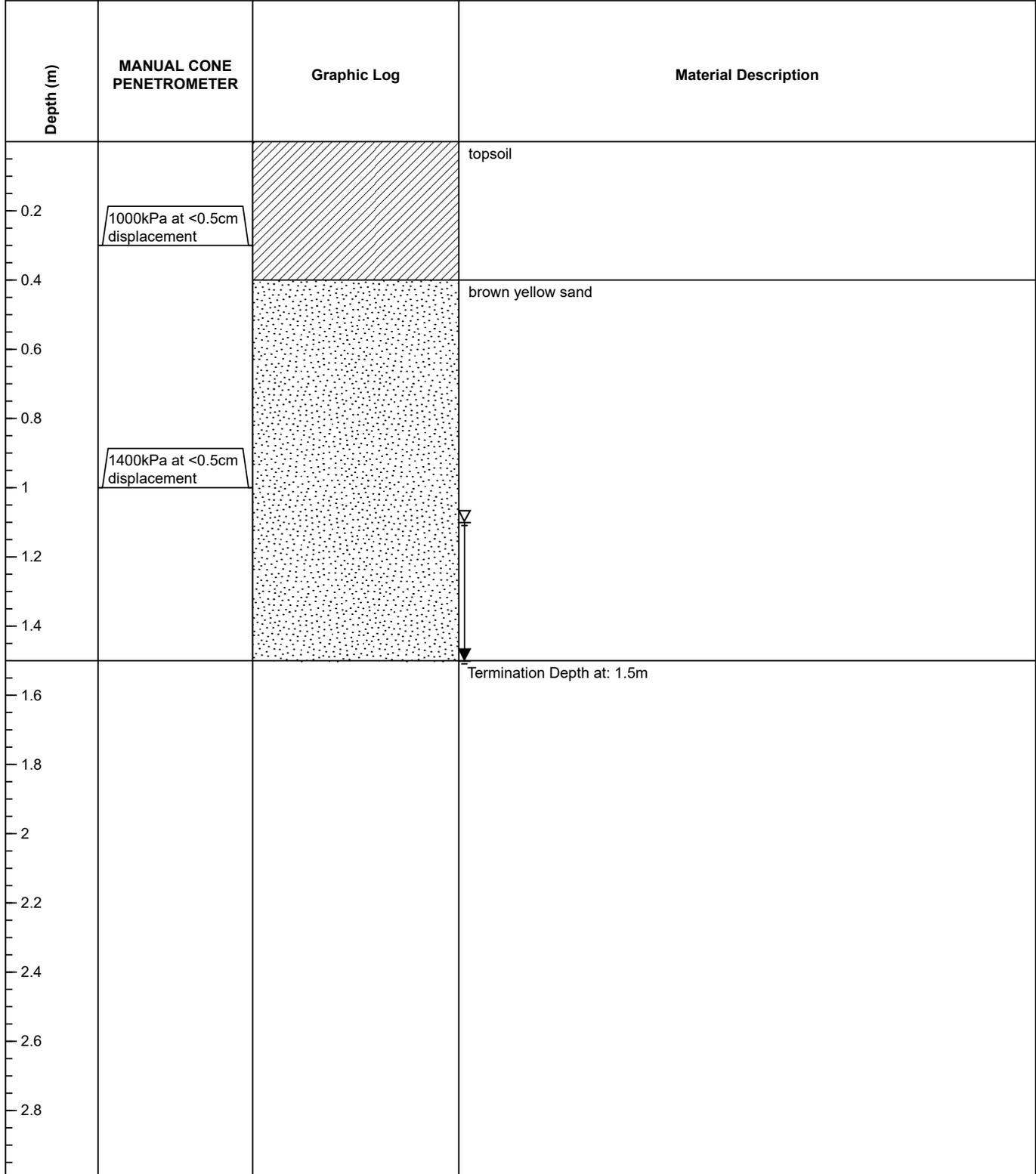
PROJECT NUMBER	DRILLING DATE APR 12, 2021	COORDINATES 725,656N, 5,004,632E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 3.7M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 4.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING 2" PVC	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN uPVC Factory Slotted	WELL TOC

COMMENTS IN PROPOSED LOT B17, UPLAND	LOGGED BY TW
	CHECKED BY



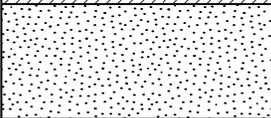
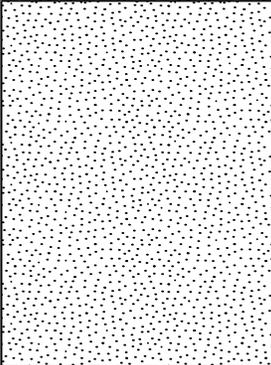
PROJECT NUMBER	DRILLING DATE NOV 15, 2021	COORDINATES 726,516N, 5,004,449E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 1.5M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 2.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN	WELL TOC

COMMENTS IN PROPOSED LOT B28	LOGGED BY TW
	CHECKED BY



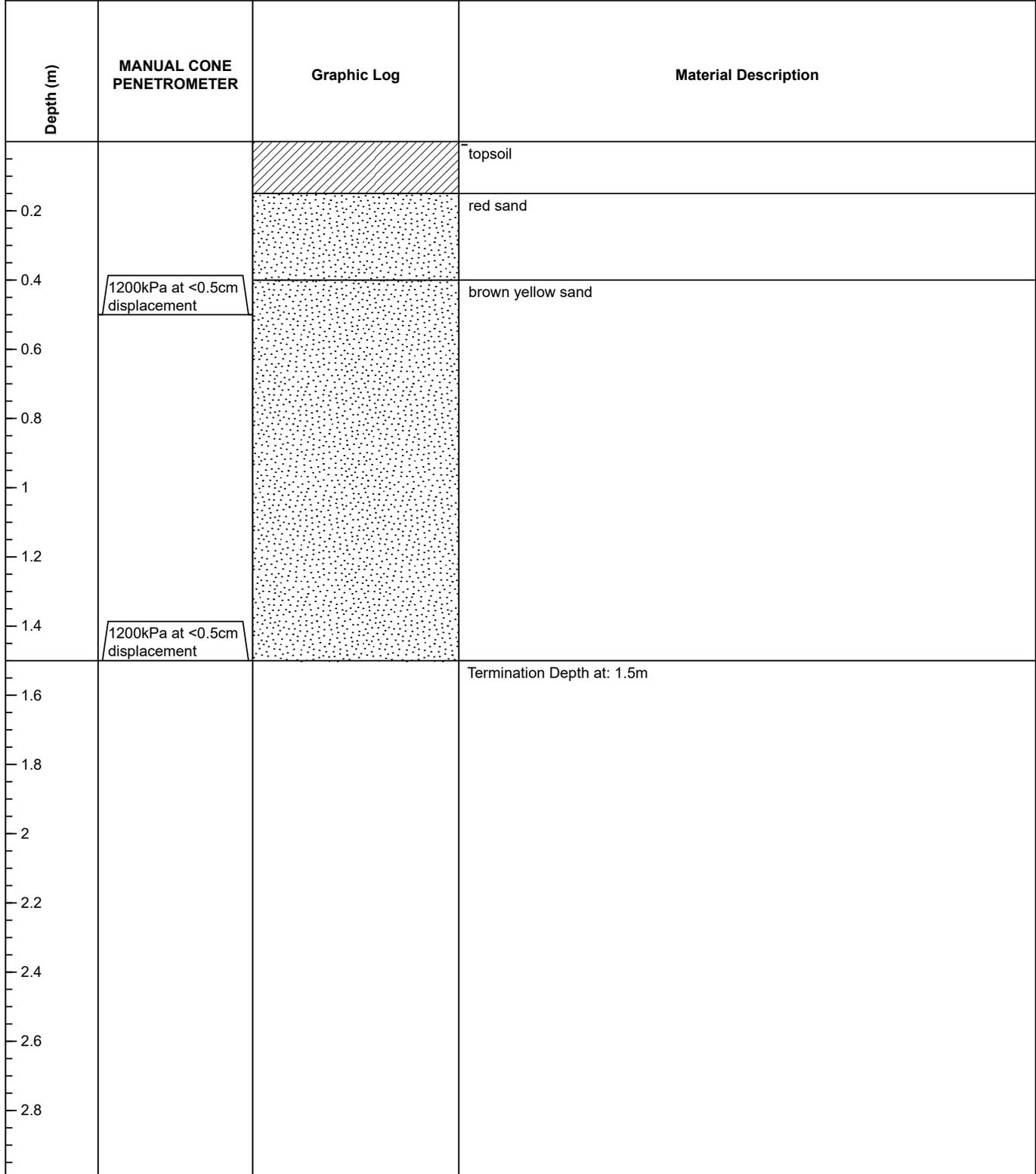
PROJECT NUMBER	DRILLING DATE NOV 15, 2021	COORDINATES 726,860N, 5,004,672E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 1.2M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 2.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN	WELL TOC

COMMENTS IN PROPOSED LOT B35	LOGGED BY TW
	CHECKED BY

Depth (m)	MANUAL CONE PENETROMETER	Graphic Log	Material Description
0.0 - 0.1			topsoil
0.1 - 0.3			red sand
0.3 - 1.2			yellow sand
1.2	1200kPa at <0.5cm displacement		Termination Depth at: 1.2m
1.2 - 1.4			
1.4 - 1.6			
1.6 - 1.8			
1.8 - 2.0			
2.0 - 2.2			
2.2 - 2.4			
2.4 - 2.6			
2.6 - 2.8			

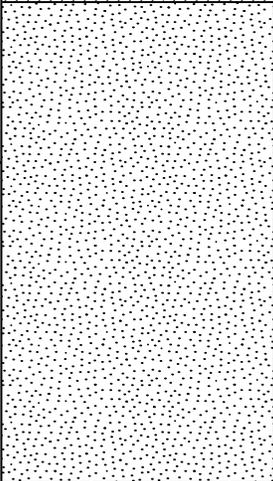
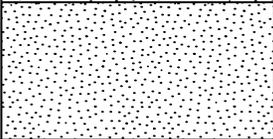
PROJECT NUMBER	DRILLING DATE NOV 15, 2021	COORDINATES 726,115N, 5,004,615E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 1.5M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 2.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN	WELL TOC

COMMENTS IN PROPOSED LOT B25	LOGGED BY TW
	CHECKED BY



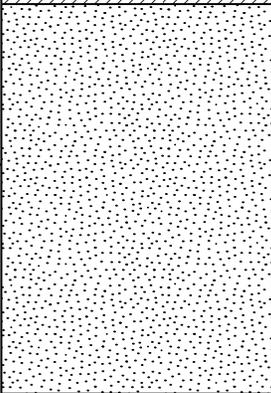
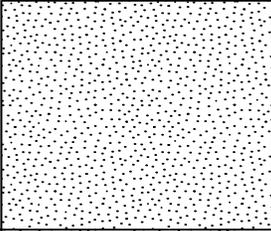
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PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 1.5M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 2.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN	WELL TOC

COMMENTS IN PROPOSED LOT B9	LOGGED BY TW
	CHECKED BY

Depth (m)	MANUAL CONE PENETROMETER	Graphic Log	Material Description
0.0			topsoil
0.2			red sand
0.4	1200kPa at <0.5cm displacement		
0.6			
0.8			
1.0			
1.2			
1.4	1200kPa with 1.0cm displacement		gray yellow sand
1.6			Termination Depth at: 1.5m
1.8			
2.0			
2.2			
2.4			
2.6			
2.8			

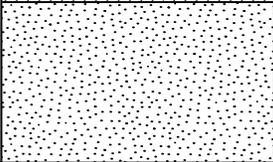
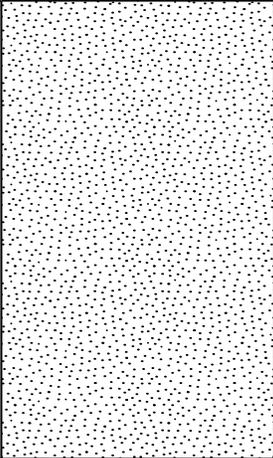
PROJECT NUMBER	DRILLING DATE NOV 15, 2021	COORDINATES 724,070N, 5,006,939E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 1.5M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 2.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN	WELL TOC

COMMENTS IN PROPOSED LOT A6	LOGGED BY TW
	CHECKED BY

Depth (m)	MANUAL CONE PENETROMETER	Graphic Log	Material Description
0.0 - 0.2			topsoil
0.2 - 1.1	1400kPa at <0.5cm displacement		red sand
1.1 - 1.4			gray sand, dry
1.4 - 1.5	1200kPa at <0.5cm displacement		Termination Depth at: 1.5m
1.5 - 2.8			

PROJECT NUMBER	DRILLING DATE NOV 15, 2021	COORDINATES 723,950N, 5,007,155E
PROJECT NAME ELEPHANT LAKE SUB-DIVISC	TOTAL DEPTH 1.5M	COORD SYS UTM-17
CLIENT 95 DEVELOPMENT INC.	DIAMETER 2.5 INCH	COMPLETION
ADDRESS ELEPHANT LAKE, DYSART ET AL	CASING	SURFACE ELEVATION
LICENCE NO. 7691	SCREEN	WELL TOC

COMMENTS IN PROPOSED LOT A4	LOGGED BY TW
	CHECKED BY

Depth (m)	MANUAL CONE PENETROMETER	Graphic Log	Material Description
0.0			topsoil
0.2			red sand
0.4	1200kPa at <0.5cm displacement		
0.6			gray yellow sand, significant amounts of small granular gravel
0.8			
1.0			
1.2			
1.4	1200kPa at <0.5cm displacement		
1.6			Termination Depth at: 1.5m
1.8			
2.0			
2.2			
2.4			
2.6			
2.8			

APPENDIX V – FIELD PERMEABILITY TEST

In-situ Measurement of Field Saturated Hydraulic Conductivity

1. Field Permeability Test

The "Constant Head Well Permeameter" (CHWP) method (Reynolds, 1993; Elrick and Reynolds, 1986) is based on the observation that when a constant height or "head" of water is ponded in a borehole or "well" augured into unsaturated soil, a "bulb" of field-saturated soil is gradually established around the base of the well. The K_{fs} value achieved through this method can be less than or equal to half of K_s (Saturated hydraulic conductivity) due to partial blocking of soil pores by air bubbles and it is preferred over K_s in the design of on-site stormwater LID infiltration design, because drainage through the soil should be designed to occur at less than complete soil saturation.

The in-situ measurements were done by the ETC Standard Soils Pask Permeameter, is an extended single-head analysis method and calculations procedure used here are based on the work of W.D. Reynolds and D.E. Elrick formerly of the University of Guelph, Ontario, Canada.

The ETC Pask Permeameter is a convenient and easy to use apparatus for ponding a constant head of water in a well, and simultaneously measuring the flow into the soil. The rate of fall (R) of the water level in the permeameter reservoir and reservoir cross-sectional area (X) allows determination of quasi steady water flow I_{rate} (Q) into the soil (i.e $Q = XR$). K_{fs} is then calculated using Equation 1 (Reynolds, 1993):

$$K_{fs} = CQ / [2\pi H^2 + C\pi a^2 + (2\pi H/\alpha^*)] \quad (\text{Eq. 1})$$

In which:

K_{fs} = the calculated permeability from the field test

Table 1. Parameters used

Parameter	Description	BH		
		201	206	203
Soil Texture Factor (α^*) in cm^{-1}	Most structured and medium textured materials; including structured clayey and loamy soils, as well as unstructured medium single-grain sands.	0.12		
R in cm/min	Quasi steady state (constant) rate of fall of water in permeameter reservoir (Measured in the site)	0.9	2	5
μ_k/μ_a	Temperature Correction Factor ($t=3^\circ\text{C}$)	1		
C	Shape factor	1.36		
X in cm^2	Cross-sectional area of permeameter reservoir	53.46		
H in cm	Height of air inlet hole from bottom of the test hole	15		
a in cm	Well hole radius	4.15		

Based on data described in the above table and using Pask Permeameter ETC Quick Field Reference Tables for Standard Soils, the K_{fs} was calculated as:

$$K_{fs201} = 4.8E-6 \text{ m/sec} = 4.8E-4 \text{ cm/sec}$$

$$K_{fs206} = 1.1E-5 \text{ m/sec} = 1.1E-3 \text{ cm/sec}$$

$$K_{fs203} = 2.7E-5 \text{ m/sec} = 2.7E-3 \text{ cm/sec}$$

And then the temperature corrected permeability would be calculated using equation 2 as follows:

$$K_a = K_{fs} \times \mu_k / \mu_a \quad (\text{Eq. 2})$$

In which:

K_a = corrected permeability adjusted for design temperature conditions

Assuming a system design temperature of 4°C based on manual, the effect of temperature on coefficient estimation is negligible in these tests and the amounts do not change.

The field permeability data sheet is in the following.

2. Percolation time/infiltration rate for design (Reynolds et al., 2015)

Correlations between Perc Time (PT) and field-saturated hydraulic conductivity (K_{fs}) are often used in development of on-site water recycling and treatment facilities that operate by infiltration into unsaturated soil. The physically based PT versus K_{fs} expression in Reynolds et al. (2015) for cylindrical test holes in unsaturated soil can be simplified to Eq. 3.

$$PT = \frac{\Delta t}{\Delta H} = m K_{fs}^{-1} \quad (\text{Eq. 3})$$

Where:

$$m = \frac{\bar{c} a^2}{\left[2\bar{H}^2 + \bar{c} a^2 + \frac{2\bar{H}[1 - \exp(\alpha \psi \alpha)]}{\alpha} \right]}; 0 < m < 1 \quad (\text{Eq. 4})$$

And a is test hole radius, \bar{H} is average water level (ponding depth) in the test hole over time interval, Δt , $\psi \alpha$ is the antecedent or background pore water pressure head in the soil surrounding the test hole, α may be viewed as the “integrally correct” slope of the soil’s unsaturated hydraulic conductivity versus pore water pressure head relationship, $K(\psi)$ and \bar{c} is a “shape function” (Reynolds et al., 2015).

Conversion of CHWP K_{fs}/k_a to equivalent Perc Time, PT for this site using $m = 5.39E-06$ (moderate capillarity category):

$$PT_{201} = m K_{fs201}^{-1} = \frac{(5.39E-6)}{(4.8E-6)} = 1.12 \text{ min/cm} \quad (\text{Infiltration Rate} = 534 \text{ mm/hour})$$

$$PT_{206} = m K_{fs206}^{-1} = \frac{(5.39E-6)}{(1.1E-5)} = 0.49 \text{ min/cm} \quad (\text{Infiltration Rate} = 1224 \text{ mm/hour})$$

$$PT_{203} = mK_{fs}^{-1} = \frac{(5.39E-6)}{(2.7E-5)} = 0.2 \text{ min/cm} \quad (\text{Infiltration Rate} = 3005 \text{ mm/hour})$$

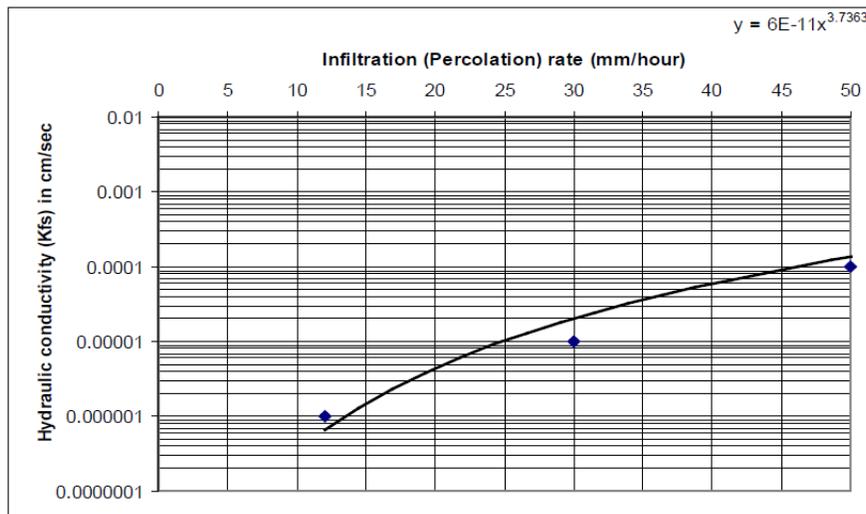
3. Percolation time/infiltration rate for design (OMMAH, 1997)

Despite the newer academic papers published by Reynolds et al. (2015), TRCA and other Conservation Authorities often still review design of infiltration basins based on historic trends. Below are two TRCA 2012 design criteria that describe the relationship between K_{fs} , PT, and infiltration rates, based on the 1997 OMMAH supplementary guidelines to OBC 1997.

Table 2. Approximate relationships between hydraulic conductivity, percolation time and infiltration rate

Hydraulic Conductivity, K_{fs} (centimetres/second)	Percolation Time, T (minutes/centimetre)	Infiltration Rate, 1/T (millimetres/hour)
0.1	2	300
0.01	4	150
0.001	8	75
0.0001	12	50
0.00001	20	30
0.000001	50	12

Source: Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario.



Source: Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario.

Figure 1. Approximate relationship between infiltration rate and hydraulic conductivity

Based on OMMAH interpolation from Table 2 and Figure 1 above, the measured K_{fs} may be interpolated as:

PT₂₀₁ = 8.5 min / cm (Infiltration Rate = 70.4 mm/hour)

PT₂₀₆ = 6.8 min / cm (Infiltration Rate = 88 mm/hour)

PT₂₀₃ = 5.4 min / cm (Infiltration Rate = 112 mm/hour)

When comparing the OMMAH result with that obtained by Reynolds et al. (2015) formula (PT= 0.2-1.12 min/cm), the two methods of conversion are completely different results and it seems that the values of the first method have overestimated the infiltration rate and Perc Time. This range of percolation time (and infiltration rate) is acceptable for coarse gravel filter materials while the soil types in this site are mostly fine sand based on the historical boreholes results. Therefore, the engineer's opinion is to trust the values obtained from the second method (OMMAH, 1997).

4. Factored Engineering Design Infiltration Rate (Wisconsin Department of Natural Resources, 2004)

For a conservative approach to infiltration speeds, the OMMAH (1997) method shall be used for the calculation of a factored design infiltration rate. PT=0.2-1.12min/cm is equal to an unfactored infiltration rate =112-70.4 mm/hour. The infiltration rate used to design an infiltration BMP must incorporate a safety correction factor that compensates for potential reductions in soil permeability due to compaction or smearing during construction, gradual accumulation of fine sediments over the lifespan of the BMP and uncertainty in measured values when less permeable soil horizons exist within 1.5 meters below the proposed bottom elevation of the BMP

Based on historic borehole data, the soil layer remains consistent of fine sands, including the soil layers 1.5 meters below the proposed bottom of the BMP. This means that based on the below Table C3, the measured infiltration rate should be divided by a safety correction factor of 2.5 to calculate the design infiltration rate. In summary, the factored engineering design infiltration rates are 28.2, 35.2, 44.8 mm/hour for three above tests, respectively.

Table 3. Safety correction factors for calculating design infiltration rates

Ratio of Mean Measured Infiltration Rates ¹	Safety Correction Factor ²
≤ 1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

Source: Wisconsin Department of Natural Resources. 2004. Conservation Practice Standards. Site Evaluation for Stormwater Infiltration (1002). Madison, WI.

Notes:

- Ratio is determined by dividing the geometric mean measured infiltration rate at the proposed bottom elevation of the BMP by the geometric mean measured infiltration rate of the least permeable soil horizon within 1.5 metres below the proposed bottom elevation of the BMP.
- The design infiltration rate is calculated by dividing the geometric mean measured infiltration rate at the proposed bottom elevation of the BMP by the safety correction factor.

