Council Meeting
Municipality of West Grey
402813 Grey County Rd 4, Durham, ON N0G 1R0

March 18, 2025, 9 a.m.

West Grey municipal office, council chambers and virtual

This meeting shall be held in the Municipality of West Grey council chambers. Members of the public may attend in person or electronically via Zoom.
To join through your computer (or smartphone with the Zoom app) go to: https://us02web.zoom.us/j/89156262480
To phone in and listen live dial +1 647 558 0588 (long-distance charges may apply)
When prompted, enter the meeting ID: 891 5626 2480
Accessibility of documents: Documents are available in alternate formats upon request. If you require an accessible format or communication support contact the Clerk's Department by email at clerk@westgrey.com or 519-369-2200 to discuss how we can meet your needs.

Pages

17.3 Bylaw No. 2025-023 379
"A bylaw to amend Fees and Charges Bylaw No. 2023-064
respecting dog tag fees."

18. Adjournment

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publicinfo@svca.on.ca

Report To: Municipality of West Grey Council

From: Matt Armstrong, Manager of Environmental Planning and Regulations, Saugeen Valley Conservation Authority

Date: March 18th, 2025

Subject: Durham Creek Floodplain Mapping Project

Purpose: To provide West Grey Council with an overview of the 2023-2024 Durham Creek floodplain mapping project

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Background

In January 2022, Natural Resources Canada launched the Flood Hazard Identification and Mapping Program (FHIMP) to make flood hazard information more accessible. Though this program, 165 million dollars was invested by the government of Canada to increase the resiliency of Canadians in the face of the rising frequency and costs of flood events and other climate-related disasters. Flood hazard maps inform decision-making in support of land use planning, flood mitigation, climate change adaptation, resilience building and protection of lives and properties.

Opportunity to partner with Saugeen Valley Conservation Authority (SVCA) was presented to all 15 municipalities in the Saugeen watershed. Up to 50% matched federal funding to provinces and territories was made available for eligible flood mapping projects. The Municipality of West Grey, the Town of Saugeen Shores, and the Township of Huron-Kinloss decided to proceed with mapping for the desired areas within their municipalities. SVCA was the program applicant and acted as project coordinator. Engineering companies were contracted through the Request for Proposal (RFP) process to complete all necessary modelling and mapping required to generate flood hazard maps, as well as for independent peer review.

In September 2022, West Grey Council approved a matching funding contribution of $25,000 towards floodplain mapping for Durham Creek, which was identified as a priority area by and for the Municipality of West Grey.

Through the RFP process, DM Wills Associates Ltd. was awarded the project, which included the creation of hydrologic and hydraulic models, two public consultation sessions, and the creation of a floodplain report and mapping (see attached). Due to the influence that the Saugeen River has on the Durham Creek Floodplain, modelling was also carried out for the Saugeen River.

All mapping results underwent extensive third-party review by an independent engineering consultant procured through the RFP process, and members of the provincial and federal government administering the grant program. Through this review process, all models and maps were thoroughly scrutinized with respect to the data collected, hypotheses made, and regulatory standards/guidelines. Extensive modelling calibration and a sensitivity analysis were completed to ensure that the hypotheses (where applicable) were valid and appropriate for the model being produced.

The project was completed in 2024, and Saugeen Conservation's floodplain hazard information has been updated to incorporate the floodplain mapping produced by DM Wills (page 252 and 253 of the DM Wills report). Similar to the rest of Durham, the Durham Creek floodplain is managed in accordance with Two-Zone policy. This policy divides the floodplain into two areas: the flood way, where flood depths and velocities are greatest and development is generally not permitted, and the flood fringe, where development may be permissible subject to conditions. These areas are shown in blue and red respectively on the DM Wills maps.

The DM Wills report included the following recommendations:

1. SVCA and the Municipality of West Grey should update the floodplain mapping for the Saugeen River and then consider updates to their Two-Zone floodplain planning policies and development approvals processes for both Durham Creek and the Saugeen River in alignment with the revised mapping.
2. Given the potential significant impacts of a failure of the dike at the Durham Upper Dam, the SVCA and Municipality of West Grey should consider the development of an Emergency Preparedness and Response Plan (EPRP) for the structure.

Prepared by:
[Original signed by:]
Matt Armstrong
Manager of Environmental Planning and Regulations

Approved by:
[Original signed by:]
Erik Downing
General Manager / Secretary-Treasurer

Flood Hazard Mapping Report

Durham Creek
Flood Hazard Mapping Project

Municipality of West Grey, Ontario

D.M. Wills Project Number 23-5591

D.M. Wills Associates Limited
Partners in Engineering
Peterborough

March 2024

Prepared for:
Saugeen Valley
Conservation Authority

Summary of Revisions

Revision	Revision Title	Date of Release	Summary of Revisions
1	Hydrology Report	December 18, 2023	Issued for Client Review
2	Draft FHM Report	February 26, 2024	Issued for Client Review
3	Final FHM Report	March 1, 2024	Issued as Final

This report / proposal has been formatted considering the requirements of the Accessibility for Ontarians with Disabilities Act.

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Figures

Tables

Appendices

1.0 Introduction

1.1 Background

The Saugeen Valley Conservation Authority (SVCA), in partnership with the Municipality of West Grey, has recognized the need to develop hydrologic and hydraulic modelling and regulatory flood hazard mapping for Durham Creek in the Town of Durham, Municipality of West Grey, Ontario. There is no existing flood hazard mapping for Durham Creek. Funding for this project is provided, in part, through the Flood Hazard Identification Mapping Program (FHIMP), which, in Ontario, is administered by the Ministry of Natural Resources and Forestry (MNRF).

1.2 Objective

The objective of this project is to provide regulatory flood hazard and flood risk mapping for Durham Creek. In addition to this work, this report covers the development of hydrologic and hydraulic models for the Saugeen River through Durham, Ontario, in order to assess the spill from the Saugeen River into Durham Creek at the Durham Upper Dam. Durham Creek extends approximately 1.3 km northeast from its confluence with the Saugeen River, which is located approximately 50 m west of the intersection of Countess Street South and South Street West. The drainage area for the Durham Creek watershed upstream of the confluence with the Saugeen River was calculated to be 0.87 km^2. The drainage area for Saugeen River upstream of the Durham Upper Dam was calculated to be 347.3 km^2.

1.3 Study Process and Report Organization

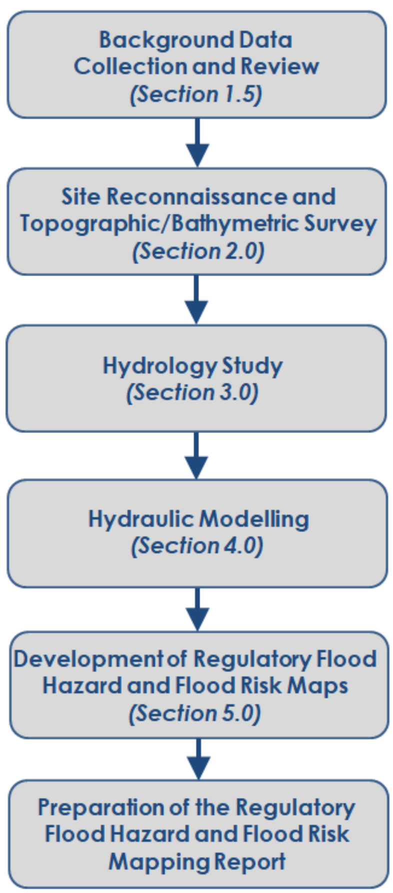
The regulatory floodplain and flood risk mapping study process is documented in Figure 1 and generally involves the following key phases:

- Background Data Collection and Review – The background data collection and review involved the collection and review of available background information from the SVCA and Municipality of West Grey. The available information is summarized in Section 1.5.
- Site Reconnaissance and Topographic/Bathymetric Survey – The site reconnaissance and topographic/bathymetric survey involved field work to survey and photograph existing bridge/culvert structures and collect in-water creek cross sections to supplement the LiDAR data. The outputs from the site reconnaissance are used as inputs into the hydraulic modelling. The site reconnaissance and topographic/bathymetric survey is described in Section 2.0.
- Hydrology Study – The hydrology study included the delineation of the Durham Creek watershed, delineation of the applicable Saugeen River watershed and sub-watersheds, characterization of the sub-watersheds, development of a HEC-HMS (Version 4.11) model, and calibration/validation of the HEC-HMS model. The outputs from the hydrology study are the Regional Storm (Hurricane Hazel), and Annual Exceedance Probability peak flow rates, which are used as inputs into

the hydraulic modelling. The hydrology study is described in Section 3.0 of this report.

- Hydraulic Modelling – The hydraulic modelling will include the preparation of the base topographic data and the development of a two-dimensional (2D) unsteady-state HEC-RAS model. The model will be created using HEC-RAS (Version 6.4.1). The development of the hydraulic model is described in Section 4.0.
- Development of Regulatory Flood Hazard and Flood Risk Maps – The development of regulatory flood hazard and flood risk maps involves using the outputs from the hydraulic modelling to create the final mapping products in ArcGIS. The outputs from this phase of the project include both paper/pdf maps as well as digital flood lines. The development of the regulatory flood hazard and flood risk maps is described in Section 5.0.
- Preparation of the Regulatory Flood Hazard and Flood Risk Mapping Report – This report documents the inputs and results of all analyses associated with the project as well as the final results.

Figure 1 – Study Process



1.4 Study Area

The primary focus of this study is on Durham Creek and the section of the Saugeen River flowing through the Town of Durham, in the Municipality of West Grey, Ontario. Durham Creek extends approximately 1.3 km northeast from its confluence with the Saugeen River. The Saugeen River study area starts just north of the Grey County Road 4 bridge crossing and extends upstream approximately 8.5 km through the Town of Durham, ending before the Concession Road 2 bridge crossing. The full extent of the study area is shown in Figure 2.

There are four bridges and three dams along the Saugeen River and there are 23 culverts and foot bridges along Durham Creek. Each bridge, culvert, and dam, as well as the upstream and downstream bathymetry (where possible), was surveyed as part of the study. Additional discussion on the site reconnaissance and topographic and bathymetric survey is provided in Section 2.0.

While the hydraulic modelling and flood hazard mapping are limited to the extents described above for Durham Creek, the hydrology study included the full extent of the Saugeen River watershed upstream of the Grey County Road 4 bridge crossing. Additional discussion on the hydrology study, including the catchment and sub-catchment area plans, is provided in Section 3.0.

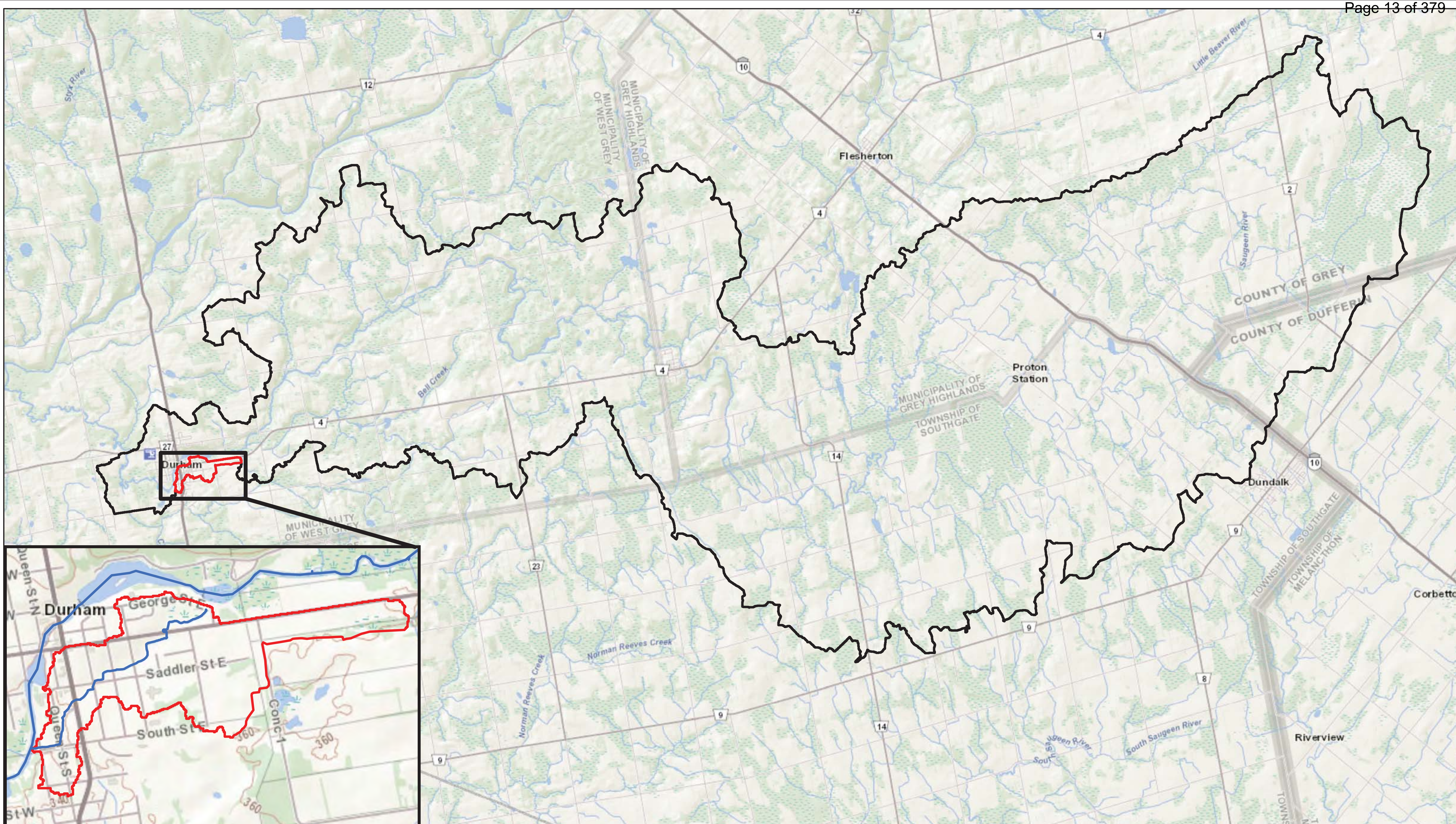
1.5 Available Information

There have been several projects addressing the hydrology and flooding of the Saugeen River and Durham Creek, dating as far back as 1966. Table 1 shows a list of the background studies and previous maps provided by SVCA as background for this project.

Table 1 – Background Information Provided

Report / Model	Description	Date
Historical Flood Records	Multiple documents reviewed for background information review.	Multiple
Durham Upper Dam Drawings	Durham Upper Dam Repair Drawings	1966
Durham Upper Dam Drawings	Plan, Sections, and drawings for the Durham Upper Dam and Dike.	1976
Durham Upper Dam Site Report	Site Investigation for the Durham Upper Dam	1976
Durham Lower Dam Drawings	Engineered Drawing for the Durham Lower Dam	1978/1982
Floodline Mapping Study	Floodplain mapping report for the Town of Durham completed by Latham Group	1983

Report / Model	Description	Date
Durham Upper Dam Hydraulic Assessment	Hydraulic Assessment of the Durham Upper Dam for the purposes of Dam Safety completed by WESA.	2009
LiDAR Mapping	Ontario Elevation Mapping Program.	2023
Existing GIS Data	Existing GIS data files of existing floodlines, floodplain data and aerial imagery.	Unknown
Stream Gauge Data	Stream gauge data for multiple gauges in the area of the site.	Data up to 2023
West Grey Official Plan	Official Plan for the Municipality of West Grey.	2012
Grey County Official Plan	Official Plan for Grey County, including Appendices A to E, Schedules A, B and C, and Secondary Schedules.	2019



Legend
Subwatershed Boundary
Durham Creek Watershed Boundary

Figure 2
Saugeen and Durham
Creek Watersheds

Data Sources:
Soil Survey Complex, GEOHUB 2023
SCOOP 2010, GEOHUB 2023

NAD 1983 UTM Zone 17N
1:110,000
Meters
0 2,500 5,000

N

Drawn By:	SO
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2.0 Site Reconnaissance and Topographic/Bathymetric Survey

2.1 Overview

The development of the hydraulic model and regulatory flood hazard and flood risk maps requires the use of topographic and bathymetric survey data. The primary source of topographic data for this project was the LiDAR Digital Terrain Model (DTM) that was provided by the Ministry of Natural Resources and Forestry (MNRF). The LiDAR DTM was supplemented with topographic survey of bridges, culverts, dams, and bathymetric survey of representative channel cross-sections. Wills' survey was completed in July 2023.

2.2 LiDAR Digital Elevation Model

The primary source of topographic data for this project was the LiDAR-derived Ontario Digital Terrain Model (DTM) that was provided by the MNRF through Ontario GeoHub. The DTM represents the bare earth surface and was generated from the classified LiDAR point cloud data. The User Guide, Digital Terrain Model (Lidar Derived) (MNRF, 2023), identifies the coordinate reference systems used as:

> The horizontal datum of the products is the North American Datum of 1983 Canadian Spatial Reference System epoch 2010 (NAD83 (CSRS)). The horizontal unit of measure (coordinate system axis units) for all raster grid cells is metres (m).
>
> The vertical coordinate system of the products is based on the Canadian Geodetic Vertical Datum 2013 (CGVD 2013) of the Geodetic Survey Division and is measured in metres (m).

The User Guide, Digital Terrain Model (Lidar Derived) (MNRF, 2023) indicated that the DEDSFM Huron-Georgian Bay LiDAR data that was utilized as part of the Durham Creek flood hazard mapping project has a non-vegetated vertical accuracy of 8.5 cm at a 95% confidence level (MNRF, 2023), and a vegetated accuracy of 10.06 cm. Further information regarding the accuracy and quality of the DTM can be found in the User Guide, Ontario Digital Terrain Model (LiDAR-Derived) (MNRF, 2023).

A comparison of the topographic survey and LiDAR DTM to determine whether the LiDAR DTM and topographic survey data points were generally within the expected margin of error of the survey equipment (+/- 0.10 m) was completed as part of the hydraulic report.

The DTM was used to create the overbank portions of cross sections for input into the hydraulic model. The DTM was also used as the base dataset to create the regulatory flood hazard and flood risk maps. All coordinates used throughout this study are expressed using NAD83 (CSRS) horizontal datum and CGVD2013 vertical datum. All future development proposals within the regulated area of Durham Creek will need to be presented on the same coordinate system to ensure a direct comparison, including referencing a control monument of appropriate accuracy.

2.3 Topographic and Bathymetric Survey

The LiDAR DTM does not include the channel surface below the water level and does not define the hydraulic conveyance characteristics of the bridges, culverts, or dams, therefore, topographic and bathymetric survey was required. Wills undertook the topographic and bathymetric survey in July 2023 using a survey grade GPS rover and total station survey equipment. The horizontal datum used in the survey was NAD83 (CSRS), and the vertical datum used in the survey was CGVD 2013 to be consistent with the LiDAR data.

As part of the topographic survey, Wills surveyed each bridge, culvert and dam crossing of Durham Creek and the Saugeen River. This survey included 30 bridges, culverts, and dams. The survey of these structures was performed with the intention of gathering the information required for the development of the hydraulic model. The bridge surveys collected elevations related to the top of deck, soffit, abutments, flow obstructions (such as barrier walls) and the overflow surface (weir flow). The culvert surveys collected elevations related to inverts, obverts, dimensions, flow obstructions (such as barrier walls) and the overflow surface (weir flow).

Bathymetric cross-sections were surveyed upstream and downstream of each bridge, culvert, and dam structure, where possible. Full creek and river cross-sections were surveyed when possible; however, there were some locations that could not be safely accessed due to water level and flow conditions in the Saugeen River. Where possible, additional cross-sections were surveyed upstream and downstream of the bridge, culvert, or dam to assist with defining the overall slope for each reach of the creek and define the bathymetry of the channel between structures.

The results of the survey, along with numerous other field measurements, were used to define the structures and channel bathymetry within the hydraulic model.

3.0 Hydrology Study

3.1 Overview

The purpose of the hydrology study is to determine the peak flows at key locations along Durham Creek and the Saugeen River for the 1% Annual Exceedance Probability (AEP) return period as well as the Regional Storm (Hurricane Hazel). The results of the hydrology study are the key inputs into the hydraulic model. The regulatory flood event for the SVCA is the flood produced by the Hurricane Hazel storm or the 1% AEP flood, whichever is greater.

The hydrology study involved the development, calibration, and validation of a new hydrologic model using HEC-HMS (Version 4.11). The hydrologic model development included the following tasks:

- Delineation of the Durham Creek and Saugeen River catchments and sub-catchments.
- Characterization of the Durham Creek and Saugeen River catchments and sub-catchments.
- Characterization of channel routing elements.
- Development of return period storms and the Hurricane Hazel hyetographs.

Traditional calibration was possible as there is a flow gauge in the Saugeen River Watershed. Wills validated the results of the of the HEC-HMS model by comparing the hydrologic modeling results to measured flows from Water Survey of Canada Station 02FC016 (Saugeen River Above Durham).

The following sections describe the background information used in the analyses, presents the results of the hydrology study, and identify the peak flows to be used in the hydraulic model.

3.2 Available Data

3.2.1 Precipitation Data and Design Storms

3.2.1.1 Annual Exceedance Probability Storm Event and Distribution

The 1% Annual Exceedance Probability (AEP) total rainfall volume for Durham Creek is based on the Intensity-Duration-Frequency (IDF) parameters in Durham in the Municipality of West Grey and come from the MTO IDF Curve Lookup Tool. The IDF parameters and additional information regarding MTO IDF Curve Lookup Tool data sources and development are provided in Appendix B1.

The 1% AEP total rainfall volume for the Saugeen River was calculated using a single station frequency analysis. The single station frequency analysis utilized one Water Survey of Canada station that is located within the Saugeen River watershed on the Saugeen River, just upstream of the Town of Durham. Further information regarding the single station frequency analysis can be found in Section 3.5.2.

The total rainfall volumes were distributed based on various synthetic storm distributions for use within the hydrologic model. The most common synthetic storm distributions for the purposes of flood hazard mapping are the 12-hour AES storm distribution, and the 6-hour, 12-hour, and 24-hour SCS Type II storm distributions. The 6-hour SCS Type II storm was used in the hydrologic model to estimate the peak flows for Durham Creek. Rationale for choosing the 6-hour duration is discussed in Section 3.3.10.

3.2.1.2 Regional (Hurricane Hazel) Storm

The Regional Storm is considered the worst storm on record to have hit a particular region. As per the Technical Guide - River and Stream Systems: Flood Hazard Limit (MNR, 2002), Figure B-1, the Durham Creek and Saugeen River watersheds are within Zone 1, meaning that the Regional Storm is the Hurricane Hazel Storm.

Hurricane Hazel was adopted by the Ministry of Natural Resources as the storm for watersheds located within Zone 1. The 48-hour storm was developed from rainfall gauge data located at Snelgrove, just north of Brampton. The full storm is to be applied to watersheds with areas less than 25 km^2, with an areal reduction factor applied for larger drainage areas. The rainfall distribution for the Hazel Storm is based on the Technical Guide - River and Stream Systems: Flood Hazard Limit (MNR, 2002); the rainfall hyetograph is included in Appendix B1.

3.2.1.3 Climate Change

Wills completed a climate change scenario for the Hurricane Hazel storm based on the methodology provided by the project team for incorporating climate change in the FHIMP where the Regulatory Storm Event is Hazel. The suggested method for incorporating climate change for flood hazard modelling under FHIMP is based on recommendations by Environment and Climate Change Canada (ECCC) and can be found on the climate data portal. The method described by ECCC is outlined as follows:

1. Obtain the hyetograph for the regulatory storm to obtain the hourly rainfall intensity.
2. Obtain the mean annual temperature change (ΔT) for the specified location from the federal climate data portal. The MNRF recommends obtaining this value for the 50th percentile of the mean annual temperature change for the RCP 4.5 scenario (using CMIP 5) for time horizon 2050. The mean annual temperature change for the RCP 4.5 was 2.94 °C for Durham Creek.
3. Calculate the future estimated rainfall intensity, R_P, using the equation below, where R_C is the historic estimate rainfall intensity and ΔT is the long term (30-year mean) annual mean temperature change.

$$R_p = R_c x 1.07^{\Delta T}$$

4. Apply the future estimated rainfall (R_P)to a hydrologic model to produce estimated flood flows.

The results of applying the estimated future intensity for the Hurricane Hazel storm for climate change scenario RCP 4.5 in the year 2051 for Durham, Ontario can be found in Table 2.

Table 2 – Estimated Future Intensity of Hurricane Hazel Storm

Time (hrs)	Historic Estimated Intensity Hazel (mm/hr)	% of the Last 12 Hours	Future Estimated **Intensity ΔT=2.94**	% Increase in Intensity
First 36 hours	2.0	-	0.0	22.0%
37.0	6.0	3.0	7.3	22.0%
38.0	4.0	2.0	4.9	22.0%
39.0	6.0	3.0	7.3	22.0%

Time (hrs)	Historic Estimated Intensity Hazel (mm/hr)	% of the Last 12 Hours	Future Estimated **Intensity ΔT=2.94**	% Increase in Intensity
40.0	13.0	6.0	15.9	22.0%
41.0	17.0	8.0	20.7	22.0%
42.0	13.0	6.0	15.9	22.0%
43.0	23.0	11.0	28.1	22.0%
44.0	13.0	6.0	15.9	22.0%
45.0	13.0	6.0	15.9	22.0%
46.0	53.0	25.0	64.7	22.0%
47.0	38.0	18.0	46.4	22.0%
48.0	13.0	6.0	15.9	22.0%
Total	285.0	100.0	347.7	22.0%

Application of this climate change scenario resulted in a total of 347.7 mm representing a 22.0% increase in rainfall volume and intensity over the historic storm. The same methodology was applied to the 4%, 2%, 1% AEP storm durations and can be found in Appendix B.

3.2.2 Land Cover and Soils Data

Soils data was obtained from the Soil Survey Complex GIS Data available on GeoHub for southern Ontario. In 2015, the Ontario Ministry of Agriculture, Food and Rural Affairs and Agriculture (OMAFRA) and Agri-Food Canada, in cooperation with the Ministry of Natural Resources, compiled a geo-spatial soils database for southern Ontario. The database consolidated the existing digital soil data, mapped on a county basis, into a digitally stitched and standardized product. The GIS data indicate that the Saugeen River watershed soils consists of mostly loam in the lower basin, and organic and silty loam in the upper basin. The GIS data also indicates that most of the Durham Creek Watershed is unavailable but has sandy loam in the middle basin, and Loam in the upper basin. For the purposes of this study the lower two basins were assumed to be sandy loam and the upper basin was assumed to be loam. The soils map is included in Figure 3.

The data used to define the land cover within the Saugeen River and Durham Creek watersheds were the Southern Ontario Land Resource Information System V3.0 (SOLRIS). The data was downloaded from the MNRF's GeoHub database. SOLRIS is a landscape level inventory of natural, rural, and urban areas for the Province of Ontario with a 15 m resolution (MNRF, 2019). There are 32 landcover types in SOLRIS and these were consolidated by Wills to 7 land cover types with similar hydrologic parameters for the purposes of this study. For example swamp and thicket swamp were grouped as "wetland", and deciduous forest and coniferous forest were grouped as "forest" (MNRF, 2019). The Saugeen River Watershed is primarily comprised of agricultural land, wetlands, and forest, while the Durham Creek Watershed is primarily built-up area and agricultural land. The land cover map is included in Figure 4.

3.2.3 Ontario Base Map Data

Ontario Base Map (OBM) data were downloaded from the MNRF's GeoHub database. The data used in this study included watercourses, wetlands, woods, and roads.

3.2.4 LiDAR Digital Terrain Model and Catchment Delineation

The primary source of topographic data for the hydrology study was the LiDAR DTM that was provided through the MNRF's GeoHub. The LiDAR for this project was collected as part of the DEDSFM Huron-Georgian Bay Project in 2022-23. The DTM represents the bare earth surface and was generated from the classified LiDAR point cloud data. Published vertical accuracy for the DEDSFM Huron-Georgian Bay Project is 8.5 cm in non-vegetated conditions and 10.06 cm in vegetated conditions (MNRF, 2023). Native Resolution of the DTM was 50 cm and was used for determining characteristics cross sections and slope data. This DTM was resampled to a 5 m resolution and was used to delineate the Saugeen River and Durham Creek basins and subbasins and longest flow paths with HEC-HMS. A map of the subbasins can be found in Figure 5.

3.2.5 Recorded Hydrometric Data

The maximum annual instantaneous discharge data and maximum annual daily discharge data were downloaded from the Water Survey of Canada website for the stream gauge station shown in Table 3. There is no discharge data available for Durham Creek.

Table 3 – Recorded Hydrometric Data

River	Station ID	Co-ordinates	Subasin Area (km^2)	Period of Record (years)
Saugeen River Above Durham	02FC016	44°11'07" N 80°47'14" W	329.0	39

The annual instantaneous peak flow data were used to complete a Single Station Frequency Analysis for the stream gauging station, the results of which were used to assist with the development and calibration of the hydrologic model.

3.2.6 Municipal Layers

Wills received Official Plans and a geodatabase for the Municipality of West Grey and Grey County. Based on the review of the Official Plan and Zoning, no areas of significant future development were identified. It is anticipated that any future land use conditions in the Town of Durham or within the Saugeen River Watershed as a whole will be similar to the current conditions. A map of the future land use conditions can be found in Appendix B4.

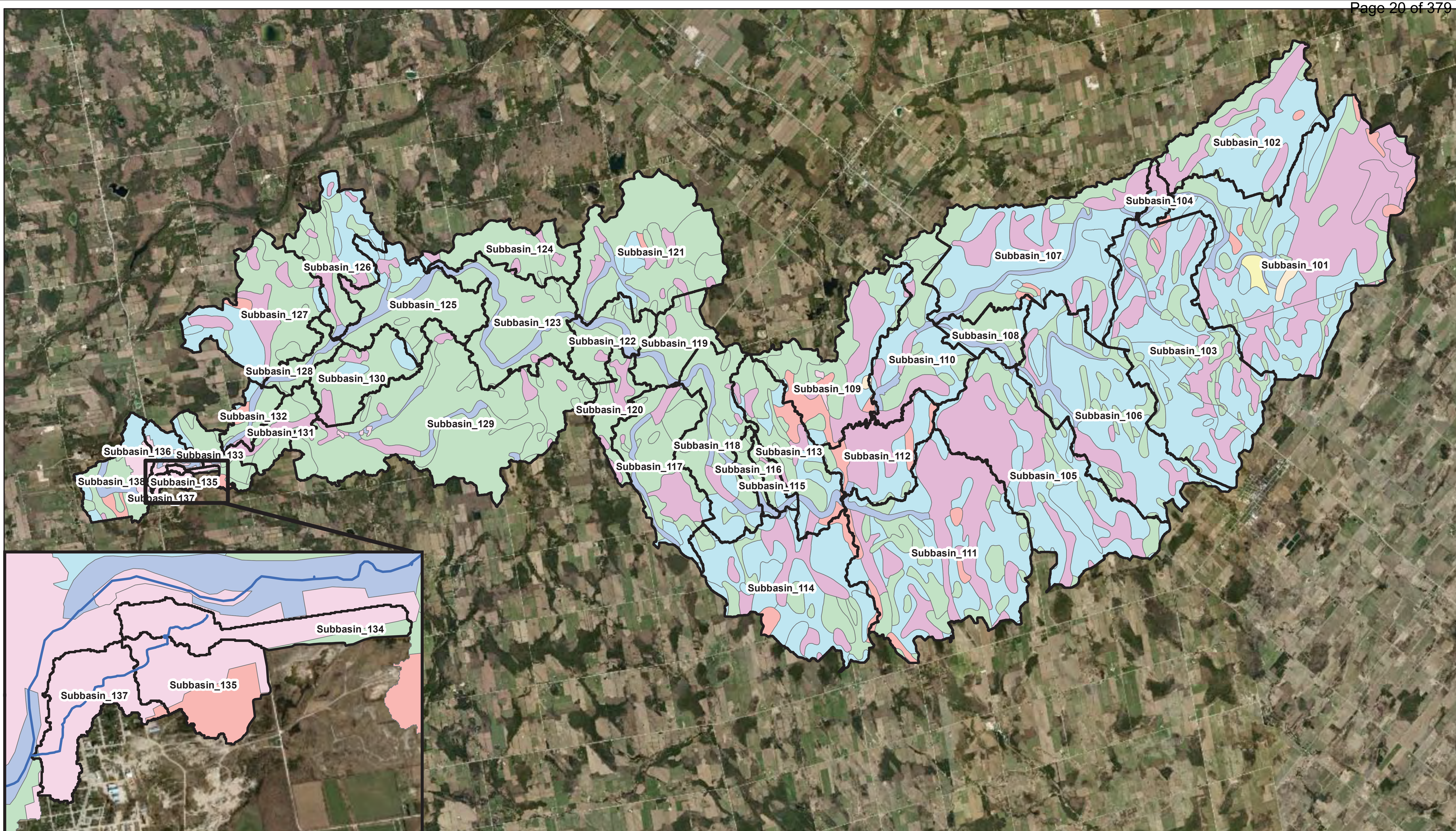

Figure 3
Soil Textures for
Durham Creek

Legend

- Watercourse
- Subwatershed Boundary

Soil Texture

- Clay Loam
- Loam
- Not Available
- Organic
- Sand
- Silty Loam
- Sandy Loam
- Variable

Data Sources:
Soil Survey Complex, GEOHUB 2023
SCOOP 2010, GEOHUB 2023

NAD 1983 UTM Zone 17N
1:110,000
Meters
0 2,500 5,000

N

Drawn By:	SO
Checked By:	MC/DG
Map Date:	2/29/24
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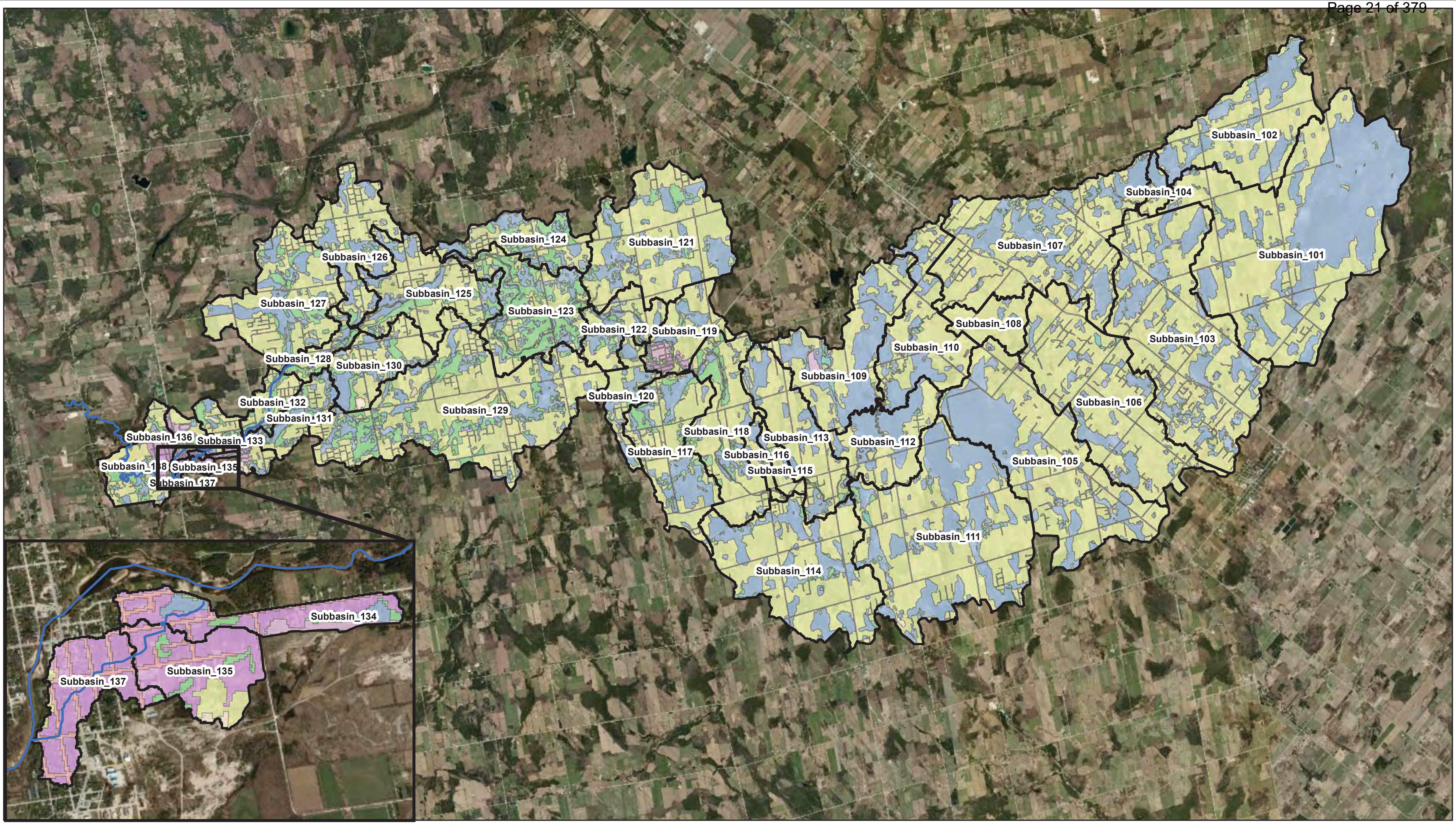

