water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Kawartha Conservation

Nogies Creek Floodplain Mapping Study
Final Report

February 29, 2024

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WE 23058

Mr. Matthew Mantle
Director, Planning and Development Services
Kawartha Conservation
277 Kenrei Road
Lindsay, ON
K9V 4R1

Dear Mr. Mantle:

RE: Nogies Creek Floodplain Mapping Study

1. Introduction

Water's Edge was authorized by the Kawartha Conservation (KC) to conduct flood hazard mapping for Nogies Creek in the Municipality of Trent Lakes. This is a summary report of this mapping RFP issued by KC (dated November 2023) and the proposal submitted by Water's Edge, dated November 17, 2023.

2. Streams Mapped

The following watercourse was included in this project:

- Nogies Creek – 7.2 km

3. Guidelines Followed

The floodplain mapping was done in accordance with the following Provincial and Federal guidelines:

- *MNR (2002). Technical Guide – River & Stream systems: Flooding Hazard Limit. Ontario Ministry of Natural Resources, Water Resources Section, Peterborough, Ontario, 2002.*

- *Natural Resources Canada (2019). Federal Hydrologic and Hydraulic Procedures for Flood Hazard Version 1.0. Natural Resources Canada, 2019. (https://doi.org/10.4095/299808)*

Moreover, the following documents were also consulted for general conformity:

- *Conservation Ontario (2005). Guidelines for Developing Schedules of Regulated Areas. October 2005.*

- *MNR (1986). Flood Plain Management in Ontario – Technical Guidelines. Ontario Ministry of Natural Resources, Conservation Authorities and Water Management Branch, Toronto.*

- *Natural Resources Canada (2019). Federal Geomatics Guidelines for Flood Mapping Version 1.0. Natural Resources Canada, 2019. (https://doi.org/10.4095/299810)*

- *Natural Resources Canada (2018). Case Studies on Climate Change in Floodplain Mapping Volume 1. Natural Resources Canada, 2018. (https://doi.org/10.4095/306436)*

- *MMAH (2020). Provincial Policy Statement, 2020 – Under the Planning Act. Ontario Ministry of Municipal Affairs and Housing, Queen's Printer for Ontario, 28 February 2020. (https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf)*

Additionally, as required by the RFP, the following documents were consulted when necessary:

- *Federal Flood Mapping Framework (Version 2.0) (available at https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=308128)*
- *Federal Airborne LIDAR Data Acquisition Guideline (Version 3.1) (available at https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=330330)*
- *Bibliography of Best Practices and References for Flood Mitigation (Version 2.0) (available at https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=308380)*
- *Federal Flood Damage Estimation Guidelines for Buildings and Infrastructure (Version 1.0) (available at https://doi.org/10.4095/327001)*
- *OpenGIS Implementation Specification for Geographic information (#06-103r4) (available at https://www.ogc.org/standards/sfa).*
- *Technical Guide for Great Lakes – St. Lawrence River Shorelines, Flooding, Erosion and Dynamic Beaches (2001) for the Great Lakes, St. Lawrence and interconnecting channels. Ontario MNR.*
- *Technical Guide for Large Inland Lakes Shorelines (1996). Ontario MNR.*

To ensure maps can be used for regulatory purposes, the Province's technical guidance, standards and policies will take precedence where any conflicts arise.

We have also followed the official manuals of all models used (HEC-HMS and HEC-RAS) and contemporary industry standards.

4. Overview of the Project

The main three steps of floodplain mapping are (a) flow estimation, (b) flood level calculation, and (c) flood line plotting. For this project, we have estimated the flood flows via hydrologic modeling using the HEC-HMS model, calculated the flood levels via hydraulic modeling using the HEC-RAS model, and then plotted the flood lines against the LIDAR topography using RAS Mapper and GIS software.

The modeling was done for a total of twelve (12) storm events: 2, 5, 10, 20, 50, 100, 200, 500 and 1000 year storm events; Timmins Storm; two climate change scenarios (high emission, mid and end of century projections).

It was found that the Regional or Timmins Storm produced higher flows and flood levels than the 100 year storm event. Therefore, Timmins Storm was taken as the governing flood event.

This summary report includes background information of the watershed, hydrologic modeling, hydraulic modeling, and floodplain delineation.

In 1988, a flood mapping study was undertaken on Nogies Creek (Kawartha Region Conservation Authority, 1988). This study is now 36 years old, and KC decided that a new mapping, utilizing recent data and technology, is in order.

A one-zone floodplain policy approach is assumed for this study. All models and mapping produced under this project were done on the one-zone policy approach.

5. Background Review and Data Collection

5.1 Information Collected and Reviewed

We have completed this project in accordance with the approved project Terms of Reference. We have collected and reviewed all available background materials and data. Specifically, it includes data sources for the analysis such as the following:

- Geospatial data: KC

- LIDAR: KC
- Soil data: KC – same as Soil survey index (GeoHub)
- Landcover: KC – same as SOLRIS 3.0
- IDF curves: Environment and Climate Change Canada (ECCC)
- Climate Change projection: Environment and Climate Change Canada(ECCC)
- Time of concentration: HEC-HMS manual/website
- Watershed delineation: HEC-HMS
- Initial stream shapefile: OHN watercourse
- SCS curve number: Developed internally in HEC-HMS
- Impervious data: estimated based on aerial photographs
- Bridge/culvert data – KC
- Cross-section data – KC
- Water level data of Pigeon Lake at Buckhorn Lock – KC
- Discussions with KC

5.2 Datum

5.2.1 Vertical Datum:

All data was surveyed and modelled using CGVD2013 datum.

5.2.2 Horizontal Datum:

CSRS(NAD83) UTM Zone 17N was used for the horizontal datum/projection.

5.3 Structure and Cross-sections

A total of three (3) road crossings (bridge/culvert) were surveyed by KC (or their contractor) during the summer of 2023. We scrutinize the collected information to ensure that it was sufficient for hydraulic modeling. The crossings are:

- Fire Route 116
- Tullys Road
- Highway 36

Many cross-sections of the river were also provided by KC, which supplemented the LIDAR in HEC-RAS to provide more accurate bathymetry at road crossings and elsewhere.

5.4 Terrain Pre-processing

The following data was provided by KC, with the following specifications:
Geospatial Reference Systems
Projection system: UTM Zones 15, 16, 17 and 18
Geometric reference system: Ex.: NAD83(CSRS)
Height reference system: CGVD2013
Geospatial File Formats: Gridded raster files must be in the GeoTIFF format. Vector files must be in the Esri Shapefile, Esri File Geodatabase or Geopackage format.

The LIDAR data provided by KC has the following technical specifications:
Minimum aggregate nominal pulse density >= 8.0 pls/m^2
The point cloud data shall meet the following accuracy benchmarks:
Non-Vegetated Vertical Accuracy (NVA): 95% Confidence level <= 9.8 cm
Vegetated Vertical Accuracy (VVA): 95th percentile <= 14.7 cm

The digital terrain model (DTM) used for watershed delineation was based on LIDAR data provided by KC. Additional manipulations of the DTM were necessary to prepare the surface for use in the hydrologic model. The LIDAR was resampled in GIS to a reduced 5m horizontal and 0.5m vertical cell size in order to allow reasonable computation. Following this, the rest of the pre-processing was completed in HEC-HMS (version 4.11). The first step was to ensure that flow paths were accurately represented in the DTM. This was accomplished using a shapefile of creek centerlines (KC/OHN watercourse) and burning in a channel through structures such as bridges and culverts (info/layer provided by KC). The next step was to fill in depressions without apparent outlets. The catchment was then delineated.

This step ensures that every cell within the watershed contributes flow to the outlet and that there is no depression storage to attenuate peak flows, resulting in a more conservative representation of surface conditions. Following the above steps, a linear workflow was followed that started with creating a flow direction raster that indicated which direction a given cell would drain to. Next, a flow accumulation raster was created that represented the number of upstream cells contributing to a given cell.

A stream network was then defined based on the minimum number of drainage areas. This was done for reasonable values to achieve a number of subcatchments suitable for each size of river. The subcatchments were delineated based on the flow change locations and to provide a logical output into the hydraulic model.

6. Hydrologic Modelling

6.1 Overall Methodology

Based on a review of available data and their limitations and in consultation with KC, it was decided that a lumped modelling approach will be taken to estimate the design flows. Thus, the entire watershed will be treated as a single unit in the hydrological model (HEC-HMS), which would require the parameters to reflect the combined effect of watershed's characteristics (topography, soil, vegetation, and land use) as well as numerous inland lakes, watercourses, and wetlands (especially their routing and flood attenuation functions). ***Version 4.11*** of HEC-HMS Model was used.

It was also decided that the results will be compared to past studies and information from other areas to check their reasonableness.

The approach yielded design flows at only one point, i.e., the outlet of the watershed. This flow was used throughout the whole length of the river/creek that was modelled in HEC-RAS. Since the drainage area associated with this lower-most reach was only about 5% of the whole watershed, the flows at the upper-most end of this reach were also only marginally lower (less than 5%) than the outlet flows. This justifies the use of a single flow throughout the entire reach.

6.2 Model Inputs

6.2.1 Catchment characteristics

In the absence of long-term streamflow data in this area, the single-event hydrologic modelling approach was taken to estimate peak flood flows corresponding to specified storm hyetograghs. The HEC-HMS model of United States Army Corps of Engineers (USACE) was chosen, as it is widely used worldwide and in Canada. It also offers many options/modules for various hydrologic phenomena.

A new HEC-HMS model was set up for the Miskwaa Ziibi River watershed. Given appropriate pour points (or catchment outlets), HMS can delineate the basin and sub-basins based on the LIDAR-based topography.

Following the preprocessing steps, HEC-HMS calculates many parameters based on the surface properties. Some of the pertinent parameters are shown in **Table 1** below. Information on Miskwaa Ziibi River, which is being studied concurrently, is also included for comparison.

Table 1 Watershed Characteristics

	Miskwaa Ziibi River Watershed	Nogies Creek Watershed
Drainage Area (km2)	201.01	187.62
Longest Flowpath Length (km)	72.98	69.44
Longest Flowpath Slope (m/m)	0.00148	0.00135
Centroidal Flowpath Length (km)	38.77	28.84
Centroidal Flowpath Slope (m/m)	0.00096	0.00098
10-85 Flowpath Length (km)	54.73	52.08
10-85 Flowpath Slope (m/m)	0.00118	0.00119
Basin Slope (m/m)	0.11285	0.11479
Basin Relief (m)	128.53	124.26
Relief Ratio	0.00176	0.00179
Elongation Ratio	0.21922	0.22259
Drainage Density (km/km2)	0.39933	0.24946

A review of the Official Plan (OP) of Township of Galway-Cavendish and Harvey, approved by the Municipality of Trent Lakes, does not indicate significant development in the foreseeable future (Township of Galway-Cavendish and Harvey, 2011). Therefore, the current land use was used in the hydrologic modelling.

6.2.2 Precipitation data and design storms

Once the basin had been set up in the model, the precipitation data were entered. The rainfall and IDF curves at Peterborough Airport were collected from ECCC website. They were used to obtain the hyetographs for the area of interest, and the ordinates were used to determine rainfall volumes for the SCS distribution (**Table 2**).

Table 2 Rainfall Depth for Various Modelling Events

Event	AEP	total rainfall	areal reduction factor	adjusted rainfall
	(%)	(mm)		(mm)
2 year	0.5	49.03	0.94	46.09
5 year	0.2	65.02	0.94	61.12
10 year	0.1	75.61	0.94	71.08
20 year	0.05	85.77	0.94	80.62
50 year	0.02	98.92	0.94	92.99
100 year	0.01	108.77	0.94	102.25
200 year	0.005	118.59	0.94	111.48
500 year	0.002	131.54	0.94	123.65
1000 year	0.001	141.33	0.94	132.85
Timmins	n/a	193.00	0.84	162.12
100ccHiEmMidCen	n/a	126.18	0.94	118.61
100ccHiEmEndCen	n/a	142.49	0.94	133.94

For SCS design storms, 24 hour storms were used for the SCS method because past experience indicates that the 24 hour storms yield conservative (higher) flows compared to shorter duration storms. Considering the size and shape of the watershed, an areal reduction factor of **0.94** was used for all AEP storm events, as per MNR (2002) Guidelines (Figure D.6 Areal Reduction Curves, page 40). For the Timmins storm, an areal reduction factor of **0.84** was used (Table D.5 Timmins – Areal Reduction, Page 36).

The modeling was done for a total of twelve (12) storm events: 2, 5, 10, 20, 50, 100, 200, 500 and 1000 year storm events; Timmins Storm; two climate change scenarios (high emission; mid and end of century projections).

6.2.3 Climate Change Considerations

The 2020 Provincial Policy Statement of Ontario (MMAH, 2020) states: “Planning authorities shall prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.” (Section 3.1.3).

NRCan (2018) encourages incorporating the effect of future climate change on floodplain mapping. They did not prescribe any specific methodology but have presented three case studies that are typical of the emerging practice. The methodologies presented are as follows:

1. Continuous long-term simulation (HSPF) with projected future climatic variables.
2. Continuous long-term simulation (VIC) with projected future climatic variables and see level rise.
3. Single event simulation (HEC-HMS) with projected future IDF curves.

The use of projected IDF curves is simple, suitable for single event hydrologic modeling, and cost effective. Moreover, such information is readily available from several sources in Ontario. This approach has been used in this project.

For estimating the 100 year hyetograph under future climatic condition, we used the CIMP6 based, climate-scaled IDF curves at Peterborough Airport, available from EC website (https://climatedata.ca/explore/variable/?coords=62.5325943454858,-98.48144531250001,4&delta=&dataset=cmip6&geo-select=&var=idf&var-group=station-data&mora=null&rcp=ssp126&decade=2040s&sector=). For different emission scenarios and time scale, we calculated the following multipliers (**Table 3**):

Table 3 Climate Scenarios

existing	future CMIP6	future CMIP6
1971_2006	2051_2080	2071_2200
medium emission	1.07	1.11
high emission	1.16	1.31

It appears that the projected increase at Peterborough is small compared to other locations in Ontario. Therefore, the high emission scenarios were chosen for this project. The mid-century (2051-2080) and the end of century (2071-2200) hyetographs can be obtained by multiplying the current 100 year hyetograph by 1.16 and 1.31 respectively.

These two future projections will be roughly equivalent to the existing 350 and 1000 year events. We anticipate that this timeframe will roughly correspond to significant updating of IDF curve as well as the next iteration of flood mapping update.

6.2.4 SCS Curve Number Grid

A curve number grid was created by in-house staff using Q-GIS to assign a curve number to each raster cell based on the soil and land cover characteristics at that point. Curve numbers were selected based on the TR-55 document from the NRCS (NRCS, 1986). Both Provincial Landcover and Open Canada Landcover were considered. It was determined that the Provincial Landcover dataset was similar to the

NRCS lookup table and best represented different infiltration classifications. This ensures accurate geospatial representation of runoff characteristics. Soil hydrologic characteristics were defined using the Ontario Soil Survey Index. The landuse categories were assigned based on the NRCS landuse classifications to facilitate the assignment of curve numbers.

Following the preparation of the soil and landuse data (obtained from KC), the layers were combined to create a layer that included both landuse and soil data. A lookup table was created to assign a curve number based on the land use type and the hydrologic soil group. The lookup table is shown in **Appendix A**. The output yielded a curve number raster that was used to determine a weighted-average curve number for the watershed, which was then recorded in the attribute table of the catchment shapefile.

6.2.5 Percent Impervious

Information pertaining to imperviousness was not available. It was therefore visually estimated from aerial photographs. It was conservatively estimated to be at 1%.

Curve Number (CN) and associated parameters are given in **Table 4**. Information on Miskwaa Ziibi River, which is being studied concurrently, is also included for comparison.

Table 4 Curve Number and Other Parameters

	Miskwaa Ziibi River Watershed	**Nogies Creek Watershed**
Drainage Area (km2)	201.01	187.62
CN	72.2	70.1
Initial Abstraction (mm)	19.6	21.7
% Impervious	1	1
Time of Concentration (hour)	20	19.25
Storage Coefficient (hour)	20	19.25
Duration of Simulation (hour)	144	144
Time Step (min)	15	15

7. HEC-HMS Model

The main components of the hydrologic model are the loss method and the transform method. Each of these components are discussed below. Initial estimates of each parameter are shown in **Appendix A**.

Version 4.11 of HEC-HMS Model was used.

The modeling was done for a total of twelve (12) storm events: 2, 5, 10, 20, 50, 100, 200, 500 and 1000 year storm events; Timmins Storm; two climate change scenarios.

7.1 Loss Method

The loss method selected was the SCS curve number approach due to its relatively small data requirements and ease of calibration. The development of the curve number grid has been described above. In addition to the curve number and percent impervious areas determined previously, initial abstraction was also calculated automatically in HEC-HMS. This calculation used the SCS method:

$$I_a = \left(0.2 * \frac{1000}{CN} - 10\right) * 25.4 = \text{(mm)}$$

7.2 Transform Method

The Clark Unit Hydrograph was used as the transform method in the model. This method uses linear reservoir storage calculations to determine how the input hydrograph is translated and attenuated through a subcatchment. The two input parameters needed for these calculations are the time of concentration and a storage coefficient. The initial estimate of the time of concentration in each subcatchment was determined using the following equation recommended by the HEC-HMS manual.

$$Tc \;=\; 2.2\left(\frac{L \cdot Lc}{\sqrt{S_{10-85}}}\right)^{0.3}$$

Where T_c is the time of concentration (hrs), L is the longest flow path (mi), Lc is the centroidal flow path (mi), S_{10-85} is the average slope of the flow path represented by 10 to 85 percent of the longest flow path (ft/mi). The SI units were converted to imperial units while using the above equation. The storage coefficient is dependent on the time of concentration and was calculated using the following equation recommended in the HEC-HMS manual:

$$\frac{R}{R + Tc} = 0.5$$

Where R is the storage coefficient. These calculations were calculated internally in HEC-HMS.

7.3 Flow Comparison

Suitable data for meaningful calibration was not available in this watershed, as is the case for most small catchments. Under such circumstances, indirect methods are employed to gain confidence in hydrologic and hydraulic models.

In this study, the calculated flows (for Timmins Storm) were compared with the Creager Envelop Curve. This curve with a coefficient of 30 fits best to Canadian data (Watt et al., 1989). Values for both Nogies Creek and Miskwaa Ziibi River were plotted as “Kawartha” in this figure.

The comparison is shown in **Figure 1**. It appears that the computed flows are well below the Creager Curve and the observed large floods (Canadian Extremes) used to derive this curve. This curve is considered the upper limit of floods in Canada. The data from our study also line up well with the observed large floods in Ontario (Ontario Extremes), which were taken from MNRF (2014). Considering all, we conclude that the estimated flows for this study are reasonable.

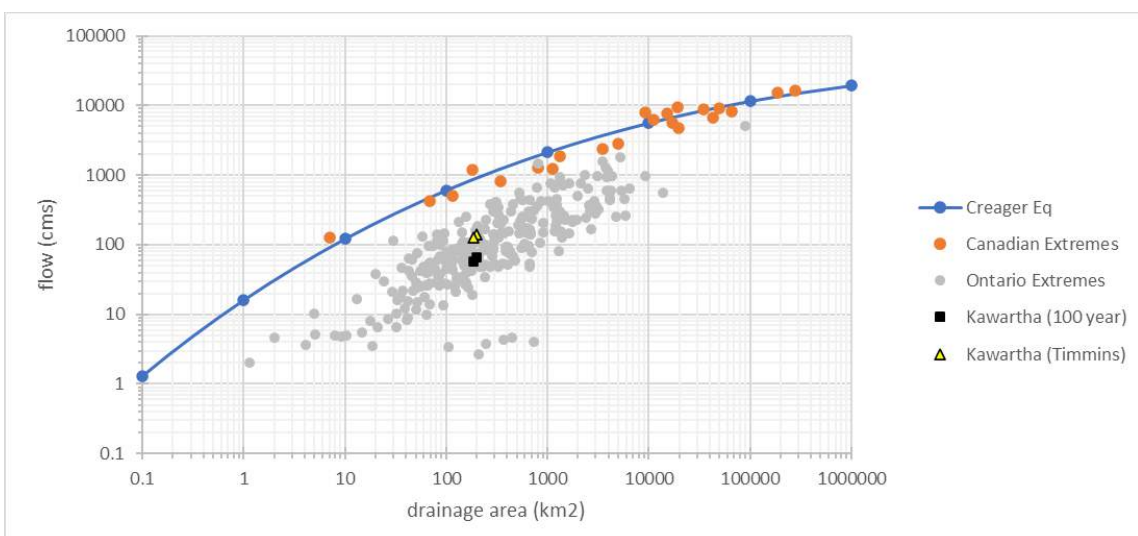

Figure 1 Flow Comparison

7.4 Sensitivity Analysis of Flow

In addition to flow comparison within the Creager framework, we also conducted a sensitivity analysis of the computed flows to important parameters (initial abstraction, time to peak and the curve number). It was found that the flow was mildly sensitive to initial abstraction and time to peak (**Figure 2**). Even a 40% variation causes less than 15% change in computed flows. However, the flows were very sensitive to the curve number (**Figure 3**). Since CN was based on high-quality soil and land cover information, it can hardly be considered a 'free' parameter that can or should be adjusted during calibration. We therefore conclude that the estimated values of the calibration parameters (initial abstraction and time to peak) are reasonable and will not greatly influence the computed flows.