APPENDIX VI – MAIN CREEK SUBWATERSHEDS WITHIN THE SITE

Subwatershed Calculations



Figure 1. Overview of watersheds and roadways

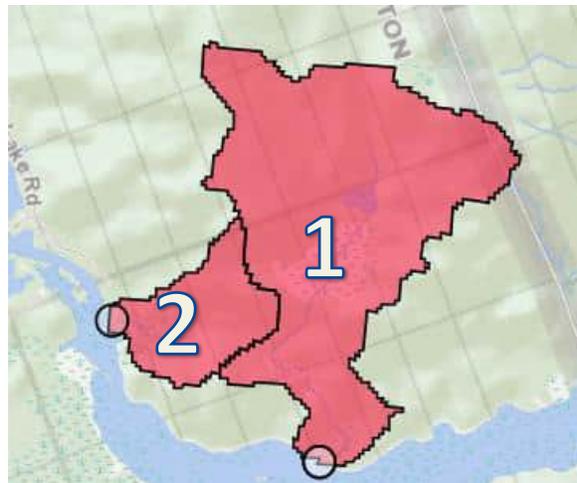


Figure 2. The main watersheds overlooking the project



Figure 3. Watershed No. 1

Table 1. Watershed No. 1 Characterization

Drainage Area (km ²)	3.125
Shape Factor ()	5.713
Length of Main Channel (km)	4.225
Maximum Channel Elevation (m)	511.680
Minimum Channel Elevation (m)	350.070
Slope of Main Channel (m/km)	38.250
Slope of Main Channel (%)	3.825
Area Lakes/Wetlands (km ²)	0.349
Area - Lakes (km ²)	0.030
Area - Wetlands (km ²)	0.320
Mean Elevation (m)	432.388
Maximum Elevation (m)	511.682
Mean Slope (%)	9.334
Annual Mean Temperature (°C)	4.500
Annual Precipitation (mm)	983.000

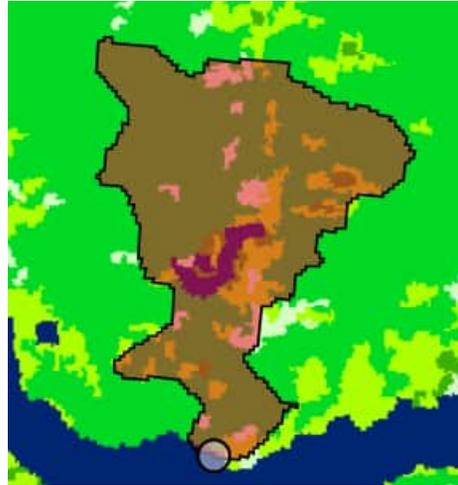


Figure 4. Watersheds No. 1 land covers

Table 2. Watershed No. 1 land covers details

	Land Cover Type	Area (Sq. Km.)	Percent
	Other	0.0	0.0%
	Cloud/Shadow	0.0	0.0%
■	Clear Open Water	0.02790	4.167%
	Turbid Water	0.0	0.0%
	Shoreline	0.0	0.0%
	Mudflats	0.0	0.0%
	Marsh	0.0	0.0%
	Swamp	0.0	0.0%
	Fen	0.0	0.0%
	Bog	0.0	0.0%
	Heath	0.0	0.0%
■	Sparse Treed	0.01170	1.747%
	Treed Upland	0.0	0.0%
■	Deciduous Treed	0.47295	70.632%
■	Mixed Treed	0.15705	23.454%
	Coniferous Treed	0.0	0.0%
	Plantations - Treed Cultivated	0.0	0.0%
	Hedge Rows	0.0	0.0%
	Disturbance	0.0	0.0%
	Open Cliff and Talus	0.0	0.0%

	Land Cover Type	Area (Sq. Km.)	Percent
	Alvar	0.0	0.0%
	Sand Barren and Dune	0.0	0.0%
	Open Tallgrass Prairie	0.0	0.0%
	Tallgrass Savannah	0.0	0.0%
	Tallgrass Woodland	0.0	0.0%
	Sand/Gravel/Mine Tailings/Extraction	0.0	0.0%
	Bedrock	0.0	0.0%
	Community/Infrastructure	0.0	0.0%
	Agriculture and Undifferentiated Rural Land Use	0.0	0.0%



Figure 5. Watershed No. 2

Table 3. Watershed No. 2 Characterization

Drainage Area (km ²)	0.670
Shape Factor ()	3.410
Length of Main Channel (km)	1.511
Maximum Channel Elevation (m)	475.450
Minimum Channel Elevation (m)	350.520
Slope of Main Channel (m/km)	82.680
Slope of Main Channel (%)	8.268
Area Lakes/Wetlands (km ²)	0.097
Area - Lakes (km ²)	0.000
Area - Wetlands (km ²)	0.097
Mean Elevation (m)	388.992
Maximum Elevation (m)	475.912
Mean Slope (%)	11.951
Annual Mean Temperature (°C)	4.500
Annual Precipitation (mm)	983.000

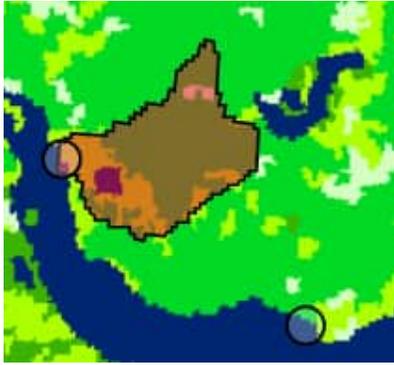


Figure 6. Watersheds No. 2 land covers

Table 4. Watershed No. 2 land covers details

	Land Cover Type	Area (Sq. Km.)	Percent
	Other	0.00000	0.000%
	Cloud/Shadow	0.00000	0.000%
	Clear Open Water	0.12330	3.946%
	Turbid Water	0.00000	0.000%
	Shoreline	0.00000	0.000%
	Mudflats	0.00000	0.000%
	Marsh	0.00000	0.000%
	Swamp	0.00000	0.000%
	Fen	0.00000	0.000%
	Bog	0.00000	0.000%
	Heath	0.00000	0.000%
	Sparse Treed	0.16717	5.350%
	Treed Upland	0.00000	0.000%
	Deciduous Treed	2.38163	76.217%
	Mixed Treed	0.37283	11.931%
	Coniferous Treed	0.07988	2.556%
	Plantations - Treed Cultivated	0.00000	0.000%
	Hedge Rows	0.00000	0.000%
	Disturbance	0.00000	0.000%
	Open Cliff and Talus	0.00000	0.000%
	Alvar	0.00000	0.000%
	Sand Barren and Dune	0.00000	0.000%

	Land Cover Type	Area (Sq. Km.)	Percent
	Open Tallgrass Prairie	0.00000	0.000%
	Tallgrass Savannah	0.00000	0.000%
	Tallgrass Woodland	0.00000	0.000%
	Sand/Gravel/Mine Tailings/Extraction	0.00000	0.000%
	Bedrock	0.00000	0.000%
	Community/Infrastructure	0.00000	0.000%
	Agriculture and Undifferentiated Rural Land Use	0.00000	0.000%

Hydrology Model Results

Table 5. Mean annual flow (MNR, 2003)

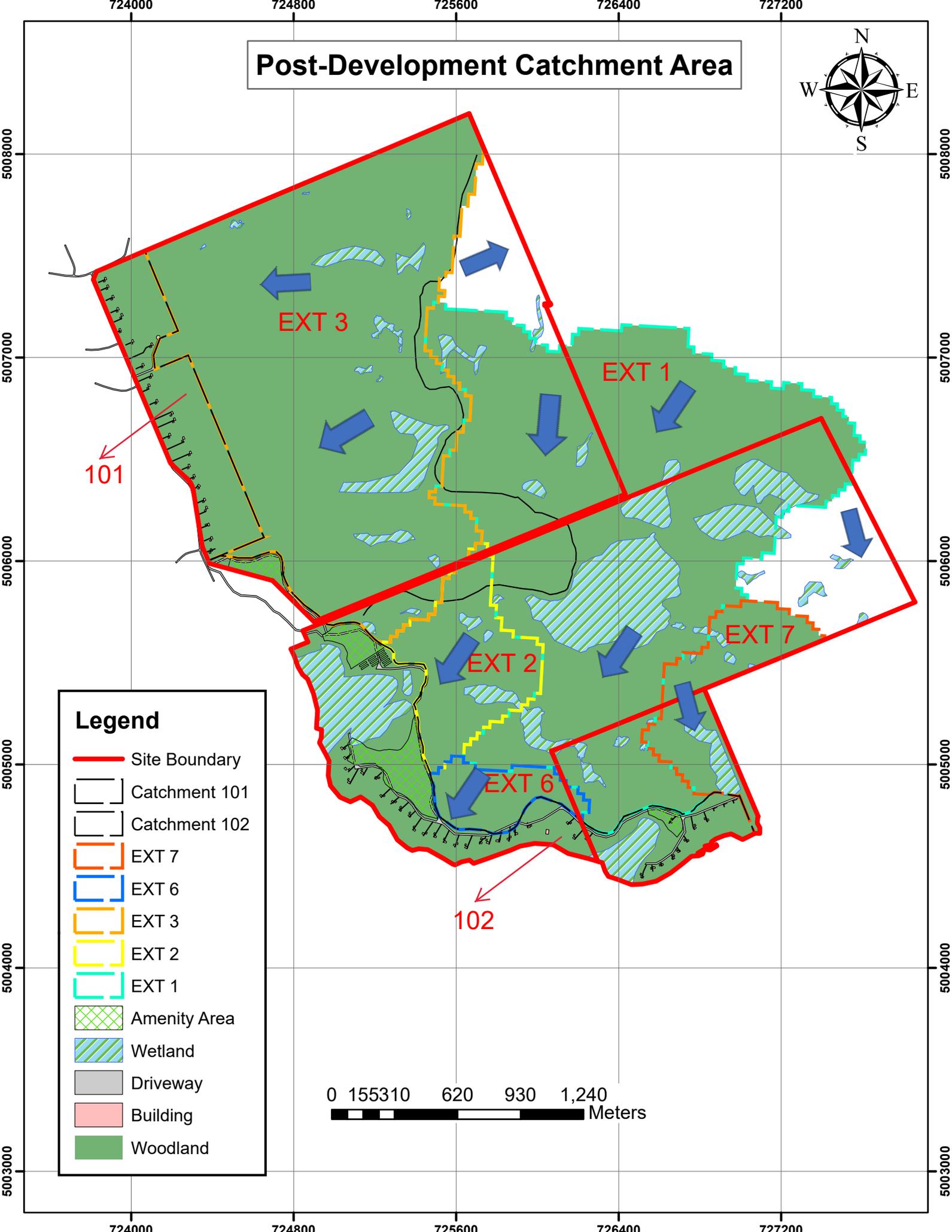
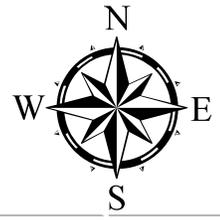
Watershed	Results (m³/s)
1	0.04
2	0.01

Table 6. Index flood method with EPA (Moin & Shaw, 1985)

Watershed	Flow	Results (m³/s)
1	Q _{1.25}	0.66
	Q ₂	0.69
	Q ₅	0.85
	Q ₁₀	0.99
	Q ₂₀	1.15
	Q ₅₀	1.37
	Q ₁₀₀	1.54
	Q ₂₀₀	1.72
	Q ₅₀₀	1.93
2	Q _{1.25}	0.14
	Q ₂	0.15
	Q ₅	0.18
	Q ₁₀	0.21
	Q ₂₀	0.25
	Q ₅₀	0.30
	Q ₁₀₀	0.33
	Q ₂₀₀	0.38
	Q ₅₀₀	0.42

APPENDIX VII – CATCHMENTS AREA (INTERNAL/EXTERNAL)

Post-Development Catchment Area

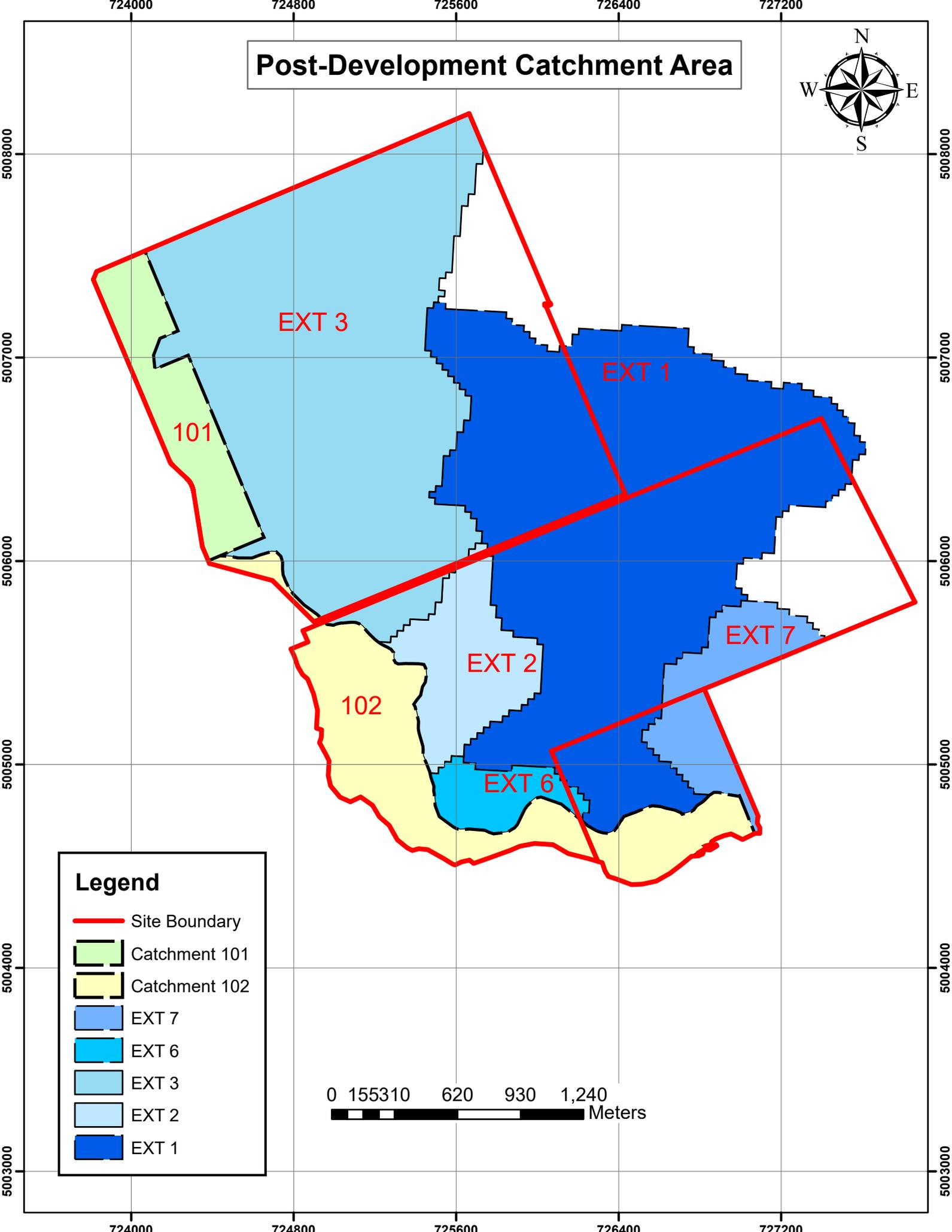
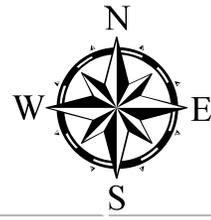


Legend

- Site Boundary
- - - Catchment 101
- - - Catchment 102
- EXT 7
- EXT 6
- EXT 3
- EXT 2
- EXT 1
- Amenity Area
- Wetland
- Driveway
- Building
- Woodland

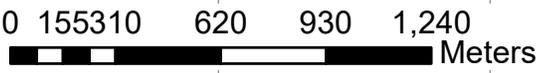
0 155310 620 930 1,240 Meters

Post-Development Catchment Area

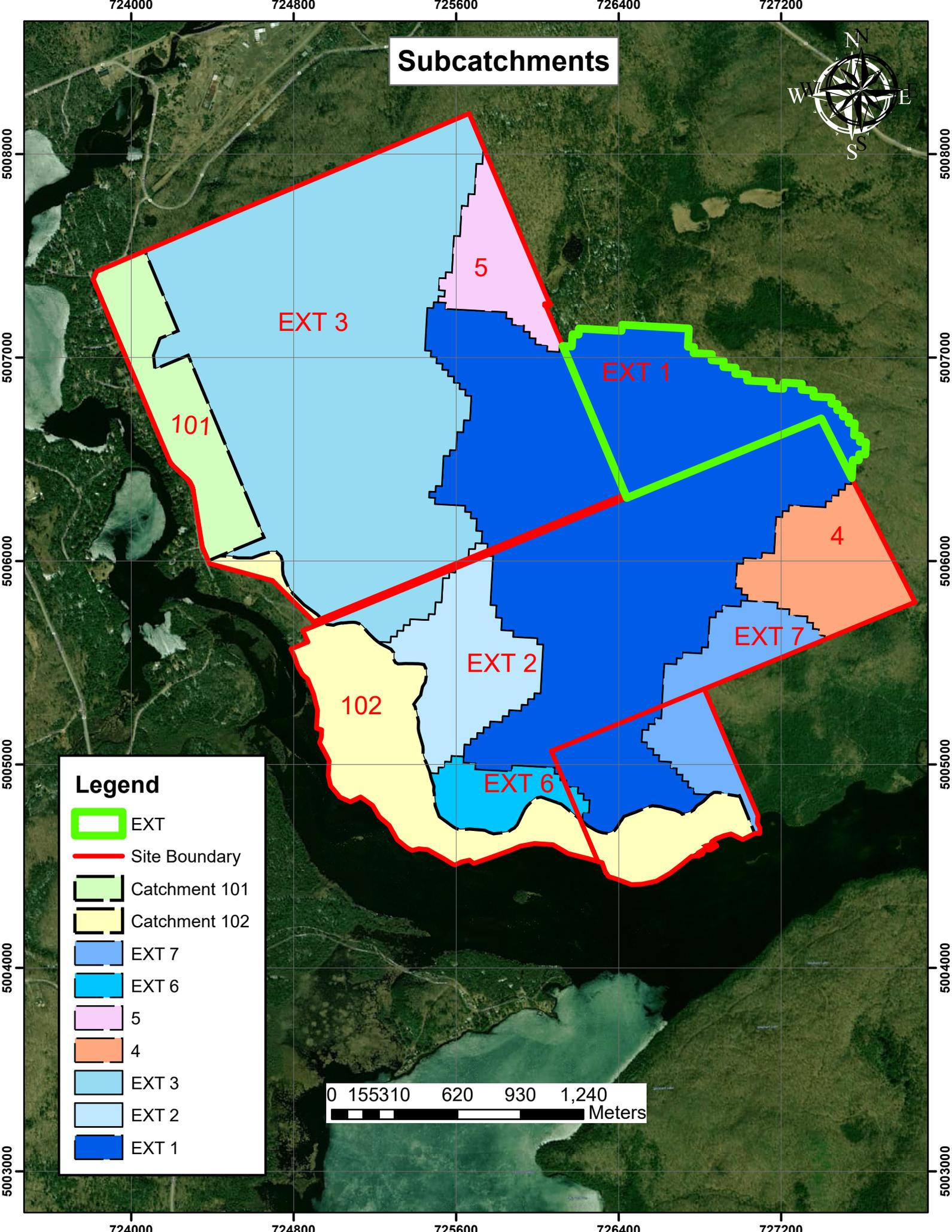


Legend

- Site Boundary
- Catchment 101
- Catchment 102
- EXT 7
- EXT 6
- EXT 3
- EXT 2
- EXT 1

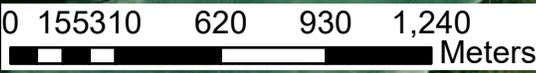


Subcatchments



Legend

- EXT
- Site Boundary
- Catchment 101
- Catchment 102
- EXT 7
- EXT 6
- 5
- 4
- EXT 3
- EXT 2
- EXT 1

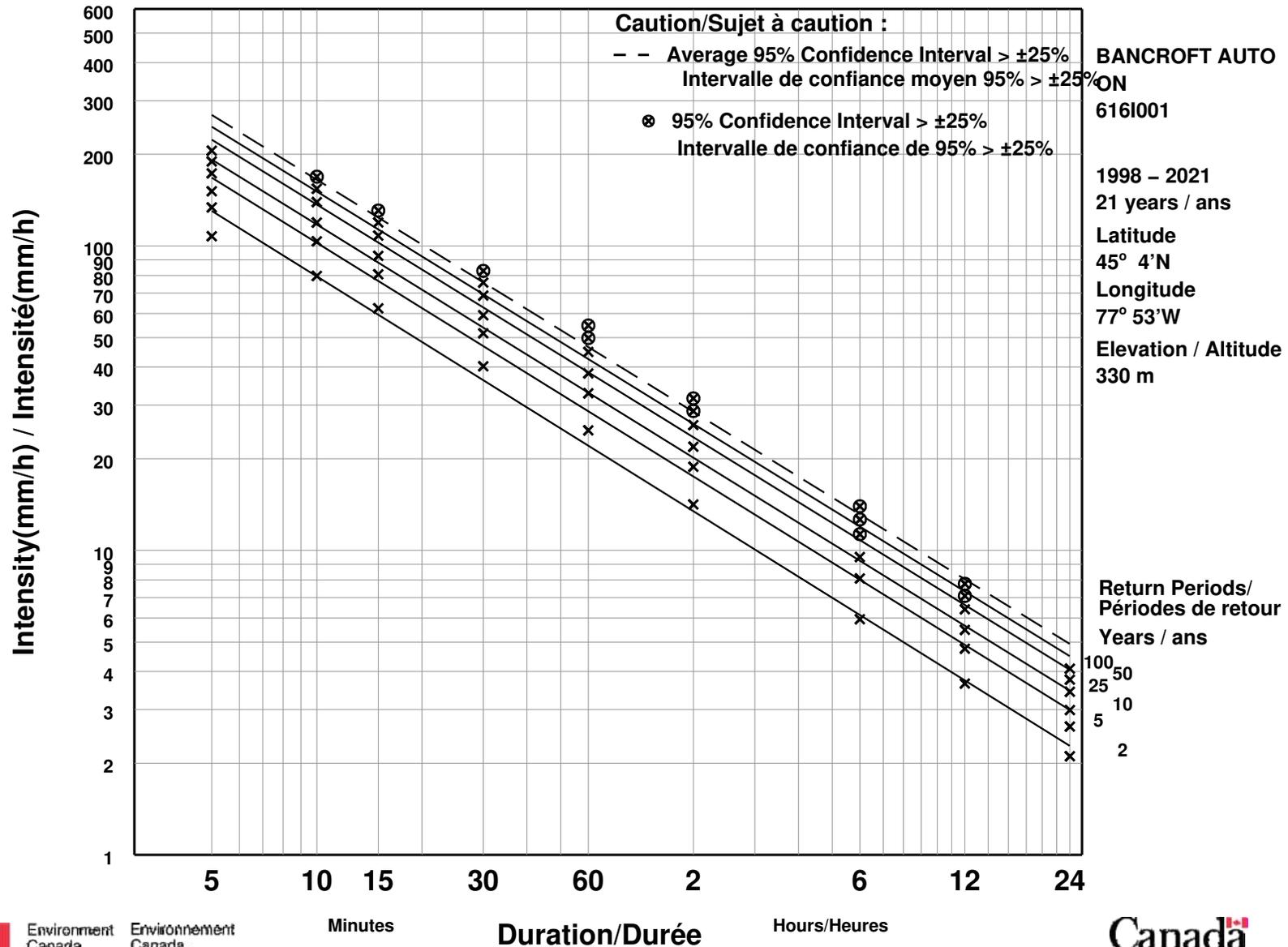


APPENDIX VIII- IDF DATA

Short Duration Rainfall Intensity–Duration–Frequency Data

2022/10/31

Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée



APPENDIX IX- RUNOFF COEFFICIENT CALCULATIONS

PRE-DEVELOPMENT (Runoff coefficient)

Ref.: Runoff Coefficients, Section 22, Appendix C, MTO Drainage Management Manual 1997 design chart 1.07 for rural & urban.