Figure 4
Land Cover for
Durham Creek

Legend

Subwatershed Boundary
Watercourse

Land Cover
- Agriculture
- Built -Up Area – Impervious
- Built -Up Area – Pervious
- Extraction – Aggregate
- Forest
- Open Water
- Transportation
- Wetland

Data Sources:
Soil Survey Complex, GEOHUB 2023
SCOOP 2010, GEOHUB 2023

NAD 1983 UTM Zone 17N
1:110,000
Meters
0 2,500 5,000

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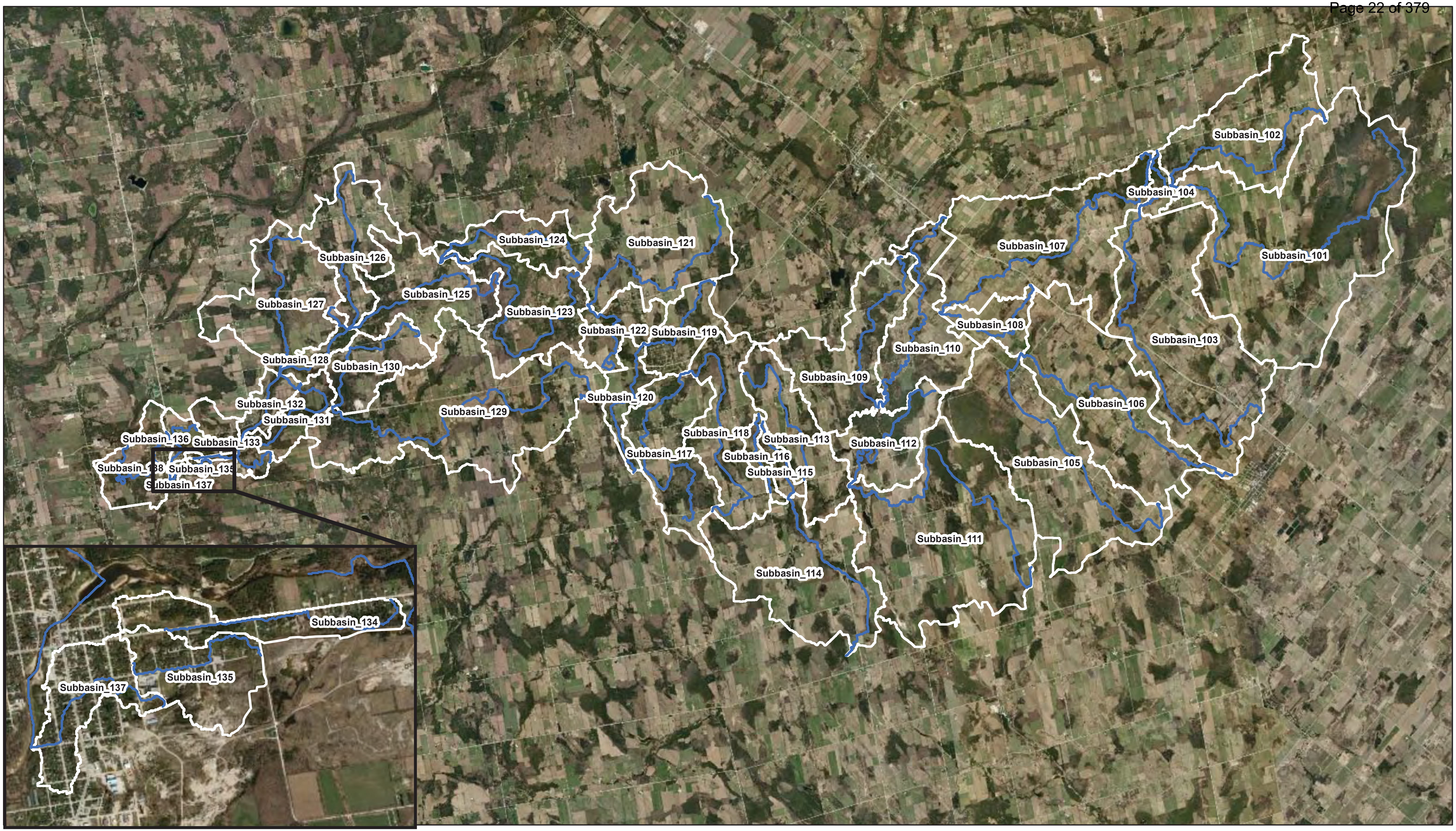

Figure 5
Subwatershed Boundary and Longest Flow Paths for the Saugeen River

Legend

Longest_Flowpath

Subwatershed Boundary

Data Sources:
Soil Survey Complex, GEOHUB 2023
SCOOP 2010, GEOHUB 2023

NAD 1983 UTM Zone 17N
1:110,000
Meters
0 2,500 5,000

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3.3 Hydrologic Model Development

3.3.1 Model Selection

The HEC-HMS (Version 4.11) hydrologic model was selected by the project team and the SVCA as the preferred hydrologic model to be used for this project. HEC-HMS is a free hydrologic modeling software developed and maintained by the U.S Army Corps of Engineer's (USACE) Hydrologic Engineering Centre (HEC) with a long history of use in Canada and internationally. The software can simulate the complete hydrologic process of watersheds including rainfall, snowmelt, evapotranspiration, and soil moisture accounting in lumped, semi-lumped or gridded models. HEC-HMS is capable of single event or continuous modeling simulations and allows the user significant control of modeling approaches for each hydrologic process. Built in analysis tools to HEC-HMS include GIS, model optimization, forecasting streamflow, assessing model uncertainty, erosion and sediment transport, and water quality. HEC-HMS is well integrated with other HEC software products. The software is suitable for many applications including watershed studies, flood hazard mapping, dam safety reviews, hydraulic structure design, and flood forecasting exercises.

The following information is required to calculate the input parameters for HEC-HMS to compute hydrographs, peak flows, and routing information:

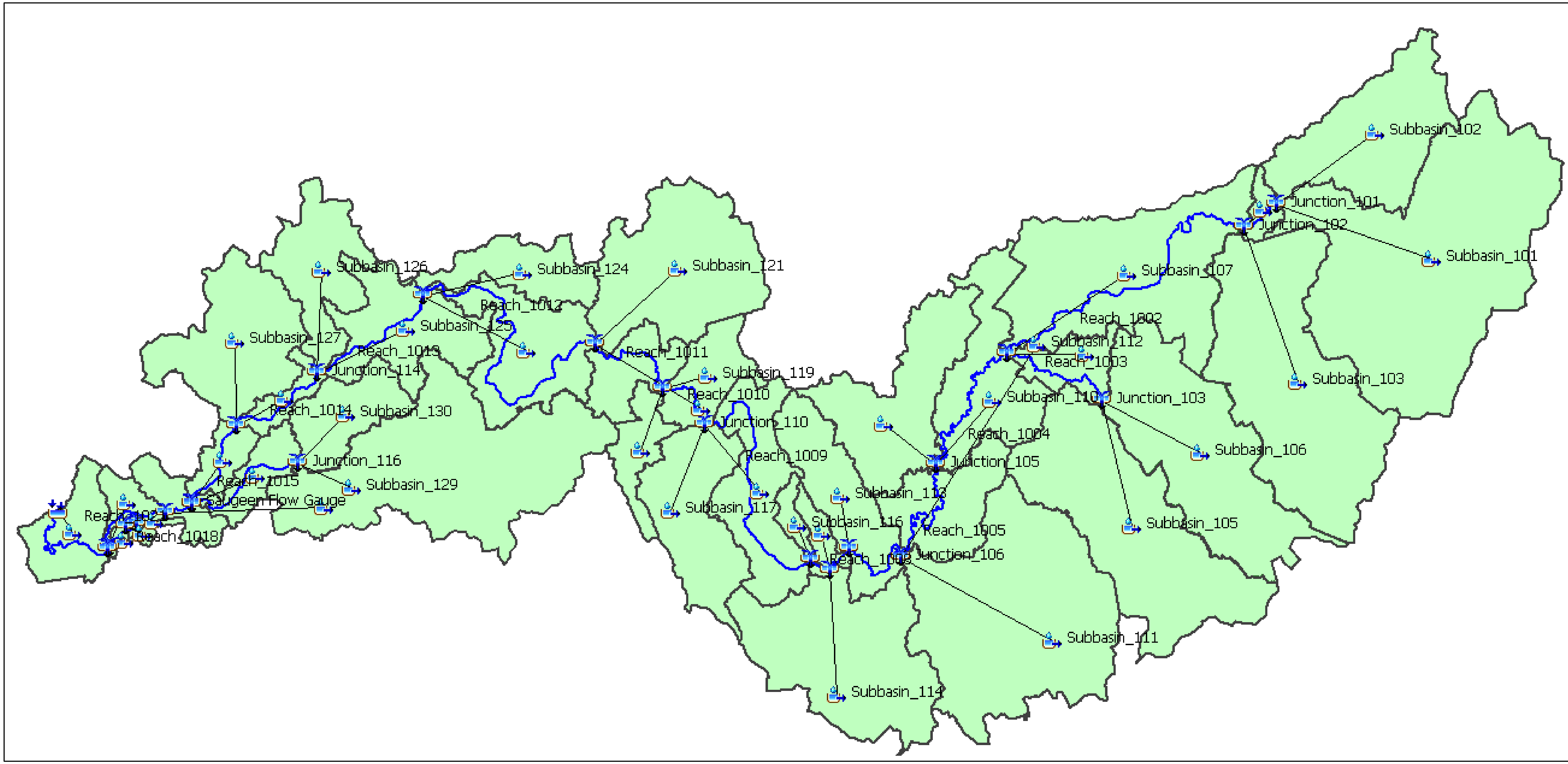
- Physical characteristics of subbasins to compute infiltration and runoff, which includes topographic information, soil drainage features, and land cover.
- Physical characteristics of the watercourses for reach routing, which includes slope, length, geometry, and reach roughness.
- Meteorological information such as rainfall, and when modeling snowmelt, temperature and snow water equivalent, to calculate hydrographs and peak flows at points of interests.

A single event, semi lumped modeling approach was chosen for computing peak flows and hydrographs for this study based on the available data and modeling objectives.

3.3.2 Subbasin Delineation and Hydrologic Elements

The Saugeen River and Durham Creek catchment areas were subdivided into 38 sub-basins, 21 routing reaches, and 21 junctions based on the various tributaries and the anticipated flow change locations in the hydraulic model. The subbasins were delineated using the 5 m resolution LiDAR DTM and enforcing hydrology in HEC-HMS. The sub-catchment boundaries can be found in Figure 5. Subbasin drainage areas ranged from 0.27 km^2 to 36.12 km^2. The routing reach lengths ranged from 335 m to 11,293 m. The model layout and schematic can be found in Figure 6.

Figure 6 – HEC-HMS Model Schematic



3.3.3 Catchment Characterization

The Saugeen River generally flows in a southwesterly direction through the Town of Durham. The headwaters originate just east of County Road 2 near the Town of Maxwell. The landcover is mixed rural and low to medium density residential with some commercial within the Town of Durham.

The Saugeen River catchment area was delineated using the LiDAR DTM and HEC-HMS. The Saugeen River has a total drainage area of 347.3 km^2 and is approximately 81.3 km by longest flowpath (not including all tributaries). Its topography can be described as rolling hills with a significant change in grade in the central watershed. The total basin relief of the watershed is 194.2 m with an average slope of 3.2%.

The hydrologic characterization parameters for each sub-catchments are provided in Table 4. These hydrologic parameters were used as the initial parameters or used to calculate other parameters in the model.

Table 4 – Subbasin Characteristics

Catchment ID	Area (km^2)	Basin Slope (m/m)	Basin Relief (m)	Longest Flow Path (km)	Longest Flow Path Slope (m/m)	10-85 Flowpath Length (km)	10-85 Flowpath Slope (m/m)	Elongation Ratio
Subbasin_101	36.12	0.026	46.6	18.67	0.002	14.00	0.002	0.363
Subbasin_102	12.72	0.039	46.3	9.97	0.005	7.48	0.004	0.404
Subbasin_103	24.35	0.032	39.9	14.72	0.003	11.04	0.002	0.378
Subbasin_104	1.18	0.038	16.6	3.45	0.005	2.59	0.002	0.355
Subbasin_105	21.00	0.027	38.8	11.06	0.004	8.30	0.003	0.467
Subbasin_106	18.32	0.032	42.8	11.75	0.004	8.81	0.004	0.411
Subbasin_107	20.67	0.037	36.3	13.75	0.002	10.32	0.002	0.373
Subbasin_108	3.34	0.030	25.5	5.67	0.004	4.25	0.003	0.364
Subbasin_109	11.36	0.037	32.5	7.87	0.002	5.90	0.001	0.483
Subbasin_110	9.48	0.036	36.3	11.60	0.003	8.70	0.002	0.300
Subbasin_111	25.59	0.030	32.8	14.00	0.002	10.50	0.002	0.408
Subbasin_112	6.81	0.033	27.2	8.10	0.002	6.08	0.001	0.363
Subbasin_113	7.99	0.037	40.0	6.55	0.004	4.91	0.004	0.487
Subbasin_114	17.00	0.035	40.8	7.86	0.003	5.89	0.003	0.592
Subbasin_115	1.37	0.033	23.4	3.27	0.007	2.46	0.006	0.404
Subbasin_116	1.27	0.042	25.0	3.23	0.007	2.42	0.006	0.393
Subbasin_117	9.51	0.063	53.5	10.89	0.003	8.17	0.003	0.319

Catchment ID	Area (km^2)	Basin Slope (m/m)	Basin Relief (m)	Longest Flow Path (km)	Longest Flow Path Slope (m/m)	10-85 Flowpath Length (km)	10-85 Flowpath Slope (m/m)	Elongation Ratio
Subbasin_118	9.23	0.070	54.6	9.27	0.004	6.95	0.002	0.370
Subbasin_119	4.46	0.072	48.0	4.60	0.008	3.45	0.007	0.517
Subbasin_120	3.29	0.053	36.0	6.03	0.005	4.52	0.003	0.340
Subbasin_121	14.99	0.053	65.2	10.14	0.006	7.60	0.005	0.431
Subbasin_122	4.22	0.067	44.0	4.56	0.007	3.42	0.008	0.508
Subbasin_123	9.55	0.108	90.8	12.40	0.006	9.30	0.004	0.281
Subbasin_124	5.42	0.087	88.2	7.73	0.010	5.80	0.010	0.340
Subbasin_125	9.03	0.072	76.4	8.02	0.009	6.02	0.008	0.423
Subbasin_126	7.72	0.047	45.0	7.00	0.006	5.25	0.004	0.448
Subbasin_127	11.40	0.064	51.4	7.29	0.005	5.47	0.003	0.523
Subbasin_128	1.85	0.081	50.5	4.56	0.009	3.42	0.008	0.336
Subbasin_129	24.81	0.084	110.3	15.69	0.007	11.77	0.006	0.358
Subbasin_130	5.45	0.073	66.3	6.05	0.010	4.54	0.007	0.435
Subbasin_131	3.11	0.070	50.2	5.70	0.008	4.28	0.005	0.349
Subbasin_132	2.19	0.078	47.8	3.95	0.012	2.96	0.012	0.422
Subbasin_133	2.57	0.068	43.8	3.50	0.009	2.62	0.006	0.517
Subbasin_134	0.27	0.063	22.9	1.70	0.011	1.27	0.008	0.345
Subbasin_135	0.32	0.081	20.2	1.12	0.015	0.84	0.011	0.568
Subbasin_136	1.71	0.075	60.4	3.34	0.017	2.51	0.020	0.441
Subbasin_137	0.28	0.062	26.0	1.28	0.020	0.96	0.012	0.469
Subbasin_138	4.88	0.068	55.5	6.10	0.008	4.57	0.004	0.409

3.3.4 Initial Abstractions

At the initial stage of rainfall, a certain amount of water is intercepted by vegetation before it can reach the ground and infiltrate. When water does it make through the vegetation it must fill depressions in the landscape before it can produce runoff. These collectively are called initial abstractions. HEC-HMS requires the user to define initial canopy storage, canopy storage, initial depression storage, and depression storage to account for initial abstractions. Initial abstractions were calculated for each catchment based on an area weighted average of typical values for land cover types in each catchment using GIS in accordance with EWRG, 2017. It was assumed that all canopy and depression storage in the subbasin were available for each event modeled. The input parameters for initial abstractions can be found in Table 5. Calculations are provided in Appendix B.

Table 5 – Canopy and Depression Storage

Catchment ID	Initial Canopy Storage	Max Canopy Storage (mm)	Initial Depression Storage	Max Depression Storage (mm)	Total Abstraction (mm)
Subbasin_101	0.0	2.0	0.0	10.1	12.0
Subbasin_102	0.0	1.8	0.0	9.0	10.8
Subbasin_103	0.0	1.6	0.0	8.3	9.9
Subbasin_104	0.0	1.9	0.0	9.4	11.3
Subbasin_105	0.0	1.7	0.0	8.9	10.7
Subbasin_106	0.0	1.4	0.0	7.3	8.7
Subbasin_107	0.0	1.8	0.0	8.7	10.5
Subbasin_108	0.0	1.2	0.0	6.7	7.9
Subbasin_109	0.0	2.0	0.0	9.8	11.8
Subbasin_110	0.0	1.7	0.0	8.5	10.2
Subbasin_111	0.0	1.8	0.0	9.2	11.0
Subbasin_112	0.0	1.9	0.0	9.8	11.8
Subbasin_113	0.0	1.6	0.0	8.0	9.6
Subbasin_114	0.0	1.7	0.0	8.4	10.1
Subbasin_115	0.0	1.5	0.0	7.6	9.1
Subbasin_116	0.0	1.7	0.0	8.3	10.0
Subbasin_117	0.0	2.1	0.0	8.4	10.6
Subbasin_118	0.0	1.8	0.0	6.8	8.6
Subbasin_119	0.0	1.6	0.0	6.6	8.2
Subbasin_120	0.0	2.2	0.0	9.2	11.4
Subbasin_121	0.0	1.8	0.0	8.0	9.8
Subbasin_122	0.0	2.0	0.0	7.8	9.8
Subbasin_123	0.0	3.1	0.0	7.2	10.3
Subbasin_124	0.0	2.7	0.0	8.5	11.2
Subbasin_125	0.0	2.1	0.0	7.8	9.9
Subbasin_126	0.0	1.9	0.0	8.4	10.3
Subbasin_127	0.0	2.1	0.0	7.9	9.9
Subbasin_128	0.0	2.2	0.0	7.1	9.3

Catchment ID	Initial Canopy Storage	Max Canopy Storage (mm)	Initial Depression Storage	Max Depression Storage (mm)	Total Abstraction (mm)
Subbasin_129	0.0	2.0	0.0	7.2	9.2
Subbasin_130	0.0	2.2	0.0	7.9	10.1
Subbasin_131	0.0	2.5	0.0	8.2	10.8
Subbasin_132	0.0	2.2	0.0	6.5	8.7
Subbasin_133	0.0	2.1	0.0	7.0	9.1
Subbasin_134	0.0	1.6	0.0	3.6	5.2
Subbasin_135	0.0	1.3	0.0	2.1	3.4
Subbasin_136	0.0	1.6	0.0	4.6	6.2
Subbasin_137	0.0	1.0	0.0	1.2	2.2
Subbasin_138	0.0	2.0	0.0	6.1	8.0

3.3.5 Infiltration Loss Method

Green and Ampt method was chosen as the loss method in the model to account for infiltration and compute rainfall excess. The Green and Ampt Model was chosen as it has a long history of use for floodplain mapping in Southern Ontario, is physically based, and parameter estimation can be done with soil texture information or measured in the field. The Green and Ampt is based on Darcy's Law and is a simplification of the Richard's equation. As water content at the soil surface increases, it is pulled through the soil column by suction at the wetting front in a piston like displacement. The parameters required in HEC-HMS for the Green and Ampt model are saturated hydraulic conductivity, initial water content, porosity, suction head at the wetting front, and percent impervious.

Saturated hydraulic conductivity, field capacity, wilting point, porosity, and suction head at the wetting front were calculated for each catchment based on an area weighted average of typical values from soil textures in each catchment using GIS. Typical values were taken from Rawl et al. (1983), and Schroeter & Associates (2006) for sandy loam, silty clay loam, loam, and organic soil textures. The initial water content for each modeling scenario was assumed to be at field capacity for all events modeled in this study. The percent impervious was calculated from land cover for each catchment. It was assumed that land cover designated as transportation to be 100% impervious and built up – impervious to be 45% impervious. The Green and Ampt parameters used in the model can found in Table 6. Calculations are provided in Appendix B.

Table 6 – Loss Method - Green and Ampt

Catchment ID	Effective Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Suction at the Wetting Front (Average) (mm)	Saturated Hydraulic Conductivity (mm/h)	% Impervious
Subbasin_101	0.500	0.350	0.188	191.2	4.6	1.8
Subbasin_102	0.490	0.310	0.163	189.7	4.4	2.2
Subbasin_103	0.490	0.310	0.160	187.3	4.7	2.1
Subbasin_104	0.510	0.360	0.194	189.0	3.8	1.5
Subbasin_105	0.510	0.350	0.186	189.1	3.7	2.7
Subbasin_106	0.480	0.300	0.152	188.7	5.0	2.5
Subbasin_107	0.490	0.310	0.160	190.0	4.7	2.5
Subbasin_108	0.450	0.260	0.134	207.9	4.2	1.7
Subbasin_109	0.470	0.300	0.156	200.1	4.8	3.5
Subbasin_110	0.470	0.300	0.154	200.4	4.1	3.3
Subbasin_111	0.500	0.330	0.176	193.3	3.8	1.8
Subbasin_112	0.510	0.350	0.189	189.1	4.1	2.8
Subbasin_113	0.460	0.270	0.141	203.5	4.4	3.3
Subbasin_114	0.490	0.300	0.153	185.9	5.2	2.2
Subbasin_115	0.460	0.280	0.150	213.7	3.1	3.3
Subbasin_116	0.440	0.260	0.142	231.6	2.6	3.4
Subbasin_117	0.460	0.290	0.155	214.4	2.7	2.5
Subbasin_118	0.450	0.270	0.139	213.6	3.5	3.5
Subbasin_119	0.440	0.250	0.132	222.2	2.7	10.1
Subbasin_120	0.470	0.300	0.159	214.1	2.2	1.7
Subbasin_121	0.450	0.260	0.132	216.7	3.0	2.2
Subbasin_122	0.440	0.250	0.134	224.9	2.7	3.5
Subbasin_123	0.440	0.250	0.134	227.2	2.6	5.1
Subbasin_124	0.450	0.250	0.131	216.5	2.8	2.6
Subbasin_125	0.450	0.260	0.137	216.8	3.3	3.1
Subbasin_126	0.470	0.280	0.146	199.9	4.0	1.5
Subbasin_127	0.470	0.290	0.151	201.4	3.7	1.6
Subbasin_128	0.430	0.260	0.138	231.6	2.5	5.4
Subbasin_129	0.440	0.250	0.129	220.0	2.8	2.7
Subbasin_130	0.460	0.270	0.138	209.2	3.3	2.3

Catchment ID	Effective Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Suction at the Wetting Front (Average) (mm)	Saturated Hydraulic Conductivity (mm/h)	% Impervious
Subbasin_131	0.460	0.290	0.153	215.8	2.3	3.2
Subbasin_132	0.440	0.270	0.140	217.4	3.9	5.0
Subbasin_133	0.440	0.240	0.121	215.5	3.8	6.3
Subbasin_134	0.430	0.230	0.116	218.9	3.0	39.9
Subbasin_135	0.410	0.190	0.085	179.6	11.0	39.0
Subbasin_136	0.470	0.290	0.148	189.1	5.8	23.0
Subbasin_137	0.410	0.190	0.085	179.6	10.9	56.6
Subbasin_138	0.450	0.260	0.134	203.0	4.8	12.4

3.3.6 Runoff Transform – Unit Hydrograph

The SCS Unit Hydrograph method was used in the model to convert excess rainfall to runoff. The SCS Unit Hydrograph method is based upon an average of unit hydrographs derived from gauged rainfall and runoff for a large number of small agricultural watersheds in the United States (USACE, 2023). This method uses a dimensionless, curvilinear unit hydrograph to route excess rainfall to the subbasin outlet. HEC-HMS requires the Peaking Rate Factor and lag time as input parameters for each subbasin.

The peaking rate factor controls the volume of water on the rising and recession limbs (NOAA, 2005). Choosing a peaking rate factor is based on land cover and topography. Hydrograph peaking factors based on general description and their associated limb ratio can be found in Table 7.

Table 7 – Hydrograph Peaking Factors & Recession Limb Ratios (Wanielista, et al 1997)

General Description	Peaking Factor	Limb Ratio (Recession to Rising)
Urban areas; steep slopes	575	1.25
Typical SCS	484	1.67
Mixed urban/rural	400	2.25
Rural, rolling hills	300	3.33
Rural, slight slopes	200	5.50
Rural, very flat	100	12.00

The peaking rate factors for the subbasins in the model were chosen based on topography, land cover, and engineering judgement.

Lag is the time from the centre of mass of excess rainfall to the time to peak of a unit hydrograph (NRCS, 2007). Lag Time can be related to most watersheds with time of concentration, T_c, using the following equation (NRCS, 2007):

$$t_p = 0.6 * T_C$$

The time of concentration is used to estimate the peak discharge from a watershed, and it depends on slope, watershed characteristics and the flow path length. Time of concentration is the longest time required for runoff from the most distant point in the watershed to travel to the outlet. Many empirical equations are available to estimate the time of concentration. In this study, the TR-55 method has been used to calculate the time of concentration. The TR-55 Method computes travel times for sheet flow, shallow concentrated flow, and channel flow along the longest flow path to calculate the time of concentration. The equation can be found below.

$$T_c = t_{sheet} + t_{shallow\ contrated} + t_{channel}$$

The detailed time of concentration calculations and equations for each component can be found in Appendix B1. The resulting peaking rate factor, time of concentration, and lag time for each catchment are presented in Table 8.

Table 8 – Runoff Transform – Unit Hydrograph

Catchment ID	Peaking Rate Factor	Time of Concentration (hrs)	Lag Time (Hrs)	Time of Concentration (mins)	Lag Time (min)
Subbasin_101	484	35.9	21.6	2155.4	1293.2
Subbasin_102	484	6.9	4.1	411.5	246.9
Subbasin_103	484	8.5	5.1	510.9	306.5
Subbasin_104	484	4.5	2.7	272.8	163.7
Subbasin_105	484	7.2	4.3	429.3	257.6
Subbasin_106	484	10.5	6.3	632.1	379.3
Subbasin_107	484	7.5	4.5	449.7	269.8
Subbasin_108	484	2.9	1.7	174.3	104.6
Subbasin_109	484	10.4	6.2	623.4	374.0
Subbasin_110	484	7.6	4.6	456.4	273.8
Subbasin_111	484	16.8	10.1	1010.6	606.3
Subbasin_112	484	15.6	9.4	936.8	562.1
Subbasin_113	484	6.6	4.0	398.5	239.1
Subbasin_114	484	8.6	5.2	515.6	309.3
Subbasin_115	484	3.3	2.0	199.8	119.9
Subbasin_116	484	2.4	1.4	142.8	85.7

Catchment ID	Peaking Rate Factor	Time of Concentration (hrs)	Lag Time (Hrs)	Time of Concentration (mins)	Lag Time (min)
Subbasin_117	484	9.1	5.5	546.4	327.8
Subbasin_118	484	3.4	2.0	201.3	120.8
Subbasin_119	484	2.2	1.3	129.4	77.6
Subbasin_120	484	2.7	1.6	160.2	96.1
Subbasin_121	484	8.1	4.9	487.3	292.4
Subbasin_122	484	3.6	2.2	217.0	130.2
Subbasin_123	484	3.2	1.9	193.4	116.0
Subbasin_124	484	4.8	2.9	289.4	173.6
Subbasin_125	484	3.7	2.2	221.7	133.0
Subbasin_126	484	4.2	2.5	252.3	151.4
Subbasin_127	484	6.6	4.0	395.5	237.3
Subbasin_128	484	1.9	1.1	114.6	68.7
Subbasin_129	484	8.3	5.0	496.1	297.7
Subbasin_130	484	5.7	3.4	340.4	204.3
Subbasin_131	484	1.5	0.9	90.3	54.2
Subbasin_132	484	1.5	0.9	90.5	54.3
Subbasin_133	484	2.3	1.4	135.7	81.4
Subbasin_134	484	2.9	1.7	172.7	103.6
Subbasin_135	484	1.1	0.7	67.1	40.3
Subbasin_136	484	1.7	1.0	101.8	61.1
Subbasin_137	484	0.9	0.6	55.6	33.3
Subbasin_138	484	3.6	2.2	217.5	130.5

3.3.7 Recession

In large rural watersheds interflow generally makes up a large proportion of the total volume on the receding limb of a hydrograph. Wills used the recession baseflow method within the HEC-HMS model to account for this phenomenon. This method uses a recession constant that controls the rate that flow recedes and a Ratio to Peak to trigger when this exponential decay becomes active in the hydrograph. The recession and ratio to peak values used for each subbasin can be found in Table 9. A recession baseflow method was not used for the Durham Creek watershed given its drainage area and time of concentration.

Table 9 – Recession Method Parameters

Hydrologic Element	Recession Constant	Ratio to Peak
Subbasin_101	0.8	0.35
Subbasin_102	0.8	0.35
Subbasin_103	0.8	0.35
Subbasin_104	0.8	0.35
Subbasin_105	0.8	0.35
Subbasin_106	0.8	0.35
Subbasin_107	0.8	0.35
Subbasin_108	0.8	0.35
Subbasin_109	0.8	0.35
Subbasin_110	0.8	0.35
Subbasin_111	0.8	0.35
Subbasin_112	0.8	0.35
Subbasin_113	0.8	0.35
Subbasin_114	0.8	0.35
Subbasin_115	0.8	0.35
Subbasin_116	0.8	0.35
Subbasin_117	0.8	0.35
Subbasin_118	0.8	0.35
Subbasin_119	0.8	0.35
Subbasin_120	0.8	0.35
Subbasin_121	0.8	0.35
Subbasin_122	0.8	0.35
Subbasin_123	0.8	0.35
Subbasin_124	0.8	0.35
Subbasin_125	0.8	0.35
Subbasin_126	0.8	0.35
Subbasin_127	0.8	0.35
Subbasin_128	0.8	0.35
Subbasin_129	0.8	0.35
Subbasin_130	0.8	0.35
Subbasin_132	0.8	0.35
Subbasin_133	0.8	0.35
Subbasin_138	0.8	0.35

3.3.8 Reach Routing

The Muskingum-Cunge method was chosen as the channel routing method in the model. The Muskingum-Cunge method is based on the solution of the continuity and momentum equation. This method was chosen as it has a long history of use in flood mapping projects in Southern Ontario and has measurable physically based parameters. The Muskingum-Cunge method in HEC-HMS requires reach length, slope of the energy grade line (estimated as channel bed slope), wave celerity, characteristic cross section, and manning roughness.

The reach length, slope, cross section, and invert were calculated using the LiDAR DTM in HEC-RAS and HEC-HMS. The manning's roughness in the channel and left and right overbank were chosen based on typical values of the land cover at the characteristic cross section. A main channel manning's roughness of 0.035 was used which is typical for Ontario (EWRG, 2017). The overbank manning roughness was chosen to be 0.055 for agricultural land, and 0.08 for forested land (EWRG, 2017). Wave Celerity was estimated to be 1.5 m/s and for most applications is adequate (USACE, 2023). The reach routing parameters used in the model can be found in Table 10.

Table 10 – Reach Routing Parameters

Reach	Length (m)	Slope (m/m)	Mannings n	Index Method	Shape	Left Overbank Mannings Roughness	Right Overbank Mannings Roughness	Invert
Reach_1001	1784	0.001	0.035	Celerity	8 Point	0.080	0.080	493.0
Reach_1002	11293	0.002	0.035	Celerity	8 Point	0.055	0.080	483.5
Reach_1003	4028	0.001	0.035	Celerity	8 Point	0.055	0.055	476.5
Reach_1004	6964	0.000	0.035	Celerity	8 Point	0.080	0.080	471.0
Reach_1005	5954	0.000	0.035	Celerity	8 Point	0.080	0.080	469.2
Reach_1006	3060	0.000	0.035	Celerity	8 Point	0.080	0.055	468.0
Reach_1007	853	0.000	0.035	Celerity	8 Point	0.055	0.055	467.3
Reach_1008	672	0.002	0.035	Celerity	8 Point	0.080	0.080	467.0
Reach_1009	7973	0.001	0.035	Celerity	8 Point	0.055	0.080	464.3
Reach_1010	2213	0.002	0.035	Celerity	8 Point	0.080	0.080	455.0
Reach_1011	3351	0.003	0.035	Celerity	8 Point	0.080	0.080	449.0
Reach_1012	11129	0.005	0.035	Celerity	8 Point	0.080	0.080	420.0
Reach_1013	4339	0.004	0.035	Celerity	8 Point	0.080	0.080	388.7
Reach_1014	3399	0.004	0.035	Celerity	8 Point	0.080	0.080	370.0
Reach_1015	2903	0.003	0.035	Celerity	8 Point	0.080	0.080	358.0
Reach_1016	4202	0.005	0.035	Celerity	8 Point	0.080	0.080	369.0
Reach_1017	967	0.003	0.035	Celerity	8 Point	0.080	0.080	351.0

Reach	Length (m)	Slope (m/m)	Mannings n	Index Method	Shape	Left Overbank Mannings Roughness	Right Overbank Mannings Roughness	Invert
Reach_1018	2488	0.007	0.035	Celerity	8 Point	0.045	0.045	350.0
Reach_1019	335	0.001	0.035	Celerity	8 Point	0.080	0.080	351.0
Reach_1020	929	0.009	0.035	Celerity	8 Point	0.045	0.045	350.0
Reach_1021	4540	0.001	0.035	Celerity	8 Point	0.080	0.080	332.0

3.3.9 Baseflow

Field surveys indicated that base flow in the context of large magnitude flood events was insignificant for Durham Creek. Therefore, baseflow has been assumed to be zero in the hydrologic model.