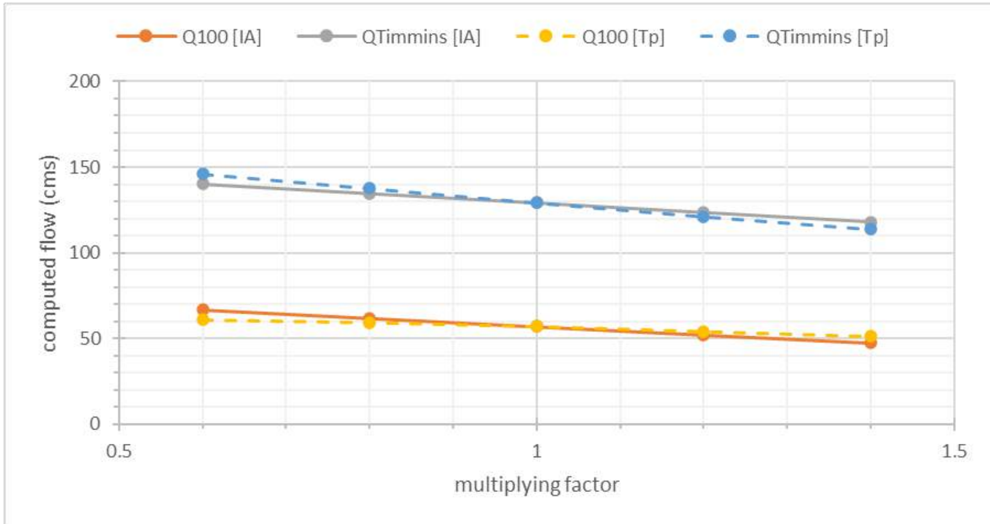

Figure 2 Sensitivity of Flow to IA and Tp

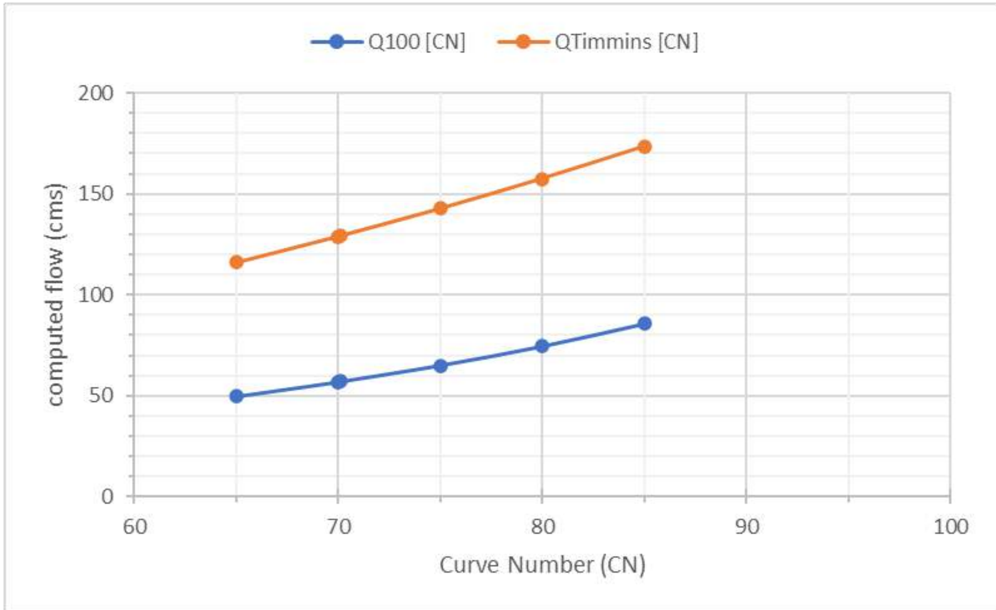

Figure 3 Sensitivity of Flow to CN

7.5 Design Flows for Hydraulic Modeling

The primary purpose of the hydrological model is to determine flow rates for use in hydraulic modelling. **Table 5** displays the HEC-HMS outputs used for hydraulic modelling. Again, information on Miskwaa Ziibi River, which is being studied concurrently, is also included for comparison.

Table 5 Peak Flow and Runoff Summary

	Storm Depth	Miskwaa Ziibi Watershed			Nogies Watershed		
		Peak Flow	Runnoff	Runoff	Peak Flow	Runoff	Runoff
	(mm)	(cms)	(m3)	(mm)	(cms)	(m3)	(mm)
2 year	46.09	10.0	1216200	6.05	7.8	919000	4.90
5 year	61.12	21.5	2585200	12.86	17.7	2068000	11.02
10 year	71.08	30.7	3675700	18.29	25.8	3005000	16.02
20 year	80.62	40.4	4827500	24.02	34.5	4006000	21.35
50 year	92.99	54.1	6448000	32.08	47.0	5430000	28.94
100 year	102.25	65.0	7738700	38.50	57.0	6572000	35.03
200 year	111.48	76.4	9080800	45.18	67.4	7766000	41.39
500 year	123.65	92.0	10922100	54.34	81.9	9413000	50.17
1000 year	132.85	104.2	12360300	61.49	93.2	10704000	57.05
Timmins	157.26	142.2	16331400	81.25	129.2	14290000	76.16
100ccHiEmMidCen	118.61	85.5	10150400	50.50	75.8	8722000	46.49
100ccHiEmEndCen	133.94	105.7	12533000	62.35	94.6	10860000	57.90

8. Hydraulic Modelling

Following current mapping guidelines, HEC-RAS manuals, and the contemporary industry standards, a 1D HEC-RAS model was set up. The design flows determined from the HEC-HMS model were used as the input to the HEC-RAS model. The purpose of the hydraulic model is to determine the water surface elevations (WSEL), energy grade, velocity, and other hydraulic parameters corresponding to design flows. The results of this modelling exercise will determine the elevations that will be used for flood plain mapping. ***Version 6.4.1*** of HEC-RAS Model was used.

8.1 Input Data

The data needed to create an accurate hydraulic model include channel geometry, structure geometry (i.e., bridges and culverts), design flow rates, Manning's roughness coefficients for the main channel and floodplains, expansion and contraction coefficients, and the boundary conditions.

8.1.1 Geometry and Structures

A finer grid 1m horizontal and 0.5m vertical cell size was used for hydraulic modeling. In total, 35 cross-sections were used. The cross-sections generated this way were further modified based on field measurements provided by KC.

The location and alignment of river cross-sections, as well as the spacing between them, were based on engineering judgment as related to the expected flow conditions during high flood events.

Appendix B shows a schematic of HEC-RAS models.

To improve the accuracy of the underwater portion of the channel cross-section, adjustments were made based on field observations provided by KC. To correct the geometry data and accurately represent the low flow channel, the model cross-sections were manually adjusted to match the channel inverts that were surveyed at each structure. While the entire low flow channel geometry is not as precise as the rest of the terrain data, the small differences in conveyance will not have a significant impact on the results or floodplain maps, as the flow within the low flow channel is a small fraction of the regulatory flows used to define the floodplain.

For each structure in the model, expansion and contraction reaches were included to assess the energy losses associated with flow entering and exiting a structure, caused by changes in geometry between cross-sections and at structures. The coefficients are higher when the transition is more abrupt, such as at crossings. The contraction and expansion coefficients used for crossings were 0.3 and 0.5, respectively, and for all other cross-sections, 0.1 and 0.3 were used. These values were recommended in the HEC-RAS manual for typical bridge sections with subcritical flow. The expansion and contraction reach lengths were determined by comparing the bankfull width of the channel to the bridge opening size, following the guidelines in the HEC-RAS manual. The use of expansion and contraction reaches (i.e., two cross-sections up- and downstream of structures) ensures that flow transitions are gradual as the flow narrows when approaching a structure and expands after one. The cross-sections immediately adjacent to the structures typically have more abrupt transitions as the flow is constrained by a culvert.

Ineffective flow areas were used in the model, primarily immediately upstream and downstream of hydraulic structures, so expansion and contraction losses could be accurately modelled. Ineffective flow areas were also used in shallow floodplain with stagnant flow.

When modelling crossings (bridge/culvert/weir), the HEC-RAS manuals were meticulously followed. Deck elevations were taken from the LIDAR for the bridges.

8.1.2 Design Flows

The flow rates were determined from the HEC-HMS hydrologic model. **Table 5** lists the estimated design flows for return periods ranging from 2 to 1000 years and Timmins Storm. Each reach in HEC-RAS can have multiple flows corresponding to multiple events.

The modeling was done for a total of twelve (12) storm events: 2, 5, 10, 20, 50, 100, 200, 500 and 1000 year storm events; Timmins Storm; two climate change scenarios.

8.1.3 Manning's Roughness Coefficient

Manning's roughness coefficients will vary based on flood stage and season. Therefore, the values were selected to represent typical summer conditions.

Manning's roughness coefficient (Manning's n) was assigned to the main channel as well as the left and right overbank areas. Estimates of Manning's n were determined by analyzing the reach characteristics including riparian vegetation to determine the most appropriate roughness coefficient from open channel hydraulics (Chow, 1959). The initial values of Manning's n were selected as 0.04 for the main channel and 0.07 for the left- and right-overbank areas, as almost all riparian areas included some trees or dense brush that would provide similar degrees of roughness. For the cross sections largely within the influence of the Pigeon Lake, 0.001 was used as the expected resistance is negligible.

8.1.4 Boundary Conditions

Downstream boundary conditions are needed for HEC-RAS models. Known or estimated water levels are usually used as the downstream boundary condition.

According to Section 4.3 of MNR (2002, p.17-18), for rivers flowing into large lakes, where the high water conditions at the confluence are generated by two independent flood events, the flood standard should be based on the higher of:

- mean annual flood level in the river and/or stream and the flood hazard limit in the connecting channel, (See The Great Lakes – St. Lawrence River System and Large Inland Lakes Technical Guide.)
- the flood hazard limit (Hurricane Hazel, Timmins Storms, observed or the 100 year event) in the mean monthly levels in the connecting channel or lake.

Accordingly, the following boundary conditions have been used for this project:
- For high flow events in the creek (Timmins Storm, 100 year, or higher events), we used the typical high summer lake level (**246.3** m).
- For smaller events in the creek (50 year, or lower events), we used the 1:100 year lake water level (**246.9** m). This level is currently being used by KC for regulation around the lake.

This lake level values for Pigeon Lake were based on our discussion with KC and about 10 years of water level data at Buckhorn Lock (2014-2023).

9. HEC-RAS Model

Once the model was set up, the computed profiles and other parameters were scrutinized to assess whether the model outputs were reasonable. Special attention was given to the computed water levels and energy profiles near road crossings. Adjustments of model parameters, primarily the channel resistance and contraction and expansion coefficients, were made as necessary.

Version 6.4.1 of HEC-RAS Model was used.

Suitable data for meaningful calibration was not available in this watershed, as is the case in most small catchments. Under such circumstances, indirect methods, such as sensitivity analysis, are employed to gain confidence in hydrologic and hydraulic models.

9.1 Sensitivity Analysis

A sensitivity analysis is used to determine the effect that parameters have on the model results. In HEC-RAS, Manning's n is the primary calibration parameter. The expansion and contraction coefficients can also have a significant impact on model results, but there is a smaller range of reasonable values. To determine the impact of parameter adjustments, the Manning's n was adjusted up and down by 10%, with corresponding multiplying factors of 0.9 and 1.1. The results are plotted to determine the relationship between the parameter adjustment factors and computer water levels.

Graphical representation of the sensitivity analysis is shown in **Figures 4** and **5**. The slope of each line in the graph represents the influence that the parameter has on water surface elevations.

It was found that the sensitivity of water level to Manning roughness is within the expected range and may be explained by local conditions. For example, at x-4288, the variation of 20 cm may be attributed to the presence of a weir and a mild slope, where roughness plays a relatively prominent role. At x-2279, the effect of roughness is small because of the presence of the bridge and wide floodplain. We conclude that the roughness coefficients used in this study are reasonable.

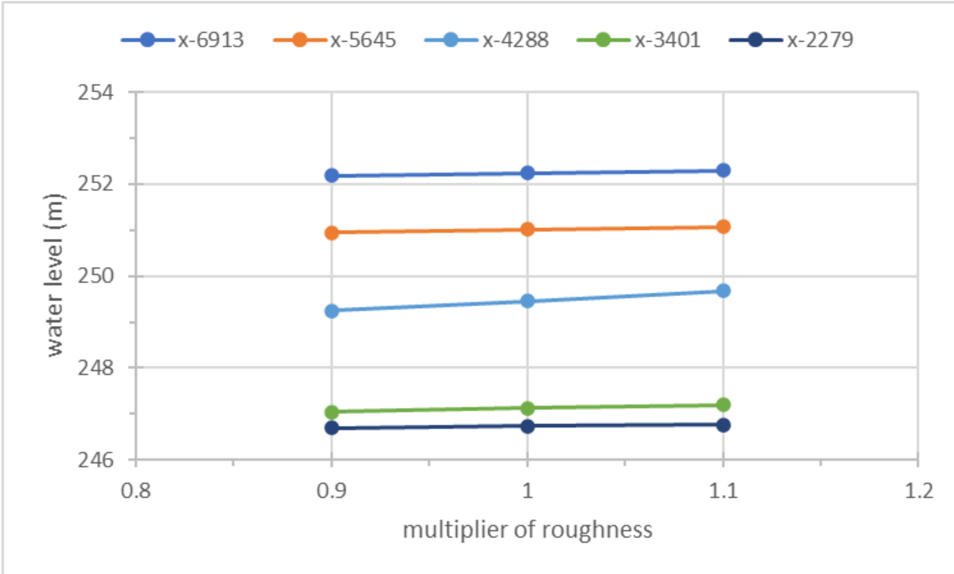

Figure 4 Sensitivity of Water Level to Manning Roughness

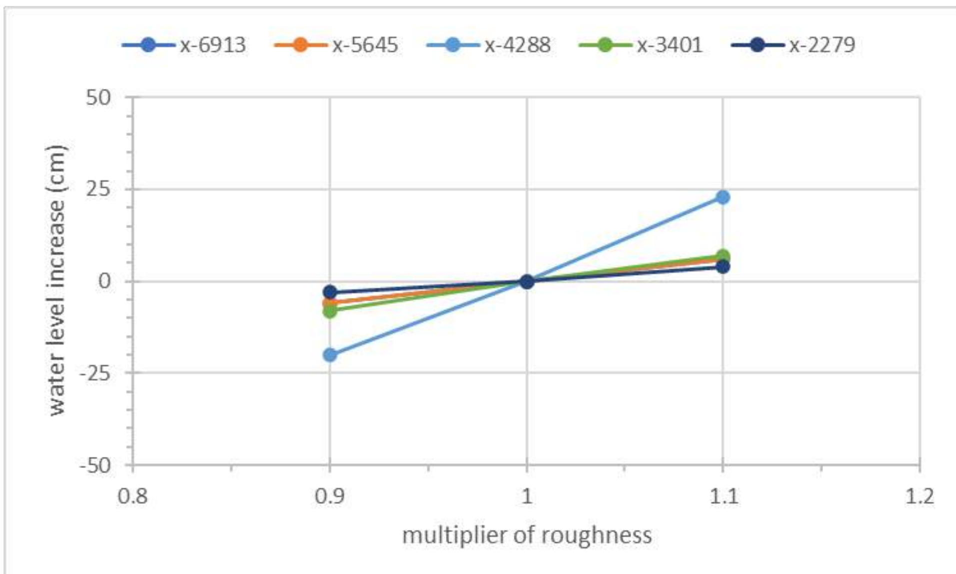

Figure 5 Variation of Water Level Increase with Manning Roughness

9.2 Regulatory Flood Levels (RFLs)

As per Section 2.3 of MNR (2002) guidelines, the regulatory flood in Zone 3, which includes the study area, is the greater of the 1:100 year and Timmins Storm floods.

It was found that Timmins Storm produced higher flows and flood levels than the 100 year storm event.

For the present study, the regulatory flood levels were set equal to the computed water surface elevation as computed from the HEC-RAS models.

As specified in the RFP, the return period flows and the corresponding water levels have been summarized for all storm events (2, 5, 10, 20, 50, 100, 200, 500 and 1000 year storm events; Timmins Storm; two climate change scenarios). This is in **Appendix B**. Detailed HEC-RAS output tables are also included.

10. Floodplain Mapping

10.1 Floodline Delineation

Once the RFLs are established, the plotting of flood lines or flood risk limits is a relatively straight forward matter. Given the topographical information in the form of LIDAR, the inundated area below the RFLs can be easily delineated manually or by using automated computer programs.

For this project, KC indicated that they would produce the flood risk maps in-house. As such, we provided them the HEC-RAS model files, which they would use for this purpose.

10.2 Spill sections

Several spill sections were identified during this study. They were minor in nature and are expected to be contained within close proximity of the floodplain.

10.3 Flood maps

As indicated above, KC will produce the flood maps in-house.

10.4 Risk Assessment

A Flood Hazard Assessment for Nogies Creek has been done. This includes water surface elevation, flood depth, flood velocity, and depth*velocity analysis.

Output of this exercise consists of large-scale maps. The maps are not included in this report but will be transferred to KC separately.

11. Deliverables

The key deliverables for this project, as per the RFP, include the following:

1. Final Floodplain Mapping with technical appendices [3 hard copies and a PDF]
2. Hydrologic (HEC-HMS) and hydraulic (HEC-RAS) model data files
3. Engineered floodline shape files
4. Record of Public Information Sessions

It is understood that all the data collected, and mapping materials produced under this project will become the property of Kawartha Conservation (KC).

12. Summary and Recommendations

12.1 Summary

The flood hazard mapping for Nogies Creek has been completed. This was done according to the RFP issued by KC (dated November, 2023) and the proposal submitted by Water's Edge, dated November 17, 2023.

The floodplain mapping was done in accordance with applicable Provincial and Federal guidelines.

HEC-HMS model was used to estimate design flows and HEC-RAS model was used to estimate flood levels.

The modeling was done for a total of twelve (12) storm events: 2, 5, 10, 20, 50, 100, 200, 500 and 1000 year storm events; Timmins Storm; two climate change scenarios (high emission; mid and end of century).

It was found that Timmins Storm produced higher flows and flood levels than the 100 year storm event. Therefore, Timmins Storm was taken as the governing flood event.

12.2 Recommendations

Based on the data, modeling, analyses, and results of this study, we recommend the following.

1. The 1D HEC-RAS model built here should be used as the model of record for the purposes of flood plain mapping.
2. A data collection program may be undertaken if more rigorous calibration or validation is envisaged in future. This will include rainfall, stream flow, and water level. This will also be helpful in future analysis of the hydrology and hydraulics of this watershed.
3. Relevant data, analysis, drawings, and reports of all structures (bridge/culvert/weir) should be collected and archived, preferably in digital format.
4. The flood mapping done here may be refined and updated as additional information becomes available.
5. The knowledge generated during this study may be used for the flood forecasting and warning program.

Respectfully submitted,

Respectfully submitted,

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President, Sr. Water Resources Engineer

Ferdous Ahmed, Ph.D., P. Eng.
Sr. Water Resources Engineer

Asal Montakhab, Ph.D.
River Scientist

Tim Antonio, P.Eng., B.A.Sc.
Water Resources Engineer

Water's Edge Environmental Solutions Team Ltd.