Developed Area (Catchment #101 or Northern Catchment)

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m ²)	A × C	A × % Imp.
Woodland	0.18	0.0	405,584.66	73,005.2	0.0
Weighted Average			405,584.66	0.18	0.0%

Developed Area (Catchment #102 or Southern Catchment)

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m ²)	A × C	A × % Imp.
Gravel Roads	0.5	100	16,187.44	8,093.7	16,187.44
Woodland	0.18	0.0	623,196.94	112,175.4	0.0
Wetland	0.05	0.0	212,922.8	10,646.1	0.0
Weighted Average			852,307.18	0.15	1.9%

External Area

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m ²)	A × % Imp.
EXT 1	0.16	0.0	2,993,639.3	0.0
EXT 2	0.17	0.0	424,014.03	0.0
EXT 3	0.16	0.0	2,612,713.5	0.0
EXT 6	0.18	0.0	177,393.3	0.0
EXT 7	0.16	0.0	351,856.16	0.0

POST-DEVELOPMENT (Runoff coefficient)

Ref.: *Runoff Coefficients, Section 22, Appendix C, MTO Drainage Management Manual 1997 design chart 1.07 for rural & urban.*

Developed Area (Catchment #101 or Northern Catchment)

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m ²)	A × C	A × % Imp.
Gravel Roads	0.5	100	5869.1	2,934.55	5869.1
Woodland	0.18	0.0	395,599.93	71,208	0.0
Building	0.95	100	4115.63	3,909.8	4115.63
Weighted Average			405,584.66	0.19	2.5%

Developed Area (Catchment #102 or Southern Catchment)

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m ²)	A × C	A × % Imp.
Gravel Roads	0.5	100	46,793.9	23,396.95	46,793.9
Woodland	0.18	0.0	434,189.97	78,154.19	0.0
Wetland	0.05	0.0	212,922.8	10,646.1	0.0
Building	0.95	100	6,396.61	6,076.8	6,396.61
Amenity Area	0.20	3.0	152,003.9	30,400.8	45,601
Weighted Average			852,307.18	0.17	11.6%

External Area

Land Use	Runoff Coefficient "C"	% Imperviousness	Total Area (m²)	A × % Imp.
EXT 1	0.16	0.0	2,993,639.3	0.0
EXT 2	0.17	0.0	424,014.03	0.0
EXT 3	0.16	0.0	2,612,713.5	0.0
EXT 6	0.18	0.0	177,393.3	0.0
EXT 7	0.16	0.0	351,856.16	0.0

APPENDIX X- HEC-RAS SIMULATION RESULTS

Hydraulic Calculations for Main Culverts

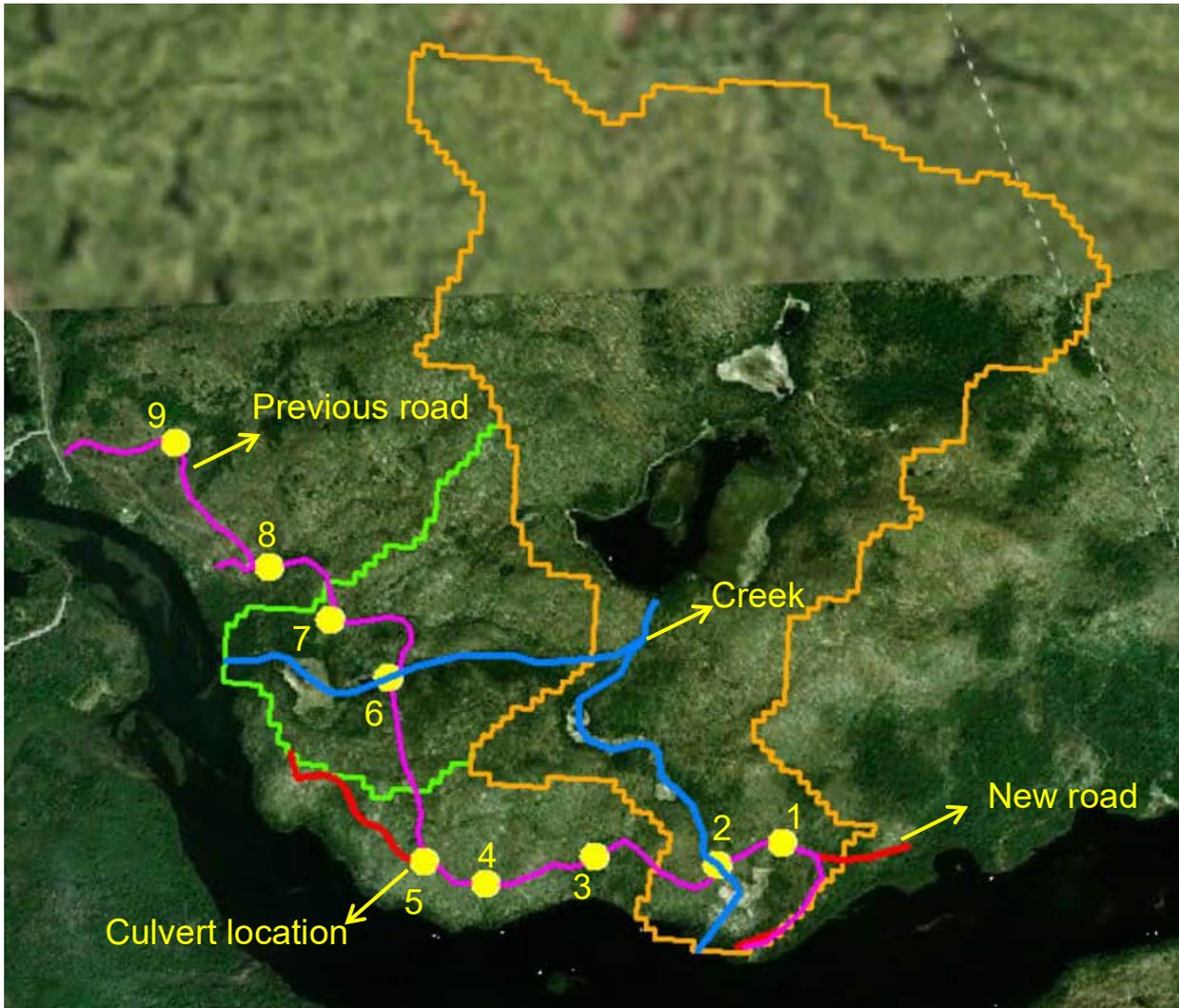


Figure 1. Overview of watersheds, roadways, main creeks and culvert locations

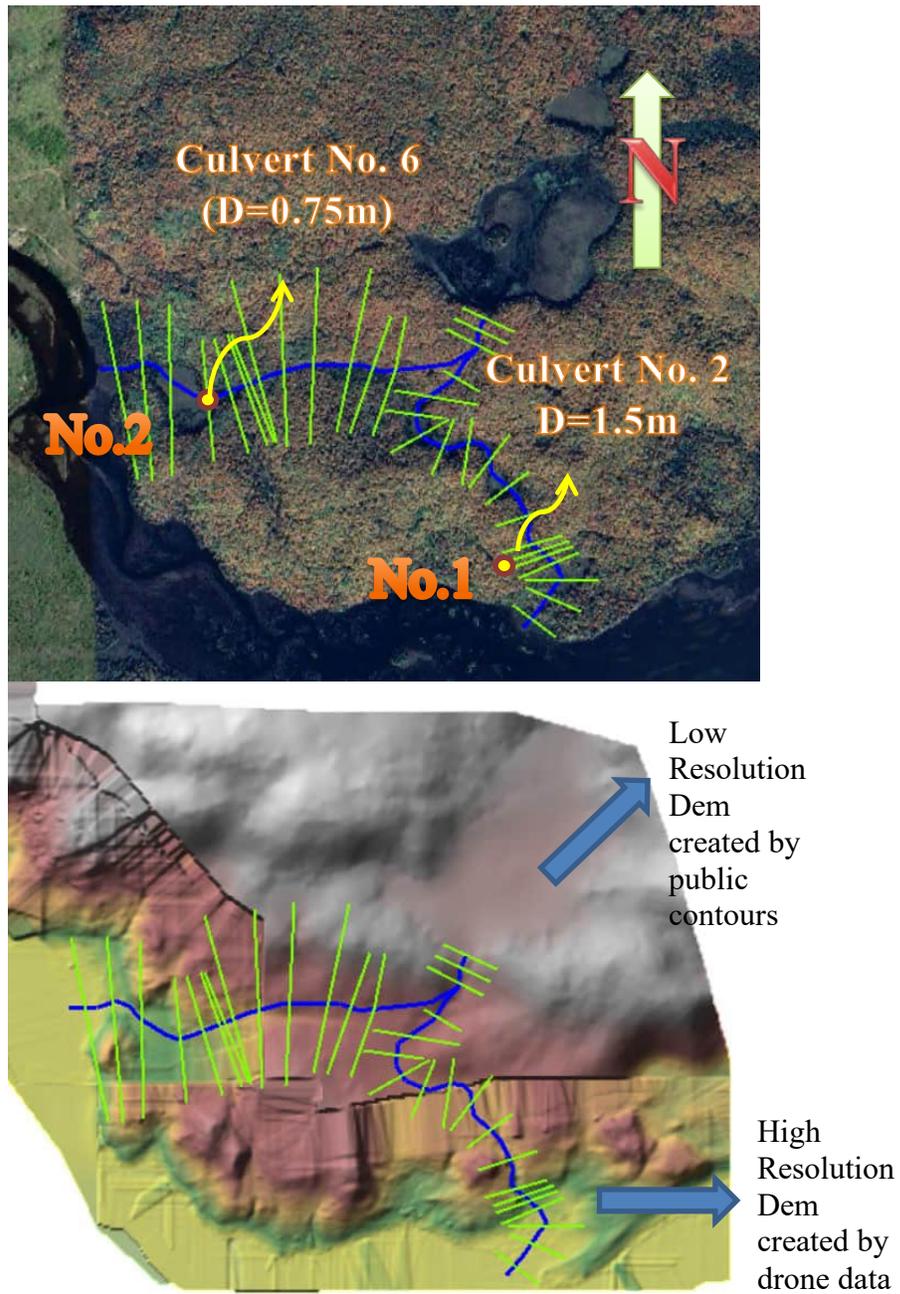


Figure 2. Main outlets of wetland (Main Creeks)

Table 1. Index flood method with EPA (Moin & Shaw, 1985)

Watershed	Flow	Results (m ³ /s)
1	Q _{1.25}	0.66
	Q ₂	0.69
	Q ₅	0.85
	Q ₁₀	0.99
	Q ₂₀	1.15
	Q ₅₀	1.37
	Q ₁₀₀	1.54
	Q ₂₀₀	1.72
	Q ₅₀₀	1.93
	Q_{max}	3.2
2	Q _{1.25}	0.14
	Q ₂	0.15
	Q ₅	0.18
	Q ₁₀	0.21
	Q ₂₀	0.25
	Q ₅₀	0.30
	Q ₁₀₀	0.33
	Q ₂₀₀	0.38
	Q ₅₀₀	0.42
	Q_{max}	0.75

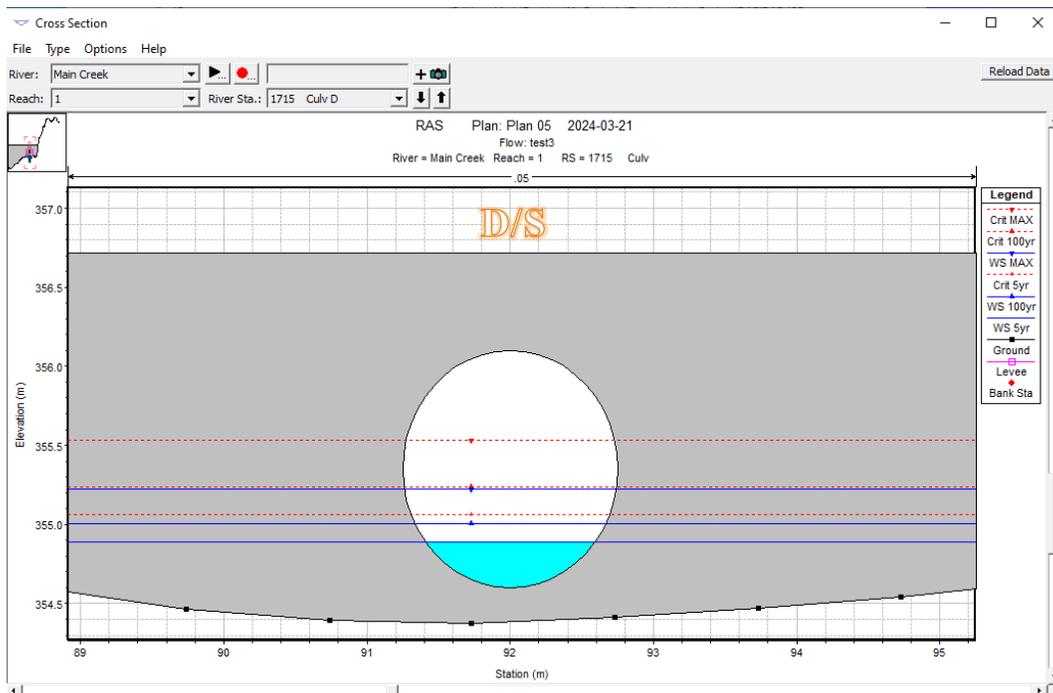
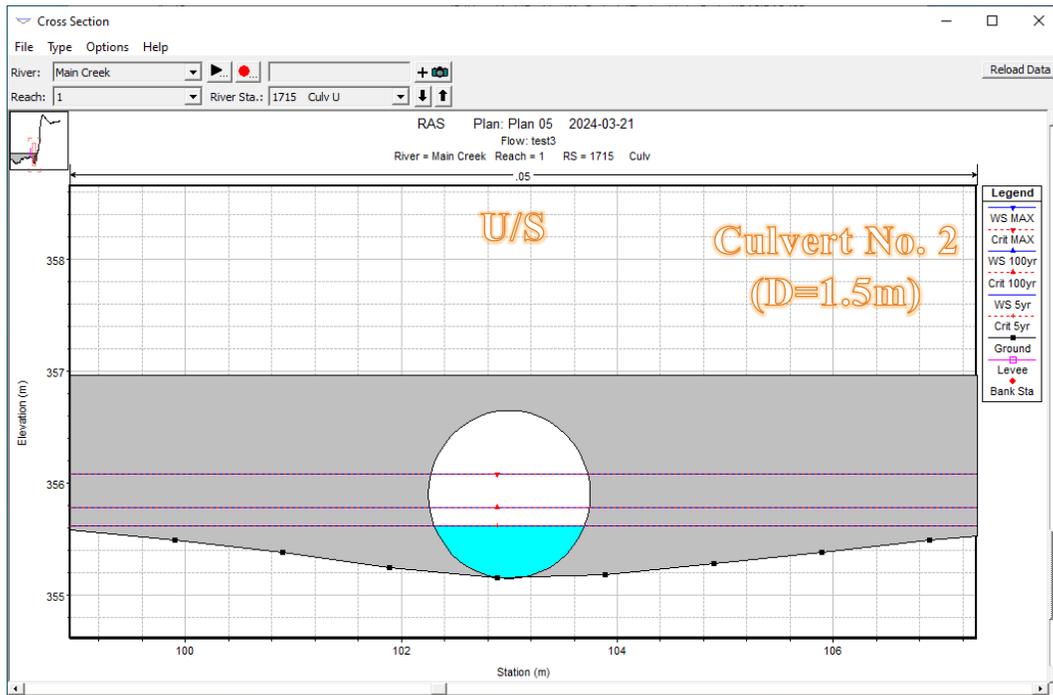


Figure 3. Main Culvert No. 2 on East Creek with different discharges (Max=3.2 cms)- U/S & D/S sections

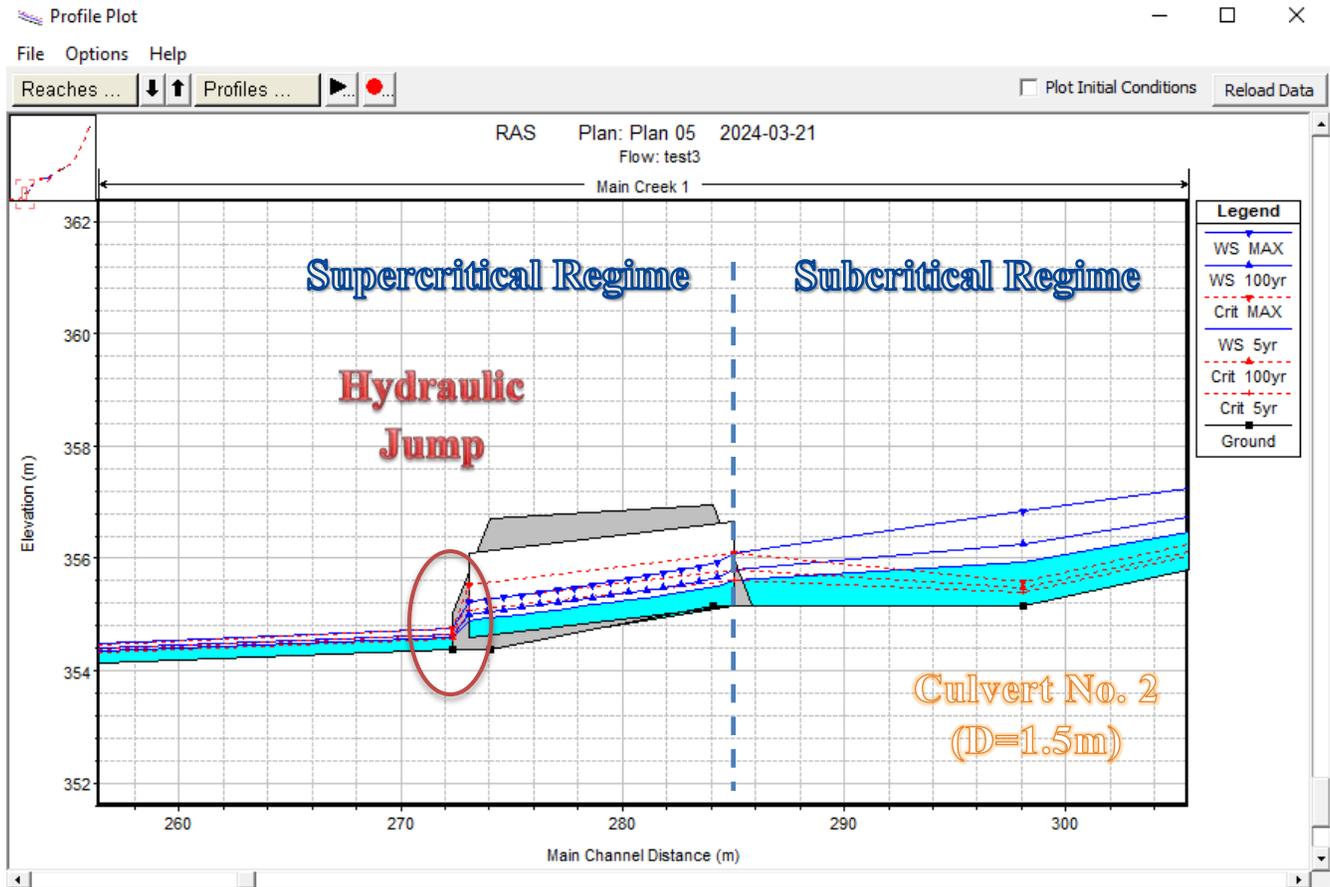


Figure 4. Longitudinal flow profile through main Culvert No. 2 on East Creek with different discharges (Max=3.2 cms)

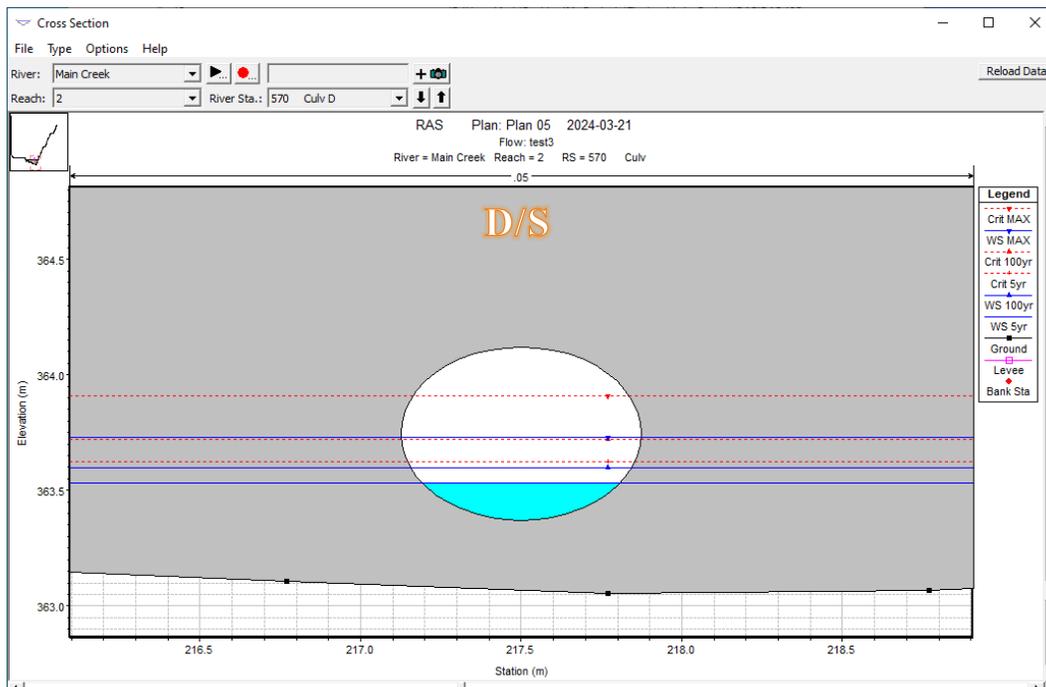
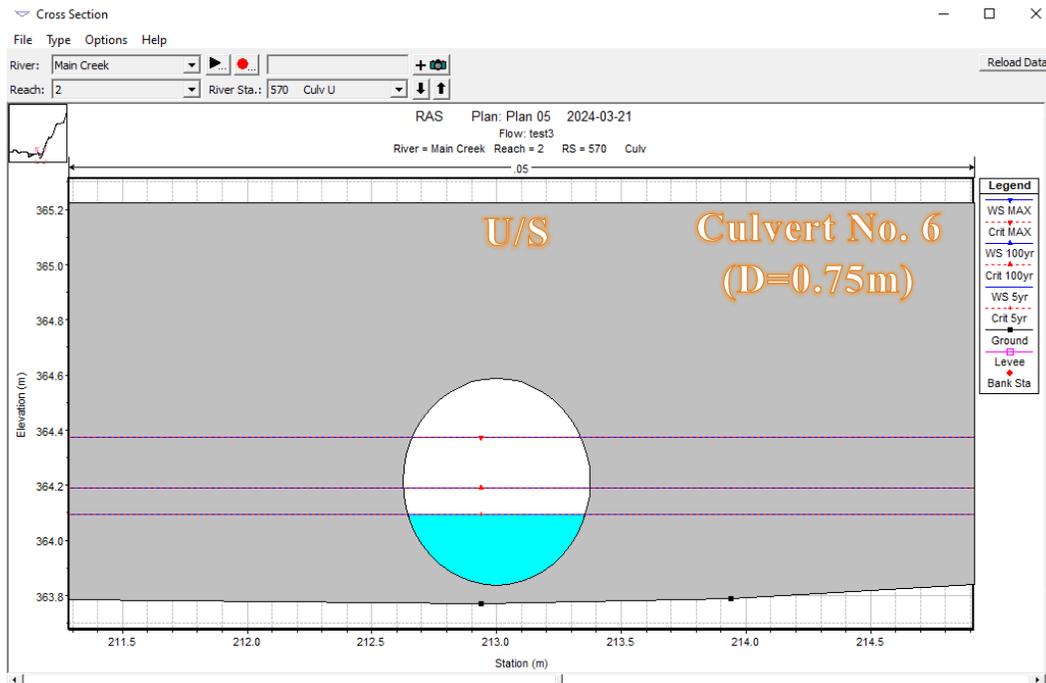