Wills reviewed the base flow for the Saugeen River at Durham flow gauge and found it was typically on the order of 4 m^3/s. Baseflow was not included for the Saugeen River portion of the hydrology model as determining the regional flow was the main objective of the model and in this context only represented 1.4% of the total flow during this event.

3.3.10 Design Storm Distribution and Duration

The primary objective of the hydrology model is determining the AEP flood events for Durham Creek and the Regional Flood event for both Durham Creek and the Saugeen River. Durham Creek does not have a flow gauge, and therefore the AEP flood events were calculated from the SCS synthetic storms. The Saugeen River does have a flow gauge, and therefore the AEP flood events could be calculated statistically. Details regarding the statistical analysis for the Saugeen River gauge can be found in Section 3.5.2.

Typically, synthetic design storms for floodplain mapping in Ontario are represented by rain on snow (spring) events or intense thunderstorms (summer) (EWRG, 2017). Choosing a design storm approach is dependent on watershed characteristics such as land cover, time of concentration, watershed size, and seasonality of when most annual maximum peak flow rates occur (EWRG, 2017). Durham Creek has a relatively small drainage area and a short time of concentration and therefore an intense thunderstorm event is likely to govern. Therefore, Wills selected the SCS Type-2 storm distribution which has a long history of use in Ontario to simulate intense thunderstorm events for floodplain mapping.

The SCS Type-2 storm is typically developed for the 6-hour, 12-hour, or 24-hour durations. The MNRF recommends that storm duration for floodplain mapping should be approximately equal to the time of concentration of the watershed for synthetic design storms (MNRF, 2002). The time of concentration for Durham Creek was calculated to be less than 6 hours. Therefore, Wills selected the 6-hour duration to be used in the model for calculating the AEP peak flows for Durham Creek. The 1% AEP 6-hour SCS total rainfall volume for the town of Durham is 88.2 mm with 29.6 mm falling during the most intense 15 minutes of the event. The SCS 6-hour design storm for all AEP flows and the regional storms run in the model have been provided in Appendix B1.

3.3.11 Rainfall and Computation Time Step

The computation time step and rainfall time step were considered based on watershed characteristics. The rainfall time step for modeling should be less than the minimum time of concentration of any catchment (EWRG, 2017). Subbasin 137 has shortest time of concentration of 55.6 minutes within the catchments and therefore 15 min rainfall time steps were considered appropriate for the purposes of this study. Computation time steps for small urban watersheds may require computational time steps between 5 and 10 minutes, but further reductions below these can result in unrealistic flows (MNRF, 2022). Therefore, a computation time step of 5 minutes was used for the purposes of this study.

3.3.12 Areal Reduction Factor

The equivalent circle diameter method was used to assess the need for application of areal reduction factors to the design storms. The first point of interest for hydraulic modeling, the Durham Upper Dam, is approximately 39.5 km as the “crow flies” from the most remote portion of the watershed which resulted in an equivalent circle diameter of 1,225.4 km^2. The second point of interest for hydraulic modeling (the upstream end of Durham Creek) is approximately 1.14 km as the “crow flies” from the most remote portion of the watershed which resulted in an equivalent diameter of 1.02 km^2. Generally, studies in Ontario do not use areal reduction factors for circular areas under 25 km^2 (MNRF, 2002). Therefore, areal reduction factors was applied to the Saugeen River watershed, but were not applied to the Durham Creek watershed during this study.

3.3.13 Future Development

In accordance with the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002), the potential for future development must be considered in the hydrologic assessment for floodplain mapping. The Official Plans and Zoning for the Municipality of West Grey and Grey County were reviewed. Based on the review of the Official plan and Zoning, no areas of significant future development were identified. The Municipality of West Grey indicated plans to construct a large retirement home in Subbasin 135 during the start up meeting. However, given its relative size to the watershed area it was determined by Wills to have negligible affects on impervious area. It is anticipated that any future land use conditions will be similar to the current conditions.

3.3.14 Model Calibration and Verification

It is important to calibrate and verify a hydrologic model if there is available observed streamflow and rainfall available to improve model performance. Wills performed a calibration exercise using the Saugeen River Above Durham rainfall and flow gauge data provided by SVCA, as well as the Grand River Near Dundalk rainfall gauge data provided by Grand River Conservation Authority (GRCA). The Dundalk gauge is not in the Saugeen River watershed, however, it is closer in distance to roughly 70% of the drainage area contributing to the streamflow gauge. The name, location, and period of record relevant for each gauge has been provided in Table 11. The location of the gauges can be found on Figure 7.

Table 11 - Recorded Rainfall and Streamflow Data

Location	Station ID	Co-ordinates	Period of Record Streamflow (years)	Period of Record Rainfall (years)
Saugeen River Above Durham	02FC016	44°11'07" N 80°47'14" W	48	39
Grand River Near Dundalk	02GA041	44°08'24" N 80°21'45" W	N/A	16

Wills used stream flow and rainfall data from a September 1986 storm to calibrate the model and a storm from September 2008 storm to verify the model. A rainfall only events was chosen by Wills for the purposes of calibration/verification because the modeling objective is to calculate peak discharge for the Hurricane Hazel event which is a rainfall only event.

The September 1986 storm had a recorded rainfall volume of 155.0 mm at the Saugeen River Above Durham over the course of approximately 40 hours. The most intense hour of the 1986 storm recorded 20.5 mm of rain. The peak discharge recorded at Saugeen River Above Durham gauge was 77.7 m^3/s for this event. An additional 57.1 mm of rainfall occurred over the next week as the Saugeen River was receding for a total of 212.1 mm. The Grand River Near Dundalk rainfall gauge's period of record did not extend to 1986 and therefore was not used for this event.

The original model parameters discussed above were modified by Wills until the modeled results reasonably fit the observed results at the Saugeen River Above Durham Gauge for the 1986 event. The observed and modeled hydrographs and the hyetograph from the calibrated model can be found in Figure 8. The modeled results match the observed hydrograph well for peak flow, and general shape. The model did a reasonable job at estimating total runoff value but appears to underestimate total volume in the first two thirds of the hydrograph and overestimate it in the last one third. The timing of the modeled peak discharge is a little earlier than the observed.

The September 2008 storm had a recorded rainfall volume of 89.6 mm at the Saugeen River Above Durham gauge and 90.8 mm at the Grand River Near Dundalk over the course of approximately 36 hours. The most intense hour of the 2008 storm recorded 27.8 mm of rain at the Saugeen River Above Durham Gauge and 18.8 mm of rain at the Grand River Near Dundalk. The peak discharge recorded at the Saugeen River Above Durham gauge was 37.9 m^3/s. An additional 6.1 mm of rain was recorded in the preceding 5 days at the Saugeen River Above Durham gauge for a total of 95.7 mm.

An additional 12.9 mm of rain was recorded in the preceding 5 days at the Grand River Near Dundalk gauge for a total of 103.7 mm.

Wills used the September 2008 event to verify that the calibrated model would produce satisfactory results without additional parameter changes. Wills initially applied the Saugeen River Above Durham Gauge rainfall to the lower half of the watershed, and the Grand River Near Dundalk gauge to the upper half of the watershed. After review of the modeled vs observed results the general shape appeared to have a significant double peak that was not present in the observed hydrograph. Wills then applied just the Grand River Near Dundalk to all subbasins and found the shape, volume, and peak flow performed well in this scenario, although the double peak is still present to a lesser degree. Given that the Dundalk gauge is closer to larger proportion of watershed area, it may have been more representative of the temporal and spatial variability of the actual rainfall. Therefore, Wills deemed it acceptable for the purposes of this study to rely on this gauge for verification. The observed and modeled hydrographs and the hyetograph from the verification exercise can be found in Figure 9. The modeled results match the observed hydrograph reasonably well for peak flow, general shape, and total runoff value, but appears to slightly underestimate total volume in the first two thirds of the hydrograph and overestimate it in the last one third. The timing of the modeled peak discharge is a little earlier than the observed for the initial peak and very well for the second peak. Statistical performance metrics typically used in hydrologic modeling for measuring model performance are percent difference in peak flow, Nash-Sutcliffe, Percent Bias, and Root Mean Square Error. Wills calculated or used HEC-HMS to calculate these statistical performance metrics and they have been provided in Table 12.

Table 12 – Calibration/Verification Performance Metrics

Start	End	Total Rainfall (mm)	Peak Discharge Observed (m^3/s)	Peak Discharge Modeled (m^3/s)	Percent Difference in Peak Flow	Nash Sutcliffe	Percent Bias	Root Mean Square Error
05Sep1986 00:00	25Sep1986 00:00	212.1	77.70	76.90	1.03%	0.867	-18.50%	0.40
09Sep2008 00:00	24Sep2008 00:00	103.7	37.90	42.73	-12.74%	0.843	13.00%	0.36

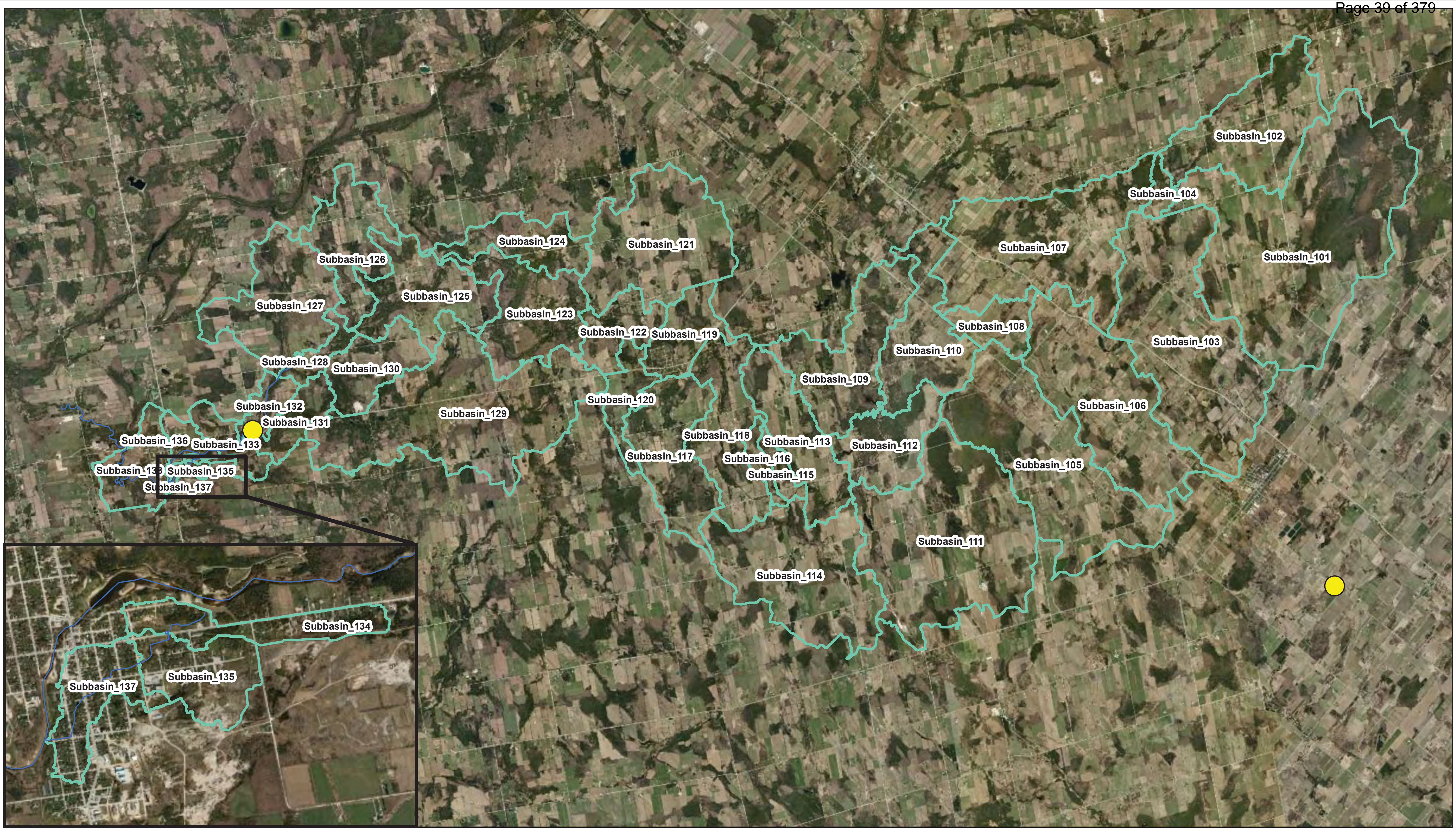


Figure 7
Rain Gauge Locations for
Durham Creek

Legend
Rain Gauge
Watercourse
Subwatershed Boundary

Data Sources:
Soil Survey Complex, GEOHUB 2023
SCOOP 2010, GEOHUB 2023

NAD 1983 UTM Zone 17N
1:110,000
Meters
0 2,500 5,000

N

Drawn By:	SO
Checked By:	MC/DG
Map Date:	2/29/24
Project Number:	5591
Map File Number	23-5591

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Figure 8 – September 1986 Calibration Event

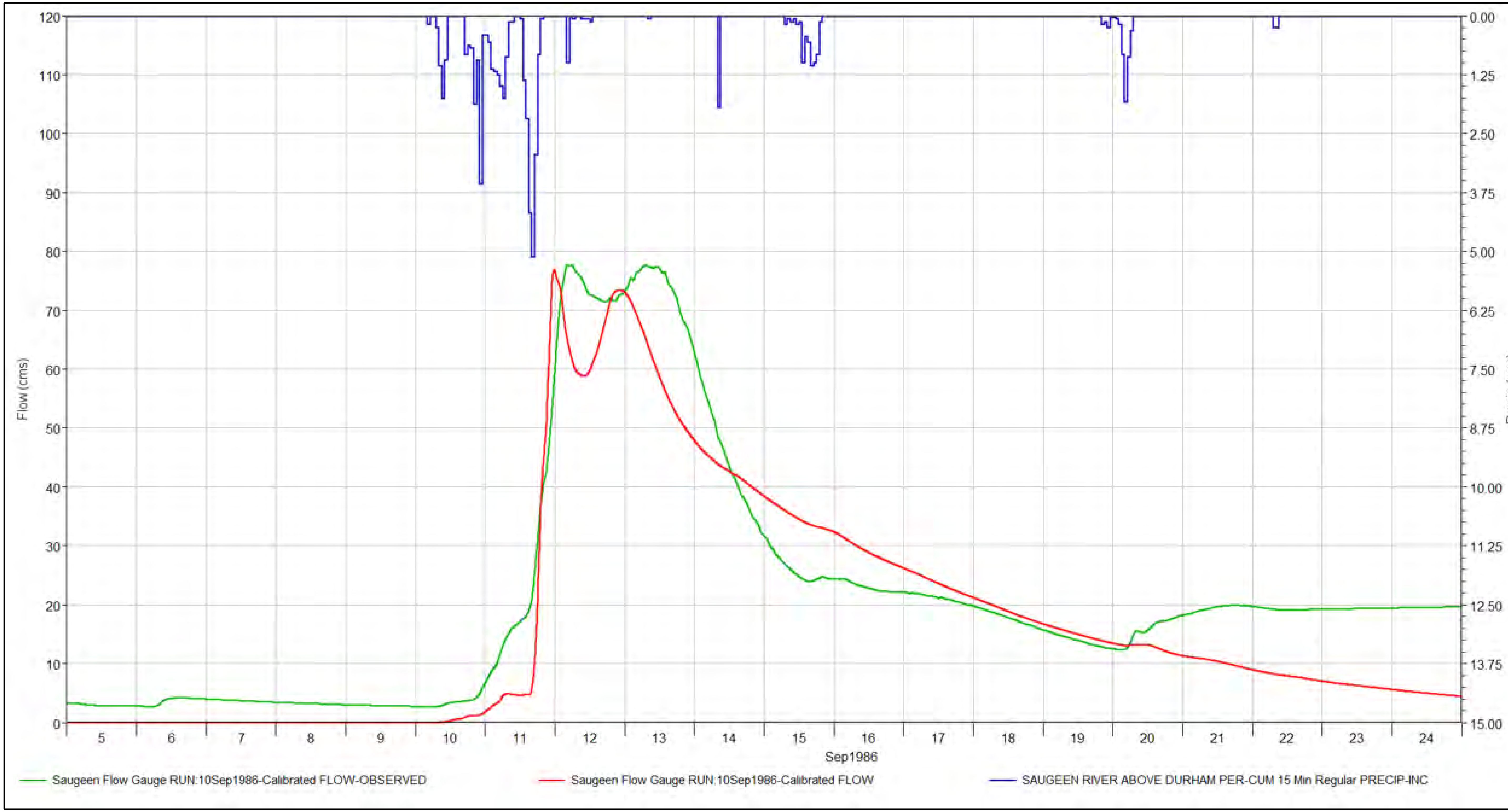
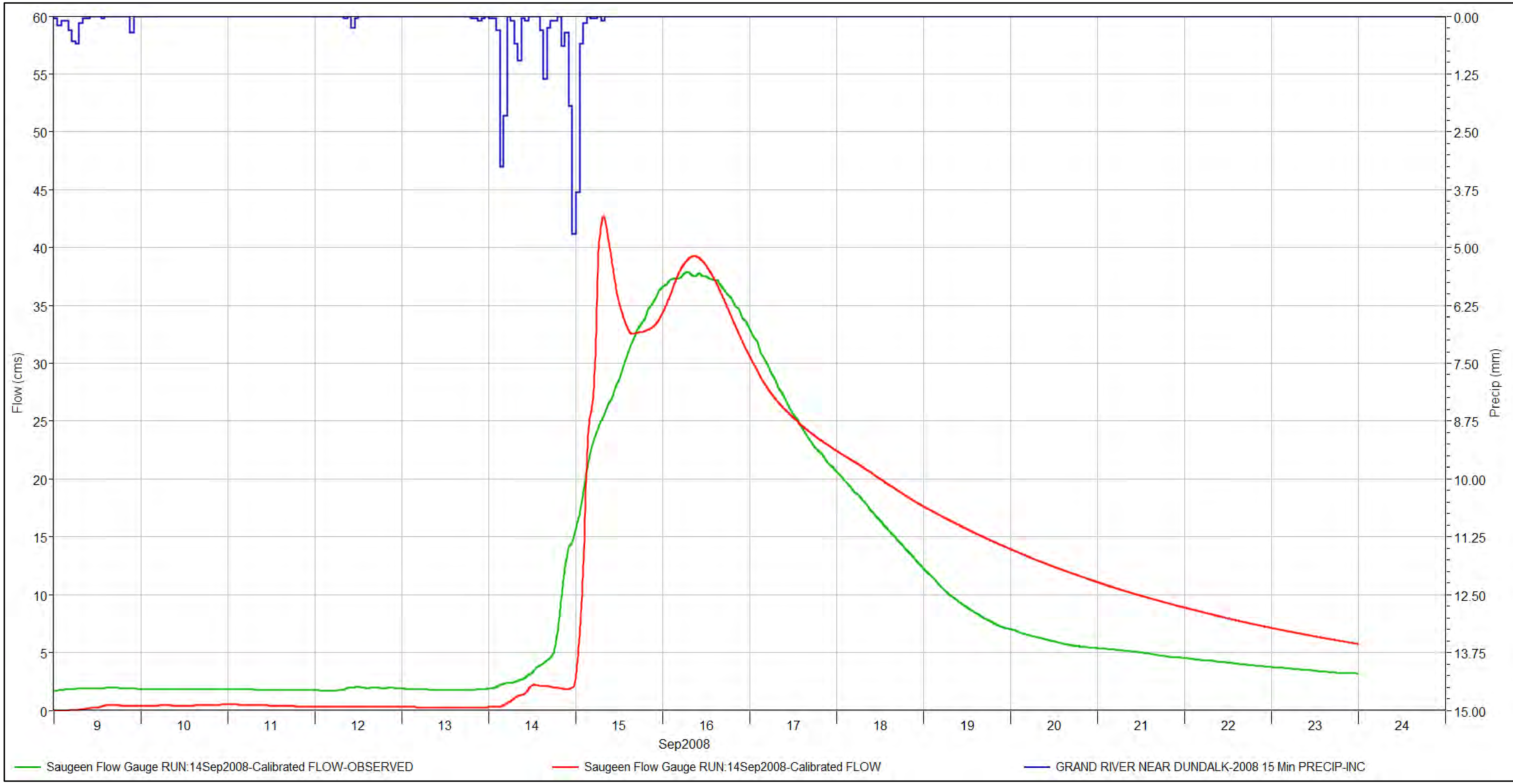


Figure 9 – September 2008 Verivication Event



Wills found the model to produce satisfactory results estimating the observed discharge at the Saugeen River Near Durham gauge during the calibration and verification exercise. Therefore, the model has been accepted for the purposes of calculating flood flows for this study. The calibrated hydrologic characterization parameters for each sub-catchment are provided in Tables 13-16 These hydrologic parameters were used to produce the results shown in Section 3.4.

Table 13 – Subbasin Characteristics – Calibrated

Catchment ID	Area (km^2)	Basin Slope (m/m)	Basin Relief (m)	Longest Flow Path (km)	Longest Flow Path Slope (m/m)	10-85 Flowpath Length (km)	10-85 Flowpath Slope (m/m)	Elongation Ratio
Subbasin_101	36.12	0.026	46.6	18.67	0.002	14.00	0.002	0.363
Subbasin_102	12.72	0.039	46.3	9.97	0.005	7.48	0.004	0.404
Subbasin_103	24.35	0.032	39.9	14.72	0.003	11.04	0.002	0.378
Subbasin_104	1.18	0.038	16.6	3.45	0.005	2.59	0.002	0.355
Subbasin_105	21.00	0.027	38.8	11.06	0.004	8.30	0.003	0.467
Subbasin_106	18.32	0.032	42.8	11.75	0.004	8.81	0.004	0.411
Subbasin_107	20.67	0.037	36.3	13.75	0.002	10.32	0.002	0.373
Subbasin_108	3.34	0.030	25.5	5.67	0.004	4.25	0.003	0.364
Subbasin_109	11.36	0.037	32.5	7.87	0.002	5.90	0.001	0.483
Subbasin_110	9.48	0.036	36.3	11.60	0.003	8.70	0.002	0.300
Subbasin_111	25.59	0.030	32.8	14.00	0.002	10.50	0.002	0.408
Subbasin_112	6.81	0.033	27.2	8.10	0.002	6.08	0.001	0.363
Subbasin_113	7.99	0.037	40.0	6.55	0.004	4.91	0.004	0.487
Subbasin_114	17.00	0.035	40.8	7.86	0.003	5.89	0.003	0.592
Subbasin_115	1.37	0.033	23.4	3.27	0.007	2.46	0.006	0.404
Subbasin_116	1.27	0.042	25.0	3.23	0.007	2.42	0.006	0.393
Subbasin_117	9.51	0.063	53.5	10.89	0.003	8.17	0.003	0.319
Subbasin_118	9.23	0.070	54.6	9.27	0.004	6.95	0.002	0.370
Subbasin_119	4.46	0.072	48.0	4.60	0.008	3.45	0.007	0.517
Subbasin_120	3.29	0.053	36.0	6.03	0.005	4.52	0.003	0.340
Subbasin_121	14.99	0.053	65.2	10.14	0.006	7.60	0.005	0.431
Subbasin_122	4.22	0.067	44.0	4.56	0.007	3.42	0.008	0.508
Subbasin_123	9.55	0.108	90.8	12.40	0.006	9.30	0.004	0.281
Subbasin_124	5.42	0.087	88.2	7.73	0.010	5.80	0.010	0.340
Subbasin_125	9.03	0.072	76.4	8.02	0.009	6.02	0.008	0.423

Catchment ID	Area (km²)	Basin Slope (m/m)	Basin Relief (m)	Longest Flow Path (km)	Longest Flow Path Slope (m/m)	10-85 Flowpath Length (km)	10-85 Flowpath Slope (m/m)	Elongation Ratio
Subbasin_126	7.72	0.047	45.0	7.00	0.006	5.25	0.004	0.448
Subbasin_127	11.40	0.064	51.4	7.29	0.005	5.47	0.003	0.523
Subbasin_128	1.85	0.081	50.5	4.56	0.009	3.42	0.008	0.336
Subbasin_129	24.81	0.084	110.3	15.69	0.007	11.77	0.006	0.358
Subbasin_130	5.45	0.073	66.3	6.05	0.010	4.54	0.007	0.435
Subbasin_131	3.11	0.070	50.2	5.70	0.008	4.28	0.005	0.349
Subbasin_132	2.19	0.078	47.8	3.95	0.012	2.96	0.012	0.422
Subbasin_133	2.57	0.068	43.8	3.50	0.009	2.62	0.006	0.517
Subbasin_134	0.27	0.063	22.9	1.70	0.011	1.27	0.008	0.345
Subbasin_135	0.32	0.081	20.2	1.12	0.015	0.84	0.011	0.568
Subbasin_136	1.71	0.075	60.4	3.34	0.017	2.51	0.020	0.441
Subbasin_137	0.28	0.062	26.0	1.28	0.020	0.96	0.012	0.469
Subbasin_138	4.88	0.068	55.5	6.10	0.008	4.57	0.004	0.409

Table 14 – Loss Method – Green and Ampt – Calibrated

Catchment ID	Effective Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Suction at the Wetting Front (Average) (mm)	Saturated Hydraulic Conductivity (mm/h)	% Impervious
Subbasin_101	0.500	0.350	0.188	191.2	4.6	1.8
Subbasin_102	0.490	0.310	0.163	189.7	4.4	2.2
Subbasin_103	0.490	0.310	0.160	187.3	4.7	2.1
Subbasin_104	0.510	0.360	0.194	189.0	3.8	1.5
Subbasin_105	0.510	0.350	0.186	189.1	3.7	2.7
Subbasin_106	0.480	0.300	0.152	188.7	5.0	2.5
Subbasin_107	0.490	0.310	0.160	190.0	4.7	2.5
Subbasin_108	0.450	0.260	0.134	207.9	4.2	1.7
Subbasin_109	0.470	0.300	0.156	200.1	4.8	3.5
Subbasin_110	0.470	0.300	0.154	200.4	4.1	3.3
Subbasin_111	0.500	0.330	0.176	193.3	3.8	1.8
Subbasin_112	0.510	0.350	0.189	189.1	4.1	2.8
Subbasin_113	0.460	0.270	0.141	203.5	4.4	3.3

Catchment ID	Effective Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Suction at the Wetting Front (Average) (mm)	Saturated Hydraulic Conductivity (mm/h)	% Impervious
Subbasin_114	0.490	0.300	0.153	185.9	5.2	2.2
Subbasin_115	0.460	0.280	0.150	213.7	3.1	3.3
Subbasin_116	0.440	0.260	0.142	231.6	2.6	3.4
Subbasin_117	0.460	0.290	0.155	214.4	2.7	2.5
Subbasin_118	0.450	0.270	0.139	213.6	3.5	3.5
Subbasin_119	0.440	0.250	0.132	222.2	2.7	10.1
Subbasin_120	0.470	0.300	0.159	214.1	2.2	1.7
Subbasin_121	0.450	0.260	0.132	216.7	3.0	2.2
Subbasin_122	0.440	0.250	0.134	224.9	2.7	3.5
Subbasin_123	0.440	0.250	0.134	227.2	2.6	5.1
Subbasin_124	0.450	0.250	0.131	216.5	2.8	2.6
Subbasin_125	0.450	0.260	0.137	216.8	3.3	3.1
Subbasin_126	0.470	0.280	0.146	199.9	4.0	1.5
Subbasin_127	0.470	0.290	0.151	201.4	3.7	1.6
Subbasin_128	0.430	0.260	0.138	231.6	2.5	5.4
Subbasin_129	0.440	0.250	0.129	220.0	2.8	2.7
Subbasin_130	0.460	0.270	0.138	209.2	3.3	2.3
Subbasin_131	0.460	0.290	0.153	215.8	2.3	3.2
Subbasin_132	0.440	0.270	0.140	217.4	3.9	5.0
Subbasin_133	0.440	0.240	0.121	215.5	3.8	6.3
Subbasin_134	0.430	0.230	0.116	218.9	3.0	39.9
Subbasin_135	0.410	0.190	0.085	179.6	11.0	39.0
Subbasin_136	0.470	0.290	0.148	189.1	5.8	23.0
Subbasin_137	0.410	0.190	0.085	179.6	10.9	56.6
Subbasin_138	0.450	0.260	0.134	203.0	4.8	12.4

Table 15 – Canopy and Depression Storage - Calibrated

Catchment ID	Initial Canopy Storage	Max Canopy Storage (mm)	Initial Depression Storage	Max Depression Storage (mm)	Total Abstraction (mm)
Subbasin_101	0.0	2.0	0.0	10.1	12.0
Subbasin_102	0.0	1.8	0.0	9.0	10.8
Subbasin_103	0.0	1.6	0.0	8.3	9.9
Subbasin_104	0.0	1.9	0.0	9.4	11.3
Subbasin_105	0.0	1.7	0.0	8.9	10.7
Subbasin_106	0.0	1.4	0.0	7.3	8.7
Subbasin_107	0.0	1.8	0.0	8.7	10.5
Subbasin_108	0.0	1.2	0.0	6.7	7.9
Subbasin_109	0.0	2.0	0.0	9.8	11.8
Subbasin_110	0.0	1.7	0.0	8.5	10.2
Subbasin_111	0.0	1.8	0.0	9.2	11.0
Subbasin_112	0.0	1.9	0.0	9.8	11.8
Subbasin_113	0.0	1.6	0.0	8.0	9.6
Subbasin_114	0.0	1.7	0.0	8.4	10.1
Subbasin_115	0.0	1.5	0.0	7.6	9.1
Subbasin_116	0.0	1.7	0.0	8.3	10.0
Subbasin_117	0.0	2.1	0.0	8.4	10.6
Subbasin_118	0.0	1.8	0.0	6.8	8.6
Subbasin_119	0.0	1.6	0.0	6.6	8.2
Subbasin_120	0.0	2.2	0.0	9.2	11.4
Subbasin_121	0.0	1.8	0.0	8.0	9.8
Subbasin_122	0.0	2.0	0.0	7.8	9.8
Subbasin_123	0.0	3.1	0.0	7.2	10.3
Subbasin_124	0.0	2.7	0.0	8.5	11.2
Subbasin_125	0.0	2.1	0.0	7.8	9.9
Subbasin_126	0.0	1.9	0.0	8.4	10.3
Subbasin_127	0.0	2.1	0.0	7.9	9.9
Subbasin_128	0.0	2.2	0.0	7.1	9.3
Subbasin_129	0.0	2.0	0.0	7.2	9.2

Catchment ID	Initial Canopy Storage	Max Canopy Storage (mm)	Initial Depression Storage	Max Depression Storage (mm)	Total Abstraction (mm)
Subbasin_130	0.0	2.2	0.0	7.9	10.1
Subbasin_131	0.0	2.5	0.0	8.2	10.8
Subbasin_132	0.0	2.2	0.0	6.5	8.7
Subbasin_133	0.0	2.1	0.0	7.0	9.1
Subbasin_134	0.0	1.6	0.0	3.6	5.2
Subbasin_135	0.0	1.3	0.0	2.1	3.4
Subbasin_136	0.0	1.6	0.0	4.6	6.2
Subbasin_137	0.0	1.0	0.0	1.2	2.2
Subbasin_138	0.0	2.0	0.0	6.1	8.0

Table 16 – Runoff Transform – Unit Hydrograph - Calibrated

Catchment ID	Peaking Rate Factor	Lag Time (min)
Subbasin_101	200	1551.9
Subbasin_102	200	296.3
Subbasin_103	200	367.8
Subbasin_104	200	196.4
Subbasin_105	200	309.1
Subbasin_106	200	455.1
Subbasin_107	200	323.8
Subbasin_108	200	125.5
Subbasin_109	200	448.8
Subbasin_110	200	328.6
Subbasin_111	200	727.6
Subbasin_112	200	674.5
Subbasin_113	200	286.9
Subbasin_114	200	371.2
Subbasin_115	200	143.8
Subbasin_116	200	102.8
Subbasin_117	200	393.4
Subbasin_118	200	144.9

Catchment ID	Peaking Rate Factor	Lag Time (min)
Subbasin_119	200	93.2
Subbasin_120	200	115.3
Subbasin_121	200	350.8
Subbasin_122	200	156.2
Subbasin_123	200	139.2
Subbasin_124	200	208.3
Subbasin_125	200	159.6
Subbasin_126	200	181.7
Subbasin_127	200	284.8
Subbasin_128	200	82.5
Subbasin_129	200	357.2
Subbasin_130	200	245.1
Subbasin_131	200	65.0
Subbasin_132	200	65.1
Subbasin_133	200	97.7
Subbasin_134	484	124.3
Subbasin_135	484	48.3
Subbasin_136	200	73.3
Subbasin_137	484	40.0
Subbasin_138	484	156.6

3.4 Hydrologic Model Results

3.4.1 Existing Condition Modeling Results

The HEC-HMS model was run for the 50% AEP, 20% AEP, 10% AEP, 4% AEP, 2% AEP, and 1% AEP SCS 6-hour storms, and the Regional storm event using the existing condition parameter set as described in Section 3.3. The peak flows for the 4%, 2%, 1% AEP, and regional storm for each hydrologic element in Durham Creek, as well as the regional flow upstream of the Upper Dam (Junction_118) are provided in Table 17. The results for all AEP storms can be found in Appendix B2.

Table 17 – Existing Condition Peak Flows

Hydrologic Element	Drainage Area (km^2)	4% AEP Peak Discharge (m^3/s)	2% AEP Peak Discharge (m^3/s)	1% AEP Peak Discharge (m^3/s)	Hazel Peak Discharge (m^3/s)
Subbasin_134	0.3	1.1	1.3	1.4	2.3
Junction_119	0.3	1.1	1.3	1.4	2.3
Reach_1019	0.3	1.1	1.2	1.4	2.3
Subbasin_135	0.3	2.3	2.6	3.0	3.2
Junction_120	0.6	2.6	3.0	3.4	4.6
Reach_1020	0.6	2.6	3.0	3.4	4.6
Subbasin_137	0.3	2.7	3.0	3.4	3.2
OutflowDurham	0.9	4.8	5.6	6.3	7.4
Junction_118	347.3	N/A[1]	N/A[1]	N/A[1]	276.4

1. 6-hour AEP storms were run for the Saugeen River, but they are not appropriate for the purposes of this study and are therefore not reported in this table. However, the results from these model runs can be found in Appendix B2.

The Regional Storm produced larger peak flows than the 1% AEP at the junctions, reaches, and most subbasins. The 1% AEP event produced larger peak flows than the Hurricane Hazel Storm at Subbasin 137. Subbasin 137 is characterized as having lower lag time and/or higher percent imperviousness.

3.4.2 Future Conditions Modeling Results

As described in Section 3.3.12, based on the review of the Official Plan and the Zoning, significant future development is not anticipated for the Town of Durham or within the Saugeen River Watershed; therefore, no future conditions were modelled as part of the hydrology study.