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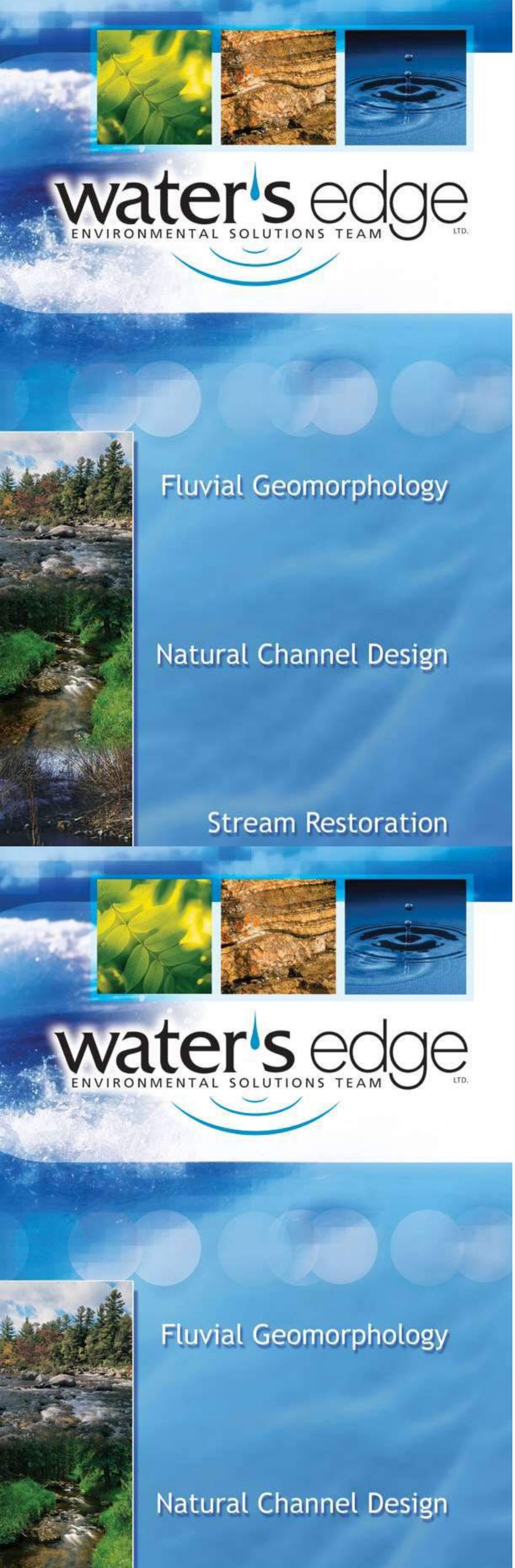


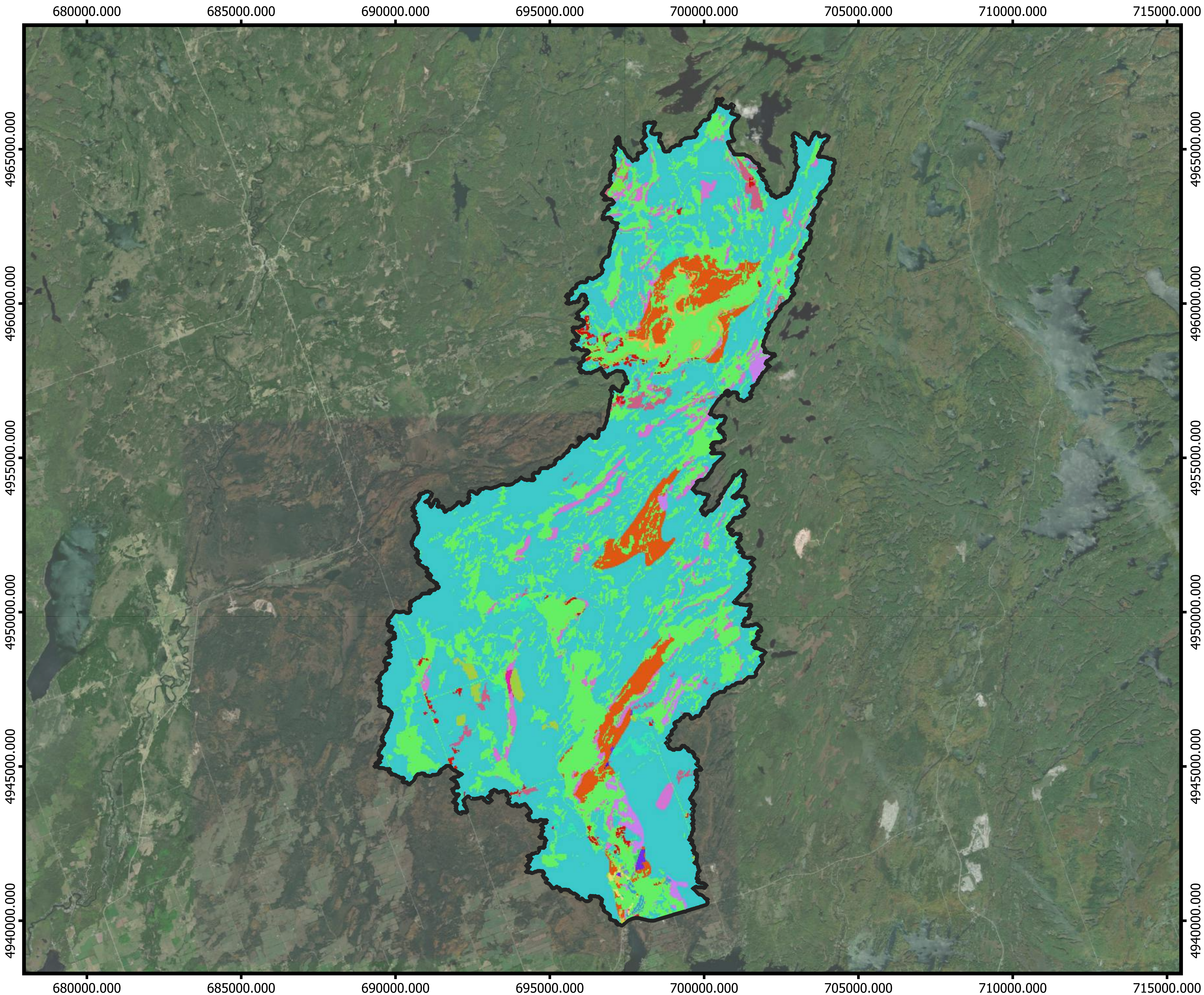
APPENDIX A:

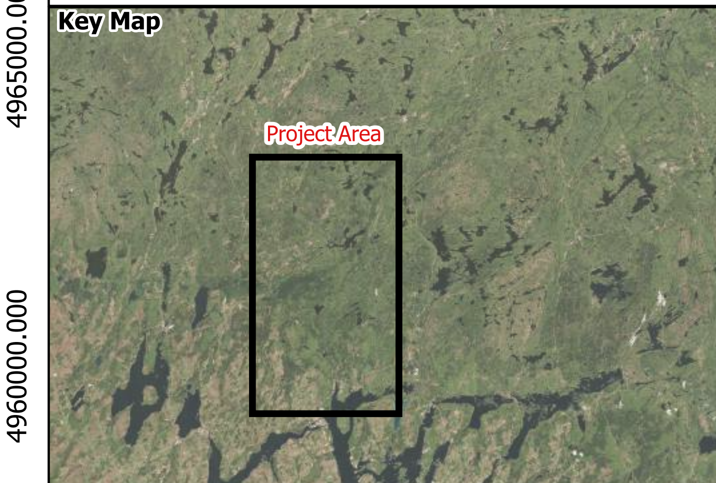
Hydrological Model

Map 1

Nogies Creek Watershed

Curve Numbers





Legend

Subbasin

Curve Numbers

- 31
- 36
- 39
- 42
- 54
- 60
- 61
- 70
- 74
- 77
- 79
- 80
- 81
- 82
- 85
- 90
- 92
- 98

KAWARTHA CONSERVATION

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.

Project number: 23059
Date: Feb. 7, 2024

NAD83-UTM Zone 17
Size: 11*17

0 1 2 3 4 5 km

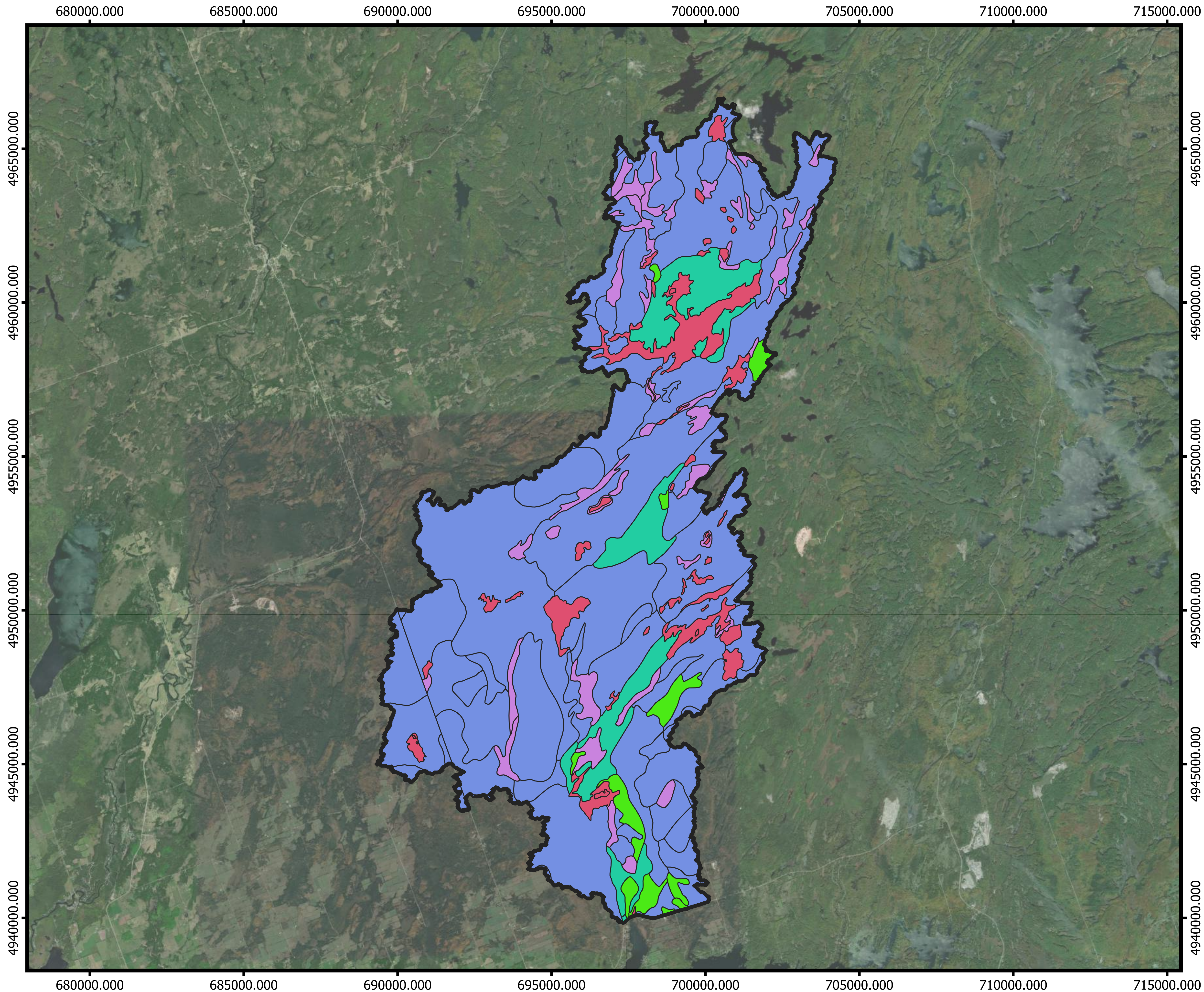
Scale: 1:120000

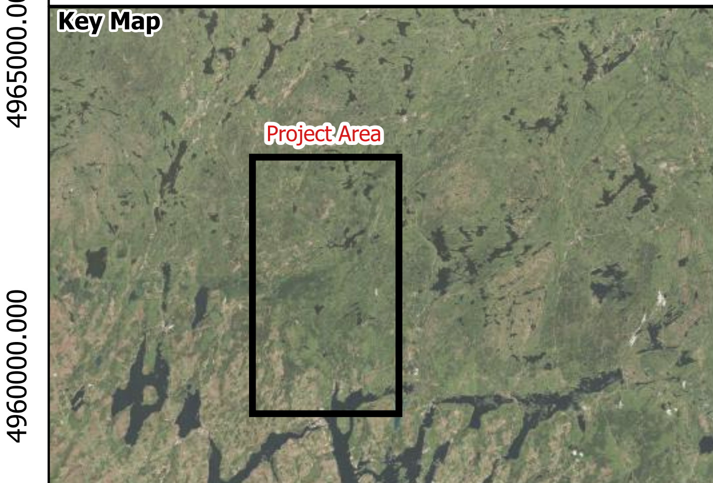
N

Map 2

Nogies Creek Watershed

Soil Survey Index





Legend

Subbasin

Soil Hydrologic Group Index

- A
- B
- C
- D
- N

KAWARTHA CONSERVATION

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.

Map produced by Water's Edge. This map is proprietary and confidential and must not be duplicated or distributed by any means without express written permission of Water's Edge. The basemap is from Bing Maps.

Project number: 23059
Date: Feb. 7, 2024

NAD83-UTM Zone 17
Size: 11*17

0 1 2 3 4 5 km

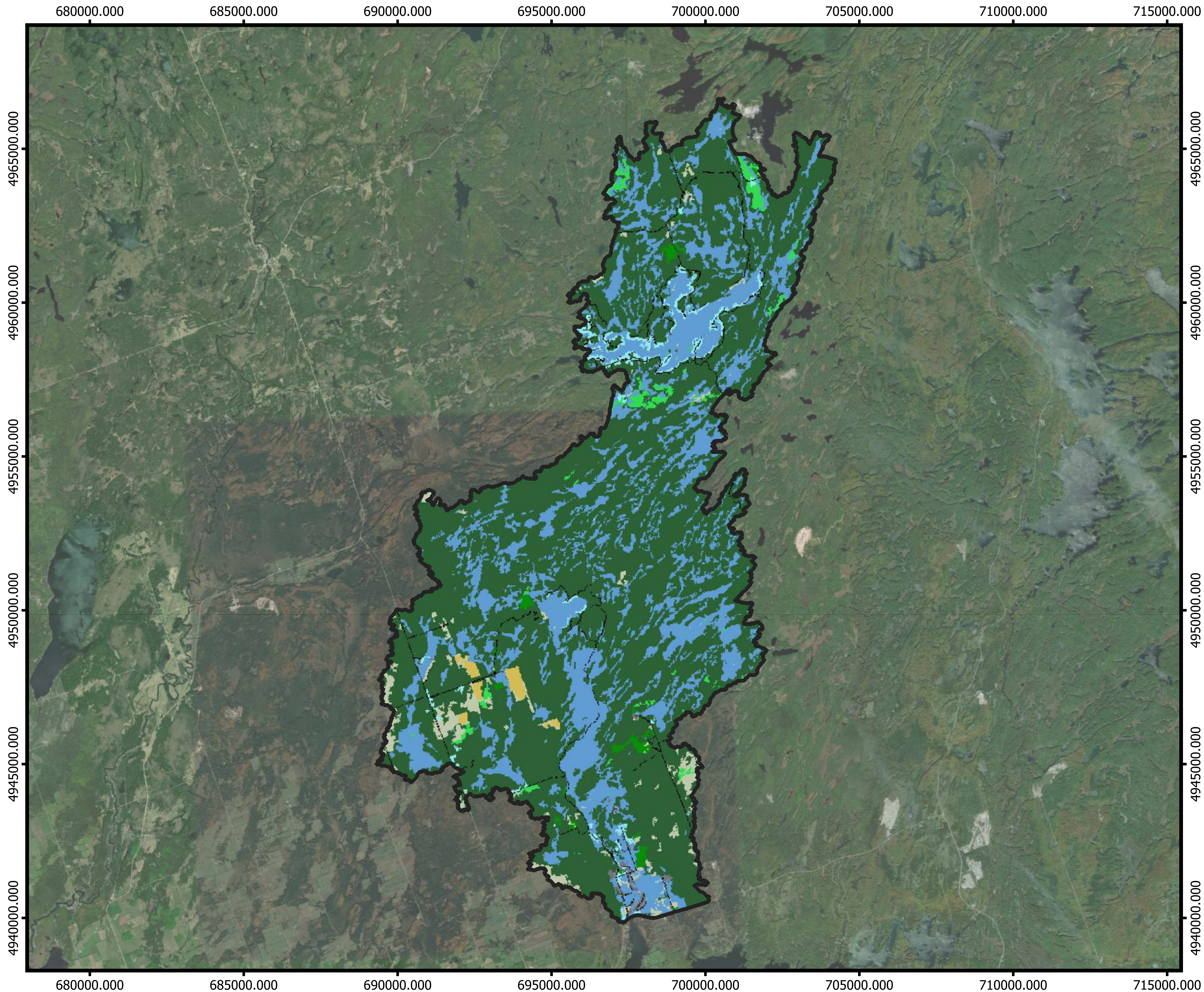
Scale: 1:120000

N

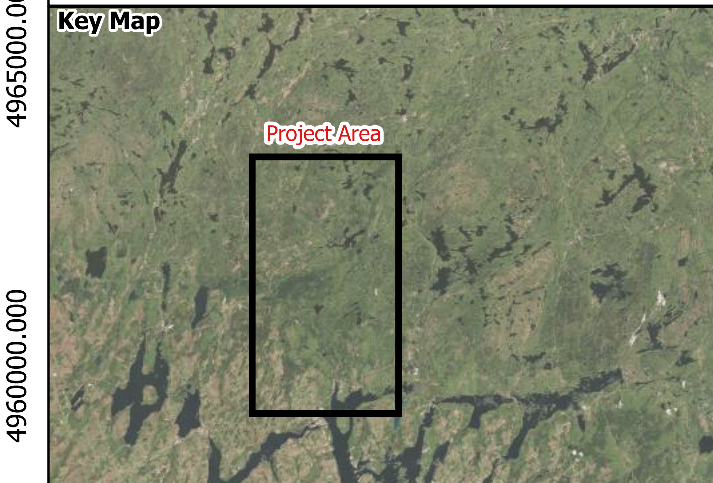
Map 3

Nogies Creek Watershed

Land Use



Key Map



Legend

- Subbasin

Land Use

- Open Cliff and Talus
- Alvar
- Open Bedrock
- Sparse Treed
- Forest
- Open Water
- Row Crops
- Transportation
- Built Up Area - Pervious
- Built Up Area - Impervious
- Undifferentiated

KAWARTHA CONSERVATION

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.