Figure 5. Main Culvert No. 6 on West Creek with different discharges (Max=0.75 cms)- U/S & D/S sections

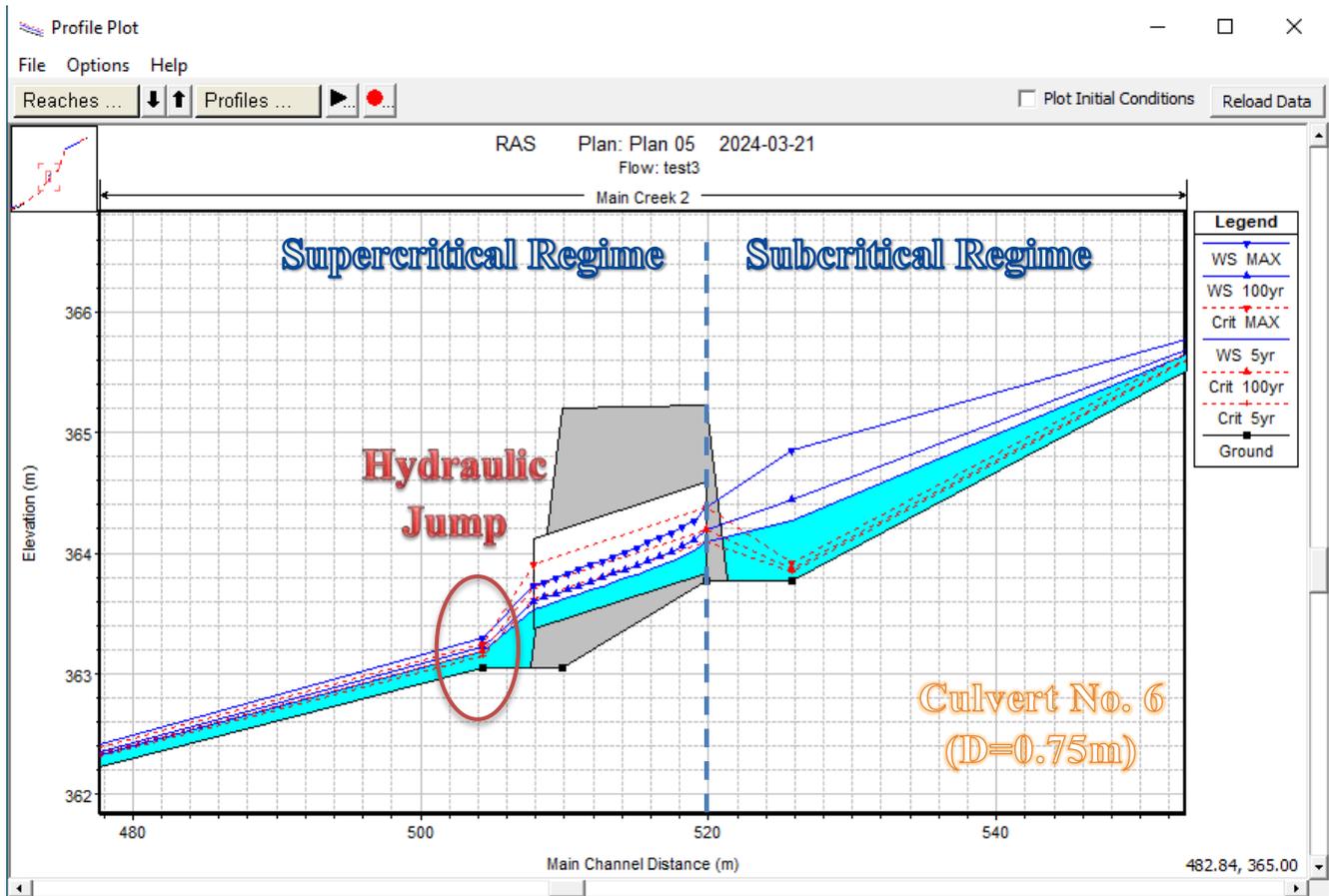


Figure 6. Longitudinal flow profile through main Culvert No. 6 on East Creek with different discharges (Max=0.75 cms)

Table 1. Output results for Main Creek No. 1 (Wetland South East Outlet)

---POLY F in Plan (5) for Main Creek No. 1

Reach	Flow Gts	Flow	Q (cfs)	Max CFC	W.D. C/F	Q (cfs)	W.D. C/F	W.D. C/F	W.D. C/F	Vel (ft/s)	Flow Area (cfs)	Top (ft)	Truce # (ft)	Cum. Vol (cfs)	Cum. Vol (cfs)	Cum. Vol (cfs)	Cum. Vol (cfs)
1	2911.34F	SW	0.35	406.86	410.34	410.34	410.34	410.34	410.34	0.37	1.36	53.17	1.15				
1	2911.34E	C/O	1.54	406.95	410.35	410.35	410.35	410.35	410.35	0.34	1.33	53.94	1.22				
1	2911.34E	MAX	1.20	406.95	410.30	410.30	410.30	410.30	410.30	0.39	2.30	41.00	1.20				
1	2064.26	SW	0.35	405.25	405.24	405.25	405.25	405.25	405.25	0.37	0.30	14.60	1.23				
1	2064.26	C/O	1.54	405.25	405.27	405.20	405.20	405.24	405.27	0.34	1.33	13.05	1.21				
1	2064.26	MAX	1.20	405.25	405.27	405.24	405.24	405.25	405.27	0.34	2.22	14.80	1.23				
1	2012.72E	SW	0.35	390.20	390.20	390.24	390.24	390.24	390.24	0.37	1.44	0.59	1.39				
1	2012.72E	C/O	1.54	390.24	390.24	390.28	390.28	390.28	390.28	0.34	1.33	0.22	1.37				
1	2012.72E	MAX	1.20	390.24	390.28	390.28	390.28	390.28	390.28	0.34	1.40	0.30	1.39				
1	2075.221	SW	0.35	306.57	306.59	306.59	306.59	306.59	306.59	0.36	0.39	1.20	1.40				
1	2075.221	C/O	1.54	306.57	306.57	306.57	306.57	306.57	306.57	0.34	1.36	1.44	1.41				
1	2075.221	MAX	1.20	306.57	306.59	306.59	306.59	306.59	306.59	0.34	2.30	1.39	1.41				
1	2569.30	SW	0.35	378.85	378.85	378.87	378.87	378.87	378.87	0.37	2.31	23.85	0.40				
1	2569.30	C/O	1.54	378.85	378.89	378.84	378.84	378.84	378.84	0.34	3.12	24.20	0.40				
1	2569.30	MAX	1.20	378.85	378.89	378.89	378.89	378.89	378.89	0.34	5.25	12.61	0.40				
1	2477.34E	SW	0.35	378.43	378.50	378.50	378.50	378.50	378.50	0.36	1.31	13.73	0.73				
1	2477.34E	C/O	1.54	378.43	378.50	378.50	378.50	378.50	378.50	0.34	2.13	11.82	0.74				
1	2477.34E	MAX	1.20	378.43	378.55	378.55	378.55	378.55	378.55	0.34	3.50	13.44	0.73				
1	2464.477	SW	0.35	377.06	377.18	377.18	377.18	377.18	377.18	0.34	1.33	17.80	0.75				
1	2464.477	C/O	1.54	377.06	377.21	377.19	377.19	377.24	377.24	0.34	2.32	13.45	0.73				
1	2464.477	MAX	1.20	377.06	377.20	377.25	377.25	377.25	377.25	0.34	3.44	14.67	0.73				
1	2319.501	SW	0.35	375.35	375.52	375.40	375.40	375.51	375.51	0.36	1.37	11.05	0.49				
1	2319.501	C/O	1.54	375.35	375.56	375.51	375.51	375.56	375.56	0.34	2.34	14.65	0.49				
1	2319.501	MAX	1.20	375.35	375.53	375.51	375.51	375.56	375.56	0.34	4.39	14.21	0.49				
1	2225.52E	SW	0.35	375.14	375.32	375.32	375.32	375.32	375.32	0.36	0.33	7.62	0.61				
1	2225.52E	C/O	1.54	375.14	375.31	375.31	375.31	375.31	375.31	0.34	1.29	8.84	0.61				
1	2225.52E	MAX	1.20	375.14	375.37	375.37	375.37	375.37	375.37	0.34	2.28	11.12	0.61				
1	2112.37	SW	0.35	367.22	367.20	367.20	367.20	367.20	367.20	0.36	10.26	11.91	0.60				
1	2112.37	C/O	1.54	367.22	367.24	367.24	367.24	367.24	367.24	0.34	12.27	11.83	0.60				
1	2112.37	MAX	1.20	367.22	367.22	367.20	367.20	367.22	367.22	0.34	17.47	11.34	0.60				
1	1962.77E	SW	0.35	368.23	368.27	368.23	368.23	368.27	368.27	0.34	1.34	0.32	0.73				
1	1962.77E	C/O	1.54	368.23	368.23	368.24	368.24	368.24	368.24	0.34	1.29	0.31	0.73				
1	1962.77E	MAX	1.20	368.23	368.23	368.23	368.23	368.23	368.23	0.34	2.37	0.60	0.73				
1	1873.707	SW	0.35	368.11	368.10	368.10	368.10	368.10	368.10	0.36	0.32	2.31	0.61				
1	1873.707	C/O	1.54	368.11	368.15	368.15	368.15	368.15	368.15	0.34	0.38	3.86	0.61				
1	1873.707	MAX	1.20	368.11	368.12	368.12	368.12	368.12	368.12	0.34	1.74	5.00	0.61				
1	1773.43	SW	0.35	368.72	368.74	368.78	368.78	368.78	368.78	0.36	1.23	3.44	0.45				
1	1773.43	C/O	1.54	368.72	368.70	368.77	368.77	368.74	368.74	0.34	0.27	2.05	0.45				
1	1773.43	MAX	1.20	368.72	368.70	368.70	368.70	368.70	368.70	0.34	1.10	4.61	0.45				
1	1723.36E	SW	0.35	368.17	368.14	368.14	368.14	368.14	368.14	0.36	0.47	15.77	0.62				
1	1723.36E	C/O	1.54	368.17	368.24	368.17	368.17	368.24	368.24	0.34	1.33	19.91	0.62				
1	1723.36E	MAX	1.20	368.17	368.23	368.20	368.20	368.23	368.23	0.34	20.33	19.38	0.62				
1	1715	SW	0.35										1.85		5.58	1.47	1.96
1	1715	C/O	1.54											2.77	4.32	3.63	3.25
1	1715	MAX	1.20											2.75	4.33	1.63	1.60
1	1703.35C	SW	0.35	354.37	354.30	354.50	354.50	354.64	354.64	0.34	0.30	3.50	0.61				
1	1703.35C	C/O	1.54	354.37	354.30	354.34	354.34	354.37	354.37	0.34	1.27	1.44	0.61				
1	1703.35C	MAX	1.20	354.37	354.35	354.35	354.35	354.37	354.37	0.34	2.31	1.36	0.61				
1	1664.78E	SW	0.35	350.85	350.89	350.85	350.85	350.85	350.85	0.34	2.70	10.43	0.41				
1	1664.78E	C/O	1.54	350.85	350.83	350.88	350.88	350.85	350.85	0.34	3.33	11.41	0.41				
1	1664.78E	MAX	1.20	350.85	350.88	350.88	350.88	350.85	350.85	0.34	6.03	11.77	0.41				
1	1664.771	SW	0.35	350.80	350.80	350.80	350.80	350.80	350.80	0.36	1.31	11.38	0.41				
1	1664.771	C/O	1.54	350.80	350.73	350.73	350.73	350.77	350.77	0.34	1.33	11.22	0.41				
1	1664.771	MAX	1.20	350.80	350.77	350.77	350.77	350.81	350.81	0.34	3.41	11.95	0.41				
1	1524.34E	SW	0.35	351.91	351.91	351.91	351.91	351.91	351.91	0.36	4.24	11.16	0.41				
1	1524.34E	C/O	1.54	351.91	352.24	352.20	352.20	352.24	352.24	0.34	7.74	15.05	0.41				
1	1524.34E	MAX	1.20	351.91	352.20	352.10	352.10	352.21	352.21	0.34	13.30	10.05	0.41				
1	1423.39E	SW	0.35	351.74	351.73	351.73	351.73	351.73	351.73	0.34	3.55	11.66	0.51				
1	1423.39E	C/O	1.54	351.74	351.70	351.70	351.70	351.76	351.76	0.34	5.23	13.95	0.51				
1	1423.39E	MAX	1.20	351.74	351.71	351.71	351.71	351.76	351.76	0.34	8.39	11.01	0.51				

Table 2. Output results for Main Creek No. 2 (Wetland South West Outlet)

HEC-RAS Plan: Plan 05

Reach	River Sta	Profile	E.G. US (m)	W.S. US (m)	E.G. IC (m)	E.G. OC (m)	Min El Weir Flow (m ³ /s)	Q Culv Group (m ³ /s)	Q Weir (m ³ /s)	Delta WS (m)	Culv Vel US (m/s)	Culv Vel DS (m/s)
2	171.702	5yr	355.94	355.94	355.78	355.94	357.03	0.85	1.34	1.82	3.58	
2	171.702	100yr	356.24	356.24	356.07	356.24	357.03	1.54	1.59	2.17	4.02	
2	171.702	MAX	356.83	356.83	356.67	356.83	357.03	3.20	2.08	2.78	4.63	
2	570	5yr	364.27	364.27	364.19	364.27	365.26	0.18	1.09	1.35	2.59	
2	570	100yr	364.45	364.45	364.36	364.45	365.26	0.33	1.22	1.63	2.95	
2	570	MAX	364.85	364.85	364.78	364.85	365.26	0.75	1.56	2.22	3.58	

Table 3. Output results for Culverts

HEC-RAS Plan: Plan 05

Reach	River Sta	Profile	E.G. US (m)	W.S. US (m)	E.G. IC (m)	E.G. OC (m)	Min El Weir Flow (m ³ /s)	Q Culv Group (m ³ /s)	Q Weir (m ³ /s)	Delta WS (m)	Culv Vel US (m/s)	Culv Vel DS (m/s)
1	1715	Culvert #1	355.94	355.94	355.78	355.94	357.03	0.85	1.34	1.82	3.58	
1	1715	Culvert #1	356.24	356.24	356.07	356.24	357.03	1.54	1.59	2.17	4.02	
1	1715	Culvert #1	356.83	356.83	356.67	356.83	357.03	3.20	2.08	2.78	4.63	
2	570	Culvert #1	364.27	364.27	364.19	364.27	365.26	0.18	1.09	1.35	2.59	
2	570	Culvert #1	364.45	364.45	364.36	364.45	365.26	0.33	1.22	1.63	2.95	
2	570	Culvert #1	364.85	364.85	364.78	364.85	365.26	0.75	1.56	2.22	3.58	

APPENDIX XI- LID TTT OUTPUT RESULTS

Summary

STORM-EVENT SCENARIO

Site	Project Name	Project Title	Storm Type
Pre-Development	Elephant Lake	Elephant Lake_PRE	storm-event
Post-Development	Elephant Lake	Elephant Lake_PRE	storm-event

Design Storm Performance Goal | Pre-Development

Rainfall Depth Control/Reduction Target	25.00 mm
Runoff Volume Control/Reduction Target	194,634.75 m ³
Runoff Volume Control Provided	756,746.23 m ³
Runoff Volume Reduction Provided	756,746.23 m ³
Runoff Volume Treated	0.00 m ³
Runoff Volume Untreated	1,895,810.00 m ³
Runoff Volume Control / Reduction Met?	Yes

Design Storm Performance Goal | Post-Development

Rainfall Depth Control/Reduction Target	25.00 mm
---	----------

Runoff Volume Control/Reduction Target	194,634.75 m ³
Runoff Volume Control Provided	727,562.04 m ³
Runoff Volume Reduction Provided	727,562.04 m ³
Runoff Volume Treated	0.00 m ³
Runoff Volume Untreated	1,926,160.00 m ³
Runoff Volume Control / Reduction Met?	Yes

Water Balance Comparison

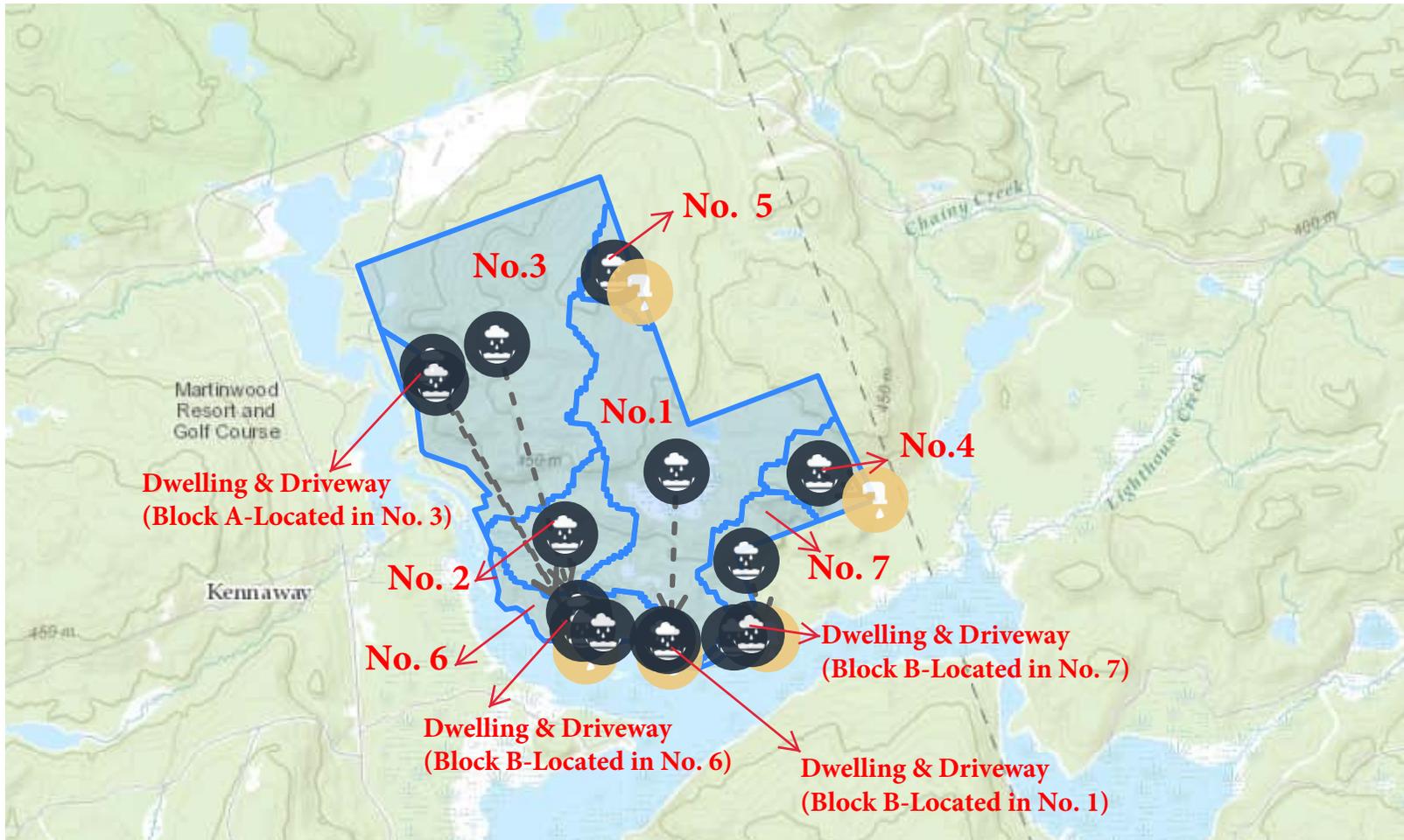
Site	Site Area	Site Rainfall In (mm) (m ³)	Site Infiltration (mm) (m ³)	Site Evapotranspiration (mm) (m ³)	External Outflow (mm) (m ³)	Rainfall Reduction (mm) (%)
Pre-Development Total	778.54 ha	340.71 mm 2,652,560.23 m ³	96.03 mm 747,651.38 m ³	0.00 mm 0.00 m ³	243.21 mm 1,893,500.00 m ³	97.50 mm 28.62 %
Post-Development Total	778.54 ha	340.86 mm 2,653,728.04 m ³	91.18 mm 709,833.11 m ³	0.00 mm 0.00 m ³	247.35 mm 1,925,700.00 m ³	93.51 mm 27.43 %
Difference	0.00 ha	0.15 mm 1,167.81 m³	-4.86 mm -37,818.28 m³	0.00 mm 0.00 m³	4.14 mm 32,200.00 m³	-3.99 mm -1.18 %
Difference	0.00 %	0.04 %	-5.06 %	NaN %	1.70 %	-4.09 %

Water Balance | Pre-Development

Catchment	Site Area	Site Rainfall In	Site Infiltration	Site Evapotranspiration	External Outflow	Rainfall Reduction
		(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (%)
1	246.67 ha	340.71 mm	103.24 mm	0.00 mm	236.35 mm	104.36 mm
		840,432.76 m ³	254,674.98 m ³	0.00 m ³	583,000.00 m ³	30.63 %
2	429.79 ha	340.71 mm	94.52 mm	0.00 mm	244.30 mm	96.41 mm
		1,464,351.14 m ³	406,259.14 m ³	0.00 m ³	1,050,000.00 m ³	28.30 %
3	41.25 ha	340.71 mm	83.96 mm	0.00 mm	256.99 mm	83.72 mm
		140,532.65 m ³	34,632.56 m ³	0.00 m ³	106,000.00 m ³	24.57 %
4	38.56 ha	340.71 mm	84.91 mm	0.00 mm	254.69 mm	86.02 mm
		131,367.55 m ³	32,738.75 m ³	0.00 m ³	98,200.00 m ³	25.25 %
5	22.27 ha	340.71 mm	86.87 mm	0.00 mm	252.81 mm	87.90 mm
		75,876.12 m ³	19,345.95 m ³	0.00 m ³	56,300.00 m ³	25.80 %
TOTAL	778.54 ha	340.71 mm	96.03 mm	0.00 mm	243.21 mm	97.50 mm
		2,652,560.23 m³	747,651.38 m³	0.00 m³	1,893,500.00 m³	28.62 %

Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In	Site Infiltration	Site Evapotranspiration	External Outflow	Rainfall Reduction
		(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (%)
1	246.67 ha	340.86 mm	97.46 mm	0.00 mm	240.40 mm	100.46 mm
		840,802.77 m ³	240,414.68 m ³	0.00 m ³	593,000.00 m ³	29.47 %
2	429.79 ha	340.86 mm	89.59 mm	0.00 mm	248.96 mm	91.90 mm
		1,464,995.83 m ³	385,056.55 m ³	0.00 m ³	1,070,000.00 m ³	26.96 %
3	41.25 ha	340.86 mm	80.42 mm	0.00 mm	259.41 mm	81.45 mm
		140,594.52 m ³	33,171.28 m ³	0.00 m ³	107,000.00 m ³	23.89 %
4	38.56 ha	340.86 mm	83.29 mm	0.00 mm	256.76 mm	84.10 mm
		131,425.39 m ³	32,114.13 m ³	0.00 m ³	99,000.00 m ³	24.67 %
5	22.27 ha	340.86 mm	85.66 mm	0.00 mm	254.60 mm	86.26 mm
		75,909.52 m ³	19,076.48 m ³	0.00 m ³	56,700.00 m ³	25.31 %
TOTAL	778.54 ha	340.86 mm	91.18 mm	0.00 mm	247.35 mm	93.51 mm
		2,653,728.04 m³	709,833.11 m³	0.00 m³	1,925,700.00 m³	27.43 %