3.4.3 Sensitivity Analysis

A sensitivity analysis was performed on several parameters to assess their relative impact on peak flows and runoff volume. The typical range for sensitivity analysis for floodplain mapping is 75% to 125% of the estimated parameter values (EWRG, 2017). A summary of the results for peak can be found in Table 18. The full results of the analysis can be found in Appendix B2.

Table 18 – Summary of Sensitivity Analysis

Parameter	75% of Estimated Value		125% of Estimated Value	
	Maximum Net Change in Peak Flow (m^3/s)	Maximum Percent Change in Peak Flow	Maximum Net Change in Peak Flow (m^3/s)	Maximum Percent Change in Peak Flow
Hydraulic Conductivity	28.9	17.5%	-26.9	-17.3%
Suction at the Wetting Front	8.7	4.7%	-8.3	-4.5%
Initial Water Content	-12.0	-7.6%	13.2	8.2%
Percent Impervious	-2.2	-4.7%	2.1	4.7%
Lag Time	61.2	33.1%	-39.9	-19.8%
Slope	-19.9	-13.3%	9.6	4.7%
Canopy Storage	0.2	0.2%	-0.2	-0.2%
Depression Storage	4.7	2.8%	-4.7	-2.7%

The results from the analyses show that hydraulic conductivity and lag time were the most sensitive parameters in the model. Canopy and Depression storage were found to be the least sensitive parameters. Channel slope, Suction at the Wetting Front, Initial Water Content and Percent Impervious were found to be moderately sensitive.

3.5 Hydrologic Model Validation

3.5.1 Overview

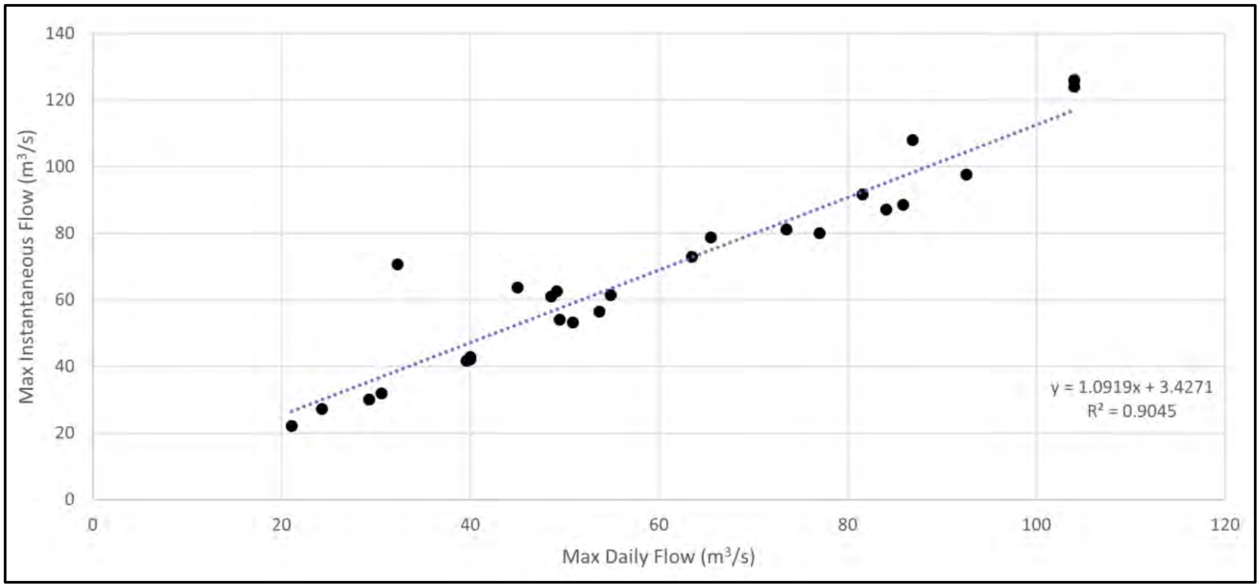
This section describes several methods used to calculate peak flows for the purpose of validating the hydrologic model and single station frequency results. While there are no regional frequency methods that were appropriate for the small drainage area associated with Durham Creek, the parameters in the model were globally changed during the calibration exercise for the Saugeen River and, therefore, Wills has assumed that the results from the calibrated model are representative of Durham Creek as well.

3.5.2 Single Station Frequency Analysis

The Saugeen River Above Durham Water Survey of Canada Gauging Station (02FC016) was used for the Single Station Frequency Analysis (SSFA). Wills downloaded the maximum annual instantaneous flow (MAIF) and the maximum annual daily flow (MADF) data from Water Survey of Canada. There were 29 years of data available for the MAIF and 37 years of MADF. In general, the MADF flow data is always more complete than then the MAIF data as WSC QA/QC process removes MAIF when flow is under the influence by ice or some other factor. These missing events can often be significant flood events that are important to the gauge record and can result in underestimated AEP flows generated from a SSFA. Additionally, general guidelines suggest that 30 years at minimum is required and 50 years preferred to confidently generate a 1% AEP event from a SSFA (Watt et al.). Therefore, it is often desirable to extend the data record if possible.

Wills used 26 events where MAIF and MADF data were both available and occurred within the same time frame (+/- 1 day) to produce a relationship using linear regression between the two data sets. The results of this analysis can be found in Figure 10.

Figure 10 – Max. Instantaneous Vs. Max. Daily Flow for Saugeen River Above Durham



The results of the linear regression analysis showed there was a good correlation between MADF and MAIF with a coefficient of determination of 0.9045. Wills then used the linear regression formula of y=1.0919x+3.471 where x is MADF and y is MAIF to estimate the missing data from MAIF where MADF was present. Wills used this method to extend the MAIF data record to 36 years which is sufficient period of record to confidently produce a 1% AEP flood event using SSFA.

Wills input the MAIF data into the statistical software package HEC-SSP. HEC-SSP is used to complete a statistical analysis of the data to determine Annual Exceedance Probability peak flows. The Log Normal 3 Parameter (LN3) and Log Pearson 3 (LP3) distributions using method of moments were evaluated. Wills found that both methods reasonably represented the data and therefore selected LN3 on the basis of that LN3 is a common distribution used in Ontario. The results from the Single Station Frequency Analysis can be found in Table 19 and the statistical plot can be Figure 11.

The drainage area to the Saugeen River gauge represents 89% of the drainage area to the Durham Upper Dam. The transposition of the data can be calculated using the following formula:

$$Q2 = Q1\left(\frac{A2}{A1}\right)^{0.75}$$

Where Q2 is the transposed flows, Q1 is the calculated AEP flows, A1 is the drainage area at the gauge, and A2 is the drainage area at the Durham Upper Dam. The results from the flow transposition can be found in Table 19.

Figure 11 – Single Station Frequency Analysis Statistical Plot – LN3

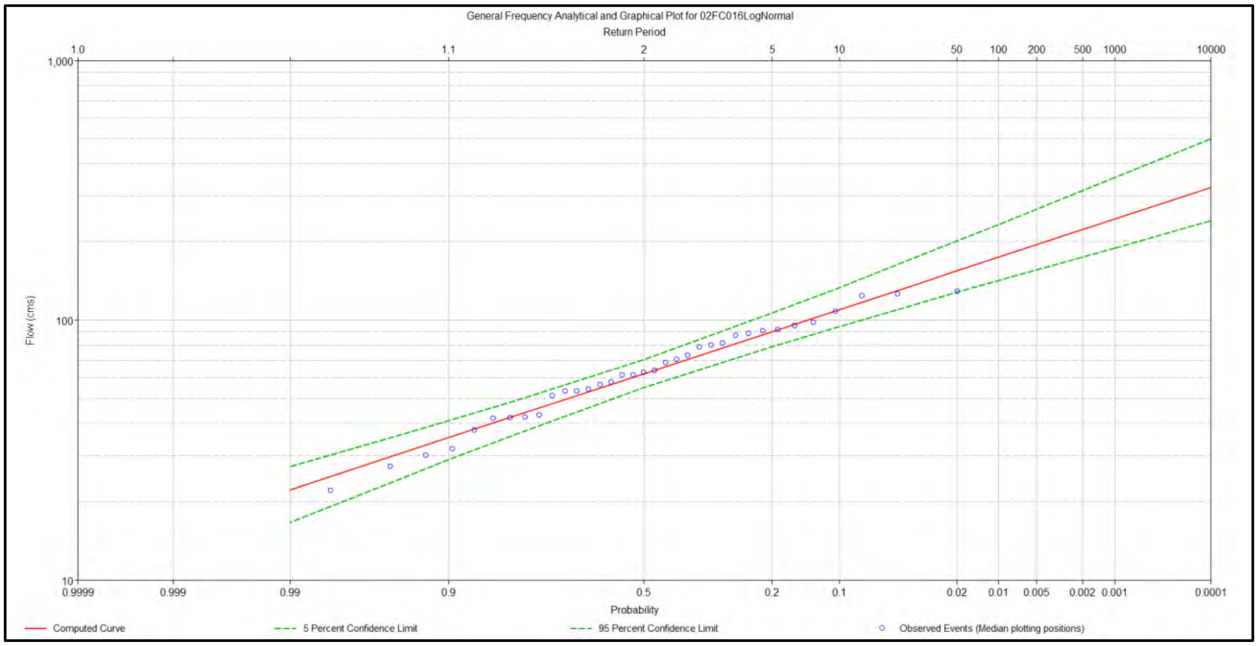


Table 19 – Single Station Frequency Analysis Results

Return Period (years)	Probability	Annual Exceedance Probability Percent	Flow at Gauge (m^3/s)	Transposed Flow (m^3/s)
1000	0.001	0.1	244.7	265.6
100	0.01	1	174.4	189.3
50	0.02	2	154.6	167.8
25	0.04	4	135.1	146.6
10	0.1	10	109.8	119.2
5	0.2	20	90.3	98.0
2	0.5	50	62.2	67.5
1.25	0.8	80	42.8	46.4
1.11	0.9	90	35.3	38.3
1.05	0.95	95	30.0	32.6
1.01	0.99	99	22.2	24.1

3.5.3 MNR Index Flow Method

The MNRF Index Flood Method (IFM) was developed by the MNRF to provide flow rates in catchments where a limited number of years of data were available. 238 gauging stations were analyzed to determine homogeneous regions with common hydrologic characteristics. 12 regions were identified, and a frequency curve was developed for each. Within this applicable region (Region 3), this method is recommended for watersheds between 86 km^2 and 3,960 km^2; therefore, this method is applicable to the Saugeen River watershed, but not the Durham Creek watershed. In Region 3, which contains the Saugeen River watershed, the index flood is calculated as:

$$Q2 = 0.20(Drainage\ Area)^{0.957}$$

Where, Q2 is the 50% AEP period index flood in m^3/s and drainage area is in km^2.

The remaining return period flows (20% AEP through 1% AEP) are calculated as ratios of the Index Flood. The applicable ratios for Region 3 are as follows:

Index	Q2	Q5	Q10	Q25	Q50	Q100
Ratio	1.00	1.35	1.60	1.90	2.20	2.50

A comparison of the modelled flows with the MNRF Index Flow Method is provided in Table 20.

3.5.4 Flood Flow Comparison Results

The results from the SSFA completed by Wills was compared to the computed results of the MNR Index flood, and the results from other flood studies completed historically for the Saugeen River. A summary table of the flood flows for the 1% AEP event can be found in Table 20.

Table 20 – Flood Flow Comparison for 1% AEP Event

Subbasin	Peak Flow (m^3/s)				
	Drainage Area (km^2)	Single Station Frequency Analysis Transposed (Wills 2023)	MNR Index Flow Method	Single Station Frequency Analysis and Transposed by Wills (WESA 2009)	Lathem Group Report (1983)
Drainage Area at Durham Upper Dam	347.3	189.3	135.0	155.2	185

In general, review of the comparison peak flows show that the MNR IFM results are lower than those produced through the SSFA completed by Wills. Wills SSFA was found to be slightly higher than Lathem Group Report 1983 which used downstream gauges on the Saugeen River (i.e., not the Saugeen River Above Durham Gauge) to estimate the 1% AEP. The SSFA completed by WESA was lower than what was estimated by Wills. Wills SSFA has a significantly longer period of record that was analyzed and therefore the results were accepted as the AEP flood events for the purposes of this study.

3.5.5 Hurricane Hazel Regional Storm

The hydrologic model was calibrated and verified for the Saugeen River using historic rainfall and flow data. In general, the model does a satisfactory job at modeling peak flows during the calibration and verification events. Therefore, the estimated peak flows calculated by the model for Hurricane Hazel Storm were assumed for the purposes of this study for both the Durham Creek and Saugeen River at the Durham Upper Dam.

3.6 Comparison to Past Study Results

The previous floodplain mapping for the Town of Durham, Ontario along the Saugeen River was completed in 1983 by Latham Group, and in 2009 by WESA. The results of the modeling for the Hurricane Hazel Storm compare reasonably well with the original peak flows produced in these studies. The Hurricane Hazel Storm flow rate calculated by Wills was 276.4 m^3/s compared to the 305 m^3/s WESA calculated. It was unclear from the report if the WESA HEC-HMS model had been calibrated.

Wills reviewed the Durham Creek background data, and it does not have previous hydrology completed.

3.7 Summary and Selection of Peak Flows for Hydraulic Model

3.7.1 Hydrology Study Summary

Wills developed a hydrologic model for the Saugeen River and Durham Creek. The model includes 38 sub-catchments based on the various tributaries as well as the anticipated flow change locations in the hydraulic model. The hydrologic model was developed with existing hydrologic parameters as most of Durham Creek is already developed.

3.7.2 Selection of the Flood Risk Mapping Peak Flows

Flood hazard mapping was completed for the 4%, 2%, and 1% AEP storms and the Regional (Hurricane Hazel) Storm plus the same storms with considerations for climate change. The peak flows recommended for use in the flood risk mapping for Durham Creek are those produced by the hydrologic model for the 6-hour SCS Type II storm distribution and Regional (Hurricane Hazel) Storm. The peak flows recommended for use in the flood risk mapping for the Saugeen River are those produced by the hydrologic model for Regional (Hurricane Hazel) Storm and the AEP flows from the SSFA.

3.7.3 Selection of the Regulatory Flood

Within the jurisdiction of the SVCA, and in keeping with the Technical Guide - River and Stream Systems: Flood Hazard Limit (MNR, 2002), Figure B-1, the subject area is in Zone 1 and therefore the Regulatory Flood is selected as the flood resulting from the Regional (Hurricane Hazel) Storm or the 1% AEP storm, whichever is greater. Based on the results of the hydrologic model results for existing conditions shown in Table 10 and described in Section 3.4, the Hurricane Hazel Storm peak flows will be used for Durham Creek. The Hurricane Hazel Storm peak flows produced higher peak flows, except for Subbasin 137 where the 1% AEP storm produced slightly higher peak flows for the individual basin (but not in the junctions or routing reach). Therefore, it is recommended that the Hurricane Hazel event be used for regulatory purposes for Durham Creek. A summary of which storm and peak flow to be used for regulatory mapping can be found in Table 21.

Table 21 – Regulatory Floodplain Mapping Peak Flows

Location	Regulatory Flood	Peak Flow (m^3/s)
Subbasin_134	Regional	2.3
Junction_119	Regional	2.3
Reach_1019	Regional	2.3
Subbasin_135	Regional	3.2
Reach_1020	Regional	4.6
Subbasin_137	Regional	3.2
OurflowDurham	Regional	7.4
Junction 118 (Inflow to Durham Upper Dam)	Regional	276.4

4.0 Hydraulics

4.1 Model Selection

The HEC-RAS (Version 6.4.1) hydraulic model was selected by the project team and the SVCA as the preferred hydraulic model to be used for this project. HEC-RAS is a free hydraulic modeling software developed and maintained by the U.S. Army Corps of Engineers' (USACE) Hydrologic Engineering Centre (HEC) with a long history of use in Canada and internationally. The software can perform hydraulic calculations in one-dimensional steady flow, one-dimensional (1D) unsteady flow, two-dimensional (2D) unsteady flow, and coupled one-dimensional/two-dimensional (1D/2D) flow conditions for a full range of natural and constructed channels. The software is suitable for many applications including floodplain mapping, open channel and hydraulic structure design, dam breach analysis, rain on grid, and sediment transport modeling. HEC-RAS includes built in GIS tools with which a significant portion of the hydraulic model can be developed, and the modeling results viewed.

The following information is required to calculate the input parameters for HEC-RAS to compute water surface elevation and velocity:

- Topographic, bathymetric, and aerial imagery information for the channel and overbanks to define the physical characteristics of the watercourse including slope, length, geometry, and Manning's roughness.
- Bridge, culvert, inline structure, and lateral structure information including geometry, construction material, alignment, and operating rules (if applicable).

- Location and geometry of obstructions to flow such as dwellings and auxiliary structures.
- Peak flows are required for a steady flow model and a hydrograph for an unsteady flow model.
- Flow and water surface elevations of past events for calibration and verification of model parameters.

The objective of the hydraulic model is to compute accurate water surface elevations and floodplain extents for several AEP and Hurricane Hazel storm events through the Town of Durham. Wills reviewed the topography, historic floodplain mapping, available background information from the SVCA, anecdotal information received from residents during the field program, and information gathered during the first Public Information Centre. Wills determined that there are several locations within the study area, including the spill into Durham Creek from the Saugeen River, where flow is two dimensional (2D). Therefore, a 2D unsteady state modeling approach was chosen by Wills based on modeling objectives, available data, topography, and the complexity of flow direction throughout the study area.

4.2 Hydraulic Model Development

4.2.1 Hydraulic Model Domain

The 2D hydraulic model covers an area of approximately 5.4 km^2. The model extends for approximately 7.3 km along the Saugeen River, extending from Grey County Road 4 (downstream end of the model) to Concession 2 (upstream end of the model) and includes the anticipated Saugeen River floodplain as well as the Durham Creek study area. The flow length of Durham Creek is approximately 1.5 km. The 2D model extents are shown in Figure 12 with a red outline and hatching.

Figure 12
Saugeen River and Durham Creek
Hydraulic Modelling Domain

Legend
- 2D Model Boundary Conditions
- 2D Flow Area

Data Sources:
SWOOP 2020, Grey County

NAD 1983 UTM Zone 17N

1:15,000

Meters
0 130 260 520 780 1,040

N

Drawn By:	DG
Checked By:	MC
Map Date:	2/29/24
Project Number:	5591
Map File Number	5591-Domain

WILLS

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150 Jameson Drive
Peterborough, Ontario
K9J 0B9

P. 705.742.2297
F. 705.748.9944
E. wills@dmwills.com

4.2.2 Topographic and Bathymetric Data

Wills used the 0.5 m LiDAR DTM discussed in Section 2.2 as the terrain file for the hydraulic model. The LiDAR DTM does not include points for the ground surface below the water surface. Therefore, it is generally necessary to supplement these areas with surveyed data to create accurate river geometry. Topographic and bathymetry surveys were completed for all hydraulic structures and selected river/creek cross sections in the study area. Bathymetric survey points were taken in-channel up to the top of bank throughout the study area, including in Durham Creek and along the Saugeen River where conditions permitted. The surveyed data between the banks was merged into the terrain in HEC-RAS. Data sources generated by different entities were placed into the same projection and datum for consistency in processing.

Road and rail crossings have one of the most significant impacts on the regulatory floodplain. Considerable backwater conditions may be present upstream of a crossing that is unable to convey the regulatory flow, causing a widespread floodplain. There are a significant number of structures that cross Durham Creek and the Saugeen River. Wills completed field surveys of all hydraulic structures within the study area. Detailed structure data sheets and photos for each crossing are contained in Appendix A.

4.2.3 2D Flow Areas

Wills created a single 2D flow area within the HEC-RAS model, as shown in Figure 12. The default initial cell size used was a 10 m resolution. The 2D area's cell sizes were further refined along the watercourse and linear infrastructure using breaklines and SA/2D Connections enforced as breaklines to ensure cell faces were aligned perpendicular to the major flow paths and the Courant numbers remained below one. Breaklines and refinement regions used near spacing between 3 m and 4 m with near repeats ranging between 1 and 9, depending on the width of the floodplain.

4.2.4 **Manning's Roughness Values**

Wills imported the SOLRIS landcover GIS layer to HEC-RAS to estimate the initial Manning's roughness values for the 2D domain. The Manning's roughness values were then further refined as needed using aerial imagery, and geospatial refinement regions within HEC-RAS. A summary of the Manning's roughness values for each type of land cover and typical calibration ranges can be found in table in Table 22.

Table 22 – Mannings Roughness Values

Raster Value SOLRIS	Land Cover Description	'n' Standard	Calibration Range	
			Minimum	Maximum
Channel				
Manual Input	Watercourse	0.035	0.025	0.045
Overbank				
90	Forest	0.08	0.04	0.12
91	Coniferous Forest	0.08	0.04	0.12
92	Mixed Forest	0.08	0.04	0.12
93	Deciduous Forest	0.08	0.04	0.12
131	Treed Swamp	0.08	0.04	0.12
135	Thicket Swamp	0.08	0.035	0.07
160	Marsh	0.08	0.035	0.07
170	Open Water	0.035	0.035	0.07
191	Plantation	0.08	0.04	0.12
192	Hedge Rows	0.08	0.04	0.12
193	Agriculture/Tilled	0.055	0.035	0.07
201	Transportation (Asphalt)[1]	0.06	-	-
202	Built Up Area-Pervious	0.045	0.03	0.055
203	Built Up Area-Impervious[1]	0.06	0.03	0.055
204	Aggregate Extraction	0.1	-	-
250	Undifferentiated	0.055	0.035	0.07
Conduit				
Manual Input	Corrugated Steel Pipe	0.024	0.021	0.027
Manual Input	Concrete	0.013	0.011	0.015

1. Transportation and Built Up-Impervious were lumped into a single composite land cover manning's value which is consistent with published low intensity developed areas from HEC-RAS 2D User Manual.

4.2.5 Hydraulic Structures

Wills completed topographic surveys of all road crossings, several private foot bridges, and three dams along Durham Creek and the Saugeen River. All road crossings were included in the model as SA/2D Connections. Private foot bridge structures without concrete abutments were not included in the model as they are likely to wash away during a high magnitude flood event. Additionally, several of the private foot bridges did not have railings and therefore represent only a small reduction in overall conveyance if they did not fail.

All galvanized guard rails were assumed to be blocked and were therefore modeled as solid portions of the bridge/culvert structure. Structures with concrete parapet walls were modeled as solid portions of the bridge/culvert structure. Steel tube railings with 1 m or greater between vertical posts were assumed to still convey flow and were therefore not included in the bridge/culvert structure. This was assumed as they are significantly less likely to become blocked during a storm. Table 23 shows the typical values for the weir coefficients used by Wills and the calibration range.

Table 23 – Weir Coefficients

Weir Flow Coefficients	'C' Standard (2D HEC-RAS Default)	Calibration Range	
		Minimum	Maximum
Broad Crested (i.e., Dams and Road Embankments)	1.66	1.4	1.7

4.2.6 Obstructions

Generally, there are two methods to include barriers to flow such as dwellings or auxiliary structures in a 2D model. The first method is to raise the terrain of the DTM to include the structure and carefully construct the cells faces for each dwelling. The second method is to significantly increase the Manning's n values for the cells within the building footprint so that water can enter the building footprint (i.e., flood the structure), but it does not account for significant conveyance. Both methods can generally produce accurate mapping if implemented correctly. Method 1 was chosen due to the ease of application and that it does not account for flow entering structures, which is conservative in terms of floodplain limits.

4.2.7 Boundary Conditions

Durham Creek and the Saugeen River required several boundary conditions in HEC-RAS as it is an unsteady model and there are multiple inflow locations. In HEC-RAS the upstream flow hydrograph boundary condition, the internal flow hydrograph boundary condition, and the downstream boundary condition all require an initial estimate of the friction slope. Wills estimated the friction slope to be the average bed slope of the terrain upstream and downstream of the boundary condition. The location, type of boundary condition, and the estimated initial friction slope can be found can be found in Table 24.

Table 24 – Boundary Conditions

Name	Location	Boundary Condition Type	Estimated Initial Friction Slope (m/m)
Saugeen Inflow BC	External	Flow Hydrograph	0.0039
Durham Creek Upstream BC	Internal	Flow Hydrograph	0.008
Durham Creek J20 BC	Internal	Flow Hydrograph	0.003
Durham Creek J21 BC	Internal	Flow Hydrograph	0.0047
Saugeen Outflow BC	External	Normal Depth	0.0023

4.2.8 Flow Data for Hydraulic Model

2D hydraulic models require the use of an unsteady flow regime. This means that an inflow hydrograph time series needs to be defined rather just a constant peak flow that is used in a steady state model. There are two approaches that can be taken to define this hydrograph. The first approach is to define the actual full hydrograph that was computed by the hydrologic model, including rising and falling limbs. The second approach is to define a "quasi" unsteady hydrograph such that the hydrograph is the peak flow calculated by the hydrologic model for all ordinates of the time series. The "quasi" unsteady hydrograph approach was used by Wills for the undertaking the hydraulic assessment as it most closely mirrors the assumptions used in a steady state model, which is recommended in the Technical Guide – River and Stream Systems: Flooding Hazard Limit (MNR, 2002).

The existing condition flows discussed in Section 3.4.1 were used for the purposes of floodplain mapping for the 4% AEP storm, 2% AEP storm, 1% AEP storm, and the Hurricane Hazel storm as well as the same events with considerations for climate change. The flow data used for inflow hydrographs at the boundary conditions can be found in Table 25 for the standard storm events and in Table 26 for the climate change scenarios. Note these are steady inflow hydrographs and are incremental for Durham Creek.

Table 25 – Inflow Hydrographs for Hydraulic Model at Boundary Conditions

Hydrologic Element	4% AEP (m^3/s)	2% AEP (m^3/s)	1% AEP (m^3/s)	Hurricane Hazel (m^3/s)
Saugeen Inflow BC	135.1	154.6	174.4	276.4
Durham Creek Upstream BC	1.1	1.3	1.4	2.3
Durham Creek J20 BC	1.5	1.7	2.0	2.3
Durham Creek J21 BC	2.2	2.6	2.9	2.8

Table 26 – Inflow Hydrographs with Climate Change Used for Hydraulic Modeling

Hydrologic Element	4% AEP Climate Change (m^3/s)	2% AEP Climate Change (m^3/s)	1% AEP Climate Change (m^3/s)	Hurricane Hazel Climate Change (m^3/s)
Saugeen Inflow BC	135.1	154.6	174.4	276.4
Durham Creek Upstream BC	1.4	1.6	1.8	2.9
Durham Creek J20 BC	2.0	2.3	2.6	3
Durham Creek J21 BC	2.8	3.3	3.7	3.6

4.3 Calibration/Validation

The development of a hydraulic model requires several input parameters. Some of the parameters are based on field measurements (i.e., survey, measurements of bridges and culverts, etc.), while other parameters are left to engineering experience and judgement based on available information (Manning's n, loss coefficients, etc.). For this reason, it is ideal to compare computed water levels to those observed in the field. Model parameters can then be adjusted (calibrated) to replicate the observed water levels more accurately during a historic flood event. Wills completed a background review of all available information and found no documentation of historic flood events within Durham Creek for which to calibrate the hydraulic model. Therefore, typical published parameters were relied upon to produce water surface elevations for the purposes of this study.

4.4 Hydraulic Model Results

Water surface elevations are shown on the engineered floodplain maps in Appendix D and the digital raster outputs which have been provided in an ESRI file geodatabase.

4.5 Sensitivity Analysis

Wills completed a sensitivity analysis of the hydraulic model using the Hurricane Hazel storm profile. In general, the most sensitive parameter within a hydraulic model is Manning's roughness. Manning's roughness is a highly variable and subjective parameter that has a significant influence on the computed water surface elevations. Therefore, it is necessary to assess the sensitivity of computed water surface elevations to changes in manning's roughness values. The typical range for sensitivity analysis for floodplain mapping is 75% to 125% of the estimated parameter values (EWRG, 2017). A summary of the results of the sensitivity analysis can be found in the histograms shown in Figure 13 (125% Initial Manning's Roughness) and Figure 14 (75% Initial Manning's Roughness. It is noted that the histograms are based on the raster water surface elevation outputs from HEC-RAS which have a cell size of 0.5 m and not the computational grid.

The results of the sensitivity analysis show that when the Manning's roughness is increased to 125% of the initial roughness, the mean increase in water level is 0.12 m. The results of the sensitivity analysis also show that when the Manning's roughness is decreased to 75% of the initial roughness, the mean decrease in water level is 0.14 m.

Figure 13 **– 125% of Initial Manning's Roughness**

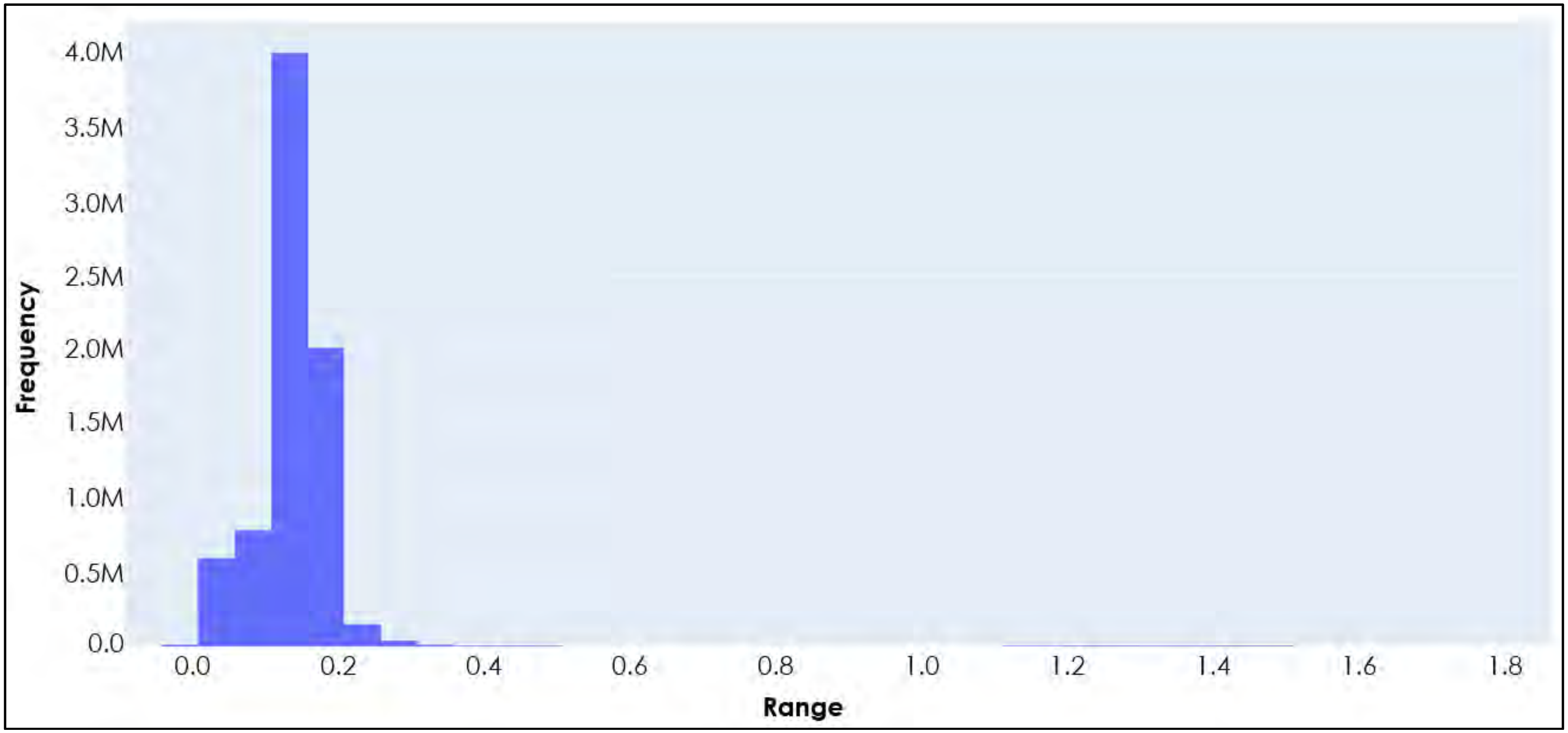
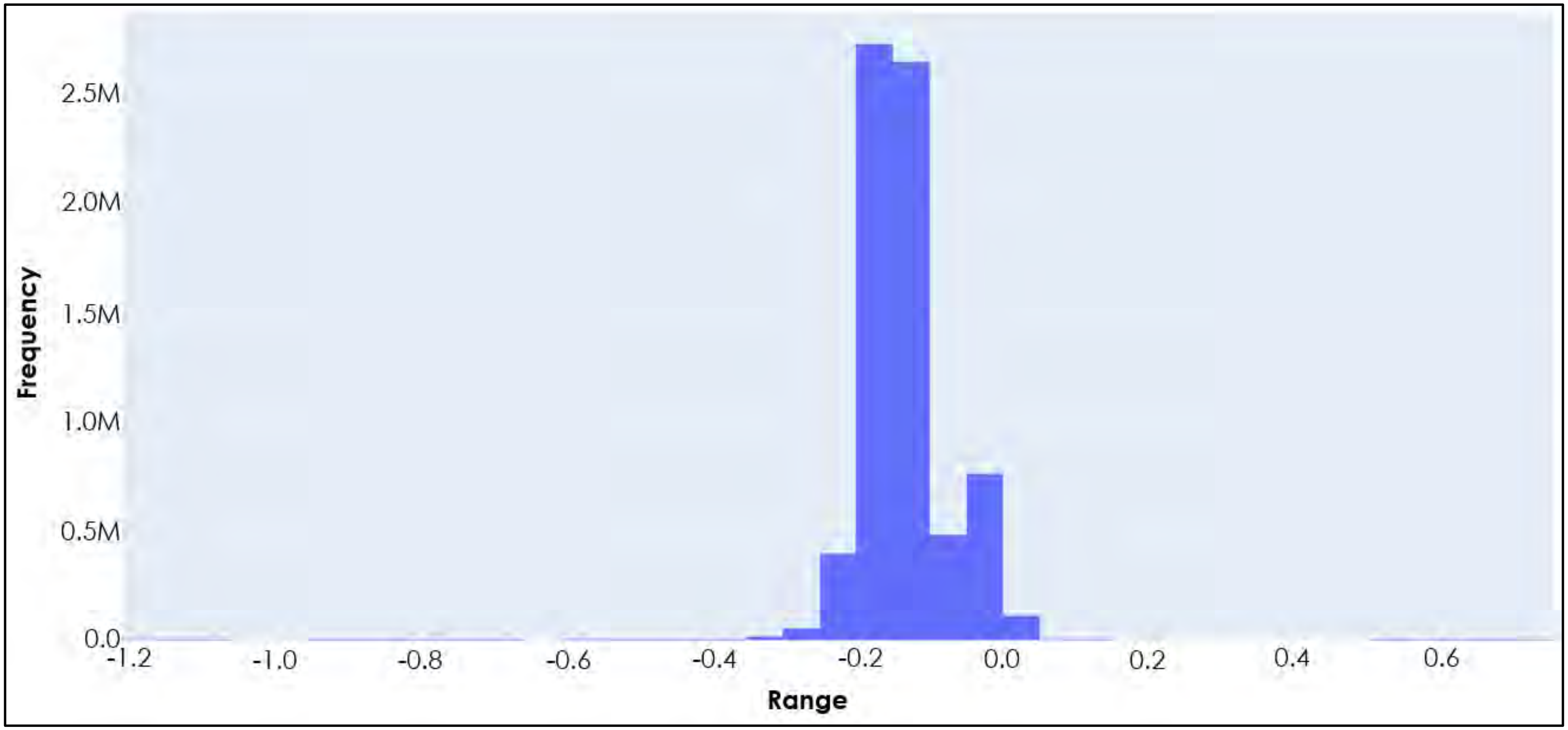


Figure 14 **– 75% of Initial Manning's Roughness**



5.0 Mapping

5.1 Overview

The regulatory floodplain and flood risk mapping is the final product produced after the water surface elevations are determined using the hydraulic model. Wills utilized the tools within HEC-RAS as well as manual interpretation and refinement in ArcGIS to delineate the floodlines.