Project number: 23059 Date: Feb. 7, 2024	NAD83-UTM Zone 17 Size: 11*17

0 1 2 3 4 5 km

Scale: 1:120000

SOLRIS Land Use		TR-55						
		Cover description			Curve numbers for hydrologic soil group			
DN Value	**SOLRIS Land Use**	**Cover type and hydrologic condition**		**Average**	**A**	**B**	**C**	**D**
11	Open Beach	Natural desert landscaping (pervious areas only)4 . .	1		63	77	85	88
21	Open Sand Dune	Natural desert landscaping (pervious areas only)4 . .	1		63	77	85	88
23	Treed Sand Dune	Artificial desert landscaping (impervious weed	2		96	96	96	96
41	Open Cliff and Talus	Gravel (including right-of-way)	3		76	85	89	91
43	Treed Cliff and Talus	Gravel (including right-of-way)	3		76	85	89	91
51	Open Alvar	Newly graded areas (pervious areas only,	4		77	86	91	94
52	Shrub Alvar	Newly graded areas (pervious areas only,	4		77	86	91	94
53	Treed Alvar	Poor condition (grass cover < 50%)	5		68	79	86	89
64	Open Bedrock	Paved; curbs and storm sewers (excluding	6		98	98	98	98
65	Sparse Treed	WOODS Fair (woods are grazed but not burned, and some forest litter covers the soil)	7		36	60	73	79
81	Open Tallgrass	Poor condition (ground cover <50% or heavily grazed with no mulch) 68 79 86 89	8		69	79	86	89
82	Tallgras Savannah	Fair condition (ground cover 50% to 75% and not heavily grazed) 49 69 79 84	9		49	69	79	84
83	Tallgras Woodland	Good condition (ground cover >75% and lightly or only occasionally grazed) 39 61 74 80	10		39	61	74	80
90	Forest	Goodwoods (woods are protected from grazing, and litter and brush adequately cover the soil)	10		30	55	70	77
91	Coniferous Forest	Goodwoods (woods are protected from grazing, and litter and brush adequately cover the soil)	10		30	55	70	77
92	Mixed Fores	Goodwoods (woods are protected from grazing, and litter and brush adequately cover the soil)	10		30	55	70	77
93	Deciduous Forest	Goodwoods (woods are protected from grazing, and litter and brush adequately cover the soil)	10		30	55	70	77
131	Treed Swamp	Open Water	11		98	98	98	98
135	Thicket Swamp	Open Water	11		98	98	98	98
140	Fen	Open Water	11		98	98	98	98
150	Bog	Open Water	11		98	98	98	98
160	Marsh	Open Water	11		98	98	98	98
170	Open Water	Open Water	11		98	98	98	98
191	Plantations -Tree Cultivated	Row Crops (good), e.g., corn, sugar beets, soy beans	12		31	42	82	85
192	Hedge Rows	Row Crops (good), e.g., corn, sugar beets, soy beans	12		31	42	82	85
193	Tilled		12		31	42	82	85
201	Transportation	Paved; curbs and storm sewers (excluding	13		98	98	98	98
202	Built Up Area - Pervious	1/2 acre	14	25	54	70	80	85
203	Built Up Area Impervious	1/8 acre or less (town houses)	15	65	77	85	90	92
204	Extraction -Aggregate	Gravel (including right-of-way)	3		76	85	89	91
205	Extraction Peat / Topsoil	Row Crops (good), e.g., corn, sugar beets, soy beans	12		31	42	82	85
250	Undifferentieated	Good condition (ground cover >75% and lightly or only occasionally grazed)	16		39	61	74	80

TR-55 Curve Numbers

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	**Average percent impervious area2**	**A**	**B**	**C**	**D**
WOODS Fair (woods are grazed but not burned, and some forest litter covers the soil)		36	60	73	79
Goodwoods (woods are protected from grazing, and litter and brush adequately cover the soil)		30	55	70	77
Fully developed urban areas					
Open space (lawns, parks, golf courses, cemeteries, etc.)3:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc.		98	98	98	98
(excluding right-of-way)					
Streets and roads:					
Paved; curbs and storm sewers (excluding		98	98	98	98
right-of-way)					
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)4 . .		63	77	85	88
Artificial desert landscaping (impervious weed		96	96	96	96
barrier, desert shrub with 1- to 2-inch sand					
or gravel mulch and basin borders)					
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acre	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only,		77	86	91	94
no vegetation)5					
Open Water		100	100	100	100
Cultivated Agricultural Lands:					
Row Crops (good), e.g., corn, sugar beets, soy beans		31	42	82	85
Small Grain (good), e.g., wheat, barley, flax		60	82	80	84
Meadow (continuous grass, protected from grazing, and generally mowed for hay):		30	58	71	78
Pasture, Grassland, or Range – Continuous Forage for Grazing:					
Poor condition (ground cover <50% or heavily grazed with no mulch) 68 79 86 89		69	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed) 49 69 79 84		49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed) 39 61 74 80		39	61	74	80

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2022/10/31

===

PETERBOROUGH A ON 6166418

Latitude: 44 14'N Longitude: 78 22'W Elevation/Altitude: 191 m

Years/Années : 1971 - 2006 # Years/Années : 33

===

****

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

****

Year Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1971	4.3	5.8	7.4	11.7	17.5	24.6	30.7	34.8	34.8
1972	5.8	6.1	8.1	10.2	13.2	16.5	22.9	41.4	44.2
1973	6.9	13.2	18.0	19.3	20.8	26.7	48.0	48.3	58.2
1974	7.6	13.5	14.0	16.0	20.1	25.7	43.9	49.8	49.8
1975	6.3	9.9	13.7	21.8	39.6	55.1	55.1	67.8	67.8
1976	5.3	8.4	11.9	15.0	16.3	16.5	22.6	24.6	37.6
1977	8.4	12.7	13.7	19.6	24.9	24.9	52.3	62.2	62.5
1978	7.2	12.4	17.3	19.2	21.7	27.7	43.9	45.6	45.8
1979	10.1	13.8	15.3	17.5	26.2	31.6	33.3	33.7	33.7
1980	8.8	16.0	21.6	29.0	32.0	48.3	61.8	62.2	83.2
1981	9.7	18.6	27.9	42.3	52.2	53.2	53.4	53.4	54.1
1982	5.3	7.6	7.8	9.9	11.7	15.4	30.3	34.1	34.1
1983	11.3	18.3	23.3	25.1	26.1	36.3	56.8	57.1	77.5
1984	8.9	14.2	17.3	18.9	25.3	29.4	35.5	37.8	39.2
1985	7.6	10.4	12.0	19.7	22.7	26.8	36.4	53.6	53.6
1986	12.5	15.8	19.3	19.7	19.7	23.2	35.8	42.0	44.8
1987	17.9	21.3	22.7	23.2	23.2	23.2	23.2	26.0	29.0
1988	7.8	11.5	14.5	20.7	23.2	24.4	27.0	28.8	30.4
1989	9.9	14.2	15.7	18.7	20.2	26.3	46.1	47.8	52.8
1990	8.9	13.4	17.8	23.2	23.7	23.7	42.2	43.4	44.8
1991	4.1	6.8	7.6	8.8	9.2	12.2	17.1	21.2	29.6
1992	8.6	9.3	12.8	20.4	25.8	31.7	38.9	45.0	51.2
1993	9.1	10.9	14.1	20.4	21.9	23.3	29.9	34.2	42.0
1994	8.8	14.4	17.4	19.8	22.2	24.1	24.1	33.6	41.5
1995	9.3	12.1	18.1	32.2	49.0	82.5	89.8	90.1	90.1
1996	6.8	8.6	10.5	13.9	16.5	22.0	38.3	40.8	41.0

1997	3.6	7.2	7.6	9.2	17.8	30.6	35.0	35.2	35.2
1998	11.4	15.7	16.5	18.7	28.1	32.4	60.0	65.1	76.2
1999	8.4	11.4	13.5	18.6	23.2	32.5	39.9	46.8	55.6
2000	6.4	10.0	12.7	16.6	18.8	23.5	47.8	61.2	61.2
2002	7.3	9.6	10.4	13.8	23.4	35.1	50.9	73.6	73.6
2004	6.2	10.9	15.2	22.0	26.5	41.6	65.9	80.1	97.8
2006	7.4	11.1	12.5	14.2	15.0	17.8	22.0	34.0	42.5
# Yrs. Années	33	33	33	33	33	33	33	33	33
Mean Moyenne	8.1	12.0	14.8	19.1	23.6	30.0	41.2	47.1	52.0
Std. Dev. Écart-type	2.7	3.7	4.8	6.7	9.1	13.7	15.5	16.4	18.1
Skew. Dissymétrie	1.33	0.45	0.55	1.30	1.66	2.13	0.92	0.75	0.92
Kurtosis	7.16	3.29	3.67	6.74	6.80	9.09	4.68	3.45	3.35

*-99.9 Indicates Missing Data/Données manquantes

Warning: annual maximum amount greater than 100-yr return period amount
Avertissement : la quantité maximale annuelle excède la quantité
pour une période de retour de 100 ans

Year/Année	Duration/Durée	Data/Données	100-yr/ans
1981	30 min	42.3	40.1
1981	1 h	52.2	52.0
1987	5 min	17.9	16.7
1995	2 h	82.5	72.9

****

Table 2a : Return Period Rainfall Amounts (mm)
Quantité de pluie (mm) par période de retour

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	7.7	10.1	11.7	13.7	15.2	16.7	33
10 min	11.4	14.6	16.8	19.5	21.5	23.5	33
15 min	14.0	18.3	21.1	24.7	27.4	30.0	33
30 min	18.0	23.9	27.8	32.8	36.4	40.1	33
1 h	22.1	30.1	35.4	42.1	47.1	52.0	33
2 h	27.7	39.8	47.8	57.9	65.4	72.9	33
6 h	38.7	52.4	61.5	72.9	81.4	89.9	33
12 h	44.4	58.9	68.5	80.6	89.5	98.4	33
24 h	49.0	65.0	75.6	88.9	98.9	108.7	33

****

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	92.0	121.0	140.2	164.4	182.3	200.2	33
	+/- 10.3	+/- 17.3	+/- 23.3	+/- 31.5	+/- 37.7	+/- 43.9	33
10 min	68.2	87.7	100.7	117.0	129.1	141.1	33
	+/- 6.9	+/- 11.7	+/- 15.7	+/- 21.2	+/- 25.4	+/- 29.6	33
15 min	56.0	73.1	84.5	98.8	109.4	120.0	33
	+/- 6.1	+/- 10.2	+/- 13.8	+/- 18.6	+/- 22.3	+/- 26.0	33
30 min	35.9	47.8	55.6	65.5	72.9	80.2	33
	+/- 4.2	+/- 7.1	+/- 9.6	+/- 12.9	+/- 15.4	+/- 18.0	33
1 h	22.1	30.1	35.4	42.1	47.1	52.0	33
	+/- 2.8	+/- 4.8	+/- 6.5	+/- 8.7	+/- 10.4	+/- 12.1	33
2 h	13.9	19.9	23.9	29.0	32.7	36.4	33
	+/- 2.1	+/- 3.6	+/- 4.9	+/- 6.6	+/- 7.9	+/- 9.2	33
6 h	6.4	8.7	10.2	12.2	13.6	15.0	33
	+/- 0.8	+/- 1.4	+/- 1.8	+/- 2.5	+/- 3.0	+/- 3.5	33
12 h	3.7	4.9	5.7	6.7	7.5	8.2	33
	+/- 0.4	+/- 0.7	+/- 1.0	+/- 1.3	+/- 1.6	+/- 1.8	33
24 h	2.0	2.7	3.1	3.7	4.1	4.5	33
	+/- 0.2	+/- 0.4	+/- 0.5	+/- 0.7	+/- 0.9	+/- 1.0	33

****

Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

****

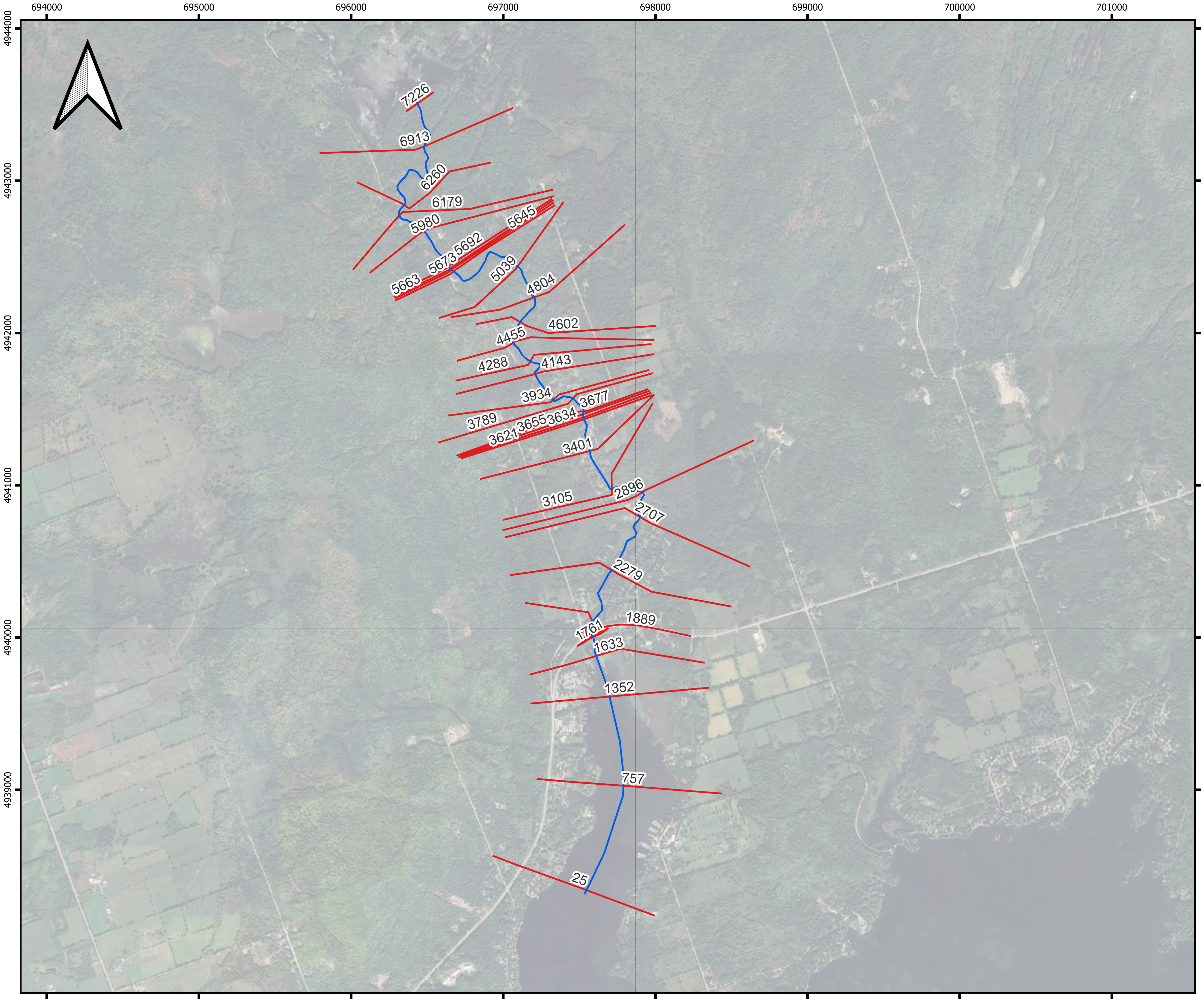
Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	33.4	44.0	51.0	59.9	66.5	73.1
Std. Dev. /Écart-type (RR)	32.1	41.8	48.1	56.2	62.2	68.1
Std. Error/Erreur-type	7.4	10.0	11.7	14.0	15.6	17.2
Coefficient (A)	20.5	27.4	31.9	37.7	41.9	46.1
Exponent/Exposant (B)	-0.680	-0.675	-0.672	-0.670	-0.669	-0.668
Mean % Error/% erreur moyenne	8.4	10.1	10.8	11.4	11.7	12.0

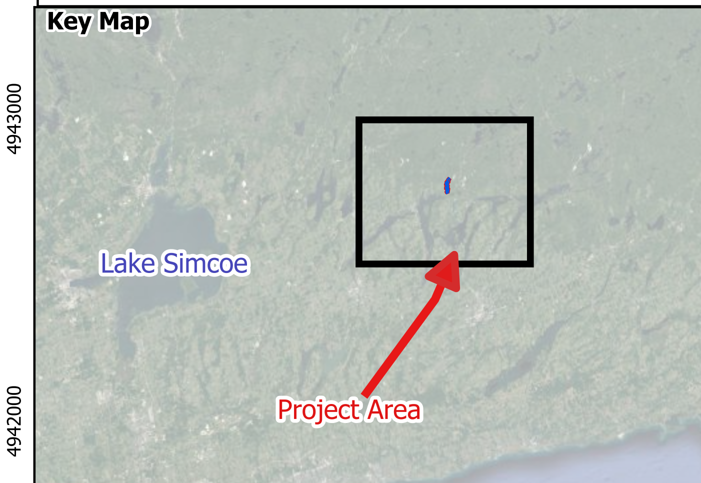
APPENDIX B:

Hydraulic Model

Kawartha Conservation, Ontario

Nogies Creek
HEC-RAS Schematic





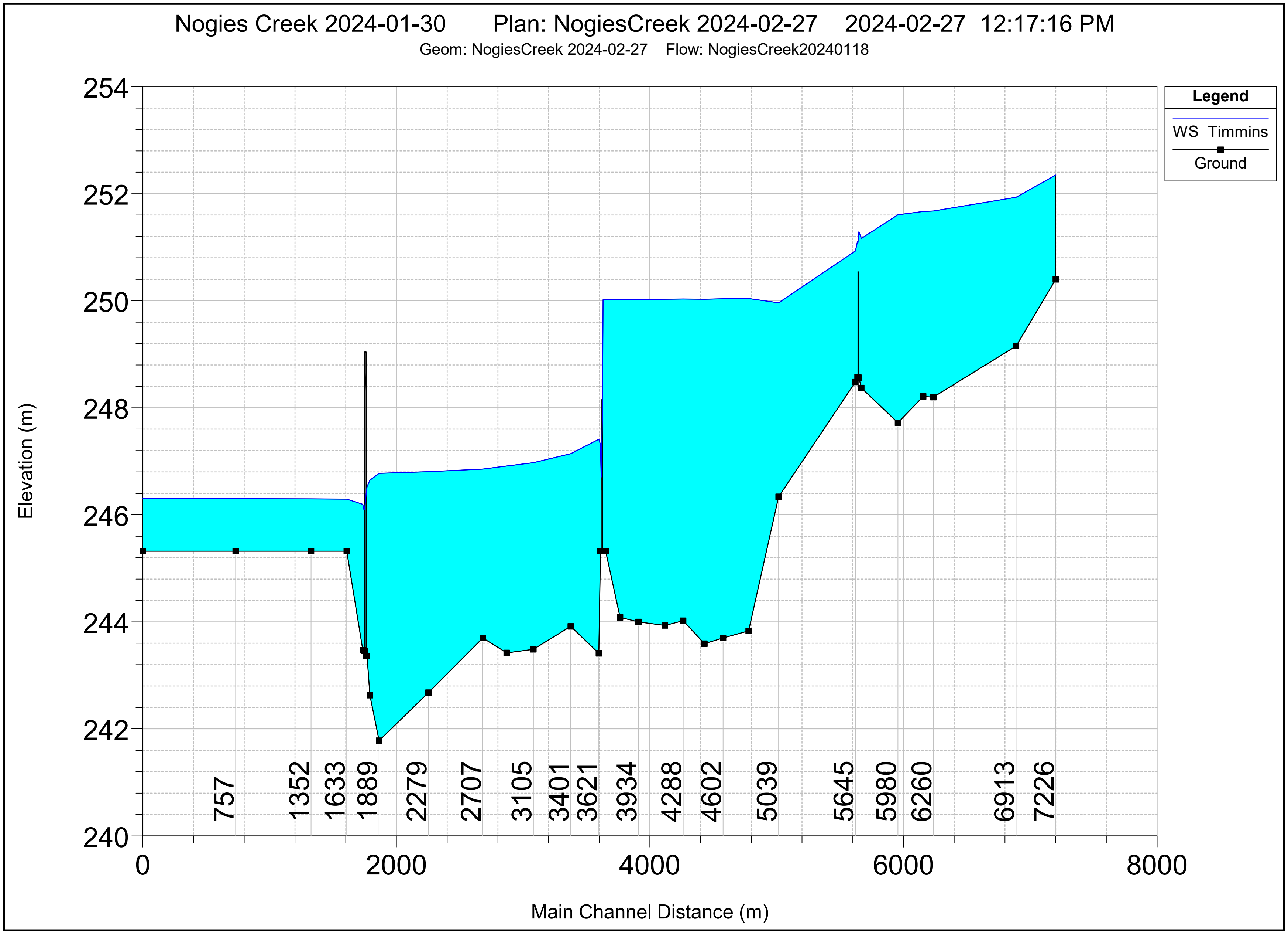
Legend

- HEC-RAS Cross Sections
- HEC-RAS River

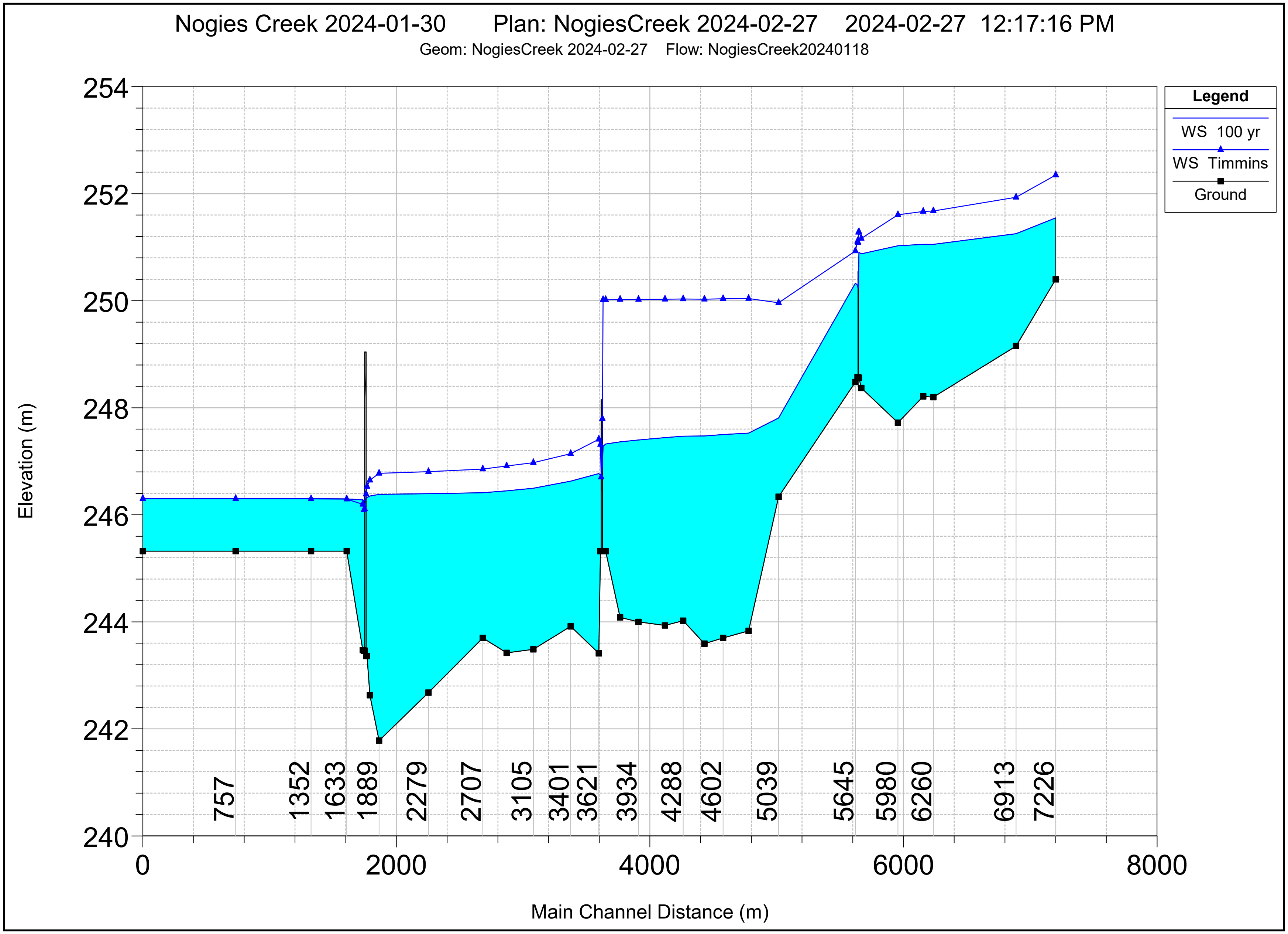
water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Project number: 23059 Date: Feb. 1, 2024	NAD83-UTM Zone 17 Size: 11*17