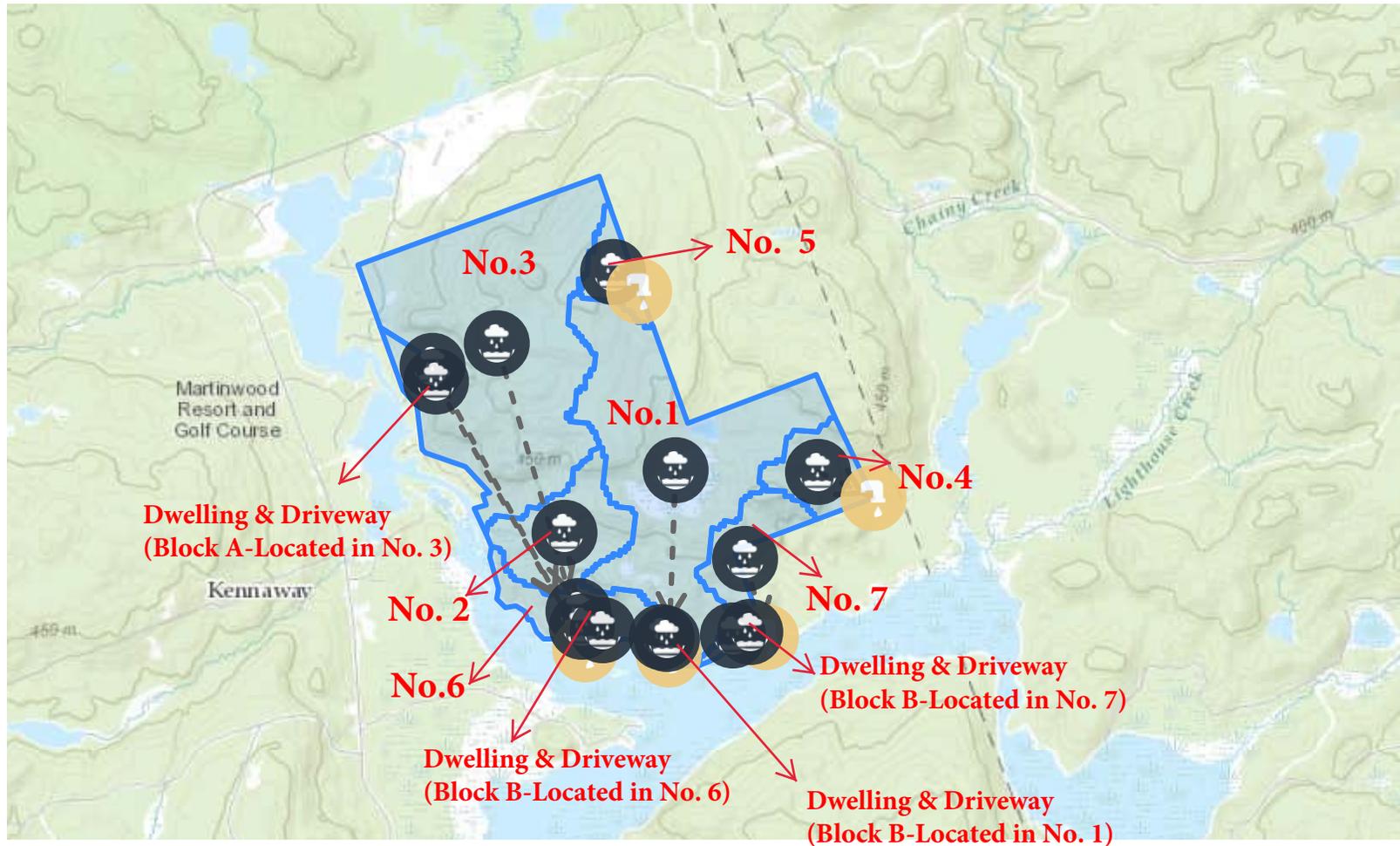


Total Number of Subcatchments = 7

Block A= Phase 1

Block B= Phase 2

* We assumed subcatchments 2,3, and 6 as a one catchment with one outlet (i.e., Catchment 2)



Total Number of Subcatchments = 7

Block A= Phase 1

Block B= Phase 2

* We assumed subcatchments 2,3, and 6 as a one catchment with one outlet (i.e., Catchment 2)

LID Summary | Post-Development

Element	Type	LID Area	Drawdown Time	Effective Impervious to Pervious Ratio	FLOW	TSS	TP
					Flow In (m ³)	Load In (kg)	Load In (kg)
					Flow Out (m ³)	Load Out (kg)	Load Out (kg)
					Actual Reduction (%)	Actual Reduction (%)	Actual Reduction (%)

Loading Summary TSS | Pre Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	29.703 m ³ /s	582,770.000 m ³ 46.611 mg/l 27,163.634 kg	582,776.000 m ³ 46.611 mg/l 27,163.634 kg
Catchment 2	0.000 %	78.502 m ³ /s	1,053,030.000 m ³ 50.985 mg/l 53,689.119 kg	1,053,026.000 m ³ 50.986 mg/l 53,689.119 kg
Catchment 3	0.000 %	22.801 m ³ /s	105,510.000 m ³ 55.000 mg/l 5,803.050 kg	105,511.000 m ³ 54.999 mg/l 5,803.050 kg
Catchment 4	0.000 %	12.358 m ³ /s	98,200.000 m ³ 55.000 mg/l 5,401.000 kg	98,202.000 m ³ 54.999 mg/l 5,401.000 kg
Catchment 5	0.000 %	9.610 m ³ /s	56,300.000 m ³ 52.900 mg/l	56,298.000 m ³ 52.902 mg/l

			2,978.270 kg	2,978.270 kg
Total	0.000 %	152.974 m³/s	1,895,810.000 m³	1,895,813.000 m³
			50.129 mg/l	50.129 mg/l
			95,035.073 kg	95,035.073 kg

Loading Summary TSS | Post Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	33.895 m ³ /s	593,070.000 m ³ 46.587 mg/l 27,629.436 kg	593,072.000 m ³ 46.587 mg/l 27,629.436 kg
Catchment 2	0.000 %	90.322 m ³ /s	1,069,900.000 m ³ 50.922 mg/l 54,481.321 kg	1,069,905.000 m ³ 50.922 mg/l 54,481.321 kg
Catchment 3	0.000 %	32.505 m ³ /s	107,440.000 m ³ 54.564 mg/l 5,862.310 kg	107,442.000 m ³ 54.563 mg/l 5,862.310 kg
Catchment 4	0.000 %	14.142 m ³ /s	99,020.000 m ³ 55.000 mg/l 5,446.100 kg	99,016.000 m ³ 55.002 mg/l 5,446.100 kg
Catchment 5	0.000 %	11.736 m ³ /s	56,730.000 m ³ 52.900 mg/l	56,730.000 m ³ 52.900 mg/l

			3,001.017 kg	3,001.017 kg
Total	0.000 %	182.600 m³/s	1,926,160.000 m³	1,926,165.000 m³
			50.058 mg/l	50.058 mg/l
			96,420.184 kg	96,420.184 kg

Loading Summary TP | Pre Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Average Concentration (mg/l)	Average Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
Catchment 1	0.000 %	29.703 m ³ /s	582,770.000 m ³ 0.346 mg/l 201.548 kg	582,776.000 m ³ 0.346 mg/l 201.548 kg
Catchment 2	0.000 %	78.502 m ³ /s	1,053,030.000 m ³ 0.285 mg/l 300.577 kg	1,053,026.000 m ³ 0.285 mg/l 300.577 kg
Catchment 3	0.000 %	22.801 m ³ /s	105,510.000 m ³ 0.230 mg/l 24.267 kg	105,511.000 m ³ 0.230 mg/l 24.267 kg
Catchment 4	0.000 %	12.358 m ³ /s	98,200.000 m ³ 0.230 mg/l 22.586 kg	98,202.000 m ³ 0.230 mg/l 22.586 kg
Catchment 5	0.000 %	9.610 m ³ /s	56,300.000 m ³ 0.259 mg/l	56,298.000 m ³ 0.259 mg/l

			14.582 kg	14.582 kg
Total	0.000 %	152.974 m³/s	1,895,810.000 m³	1,895,813.000 m³
			0.297 mg/l	0.297 mg/l
			563.560 kg	563.560 kg

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	33.895 m ³ /s	593,070.000 m ³ 0.346 mg/l 204.998 kg	593,072.000 m ³ 0.346 mg/l 204.998 kg
Catchment 2	0.000 %	90.322 m ³ /s	1,069,900.000 m ³ 0.285 mg/l 304.902 kg	1,069,905.000 m ³ 0.285 mg/l 304.902 kg
Catchment 3	0.000 %	32.505 m ³ /s	107,440.000 m ³ 0.228 mg/l 24.455 kg	107,442.000 m ³ 0.228 mg/l 24.455 kg
Catchment 4	0.000 %	14.142 m ³ /s	99,020.000 m ³ 0.230 mg/l 22.775 kg	99,016.000 m ³ 0.230 mg/l 22.775 kg
Catchment 5	0.000 %	11.736 m ³ /s	56,730.000 m ³ 0.259 mg/l	56,730.000 m ³ 0.259 mg/l

			14.693 kg	14.693 kg
Total	0.000 %	182.600 m³/s	1,926,160.000 m³	1,926,165.000 m³
			0.297 mg/l	0.297 mg/l
			571.823 kg	571.823 kg

Peak Flow | Pre-Development

Catchment	Element	Description	Peak outflow
1	No. 1	PEAK RUNOFF FLOW from	29.53 m ³ /s
	Out#1	MAXIMUM FLOW at	29.703 m ³ /s
	Block B2-Dwelling	PEAK RUNOFF FLOW from	0.13 m ³ /s
	Block B2-Driveway	PEAK RUNOFF FLOW from	0.06 m ³ /s
2	No. 2	PEAK RUNOFF FLOW from	15.27 m ³ /s
	No. 3	PEAK RUNOFF FLOW from	42.40 m ³ /s
	No. 6	PEAK RUNOFF FLOW from	20.15 m ³ /s
	Out#2,3,6	MAXIMUM FLOW at	78.502 m ³ /s
	Block A-Dwelling	PEAK RUNOFF FLOW from	0.19 m ³ /s
	Block A-Driveway	PEAK RUNOFF FLOW from	0.05 m ³ /s
	Block B1-Dwelling	PEAK RUNOFF FLOW from	0.32 m ³ /s
	Block B1-Driveway	PEAK RUNOFF FLOW from	0.11 m ³ /s
3	No. 7	PEAK RUNOFF FLOW from	22.56 m ³ /s
	Out#7	MAXIMUM FLOW at	22.801 m ³ /s
	Block B3-Dwelling	PEAK RUNOFF FLOW from	0.18 m ³ /s
	Block B3-Driveway	PEAK RUNOFF FLOW from	0.07 m ³ /s

4	No.4	PEAK RUNOFF FLOW from	12.36 m ³ /s
	Out#4	MAXIMUM FLOW at	12.358 m ³ /s
5	No. 5	PEAK RUNOFF FLOW from	9.61 m ³ /s
	Out#5	MAXIMUM FLOW at	9.610 m ³ /s

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	No. 1	PEAK RUNOFF FLOW from	33.82 m ³ /s
	Out#1	MAXIMUM FLOW at	33.895 m ³ /s
	Block B2-Dwelling	PEAK RUNOFF FLOW from	0.56 m ³ /s
	Block B2-Driveway	PEAK RUNOFF FLOW from	0.31 m ³ /s
2	No. 2	PEAK RUNOFF FLOW from	17.22 m ³ /s
	No. 3	PEAK RUNOFF FLOW from	48.19 m ³ /s
	No. 6	PEAK RUNOFF FLOW from	24.47 m ³ /s
	Out#2,3,6	MAXIMUM FLOW at	90.322 m ³ /s
	Block A-Dwelling	PEAK RUNOFF FLOW from	1.58 m ³ /s
	Block A-Driveway	PEAK RUNOFF FLOW from	0.38 m ³ /s
	Block B1-Dwelling	PEAK RUNOFF FLOW from	2.14 m ³ /s
	Block B1-Driveway	PEAK RUNOFF FLOW from	0.88 m ³ /s
3	No. 7	PEAK RUNOFF FLOW from	30.57 m ³ /s
	Out#7	MAXIMUM FLOW at	32.505 m ³ /s
	Block B3-Dwelling	PEAK RUNOFF FLOW from	1.32 m ³ /s
	Block B3-Driveway	PEAK RUNOFF FLOW from	0.62 m ³ /s
4	No.4	PEAK RUNOFF FLOW from	14.14 m ³ /s

	Out#4	MAXIMUM FLOW at	14.142 m ³ /s
5	No. 5	PEAK RUNOFF FLOW from	11.74 m ³ /s
	Out#5	MAXIMUM FLOW at	11.736 m ³ /s

Loading TSS | Pre Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming		Outgoing	
			Total Flow (m ³)	Concentration (mg/l)	Total Flow (m ³)	Concentration (mg/l)
			Total Load (kg)			Total Load (kg)
No. 1	0 %	29.53 m ³ /s	839,431.077 m ³	46.600 mg/l	581,990.000 m ³	46.600 mg/l
			39,117.488 kg		27,120.734 kg	
Block B2-Dwelling	0 %	0.13 m ³ /s	613.278 m ³	55.000 mg/l	480.000 m ³	55.000 mg/l
			33.730 kg		26.400 kg	
Block B2-Driveway	0 %	0.06 m ³ /s	388.409 m ³	55.000 mg/l	300.000 m ³	55.000 mg/l
			21.363 kg		16.500 kg	
Out#1	0 %	29.703 m ³ /s	582,776.000 m ³	46.611 mg/l	582,776.000 m ³	46.611 mg/l
			27,163.634 kg		27,163.634 kg	

TSS - Catchment 2

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 2	0 %	15.27 m ³ /s	227,526.138 m ³ 48.700 mg/l 11,080.523 kg	162,510.000 m ³ 48.700 mg/l 7,914.237 kg
No. 3	0 %	42.4 m ³ /s	1,066,374.601 m ³ 50.800 mg/l 54,171.830 kg	762,790.000 m ³ 50.800 mg/l 38,749.732 kg
No. 6	0 %	20.15 m ³ /s	160,665.208 m ³ 55.000 mg/l 8,836.586 kg	120,620.000 m ³ 55.000 mg/l 6,634.100 kg
Block A-Dwelling	0 %	0.19 m ³ /s	2,412.227 m ³ 55.000 mg/l 132.672 kg	1,510.000 m ³ 55.000 mg/l 83.050 kg
Block A-Driveway	0 %	0.05 m ³ /s	504.251 m ³ 55.000 mg/l 27.734 kg	320.000 m ³ 55.000 mg/l 17.600 kg
Block B1-Dwelling	0 %	0.32 m ³ /s	4,224.804 m ³	3,260.000 m ³

			55.000 mg/l	55.000 mg/l
			232.364 kg	179.300 kg
Block B1-Driveway	0 %	0.11 m ³ /s	2,643.910 m ³	2,020.000 m ³
			55.000 mg/l	55.000 mg/l
			145.415 kg	111.100 kg
Out#2,3,6	0 %	78.502 m ³ /s	1,053,026.000 m ³	1,053,026.000 m ³
			50.986 mg/l	50.986 mg/l
			53,689.119 kg	53,689.119 kg

TSS - Catchment 3

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	22.56 m ³ /s	137,558.255 m ³	103,650.000 m ³
			55.000 mg/l	55.000 mg/l
			7,565.704 kg	5,700.750 kg
Block B3-Dwelling	0 %	0.18 m ³ /s	1,809.170 m ³	1,140.000 m ³
			55.000 mg/l	55.000 mg/l
			99.504 kg	62.700 kg
Block B3-Driveway	0 %	0.07 m ³ /s	1,165.228 m ³	720.000 m ³

			55.000 mg/l	55.000 mg/l
			64.088 kg	39.600 kg
Out#7	0 %	22.801 m ³ /s	105,511.000 m ³	105,511.000 m ³
			54.999 mg/l	54.999 mg/l
			5,803.050 kg	5,803.050 kg

TSS - Catchment 4

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	12.36 m ³ /s	131,367.555 m ³	98,200.000 m ³
			55.000 mg/l	55.000 mg/l
			7,225.216 kg	5,401.000 kg
Out#4	0 %	12.358 m ³ /s	98,202.000 m ³	98,202.000 m ³
			54.999 mg/l	54.999 mg/l
			5,401.000 kg	5,401.000 kg

TSS - Catchment 5

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	9.61 m ³ /s	75,876.117 m ³ 52.900 mg/l 4,013.847 kg	56,300.000 m ³ 52.900 mg/l 2,978.270 kg
Out#5	0 %	9.61 m ³ /s	56,298.000 m ³ 52.902 mg/l 2,978.270 kg	56,298.000 m ³ 52.902 mg/l 2,978.270 kg

Loading TSS | Post Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming		Outgoing	
			Total Flow (m ³)	Concentration (mg/l)	Total Flow (m ³)	Concentration (mg/l)
			Total Load (kg)		Total Load (kg)	
No. 1	0 %	33.82 m ³ /s	839,800.642 m ³	46.600 mg/l	592,060.000 m ³	46.600 mg/l
			39,134.710 kg		27,589.996 kg	
Block B2-Dwelling	0 %	0.56 m ³ /s	613.548 m ³	7.000 mg/l	620.000 m ³	7.000 mg/l
			4.295 kg		4.340 kg	
Block B2-Driveway	0 %	0.31 m ³ /s	388.580 m ³	90.000 mg/l	390.000 m ³	90.000 mg/l
			34.972 kg		35.100 kg	
Out#1	0 %	33.895 m ³ /s	593,072.000 m ³	46.587 mg/l	593,072.000 m ³	46.587 mg/l
			27,629.436 kg		27,629.436 kg	

TSS - Catchment 2

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³) Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Concentration (mg/l) Total Load (kg)
No. 2	0 %	17.22 m ³ /s	227,626.308 m ³ 48.700 mg/l 11,085.401 kg	164,270.000 m ³ 48.700 mg/l 7,999.949 kg
No. 3	0 %	48.19 m ³ /s	1,066,844.080 m ³ 50.800 mg/l 54,195.679 kg	774,290.000 m ³ 50.800 mg/l 39,333.932 kg
No. 6	0 %	24.47 m ³ /s	160,735.942 m ³ 55.000 mg/l 8,840.477 kg	121,520.000 m ³ 55.000 mg/l 6,683.600 kg
Block A-Dwelling	0 %	1.58 m ³ /s	2,413.289 m ³ 62.000 mg/l 149.624 kg	2,430.000 m ³ 62.000 mg/l 150.660 kg
Block A-Driveway	0 %	0.38 m ³ /s	504.473 m ³ 90.000 mg/l 45.403 kg	510.000 m ³ 90.000 mg/l 45.900 kg
Block B1-Dwelling	0 %	2.14 m ³ /s	4,226.664 m ³	4,240.000 m ³

			7.000 mg/l	7.000 mg/l
			29.587 kg	29.680 kg
Block B1-Driveway	0 %	0.88 m ³ /s	2,645.074 m ³	2,640.000 m ³
			90.000 mg/l	90.000 mg/l
			238.057 kg	237.600 kg
Out#2,3,6	0 %	90.322 m ³ /s	1,069,905.000 m ³	1,069,905.000 m ³
			50.922 mg/l	50.922 mg/l
			54,481.321 kg	54,481.321 kg

TSS - Catchment 3

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	30.57 m ³ /s	137,618.816 m ³	104,440.000 m ³
			55.000 mg/l	55.000 mg/l
			7,569.035 kg	5,744.200 kg
Block B3-Dwelling	0 %	1.32 m ³ /s	1,809.967 m ³	1,830.000 m ³
			7.000 mg/l	7.000 mg/l
			12.670 kg	12.810 kg
Block B3-Driveway	0 %	0.62 m ³ /s	1,165.741 m ³	1,170.000 m ³

			90.000 mg/l	90.000 mg/l
			104.917 kg	105.300 kg
Out#7	0 %	32.505 m ³ /s	107,442.000 m ³	107,442.000 m ³
			54.563 mg/l	54.563 mg/l
			5,862.310 kg	5,862.310 kg

TSS - Catchment 4

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	14.14 m ³ /s	131,425.390 m ³	99,020.000 m ³
			55.000 mg/l	55.000 mg/l
			7,228.396 kg	5,446.100 kg
Out#4	0 %	14.142 m ³ /s	99,016.000 m ³	99,016.000 m ³
			55.002 mg/l	55.002 mg/l
			5,446.100 kg	5,446.100 kg

TSS - Catchment 5

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	11.74 m ³ /s	75,909.522 m ³ 52.900 mg/l 4,015.614 kg	56,730.000 m ³ 52.900 mg/l 3,001.017 kg
Out#5	0 %	11.736 m ³ /s	56,730.000 m ³ 52.900 mg/l 3,001.017 kg	56,730.000 m ³ 52.900 mg/l 3,001.017 kg

Loading TP | Pre Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³) Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Concentration (mg/l) Total Load (kg)
No. 1	0 %	29.53 m ³ /s	839,431.077 m ³ 0.346 mg/l 290.443 kg	581,990.000 m ³ 0.346 mg/l 201.369 kg
Block B2-Dwelling	0 %	0.13 m ³ /s	613.278 m ³ 0.230 mg/l 0.141 kg	480.000 m ³ 0.230 mg/l 0.110 kg
Block B2-Driveway	0 %	0.06 m ³ /s	388.409 m ³ 0.230 mg/l 0.089 kg	300.000 m ³ 0.230 mg/l 0.069 kg
Out#1	0 %	29.703 m ³ /s	582,776.000 m ³ 0.346 mg/l 201.548 kg	582,776.000 m ³ 0.346 mg/l 201.548 kg

TP - Catchment 2

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 2	0 %	15.27 m ³ /s	227,526.138 m ³	162,510.000 m ³
			0.317 mg/l	0.317 mg/l
			72.126 kg	51.516 kg
No. 3	0 %	42.4 m ³ /s	1,066,374.601 m ³	762,790.000 m ³
			0.288 mg/l	0.288 mg/l
			307.116 kg	219.684 kg
No. 6	0 %	20.15 m ³ /s	160,665.208 m ³	120,620.000 m ³
			0.230 mg/l	0.230 mg/l
			36.953 kg	27.743 kg
Block A-Dwelling	0 %	0.19 m ³ /s	2,412.227 m ³	1,510.000 m ³
			0.230 mg/l	0.230 mg/l
			0.555 kg	0.347 kg
Block A-Driveway	0 %	0.05 m ³ /s	504.251 m ³	320.000 m ³
			0.230 mg/l	0.230 mg/l
			0.116 kg	0.074 kg
Block B1-Dwelling	0 %	0.32 m ³ /s	4,224.804 m ³	3,260.000 m ³

			0.230 mg/l	0.230 mg/l
			0.972 kg	0.750 kg
Block B1-Driveway	0 %	0.11 m ³ /s	2,643.910 m ³	2,020.000 m ³
			0.230 mg/l	0.230 mg/l
			0.608 kg	0.465 kg
Out#2,3,6	0 %	78.502 m ³ /s	1,053,026.000 m ³	1,053,026.000 m ³
			0.285 mg/l	0.285 mg/l
			300.577 kg	300.577 kg

TP - Catchment 3

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	22.56 m ³ /s	137,558.255 m ³	103,650.000 m ³
			0.230 mg/l	0.230 mg/l
			31.638 kg	23.840 kg
Block B3-Dwelling	0 %	0.18 m ³ /s	1,809.170 m ³	1,140.000 m ³
			0.230 mg/l	0.230 mg/l
			0.416 kg	0.262 kg
Block B3-Driveway	0 %	0.07 m ³ /s	1,165.228 m ³	720.000 m ³

			0.230 mg/l	0.230 mg/l
			0.268 kg	0.166 kg
Out#7	0 %	22.801 m ³ /s	105,511.000 m ³	105,511.000 m ³
			0.230 mg/l	0.230 mg/l
			24.267 kg	24.267 kg