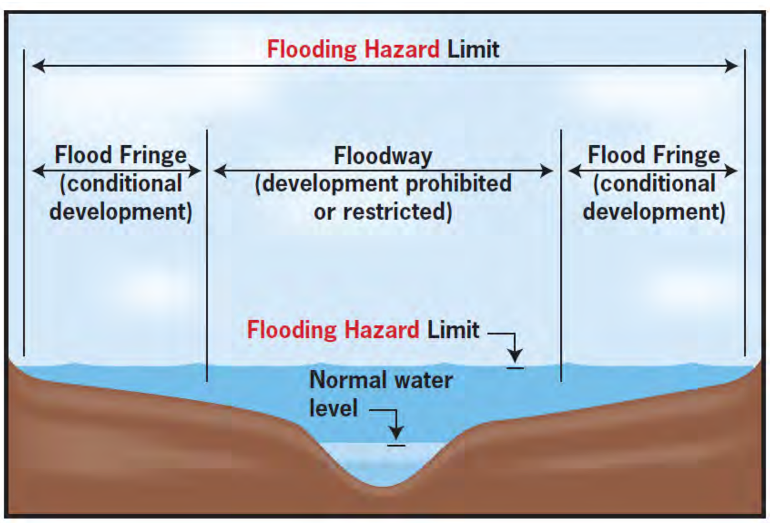
The 2020 South Western Ontario Orthophotography Project (SWOOP) Aerial Imagery was used as the background layer for all mapping. The orthoimagery was obtained from the Grey County GIS Server. The LiDAR DTM discussed earlier in the report is the base topographic dataset used for computing inundation boundaries, depths, and water surface elevations. For visualization purposes, contours were created from the DTM at 1.0 m and 5.0 m intervals.

The regulatory floodplain and flood risk maps are provided in Appendix D.

5.2 Two Zone Flood Hazard Concept

The Municipality of West Grey has adopted a two zone flood hazard policy approach for Durham Creek. The two zone approach recognizes the fact that the flood hazard can often be divided into two zones, the floodway, and the flood fringe. The floodway is the inner portion of the flood hazard that represents the area required for the safe passage of flood flow and/or the area where flood depth and/or velocities are considered to be such that they pose a potential threat to life and/or property damage. The two zone approach is shown in Figure 15.

Figure 15 – Two Zone Flood Hazard Approach



The two zone flood hazard limit for Durham Creek is complicated by the presence of a flood dike at the Durham Upper Dam. This dike stops the Saugeen River from spilling into Durham Creek. The Technical Guide – River and Stream Systems: Flooding Hazard Limit

(MNR, 2002) states that the area behind a dike is regarded as flood fringe if the dike is high enough to provide protection against the Regional flood. The dike at the Durham Upper Dam has a freeboard of approximately 0.50 m during the Regional flood; therefore, the area that the dike protects from flooding can be considered as flood fringe.

In summary, the outer extent of the flood hazard limit is defined as the Regional flood limit for Durham Creek plus the Regional flood limit for the case where the dike at the Durham Upper Dam is not present. The floodway is defined by looking at a combination of the depth (>0.8 m), velocity (>1.7 m/s), and depth x velocity (>0.40 m^2/s).

5.3 Floodline Delineation

RAS Mapper, a tool within HEC-RAS, was used to generate the floodlines for the regulatory floodplain and flood risk mapping. RAS Mapper projects the hydraulic model results across the terrain data (LiDAR DEM) to create the floodlines for the chosen plans. The computed floodlines are a reasonable estimate; however, further evaluation and revisions to correct abnormalities is generally required. Manual interpretation and refinement were completed within ArcGIS to ensure all floodlines conform to the principles of hydraulic engineering. Areas shown as inundated that are not hydraulically connected were excluded from the floodplain. Furthermore, high points of land that are not subject to flooding during a regional event but are surrounded by flooded land are within the limits of the delineated flood line. Some engineering judgement was used for properties within an "island" that were clearly built to be higher than the floodplain.

The following summarized the manual adjustments of interest that were made to create the floodlines for Durham Creek:

- All islands within the floodplain were removed.
- Areas resembling an island connected only by a narrow strip of land were removed and considered to be within the floodplain.
- Connection of the floodlines were made for any overtopping hydraulic structures.
- The floodway was defined using GIS tools and the depth, velocity, and depth x velocity HEC-RAS outputs.

The results of the floodline delineation are shown on the regulatory floodplain and flood risk maps in Appendix D.

5.4 Floodplain Mapping Results

5.4.1 Floodline Comparison

There are no existing floodlines for Durham Creek with which to compare the current Durham Creek floodlines. Therefore, Wills compared the results of the 1983 Latham Group floodplain mapping for the Saugeen River to the results of Wills 2D hydraulic model for the Saugeen River. The two results compare reasonably well; however, the

1983 floodlines show more flooded area in most places. These differences are most likely attributable to the differences in topographic data sources, and changes in the modelling approach.

5.4.2 Roadway Overtopping

There are several culvert structures along Durham Creek that overtop during the modelled flood events. Will identified these culverts by analyzing the results of the HEC-RAS model. The results of the analyses for each event were extracted from HEC-RAS and input into a Microsoft Excel spreadsheet where they were formatted for input into the report.

The results of the analyses are included in Table 27 and in Table 28 for the climate change scenarios. There are a number of culverts that overtop under the various scenarios, including many where the Maximum Overtopping Depth exceeds 0.30 m (the maximum allowable depth for safe access). These locations/events are highlighted in red/bold in Tables 27 and 28. The Overtopping Velocities are generally within the erosion threshold for gravel substrates, which is in the range of 0.75 m/s to 1.2 m/s based on Design Chart 2.17 from the MTO Drainage Management Manual (MTO, 2023). The locations/events that exceed 0.75 m/s are shown in orange/bold in Tables 27 and 28 and the locations/events that exceed 1.2 m/s are highlighted in red/bold in Tables 27 and 28. Locations where the erosion threshold of 1.2 m/s is exceeded have an increased risk of erosion during overtopping.

5.4.3 Impacts to Buildings

There are several buildings included in the floodplain for the various flood events. These buildings were identified by Wills through an analysis completed in ArcGIS using the outputs from the HEC-RAS model, DTM, building footprints, and Grey County parcel fabric. Wills related the building footprints with the parcel fabric so that each building had a 911 address associated with it. The minimum DTM elevation, maximum water surface elevation, and maximum flood depth were then determined for each building.

The results of the analyses are included in Table 29 for the regular flood events and Table 30 for the climate change events. In total, there are approximately 174 buildings that could be flooded under different scenarios. Of the 174 buildings that that could be impacted, approximately 58 of them are only flooded in the case where the dike at the Durham Upper Dam remains in place.

Table 27 – Roadway Overtopping

Street	25-Year			50-Year			100-Year			Hazel			Hazel No Dike		
	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)
Lambton Street East	1.1	0.30	0.56	1.3	0.34	0.58	1.4	0.36	0.60	2.3	0.38	0.65	160.7	1.27	2.37
Kincardine Street North	2.6	0.61	0.25	2.4	0.65	0.37	2.8	0.69	0.28	4.0	0.78	0.32	175.9	1.78	1.52
Elgin Street South	4.8	0.35	0.47	5.6	0.37	0.50	6.3	0.39	0.52	7.4	0.41	0.54	163.0	1.25	2.22
Saddler Street East	4.8	0.84	0.58	5.6	0.89	0.57	6.3	0.92	0.59	7.4	0.93	0.65	162.9	2.18	2.04
Albert Street South	4.4	0.89	0.32	5.2	0.93	0.34	5.9	0.97	0.35	6.7	1.01	0.36	150.9	1.84	1.94
Highway 6	4.8	0.64	0.24	5.6	0.69	0.27	6.3	0.72	0.29	7.4	0.77	0.31	151.3	1.93	1.44
Queen Street South	4.7	0.97	0.62	5.5	1.09	0.71	6.3	1.20	0.79	8.7	1.56	1.07	159.6	1.52	1.40

Table 28 – Roadway Overtopping Climate Change

Street	25-Year CC			50-Year CC			100-Year CC			Hazel CC		
	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)	Flow (m^3/s)	Maximum Overtopping Velocity (m/s)	Maximum Overtopping Depth (m)
Lambton Street East	1.4	0.41	0.60	1.6	0.35	0.62	1.8	0.37	0.64	2.9	0.44	0.70
Kincardine Street North	3.4	0.69	0.28	3.9	0.73	0.30	4.4	0.77	0.31	5.9	0.86	0.35
Elgin Street South	6.2	0.40	0.52	7.2	0.41	0.54	8.1	0.43	0.57	9.5	0.47	0.60
Saddler Street East	6.2	0.92	0.62	7.2	0.95	0.61	8.1	0.99	0.63	9.5	1.03	0.69
Albert Street South	5.8	0.96	0.35	6.8	1.01	0.36	7.7	1.04	0.37	9.1	1.08	0.40
Highway 6	6.2	0.72	0.28	7.2	0.76	0.31	8.1	0.80	0.33	9.5	0.84	0.36
Queen Street South	6.1	0.99	0.64	7.1	1.08	0.71	8.1	1.18	0.79	10.8	1.54	1.08

Table 29 – Impacts to Buildings and Structures

Address	Lowest DTM Elevation (m)	25-Year		50-Year		100-Year		Hazel		Hazel No Dike	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
592 Lambton St East	348.73									349.71	0.76
573 George St East	347.53									349.21	1.39
561 George St East	348.33									348.80	0.51
165 Cross St S	343.20	344.56	0.23	344.56	0.23	344.57	0.24	344.55	0.25	344.69	1.44
429 Lambton St E	343.02									344.28	1.43
421 Lambton St E	343.96									344.28	0.42
155 Kincardine St S	342.86									344.28	1.41
175 Kincardine St S	342.93									344.14	1.16
176 Kincardine St S	341.27	342.36	0.37	342.39	0.39	342.41	0.41	342.45	0.46	343.75	1.65
180 Kincardine St S	340.44	342.37	0.45	342.39	0.47	342.41	0.49	342.46	0.53	343.78	2.19
196 Kincardine St S	342.07									343.80	0.93
154 Kincardine St S	340.69	340.75	0.07	340.78	0.10	340.84	0.13	342.32	0.33	343.80	2.01
122 Kincardine St S	341.75									343.85	1.23
479 Lambton St E	342.44	342.72	0.32	342.75	0.34	342.77	0.36	342.82	0.41	344.48	2.04
493 Lambton St E	344.32									344.65	0.28
489 Lambton St E	343.94									344.57	0.48
582 Cedar Ln	344.45									344.43	0.08
580 Cedar Ln	343.74									344.43	0.64
380 Saddler St E	341.49									343.36	1.24
368 Saddler St E	340.70	340.91	0.10	340.97	0.12	340.99	0.15	340.99	0.18	342.62	1.94
344 Saddler St E	340.40	340.85	0.32	340.96	0.34	341.05	0.40	341.04	0.43	342.61	2.14
191 Elgin St S	340.56	340.84	0.19	340.86	0.22	340.86	0.24	340.83	0.27	342.47	1.94
187 Elgin St S	340.18	340.71	0.53	340.74	0.56	340.77	0.59	340.81	0.62	342.66	2.32
175 Elgin St S	340.40	340.73	0.25	340.77	0.28	340.80	0.30	340.84	0.34	342.73	2.14
169 Elgin St S	340.75	340.73	0.02	340.77	0.06	340.80	0.08	340.85	0.12	342.70	1.97
157 Elgin St S	340.25	340.74	0.57	340.78	0.60	340.81	0.63	340.85	0.67	342.69	2.51
209 Garafraxa St N	338.52	342.02	3.38	342.34	3.70	342.63	3.96	344.28	5.58	341.58	3.01
144 Garafraxa St N	340.06	340.67	0.55	340.86	0.76	341.06	0.97	343.49	2.26	340.51	0.40
120 Garafraxa St N	341.06			340.82	0.03	341.04	0.02	343.43	1.11		
108 Garafraxa St S	342.45							343.14	0.38		
115 Lambton St W	342.54							342.92	0.34		
169 Lambton St W	342.30							342.72	0.18		
118 Queen St S	341.97							342.56	0.13		
124 Garafraxa St S	341.48							342.59	0.39		
157 Garafraxa St S	342.77							343.72	0.79		
137 Garafraxa St S	343.10							343.43	0.34		
105 Garafraxa St S	343.15							343.41	0.25		

Address	Lowest DTM Elevation (m)	25-Year		50-Year		100-Year		Hazel		Hazel No Dike	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
150 Mill St East	344.09							344.32	0.24		
119 Garafraxa St S	342.24							343.18	0.12		
156 Garafraxa St S	340.76							341.67	0.22		
157 Garafraxa St S	340.98							341.07	0.09		
168 Garafraxa St S	340.29							340.60	0.34		
168 Garafraxa St S	339.90							340.28	0.18	340.19	0.24
190 Garafraxa St S	339.30							340.03	0.11	340.12	0.32
173 Garafraxa St S	340.30								0.00		
185 Garafraxa St S	340.07							340.29	0.29	340.19	0.10
193 Garafraxa St S	340.17							340.28	0.06	340.20	0.05
197 Garafraxa St S	341.02									340.21	0.03
292 Saddler St E	340.64	340.64	0.03	340.66	0.05	340.69	0.08	340.72	0.11	342.36	1.74
176 Elgin St S	340.65	340.61	0.11	340.64	0.13	340.67	0.16	340.70	0.19	342.42	1.85
190 Elgin St S	340.37	340.61	0.45	340.64	0.48	340.66	0.50	340.70	0.53	342.44	2.26
270 Saddler St E	340.24	340.60	0.64	340.62	0.66	340.64	0.68	340.67	0.71	342.22	2.11
242 Saddler St E	339.94	340.58	0.84	340.60	0.86	340.62	0.87	340.64	0.90	342.15	2.12
193 Albert St S	341.15									341.87	1.00
208 Queen St S	338.04	338.63	0.57	338.72	0.66	338.81	0.74	339.11	1.04	339.21	1.12
212 Queen St S	338.29	338.56	0.43	338.66	0.50	338.74	0.56	339.05	0.69	339.17	0.83
216 Queen St S	338.28	338.41	0.14	338.50	0.22	338.56	0.29	338.80	0.53	339.10	0.82
226 Queen St S	337.83	338.38	0.29	338.43	0.37	338.48	0.43	338.64	0.68	339.07	1.15
248 Queen St S	337.89	338.16	0.19	338.22	0.26	338.27	0.30	338.40	0.44	338.85	0.90
252 Queen St S	337.32	337.75	0.43	337.81	0.49	337.87	0.54	338.06	0.73	338.55	1.20
264 Queen St S	337.29	337.65	0.37	337.71	0.43	337.76	0.48	337.93	0.65	338.33	1.05
270 Queen St S	337.40	337.60	0.21	337.67	0.27	337.72	0.32	337.87	0.48	338.27	0.88
278 Queen St S	336.92	337.36	0.37	337.42	0.43	337.47	0.48	337.64	0.65	338.12	1.12
284 Queen St S	336.68	337.30	0.50	337.36	0.57	337.41	0.61	337.57	0.76	338.04	1.23
292 Queen St S	337.38	337.12	0.14	337.18	0.11	337.22	0.15	337.47	0.27	337.95	0.71
250 South Street W	336.26	337.12	0.91	337.18	0.97	337.22	1.01	337.34	1.12	337.80	1.53
274 South Street W	336.11	337.12	1.05	337.18	1.11	337.22	1.14	337.33	1.25	337.77	1.62
273 Countess St S	337.10	337.10	0.00	337.17	0.03	337.20	0.06	337.31	0.15	337.68	0.52
279 Countess St S	336.92	337.12	0.09	337.17	0.16	337.21	0.19	337.31	0.29	337.69	0.65
285 Countess St S	336.95	337.11	0.13	337.17	0.19	337.19	0.18	337.29	0.29	337.66	0.63
209 Queen St S	338.47	338.73	0.25	338.85	0.35	338.95	0.44	339.32	0.80	339.29	0.77
151 Saddler St W	338.57	338.74	0.19	338.85	0.31	338.96	0.41	339.32	0.77	339.48	0.88
213 Queen St S	338.56			338.60	0.09	338.85	0.17	339.12	0.45	339.42	0.66
217 Queen St S	338.54			338.70	0.02	338.70	0.09	339.06	0.40	339.41	0.86
223 Queen St S	337.52	338.38	0.73	338.46	0.79	338.53	0.85	338.77	1.05	339.31	1.79
231 Queen St S	337.86	338.15	0.29	338.21	0.35	338.27	0.40	338.49	0.61	339.22	1.36

Address	Lowest DTM Elevation (m)	25-Year		50-Year		100-Year		Hazel		Hazel No Dike	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
245 Queen St S	337.66	338.08	0.44	338.14	0.50	338.19	0.56	338.40	0.76	339.09	1.45
249 Queen St S	337.65	337.99	0.28	338.04	0.33	338.09	0.38	338.28	0.59	338.93	1.21
253 Queen St S	337.62	337.84	0.15	337.90	0.21	337.95	0.26	338.16	0.46	338.78	1.08
265 Queen St S	337.21	337.68	0.46	337.74	0.52	337.80	0.58	338.00	0.78	338.58	1.35
269 Queen St S	337.62			337.65	0.04	337.70	0.09	337.88	0.26	338.34	0.66
295 Queen St S	336.33	337.34	1.24	337.41	1.29	337.47	1.34	337.64	1.52	338.14	2.01
204 Garafraxa St S	339.02	339.26	0.02	339.27	0.11	339.27	0.21	339.37	0.58	340.17	0.91
218 Garafraxa St S	338.35	338.97	0.27	338.99	0.29	339.00	0.31	339.05	0.40	340.08	1.38
226 Garafraxa St S	337.85	338.95	0.43	338.97	0.46	338.98	0.48	339.00	0.57	339.98	1.45
232 Garafraxa St S	337.69	339.08	1.07	339.09	1.09	339.10	1.11	338.97	1.14	339.97	2.03
232 Garafraxa St S	338.03	339.08	1.07	338.48	0.45	338.49	0.47	338.57	0.59	339.43	1.45
240 Garafraxa St S	337.97	338.27	0.20	338.28	0.21	338.29	0.22	338.36	0.43	340.08	1.27
248 Garafraxa St S	338.39	337.99	0.04	338.07	0.10	338.11	0.07	338.34	0.29	339.44	1.03
266 Garafraxa St S	340.50									340.55	0.05
280 Garafraxa St S	339.26									340.04	0.69
282 Garafraxa St S	340.02									340.49	0.17
176 South Street W	337.76							337.77	0.01	338.08	0.36
293 Queen St S	337.75							337.76	0.01	338.16	0.44
194 South St W	337.23			337.26	0.05	337.36	0.10	337.56	0.27	338.07	0.77
307 Queen St S	336.48	337.14	0.68	337.20	0.74	337.25	0.79	337.39	0.93	337.90	1.44
189 South Street W	336.79	337.14	0.36	337.20	0.43	337.25	0.47	337.39	0.62	337.90	1.12
175 South Street W	337.45							337.38	0.10	337.90	0.62
315 Queen St S	336.42	337.13	0.77	337.20	0.84	337.24	0.88	337.38	1.02	337.90	1.54
321 Queen St S	336.13	337.13	1.03	337.19	1.09	337.24	1.14	337.38	1.28	337.90	1.79
320 Queen St S	336.24	337.13	0.89	337.19	0.96	337.24	1.00	337.38	1.14	337.89	1.62
332 Queen St S	336.68	337.13	0.50	337.19	0.56	337.24	0.61	337.38	0.75	337.89	1.26
333 Queen St S	336.28	337.13	0.97	337.19	1.04	337.24	1.08	337.38	1.23	337.90	1.74
351 Queen St S	336.25	337.13	0.91	337.19	0.98	337.24	1.02	337.38	1.16	337.90	1.68
367 Queen St S	336.11	337.13	1.07	337.19	1.13	337.24	1.18	337.38	1.32	337.91	1.83
373 Queen St S	336.87	337.13	0.29	337.19	0.35	337.24	0.40	337.38	0.54	337.91	1.06
308 Queen St S	336.48	337.13	0.70	337.20	0.76	337.24	0.80	337.39	0.94	337.89	1.42
314 Queen St S	336.50	337.13	0.66	337.19	0.72	337.24	0.76	337.38	0.90	337.89	1.39
249 South Street W	336.18	337.12	0.97	337.18	1.03	337.22	1.07	337.36	1.21	337.84	1.69
293 South Street W	336.34	337.11	0.82	337.17	0.87	337.21	0.90	337.32	1.01	337.78	1.35
348 Queen St S	337.32					337.24	0.01	337.38	0.10	337.89	0.61
356 Queen St S	337.35								0.03	337.89	0.54
374 Queen St S	337.89									337.89	0.07
344 Garafraxa St S	336.69	337.13	0.53	337.19	0.59	337.24	0.64	337.38	0.78	338.06	1.30
378 Garafraxa St S	337.64									338.06	0.64

Address	Lowest DTM Elevation (m)	25-Year		50-Year		100-Year		Hazel		Hazel No Dike	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
150 Elizabeth St W	337.77									338.06	0.39
132 Elizabeth St W	337.00							337.19	0.19	338.06	1.06
390 Garafraxa St S	336.54							337.19	0.66	338.06	1.52
205 Albert St S	340.43	340.32	0.56	340.34	0.58	340.28	0.56	340.62	0.58	341.80	1.86
233 Saddler St E	340.61	340.57	0.01	340.59	0.03	340.61	0.04	340.63	0.06	342.00	1.26
257 Saddler St E	340.21	340.59	0.36	340.61	0.39	340.63	0.40	340.65	0.43	342.07	1.85
275 Saddler St E	339.93	340.59	0.41	340.61	0.43	340.63	0.45	340.66	0.48	342.15	1.88
204 Elgin St S	340.45	340.62	0.20	340.64	0.22	340.66	0.24	340.69	0.26	342.27	1.82
216 Elgin St S	339.82	340.39	0.31	340.42	0.33	340.45	0.35	340.48	0.39	342.25	1.82
224 Elgin St S	341.16									342.24	1.07
236 Elgin St S	341.70									342.19	0.44
240 Elgin St S	341.84									342.16	0.27
244 Elgin St S	341.55									341.97	0.33
291 Albert St S	339.03									340.01	0.95
289 Albert St S	339.30									340.23	0.81
283 Albert St S	339.66									340.46	0.62
279 Albert St S	339.73									340.60	0.79
271 Albert St S	340.29									340.76	0.40
267 Albert St S	340.60									340.79	0.16
225 Albert St S	341.33									341.62	0.25
219 Albert St S	340.32									341.74	1.23
215 Albert St S	339.98	340.22	0.23	340.25	0.26	340.28	0.29	340.32	0.33	341.81	1.82
211 Albert St S	339.69	340.21	0.45	340.25	0.48	340.28	0.51	340.32	0.54	341.81	1.92
341 Saddler St E	342.01									342.41	0.45
207 Elgin St S	341.16									342.38	1.20
215 Elgin St S	341.76									342.28	0.42
203 Garafraxa St S	337.77	339.63	0.65	339.63	0.68	339.64	0.71	339.64	0.75	341.14	2.33
215 Garafraxa St S	338.60	339.45	0.95	339.48	0.98	339.51	1.01	339.55	1.05	341.17	2.67
229 Garafraxa St S	339.06	339.36	0.30	339.40	0.33	339.42	0.36	339.46	0.39	341.00	1.89
145 Saddler St E	340.01									341.20	1.10
161 Saddler St E	339.85	340.01	0.08	340.01	0.09	340.02	0.09	340.02	0.10	341.27	1.38
173 Saddler St E	339.64	339.95	0.17	339.95	0.18	339.96	0.18	339.94	0.20	341.27	1.66
185 Saddler St E	339.52	340.01	0.20	340.03	0.21	340.04	0.21	340.05	0.23	341.41	1.71
197 Saddler St E	339.65	340.05	0.15	340.06	0.18	340.06	0.21	340.07	0.26	341.54	1.83
210 Albert St S	338.79	339.74	0.69	339.75	0.73	339.76	0.76	339.79	0.80	341.46	2.40
218 Albert St S	339.59			339.77	0.08	339.78	0.10	339.80	0.12	341.45	1.76
222 Albert St S	339.97									341.36	1.20
273 Garafraxa St S	340.27									340.61	0.30
265 Garafraxa St S	340.24									340.83	0.62

Address	Lowest DTM Elevation (m)	25-Year		50-Year		100-Year		Hazel		Hazel No Dike	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
239 Garafraxa St S	339.95									341.00	1.15
247 Garafraxa St S	340.49									340.98	0.49
269 Garafraxa St S	340.19									340.83	0.51
299 Garafraxa St S	339.66									340.04	0.26
286 Albert St S	339.11									339.92	0.85
290 Albert St S	338.09									339.92	1.70
172 South Street E	338.76									339.92	1.23
172 South Street E	338.93									339.91	1.03
317 Garafraxa St S	339.78									339.90	0.25
345 Garafraxa St S	339.15									339.37	0.15
317 Garafraxa St S	338.68									339.37	0.25
351 Garafraxa St S	338.10									338.63	0.40
377 Garafraxa St S	337.88									338.74	0.34
411 Garafraxa St S	337.14							337.16	0.02	338.06	0.95
268 George St East	344.97							345.66	0.70		
255 South Street E	339.75									339.92	0.16
263 South Street E	339.89									339.92	0.14
280 Albert St S	339.92									339.94	0.10
111 Elizabeth St W	338.08									338.06	0.04
240 Queen St S	337.98	338.29	0.15	338.33	0.19	338.36	0.22	338.45	0.32	338.81	0.68

Table 30 – Impacts to Buildings and Structures Climate Change

Address	Lowest DTM Elevation (m)	25-Year CC		50-Year CC		100-Year CC		Hazel CC	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
592 Lambton St East	348.73								
573 George St East	347.53								
561 George St East	348.33								
165 Cross St S	343.20	344.57	0.24	344.57	0.24	344.58	0.25	344.59	0.26
429 Lambton St E	343.02							342.86	0.02
421 Lambton St E	343.96								
155 Kincardine St S	342.86							342.86	0.04
175 Kincardine St S	342.93								
176 Kincardine St S	341.27	342.41	0.41	342.43	0.43	342.45	0.45	342.50	0.49
180 Kincardine St S	340.44	342.41	0.48	342.44	0.50	342.45	0.53	342.51	0.59
196 Kincardine St S	342.07								
154 Kincardine St S	340.69	340.84	0.13	340.88	0.17	342.31	0.34	342.34	0.38
122 Kincardine St S	341.75								
479 Lambton St E	342.44	342.77	0.36	342.79	0.38	342.81	0.41	342.87	0.46
493 Lambton St E	344.32								
489 Lambton St E	343.94								
582 Cedar Ln	344.45								
580 Cedar Ln	343.74								
380 Saddler St E	341.49								
368 Saddler St E	340.70	340.98	0.14	341.17	0.19	341.22	0.22	341.28	0.26
344 Saddler St E	340.40	341.05	0.39	341.14	0.43	341.16	0.45	341.25	0.50
191 Elgin St S	340.56	340.86	0.23	340.87	0.26	340.87	0.29	340.87	0.32
187 Elgin St S	340.18	340.77	0.58	340.80	0.62	340.84	0.64	340.88	0.69
175 Elgin St S	340.40	340.79	0.30	340.83	0.33	340.86	0.36	340.91	0.39
169 Elgin St S	340.75	340.80	0.08	340.84	0.12	340.87	0.14	340.91	0.19
157 Elgin St S	340.25	340.80	0.63	340.84	0.67	340.87	0.70	340.92	0.75
209 Garafraxa St N	338.52	342.02	3.38	342.34	3.70	342.63	3.96	344.31	5.58
144 Garafraxa St N	340.06	340.67	0.55	340.86	0.76	341.06	0.97	343.49	2.26
120 Garafraxa St N	341.06			340.82	0.03	341.04	0.02	343.43	1.11
108 Garafraxa St S	342.45							343.14	0.38
115 Lambton St W	342.54							342.92	0.34
169 Lambton St W	342.30							342.72	0.18
118 Queen St S	341.97							342.56	0.13
124 Garafraxa St S	341.48							342.59	0.39
157 Garafraxa St S	342.77							343.73	0.79
137 Garafraxa St S	343.10							343.43	0.34
105 Garafraxa St S	343.15							343.41	0.25

Address	Lowest DTM Elevation (m)	25-Year CC		50-Year CC		100-Year CC		Hazel CC	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
150 Mill St East	344.09							344.32	0.24
119 Garafraxa St S	342.24							343.19	0.12
156 Garafraxa St S	340.76							341.70	0.22
157 Garafraxa St S	340.98							341.65	0.09
168 Garafraxa St S	340.29							340.60	0.33
168 Garafraxa St S	339.90							340.29	0.18
190 Garafraxa St S	339.30							340.03	0.11
173 Garafraxa St S	340.30							340.33	0.00
185 Garafraxa St S	340.07							340.29	0.29
193 Garafraxa St S	340.17							340.28	0.06
197 Garafraxa St S	341.02								
292 Saddler St E	340.64	340.68	0.07	340.71	0.10	340.74	0.13	340.77	0.16
176 Elgin St S	340.65	340.66	0.15	340.69	0.18	340.72	0.21	340.76	0.24
190 Elgin St S	340.37	340.66	0.50	340.69	0.53	340.72	0.55	340.75	0.59
270 Saddler St E	340.24	340.64	0.68	340.67	0.70	340.69	0.72	340.72	0.75
242 Saddler St E	339.94	340.61	0.87	340.63	0.89	340.65	0.91	340.68	0.94
193 Albert St S	341.15								
208 Queen St S	338.04	338.63	0.57	338.72	0.66	338.81	0.74	339.12	1.04
212 Queen St S	338.29	338.56	0.44	338.66	0.30	338.74	0.56	339.05	0.76
216 Queen St S	338.28	338.41	0.14	338.50	0.23	338.57	0.29	338.81	0.53
226 Queen St S	337.83	338.38	0.31	338.43	0.38	338.48	0.44	338.64	0.69
248 Queen St S	337.89	338.16	0.20	338.23	0.26	338.27	0.31	338.41	0.45
252 Queen St S	337.32	337.77	0.45	337.84	0.51	337.89	0.56	338.08	0.74
264 Queen St S	337.29	337.67	0.39	337.73	0.45	337.78	0.50	337.94	0.66
270 Queen St S	337.40	337.62	0.23	337.69	0.29	337.74	0.34	337.89	0.50
278 Queen St S	336.92	337.38	0.39	337.44	0.45	337.49	0.50	337.66	0.67
284 Queen St S	336.68	337.32	0.53	337.38	0.59	337.43	0.63	337.59	0.77
292 Queen St S	337.38	337.14	0.07	337.20	0.13	337.24	0.17	337.49	0.29
250 South Street W	336.26	337.15	0.93	337.20	0.99	337.24	1.02	337.36	1.13
274 South Street W	336.11	337.14	1.07	337.20	1.13	337.23	1.16	337.34	1.26
273 Countess St S	337.10	337.13	0.02	337.19	0.05	337.22	0.07	337.32	0.17
279 Countess St S	336.92	337.14	0.12	337.19	0.18	337.22	0.20	337.33	0.30
285 Countess St S	336.95	337.13	0.16	337.17	0.17	337.20	0.20	337.30	0.30
209 Queen St S	338.47	338.73	0.25	338.85	0.35	338.95	0.44	339.32	0.80
151 Saddler St W	338.57	338.87	0.19	338.87	0.31	338.96	0.41	339.32	0.77
213 Queen St S	338.56	338.83	0.06	338.84	0.09	338.85	0.17	339.13	0.45
217 Queen St S	338.54	338.69	0.03	338.71	0.05	338.72	0.09	339.06	0.41
223 Queen St S	337.52	338.38	0.76	338.47	0.82	338.53	0.87	338.78	1.07
231 Queen St S	337.86	338.19	0.32	338.24	0.38	338.29	0.43	338.51	0.63

Address	Lowest DTM Elevation (m)	25-Year CC		50-Year CC		100-Year CC		Hazel CC	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
245 Queen St S	337.66	338.11	0.47	338.17	0.53	338.22	0.58	338.42	0.78
249 Queen St S	337.65	338.01	0.31	338.07	0.36	338.12	0.41	338.30	0.61
253 Queen St S	337.62	337.87	0.18	337.93	0.23	337.98	0.29	338.18	0.48
265 Queen St S	337.21	337.71	0.49	337.77	0.55	337.83	0.61	338.03	0.80
269 Queen St S	337.62	337.60	0.01	337.67	0.06	337.72	0.11	337.90	0.27
295 Queen St S	336.33	337.37	1.25	337.43	1.31	337.49	1.36	337.66	1.53
204 Garafraxa St S	339.02	339.27	0.02	339.27	0.11	339.27	0.21	339.38	0.58
218 Garafraxa St S	338.35	339.00	0.30	339.02	0.33	339.04	0.35	339.09	0.43
226 Garafraxa St S	337.85	338.98	0.47	339.00	0.50	339.02	0.52	339.05	0.61
232 Garafraxa St S	337.69	339.10	1.10	339.12	1.12	339.14	1.14	339.16	1.17
232 Garafraxa St S	338.03	339.10	1.10	338.50	0.49	338.52	0.51	338.61	0.62
240 Garafraxa St S	337.97	338.29	0.22	338.30	0.23	338.33	0.25	338.42	0.46
248 Garafraxa St S	338.39	338.04	0.07	338.09	0.04	338.15	0.10	338.37	0.32
266 Garafraxa St S	340.50								
280 Garafraxa St S	339.26								
282 Garafraxa St S	340.02								
176 South Street W	337.76							337.58	0.03
293 Queen St S	337.75							337.67	0.02
194 South St W	337.23	337.22	0.01	337.32	0.07	337.39	0.12	337.58	0.29
307 Queen St S	336.48	337.16	0.71	337.22	0.77	337.27	0.81	337.41	0.95
189 South Street W	336.79	337.16	0.39	337.22	0.45	337.27	0.49	337.41	0.63
175 South Street W	337.45							337.40	0.12
315 Queen St S	336.42	337.16	0.80	337.22	0.86	337.26	0.90	337.40	1.04
321 Queen St S	336.13	337.16	1.05	337.22	1.11	337.26	1.16	337.40	1.30
320 Queen St S	336.24	337.16	0.92	337.22	0.98	337.26	1.02	337.40	1.15
332 Queen St S	336.68	337.16	0.52	337.22	0.58	337.26	0.62	337.40	0.76
333 Queen St S	336.28	337.16	1.00	337.22	1.06	337.26	1.10	337.40	1.24
351 Queen St S	336.25	337.16	0.94	337.22	1.00	337.26	1.04	337.40	1.18
367 Queen St S	336.11	337.16	1.09	337.22	1.15	337.26	1.20	337.40	1.34
373 Queen St S	336.87	337.16	0.31	337.22	0.37	337.26	0.41	337.40	0.55
308 Queen St S	336.48	337.16	0.72	337.22	0.78	337.26	0.82	337.40	0.95
314 Queen St S	336.50	337.16	0.68	337.22	0.74	337.26	0.78	337.40	0.91
249 South Street W	336.18	337.14	1.00	337.20	1.05	337.24	1.09	337.37	1.22
293 South Street W	336.34	337.13	0.84	337.19	0.89	337.22	0.92	337.35	1.02
348 Queen St S	337.32					337.26	0.03	337.40	0.12
356 Queen St S	337.35							337.40	0.05
374 Queen St S	337.89								
344 Garafraxa St S	336.69	337.16	0.55	337.22	0.61	337.26	0.66	337.40	0.80
378 Garafraxa St S	337.64								

Address	Lowest DTM Elevation (m)	25-Year CC		50-Year CC		100-Year CC		Hazel CC	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
150 Elizabeth St W	337.77								
132 Elizabeth St W	337.00							337.21	0.21
390 Garafraxa St S	336.54					336.56	0.02	337.21	0.67
205 Albert St S	340.43	340.28	0.56	340.62	0.57	340.64	0.59	340.65	0.60
233 Saddler St E	340.61	340.61	0.04	340.63	0.06	340.65	0.07	340.67	0.10
257 Saddler St E	340.21	340.62	0.40	340.65	0.43	340.67	0.44	340.69	0.47
275 Saddler St E	339.93	340.63	0.45	340.65	0.48	340.67	0.51	340.70	0.55
204 Elgin St S	340.45	340.66	0.24	340.68	0.26	340.70	0.28	340.73	0.30
216 Elgin St S	339.82	340.44	0.35	340.47	0.38	340.51	0.41	340.56	0.45
224 Elgin St S	341.16								
236 Elgin St S	341.70								
240 Elgin St S	341.84								
244 Elgin St S	341.55								
291 Albert St S	339.03								
289 Albert St S	339.30								
283 Albert St S	339.66								
279 Albert St S	339.73								
271 Albert St S	340.29								
267 Albert St S	340.60								
225 Albert St S	341.33								
219 Albert St S	340.32								
215 Albert St S	339.98	340.28	0.28	340.32	0.32	340.35	0.35	340.40	0.40
211 Albert St S	339.69	340.27	0.50	340.31	0.54	340.35	0.56	340.40	0.60
341 Saddler St E	342.01								
207 Elgin St S	341.16								
215 Elgin St S	341.76								
203 Garafraxa St S	337.77	339.64	0.71	339.64	0.74	339.65	0.78	339.66	0.82
215 Garafraxa St S	338.60	339.50	1.00	339.54	1.04	339.57	1.07	339.62	1.12
229 Garafraxa St S	339.06	339.42	0.35	339.46	0.39	339.49	0.41	339.53	0.45
145 Saddler St E	340.01							340.05	0.01
161 Saddler St E	339.85	340.02	0.09	340.03	0.10	340.03	0.10	340.04	0.11
173 Saddler St E	339.64	339.96	0.18	339.96	0.19	339.96	0.20	339.97	0.22
185 Saddler St E	339.52	340.04	0.21	340.05	0.23	340.06	0.24	340.07	0.26
197 Saddler St E	339.65	340.06	0.21	340.07	0.25	340.08	0.28	340.10	0.32
210 Albert St S	338.79	339.76	0.75	339.80	0.79	339.82	0.83	339.85	0.87
218 Albert St S	339.59	339.78	0.10	339.79	0.11	339.81	0.13	339.83	0.17
222 Albert St S	339.97								
273 Garafraxa St S	340.27								
265 Garafraxa St S	340.24								

Address	Lowest DTM Elevation (m)	25-Year CC		50-Year CC		100-Year CC		Hazel CC	
		WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)	WSE (m)	Depth (m)
239 Garafraxa St S	339.95								
247 Garafraxa St S	340.49								
269 Garafraxa St S	340.19								
299 Garafraxa St S	339.66								
286 Albert St S	339.11								
290 Albert St S	338.09								
172 South Street E	338.76								
172 South Street E	338.93								
317 Garafraxa St S	339.78								
345 Garafraxa St S	339.15								
317 Garafraxa St S	338.68								
351 Garafraxa St S	338.10								
377 Garafraxa St S	337.88								
411 Garafraxa St S	337.14							337.20	0.03
268 George St East	344.97							345.66	0.70
255 South Street E	339.75								
263 South Street E	339.89								
280 Albert St S	339.92								
111 Elizabeth St W	338.08								
240 Queen St S	337.98	338.29	0.15	338.33	0.19	338.36	0.22	338.46	0.32

5.4.4 Mitigation Options

Wills undertook a high-level assessment of potential flood mitigation options for Durham Creek. The most significant flood mitigation measure, the dike at the Durham Upper Dam, has already been put in place. This dike significantly reduces the amount of flooding in Durham Creek. During the Hurricane Hazel flood, the flow in the Saugeen River is approximately 276.4 m^3/s. If the dike were not in place, approximately 160.8 m^3/s would spill through Durham Creek. Without the dike in place there would be significant property damages as well as damage to built infrastructure such as roads and culverts. The inspection and maintenance of this dike should be seen as a high priority for the SVCA and Municipality of West Grey.