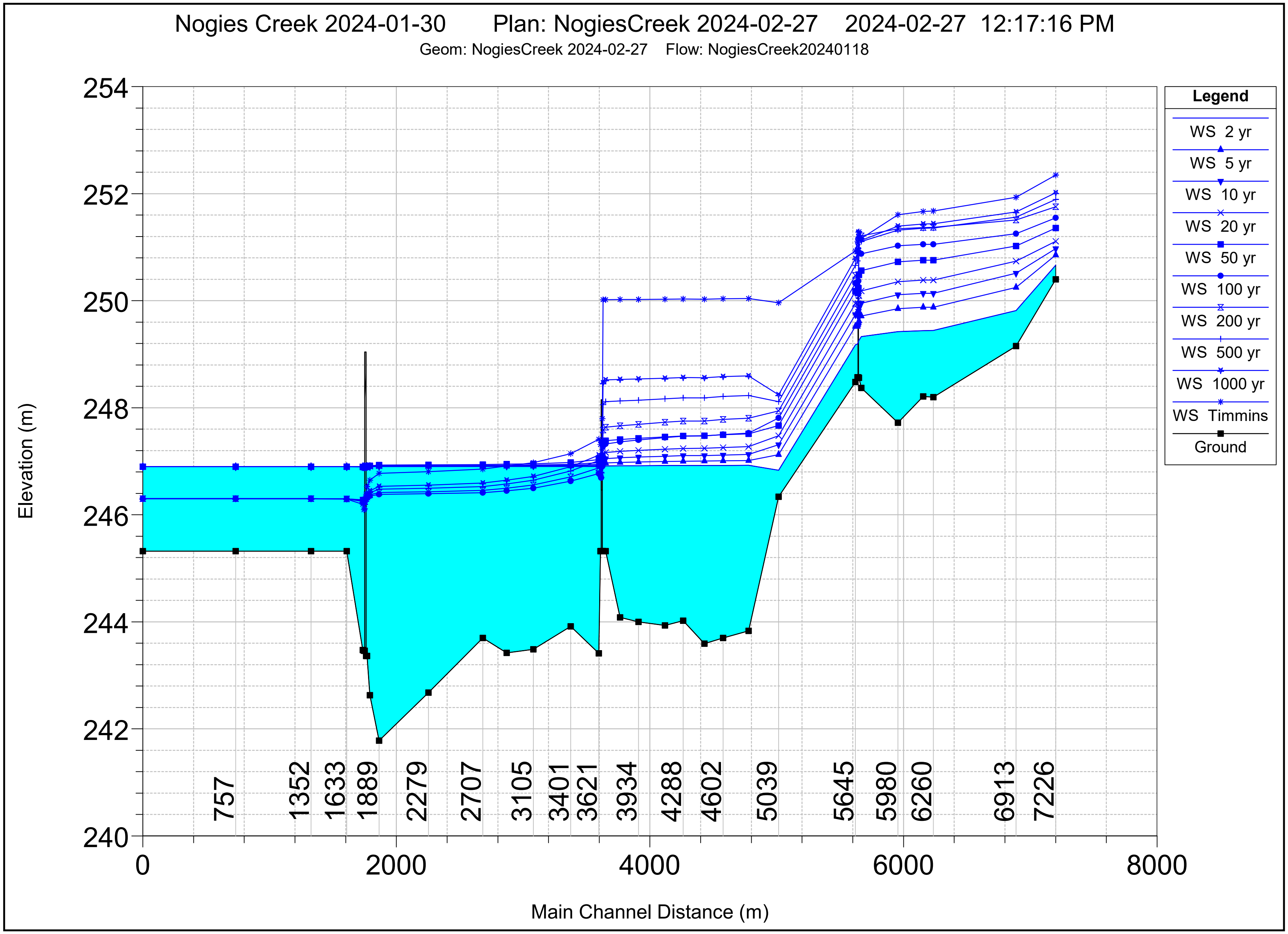
0 250 500 m



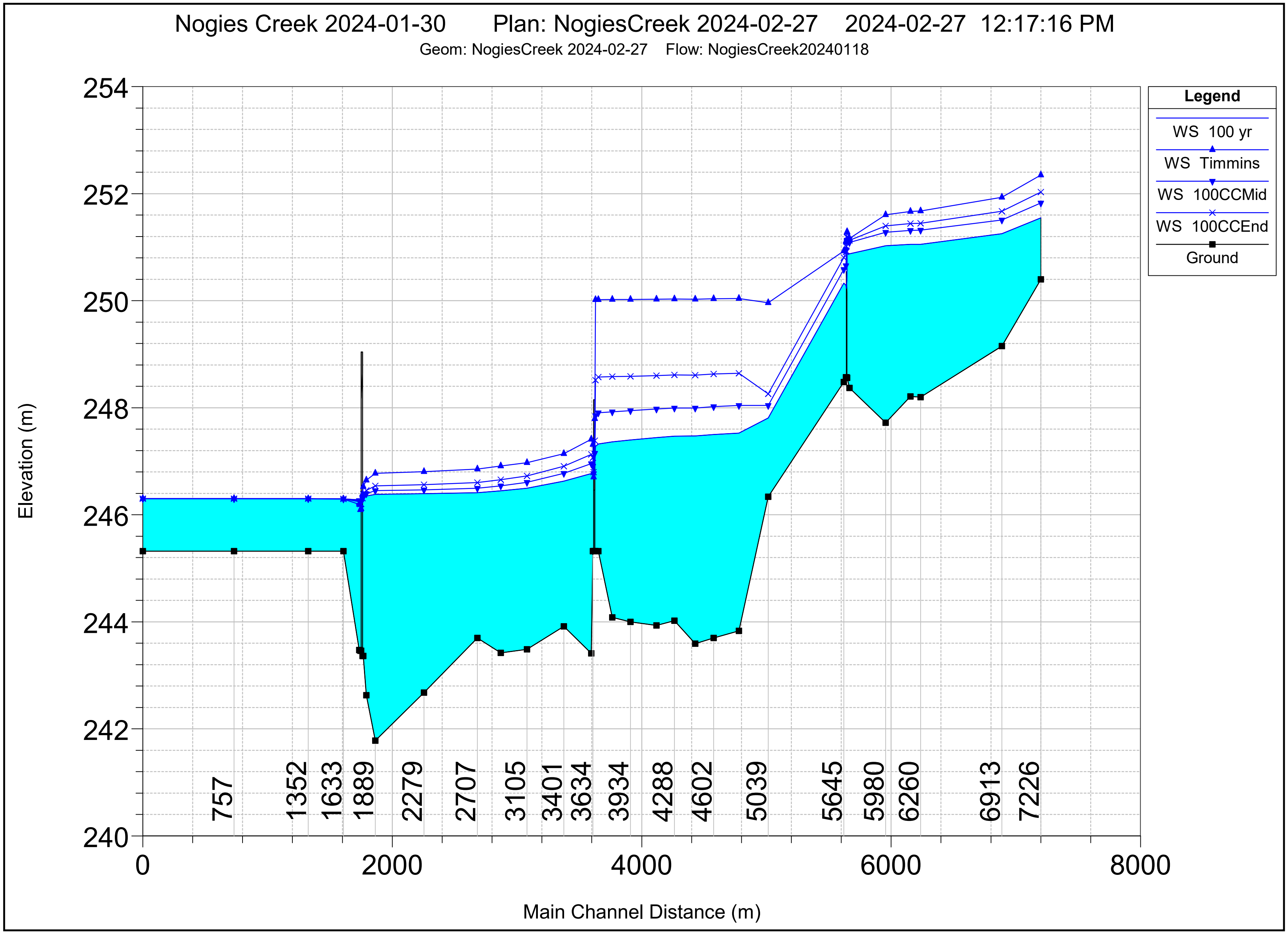
Nogies Creek 2024-01-30 Plan: NogiesCreek 2024-02-27 2024-02-27 12:17:16 PM
Geom: NogiesCreek 2024-02-27 Flow: NogiesCreek20240118
Legend
WS Timmins
Ground
Elevation (m)
Main Channel Distance (m)
254
252
250
248
246
244
242
240
0
2000
4000
6000
8000
757
1352
1633
1889
2279
2707
3105
3401
3621
3934
4288
4602
5039
5645
5980
6260
6913
7226



Nogies Creek 2024-01-30 Plan: NogiesCreek 2024-02-27 2024-02-27 12:17:16 PM
Geom: NogiesCreek 2024-02-27 Flow: NogiesCreek20240118
Legend
WS 100 yr
WS Timmins
Ground
Elevation (m)
254
252
250
248
246
244
242
240
757
1352
1633
1889
2279
2707
3105
3401
3621
3934
4288
4602
5039
5645
5980
6260
6913
7226
0
2000
4000
6000
8000
Main Channel Distance (m)



Nogies Creek 2024-01-30 Plan: NogiesCreek 2024-02-27 2024-02-27 12:17:16 PM
Geom: NogiesCreek 2024-02-27 Flow: NogiesCreek20240118
Legend
WS 2 yr
WS 5 yr
WS 10 yr
WS 20 yr
WS 50 yr
WS 100 yr
WS 200 yr
WS 500 yr
WS 1000 yr
WS Timmins
Ground
Elevation (m)
254
252
250
248
246
244
242
240
757
1352
1633
1889
2279
2707
3105
3401
3621
3934
4288
4602
5039
5645
5980
6260
6913
7226
0
2000
4000
6000
8000
Main Channel Distance (m)


Nogies Creek 2024-01-30 Plan: NogiesCreek 2024-02-27 2024-02-27 12:17:16 PM
Geom: NogiesCreek 2024-02-27 Flow: NogiesCreek20240118
Legend
WS 100 yr
WS Timmins
WS 100CCMid
WS 100CCEnd
Ground
Elevation (m)
254
252
250
248
246
244
242
240
757
1352
1633
1889
2279
2707
3105
3401
3634
3934
4288
4602
5039
5645
5980
6260
6913
7226
0
2000
4000
6000
8000
Main Channel Distance (m)

HEC-RAS Plan: NogiesCreek 2024-02-27 River: Nogies Creek Reach: Reach 1 Profile: Timmins

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	7226	Timmins	129.00	250.40	252.35		252.68	0.005541	2.56	51.36	36.10	0.64
Reach 1	6913	Timmins	129.00	249.15	251.93	250.53	252.03	0.000926	1.39	102.52	153.29	0.28
Reach 1	6260	Timmins	129.00	248.20	251.68	250.35	251.70	0.000341	0.94	286.24	439.84	0.17
Reach 1	6179	Timmins	129.00	248.21	251.67	249.55	251.67	0.000099	0.54	425.94	418.41	0.10
Reach 1	5980	Timmins	129.00	247.72	251.61	249.79	251.64	0.000354	1.00	216.22	246.83	0.18
Reach 1	5692	Timmins	129.00	248.37	251.16	250.29	251.40	0.002980	2.15	60.44	200.82	0.48
Reach 1	5673	Timmins	129.00	248.56	251.29	250.56	251.31	0.000649	0.99	248.41	244.95	0.22
Reach 1	5670		Bridge									
Reach 1	5663	Timmins	129.00	248.57	251.11	250.63	251.15	0.001103	1.20	233.43	326.39	0.29
Reach 1	5645	Timmins	129.00	248.48	250.93	250.11	251.09	0.002161	1.88	87.71	381.58	0.42
Reach 1	5039	Timmins	129.00	246.34	249.96	248.59	250.10	0.001389	1.82	107.11	212.39	0.34
Reach 1	4804	Timmins	129.00	243.83	250.04	245.74	250.05	0.000017	0.29	725.63	562.42	0.04
Reach 1	4602	Timmins	129.00	243.70	250.04	246.19	250.04	0.000028	0.38	625.06	523.59	0.05
Reach 1	4455	Timmins	129.00	243.59	250.03	245.81	250.04	0.000050	0.52	409.95	503.83	0.07
Reach 1	4288	Timmins	129.00	244.02	250.03	246.32	250.03	0.000007	0.19	1557.85	732.05	0.03
Reach 1	4143	Timmins	129.00	243.93	250.03	246.13	250.03	0.000015	0.27	1127.39	666.84	0.04
Reach 1	3934	Timmins	129.00	244.00	250.02		250.03	0.000015	0.27	1082.25	483.62	0.04
Reach 1	3789	Timmins	129.00	244.08	250.02		250.02	0.000014	0.27	1128.48	477.72	0.04
Reach 1	3677	Timmins	129.00	245.32	250.02		250.02	0.000018	0.30	972.31	413.86	0.04
Reach 1	3655	Timmins	129.00	245.32	250.02	246.71	250.02	0.000017	0.29	987.63	420.32	0.04
Reach 1	3650		Bridge									
Reach 1	3634	Timmins	129.00	245.32	247.31	246.85	247.63	0.004887	2.55	54.04	164.56	0.61
Reach 1	3621	Timmins	129.00	243.41	247.41		247.49	0.000879	1.40	163.54	206.66	0.27
Reach 1	3401	Timmins	129.00	243.92	247.14		247.25	0.001326	1.54	109.10	103.69	0.33
Reach 1	3105	Timmins	129.00	243.49	246.97		247.01	0.000508	0.99	263.99	432.18	0.21
Reach 1	2896	Timmins	129.00	243.42	246.91		246.93	0.000297	0.60	372.38	606.69	0.15
Reach 1	2707	Timmins	129.00	243.70	246.86	245.06	246.88	0.000253	0.67	286.04	619.98	0.14
Reach 1	2279	Timmins	129.00	242.68	246.81	244.48	246.81	0.000087	0.42	345.90	281.40	0.09
Reach 1	1889	Timmins	129.00	241.78	246.77	243.73	246.78	0.000067	0.42	309.63	144.09	0.08
Reach 1	1817	Timmins	129.00	242.63	246.64		246.76	0.001231	1.51	85.63	38.31	0.32
Reach 1	1794	Timmins	129.00	243.36	246.53	245.44	246.72	0.002186	1.93	67.03	34.61	0.42
Reach 1	1780		Bridge									
Reach 1	1770	Timmins	129.00	243.46	246.09	245.69	246.52	0.006976	2.88	44.78	27.00	0.71
Reach 1	1761	Timmins	129.00	243.47	246.19	245.30	246.35	0.002247	1.78	79.00	90.93	0.42
Reach 1	1633	Timmins	129.00	245.32	246.29		246.31	0.000000	0.55	237.01	299.65	0.20
Reach 1	1352	Timmins	129.00	245.32	246.30		246.30	0.000000	0.33	422.68	566.30	0.11
Reach 1	757	Timmins	129.00	245.32	246.30		246.30	0.000000	0.24	534.97	551.60	0.08
Reach 1	25	Timmins	129.00	245.32	246.30	245.51	246.30	0.000000	0.26	493.38	507.36	0.08

HEC-RAS Plan: NogiesCreek 2024-02-27   River: Nogies Creek   Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	7226	100 yr	57.00	250.40	251.55		251.80	0.009096	2.20	25.87	28.81	0.74
Reach 1	7226	Timmins	129.00	250.40	252.35		252.68	0.005541	2.56	51.36	36.10	0.64
Reach 1	6913	100 yr	57.00	249.15	251.25	249.96	251.29	0.000551	0.87	68.97	122.27	0.21
Reach 1	6913	Timmins	129.00	249.15	251.93	250.53	252.03	0.000926	1.39	102.52	153.29	0.28
Reach 1	6260	100 yr	57.00	248.20	251.05	249.58	251.07	0.000245	0.68	161.72	317.31	0.14
Reach 1	6260	Timmins	129.00	248.20	251.68	250.35	251.70	0.000341	0.94	286.24	439.84	0.17
Reach 1	6179	100 yr	57.00	248.21	251.05	249.10	251.06	0.000050	0.33	294.74	305.73	0.07
Reach 1	6179	Timmins	129.00	248.21	251.67	249.55	251.67	0.000099	0.54	425.94	418.41	0.10
Reach 1	5980	100 yr	57.00	247.72	251.03	249.18	251.04	0.000170	0.60	142.29	217.30	0.12
Reach 1	5980	Timmins	129.00	247.72	251.61	249.79	251.64	0.000354	1.00	216.22	246.83	0.18
Reach 1	5692	100 yr	57.00	248.37	250.88	249.59	250.94	0.000962	1.11	51.55	179.97	0.27
Reach 1	5692	Timmins	129.00	248.37	251.16	250.29	251.40	0.002980	2.15	60.44	200.82	0.48
Reach 1	5673	100 yr	57.00	248.56	250.90	249.90	250.91	0.000361	0.64	167.71	190.62	0.16
Reach 1	5673	Timmins	129.00	248.56	251.29	250.56	251.31	0.000649	0.99	248.41	244.95	0.22
Reach 1	5670		Bridge									
Reach 1	5663	100 yr	57.00	248.57	250.29	249.94	250.53	0.005943	2.20	25.94	147.47	0.63
Reach 1	5663	Timmins	129.00	248.57	251.11	250.63	251.15	0.001103	1.20	233.43	326.39	0.29
Reach 1	5645	100 yr	57.00	248.48	250.33	249.50	250.40	0.001479	1.24	53.13	191.32	0.33
Reach 1	5645	Timmins	129.00	248.48	250.93	250.11	251.09	0.002161	1.88	87.71	381.58	0.42
Reach 1	5039	100 yr	57.00	246.34	247.81	247.81	248.32	0.015282	3.18	18.18	18.84	0.98
Reach 1	5039	Timmins	129.00	246.34	249.96	248.59	250.10	0.001389	1.82	107.11	212.39	0.34
Reach 1	4804	100 yr	57.00	243.83	247.53	245.37	247.53	0.000061	0.35	185.93	173.16	0.07
Reach 1	4804	Timmins	129.00	243.83	250.04	245.74	250.05	0.000017	0.29	725.63	562.42	0.04
Reach 1	4602	100 yr	57.00	243.70	247.50	245.52	247.51	0.000147	0.55	153.17	130.84	0.11
Reach 1	4602	Timmins	129.00	243.70	250.04	246.19	250.04	0.000028	0.38	625.06	523.59	0.05
Reach 1	4455	100 yr	57.00	243.59	247.47	245.02	247.49	0.000165	0.60	110.15	68.85	0.12
Reach 1	4455	Timmins	129.00	243.59	250.03	245.81	250.04	0.000050	0.52	409.95	503.83	0.07
Reach 1	4288	100 yr	57.00	244.02	247.47	245.68	247.47	0.000056	0.32	340.17	252.07	0.07
Reach 1	4288	Timmins	129.00	244.02	250.03	246.32	250.03	0.000007	0.19	1557.85	732.05	0.03
Reach 1	4143	100 yr	57.00	243.93	247.44	245.46	247.46	0.000184	0.57	126.00	102.57	0.12
Reach 1	4143	Timmins	129.00	243.93	250.03	246.13	250.03	0.000015	0.27	1127.39	666.84	0.04
Reach 1	3934	100 yr	57.00	244.00	247.40		247.42	0.000213	0.60	128.49	102.30	0.13
Reach 1	3934	Timmins	129.00	244.00	250.02		250.03	0.000015	0.27	1082.25	483.62	0.04
Reach 1	3789	100 yr	57.00	244.08	247.36		247.38	0.000252	0.71	117.31	130.60	0.15
Reach 1	3789	Timmins	129.00	244.08	250.02		250.02	0.000014	0.27	1128.48	477.72	0.04
Reach 1	3677	100 yr	57.00	245.32	247.32		247.35	0.000410	0.80	118.87	164.40	0.18
Reach 1	3677	Timmins	129.00	245.32	250.02		250.02	0.000018	0.30	972.31	413.86	0.04
Reach 1	3655	100 yr	57.00	245.32	247.28	246.13	247.33	0.000809	1.05	54.27	163.79	0.25
Reach 1	3655	Timmins	129.00	245.32	250.02	246.71	250.02	0.000017	0.29	987.63	420.32	0.04
Reach 1	3650		Bridge									
Reach 1	3634	100 yr	57.00	245.32	246.74	246.24	246.88	0.003675	1.70	35.16	72.02	0.50
Reach 1	3634	Timmins	129.00	245.32	247.31	246.85	247.63	0.004887	2.55	54.04	164.56	0.61
Reach 1	3621	100 yr	57.00	243.41	246.77		246.81	0.000607	0.97	76.03	90.44	0.22
Reach 1	3621	Timmins	129.00	243.41	247.41		247.49	0.000879	1.40	163.54	206.66	0.27
Reach 1	3401	100 yr	57.00	243.92	246.63		246.67	0.000698	0.94	69.71	62.06	0.23
Reach 1	3401	Timmins	129.00	243.92	247.14		247.25	0.001326	1.54	109.10	103.69	0.33
Reach 1	3105	100 yr	57.00	243.49	246.50		246.52	0.000359	0.72	118.23	243.03	0.17
Reach 1	3105	Timmins	129.00	243.49	246.97		247.01	0.000508	0.99	263.99	432.18	0.21
Reach 1	2896	100 yr	57.00	243.42	246.45		246.46	0.000262	0.45	165.00	341.28	0.13