TP - Catchment 4

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	12.36 m ³ /s	131,367.555 m ³	98,200.000 m ³
			0.230 mg/l	0.230 mg/l
			30.215 kg	22.586 kg
Out#4	0 %	12.358 m ³ /s	98,202.000 m ³	98,202.000 m ³
			0.230 mg/l	0.230 mg/l
			22.586 kg	22.586 kg

TP - Catchment 5

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	9.61 m ³ /s	75,876.117 m ³ 0.259 mg/l 19.652 kg	56,300.000 m ³ 0.259 mg/l 14.582 kg
Out#5	0 %	9.61 m ³ /s	56,298.000 m ³ 0.259 mg/l 14.582 kg	56,298.000 m ³ 0.259 mg/l 14.582 kg

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 1	0 %	33.82 m ³ /s	839,800.642 m ³	592,060.000 m ³
			0.346 mg/l	0.346 mg/l
			290.571 kg	204.853 kg
Block B2-Dwelling	0 %	0.56 m ³ /s	613.548 m ³	620.000 m ³
			0.090 mg/l	0.090 mg/l
			0.055 kg	0.056 kg
Block B2-Driveway	0 %	0.31 m ³ /s	388.580 m ³	390.000 m ³
			0.230 mg/l	0.230 mg/l
			0.089 kg	0.090 kg
Out#1	0 %	33.895 m ³ /s	593,072.000 m ³	593,072.000 m ³
			0.346 mg/l	0.346 mg/l
			204.998 kg	204.998 kg

TP - Catchment 2

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 2	0 %	17.22 m ³ /s	227,626.308 m ³	164,270.000 m ³
			0.317 mg/l	0.317 mg/l
			72.158 kg	52.074 kg
No. 3	0 %	48.19 m ³ /s	1,066,844.080 m ³	774,290.000 m ³
			0.288 mg/l	0.288 mg/l
			307.251 kg	222.996 kg
No. 6	0 %	24.47 m ³ /s	160,735.942 m ³	121,520.000 m ³
			0.230 mg/l	0.230 mg/l
			36.969 kg	27.950 kg
Block A-Dwelling	0 %	1.58 m ³ /s	2,413.289 m ³	2,430.000 m ³
			0.320 mg/l	0.320 mg/l
			0.772 kg	0.778 kg
Block A-Driveway	0 %	0.38 m ³ /s	504.473 m ³	510.000 m ³
			0.230 mg/l	0.230 mg/l
			0.116 kg	0.117 kg
Block B1-Dwelling	0 %	2.14 m ³ /s	4,226.664 m ³	4,240.000 m ³

			0.090 mg/l	0.090 mg/l
			0.380 kg	0.382 kg
Block B1-Driveway	0 %	0.88 m ³ /s	2,645.074 m ³	2,640.000 m ³
			0.230 mg/l	0.230 mg/l
			0.608 kg	0.607 kg
Out#2,3,6	0 %	90.322 m ³ /s	1,069,905.000 m ³	1,069,905.000 m ³
			0.285 mg/l	0.285 mg/l
			304.902 kg	304.902 kg

TP - Catchment 3

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	30.57 m ³ /s	137,618.816 m ³	104,440.000 m ³
			0.230 mg/l	0.230 mg/l
			31.652 kg	24.021 kg
Block B3-Dwelling	0 %	1.32 m ³ /s	1,809.967 m ³	1,830.000 m ³
			0.090 mg/l	0.090 mg/l
			0.163 kg	0.165 kg
Block B3-Driveway	0 %	0.62 m ³ /s	1,165.741 m ³	1,170.000 m ³

			0.230 mg/l	0.230 mg/l
			0.268 kg	0.269 kg
Out#7	0 %	32.505 m ³ /s	107,442.000 m ³	107,442.000 m ³
			0.228 mg/l	0.228 mg/l
			24.455 kg	24.455 kg

TP - Catchment 4

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	14.14 m ³ /s	131,425.390 m ³	99,020.000 m ³
			0.230 mg/l	0.230 mg/l
			30.228 kg	22.775 kg
Out#4	0 %	14.142 m ³ /s	99,016.000 m ³	99,016.000 m ³
			0.230 mg/l	0.230 mg/l
			22.775 kg	22.775 kg

TP - Catchment 5

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	11.74 m ³ /s	75,909.522 m ³ 0.259 mg/l 19.661 kg	56,730.000 m ³ 0.259 mg/l 14.693 kg
Out#5	0 %	11.736 m ³ /s	56,730.000 m ³ 0.259 mg/l 14.693 kg	56,730.000 m ³ 0.259 mg/l 14.693 kg

Detailed Report Parameters | Pre Development

No.4

Field	Value
Subcatchment name	No.4
Catchment	4
Total AREA (HA)	38.557
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	38.557
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 1

	Field	Value
	Subcatchment name	No. 1
	Catchment	1
	Total AREA (HA)	246.377
	Impervious area (HA)	0
	Roof area (HA)	0
	Landscaped area (HA)	0
	Row Crop area (HA)	0
	Open Space / Parkland area (HA)	0
	Forest area (HA)	197.10160000000002
	Wetland area (HA)	49.275400000000005
	Other area (HA)	0
	Manning's n for impervious areas	0.01
	Manning's n for pervious areas	0.1
	Depression storage for impervious areas (mm)	2
	Depression storage for pervious areas (mm)	2.54
	Weighted Curve Number	66.8

No. 2

Field	Value
Subcatchment name	No. 2
Catchment	2
Total AREA (HA)	66.78
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	56.763
Wetland area (HA)	10.017
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	67.8

No. 3

Field	Value
Subcatchment name	No. 3
Catchment	2

Total AREA (HA)	312.986
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	281.6874
Wetland area (HA)	31.2986
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	68.9

No. 5

Field	Value
Subcatchment name	No. 5
Catchment	5
Total AREA (HA)	22.27
Impervious area (HA)	0

Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	21.156499999999998
Wetland area (HA)	1.1135
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	70

No. 6

Field	Value
Subcatchment name	No. 6
Catchment	2
Total AREA (HA)	47.156
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0

Open Space / Parkland area (HA)	0
Forest area (HA)	47.156
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 7

Field	Value
Subcatchment name	No. 7
Catchment	3
Total AREA (HA)	40.374
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	40.374

Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

Out#4

Field	Value
Name	Out#4
Catchment	4
Outfall Elevation (m)	0

Out#1

Field	Value
Name	Out#1
Catchment	1
Outfall Elevation (m)	0

Out#2,3,6

Field	Value

Name	Out#2,3,6
Catchment	2
Outfall Elevation (m)	0

Out#7

Field	Value
Name	Out#7
Catchment	3
Outfall Elevation (m)	0

Out#5

Field	Value
Name	Out#5
Catchment	5
Outfall Elevation (m)	0

Block A-Dwelling

Field	Value
Subcatchment name	Block A-Dwelling
Catchment	2
Total AREA (HA)	0.708
Impervious area (HA)	0

Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.708
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block A-Driveway

Field	Value
Subcatchment name	Block A-Driveway
Catchment	2
Total AREA (HA)	0.148
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0

Open Space / Parkland area (HA)	0
Forest area (HA)	0.148
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block B1-Dwelling

Field	Value
Subcatchment name	Block B1-Dwelling
Catchment	2
Total AREA (HA)	1.24
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	1.24

Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B1-Driveway

Field	Value
Subcatchment name	Block B1-Driveway
Catchment	2
Total AREA (HA)	0.776
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.776
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01

Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B2-Dwelling

Field	Value
Subcatchment name	Block B2-Dwelling
Catchment	1
Total AREA (HA)	0.18
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.18
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2

Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B2-Driveway

Field	Value
Subcatchment name	Block B2-Driveway
Catchment	1
Total AREA (HA)	0.114
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.114
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B3-Dwelling

Field	Value
Subcatchment name	Block B3-Dwelling
Catchment	3
Total AREA (HA)	0.531
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.531
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block B3-Driveway

Field

Value

Subcatchment name	Block B3-Driveway
Catchment	3
Total AREA (HA)	0.342
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.342
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Detailed Report Parameters | Post Development

No.4

Field	Value
Subcatchment name	No.4
Catchment	4
Total AREA (HA)	38.557
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	38.557
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 1

Field	Value
Subcatchment name	No. 1
Catchment	1
Total AREA (HA)	246.377
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	197.10160000000002
Wetland area (HA)	49.275400000000005
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	66.8

No. 2**Field****Value**

Subcatchment name	No. 2
Catchment	2
Total AREA (HA)	66.78
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	56.763
Wetland area (HA)	10.017
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	67.8

No. 3

Field	Value
Subcatchment name	No. 3
Catchment	2

Total AREA (HA)	312.986
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	281.6874
Wetland area (HA)	31.2986
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	68.9

No. 5

Field	Value
Subcatchment name	No. 5
Catchment	5
Total AREA (HA)	22.27
Impervious area (HA)	0
Roof area (HA)	0

Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	21.156499999999998
Wetland area (HA)	1.1135
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	70

No. 6

Field	Value
Subcatchment name	No. 6
Catchment	2
Total AREA (HA)	47.156
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0

Open Space / Parkland area (HA)	0
Forest area (HA)	47.156
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 7

Field	Value
Subcatchment name	No. 7
Catchment	3
Total AREA (HA)	40.374
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	40.374
Wetland area (HA)	0

Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

Out#4

	Field	Value
	Name	Out#4
	Catchment	4
	Outfall Elevation (m)	0

Out#1

	Field	Value
	Name	Out#1
	Catchment	1
	Outfall Elevation (m)	0

Out#2,3,6

	Field	Value
	Name	Out#2,3,6

Catchment	2
Outfall Elevation (m)	0

Out#7

Field	Value
Name	Out#7
Catchment	3
Outfall Elevation (m)	0

Out#5

Field	Value
Name	Out#5
Catchment	5
Outfall Elevation (m)	0

Block A-Dwelling

Field	Value
Subcatchment name	Block A-Dwelling
Catchment	2
Total AREA (HA)	0.708
Impervious area (HA)	0
Roof area (HA)	0.708

Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.708
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block A-Driveway

Field	Value
Subcatchment name	Block A-Driveway
Catchment	2
Total AREA (HA)	0.148
Impervious area (HA)	0.148
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0

Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B1-Dwelling

Field	Value
Subcatchment name	Block B1-Dwelling
Catchment	2
Total AREA (HA)	1.24
Impervious area (HA)	0
Roof area (HA)	1.24
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0

Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B1-Driveway

Field	Value
Subcatchment name	Block B1-Driveway
Catchment	2
Total AREA (HA)	0.776
Impervious area (HA)	0.776
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1

Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B2-Dwelling

Field	Value
Subcatchment name	Block B2-Dwelling
Catchment	1
Total AREA (HA)	0.18
Impervious area (HA)	0
Roof area (HA)	0.18
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54

Block B2-Driveway

Field	Value
Subcatchment name	Block B2-Driveway
Catchment	1
Total AREA (HA)	0.114
Impervious area (HA)	0.114
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B3-Dwelling

Field	Value
Subcatchment name	Block B3-Dwelling
Catchment	3
Total AREA (HA)	0.531
Impervious area (HA)	0
Roof area (HA)	0.531
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B3-Driveway

Field	Value
Subcatchment name	Block B3-Driveway
Catchment	3

Total AREA (HA)	0.342
Impervious area (HA)	0.342
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Summary

AVERAGE-ANNUAL SCENARIO

Site	Project Name	Project Title	Storm Type
Pre-Development	Elephant Lake	Elephant Lake_PRE	avg-annual
Post-Development	Elephant Lake	Elephant Lake_PRE	avg-annual

Water Balance Comparison

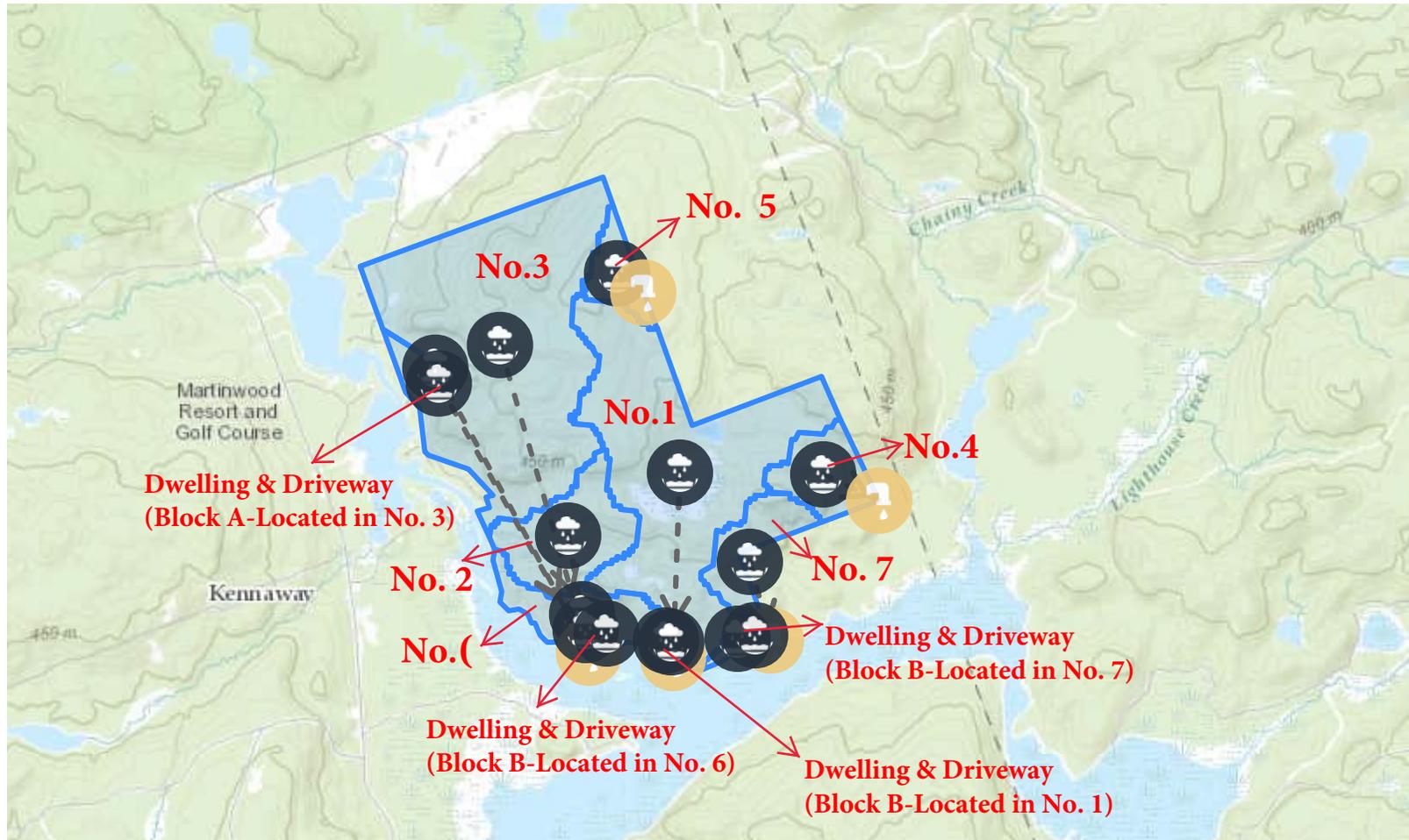
Site	Site Area	Site Rainfall In (mm) (m ³)	Site Infiltration (mm) (m ³)	Site Evapotranspiration (mm) (m ³)	External Outflow (mm) (m ³)	Rainfall Reduction (mm) (%)
Pre-Development Total	778.54 ha	944.70 mm 7,354,857.93 m ³	240.28 mm 1,870,709.92 m ³	605.80 mm 4,716,392.86 m ³	97.81 mm 761,500.00 m ³	846.89 mm 89.65 %
Post-Development Total	778.54 ha	944.70 mm 7,354,857.93 m ³	239.06 mm 1,861,161.77 m ³	603.73 mm 4,700,249.43 m ³	101.14 mm 787,400.00 m ³	843.56 mm 89.29 %
Difference	0.00 ha	0.00 mm 0.00 m³	-1.23 mm -9,548.15 m³	-2.07 mm -16,143.43 m³	3.33 mm 25,900.00 m³	-3.33 mm -0.35 %
Difference	0.00 %	0.00 %	-0.51 %	-0.34 %	3.40 %	-0.39 %

Water Balance | Pre-Development

Catchment	Site Area	Site Rainfall In	Site Infiltration	Site Evapotranspiration	External Outflow	Rainfall Reduction
		(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (%)
1	246.67 ha	944.70 mm	254.54 mm	605.36 mm	83.92 mm	860.78 mm
		2,330,300.94 m ³	627,875.23 m ³	1,493,251.33 m ³	207,000.00 m ³	91.12 %
2	429.79 ha	944.70 mm	236.89 mm	606.03 mm	100.98 mm	843.72 mm
		4,060,263.92 m ³	1,018,133.75 m ³	2,604,701.00 m ³	434,000.00 m ³	89.31 %
3	41.25 ha	944.70 mm	218.99 mm	605.87 mm	119.28 mm	825.42 mm
		389,660.41 m ³	90,327.01 m ³	249,901.20 m ³	49,200.00 m ³	87.37 %
4	38.56 ha	944.70 mm	216.65 mm	605.98 mm	121.38 mm	823.32 mm
		364,247.98 m ³	83,533.74 m ³	233,647.71 m ³	46,800.00 m ³	87.15 %
5	22.27 ha	944.70 mm	228.29 mm	605.71 mm	110.01 mm	834.69 mm
		210,384.69 m ³	50,840.18 m ³	134,891.62 m ³	24,500.00 m ³	88.35 %
TOTAL	778.54 ha	944.70 mm	240.28 mm	605.80 mm	97.81 mm	846.89 mm
		7,354,857.93 m³	1,870,709.92 m³	4,716,392.86 m³	761,500.00 m³	89.65 %

Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In	Site Infiltration	Site Evapotranspiration	External Outflow	Rainfall Reduction
		(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (m ³)	(mm) (%)
1	246.67 ha	944.70 mm 2,330,300.94 m ³	254.32 mm 627,325.12 m ³	604.87 mm 1,492,033.92 m ³	84.73 mm 209,000.00 m ³	859.97 mm 91.03 %
2	429.79 ha	944.70 mm 4,060,263.92 m ³	235.37 mm 1,011,604.87 m ³	603.38 mm 2,593,280.06 m ³	105.17 mm 452,000.00 m ³	839.53 mm 88.87 %
3	41.25 ha	944.70 mm 389,660.41 m ³	213.00 mm 87,857.86 m ³	597.37 mm 246,396.12 m ³	133.59 mm 55,100.00 m ³	811.11 mm 85.86 %
4	38.56 ha	944.70 mm 364,247.98 m ³	216.65 mm 83,533.74 m ³	605.98 mm 233,647.71 m ³	121.38 mm 46,800.00 m ³	823.32 mm 87.15 %
5	22.27 ha	944.70 mm 210,384.69 m ³	228.29 mm 50,840.18 m ³	605.71 mm 134,891.62 m ³	110.01 mm 24,500.00 m ³	834.69 mm 88.35 %
TOTAL	778.54 ha	944.70 mm 7,354,857.93 m³	239.06 mm 1,861,161.77 m³	603.73 mm 4,700,249.43 m³	101.14 mm 787,400.00 m³	843.56 mm 89.29 %

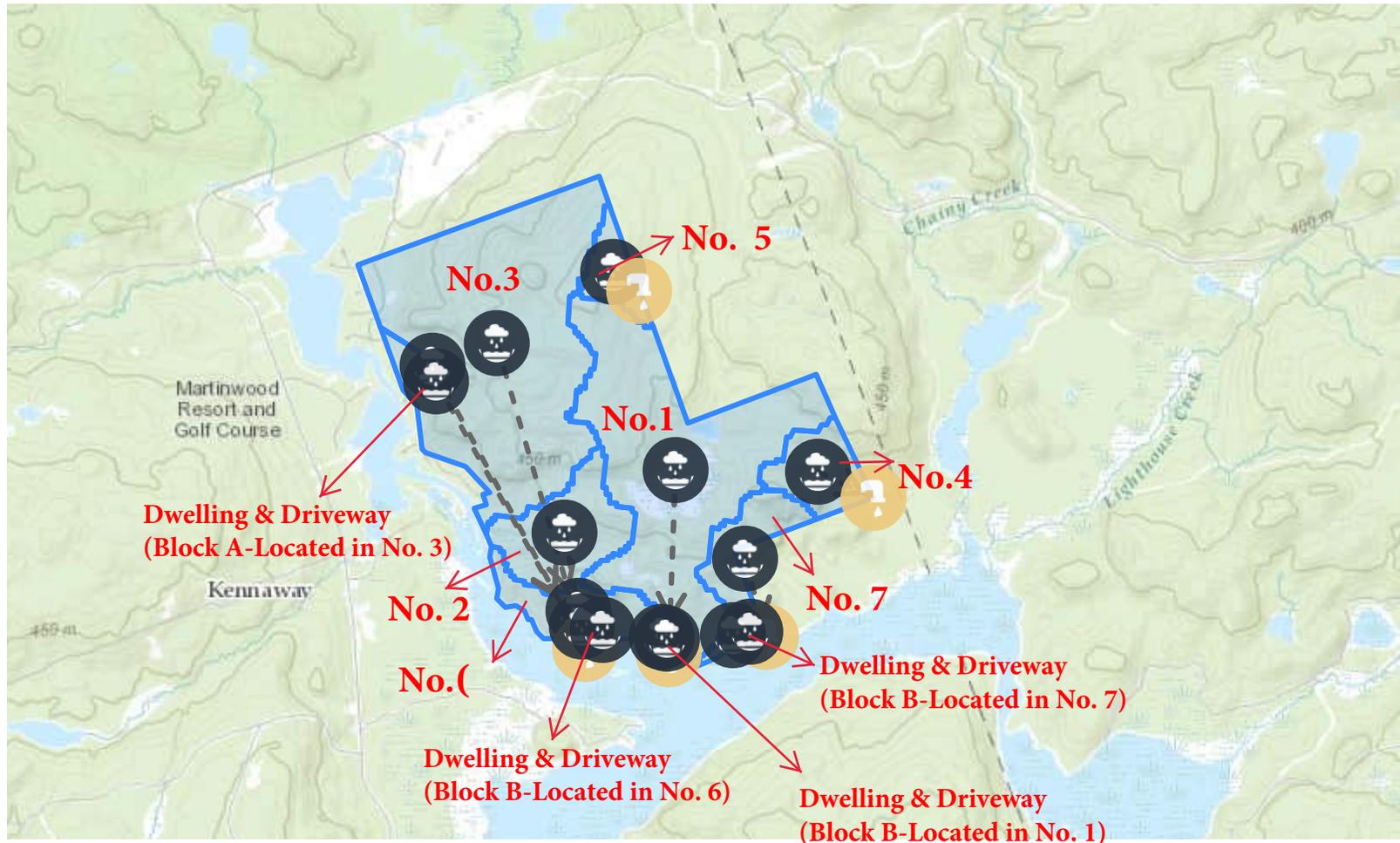


Total Number of Subcatchments = 7

Block A= Phase 1

Block B= Phase 2

* We assumed subcatchments 2,3, and 6 as a one catchment with one outlet (i.e., Catchment 2)



Total Number of Subcatchments = 7

Block A= Phase 1

Block B= Phase 2

* We assumed subcatchments 2,3, and 6 as a one catchment with one outlet (i.e., Catchment 2)

LID Summary | Post-Development

Element	Type	LID Area	Drawdown Time	Effective Impervious to Pervious Ratio	FLOW	TSS	TP
					Flow In (m ³)	Load In (kg)	Load In (kg)
					Flow Out (m ³)	Load Out (kg)	Load Out (kg)
					Actual Reduction (%)	Actual Reduction (%)	Actual Reduction (%)