Another similar flood mitigation measure would be to construct a new flood dike at the downstream end of Durham Creek along the east bank of the Saugeen River to prevent the Saugeen River from backing up into Durham Creek. The new dike would incorporate (and raise) the existing dike at the Durham Lower Dam and would extend downstream to approximately 120 m south of South Street West. The Durham Creek outlet would need to incorporate a flap gate, or manually controlled valve, and possibly a stormwater pumping station to pump water out of Durham Creek and into the Saugeen River when the river is at flood stage. There appears to be sufficient property available to construct the dike and the existing trail could be incorporated into the new dike crest. Additional detailed studies would be required to determine the potential impacts to the remainder of the Saugeen River floodplain and to determine if there is a large enough reduction in the Durham Creek floodplain limits to make the significant cost worthwhile.

During the two Public Information Centers (PICs) that were held in the Town of Durham, many residents provided comments related to flooding during the most frequent flood events (i.e., annual floods). Methods that could be used to reduce flooding during these events include:

- Clear vegetation, sediment, and debris from the Durham Creek Channel. This work would need to incorporate considerations for fisheries and timing windows.
- Expand the capacity of the Durham Creek Channel. This work would need to incorporate considerations for fisheries and timing windows.
- Clear sediment from the existing culverts.
- Consider increasing culvert sizes to the maximum allowable size based on cover and other geometrical restrictions. This could be completed during future road reconstructions or as one-off culvert improvements.
- Expand the capacity of the storm sewer systems on the streets within Durham Creek and potentially construct a larger trunk sewer that could convey a more significant quantity of water directly to the Saugeen River, rather than into Durham Creek.

While these mitigation measures may have a positive impact on drainage during the more frequent flood events (i.e., annually), it is anticipated that they would only have a small impact on the extents of the Regulatory floodplain and floodway.

6.0 Conclusion

The Saugeen Valley Conservation Authority (SVCA), in partnership with the Municipality of West Grey, has recognized the need to develop hydrologic and hydraulic modelling and regulatory flood hazard mapping for Durham Creek in the Town of Durham, Municipality of West Grey, Ontario. There is no existing flood hazard mapping for Durham Creek. The intent of this hydrology report is to provide the hydrologic inputs to the floodplain mapping. This hydrology report included the following key phases:

- Background Data Collection and Review – Wills reviewed all available background information provided by the SVCA.
- Site Reconnaissance and Topographic/Bathymetric Survey – Wills undertook a site reconnaissance of the entire study reach and collected topographic and bathymetric survey data to define the numerous structures crossing the Saugeen River and Durham Creek and to validate the LiDAR DTM. The quality and accuracy of the DTM was validated.
- Hydrology Study – Wills undertook a hydrology study to define the peak flows that would be used in the hydraulic model. The hydrology study was completed using HEC-HMS (Version 4.11). Wills completed a calibration and verification exercise on the hydrologic model for two historic storms. Wills computed flood flows for the 6 hour SCS Type-2 AEP storms and the Regional storm. Wills also computed the peak flows for the same storms while considering the potential impacts of climate change.
- Hydraulics Study – Wills undertook a hydraulics study to develop a hydraulic model to compute water surface elevation, velocity, and depth for all parts of the modeling domain for the 4% AEP, 2% AEP storm, 1% AEP storm, Hurricane Hazel storm. The impacts the hydraulics study was completed using HEC-RAS (Version 6.4.1). Wills also computed the hydraulic parameters for the same storms while considering the potential impacts of climate change.
- Development of Regulatory Floodplain and Flood Risk Maps – Wills developed regulatory floodplain and flood risk maps using the outputs from the hydraulic modelling to create the final mapping products in ArcGIS.
- Preparation of the Regulatory Floodplain and Flood Risk Mapping Report – Wills prepared this report documenting the inputs and results of all analyses associated with the project as well as the results.

Based on the results of the analyses completed, Wills recommends that the SVCA and the Municipality of West Grey update the regulatory floodplain mapping for the Saugeen River and then consider updates to their two zone floodplain planning policies and development approvals processes for both Durham Creek and the Saugeen River together. Additionally, given the potential significant impacts of a failure of the dike at the Durham Upper Dam, the SVCA and Municipality of West Grey should consider the development of an Emergency Preparedness and Response Plan (EPRP) for the structure. The EPRP could be incorporated within the West Grey's existing Emergency Plan or could be a stand-alone document that is coordinated with West Grey's existing Emergency Plan.

Respectfully submitted,

Matt Churly, P.Eng.
Senior Project Engineer,
Water Resources Engineering

David Green, P.Eng.
Group Leader, Dams Engineering,
Water Resources Engineering

Sarah Ormel, P.Eng.
Project Engineer,
Water Resources Engineering

MC/DG/SO

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Appendix A

Hydraulic Structure Surveys

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID:
Township:
Highway ID: Countess St
Chainage or LHRS:
Type:
Location: 285 Countess LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP
Desc: 0 Culvert
Size (mm): 730 (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

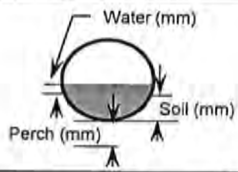
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

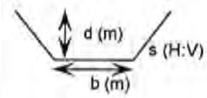
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

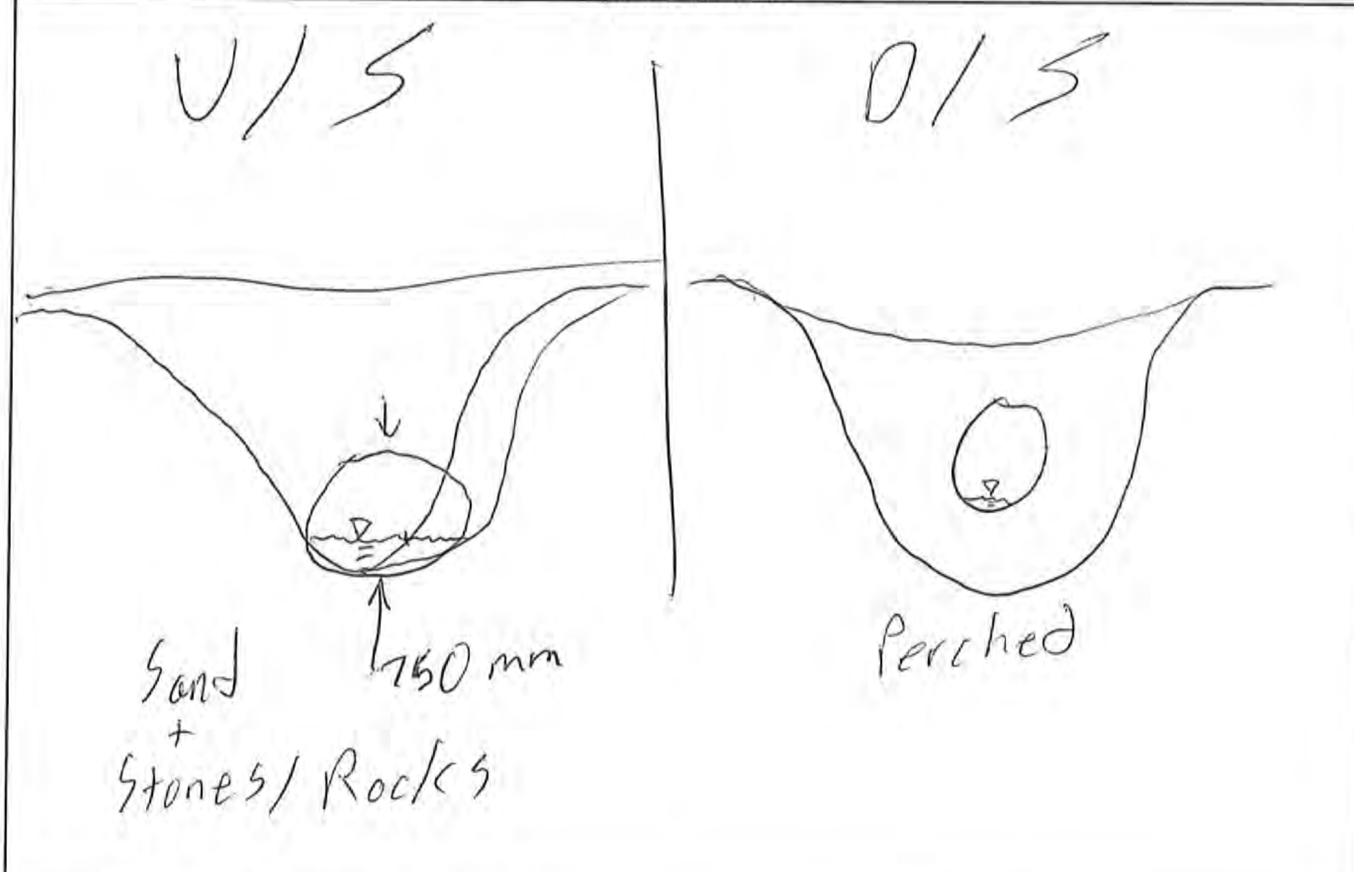


Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes



Filename: 20230704_115210.jpg Photo 1 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Countess St S Upstream Face

Filename: 20230704_115225.jpg Photo 2 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Countess St S Looking Upstream

Filename: 20230704_124727.jpg Photo 3 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Diversion Structure

Filename: 20230704_115315.jpg Photo 4 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Countess St S Looking Downstream

Filename: 20230704_120149.jpg Photo 5 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Countess St S Donwnstream End

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 1 Culvert 2
Township: Durham ON
Highway ID: South St W
Chainage or LHRS:
Type:
Location: 274 South St W LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP
Desc: ~~&~~ Culvert (Oval)
Size (mm): 600 h x 900 w (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
RT: Long
LT: Lat
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

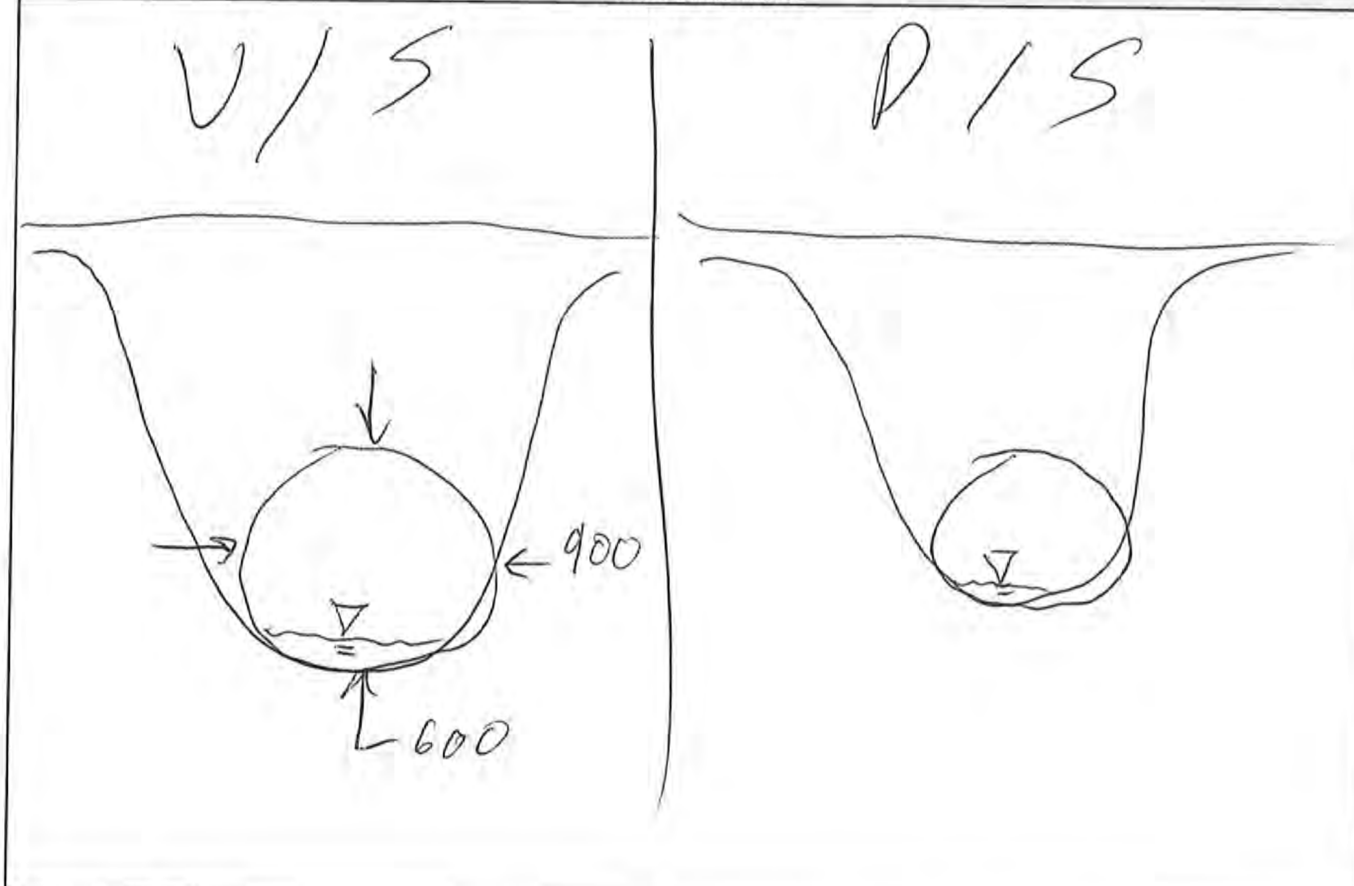
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



Filename: 20230704_125745.jpg Photo 7 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 274 South St W Driveway Upstream Face

Filename: 20230704_125804.jpg Photo 8 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 274 South St W Driveway Looking Upstream

Filename: 20230704_125815.jpg Photo 9 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 274 South St W Driveway Facing Downstream

Filename: 20230704_125833.jpg Photo 10 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 274 South St W Driveway Downstream Face

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 1 Culvert 3
Township: Durham
Highway ID: Queen St S
Chainage or LHRS:
Type:
Location: Queen @ South LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP culvert
Desc: 0 30° skew Oval
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

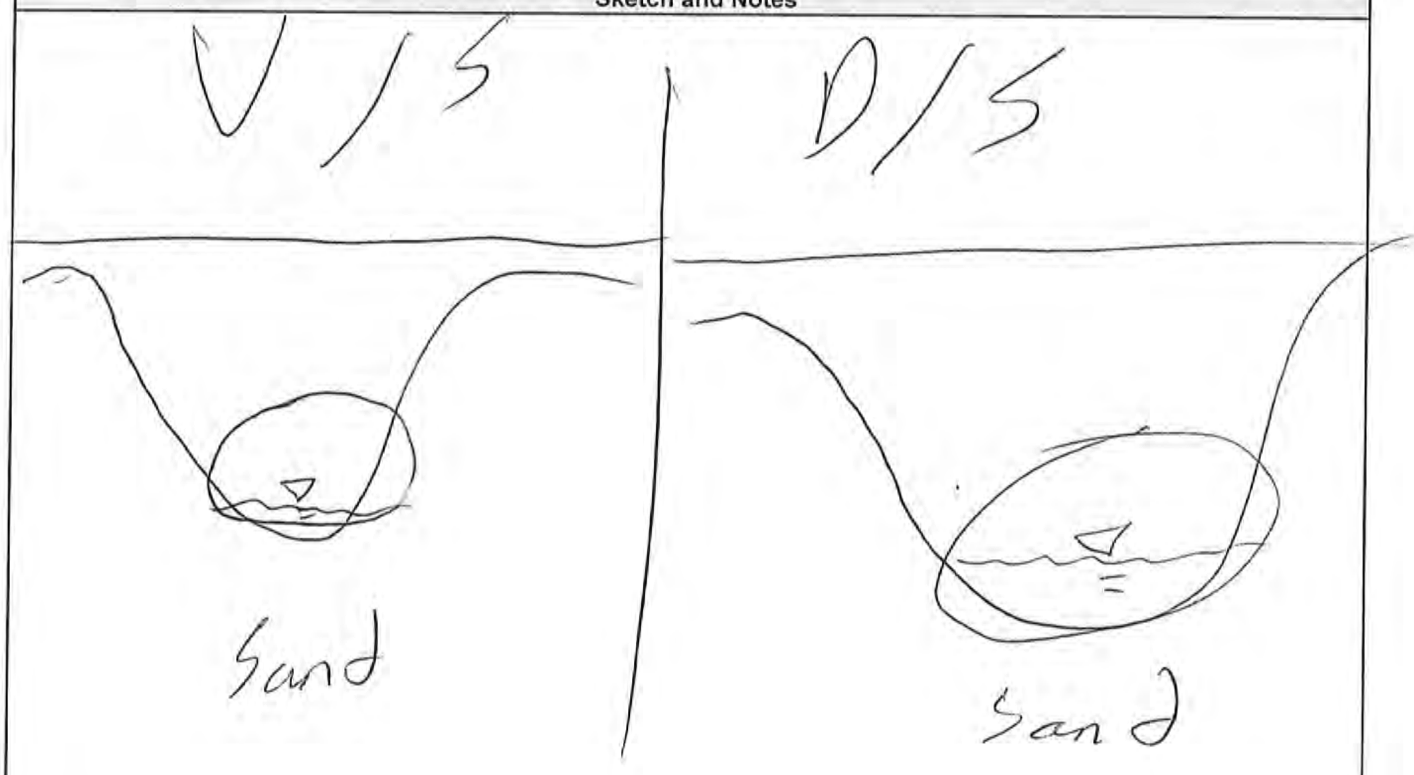
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



Filename: 20230704_131413.jpg Photo 13 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Queen St S Upstream Face

Filename: 20230704_131426.jpg Photo 14 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Queen St S Looking Upstream

Filename: 20230704_131509.jpg Photo 15 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Queen St S Looking Downstream

Filename: 20230704_131455.jpg Photo 16 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Queen St S Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 1 Culvert 4
Township: Durham
Highway ID: Queen St W
Chainage or LHRS:
Type:
Location: 295 Queen St LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP Culvert
Desc: Oval
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

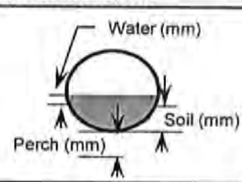
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

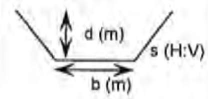
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

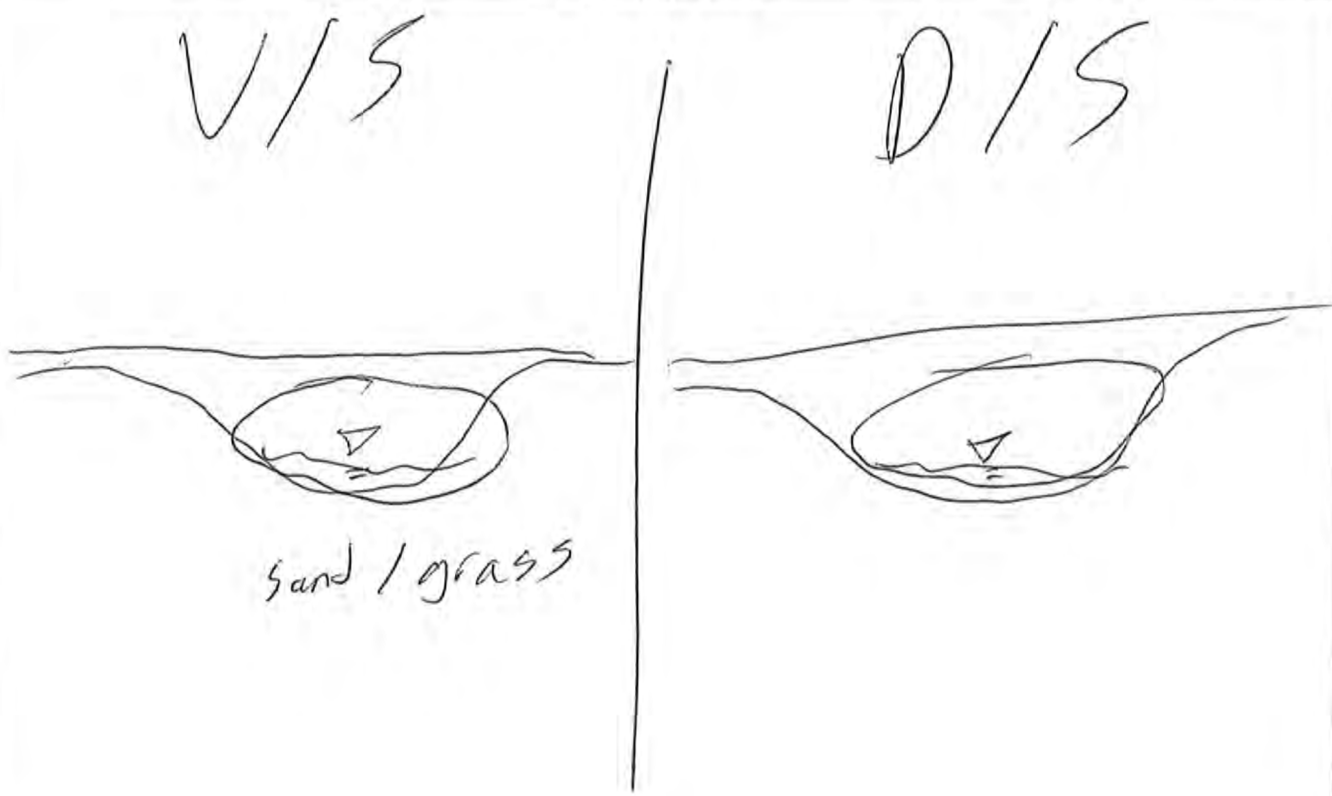


Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes



Filename: 20230704_133408.jpg Photo 19 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 295 Queen St S Driveway Upstream Face

Filename: 20230704_133425.jpg Photo 20 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 295 Queen St S Driveway Looking Upstream

Filename: 20230704_133433.jpg Photo 21 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 295 Queen St S Driveway Looking Downstream

Filename: 20230704_133445.jpg Photo 22 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 295 Queen St S Driveway Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 1 Crossing 3
Township: Durham
Highway ID: Queen
Chainage or LHRS:
Type:
Location: 269 Queen LT/RT:

Physical Characteristics

Structure: Bridge (Pedestrian)
Desc.: Wood
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

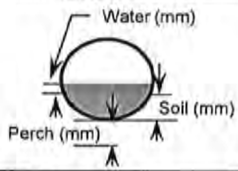
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

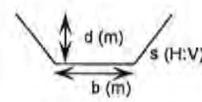
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

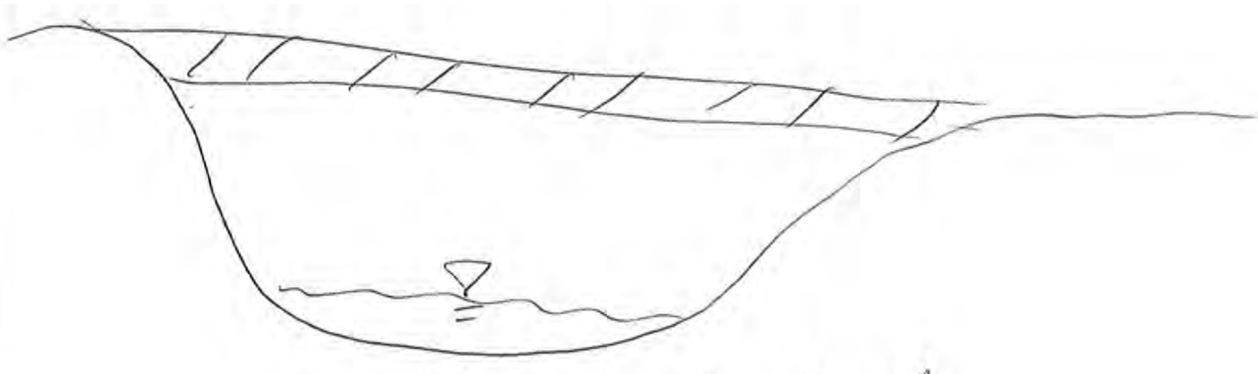


Downstream Channel Section ()

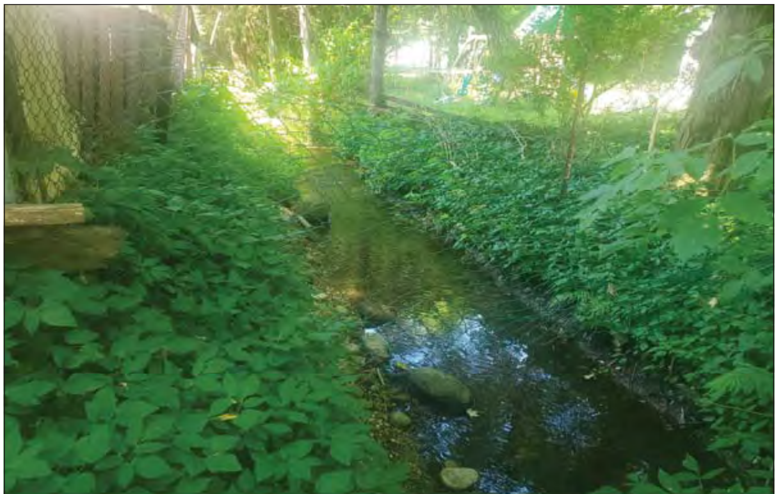
Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes

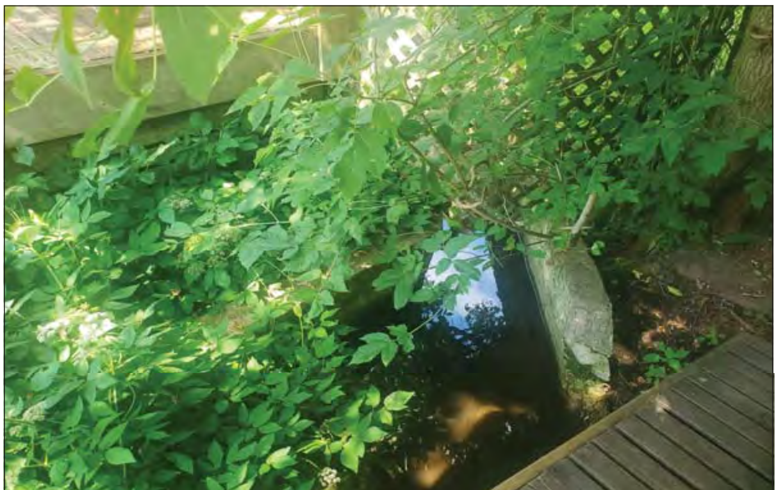


Stones and Sand

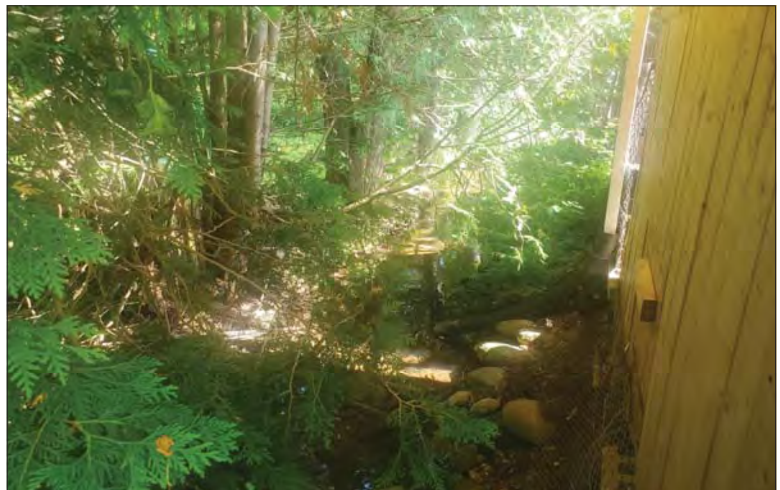


Filename: 20230704_151342.jpg Photo 25 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 269 Queen St S Fence

Filename: 20230704_155826.jpg Photo 26 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 269 Queen St S Backyard Footbridge



Filename: 20230704_155546.jpg Photo 27 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 269 Queen St S Footbridge Looking Upstream



Filename: 20230704_155554.jpg Photo 28 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 269 Queen St S Footbridge Looking Downstream

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 1 Crossing 6+7
Township: Durham
Highway ID: Queen St
Chainage or LHRS:
Type:
Location: 265 Queen LT/RT:

Physical Characteristics

Structure: Bridge foot bridges
Desc: Concrete
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

Water (mm)
Soil (mm)
Perch (mm)

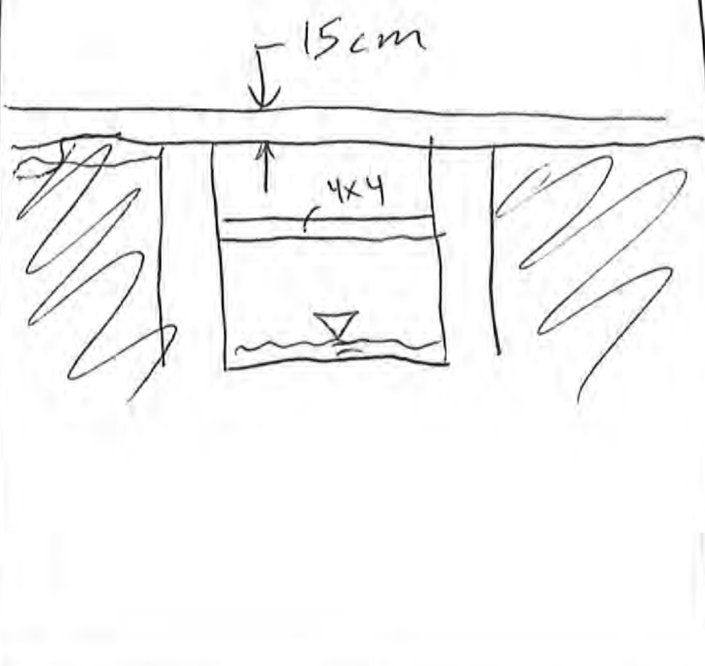
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

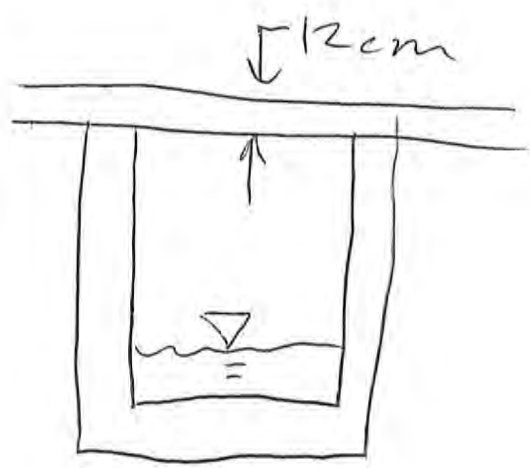
d (m)
s (H:V)
b (m)