HEC-RAS Plan: NogiesCreek 2024-02-27 River: Nogies Creek Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	2896	Timmins	129.00	243.42	246.91		246.93	0.000297	0.60	372.38	606.69	0.15
Reach 1	2707	100 yr	57.00	243.70	246.41	244.63	246.42	0.000127	0.41	163.73	209.06	0.10
Reach 1	2707	Timmins	129.00	243.70	246.86	245.06	246.88	0.000253	0.67	286.04	619.98	0.14
Reach 1	2279	100 yr	57.00	242.68	246.39	244.13	246.40	0.000032	0.23	269.05	165.47	0.05
Reach 1	2279	Timmins	129.00	242.68	246.81	244.48	246.81	0.000087	0.42	345.90	281.40	0.09
Reach 1	1889	100 yr	57.00	241.78	246.38	243.25	246.39	0.000021	0.22	264.99	105.00	0.04
Reach 1	1889	Timmins	129.00	241.78	246.77	243.73	246.78	0.000067	0.42	309.63	144.09	0.08
Reach 1	1817	100 yr	57.00	242.63	246.35		246.38	0.000357	0.76	74.75	35.52	0.17
Reach 1	1817	Timmins	129.00	242.63	246.64		246.76	0.001231	1.51	85.63	38.31	0.32
Reach 1	1794	100 yr	57.00	243.36	246.32	244.72	246.37	0.000594	0.94	60.59	32.93	0.21
Reach 1	1794	Timmins	129.00	243.36	246.53	245.44	246.72	0.002186	1.93	67.03	34.61	0.42
Reach 1	1780		Bridge									
Reach 1	1770	100 yr	57.00	243.46	246.27	244.94	246.33	0.001032	1.15	49.58	28.24	0.28
Reach 1	1770	Timmins	129.00	243.46	246.09	245.69	246.52	0.006976	2.88	44.78	27.00	0.71
Reach 1	1761	100 yr	57.00	243.47	246.28	244.73	246.31	0.000373	0.75	84.22	110.92	0.17
Reach 1	1761	Timmins	129.00	243.47	246.19	245.30	246.35	0.002247	1.78	79.00	90.93	0.42
Reach 1	1633	100 yr	57.00	245.32	246.30		246.30	0.000000	0.24	238.89	299.69	0.09
Reach 1	1633	Timmins	129.00	245.32	246.29		246.31	0.000000	0.55	237.01	299.65	0.20
Reach 1	1352	100 yr	57.00	245.32	246.30		246.30	0.000000	0.14	423.06	566.40	0.05
Reach 1	1352	Timmins	129.00	245.32	246.30		246.30	0.000000	0.33	422.68	566.30	0.11
Reach 1	757	100 yr	57.00	245.32	246.30		246.30	0.000000	0.11	534.70	551.60	0.03
Reach 1	757	Timmins	129.00	245.32	246.30		246.30	0.000000	0.24	534.97	551.60	0.08
Reach 1	25	100 yr	57.00	245.32	246.30	245.43	246.30	0.000000	0.12	493.38	507.36	0.04
Reach 1	25	Timmins	129.00	245.32	246.30	245.51	246.30	0.000000	0.26	493.38	507.36	0.08

HEC-RAS Plan: NogiesCreek 2024-02-27 River: Nogies Creek Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	7226	2 yr	7.80	250.40	250.67	250.67	250.79	0.025359	1.58	4.95	19.80	1.01
Reach 1	7226	5 yr	17.70	250.40	250.85	250.85	251.06	0.021278	2.01	8.79	21.32	1.00
Reach 1	7226	10 yr	25.80	250.40	250.97	250.97	251.23	0.019959	2.26	11.40	22.07	1.01
Reach 1	7226	20 yr	34.50	250.40	251.11	251.09	251.40	0.017116	2.39	14.45	22.97	0.96
Reach 1	7226	50 yr	47.00	250.40	251.36		251.62	0.011837	2.28	20.58	26.48	0.83
Reach 1	7226	100 yr	57.00	250.40	251.55		251.80	0.009096	2.20	25.87	28.81	0.74
Reach 1	7226	200 yr	67.40	250.40	251.76		251.98	0.006746	2.11	32.01	30.47	0.66
Reach 1	7226	500 yr	81.90	250.40	251.89		252.15	0.006660	2.26	36.25	31.06	0.66
Reach 1	7226	1000 yr	93.20	250.40	252.02		252.29	0.006220	2.33	40.06	31.56	0.65
Reach 1	7226	Timmins	129.00	250.40	252.35		252.68	0.005541	2.56	51.36	36.10	0.64
Reach 1	7226	100CCMid	75.80	250.40	251.82		252.08	0.006984	2.22	34.10	30.79	0.67
Reach 1	7226	100CCEnd	94.60	250.40	252.03		252.31	0.006186	2.34	40.49	31.62	0.65
Reach 1	6913	2 yr	7.80	249.15	249.82	249.38	249.83	0.000659	0.46	17.04	28.10	0.19
Reach 1	6913	5 yr	17.70	249.15	250.25	249.54	250.27	0.000612	0.59	29.85	67.51	0.19
Reach 1	6913	10 yr	25.80	249.15	250.51	249.64	250.54	0.000631	0.67	38.54	81.48	0.20
Reach 1	6913	20 yr	34.50	249.15	250.74	249.74	250.77	0.000631	0.74	46.98	95.19	0.21
Reach 1	6913	50 yr	47.00	249.15	251.02	249.87	251.05	0.000600	0.82	58.67	107.34	0.21
Reach 1	6913	100 yr	57.00	249.15	251.25	249.96	251.29	0.000551	0.87	68.97	122.27	0.21
Reach 1	6913	200 yr	67.40	249.15	251.51	250.06	251.55	0.000486	0.89	81.07	130.19	0.20
Reach 1	6913	500 yr	81.90	249.15	251.56	250.18	251.62	0.000657	1.05	83.67	131.54	0.23
Reach 1	6913	1000 yr	93.20	249.15	251.66	250.27	251.72	0.000727	1.14	88.48	134.49	0.24
Reach 1	6913	Timmins	129.00	249.15	251.93	250.53	252.03	0.000926	1.39	102.52	153.29	0.28
Reach 1	6913	100CCMid	75.80	249.15	251.51	250.13	251.56	0.000616	1.00	81.05	130.18	0.22
Reach 1	6913	100CCEnd	94.60	249.15	251.67	250.28	251.74	0.000737	1.15	88.98	134.81	0.25
Reach 1	6260	2 yr	7.80	248.20	249.45	248.71	249.46	0.000499	0.46	17.76	28.00	0.17
Reach 1	6260	5 yr	17.70	248.20	249.88	248.97	249.90	0.000535	0.62	31.71	44.21	0.19
Reach 1	6260	10 yr	25.80	248.20	250.14	249.15	250.16	0.000535	0.72	44.40	135.68	0.19
Reach 1	6260	20 yr	34.50	248.20	250.39	249.30	250.41	0.000497	0.77	66.75	207.91	0.19
Reach 1	6260	50 yr	47.00	248.20	250.76	249.47	250.78	0.000341	0.73	113.01	280.85	0.16
Reach 1	6260	100 yr	57.00	248.20	251.05	249.58	251.07	0.000245	0.68	161.72	317.31	0.14
Reach 1	6260	200 yr	67.40	248.20	251.37	249.68	251.38	0.000170	0.61	218.71	381.73	0.12
Reach 1	6260	500 yr	81.90	248.20	251.36	249.79	251.38	0.000257	0.75	216.55	378.27	0.15
Reach 1	6260	1000 yr	93.20	248.20	251.44	249.91	251.46	0.000283	0.81	233.31	396.91	0.16
Reach 1	6260	Timmins	129.00	248.20	251.68	250.35	251.70	0.000341	0.94	286.24	439.84	0.17
Reach 1	6260	100CCMid	75.80	248.20	251.32	249.73	251.33	0.000241	0.72	208.01	362.39	0.14
Reach 1	6260	100CCEnd	94.60	248.20	251.45	249.92	251.47	0.000287	0.81	234.88	398.07	0.16
Reach 1	6179	2 yr	7.80	248.21	249.44	248.51	249.44	0.000064	0.19	52.17	107.09	0.06
Reach 1	6179	5 yr	17.70	248.21	249.88	248.66	249.88	0.000066	0.25	104.15	125.63	0.07
Reach 1	6179	10 yr	25.80	248.21	250.14	248.76	250.14	0.000069	0.29	139.46	183.56	0.07
Reach 1	6179	20 yr	34.50	248.21	250.39	248.86	250.39	0.000069	0.32	177.80	272.10	0.07
Reach 1	6179	50 yr	47.00	248.21	250.76	249.01	250.76	0.000059	0.33	240.83	297.37	0.07
Reach 1	6179	100 yr	57.00	248.21	251.05	249.10	251.06	0.000050	0.33	294.74	305.73	0.07
Reach 1	6179	200 yr	67.40	248.21	251.37	249.19	251.37	0.000042	0.33	353.94	323.78	0.06
Reach 1	6179	500 yr	81.90	248.21	251.35	249.30	251.36	0.000063	0.40	351.52	322.11	0.08
Reach 1	6179	1000 yr	93.20	248.21	251.43	249.37	251.44	0.000073	0.44	367.39	339.88	0.08
Reach 1	6179	Timmins	129.00	248.21	251.67	249.55	251.67	0.000099	0.54	425.94	418.41	0.10
Reach 1	6179	100CCMid	75.80	248.21	251.31	249.23	251.32	0.000058	0.38	343.29	315.71	0.07
Reach 1	6179	100CCEnd	94.60	248.21	251.44	249.39	251.45	0.000074	0.44	368.91	341.89	0.08
Reach 1	5980	2 yr	7.80	247.72	249.42	248.35	249.42	0.000137	0.29	29.41	44.37	0.09
Reach 1	5980	5 yr	17.70	247.72	249.85	248.60	249.86	0.000187	0.42	51.48	57.04	0.11
Reach 1	5980	10 yr	25.80	247.72	250.11	248.76	250.12	0.000204	0.49	66.98	83.52	0.12
Reach 1	5980	20 yr	34.50	247.72	250.36	248.90	250.37	0.000212	0.55	82.70	157.14	0.13
Reach 1	5980	50 yr	47.00	247.72	250.73	249.06	250.74	0.000196	0.59	109.64	187.06	0.13
Reach 1	5980	100 yr	57.00	247.72	251.03	249.18	251.04	0.000170	0.60	142.29	217.30	0.12
Reach 1	5980	200 yr	67.40	247.72	251.34	249.31	251.36	0.000142	0.59	181.62	230.87	0.11
Reach 1	5980	500 yr	81.90	247.72	251.32	249.46	251.34	0.000218	0.73	178.48	230.05	0.14
Reach 1	5980	1000 yr	93.20	247.72	251.39	249.56	251.42	0.000252	0.80	187.83	232.48	0.15
Reach 1	5980	Timmins	129.00	247.72	251.61	249.79	251.64	0.000354	1.00	216.22	246.83	0.18
Reach 1	5980	100CCMid	75.80	247.72	251.28	249.39	251.30	0.000199	0.69	173.46	228.80	0.13
Reach 1	5980	100CCEnd	94.60	247.72	251.40	249.57	251.42	0.000257	0.81	188.64	232.68	0.15
Reach 1	5692	2 yr	7.80	248.37	249.33	248.77	249.34	0.000795	0.56	13.84	18.73	0.21
Reach 1	5692	5 yr	17.70	248.37	249.71	249.00	249.75	0.001117	0.82	21.62	32.06	0.26
Reach 1	5692	10 yr	25.80	248.37	249.95	249.15	250.00	0.001262	0.96	26.95	44.34	0.28
Reach 1	5692	20 yr	34.50	248.37	250.18	249.29	250.24	0.001324	1.06	32.52	146.16	0.30
Reach 1	5692	50 yr	47.00	248.37	250.56	249.46	250.62	0.001162	1.11	42.45	162.65	0.29
Reach 1	5692	100 yr	57.00	248.37	250.88	249.59	250.94	0.000962	1.11	51.55	179.97	0.27
Reach 1	5692	200 yr	67.40	248.37	251.21	249.71	251.27	0.000751	1.10	62.03	204.29	0.24
Reach 1	5692	500 yr	81.90	248.37	251.10	249.86	251.21	0.001323	1.41	58.57	194.78	0.32
Reach 1	5692	1000 yr	93.20	248.37	251.13	249.98	251.26	0.001644	1.58	59.36	197.56	0.36
Reach 1	5692	Timmins	129.00	248.37	251.16	250.29	251.40	0.002980	2.15	60.44	200.82	0.48
Reach 1	5692	100CCMid	75.80	248.37	251.09	249.80	251.18	0.001162	1.31	58.10	193.27	0.30
Reach 1	5692	100CCEnd	94.60	248.37	251.13	249.99	251.26	0.001696	1.61	59.33	197.44	0.36
Reach 1	5673	2 yr	7.80	248.56	249.26	249.03	249.31	0.004282	1.01	7.71	15.46	0.46