Loading Summary TSS | Pre Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.915 m ³ /s	207,430.000 m ³ 46.618 mg/l 9,669.934 kg	207,429.000 m ³ 46.618 mg/l 9,669.934 kg
Catchment 2	0.000 %	2.366 m ³ /s	434,470.000 m ³ 51.088 mg/l 22,196.131 kg	434,476.000 m ³ 51.087 mg/l 22,196.131 kg
Catchment 3	0.000 %	0.820 m ³ /s	49,160.000 m ³ 55.000 mg/l 2,703.800 kg	49,154.000 m ³ 55.007 mg/l 2,703.800 kg
Catchment 4	0.000 %	0.374 m ³ /s	46,810.000 m ³ 55.000 mg/l 2,574.550 kg	46,807.000 m ³ 55.004 mg/l 2,574.550 kg
Catchment 5	0.000 %	0.284 m ³ /s	24,510.000 m ³ 52.900 mg/l	24,507.000 m ³ 52.906 mg/l

			1,296.579 kg	1,296.579 kg
Total	0.000 %	4.759 m³/s	762,380.000 m³	762,373.000 m³
			50.422 mg/l	50.423 mg/l
			38,440.994 kg	38,440.994 kg

Loading Summary TSS | Post Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.915 m ³ /s	209,200.000 m ³ 46.519 mg/l 9,731.754 kg	209,196.000 m ³ 46.520 mg/l 9,731.754 kg
Catchment 2	0.000 %	2.397 m ³ /s	452,390.000 m ³ 50.875 mg/l 23,015.511 kg	452,402.000 m ³ 50.874 mg/l 23,015.511 kg
Catchment 3	0.000 %	0.934 m ³ /s	55,120.000 m ³ 53.152 mg/l 2,929.720 kg	55,123.000 m ³ 53.149 mg/l 2,929.720 kg
Catchment 4	0.000 %	0.374 m ³ /s	46,810.000 m ³ 55.000 mg/l 2,574.550 kg	46,807.000 m ³ 55.004 mg/l 2,574.550 kg
Catchment 5	0.000 %	0.284 m ³ /s	24,510.000 m ³ 52.900 mg/l	24,507.000 m ³ 52.906 mg/l

			1,296.579 kg	1,296.579 kg
Total	0.000 %	4.904 m³/s	788,030.000 m³	788,035.000 m³
			50.186 mg/l	50.186 mg/l
			39,548.114 kg	39,548.114 kg

Loading Summary TP | Pre Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.915 m ³ /s	207,430.000 m ³ 0.346 mg/l 71.720 kg	207,429.000 m ³ 0.346 mg/l 71.720 kg
Catchment 2	0.000 %	2.366 m ³ /s	434,470.000 m ³ 0.284 mg/l 123.400 kg	434,476.000 m ³ 0.284 mg/l 123.400 kg
Catchment 3	0.000 %	0.820 m ³ /s	49,160.000 m ³ 0.230 mg/l 11.307 kg	49,154.000 m ³ 0.230 mg/l 11.307 kg
Catchment 4	0.000 %	0.374 m ³ /s	46,810.000 m ³ 0.230 mg/l 10.766 kg	46,807.000 m ³ 0.230 mg/l 10.766 kg
Catchment 5	0.000 %	0.284 m ³ /s	24,510.000 m ³ 0.259 mg/l	24,507.000 m ³ 0.259 mg/l

			6.348 kg	6.348 kg
Total	0.000 %	4.759 m³/s	762,380.000 m³	762,373.000 m³
			0.293 mg/l	0.293 mg/l
			223.541 kg	223.541 kg

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Average Concentration (mg/l)	Average Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
Catchment 1	0.000 %	0.915 m ³ /s	209,200.000 m ³ 0.344 mg/l 71.936 kg	209,196.000 m ³ 0.344 mg/l 71.936 kg
Catchment 2	0.000 %	2.397 m ³ /s	452,390.000 m ³ 0.280 mg/l 126.717 kg	452,402.000 m ³ 0.280 mg/l 126.717 kg
Catchment 3	0.000 %	0.934 m ³ /s	55,120.000 m ³ 0.220 mg/l 12.123 kg	55,123.000 m ³ 0.220 mg/l 12.123 kg
Catchment 4	0.000 %	0.374 m ³ /s	46,810.000 m ³ 0.230 mg/l 10.766 kg	46,807.000 m ³ 0.230 mg/l 10.766 kg
Catchment 5	0.000 %	0.284 m ³ /s	24,510.000 m ³ 0.259 mg/l	24,507.000 m ³ 0.259 mg/l

			6.348 kg	6.348 kg
Total	0.000 %	4.904 m³/s	788,030.000 m³	788,035.000 m³
			0.289 mg/l	0.289 mg/l
			227.891 kg	227.891 kg

Peak Flow | Pre-Development

Catchment	Element	Description	Peak outflow
1	No. 1	PEAK RUNOFF FLOW from	0.91 m ³ /s
	Out#1	MAXIMUM FLOW at	0.915 m ³ /s
	Block B2-Dwelling	PEAK RUNOFF FLOW from	0.01 m ³ /s
	Block B2-Driveway	PEAK RUNOFF FLOW from	0.00 m ³ /s
2	No. 2	PEAK RUNOFF FLOW from	0.45 m ³ /s
	No. 3	PEAK RUNOFF FLOW from	1.38 m ³ /s
	No. 6	PEAK RUNOFF FLOW from	0.61 m ³ /s
	Out#2,3,6	MAXIMUM FLOW at	2.366 m ³ /s
	Block A-Dwelling	PEAK RUNOFF FLOW from	0.00 m ³ /s
	Block A-Driveway	PEAK RUNOFF FLOW from	0.00 m ³ /s
	Block B1-Dwelling	PEAK RUNOFF FLOW from	0.01 m ³ /s
	Block B1-Driveway	PEAK RUNOFF FLOW from	0.00 m ³ /s
3	No. 7	PEAK RUNOFF FLOW from	0.82 m ³ /s
	Out#7	MAXIMUM FLOW at	0.820 m ³ /s
	Block B3-Dwelling	PEAK RUNOFF FLOW from	0.00 m ³ /s
	Block B3-Driveway	PEAK RUNOFF FLOW from	0.00 m ³ /s

4	No.4 Out#4	PEAK RUNOFF FLOW from MAXIMUM FLOW at	0.37 m ³ /s 0.374 m ³ /s
5	No. 5 Out#5	PEAK RUNOFF FLOW from MAXIMUM FLOW at	0.28 m ³ /s 0.284 m ³ /s

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	No. 1	PEAK RUNOFF FLOW from	0.91 m ³ /s
	Out#1	MAXIMUM FLOW at	0.915 m ³ /s
	Block B2-Dwelling	PEAK RUNOFF FLOW from	0.02 m ³ /s
	Block B2-Driveway	PEAK RUNOFF FLOW from	0.02 m ³ /s
2	No. 2	PEAK RUNOFF FLOW from	0.45 m ³ /s
	No. 3	PEAK RUNOFF FLOW from	1.38 m ³ /s
	No. 6	PEAK RUNOFF FLOW from	0.61 m ³ /s
	Out#2,3,6	MAXIMUM FLOW at	2.397 m ³ /s
	Block A-Dwelling	PEAK RUNOFF FLOW from	0.10 m ³ /s
	Block A-Driveway	PEAK RUNOFF FLOW from	0.02 m ³ /s
	Block B1-Dwelling	PEAK RUNOFF FLOW from	0.16 m ³ /s
Block B1-Driveway	PEAK RUNOFF FLOW from	0.08 m ³ /s	
3	No. 7	PEAK RUNOFF FLOW from	0.82 m ³ /s
	Out#7	MAXIMUM FLOW at	0.934 m ³ /s
	Block B3-Dwelling	PEAK RUNOFF FLOW from	0.07 m ³ /s
	Block B3-Driveway	PEAK RUNOFF FLOW from	0.04 m ³ /s
4	No.4	PEAK RUNOFF FLOW from	0.37 m ³ /s

	Out#4	MAXIMUM FLOW at	0.374 m ³ /s
5	No. 5	PEAK RUNOFF FLOW from	0.28 m ³ /s
	Out#5	MAXIMUM FLOW at	0.284 m ³ /s

Loading TSS | Pre Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 1	0 %	0.91 m ³ /s	2,327,523.519 m ³	206,990.000 m ³
			46.600 mg/l	46.600 mg/l
			108,462.596 kg	9,645.734 kg
Block B2-Dwelling	0 %	0.01 m ³ /s	1,700.460 m ³	270.000 m ³
			55.000 mg/l	55.000 mg/l
			93.525 kg	14.850 kg
Block B2-Driveway	0 %	0 m ³ /s	1,076.958 m ³	170.000 m ³
			55.000 mg/l	55.000 mg/l
			59.233 kg	9.350 kg
Out#1	0 %	0.915 m ³ /s	207,429.000 m ³	207,429.000 m ³
			46.618 mg/l	46.618 mg/l
			9,669.934 kg	9,669.934 kg

TSS - Catchment 2

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³) Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Concentration (mg/l) Total Load (kg)
No. 2	0 %	0.45 m ³ /s	630,870.660 m ³ 48.700 mg/l 30,723.401 kg	66,670.000 m ³ 48.700 mg/l 3,246.829 kg
No. 3	0 %	1.38 m ³ /s	2,956,778.742 m ³ 50.800 mg/l 150,204.360 kg	304,690.000 m ³ 50.800 mg/l 15,478.252 kg
No. 6	0 %	0.61 m ³ /s	445,482.732 m ³ 55.000 mg/l 24,501.550 kg	59,920.000 m ³ 55.000 mg/l 3,295.600 kg
Block A-Dwelling	0 %	0 m ³ /s	6,688.476 m ³ 55.000 mg/l 367.866 kg	420.000 m ³ 55.000 mg/l 23.100 kg
Block A-Driveway	0 %	0 m ³ /s	1,398.156 m ³ 55.000 mg/l 76.899 kg	90.000 m ³ 55.000 mg/l 4.950 kg
Block B1-Dwelling	0 %	0.01 m ³ /s	11,714.280 m ³	1,700.000 m ³

			55.000 mg/l	55.000 mg/l
			644.285 kg	93.500 kg
Block B1-Driveway	0 %	0 m ³ /s	7,330.872 m ³	980.000 m ³
			55.000 mg/l	55.000 mg/l
			403.198 kg	53.900 kg
Out#2,3,6	0 %	2.366 m ³ /s	434,476.000 m ³	434,476.000 m ³
			51.087 mg/l	51.087 mg/l
			22,196.131 kg	22,196.131 kg

TSS - Catchment 3

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	0.82 m ³ /s	381,413.178 m ³	48,640.000 m ³
			55.000 mg/l	55.000 mg/l
			20,977.725 kg	2,675.200 kg
Block B3-Dwelling	0 %	0 m ³ /s	5,016.357 m ³	330.000 m ³
			55.000 mg/l	55.000 mg/l
			275.900 kg	18.150 kg
Block B3-Driveway	0 %	0 m ³ /s	3,230.874 m ³	190.000 m ³

			55.000 mg/l	55.000 mg/l
			177.698 kg	10.450 kg
Out#7	0 %	0.82 m ³ /s	49,154.000 m ³	49,154.000 m ³
			55.007 mg/l	55.007 mg/l
			2,703.800 kg	2,703.800 kg

TSS - Catchment 4

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	0.37 m ³ /s	364,247.979 m ³	46,810.000 m ³
			55.000 mg/l	55.000 mg/l
			20,033.639 kg	2,574.550 kg
Out#4	0 %	0.374 m ³ /s	46,807.000 m ³	46,807.000 m ³
			55.004 mg/l	55.004 mg/l
			2,574.550 kg	2,574.550 kg

TSS - Catchment 5

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	0.28 m ³ /s	210,384.690 m ³ 52.900 mg/l 11,129.350 kg	24,510.000 m ³ 52.900 mg/l 1,296.579 kg
Out#5	0 %	0.284 m ³ /s	24,507.000 m ³ 52.906 mg/l 1,296.579 kg	24,507.000 m ³ 52.906 mg/l 1,296.579 kg

Loading TSS | Post Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³) Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Concentration (mg/l) Total Load (kg)
No. 1	0 %	0.91 m ³ /s	2,327,523.519 m ³ 46.600 mg/l 108,462.596 kg	206,990.000 m ³ 46.600 mg/l 9,645.734 kg
Block B2-Dwelling	0 %	0.02 m ³ /s	1,700.460 m ³ 7.000 mg/l 11.903 kg	1,360.000 m ³ 7.000 mg/l 9.520 kg
Block B2-Driveway	0 %	0.02 m ³ /s	1,076.958 m ³ 90.000 mg/l 96.926 kg	850.000 m ³ 90.000 mg/l 76.500 kg
Out#1	0 %	0.915 m ³ /s	209,196.000 m ³ 46.520 mg/l 9,731.754 kg	209,196.000 m ³ 46.520 mg/l 9,731.754 kg

TSS - Catchment 2

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³) Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Concentration (mg/l) Total Load (kg)
No. 2	0 %	0.45 m ³ /s	630,870.660 m ³ 48.700 mg/l 30,723.401 kg	66,670.000 m ³ 48.700 mg/l 3,246.829 kg
No. 3	0 %	1.38 m ³ /s	2,956,778.742 m ³ 50.800 mg/l 150,204.360 kg	304,690.000 m ³ 50.800 mg/l 15,478.252 kg
No. 6	0 %	0.61 m ³ /s	445,482.732 m ³ 55.000 mg/l 24,501.550 kg	59,920.000 m ³ 55.000 mg/l 3,295.600 kg
Block A-Dwelling	0 %	0.1 m ³ /s	6,688.476 m ³ 62.000 mg/l 414.686 kg	5,260.000 m ³ 62.000 mg/l 326.120 kg
Block A-Driveway	0 %	0.02 m ³ /s	1,398.156 m ³ 90.000 mg/l 125.834 kg	1,100.000 m ³ 90.000 mg/l 99.000 kg
Block B1-Dwelling	0 %	0.16 m ³ /s	11,714.280 m ³	9,130.000 m ³

			7.000 mg/l	7.000 mg/l
			82.000 kg	63.910 kg
Block B1-Driveway	0 %	0.08 m ³ /s	7,330.872 m ³	5,620.000 m ³
			90.000 mg/l	90.000 mg/l
			659.778 kg	505.800 kg
Out#2,3,6	0 %	2.397 m ³ /s	452,402.000 m ³	452,402.000 m ³
			50.874 mg/l	50.874 mg/l
			23,015.511 kg	23,015.511 kg

TSS - Catchment 3

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	0.82 m ³ /s	381,413.178 m ³	48,640.000 m ³
			55.000 mg/l	55.000 mg/l
			20,977.725 kg	2,675.200 kg
Block B3-Dwelling	0 %	0.07 m ³ /s	5,016.357 m ³	3,960.000 m ³
			7.000 mg/l	7.000 mg/l
			35.114 kg	27.720 kg
Block B3-Driveway	0 %	0.04 m ³ /s	3,230.874 m ³	2,520.000 m ³

			90.000 mg/l	90.000 mg/l
			290.779 kg	226.800 kg
Out#7	0 %	0.934 m ³ /s	55,123.000 m ³	55,123.000 m ³
			53.149 mg/l	53.149 mg/l
			2,929.720 kg	2,929.720 kg

TSS - Catchment 4

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	0.37 m ³ /s	364,247.979 m ³	46,810.000 m ³
			55.000 mg/l	55.000 mg/l
			20,033.639 kg	2,574.550 kg
Out#4	0 %	0.374 m ³ /s	46,807.000 m ³	46,807.000 m ³
			55.004 mg/l	55.004 mg/l
			2,574.550 kg	2,574.550 kg

TSS - Catchment 5

Name	LID Type (removal)	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	0.28 m ³ /s	210,384.690 m ³ 52.900 mg/l 11,129.350 kg	24,510.000 m ³ 52.900 mg/l 1,296.579 kg
Out#5	0 %	0.284 m ³ /s	24,507.000 m ³ 52.906 mg/l 1,296.579 kg	24,507.000 m ³ 52.906 mg/l 1,296.579 kg

Loading TP | Pre Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 1	0 %	0.91 m ³ /s	2,327,523.519 m ³	206,990.000 m ³
			0.346 mg/l	0.346 mg/l
			805.323 kg	71.619 kg
Block B2-Dwelling	0 %	0.01 m ³ /s	1,700.460 m ³	270.000 m ³
			0.230 mg/l	0.230 mg/l
			0.391 kg	0.062 kg
Block B2-Driveway	0 %	0 m ³ /s	1,076.958 m ³	170.000 m ³
			0.230 mg/l	0.230 mg/l
			0.248 kg	0.039 kg
Out#1	0 %	0.915 m ³ /s	207,429.000 m ³	207,429.000 m ³
			0.346 mg/l	0.346 mg/l
			71.720 kg	71.720 kg

TP - Catchment 2

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 2	0 %	0.45 m ³ /s	630,870.660 m ³ 0.317 mg/l 199.986 kg	66,670.000 m ³ 0.317 mg/l 21.134 kg
No. 3	0 %	1.38 m ³ /s	2,956,778.742 m ³ 0.288 mg/l 851.552 kg	304,690.000 m ³ 0.288 mg/l 87.751 kg
No. 6	0 %	0.61 m ³ /s	445,482.732 m ³ 0.230 mg/l 102.461 kg	59,920.000 m ³ 0.230 mg/l 13.782 kg
Block A-Dwelling	0 %	0 m ³ /s	6,688.476 m ³ 0.230 mg/l 1.538 kg	420.000 m ³ 0.230 mg/l 0.097 kg
Block A-Driveway	0 %	0 m ³ /s	1,398.156 m ³ 0.230 mg/l 0.322 kg	90.000 m ³ 0.230 mg/l 0.021 kg
Block B1-Dwelling	0 %	0.01 m ³ /s	11,714.280 m ³	1,700.000 m ³

			0.230 mg/l	0.230 mg/l
			2.694 kg	0.391 kg
Block B1-Driveway	0 %	0 m ³ /s	7,330.872 m ³	980.000 m ³
			0.230 mg/l	0.230 mg/l
			1.686 kg	0.225 kg
Out#2,3,6	0 %	2.366 m ³ /s	434,476.000 m ³	434,476.000 m ³
			0.284 mg/l	0.284 mg/l
			123.400 kg	123.400 kg

TP - Catchment 3

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	0.82 m ³ /s	381,413.178 m ³	48,640.000 m ³
			0.230 mg/l	0.230 mg/l
			87.725 kg	11.187 kg
Block B3-Dwelling	0 %	0 m ³ /s	5,016.357 m ³	330.000 m ³
			0.230 mg/l	0.230 mg/l
			1.154 kg	0.076 kg
Block B3-Driveway	0 %	0 m ³ /s	3,230.874 m ³	190.000 m ³

			0.230 mg/l	0.230 mg/l
			0.743 kg	0.044 kg
Out#7	0 %	0.82 m ³ /s	49,154.000 m ³	49,154.000 m ³
			0.230 mg/l	0.230 mg/l
			11.307 kg	11.307 kg

TP - Catchment 4

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	0.37 m ³ /s	364,247.979 m ³	46,810.000 m ³
			0.230 mg/l	0.230 mg/l
			83.777 kg	10.766 kg
Out#4	0 %	0.374 m ³ /s	46,807.000 m ³	46,807.000 m ³
			0.230 mg/l	0.230 mg/l
			10.766 kg	10.766 kg

TP - Catchment 5

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	0.28 m ³ /s	210,384.690 m ³ 0.259 mg/l 54.490 kg	24,510.000 m ³ 0.259 mg/l 6.348 kg
Out#5	0 %	0.284 m ³ /s	24,507.000 m ³ 0.259 mg/l 6.348 kg	24,507.000 m ³ 0.259 mg/l 6.348 kg

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³) Concentration (mg/l) Total Load (kg)	Total Flow (m ³) Concentration (mg/l) Total Load (kg)
No. 1	0 %	0.91 m ³ /s	2,327,523.519 m ³ 0.346 mg/l 805.323 kg	206,990.000 m ³ 0.346 mg/l 71.619 kg
Block B2-Dwelling	0 %	0.02 m ³ /s	1,700.460 m ³ 0.090 mg/l 0.153 kg	1,360.000 m ³ 0.090 mg/l 0.122 kg
Block B2-Driveway	0 %	0.02 m ³ /s	1,076.958 m ³ 0.230 mg/l 0.248 kg	850.000 m ³ 0.230 mg/l 0.195 kg
Out#1	0 %	0.915 m ³ /s	209,196.000 m ³ 0.344 mg/l 71.936 kg	209,196.000 m ³ 0.344 mg/l 71.936 kg

TP - Catchment 2

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 2	0 %	0.45 m ³ /s	630,870.660 m ³	66,670.000 m ³
			0.317 mg/l	0.317 mg/l
			199.986 kg	21.134 kg
No. 3	0 %	1.38 m ³ /s	2,956,778.742 m ³	304,690.000 m ³
			0.288 mg/l	0.288 mg/l
			851.552 kg	87.751 kg
No. 6	0 %	0.61 m ³ /s	445,482.732 m ³	59,920.000 m ³
			0.230 mg/l	0.230 mg/l
			102.461 kg	13.782 kg
Block A-Dwelling	0 %	0.1 m ³ /s	6,688.476 m ³	5,260.000 m ³
			0.320 mg/l	0.320 mg/l
			2.140 kg	1.683 kg
Block A-Driveway	0 %	0.02 m ³ /s	1,398.156 m ³	1,100.000 m ³
			0.230 mg/l	0.230 mg/l
			0.322 kg	0.253 kg
Block B1-Dwelling	0 %	0.16 m ³ /s	11,714.280 m ³	9,130.000 m ³

			0.090 mg/l	0.090 mg/l
			1.054 kg	0.822 kg
Block B1-Driveway	0 %	0.08 m ³ /s	7,330.872 m ³	5,620.000 m ³
			0.230 mg/l	0.230 mg/l
			1.686 kg	1.293 kg
Out#2,3,6	0 %	2.397 m ³ /s	452,402.000 m ³	452,402.000 m ³
			0.280 mg/l	0.280 mg/l
			126.717 kg	126.717 kg

TP - Catchment 3

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No. 7	0 %	0.82 m ³ /s	381,413.178 m ³	48,640.000 m ³
			0.230 mg/l	0.230 mg/l
			87.725 kg	11.187 kg
Block B3-Dwelling	0 %	0.07 m ³ /s	5,016.357 m ³	3,960.000 m ³
			0.090 mg/l	0.090 mg/l
			0.451 kg	0.356 kg
Block B3-Driveway	0 %	0.04 m ³ /s	3,230.874 m ³	2,520.000 m ³

			0.230 mg/l	0.230 mg/l
			0.743 kg	0.580 kg
Out#7	0 %	0.934 m ³ /s	55,123.000 m ³	55,123.000 m ³
			0.220 mg/l	0.220 mg/l
			12.123 kg	12.123 kg

TP - Catchment 4

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)
No.4	0 %	0.37 m ³ /s	364,247.979 m ³	46,810.000 m ³
			0.230 mg/l	0.230 mg/l
			83.777 kg	10.766 kg
Out#4	0 %	0.374 m ³ /s	46,807.000 m ³	46,807.000 m ³
			0.230 mg/l	0.230 mg/l
			10.766 kg	10.766 kg

TP - Catchment 5

Name	LID Type	Peak Outflow	Incoming	Outgoing
			Total Flow (m ³)	Total Flow (m ³)
			Concentration (mg/l)	Concentration (mg/l)
			Total Load (kg)	Total Load (kg)

No. 5	0 %	0.28 m ³ /s	210,384.690 m ³ 0.259 mg/l 54.490 kg	24,510.000 m ³ 0.259 mg/l 6.348 kg
Out#5	0 %	0.284 m ³ /s	24,507.000 m ³ 0.259 mg/l 6.348 kg	24,507.000 m ³ 0.259 mg/l 6.348 kg

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No.4

Field	Value
Subcatchment name	No.4
Catchment	4
Total AREA (HA)	38.557
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	38.557
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 1