Sketch and Notes

Crossing 6



Crossing 7

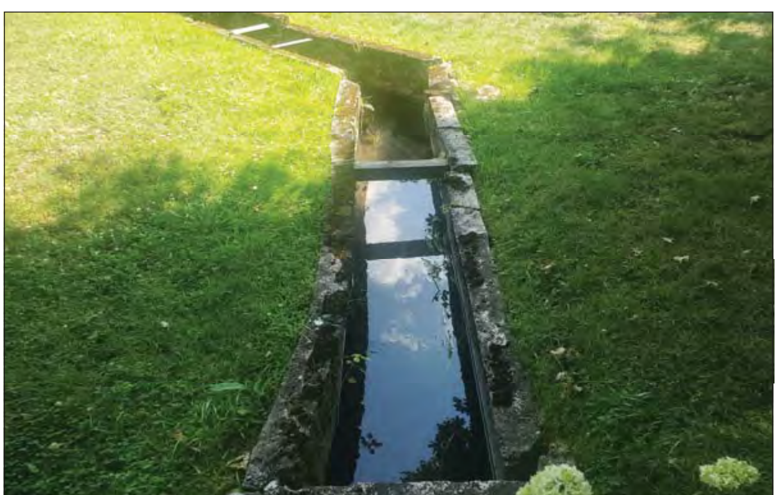


Filename: 20230704_155806.jpg Photo 31 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 265 Queen St S Backyard Channel Looking Downstream

Filename: 20230704_155813.jpg Photo 32 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 265 Queen St S Backyard Channel Looking Upstream

Filename: 20230704_163742.jpg Photo 33 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 265 Queen St S Backyard Channel Looking Downstream

Filename: 20230704_163750.jpg Photo 34 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 265 Queen St S Backyard Channel Looking Upstream



Filename: 20230704_163814.jpg Photo 35 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 265 Queen St S Backyard Channel

Filename: 20230704_163805.jpg Photo 36 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 265 Queen St S Backyard Looking Upstream

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 1 Xing 8
Township: Durham ON
Highway ID:
Chainage or LHRS:
Type:
Location: 263 LT/RT:

Physical Characteristics

Structure: Bridge Foot Bridge
Desc: Wood
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

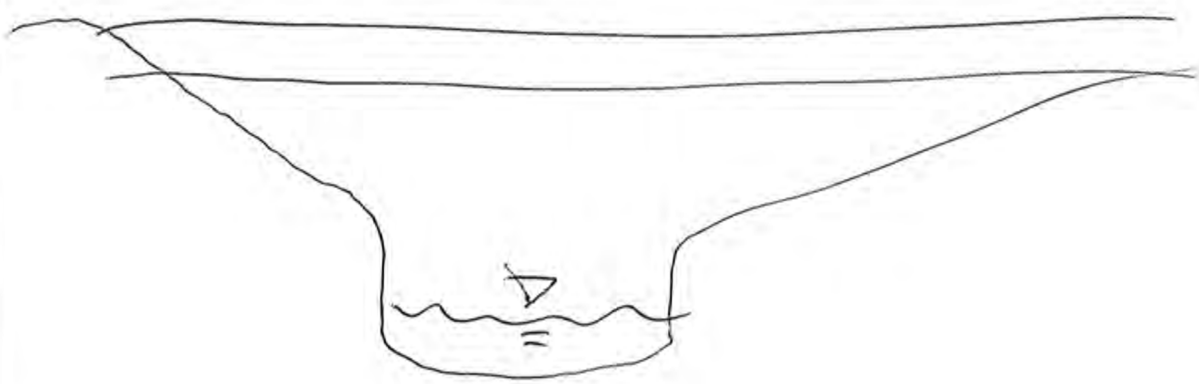
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



Stones and Sand

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 crossing 1+2
Township:
Highway ID:
Chainage or LHRS:
Type:
Location: 261
LT/RT:

Physical Characteristics

Structure: Bridge Foot
Desc: ~~0~~ Wooden
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

Water (mm)
Soil (mm)
Perch (mm)

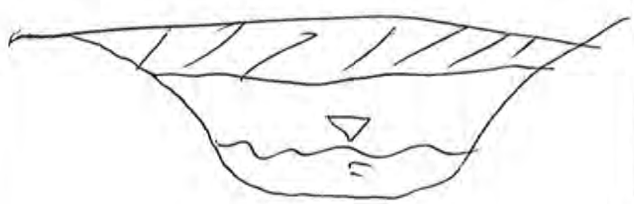
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

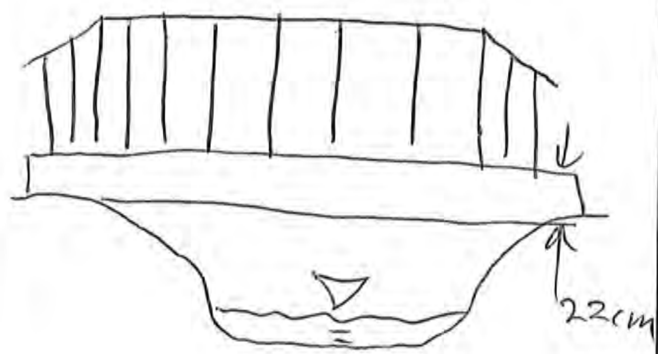
d (m)
s (H:V)
b (m)

Sketch and Notes

1



2



Filename: 20230705_092722.jpg Photo 37 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Wildlife Sighting

Filename: 20230705_092733.jpg Photo 38 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 1 Upstream Face

Filename: 20230705_092747.jpg Photo 39 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 1 Looking Upstream

Filename: 20230705_092806.jpg Photo 40 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 1 Looking Downstream

Filename: 20230705_092802.jpg Photo 41 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 1 Downstream Face

Filename: 20230705_093837.jpg Photo 42 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 2 Upstream Face

Filename: 20230705_093848.jpg Photo 43 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 2
Looking Upstream

Filename: 20230705_093855.jpg Photo 44 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 2
Looking Downstream

Filename: 20230705_093926.jpg Photo 45 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 249 Queen St S Backyard Footbridge 2
Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 crossing 3,4,5
Township: Durham
Highway ID:
Chainage or LHRS:
Type:
Location: LT/RT:

Physical Characteristics

Structure: Bridge Foot + Fences
Desc: 0 Wood
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

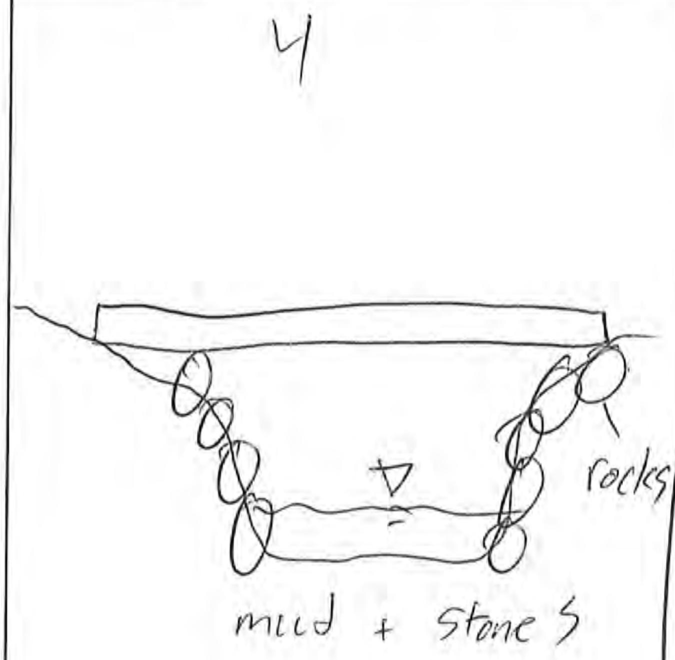
Water (mm)
Soil (mm)
Perch (mm)

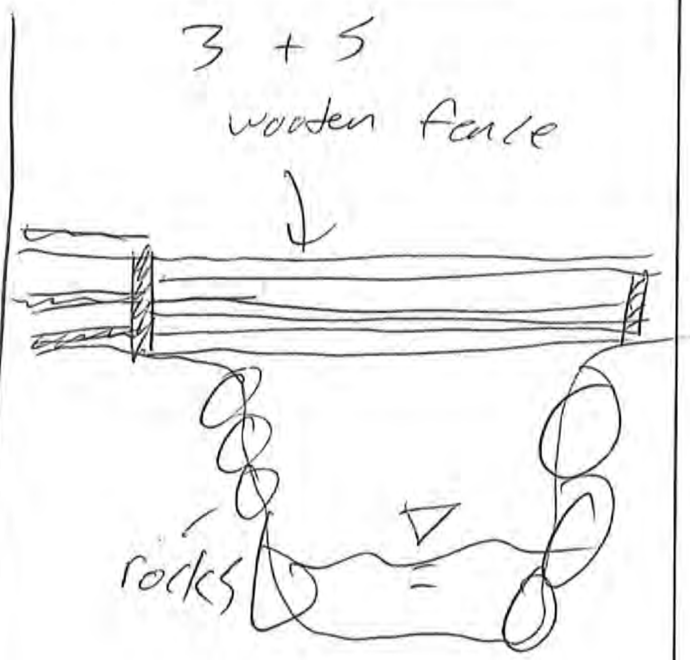
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes





Filename: 20230705_101052.jpg Photo 49 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 245 Queen St S Backyard Footbridge Upstream Face

Filename: 20230705_101059.jpg Photo 50 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 245 Queen St S Backyard Footbridge Looking Upstream

Filename: 20230705_101104.jpg Photo 51 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 245 Queen St S Backyard Footbridge Looking Downstream

Filename: 20230705_101114.jpg Photo 52 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 245 Queen St S Backyard Footbridge Downstream Face

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 Xing 6+7
Township: Durham ON
Highway ID: 6
Chainage or LHRS:
Type:
Location: LT/RT:

Physical Characteristics

Structure: Bridge + Fence
Desc: 0 wooden
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

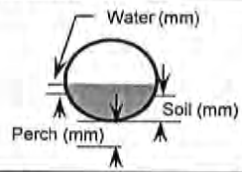
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

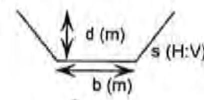
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

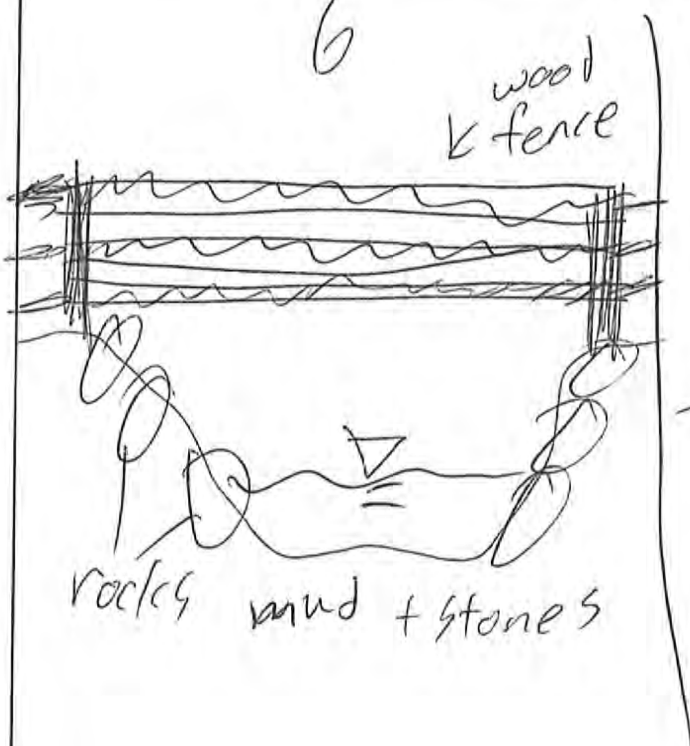


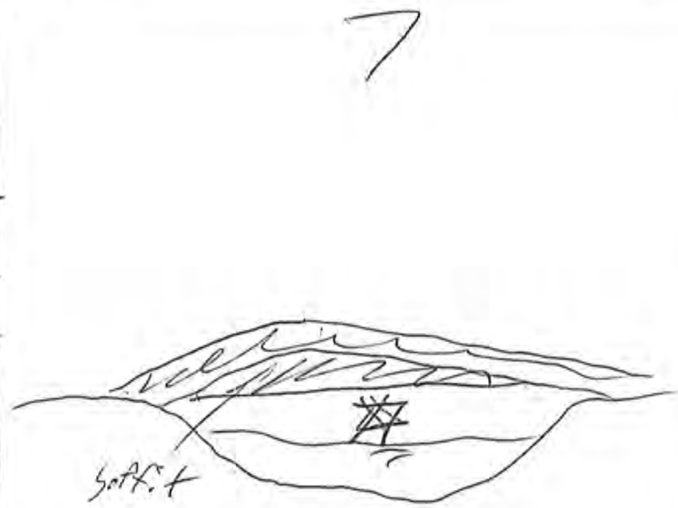
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes





Filename: 20230705_105448.jpg Photo 55 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 240 Garafraxa St S Backyard Looking Downstream

Filename: 20230705_105454.jpg Photo 56 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 240 Garafraxa St S Backyard Footbridge Downstream Face

Filename: 20230705_105515.jpg Photo 57 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 240 Garafraxa St S Backyard Footbridge Upstream Face

Filename: 20230705_105519.jpg Photo 58 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 240 Garafraxa St S Backyard Footbridge Looking Upstream

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck
Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 Crossing 7
Township: Durham
Highway ID: Garafraxa S
Chainage or LHRS:
Type:
Location: 232
LT/RT:

Physical Characteristics

Structure: Bridge
Desc: 0
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

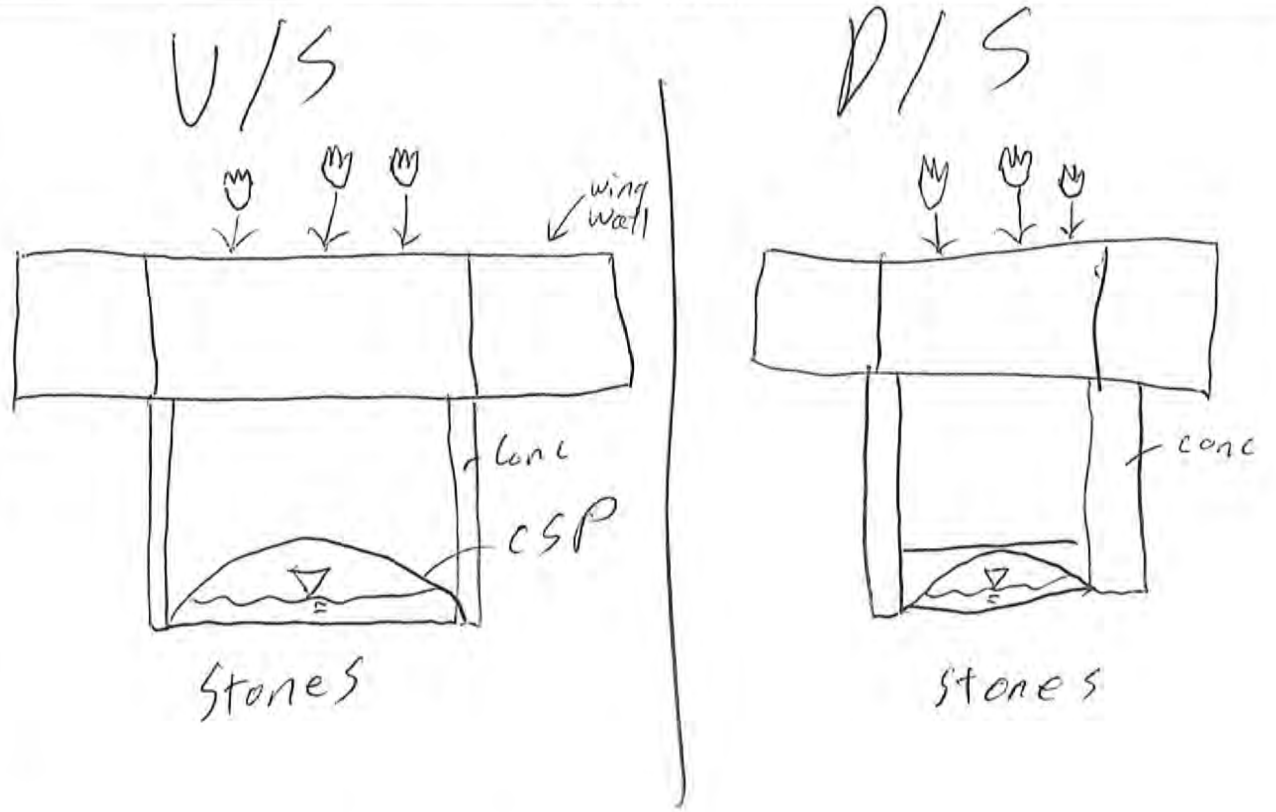
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



WILLS | Saugeen Conservation

Filename: 20230705_123001.jpg Photo 67 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 232 Garafraxa St S Driveway Culvert Upstream Face

WILLS | Saugeen Conservation

Filename: 20230705_123005.jpg Photo 68 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 232 Garafraxa St S Driveway Culvert Upstream Face

WILLS | Saugeen Conservation

Filename: 20230705_123017.jpg Photo 69 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 232 Garafraxa St S Driveway Culvert Looking Upstream

WILLS | Saugeen Conservation

Filename: 20230705_123026.jpg Photo 70 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 232 Garafraxa St S Driveway Culvert Looking Downstream

WILLS | Saugeen Conservation

Filename: 20230705_123037.jpg Photo 71 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 232 Garafraxa St S Driveway Culvert Downstream Face

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 Crossing 8?
Township: Durham
Highway ID: Grafton's Hwy 4
Chainage or LHRS:
Type:
Location: 229 A
LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Box Culvert
Desc: concrete
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
RT: Long
LT: Lat
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Beaver Evidence
[ ] Groundwater Above Invert
[ ] Navigable
[ ] Animal Grate
[ ] Local Wells~200m
[ ] Nesting Structure
[ ] Sensitive Env or Pollutant

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

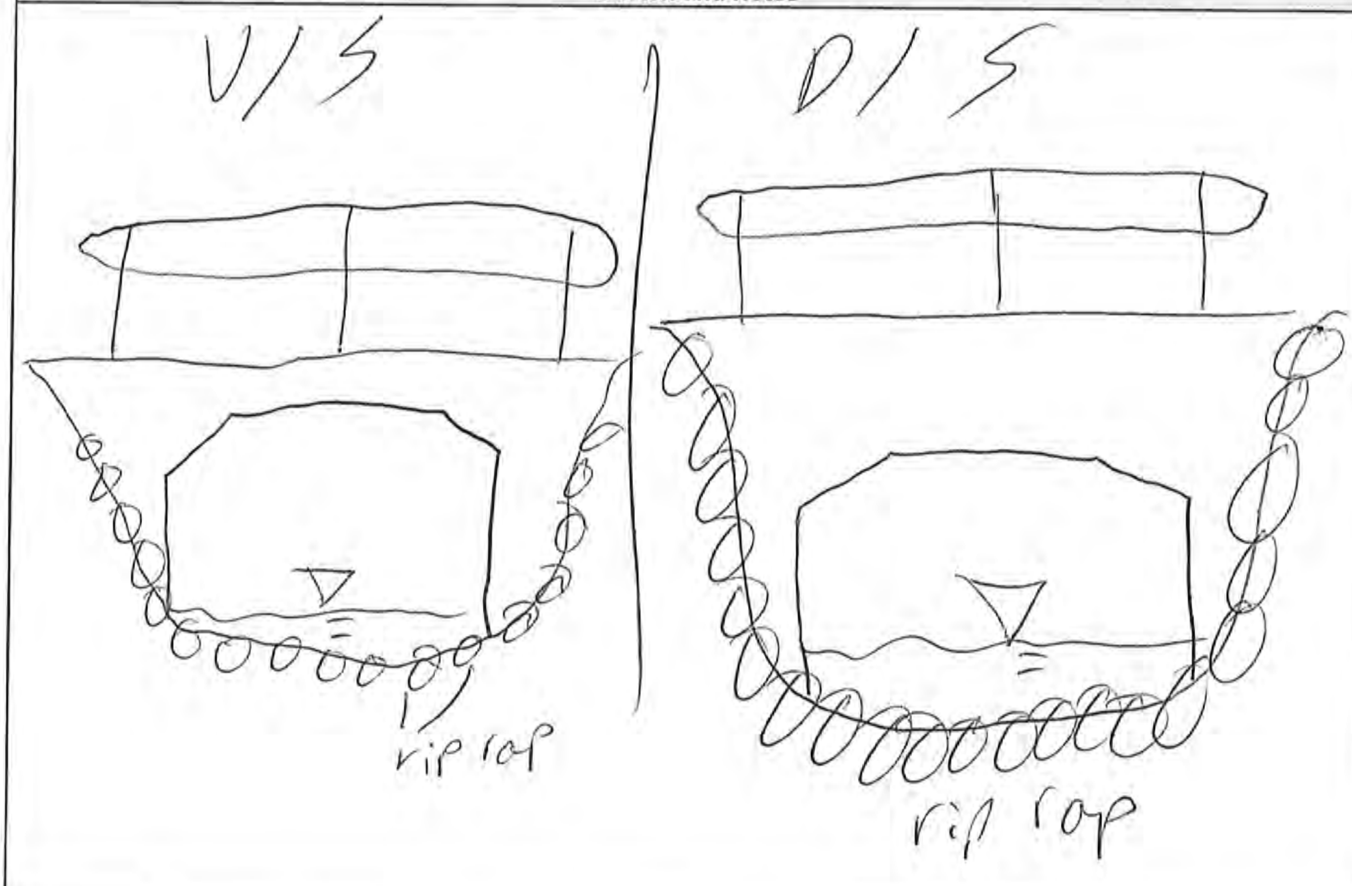
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



Filename: 20230705_112443.jpg Photo 61 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Garafraxa St S Culvert Upstream Face

Filename: 20230705_112451.jpg Photo 62 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Garafraxa St S Culvert Looking Upstream

Filename: 20230705_112558.jpg Photo 63 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Garafraxa St S Culvert Looking Downstream

Filename: 20230705_112548.jpg Photo 64 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Garafraxa St S Culvert Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 Crossing 10
Township: Durham
Highway ID:
Chainage or LHRS:
Type:
Location: 147 Saddler St LT/RT:

Physical Characteristics

Structure: Bridge Foot
Desc: Wood
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
RT: Long
LT: Lat
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

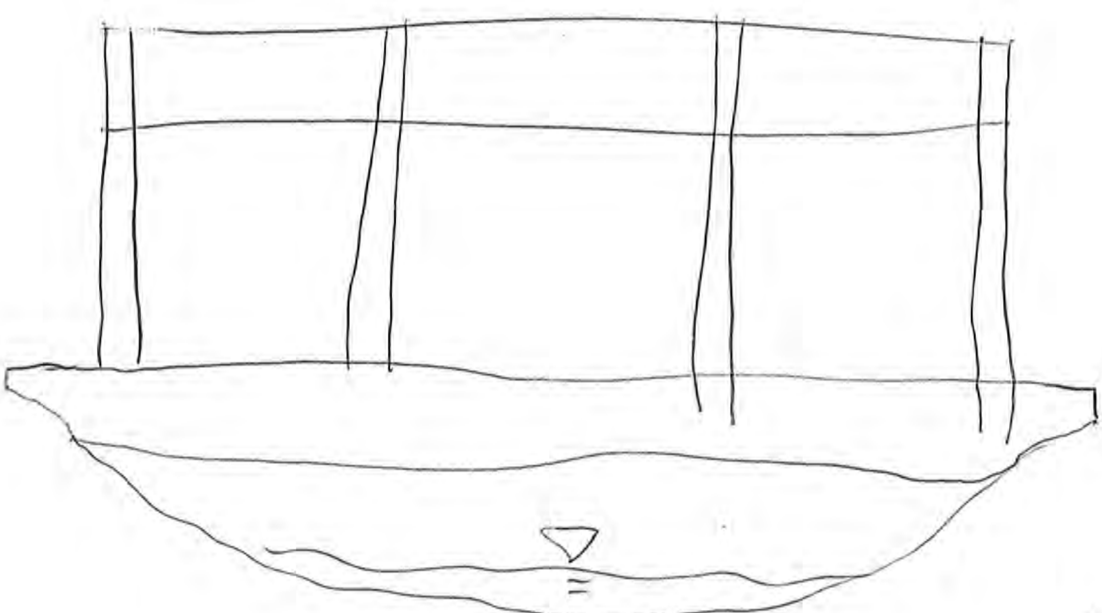
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



grass + weeds

Filename: 20230705_131036.jpg Photo 73 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 197 Saddler St E Backyard Footbridge Upstream Face

Filename: 20230705_131047.jpg Photo 74 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 197 Saddler St E Backyard Footbridge Looking Upstream

Filename: 20230705_131054.jpg Photo 75 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 197 Saddler St E Backyard Footbridge Looking Downstream

Filename: 20230705_131104.jpg Photo 76 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 197 Saddler St E Backyard Footbridge Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2, -11
Township:
Highway ID: Albert St
Chainage or LHRS:
Type: 205
Location: ~~Sadd~~ Albert St LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Culvert
Desc: 0 CSP
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
RT: Long
LT: Lat
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Beaver Evidence
[ ] Groundwater Above Invert
[ ] Navigable
[ ] Animal Grate
[ ] Local Wells~200m
[ ] Nesting Structure
[ ] Sensitive Env or Pollutant

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

Water (mm)
Soil (mm)
Perch (mm)

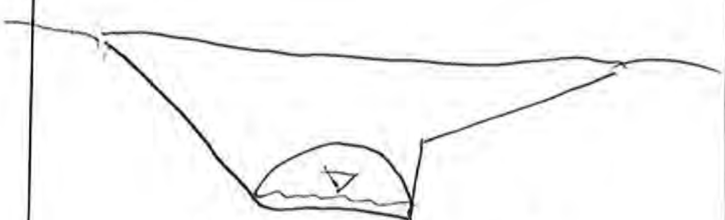
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

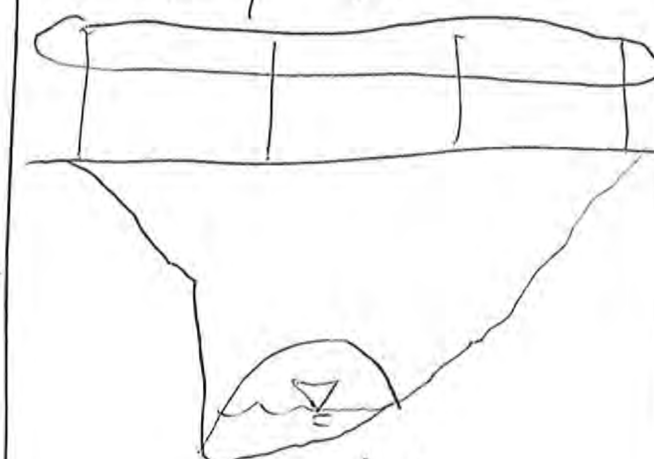
Sketch and Notes

U/S



Stones + Sand

D/S



weeds

Filename: 20230705_131203.jpg Photo 79 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Albert St S Culvert Upstream Face

Filename: 20230705_131212.jpg Photo 80 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Albert St S Culvert Looking Upstream

Filename: 20230705_131124.jpg Photo 81 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 197 Saddler St E Side-yard Channel Looking Upstream

Filename: 20230705_131239.jpg Photo 82 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Albert St S Culvert Looking Downstream

Filename: 20230705_131231.jpg Photo 83 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Albert St S Culvert Downstream Face

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 - 12
Township:
Highway ID: Saddler St
Chainage or LHRS:
Type:
Location: @ Albert
LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Culvert
Desc: ~~0~~ CSP
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes

Filename: 20230705_131937.jpg Photo 85 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Saddler St E Culvert Upstream Face

Filename: 20230705_131944.jpg Photo 86 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Saddler St E Culvert Looking Upstream

Filename: 20230705_132031.jpg Photo 87 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Saddler St E Culvert Downstream Face

Filename: 20230705_132043.jpg Photo 88 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Saddler St E Culvert Looking Downstream

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 – 13
Township: Durham
Highway ID: Saddle
Chainage or LHRS:
Type:
Location: 2.42 LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP
Desc.: ~~0~~ Culverts
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

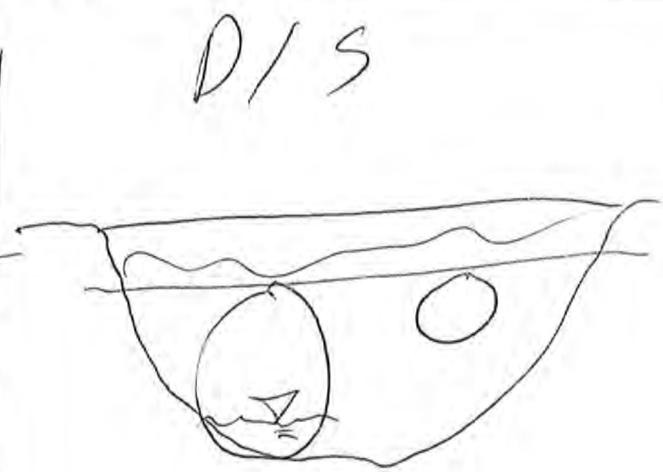
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Sketch and Notes



Filename: 20230705_133928.jpg Photo 91 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 242 Saddler St E Driveway Culvert Upstream Face

Filename: 20230705_133939.jpg Photo 92 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 242 Saddler St E Driveway Culvert Looking Upstream

Filename: 20230705_133951.jpg Photo 93 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 242 Saddler St E Driveway Culvert Looking Downstream

Filename: 20230705_134004.jpg Photo 94 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 242 Saddler St E Driveway Culvert Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 - 17
Township: Durham ON
Highway ID:
Chainage or LHRS:
Type:
Location: 187 LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP
Desc: 0
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

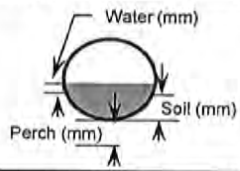
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

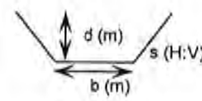
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

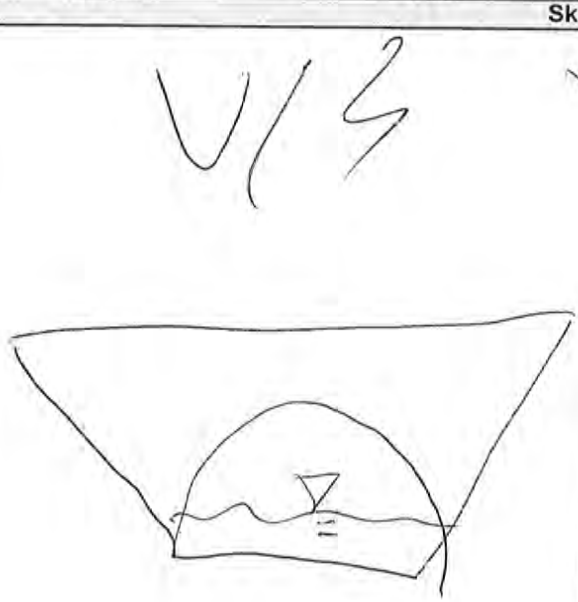


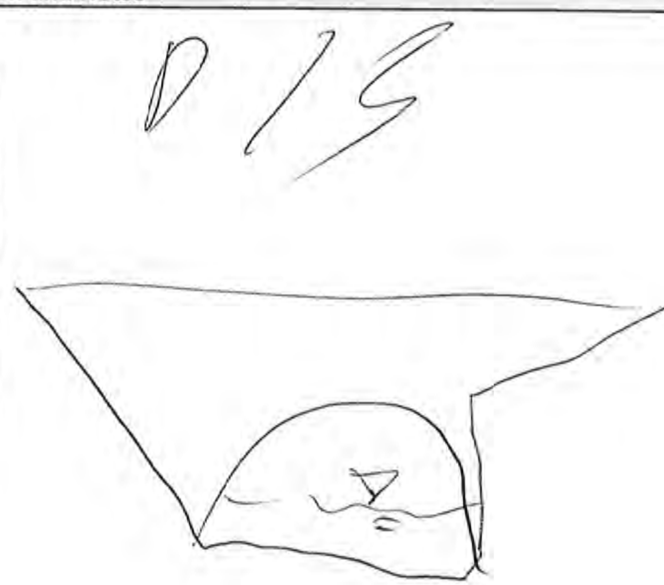
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes





Filename: 20230705_145625.jpg Photo 97 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Elgin St S Culvert Upstream Face

Filename: 20230705_145634.jpg Photo 98 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Elgin St S Culvert Looking Upstream

Filename: 20230705_145709.jpg Photo 99 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Elgin St S Culvert Looking Downstream

Filename: 20230705_145718.jpg Photo 100 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Elgin St S Culvert Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 2 - 15
Township:
Highway ID:
Chainage or LHRS:
Type:
Location: 180 LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ CSP
Desc: culvert
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

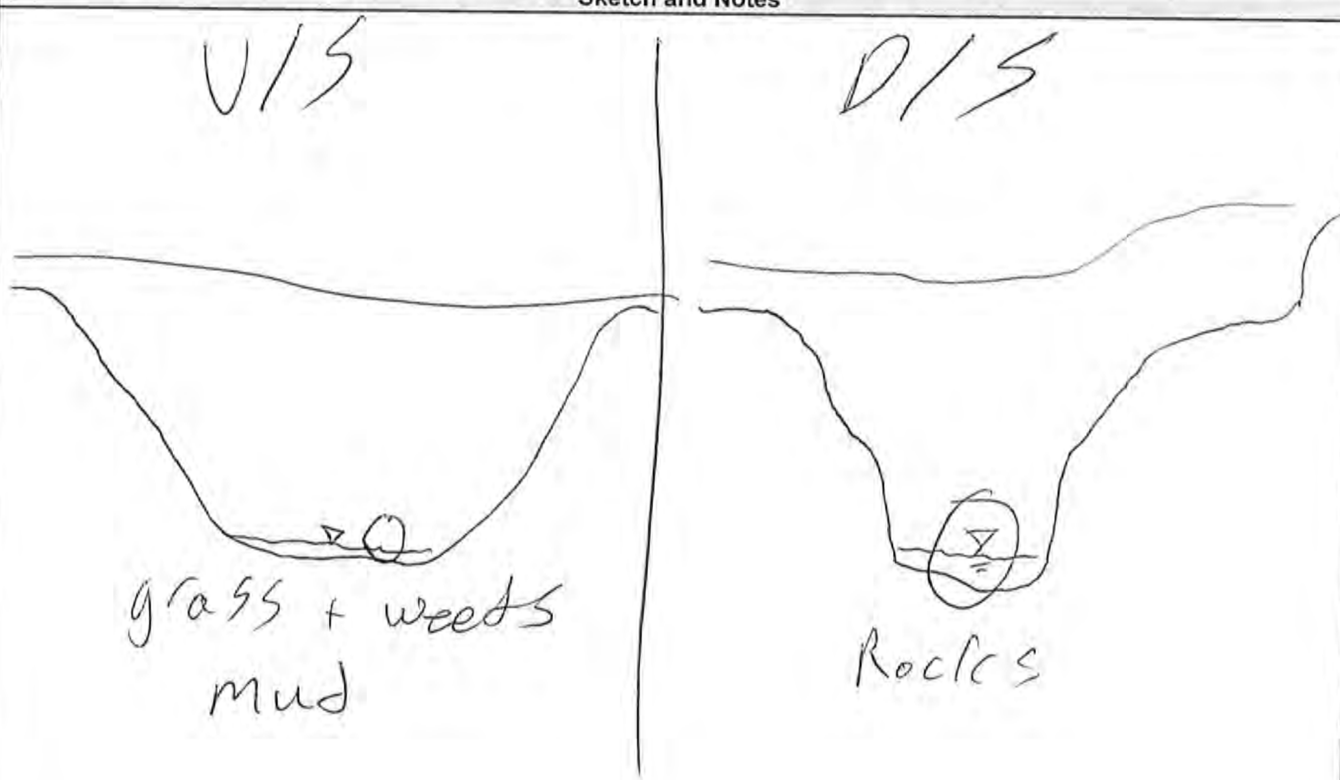
Water (mm) / Soil (mm) / Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m) / s (H:V) / b (m)