HEC-RAS Plan: NogiesCreek 2024-02-27   River: Nogies Creek   Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	5673	5 yr	17.70	248.56	249.62	249.27	249.71	0.004054	1.28	13.80	23.08	0.48
Reach 1	5673	10 yr	25.80	248.56	249.85	249.43	249.95	0.003954	1.40	18.43	37.45	0.48
Reach 1	5673	20 yr	34.50	248.56	250.09	249.58	250.20	0.003287	1.46	23.57	51.25	0.45
Reach 1	5673	50 yr	47.00	248.56	250.48	249.77	250.59	0.002250	1.44	32.68	177.44	0.39
Reach 1	5673	100 yr	57.00	248.56	250.90	249.90	250.91	0.000361	0.64	167.71	190.62	0.16
Reach 1	5673	200 yr	67.40	248.56	251.24	250.01	251.25	0.000197	0.54	238.02	233.01	0.12
Reach 1	5673	500 yr	81.90	248.56	251.15	250.14	251.17	0.000365	0.71	218.03	214.77	0.17
Reach 1	5673	1000 yr	93.20	248.56	251.19	250.25	251.21	0.000428	0.78	226.58	221.59	0.18
Reach 1	5673	Timmins	129.00	248.56	251.29	250.56	251.31	0.000649	0.99	248.41	244.95	0.22
Reach 1	5673	100CCMid	75.80	248.56	251.13	250.09	251.14	0.000331	0.67	213.38	210.49	0.16
Reach 1	5673	100CCEnd	94.60	248.56	251.19	250.27	251.21	0.000440	0.79	226.80	221.80	0.18
Reach 1	5670		Bridge									
Reach 1	5663	2 yr	7.80	248.57	249.19	248.97	249.26	0.004993	1.15	6.80	12.77	0.50
Reach 1	5663	5 yr	17.70	248.57	249.52	249.25	249.64	0.005872	1.55	11.42	15.34	0.57
Reach 1	5663	10 yr	25.80	248.57	249.73	249.42	249.89	0.006277	1.73	14.90	29.49	0.60
Reach 1	5663	20 yr	34.50	248.57	249.93	249.59	250.11	0.006048	1.84	18.75	40.76	0.61
Reach 1	5663	50 yr	47.00	248.57	250.15	249.80	250.36	0.005799	2.03	23.11	81.15	0.61
Reach 1	5663	100 yr	57.00	248.57	250.29	249.94	250.53	0.005943	2.20	25.94	147.47	0.63
Reach 1	5663	200 yr	67.40	248.57	250.42	250.05	250.70	0.006071	2.35	28.69	159.67	0.64
Reach 1	5663	500 yr	81.90	248.57	250.74	250.20	250.79	0.001444	1.22	132.56	229.25	0.32
Reach 1	5663	1000 yr	93.20	248.57	250.89	250.31	250.93	0.001107	1.12	168.99	264.81	0.28
Reach 1	5663	Timmins	129.00	248.57	251.11	250.63	251.15	0.001103	1.20	233.43	326.39	0.29
Reach 1	5663	100CCMid	75.80	248.57	250.65	250.14	250.71	0.001742	1.29	112.80	196.74	0.35
Reach 1	5663	100CCEnd	94.60	248.57	250.91	250.33	250.95	0.001075	1.11	173.66	270.02	0.28
Reach 1	5645	2 yr	7.80	248.48	249.17	248.83	249.19	0.001383	0.62	12.74	25.01	0.27
Reach 1	5645	5 yr	17.70	248.48	249.52	249.01	249.56	0.001421	0.84	22.10	29.83	0.29
Reach 1	5645	10 yr	25.80	248.48	249.74	249.14	249.79	0.001438	0.96	29.10	50.03	0.30
Reach 1	5645	20 yr	34.50	248.48	249.95	249.25	250.00	0.001460	1.04	36.62	70.81	0.31
Reach 1	5645	50 yr	47.00	248.48	250.18	249.39	250.24	0.001473	1.15	46.17	160.92	0.32
Reach 1	5645	100 yr	57.00	248.48	250.33	249.50	250.40	0.001479	1.24	53.13	191.32	0.33
Reach 1	5645	200 yr	67.40	248.48	250.47	249.60	250.55	0.001477	1.32	60.43	224.46	0.33
Reach 1	5645	500 yr	81.90	248.48	250.66	249.74	250.75	0.001470	1.41	70.75	304.76	0.34
Reach 1	5645	1000 yr	93.20	248.48	250.79	249.84	250.89	0.001465	1.48	78.35	340.22	0.34
Reach 1	5645	Timmins	129.00	248.48	250.93	250.11	251.09	0.002161	1.88	87.71	381.58	0.42
Reach 1	5645	100CCMid	75.80	248.48	250.58	249.68	250.67	0.001474	1.38	66.40	267.73	0.33
Reach 1	5645	100CCEnd	94.60	248.48	250.80	249.85	250.91	0.001465	1.49	79.31	345.90	0.34
Reach 1	5039	2 yr	7.80	246.34	246.83	246.83	247.02	0.022681	1.94	4.02	10.72	1.01
Reach 1	5039	5 yr	17.70	246.34	247.12	247.12	247.42	0.019154	2.40	7.38	12.54	1.00
Reach 1	5039	10 yr	25.80	246.34	247.31	247.31	247.66	0.018198	2.60	9.91	14.31	1.00
Reach 1	5039	20 yr	34.50	246.34	247.48	247.48	247.87	0.017495	2.77	12.44	15.83	1.00
Reach 1	5039	50 yr	47.00	246.34	247.67	247.67	248.13	0.016381	3.03	15.59	17.55	1.00
Reach 1	5039	100 yr	57.00	246.34	247.81	247.81	248.32	0.015282	3.18	18.18	18.84	0.98
Reach 1	5039	200 yr	67.40	246.34	247.94	247.94	248.51	0.014584	3.33	20.78	19.99	0.97
Reach 1	5039	500 yr	81.90	246.34	248.11	248.11	248.74	0.013920	3.52	24.29	21.26	0.97
Reach 1	5039	1000 yr	93.20	246.34	248.24	248.24	248.90	0.013355	3.63	27.09	22.15	0.96
Reach 1	5039	Timmins	129.00	246.34	249.96	248.59	250.10	0.001389	1.82	107.11	212.39	0.34
Reach 1	5039	100CCMid	75.80	246.34	248.04	248.04	248.64	0.014152	3.44	22.84	20.74	0.97
Reach 1	5039	100CCEnd	94.60	246.34	248.26	248.26	248.92	0.013271	3.64	27.45	22.24	0.96
Reach 1	4804	2 yr	7.80	243.83	246.92	244.50	246.92	0.000003	0.07	124.89	96.89	0.02
Reach 1	4804	5 yr	17.70	243.83	247.01	244.76	247.02	0.000013	0.14	133.78	98.04	0.03
Reach 1	4804	10 yr	25.80	243.83	247.13	244.93	247.13	0.000024	0.20	144.83	101.63	0.04
Reach 1	4804	20 yr	34.50	243.83	247.27	245.07	247.27	0.000033	0.24	159.50	139.41	0.05
Reach 1	4804	50 yr	47.00	243.83	247.51	245.29	247.52	0.000042	0.29	184.60	171.85	0.06
Reach 1	4804	100 yr	57.00	243.83	247.53	245.37	247.53	0.000061	0.35	185.93	173.16	0.07
Reach 1	4804	200 yr	67.40	243.83	247.80	245.43	247.81	0.000058	0.37	216.19	230.18	0.07
Reach 1	4804	500 yr	81.90	243.83	248.23	245.51	248.23	0.000050	0.37	267.95	287.29	0.07
Reach 1	4804	1000 yr	93.20	243.83	248.60	245.56	248.60	0.000042	0.37	334.00	351.55	0.06
Reach 1	4804	Timmins	129.00	243.83	250.04	245.74	250.05	0.000017	0.29	725.63	562.42	0.04
Reach 1	4804	100CCMid	75.80	243.83	248.04	245.48	248.05	0.000054	0.37	243.66	255.97	0.07
Reach 1	4804	100CCEnd	94.60	243.83	248.65	245.57	248.65	0.000040	0.36	344.15	362.42	0.06
Reach 1	4602	2 yr	7.80	243.70	246.92	244.43	246.92	0.000008	0.11	90.21	92.24	0.03
Reach 1	4602	5 yr	17.70	243.70	247.01	244.79	247.01	0.000036	0.24	98.38	96.18	0.05
Reach 1	4602	10 yr	25.80	243.70	247.12	244.97	247.12	0.000061	0.32	108.96	100.40	0.07
Reach 1	4602	20 yr	34.50	243.70	247.26	245.14	247.26	0.000083	0.39	123.52	106.64	0.08
Reach 1	4602	50 yr	47.00	243.70	247.50	245.36	247.50	0.000101	0.46	152.54	130.72	0.09
Reach 1	4602	100 yr	57.00	243.70	247.50	245.52	247.51	0.000147	0.55	153.17	130.84	0.11
Reach 1	4602	200 yr	67.40	243.70	247.78	245.66	247.79	0.000127	0.55	190.78	139.29	0.11
Reach 1	4602	500 yr	81.90	243.70	248.21	245.82	248.22	0.000097	0.53	260.48	278.22	0.09
Reach 1	4602	1000 yr	93.20	243.70	248.58	245.91	248.59	0.000074	0.50	327.45	391.58	0.08
Reach 1	4602	Timmins	129.00	243.70	250.04	246.19	250.04	0.000028	0.38	625.06	523.59	0.05
Reach 1	4602	100CCMid	75.80	243.70	248.02	245.76	248.03	0.000111	0.55	228.56	168.65	0.10
Reach 1	4602	100CCEnd	94.60	243.70	248.63	245.92	248.64	0.000071	0.49	336.53	394.86	0.08

HEC-RAS Plan: NogiesCreek 2024-02-27 River: Nogies Creek Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	4455	2 yr	7.80	243.59	246.92	244.13	246.92	0.000007	0.11	77.06	51.80	0.02
Reach 1	4455	5 yr	17.70	243.59	247.00	244.39	247.01	0.000033	0.23	81.43	53.88	0.05
Reach 1	4455	10 yr	25.80	243.59	247.11	244.55	247.11	0.000059	0.32	87.17	58.30	0.07
Reach 1	4455	20 yr	34.50	243.59	247.24	244.70	247.25	0.000085	0.40	95.33	61.01	0.08
Reach 1	4455	50 yr	47.00	243.59	247.48	244.89	247.49	0.000111	0.49	110.43	68.96	0.10
Reach 1	4455	100 yr	57.00	243.59	247.47	245.02	247.49	0.000165	0.60	110.15	68.85	0.12
Reach 1	4455	200 yr	67.40	243.59	247.75	245.15	247.77	0.000156	0.62	130.56	77.15	0.12
Reach 1	4455	500 yr	81.90	243.59	248.18	245.31	248.20	0.000135	0.63	168.27	203.34	0.11
Reach 1	4455	1000 yr	93.20	243.59	248.56	245.43	248.58	0.000112	0.62	206.86	309.72	0.10
Reach 1	4455	Timmins	129.00	243.59	250.03	245.81	250.04	0.000050	0.52	409.95	503.83	0.07
Reach 1	4455	100CCMid	75.80	243.59	248.00	245.24	248.01	0.000146	0.63	150.60	89.40	0.12
Reach 1	4455	100CCEnd	94.60	243.59	248.61	245.44	248.63	0.000109	0.62	212.19	320.71	0.10
Reach 1	4288	2 yr	7.80	244.02	246.92	244.67	246.92	0.000004	0.07	208.60	230.21	0.02
Reach 1	4288	5 yr	17.70	244.02	247.00	245.14	247.00	0.000016	0.15	227.45	235.20	0.03
Reach 1	4288	10 yr	25.80	244.02	247.10	245.28	247.11	0.000026	0.19	251.66	238.16	0.04
Reach 1	4288	20 yr	34.50	244.02	247.24	245.40	247.24	0.000033	0.23	284.37	241.18	0.05
Reach 1	4288	50 yr	47.00	244.02	247.47	245.56	247.48	0.000038	0.26	341.59	252.20	0.05
Reach 1	4288	100 yr	57.00	244.02	247.47	245.68	247.47	0.000056	0.32	340.17	252.07	0.07
Reach 1	4288	200 yr	67.40	244.02	247.75	245.78	247.75	0.000046	0.31	412.89	263.45	0.06
Reach 1	4288	500 yr	81.90	244.02	248.19	246.04	248.19	0.000033	0.29	552.55	414.80	0.05
Reach 1	4288	1000 yr	93.20	244.02	248.56	246.14	248.57	0.000026	0.28	721.86	484.90	0.05
Reach 1	4288	Timmins	129.00	244.02	250.03	246.32	250.03	0.000007	0.19	1557.85	732.05	0.03
Reach 1	4288	100CCMid	75.80	244.02	248.00	245.90	248.00	0.000038	0.30	480.60	325.01	0.06
Reach 1	4288	100CCEnd	94.60	244.02	248.61	246.14	248.62	0.000024	0.27	745.74	495.78	0.05
Reach 1	4143	2 yr	7.80	243.93	246.92	244.59	246.92	0.000010	0.11	81.16	79.85	0.03
Reach 1	4143	5 yr	17.70	243.93	247.00	244.85	247.00	0.000042	0.24	87.41	82.49	0.06
Reach 1	4143	10 yr	25.80	243.93	247.09	245.00	247.10	0.000073	0.32	95.56	83.92	0.07
Reach 1	4143	20 yr	34.50	243.93	247.23	245.14	247.23	0.000100	0.39	106.80	85.85	0.09
Reach 1	4143	50 yr	47.00	243.93	247.46	245.32	247.47	0.000122	0.47	127.51	105.85	0.10
Reach 1	4143	100 yr	57.00	243.93	247.44	245.46	247.46	0.000184	0.57	126.00	102.57	0.12
Reach 1	4143	200 yr	67.40	243.93	247.73	245.61	247.74	0.000158	0.57	157.56	114.80	0.12
Reach 1	4143	500 yr	81.90	243.93	248.17	245.76	248.18	0.000119	0.55	241.57	323.82	0.10
Reach 1	4143	1000 yr	93.20	243.93	248.55	245.85	248.56	0.000077	0.48	392.33	441.54	0.08
Reach 1	4143	Timmins	129.00	243.93	250.03	246.13	250.03	0.000015	0.27	1127.39	666.84	0.04
Reach 1	4143	100CCMid	75.80	243.93	247.97	245.70	247.99	0.000136	0.56	191.39	192.25	0.11
Reach 1	4143	100CCEnd	94.60	243.93	248.60	245.87	248.61	0.000072	0.47	414.53	446.70	0.08
Reach 1	3934	2 yr	7.80	244.00	246.92		246.92	0.000010	0.11	84.42	77.77	0.03
Reach 1	3934	5 yr	17.70	244.00	246.99		246.99	0.000046	0.24	90.06	83.38	0.06
Reach 1	3934	10 yr	25.80	244.00	247.08		247.08	0.000081	0.33	97.81	86.76	0.08
Reach 1	3934	20 yr	34.50	244.00	247.20		247.21	0.000112	0.41	109.26	94.34	0.09
Reach 1	3934	50 yr	47.00	244.00	247.43		247.44	0.000137	0.49	131.51	103.68	0.11
Reach 1	3934	100 yr	57.00	244.00	247.40		247.42	0.000213	0.60	128.49	102.30	0.13
Reach 1	3934	200 yr	67.40	244.00	247.69		247.71	0.000181	0.60	164.32	172.76	0.12
Reach 1	3934	500 yr	81.90	244.00	248.14		248.15	0.000120	0.55	279.42	335.30	0.10
Reach 1	3934	1000 yr	93.20	244.00	248.54		248.54	0.000073	0.47	424.16	389.70	0.08
Reach 1	3934	Timmins	129.00	244.00	250.02		250.03	0.000015	0.27	1082.25	483.62	0.04
Reach 1	3934	100CCMid	75.80	244.00	247.95		247.96	0.000146	0.58	219.45	264.58	0.11
Reach 1	3934	100CCEnd	94.60	244.00	248.59		248.59	0.000068	0.46	444.32	397.37	0.08
Reach 1	3789	2 yr	7.80	244.08	246.92		246.92	0.000011	0.13	76.36	71.89	0.03
Reach 1	3789	5 yr	17.70	244.08	246.98		246.98	0.000049	0.28	80.97	73.55	0.06
Reach 1	3789	10 yr	25.80	244.08	247.06		247.07	0.000089	0.39	87.32	75.76	0.08
Reach 1	3789	20 yr	34.50	244.08	247.18		247.20	0.000127	0.48	97.55	93.92	0.10
Reach 1	3789	50 yr	47.00	244.08	247.41		247.42	0.000158	0.57	123.27	142.88	0.12
Reach 1	3789	100 yr	57.00	244.08	247.36		247.38	0.000252	0.71	117.31	130.60	0.15
Reach 1	3789	200 yr	67.40	244.08	247.66		247.68	0.000206	0.69	171.91	234.47	0.13
Reach 1	3789	500 yr	81.90	244.08	248.13		248.14	0.000119	0.59	310.91	341.24	0.10
Reach 1	3789	1000 yr	93.20	244.08	248.53		248.54	0.000071	0.49	462.78	405.12	0.08
Reach 1	3789	Timmins	129.00	244.08	250.02		250.02	0.000014	0.27	1128.48	477.72	0.04
Reach 1	3789	100CCMid	75.80	244.08	247.92		247.94	0.000157	0.65	244.30	305.82	0.12
Reach 1	3789	100CCEnd	94.60	244.08	248.58		248.59	0.000066	0.48	483.95	412.18	0.08
Reach 1	3677	2 yr	7.80	245.32	246.91		246.91	0.000022	0.16	66.00	99.42	0.04
Reach 1	3677	5 yr	17.70	245.32	246.97		246.98	0.000097	0.34	71.82	107.66	0.09
Reach 1	3677	10 yr	25.80	245.32	247.05		247.06	0.000169	0.47	80.59	115.64	0.11
Reach 1	3677	20 yr	34.50	245.32	247.16		247.18	0.000225	0.56	94.66	133.50	0.13
Reach 1	3677	50 yr	47.00	245.32	247.38		247.40	0.000240	0.63	128.88	169.57	0.14
Reach 1	3677	100 yr	57.00	245.32	247.32		247.35	0.000410	0.80	118.87	164.40	0.18
Reach 1	3677	200 yr	67.40	245.32	247.64		247.65	0.000270	0.72	178.61	215.66	0.15
Reach 1	3677	500 yr	81.90	245.32	248.11		248.12	0.000145	0.60	295.98	282.16	0.11
Reach 1	3677	1000 yr	93.20	245.32	248.52		248.53	0.000084	0.50	421.13	323.49	0.09
Reach 1	3677	Timmins	129.00	245.32	250.02		250.02	0.000018	0.30	972.31	413.86	0.04
Reach 1	3677	100CCMid	75.80	245.32	247.91		247.92	0.000186	0.64	240.93	249.79	0.13
Reach 1	3677	100CCEnd	94.60	245.32	248.57		248.58	0.000079	0.49	438.15	326.75	0.09
Reach 1	3655	2 yr	7.80	245.32	246.91	245.55	246.91	0.000032	0.18	43.30	93.40	0.05

HEC-RAS Plan: NogiesCreek 2024-02-27 River: Nogies Creek Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	3655	5 yr	17.70	245.32	246.96	245.70	246.97	0.000147	0.40	44.86	105.40	0.10
Reach 1	3655	10 yr	25.80	245.32	247.04	245.81	247.05	0.000266	0.55	47.05	117.61	0.14
Reach 1	3655	20 yr	34.50	245.32	247.14	245.91	247.17	0.000381	0.69	50.30	134.99	0.17
Reach 1	3655	50 yr	47.00	245.32	247.35	246.04	247.39	0.000479	0.83	56.58	175.71	0.19
Reach 1	3655	100 yr	57.00	245.32	247.28	246.13	247.33	0.000809	1.05	54.27	163.79	0.25
Reach 1	3655	200 yr	67.40	245.32	247.58	246.23	247.64	0.000671	1.07	63.52	207.70	0.23
Reach 1	3655	500 yr	81.90	245.32	248.06	246.35	248.11	0.000506	1.06	77.76	289.17	0.21
Reach 1	3655	1000 yr	93.20	245.32	248.46	246.44	248.52	0.000404	1.04	89.99	344.66	0.19
Reach 1	3655	Timmins	129.00	245.32	250.02	246.71	250.02	0.000017	0.29	987.63	420.32	0.04
Reach 1	3655	100CCMid	75.80	245.32	247.85	246.30	247.91	0.000571	1.06	71.58	240.89	0.22
Reach 1	3655	100CCEnd	94.60	245.32	248.52	246.45	248.57	0.000392	1.04	91.56	349.03	0.19
Reach 1	3650		Bridge									
Reach 1	3634	2 yr	7.80	245.32	246.90	245.57	246.91	0.000044	0.20	40.67	106.17	0.06
Reach 1	3634	5 yr	17.70	245.32	246.92	245.75	246.93	0.000218	0.46	41.14	107.78	0.12
Reach 1	3634	10 yr	25.80	245.32	246.94	245.87	246.96	0.000441	0.65	41.77	109.95	0.18
Reach 1	3634	20 yr	34.50	245.32	246.96	245.99	247.00	0.000738	0.86	42.67	113.03	0.23
Reach 1	3634	50 yr	47.00	245.32	247.01	246.13	247.08	0.001218	1.13	44.29	118.56	0.30
Reach 1	3634	100 yr	57.00	245.32	246.74	246.24	246.88	0.003675	1.70	35.16	72.02	0.50
Reach 1	3634	200 yr	67.40	245.32	246.83	246.36	247.00	0.003920	1.85	38.38	100.03	0.52
Reach 1	3634	500 yr	81.90	245.32	246.96	246.50	247.17	0.004198	2.04	42.54	112.59	0.54
Reach 1	3634	1000 yr	93.20	245.32	247.05	246.60	247.29	0.004371	2.17	45.60	123.03	0.56
Reach 1	3634	Timmins	129.00	245.32	247.31	246.85	247.63	0.004887	2.55	54.04	164.56	0.61
Reach 1	3634	100CCMid	75.80	245.32	246.91	246.44	247.10	0.004088	1.96	40.83	106.74	0.53
Reach 1	3634	100CCEnd	94.60	245.32	247.07	246.61	247.30	0.004395	2.19	45.95	123.99	0.56
Reach 1	3621	2 yr	7.80	243.41	246.90		246.90	0.000009	0.12	89.75	113.16	0.03
Reach 1	3621	5 yr	17.70	243.41	246.92		246.92	0.000043	0.27	91.62	114.83	0.06
Reach 1	3621	10 yr	25.80	243.41	246.94		246.95	0.000088	0.39	94.17	116.89	0.08
Reach 1	3621	20 yr	34.50	243.41	246.97		246.99	0.000147	0.51	97.86	119.81	0.11
Reach 1	3621	50 yr	47.00	243.41	247.03		247.05	0.000244	0.66	104.73	125.19	0.14
Reach 1	3621	100 yr	57.00	243.41	246.77		246.81	0.000607	0.97	76.03	90.44	0.22
Reach 1	3621	200 yr	67.40	243.41	246.88		246.93	0.000684	1.06	86.56	108.46	0.23
Reach 1	3621	500 yr	81.90	243.41	247.01		247.07	0.000766	1.17	102.74	123.65	0.25
Reach 1	3621	1000 yr	93.20	243.41	247.12		247.18	0.000810	1.24	115.97	133.95	0.26
Reach 1	3621	Timmins	129.00	243.41	247.41		247.49	0.000879	1.40	163.54	206.66	0.27
Reach 1	3621	100CCMid	75.80	243.41	246.96		247.01	0.000735	1.13	95.84	118.22	0.24
Reach 1	3621	100CCEnd	94.60	243.41	247.13		247.20	0.000815	1.25	117.60	135.43	0.26
Reach 1	3401	2 yr	7.80	243.92	246.90		246.90	0.000008	0.11	88.29	75.77	0.02
Reach 1	3401	5 yr	17.70	243.92	246.91		246.91	0.000038	0.24	89.02	75.96	0.05
Reach 1	3401	10 yr	25.80	243.92	246.92		246.93	0.000079	0.35	90.01	76.21	0.08
Reach 1	3401	20 yr	34.50	243.92	246.94		246.95	0.000137	0.47	91.44	77.29	0.10
Reach 1	3401	50 yr	47.00	243.92	246.98		247.00	0.000237	0.62	94.18	81.54	0.14
Reach 1	3401	100 yr	57.00	243.92	246.63		246.67	0.000698	0.94	69.71	62.06	0.23
Reach 1	3401	200 yr	67.40	243.92	246.71		246.76	0.000822	1.05	74.89	64.45	0.25
Reach 1	3401	500 yr	81.90	243.92	246.82		246.89	0.000977	1.19	82.03	67.61	0.28
Reach 1	3401	1000 yr	93.20	243.92	246.90		246.98	0.001087	1.30	88.04	75.71	0.29
Reach 1	3401	Timmins	129.00	243.92	247.14		247.25	0.001326	1.54	109.10	103.69	0.33
Reach 1	3401	100CCMid	75.80	243.92	246.77		246.84	0.000915	1.14	79.03	66.30	0.27
Reach 1	3401	100CCEnd	94.60	243.92	246.91		246.99	0.001099	1.31	88.78	75.90	0.29
Reach 1	3105	2 yr	7.80	243.49	246.90		246.90	0.000002	0.06	234.94	374.61	0.01
Reach 1	3105	5 yr	17.70	243.49	246.91		246.91	0.000011	0.15	237.31	379.56	0.03
Reach 1	3105	10 yr	25.80	243.49	246.92		246.92	0.000024	0.21	240.62	385.55	0.04
Reach 1	3105	20 yr	34.50	243.49	246.93		246.93	0.000041	0.28	245.58	393.95	0.06
Reach 1	3105	50 yr	47.00	243.49	246.95		246.96	0.000071	0.37	255.33	414.56	0.08
Reach 1	3105	100 yr	57.00	243.49	246.50		246.52	0.000359	0.72	118.23	243.03	0.17
Reach 1	3105	200 yr	67.40	243.49	246.56		246.59	0.000426	0.80	133.39	254.98	0.18
Reach 1	3105	500 yr	81.90	243.49	246.65		246.68	0.000492	0.89	156.23	266.86	0.20
Reach 1	3105	1000 yr	93.20	243.49	246.72		246.75	0.000524	0.94	175.97	282.81	0.21
Reach 1	3105	Timmins	129.00	243.49	246.97		247.01	0.000508	0.99	263.99	432.18	0.21
Reach 1	3105	100CCMid	75.80	243.49	246.61		246.64	0.000468	0.85	146.34	261.58	0.19
Reach 1	3105	100CCEnd	94.60	243.49	246.73		246.76	0.000527	0.94	178.53	285.52	0.21
Reach 1	2896	2 yr	7.80	243.42	246.90		246.90	0.000001	0.04	365.95	590.66	0.01
Reach 1	2896	5 yr	17.70	243.42	246.91		246.91	0.000006	0.08	369.13	599.08	0.02
Reach 1	2896	10 yr	25.80	243.42	246.91		246.91	0.000012	0.12	373.56	608.85	0.03
Reach 1	2896	20 yr	34.50	243.42	246.92		246.93	0.000020	0.16	380.26	620.72	0.04
Reach 1	2896	50 yr	47.00	243.42	246.95		246.95	0.000035	0.21	393.53	642.76	0.05
Reach 1	2896	100 yr	57.00	243.42	246.45		246.46	0.000262	0.45	165.00	341.28	0.13
Reach 1	2896	200 yr	67.40	243.42	246.50		246.51	0.000307	0.50	183.31	369.37	0.14
Reach 1	2896	500 yr	81.90	243.42	246.58		246.59	0.000341	0.55	213.75	386.58	0.15
Reach 1	2896	1000 yr	93.20	243.42	246.65		246.66	0.000348	0.58	241.48	406.99	0.16
Reach 1	2896	Timmins	129.00	243.42	246.91		246.93	0.000297	0.60	372.38	606.69	0.15
Reach 1	2896	100CCMid	75.80	243.42	246.54		246.56	0.000331	0.53	200.27	379.64	0.15
Reach 1	2896	100CCEnd	94.60	243.42	246.66		246.67	0.000348	0.58	245.18	411.71	0.16