Field	Value
Subcatchment name	No. 1
Catchment	1
Total AREA (HA)	246.377
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	197.10160000000002
Wetland area (HA)	49.275400000000005
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	66.8

No. 2

Field	Value
Subcatchment name	No. 2
Catchment	2
Total AREA (HA)	66.78
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	56.763
Wetland area (HA)	10.017
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	67.8

No. 3

Field	Value
Subcatchment name	No. 3
Catchment	2

Total AREA (HA)	312.986
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	281.6874
Wetland area (HA)	31.2986
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	68.9

No. 5

Field	Value
Subcatchment name	No. 5
Catchment	5
Total AREA (HA)	22.27
Impervious area (HA)	0

Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	21.156499999999998
Wetland area (HA)	1.1135
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	70

No. 6

Field	Value
Subcatchment name	No. 6
Catchment	2
Total AREA (HA)	47.156
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0

Open Space / Parkland area (HA)	0
Forest area (HA)	47.156
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 7

Field	Value
Subcatchment name	No. 7
Catchment	3
Total AREA (HA)	40.374
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	40.374

Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

Out#4

Field	Value
Name	Out#4
Catchment	4
Outfall Elevation (m)	0

Out#1

Field	Value
Name	Out#1
Catchment	1
Outfall Elevation (m)	0

Out#2,3,6

Field	Value

Name	Out#2,3,6
Catchment	2
Outfall Elevation (m)	0

Out#7

Field	Value
Name	Out#7
Catchment	3
Outfall Elevation (m)	0

Out#5

Field	Value
Name	Out#5
Catchment	5
Outfall Elevation (m)	0

Block A-Dwelling

Field	Value
Subcatchment name	Block A-Dwelling
Catchment	2
Total AREA (HA)	0.708
Impervious area (HA)	0

Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.708
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block A-Driveway

Field	Value
Subcatchment name	Block A-Driveway
Catchment	2
Total AREA (HA)	0.148
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0

Open Space / Parkland area (HA)	0
Forest area (HA)	0.148
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block B1-Dwelling

Field	Value
Subcatchment name	Block B1-Dwelling
Catchment	2
Total AREA (HA)	1.24
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	1.24

Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B1-Driveway

Field	Value
Subcatchment name	Block B1-Driveway
Catchment	2
Total AREA (HA)	0.776
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.776
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01

Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B2-Dwelling

Field	Value
Subcatchment name	Block B2-Dwelling
Catchment	1
Total AREA (HA)	0.18
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.18
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2

Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B2-Driveway

Field	Value
Subcatchment name	Block B2-Driveway
Catchment	1
Total AREA (HA)	0.114
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.114
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Block B3-Dwelling

Field	Value
Subcatchment name	Block B3-Dwelling
Catchment	3
Total AREA (HA)	0.531
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.531
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block B3-Driveway

Field

Value

Subcatchment name	Block B3-Driveway
Catchment	3
Total AREA (HA)	0.342
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.342
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

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No.4

Field	Value
Subcatchment name	No.4
Catchment	4
Total AREA (HA)	38.557
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	38.557
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 1

Field	Value
Subcatchment name	No. 1
Catchment	1
Total AREA (HA)	246.377
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	197.10160000000002
Wetland area (HA)	49.275400000000005
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	66.8

No. 2**Field****Value**

Subcatchment name	No. 2
Catchment	2
Total AREA (HA)	66.78
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	56.763
Wetland area (HA)	10.017
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	67.8

No. 3

Field	Value
Subcatchment name	No. 3
Catchment	2

Total AREA (HA)	312.986
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	281.6874
Wetland area (HA)	31.2986
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	68.9

No. 5

Field	Value
Subcatchment name	No. 5
Catchment	5
Total AREA (HA)	22.27
Impervious area (HA)	0
Roof area (HA)	0

Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	21.156499999999998
Wetland area (HA)	1.1135
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	70

No. 6

Field	Value
Subcatchment name	No. 6
Catchment	2
Total AREA (HA)	47.156
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0

Open Space / Parkland area (HA)	0
Forest area (HA)	47.156
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

No. 7

Field	Value
Subcatchment name	No. 7
Catchment	3
Total AREA (HA)	40.374
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	40.374
Wetland area (HA)	0

Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	71

Out#4

	Field	Value
	Name	Out#4
	Catchment	4
	Outfall Elevation (m)	0

Out#1

	Field	Value
	Name	Out#1
	Catchment	1
	Outfall Elevation (m)	0

Out#2,3,6

	Field	Value
	Name	Out#2,3,6

Catchment	2
Outfall Elevation (m)	0

Out#7

Field	Value
Name	Out#7
Catchment	3
Outfall Elevation (m)	0

Out#5

Field	Value
Name	Out#5
Catchment	5
Outfall Elevation (m)	0

Block A-Dwelling

Field	Value
Subcatchment name	Block A-Dwelling
Catchment	2
Total AREA (HA)	0.708
Impervious area (HA)	0
Roof area (HA)	0.708

Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.708
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	58

Block A-Driveway

Field	Value
Subcatchment name	Block A-Driveway
Catchment	2
Total AREA (HA)	0.148
Impervious area (HA)	0.148
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0

Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B1-Dwelling

Field	Value
Subcatchment name	Block B1-Dwelling
Catchment	2
Total AREA (HA)	1.24
Impervious area (HA)	0
Roof area (HA)	1.24
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0

Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B1-Driveway

Field	Value
Subcatchment name	Block B1-Driveway
Catchment	2
Total AREA (HA)	0.776
Impervious area (HA)	0.776
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1

Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B2-Dwelling

Field	Value
Subcatchment name	Block B2-Dwelling
Catchment	1
Total AREA (HA)	0.18
Impervious area (HA)	0
Roof area (HA)	0.18
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54

Block B2-Driveway

Field	Value
Subcatchment name	Block B2-Driveway
Catchment	1
Total AREA (HA)	0.114
Impervious area (HA)	0.114
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B3-Dwelling

Field	Value
Subcatchment name	Block B3-Dwelling
Catchment	3
Total AREA (HA)	0.531
Impervious area (HA)	0
Roof area (HA)	0.531
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Block B3-Driveway

Field	Value
Subcatchment name	Block B3-Driveway
Catchment	3

Total AREA (HA)	0.342
Impervious area (HA)	0.342
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

APPENDIX XII- SCS MODIFIED CN METHOD

SCS MODIFIED CURVE NUMBER (CN) METHOD

The 24-hour SCS type II distribution was used to generate the precipitation distribution for the worst-case design storm, i.e., 100 years. Typically, the 4-hour Chicago distribution provides the more conservative response in urban catchments, while 24-hour SCS type II distribution produces the more conservative response in rural catchments. Since there is a significant rural drainage area in each of the existing sub-watersheds, the 24-hour SCS type II distribution storm produced more conservative results. The SCS Curve Numbers have been established using Chart 1.09 of the MTO Drainage Management Manual (Ministry of Transportation, 1997).

MTO Drainage Management Manual (1997)
Design Chart 1.09: Soil/Land Use Curve Numbers

Land Use or Surface	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Fallow (special cases only)	77	82	86	89	91	93	94
Crop and other improved land	66** (62)	70** (68)	74	78	82	84	86 AMC I
Pasture & other unimproved land	58* (38)	62* (51)	65	71	76	79	81
Woodlots and forest	50* (30)	54* (44)	58	65	71	74	77
Impervious areas (paved)							98
Bare bedrock draining directly to stream by surface flow							98
Bare bedrock draining indirectly to stream as groundwater (usual case)							70
Lakes and wetlands							50

Notes

- (i) All values are based on AMC II except those marked by * (AMC III) or ** (mean of AMC II and AMC III).
- (ii) Values in brackets are AMC II and are to be used only for special cases.
- (iii) Table is not applicable to frozen soils or to periods in which snowmelt contributes to runoff.

SCS Type II – 24 Hour, 100 Year Storm Event for Bancroft (ID: 6161001) Under Climate Change Condition (Total Rainfall = 130.59 mm)

The intensity-duration-frequency (IDF) data should be obtained from Environment Canada’s station at Bancroft (ID: 6161001). Cited in <https://www.idf-cc-uwo.ca/>

IDF for: BANCROFT AUTO ID:6161001

Station name: **BANCROFT AUTO**

ID: **6161001**

Latitude: **45.07**

Longitude: **-77.88**

Starting year: **1998**

Ending year: **2021**

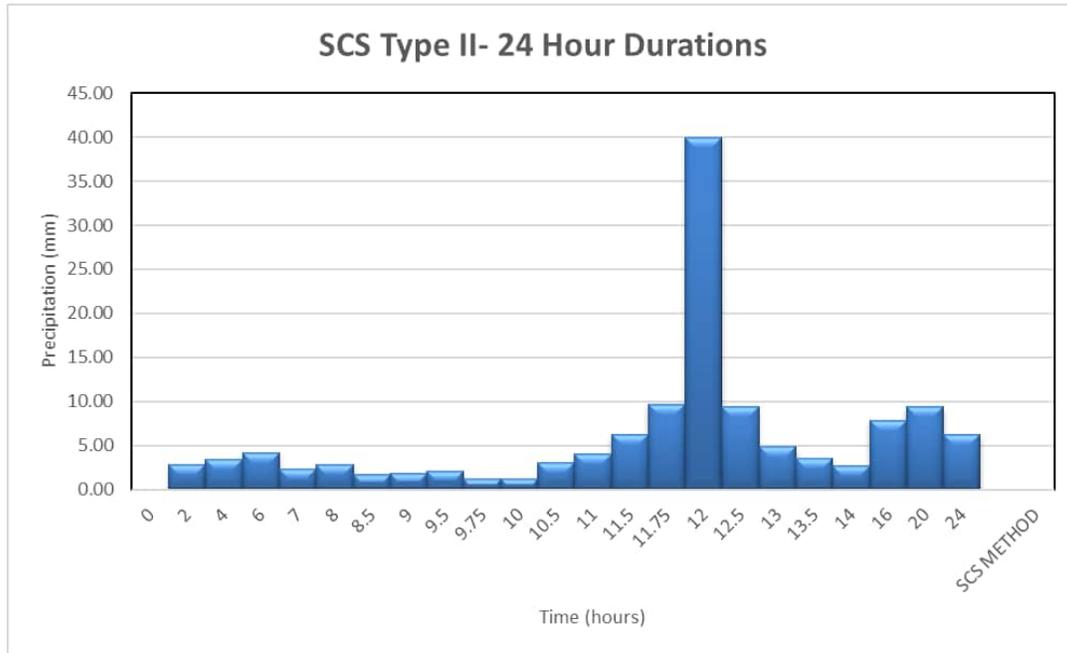
Number of years (with data): **21**

Total PPT (mm) Intensity rates (mm/h)

T (years)	2	5	10	20	25	50	100
5 min	10.38	13.07	14.65	16.17	16.64	18.02	19.14
10 min	15.33	20.16	23.09	25.98	26.87	29.56	31.82
15 min	18.20	23.79	26.99	30.05	30.96	33.65	35.91
30 min	23.61	30.55	34.42	38.03	39.09	42.17	44.76
1 h	29.22	38.98	44.42	49.44	50.91	55.16	58.84
2 h	32.49	43.83	50.92	57.99	60.20	66.85	72.79
6 h	38.34	51.75	62.72	76.41	81.20	98.91	118.67
12 h	47.32	60.31	71.15	85.35	90.59	110.39	130.31
24 h	55.91	70.38	81.35	94.02	98.63	114.59	130.59

Total PPT (mm) Intensity rates (mm/h)

T (years)	2	5	10	20	25	50	100
5 min	124.56	156.89	175.75	194.07	199.65	216.26	229.66
10 min	91.99	120.98	138.56	155.87	161.20	177.34	190.93
15 min	72.79	95.15	107.96	120.21	123.86	134.59	143.64
30 min	47.21	61.10	68.83	76.06	78.18	84.33	89.52
1 h	29.22	38.98	44.42	49.44	50.91	55.16	58.84
2 h	16.25	21.91	25.46	29.00	30.10	33.43	36.40
6 h	6.39	8.62	10.45	12.73	13.53	16.48	19.78
12 h	3.94	5.03	5.93	7.11	7.55	9.20	10.86
24 h	2.33	2.93	3.39	3.92	4.11	4.77	5.44



Sub-catchment Parameterization

The sub-catchment parameters have been determined for the existing land use and soils within the area. The time of concentration for the sub-catchments has been calculated using the Airport Equation ($C < 0.4$).

Catchment	Area (ha)	Catchment Length, L (m)	Avg. Slope, S_w (%)	Runoff Coefficient (C)	T_c (min)	T_c (hr)	Drainage Description
1	312.6	3246	4.7	0.17	104	1.73	Input
2	66.8	1402	8.8	0.17	55.6	0.93	Input
3	312.4	1947	6.7	0.17	71.6	1.19	Input
4	37.7	889	10.1	0.17	42.3	0.70	Output*
5	25.7	513	6.8	0.17	36.6	0.61	Output*
6	46.5	534	10.9	0.17	32	0.53	Input
7	43.6	950	9.3	0.17	44.9	0.75	Input

* Please note that the runoff collected by these catchments does not flow towards the development area (Northern and Southern catchments, i.e., Catchments #101 & 102) but instead leaves the site in a different direction and is considered as the output from the site boundary.

$$T_c = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w^{0.33}} \quad (\text{Airport Equation})$$

In which:

T_c = time of concentration (min), C = runoff coefficient, L = catchment length, (m), S_w = catchment slope (%).

SCS Parameters: IA & CN*

CN to CN* Convention:

P (12-hour, 100-year) = 99.1 mm (from Bancroft 100yr 24 hr SCS)

$IA = 0.075S$ ($CN \leq 70$) (from Visual OTTHYMO Reference Manual, v6.0, 2019)

$S = 25400 / CN - 254$

$$Q = \frac{A(P-IA)^2}{P-IA+S}$$

In which:

Q = the overland runoff depth (mm); P = the rainfall (mm); S = the total potential losses or storage parameter (mm); IA = the initial abstraction (mm); and CN = Curve Number.

Pre-development

Subcatchment	IA (mm)	CN (AMC II)	CN (AMC III)	S (mm)	Q (mm)	IA* (mm)	S* (mm)	CN* (AMC III)	CN* (AMC II)
All	19.1	30	50	254	7.7	10	750	25	15

Post-development

Subcatchment	IA (mm)	CN (AMC II)	CN (AMC III)	S (mm)	Q (mm)	IA* (mm)	S* (mm)	CN* (AMC III)	CN* (AMC II)
All	18.6	31	51	248	8.2	10	708	26	16

SCS TR-55 Graphical Method (Soil Conservation Service, 1986)

Determines peak runoff, the runoff volume, and the time to peak for a single homogeneous sub-area or watershed only for drainage areas up to 2000 acres. The Graphical Peak Discharge method is derived from TR-20 (SCS, 1983) output.

$$q_p = q_u A_m Q F_p$$

$$\text{Log}(q_u) = C_0 + C_1 \cdot \text{Log}(T_c) + C_2 \cdot [\text{Log}(T_c)]^2$$

Where:

q_p = peak discharge (cfs), q_u = unit peak discharge (csm/in), A_m = drainage area (mi²), Q = runoff (in), T_c = time of concentration (hr), C_0 , C_1 , C_2 = Coefficients from Table F-1 in TR-55 (next page), and F_p = pond and swamp adjustment factor (table below).

Percent of pond & swamp areas in watershed	F_p
0	1.00
0.2	0.97
1.0	0.87
3.0	0.75
5.0	0.72

Rainfall Type	I _a /P	C ₀	C ₁	C ₂
I	0.10	2.30550	-0.51429	-0.11750
	0.20	2.23537	-0.50387	-0.08929
	0.25	2.18219	-0.48488	-0.06589
	0.30	2.10624	-0.45695	-0.02835
	0.35	2.00303	-0.40769	0.01983
	0.40	1.87733	-0.32274	0.05754
	0.45	1.76312	-0.15644	0.00453
	0.50	1.67889	-0.06930	0.0
IA	0.10	2.03250	-0.31583	-0.13748
	0.20	1.91978	-0.28215	-0.07020
	0.25	1.83842	-0.25543	-0.02597
	0.30	1.72657	-0.19826	0.02633
	0.50	1.63417	-0.09100	0.0
II	0.10	2.55323	-0.61512	-0.16403
	0.30	2.46532	-0.62257	-0.11657
	0.35	2.41896	-0.61594	-0.08820
	0.40	2.36409	-0.59857	-0.05621
	0.45	2.29238	-0.57005	-0.02281
	0.50	2.20282	-0.51599	-0.01259
III	0.10	2.47317	-0.51848	-0.17083
	0.30	2.39628	-0.51202	-0.13245
	0.35	2.35477	-0.49735	-0.11985
	0.40	2.30726	-0.46541	-0.11094
	0.45	2.24876	-0.41314	-0.11508
	0.50	2.17772	-0.36803	-0.09525

Interpolating for IA/P = 0.19

Pre-Dev.	Post-Dev.
<i>C₀ = 2.512705455</i>	<i>C₀ = 2.514608593</i>
<i>C₁ = -0.61855428</i>	<i>C₁ = -0.618393</i>
<i>C₂ = -0.142152</i>	<i>C₂ = -0.14317945</i>

Pre-development

Subcatchment	Area (ha)	Area (mi ²)	IA/P	T _c (hr)	q _u (cms/in)	F _p	Q _{p-100yr} (cfs)	Q _{p-100yr} (cms)
1	312.6	1.21	0.19	1.73	227.46	0.97	44.23	1.25
2	66.8	0.26	0.19	0.93	341.36	0.99	14.49	0.41
3	312.4	1.21	0.19	1.19	291.24	1	58.35	1.65
4*	37.7	0.15	0.19	0.70	401.32	1	9.71	0.27
5*	25.7	0.10	0.19	0.61	435.51	1	7.19	0.20
6	46.5	0.18	0.19	0.53	469.19	1	13.99	0.40
7	43.6	0.17	0.19	0.75	387.52	1	10.84	0.31
Total**								4.50

* Subcatchments 4 and 5 do not impact the development site (Northern & Southern Catchment, i.e., 101 & 102), as their outflows move in the other direction, exiting through the northern and eastern boundaries of the site.

** The total drainage amount exits the site boundaries in all directions.

Post-development

Subcatchment	Area (ha)	Area (mi ²)	IA/P	T _c (hr)	q _u (cms/in)	F _p	Q _{p-100yr} (cfs)	Q _{p-100yr} (cms)
1	312.6	1.21	0.19	1.73	229.09	0.97	48.39	1.37
2	66.8	0.26	0.19	0.92	343.70	0.99	15.84	0.45
3	312.4	1.21	0.19	1.19	293.28	1	63.82	1.81
4*	37.7	0.15	0.19	0.70	403.98	1	10.62	0.30
5*	25.7	0.10	0.19	0.61	438.33	1	7.85	0.22
6	46.5	0.18	0.19	0.53	472.15	1	15.29	0.43
7	43.6	0.17	0.19	0.75	390.11	1	11.85	0.34
Total**								4.92

* Subcatchments 4 and 5 do not impact the development site (Northern & Southern Catchment, i.e., 101 & 102), as their outflows move in the other direction, exiting through the northern and eastern boundaries of the site.

** The total drainage amount exits the site boundaries in all directions.

Comparison of the runoff estimation (Q₁₀₀) for both methods (cms)*

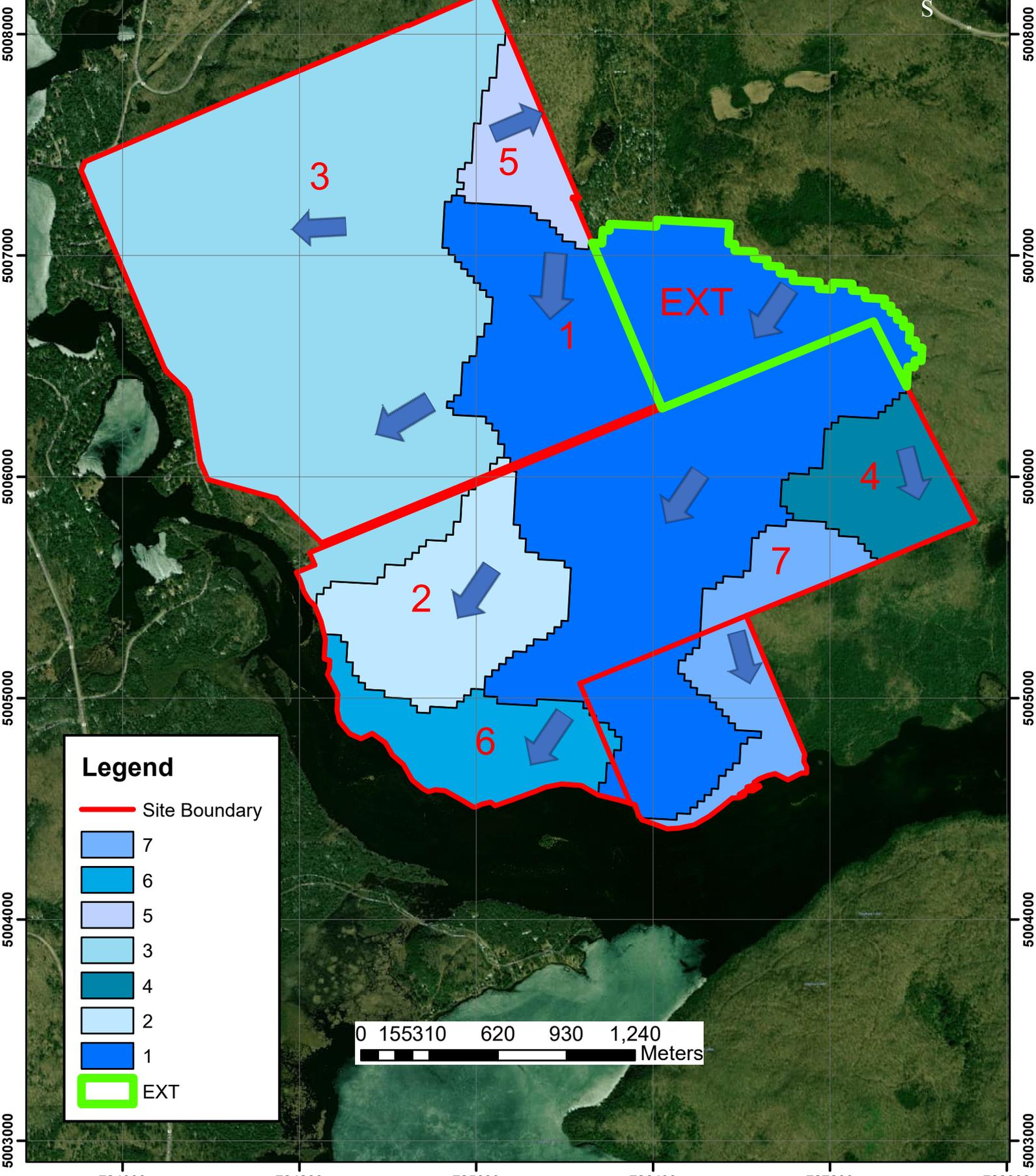
Method	Rational Method 12-hour 100-year	SCS II 12-hour 100-year
Pre-development	4.74	4.02
Post-development	4.82	4.40

* It should be noted that the total drainage area contributing to the runoff is 845.4 ha, while the total site area within the boundary is 781.4 ha. The total area draining towards the developed site, including the construction area itself, is 781.9 ha.

As can be seen in the above table, comparing the values of the both methods for the 100-year peak discharge of 12-hour rainfall, shows that the method used in Sections 3-4 (Rational Method) obtains higher values than the SCS Type II method and will be more conservative while the Rational method is recommended to predict peak flows for small drainage areas (<200 acre).

724000 724800 725600 726400 727200 728000

Subcatchments



Legend

- Site Boundary
- 7
- 6
- 5
- 3
- 4
- 2
- 1
- EXT

0 155 310 620 930 1,240 Meters