HEC-RAS Plan: NogiesCreek 2024-02-27 River: Nogies Creek Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	2707	2 yr	7.80	243.70	246.90	244.00	246.90	0.000001	0.04	302.29	641.29	0.01
Reach 1	2707	5 yr	17.70	243.70	246.91	244.18	246.91	0.000004	0.09	303.96	643.20	0.02
Reach 1	2707	10 yr	25.80	243.70	246.91	244.29	246.91	0.000009	0.13	306.28	645.85	0.03
Reach 1	2707	20 yr	34.50	243.70	246.92	244.40	246.92	0.000016	0.17	309.75	650.08	0.04
Reach 1	2707	50 yr	47.00	243.70	246.94	244.52	246.94	0.000028	0.23	316.59	661.62	0.05
Reach 1	2707	100 yr	57.00	243.70	246.41	244.63	246.42	0.000127	0.41	163.73	209.06	0.10
Reach 1	2707	200 yr	67.40	243.70	246.46	244.72	246.47	0.000161	0.47	172.76	221.89	0.11
Reach 1	2707	500 yr	81.90	243.70	246.53	244.82	246.54	0.000204	0.54	188.82	282.42	0.13
Reach 1	2707	1000 yr	93.20	243.70	246.59	244.89	246.61	0.000231	0.59	205.22	362.26	0.14
Reach 1	2707	Timmins	129.00	243.70	246.86	245.06	246.88	0.000253	0.67	286.04	619.98	0.14
Reach 1	2707	100CCMid	75.80	243.70	246.50	244.78	246.51	0.000187	0.51	181.44	246.45	0.12
Reach 1	2707	100CCEnd	94.60	243.70	246.60	244.90	246.62	0.000234	0.60	207.50	376.57	0.14
Reach 1	2279	2 yr	7.80	242.68	246.90	243.41	246.90	0.000000	0.02	368.96	356.48	0.00
Reach 1	2279	5 yr	17.70	242.68	246.90	243.64	246.90	0.000001	0.06	369.99	359.62	0.01
Reach 1	2279	10 yr	25.80	242.68	246.91	243.79	246.91	0.000003	0.08	371.44	363.97	0.02
Reach 1	2279	20 yr	34.50	242.68	246.92	243.95	246.92	0.000005	0.11	373.62	369.48	0.02
Reach 1	2279	50 yr	47.00	242.68	246.93	244.07	246.93	0.000010	0.14	378.00	379.97	0.03
Reach 1	2279	100 yr	57.00	242.68	246.39	244.13	246.40	0.000032	0.23	269.05	165.47	0.05
Reach 1	2279	200 yr	67.40	242.68	246.43	244.19	246.43	0.000042	0.26	275.19	167.63	0.06
Reach 1	2279	500 yr	81.90	242.68	246.49	244.28	246.50	0.000056	0.31	285.81	175.42	0.07
Reach 1	2279	1000 yr	93.20	242.68	246.55	244.34	246.56	0.000066	0.34	296.10	182.55	0.07
Reach 1	2279	Timmins	129.00	242.68	246.81	244.48	246.81	0.000087	0.42	345.90	281.40	0.09
Reach 1	2279	100CCMid	75.80	242.68	246.47	244.24	246.47	0.000050	0.29	281.01	171.67	0.06
Reach 1	2279	100CCEnd	94.60	242.68	246.56	244.34	246.57	0.000067	0.35	297.51	183.53	0.07
Reach 1	1889	2 yr	7.80	241.78	246.90	242.44	246.90	0.000000	0.02	329.21	160.50	0.00
Reach 1	1889	5 yr	17.70	241.78	246.90	242.69	246.90	0.000001	0.06	329.77	160.58	0.01
Reach 1	1889	10 yr	25.80	241.78	246.91	242.85	246.91	0.000002	0.08	330.54	160.70	0.01
Reach 1	1889	20 yr	34.50	241.78	246.92	242.99	246.92	0.000004	0.11	331.70	160.88	0.02
Reach 1	1889	50 yr	47.00	241.78	246.93	243.15	246.93	0.000007	0.15	333.99	161.23	0.03
Reach 1	1889	100 yr	57.00	241.78	246.38	243.25	246.39	0.000021	0.22	264.99	105.00	0.04
Reach 1	1889	200 yr	67.40	241.78	246.42	243.34	246.42	0.000028	0.25	268.62	106.98	0.05
Reach 1	1889	500 yr	81.90	241.78	246.48	243.45	246.48	0.000038	0.30	274.93	108.32	0.06
Reach 1	1889	1000 yr	93.20	241.78	246.53	243.52	246.54	0.000046	0.33	280.96	109.42	0.06
Reach 1	1889	Timmins	129.00	241.78	246.77	243.73	246.78	0.000067	0.42	309.63	144.09	0.08
Reach 1	1889	100CCMid	75.80	241.78	246.45	243.40	246.45	0.000034	0.28	272.09	107.80	0.05
Reach 1	1889	100CCEnd	94.60	241.78	246.54	243.53	246.55	0.000047	0.34	281.78	109.57	0.06
Reach 1	1817	2 yr	7.80	242.63	246.90		246.90	0.000003	0.08	95.92	41.85	0.02
Reach 1	1817	5 yr	17.70	242.63	246.90		246.90	0.000017	0.19	96.00	41.87	0.04
Reach 1	1817	10 yr	25.80	242.63	246.90		246.91	0.000036	0.27	96.11	41.89	0.05
Reach 1	1817	20 yr	34.50	242.63	246.91		246.92	0.000064	0.36	96.27	41.93	0.07
Reach 1	1817	50 yr	47.00	242.63	246.92		246.93	0.000117	0.49	96.61	42.01	0.10
Reach 1	1817	100 yr	57.00	242.63	246.35		246.38	0.000357	0.76	74.75	35.52	0.17
Reach 1	1817	200 yr	67.40	242.63	246.37		246.41	0.000484	0.89	75.53	35.74	0.20
Reach 1	1817	500 yr	81.90	242.63	246.41		246.47	0.000676	1.06	76.94	36.13	0.23
Reach 1	1817	1000 yr	93.20	242.63	246.45		246.52	0.000830	1.19	78.36	36.48	0.26
Reach 1	1817	Timmins	129.00	242.63	246.64		246.76	0.001231	1.51	85.63	38.31	0.32
Reach 1	1817	100CCMid	75.80	242.63	246.39		246.44	0.000594	0.99	76.29	35.95	0.22
Reach 1	1817	100CCEnd	94.60	242.63	246.46		246.53	0.000849	1.20	78.56	36.53	0.26
Reach 1	1794	2 yr	7.80	243.36	246.90	243.84	246.90	0.000005	0.10	78.99	40.06	0.02
Reach 1	1794	5 yr	17.70	243.36	246.90	244.09	246.90	0.000024	0.23	79.01	40.07	0.05
Reach 1	1794	10 yr	25.80	243.36	246.90	244.26	246.91	0.000051	0.33	79.05	40.09	0.07
Reach 1	1794	20 yr	34.50	243.36	246.90	244.41	246.91	0.000091	0.44	79.10	40.11	0.09
Reach 1	1794	50 yr	47.00	243.36	246.91	244.59	246.93	0.000169	0.60	79.21	40.15	0.12
Reach 1	1794	100 yr	57.00	243.36	246.32	244.72	246.37	0.000594	0.94	60.59	32.93	0.21
Reach 1	1794	200 yr	67.40	243.36	246.33	244.85	246.40	0.000815	1.11	60.93	33.02	0.25
Reach 1	1794	500 yr	81.90	243.36	246.35	245.00	246.44	0.001160	1.33	61.61	33.20	0.30
Reach 1	1794	1000 yr	93.20	243.36	246.38	245.12	246.49	0.001443	1.50	62.37	33.40	0.34
Reach 1	1794	Timmins	129.00	243.36	246.53	245.44	246.72	0.002186	1.93	67.03	34.61	0.42
Reach 1	1794	100CCMid	75.80	243.36	246.34	244.93	246.42	0.001011	1.24	61.29	33.11	0.28
Reach 1	1794	100CCEnd	94.60	243.36	246.38	245.13	246.50	0.001478	1.52	62.48	33.42	0.34
Reach 1	1780		Bridge									
Reach 1	1770	2 yr	7.80	243.46	246.90	244.00	246.90	0.000007	0.11	68.55	32.78	0.02
Reach 1	1770	5 yr	17.70	243.46	246.90	244.28	246.90	0.000039	0.26	68.51	32.77	0.06
Reach 1	1770	10 yr	25.80	243.46	246.90	244.46	246.90	0.000082	0.38	68.44	32.76	0.08
Reach 1	1770	20 yr	34.50	243.46	246.89	244.61	246.91	0.000147	0.50	68.35	32.73	0.11
Reach 1	1770	50 yr	47.00	243.46	246.89	244.81	246.91	0.000276	0.69	68.17	32.69	0.15
Reach 1	1770	100 yr	57.00	243.46	246.27	244.94	246.33	0.001032	1.15	49.58	28.24	0.28
Reach 1	1770	200 yr	67.40	243.46	246.25	245.07	246.35	0.001474	1.37	49.18	28.14	0.33
Reach 1	1770	500 yr	81.90	243.46	246.23	245.23	246.37	0.002262	1.69	48.50	27.97	0.41
Reach 1	1770	1000 yr	93.20	243.46	246.20	245.36	246.40	0.003040	1.95	47.84	27.80	0.47
Reach 1	1770	Timmins	129.00	243.46	246.09	245.69	246.52	0.006976	2.88	44.78	27.00	0.71
Reach 1	1770	100CCMid	75.80	243.46	246.24	245.17	246.36	0.001904	1.55	48.81	28.04	0.38
Reach 1	1770	100CCEnd	94.60	243.46	246.20	245.37	246.40	0.003149	1.98	47.75	27.77	0.48

HEC-RAS Plan: NogiesCreek 2024-02-27   River: Nogies Creek   Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	1761	2 yr	7.80	243.47	246.90	243.98	246.90	0.000003	0.07	125.17	175.13	0.01
Reach 1	1761	5 yr	17.70	243.47	246.90	244.20	246.90	0.000013	0.17	125.12	175.12	0.03
Reach 1	1761	10 yr	25.80	243.47	246.90	244.35	246.90	0.000027	0.24	125.05	175.10	0.05
Reach 1	1761	20 yr	34.50	243.47	246.90	244.48	246.90	0.000049	0.33	124.95	175.08	0.07
Reach 1	1761	50 yr	47.00	243.47	246.89	244.63	246.90	0.000092	0.45	124.75	175.02	0.09
Reach 1	1761	100 yr	57.00	243.47	246.28	244.73	246.31	0.000373	0.75	84.22	110.92	0.17
Reach 1	1761	200 yr	67.40	243.47	246.27	244.83	246.31	0.000529	0.89	83.74	109.47	0.20
Reach 1	1761	500 yr	81.90	243.47	246.26	244.96	246.32	0.000801	1.09	82.94	106.31	0.25
Reach 1	1761	1000 yr	93.20	243.47	246.25	245.05	246.32	0.001062	1.25	82.18	102.86	0.29
Reach 1	1761	Timmins	129.00	243.47	246.19	245.30	246.35	0.002247	1.78	79.00	90.93	0.42
Reach 1	1761	100CCMid	75.80	243.47	246.27	244.90	246.32	0.000679	1.00	83.30	107.67	0.23
Reach 1	1761	100CCEnd	94.60	243.47	246.25	245.05	246.33	0.001097	1.27	82.08	102.45	0.29
Reach 1	1633	2 yr	7.80	245.32	246.90		246.90	0.000000	0.02	477.29	561.64	0.00
Reach 1	1633	5 yr	17.70	245.32	246.90		246.90	0.000000	0.04	477.28	561.63	0.01
Reach 1	1633	10 yr	25.80	245.32	246.90		246.90	0.000000	0.06	477.26	561.62	0.02
Reach 1	1633	20 yr	34.50	245.32	246.90		246.90	0.000000	0.08	477.21	561.59	0.02
Reach 1	1633	50 yr	47.00	245.32	246.90		246.90	0.000000	0.11	477.14	561.55	0.03
Reach 1	1633	100 yr	57.00	245.32	246.30		246.30	0.000000	0.24	238.89	299.69	0.09
Reach 1	1633	200 yr	67.40	245.32	246.30		246.30	0.000000	0.28	238.71	299.68	0.10
Reach 1	1633	500 yr	81.90	245.32	246.30		246.30	0.000000	0.35	238.41	299.68	0.12
Reach 1	1633	1000 yr	93.20	245.32	246.30		246.30	0.000000	0.39	238.14	299.67	0.14
Reach 1	1633	Timmins	129.00	245.32	246.29		246.31	0.000000	0.55	237.01	299.65	0.20
Reach 1	1633	100CCMid	75.80	245.32	246.30		246.30	0.000000	0.32	238.54	299.68	0.11
Reach 1	1633	100CCEnd	94.60	245.32	246.30		246.30	0.000000	0.40	238.10	299.67	0.14
Reach 1	1352	2 yr	7.80	245.32	246.90		246.90	0.000000	0.01	800.16	677.19	0.00
Reach 1	1352	5 yr	17.70	245.32	246.90		246.90	0.000000	0.02	800.16	677.19	0.01
Reach 1	1352	10 yr	25.80	245.32	246.90		246.90	0.000000	0.04	800.16	677.19	0.01
Reach 1	1352	20 yr	34.50	245.32	246.90		246.90	0.000000	0.05	800.15	677.18	0.01
Reach 1	1352	50 yr	47.00	245.32	246.90		246.90	0.000000	0.06	800.16	677.19	0.02
Reach 1	1352	100 yr	57.00	245.32	246.30		246.30	0.000000	0.14	423.06	566.40	0.05
Reach 1	1352	200 yr	67.40	245.32	246.30		246.30	0.000000	0.17	423.02	566.39	0.06
Reach 1	1352	500 yr	81.90	245.32	246.30		246.30	0.000000	0.21	422.96	566.37	0.07
Reach 1	1352	1000 yr	93.20	245.32	246.30		246.30	0.000000	0.24	422.91	566.36	0.08
Reach 1	1352	Timmins	129.00	245.32	246.30		246.30	0.000000	0.33	422.68	566.30	0.11
Reach 1	1352	100CCMid	75.80	245.32	246.30		246.30	0.000000	0.19	422.99	566.38	0.06
Reach 1	1352	100CCEnd	94.60	245.32	246.30		246.30	0.000000	0.24	422.90	566.36	0.08
Reach 1	757	2 yr	7.80	245.32	246.90		246.90	0.000000	0.01	871.18	573.47	0.00
Reach 1	757	5 yr	17.70	245.32	246.90		246.90	0.000000	0.02	871.18	573.47	0.01
Reach 1	757	10 yr	25.80	245.32	246.90		246.90	0.000000	0.03	871.20	573.47	0.01
Reach 1	757	20 yr	34.50	245.32	246.90		246.90	0.000000	0.04	871.20	573.47	0.01
Reach 1	757	50 yr	47.00	245.32	246.90		246.90	0.000000	0.05	871.20	573.47	0.01
Reach 1	757	100 yr	57.00	245.32	246.30		246.30	0.000000	0.11	534.70	551.60	0.03
Reach 1	757	200 yr	67.40	245.32	246.30		246.30	0.000000	0.13	534.72	551.60	0.04
Reach 1	757	500 yr	81.90	245.32	246.30		246.30	0.000000	0.15	534.77	551.60	0.05
Reach 1	757	1000 yr	93.20	245.32	246.30		246.30	0.000000	0.17	534.81	551.60	0.06
Reach 1	757	Timmins	129.00	245.32	246.30		246.30	0.000000	0.24	534.97	551.60	0.08
Reach 1	757	100CCMid	75.80	245.32	246.30		246.30	0.000000	0.14	534.75	551.60	0.05
Reach 1	757	100CCEnd	94.60	245.32	246.30		246.30	0.000000	0.18	534.81	551.60	0.06
Reach 1	25	2 yr	7.80	245.32	246.90	245.35	246.90	0.000000	0.01	800.34	515.88	0.00
Reach 1	25	5 yr	17.70	245.32	246.90	245.37	246.90	0.000000	0.02	800.34	515.88	0.01
Reach 1	25	10 yr	25.80	245.32	246.90	245.38	246.90	0.000000	0.03	800.34	515.88	0.01
Reach 1	25	20 yr	34.50	245.32	246.90	245.40	246.90	0.000000	0.04	800.34	515.88	0.01
Reach 1	25	50 yr	47.00	245.32	246.90	245.42	246.90	0.000000	0.06	800.34	515.88	0.02
Reach 1	25	100 yr	57.00	245.32	246.30	245.43	246.30	0.000000	0.12	493.38	507.36	0.04
Reach 1	25	200 yr	67.40	245.32	246.30	245.44	246.30	0.000000	0.14	493.38	507.36	0.04
Reach 1	25	500 yr	81.90	245.32	246.30	245.46	246.30	0.000000	0.17	493.38	507.36	0.05
Reach 1	25	1000 yr	93.20	245.32	246.30	245.47	246.30	0.000000	0.19	493.38	507.36	0.06
Reach 1	25	Timmins	129.00	245.32	246.30	245.51	246.30	0.000000	0.26	493.38	507.36	0.08
Reach 1	25	100CCMid	75.80	245.32	246.30	245.45	246.30	0.000000	0.15	493.38	507.36	0.05
Reach 1	25	100CCEnd	94.60	245.32	246.30	245.47	246.30	0.000000	0.19	493.38	507.36	0.06