Sketch and Notes



Filename: 20230705_153029.jpg Photo 103 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Kincardine St S Culvert Upstream Face

Filename: 20230705_153051.jpg Photo 104 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Kincardine St S Culvert Looking Upstream

Filename: 20230705_153204.jpg Photo 105 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Kincardine St S Culvert Looking Downstream

Filename: 20230705_153222.jpg Photo 106 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Kincardine St S Culvert Downstream Face

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID:
Township:
Highway ID:
Chainage or LHRS:
Type:
Location: 479 LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Culvert
Desc: 0 CSP Driveway
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

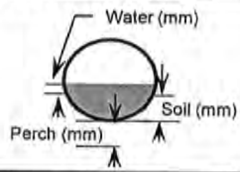
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

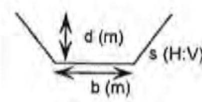
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

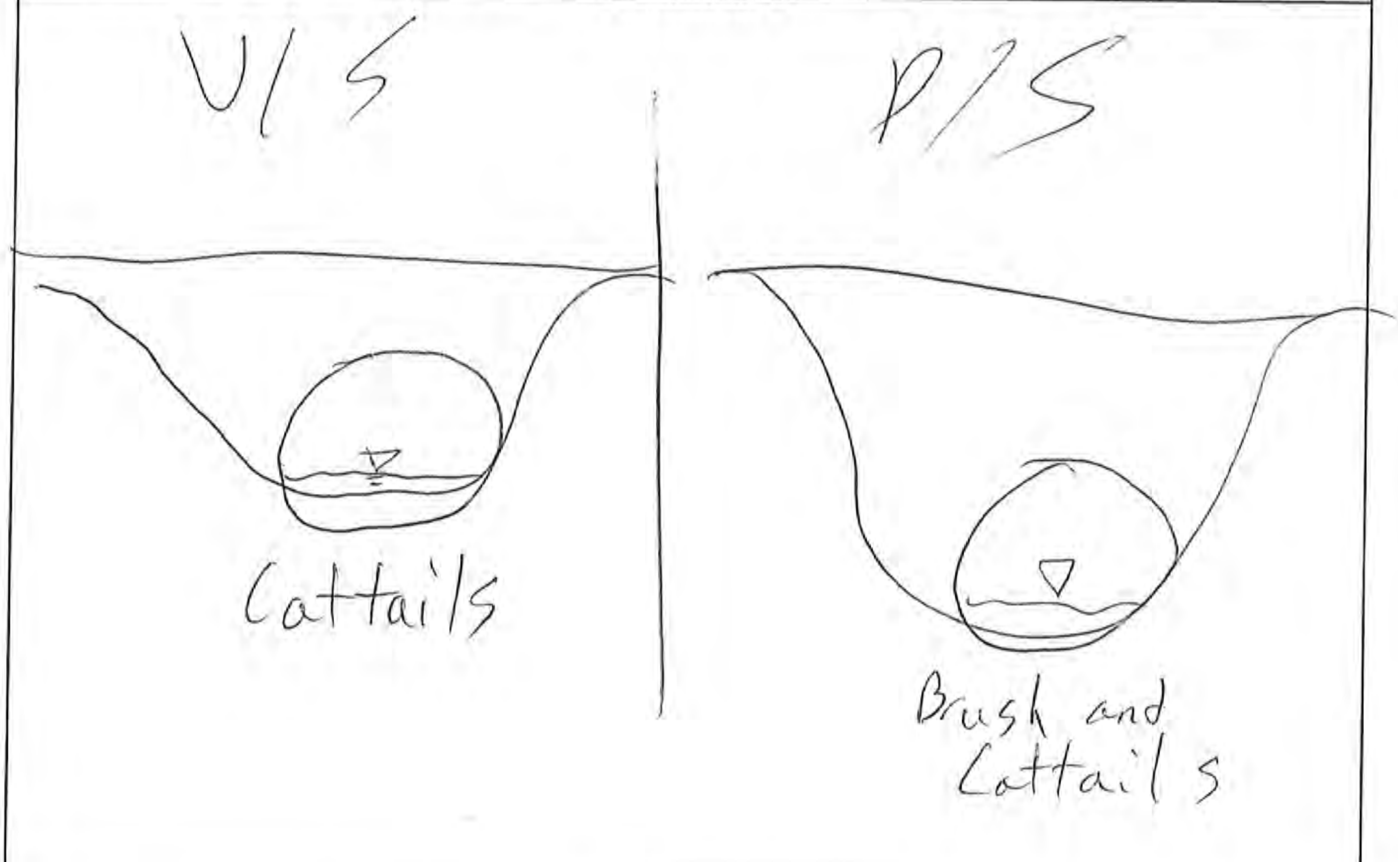


Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes



Filename: 20230705_162635.jpg Photo 109 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 479 Lambton St E Driveway Culvert Upstream End

Filename: 20230705_162647.jpg Photo 110 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 479 Lambton St E Driveway Culvert Outlet

Filename: 20230705_170106.jpg Photo 111 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 479 Lambton St E SWM Pond Outlet

Filename: 20230705_165940.jpg Photo 112 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: 479 Lambton St E SWM Pond

Filename: 20230707_143833.jpg Photo 115 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Grey County Rd 4 Culvert Upstream Face

Filename: 20230707_143837.jpg Photo 116 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Grey County Rd 4 Culvert Upstream Looking West

Filename: 20230707_143843.jpg Photo 117 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Grey County Rd 4 Culvert Looking Upstream

Filename: 20230707_143944.jpg Photo 118 - October 26, 2023
Durham Creek Flood Plain Mapping
Durham Creek: Grey County Rd 4 Culvert Downstream Outlet

Culvert Inspection Worksheet: 17+592

WILLS

Agreement No.: Durham CK/Saugeen River
Assignment No.: 5591 -
Project Limits:

Date: 09/14/2023
Weather: Sunny w/clouds
Inspectors: MC/MK

Location

Culvert ID: [illegible] Saugeen@Hwy4
Township: Durham Grey RD
Highway ID:
Chainage or LHRS:
Type: Centreline
Location: Main LT/RT:

Physical Characteristics

Material: Bridge, Single Span.
Pipe Desc:
Size (mm): N/A (dia. or span x rise)
Cover (m): N/A (Approx.)
Length (m): 11.5m (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type: Lam U.S, Turb D.S
Type of Water Feature:
Flow Direction: South to North
(Approx.) Flow Velocity:
High Water Mark:
(% of culvert height)

Samples:
[x] Water
[x] Soil

Geomatics

RT: Lat
RT: Long

Environmental Considerations

[x] Fish Observed
[✓] Navigable
[ ] Nesting Structure
[x] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

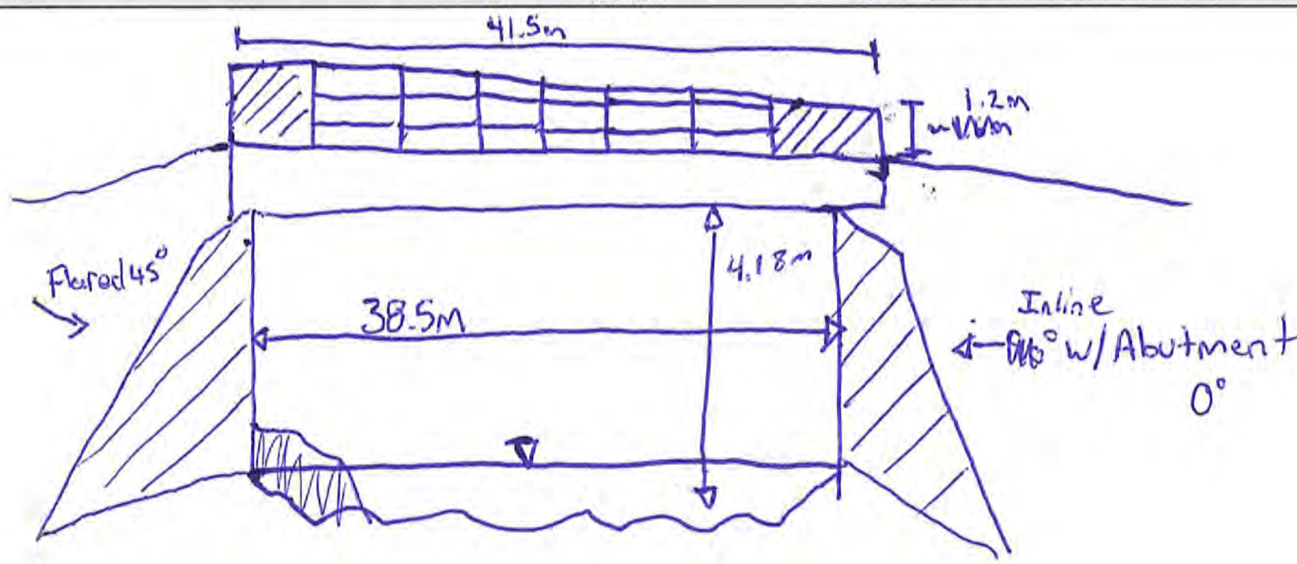
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section (Rt)

Open Outlet : Yes
Bottom Width (b): yes→
Depth (d): varied
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

Notes



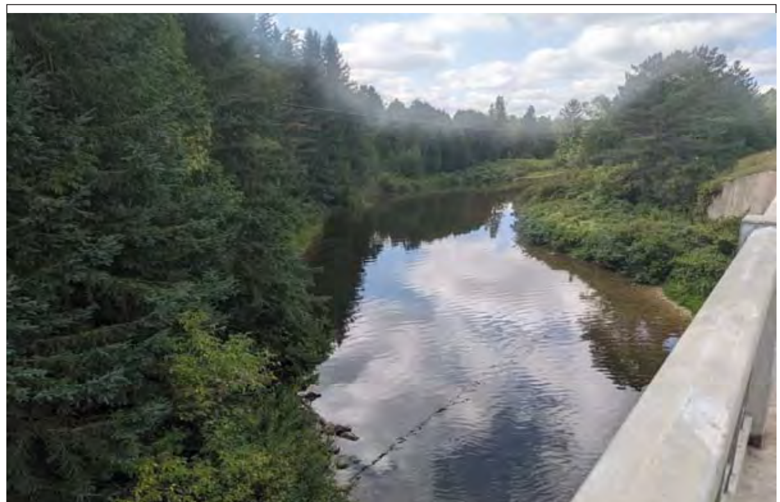
Aerial View / Sketched Notes

Notes: Values in Blue are taken from GIS data provided by the Ministry and found to be in general conformance in the field
**: Rt. and Lt. ends are determined when facing up-chainage. For entrance / sideroad culverts, the Lt. side is always up-chainage

Filename: PXL_20230914_161914005.jpg
Photo 1 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Upstream Face

Filename: PXL_20230914_161825667.jpg
Photo 2 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Upstream Soffit and West Wingwall

Filename: PXL_20230914_161831636.jpg
Photo 3 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Upstream Soffit and East Abutment



Filename: PXL_20230914_161929450.jpg
Photo 4 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Looking Upstream

Filename: PXL_20230914_161730650.jpg
Photo 5 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Downstream West Wingwall

Filename: PXL_20230914_161732619.jpg
Photo 6 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Downstream Face

Filename: PXL_20230914_161734291.jpg
Photo 7 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Downstream East Bank

Filename: PXL_20230914_161738066.jpg
Photo 8 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Looking Downstream

Filename: PXL_20230914_161940372.jpg
Photo 9 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Looking Downstream

Filename: PXL_20230914_162306638.MP.jpg
Photo 10 - September 14, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Grey County Road 4 Bridge Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 3 Dam 1
Township: Durham
Highway ID: Countess
Chainage or LHRS:
Type:
Location: 185 LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Dam
Desc: ~~0~~ Walkway along top of Conc Struc
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

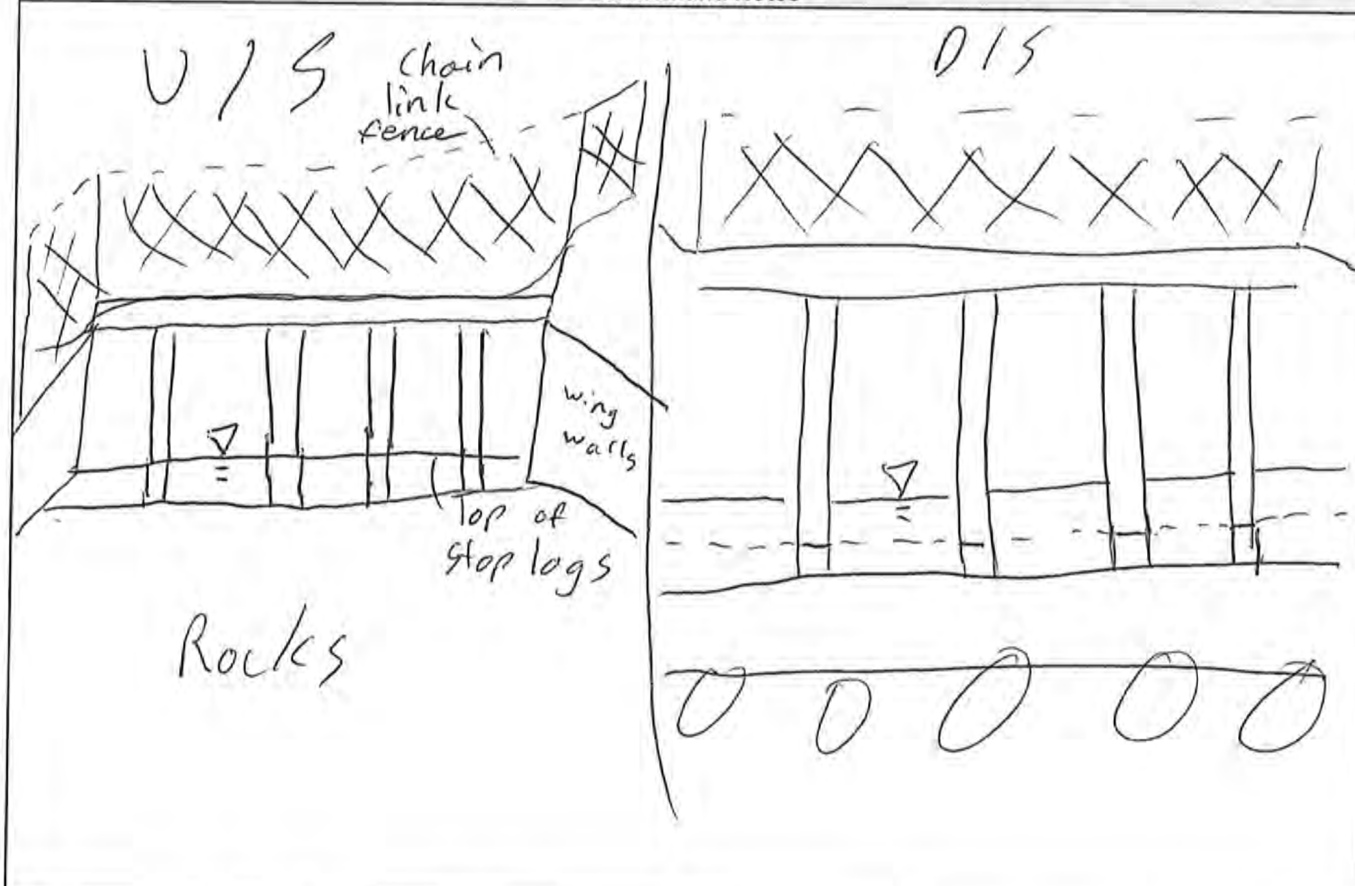
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m)
s (H:V)
b (m)

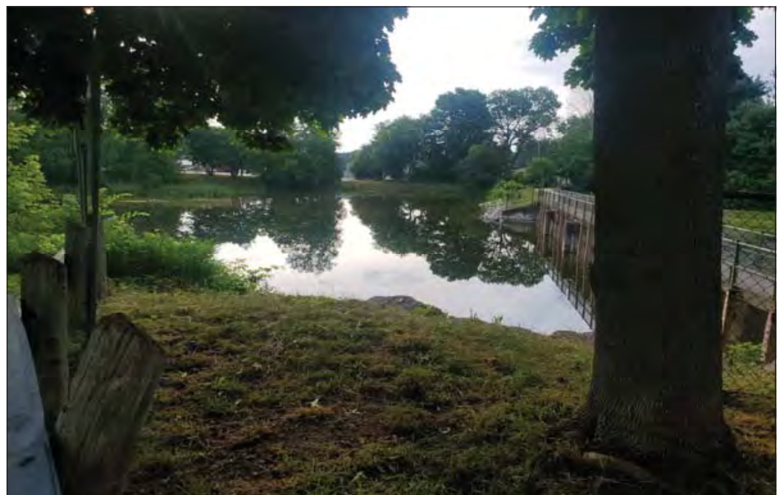
Sketch and Notes



Filename: 20230706_075917.jpg Photo 121 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Upstream Face

Filename: 20230706_081312.jpg Photo 122 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Immediately Upstream

Filename: 20230706_080029.jpg Photo 123 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Looking Upstream



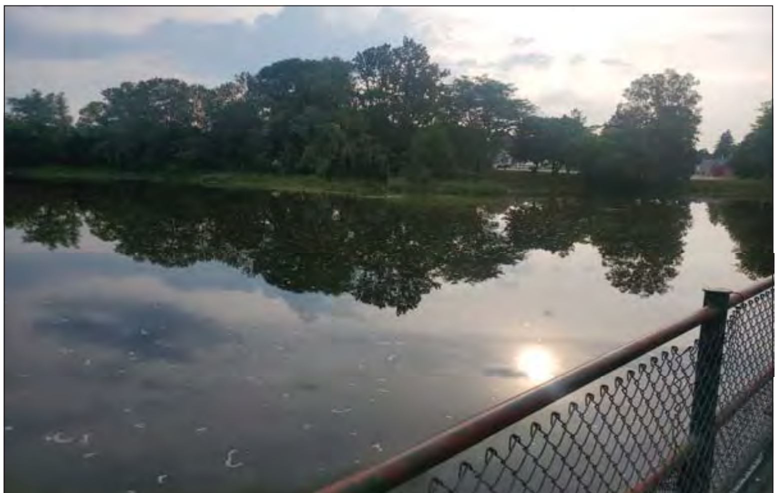
Filename: 20230706_075952.jpg Photo 124 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Reservoir

Filename: 20230706_075937.jpg Photo 125 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam From Countess St S

Filename: 20230706_080034.jpg Photo 126 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Access Gate

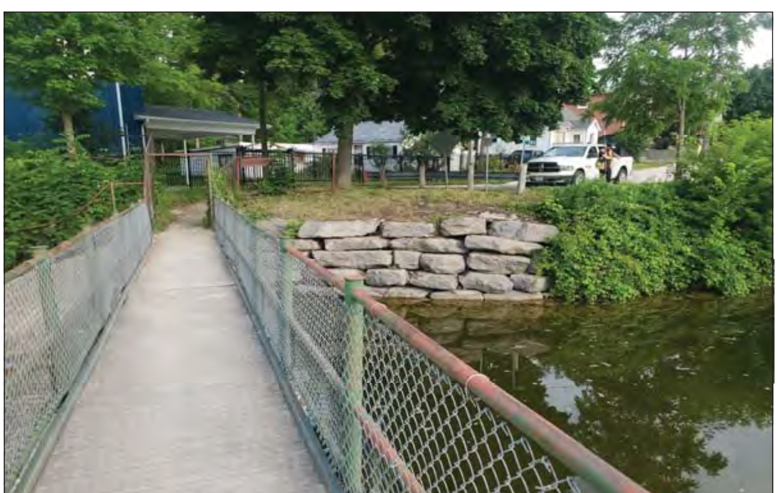
Filename: 20230706_080003.jpg Photo 127 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Top of Deck

Filename: 20230706_080024.jpg Photo 128 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Looking Downstream

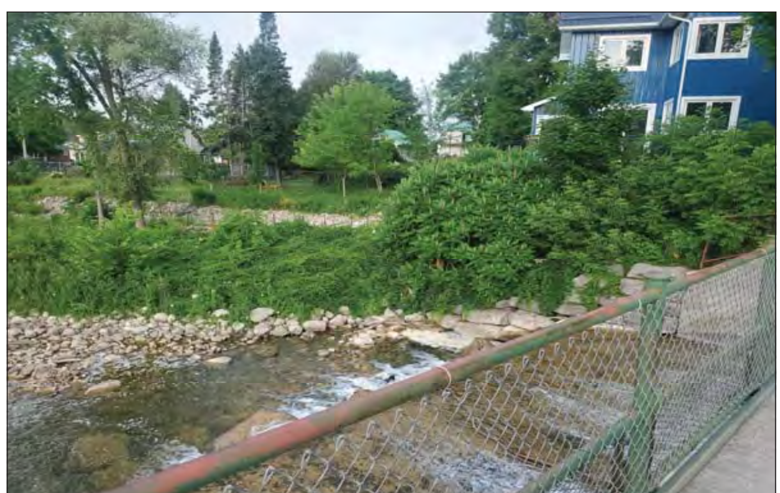


Filename: 20230706_080057.jpg Photo 129 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Reservoir

Filename: 20230706_080102.jpg Photo 130 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Looking Upstream



Filename: 20230706_080109.jpg Photo 131 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Upstream West Bank



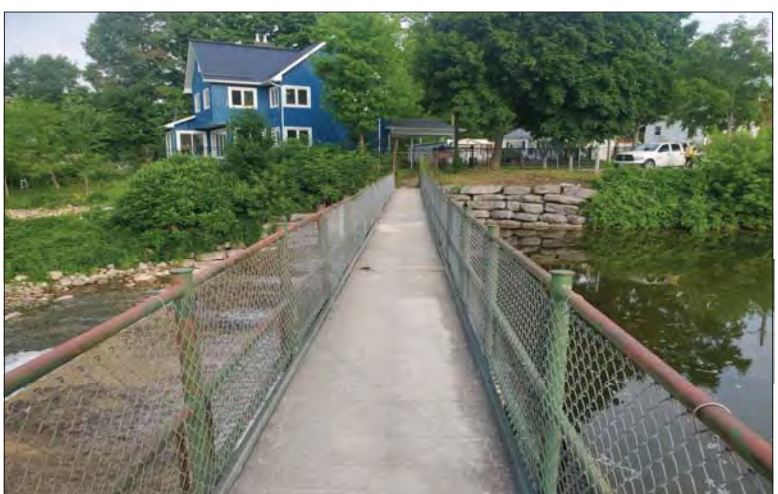
Filename: 20230706_080113.jpg Photo 132 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream West Bank

Filename: 20230706_080117.jpg Photo 133 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Looking Downstream

Filename: 20230706_080121.jpg Photo 134 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream East Bank

Filename: 20230706_080145.jpg Photo 135 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Looking Upstream

Filename: 20230706_080151.jpg Photo 136 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Upstream West Bank



Filename: 20230706_080155.jpg Photo 137 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Deck

Filename: 20230706_080159.jpg Photo 138 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream West Bank

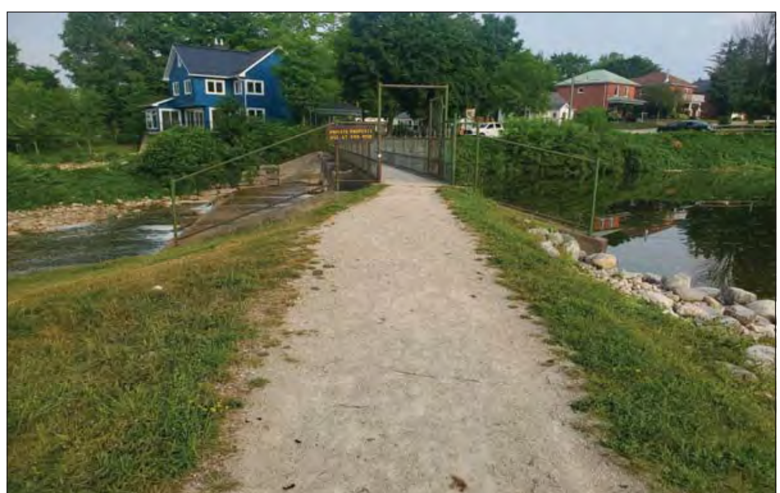
Filename: 20230706_080202.jpg Photo 139 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Looking Downstream

Filename: 20230706_080206.jpg Photo 140 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream East Bank

Filename: 20230706_080227.jpg Photo 141 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Earth Berm

Filename: 20230706_080232.jpg Photo 142 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Reservoir

Filename: 20230706_080236.jpg Photo 143 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Reservoir



Filename: 20230706_080240.jpg Photo 144 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam East Approach

Filename: 20230706_080246.jpg Photo 145 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream

Filename: 20230706_080254.jpg Photo 146 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Emergency Spillway

Filename: 20230706_080803.jpg Photo 147 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Emergency Spillway

Filename: 20230706_080249.jpg Photo 148 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Emergency Spillway

Filename: 20230706_080843.jpg Photo 149 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Emergency Spillway

Filename: 20230706_080902.jpg Photo 150 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Emergency Spillway

WILLS Saugeen Conservation

Filename: 20230706_081019.jpg Photo 151 - October 26, 2023

Durham Creek Flood Plain Mapping

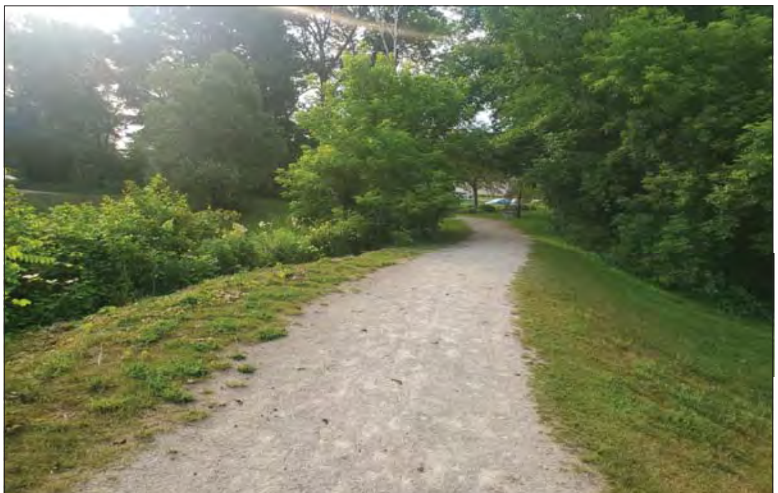
Saugeen River: Lower Durham Dam End of Emergency Spillway

WILLS Saugeen Conservation

Filename: 20230706_081029.jpg Photo 152 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam End of Emergency Spillway



WILLS Saugeen Conservation

Filename: 20230706_080318.jpg Photo 153 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam Earth Berm

WILLS Saugeen Conservation

Filename: 20230706_080328.jpg Photo 154 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam Earth Berm and Emergency Spillway

WILLS Saugeen Conservation

Filename: 20230706_080331.jpg Photo 155 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam Emergency Spillway

WILLS Saugeen Conservation

Filename: 20230706_080335.jpg Photo 156 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam Downstream of Earth Berm

Filename: 20230706_080408.jpg Photo 157 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam East End of Earth Berm

Filename: 20230706_080411.jpg Photo 158 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam East End of Earth Berm

Filename: 20230706_080415.jpg Photo 159 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Reservoir

Filename: 20230706_080419.jpg Photo 160 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Earth Berm From East End

Filename: 20230706_080434.jpg Photo 161 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Memorial Plaque

Filename: 20230706_080536.jpg Photo 162 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam East End of Earth Berm

Filename: 20230706_080541.jpg Photo 163 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam East End of Earth Berm

Filename: 20230706_080546.jpg Photo 164 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Reservoir

Filename: 20230706_080550.jpg Photo 165 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Earth Berm From East End

Filename: 20230706_080627.jpg Photo 166 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Upstream Side of Earth Berm

Filename: 20230706_081002.jpg Photo 167 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream Face

Filename: 20230706_081007.jpg Photo 168 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lower Durham Dam Downstream West Bank

WILLS | Saugeen Conservation

Filename: 20230706_081120.jpg Photo 169 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam Immediately Downstream

WILLS | Saugeen Conservation

Filename: 20230706_081151.jpg Photo 170 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Lower Durham Dam

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: County Rd 4
Township: Durham
Highway ID:
Chainage or LHRS:
Type:
Location: ~~Queens~~ Lambton St @ Queen LT/RT:

Physical Characteristics

Structure: Bridge
Desc: ~~0~~ Concrete
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

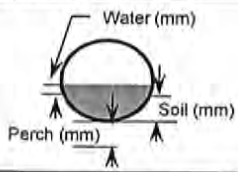
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

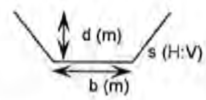
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

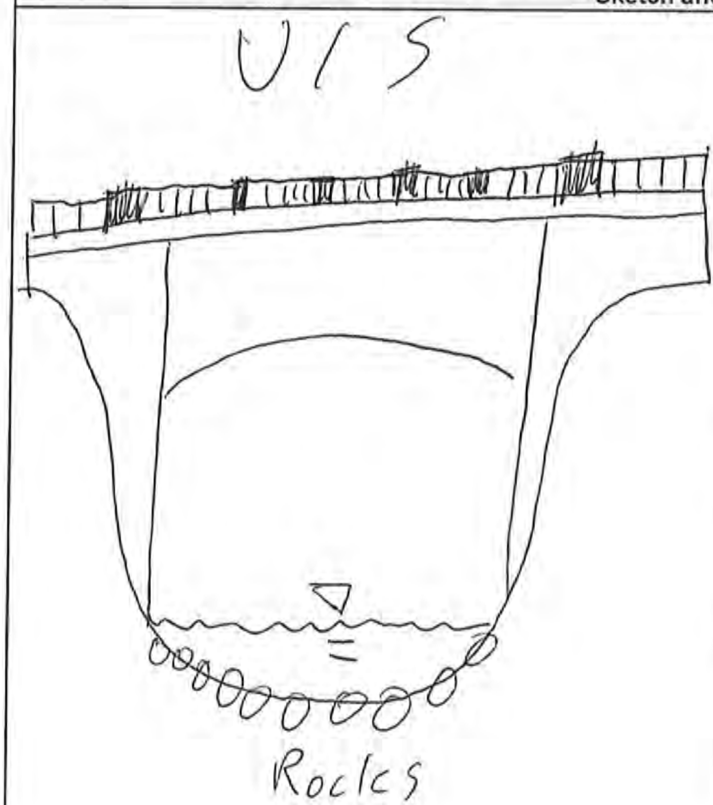


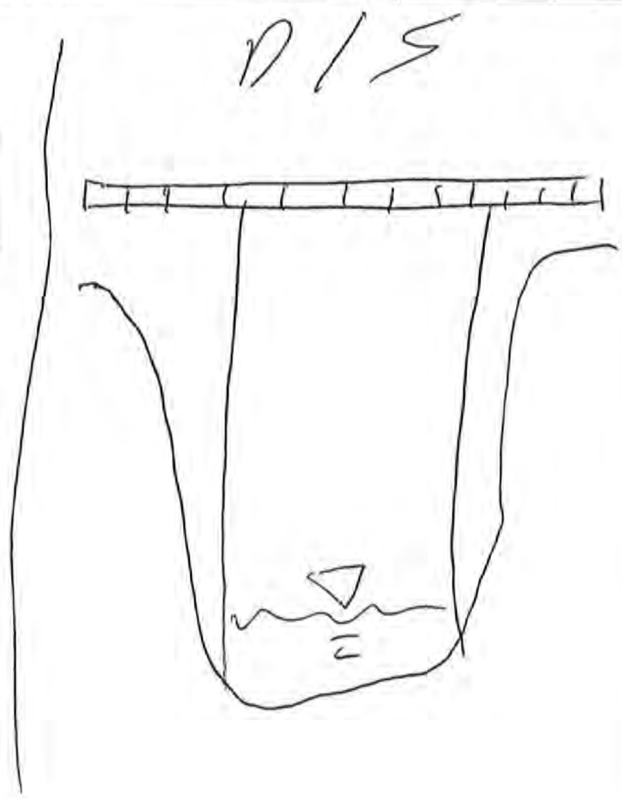
Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:



Sketch and Notes



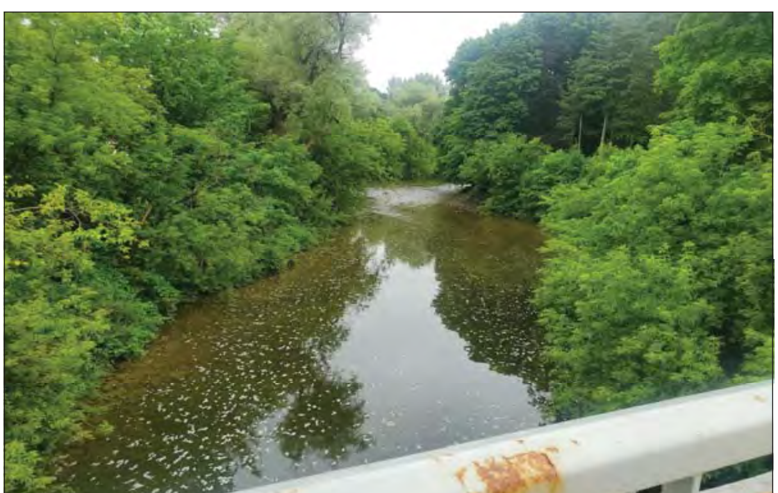


Filename: 20230706_154354.jpg Photo 175 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Upstream Face

Filename: 20230706_154405.jpg Photo 176 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Upstream Face and West Wingwall

Filename: 20230706_170811.jpg Photo 177 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Upstream Face

Filename: 20230706_154549.jpg Photo 178 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Looking Downstream at the Lambton St E Bridge



Filename: 20230706_154325.jpg Photo 179 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Looking Upstream

Filename: 20230706_154202.jpg Photo 180 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Looking Downstream

Filename: 20230706_154207.jpg Photo 181 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Looking East

Filename: 20230706_154214.jpg Photo 182 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Looking North

Filename: 20230706_154331.jpg Photo 183 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Looking West

Filename: 20230706_154335.jpg Photo 184 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Lambton St E Bridge Looking East

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Hwy 6 Bridge
Township: Durham
Highway ID: Hwy 6
Chainage or LHRS:
Type:
Location: Durham
LT/RT:

Physical Characteristics

Structure: Bridge
Desc: ~~0~~ Concrete
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type:
Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat
LT: Lat
RT: Long
LT: Long

Environmental Considerations

[ ] Fish Observed
[ ] Navigable
[ ] Nesting Structure
[ ] Beaver Evidence
[ ] Animal Grate
[ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert
[ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

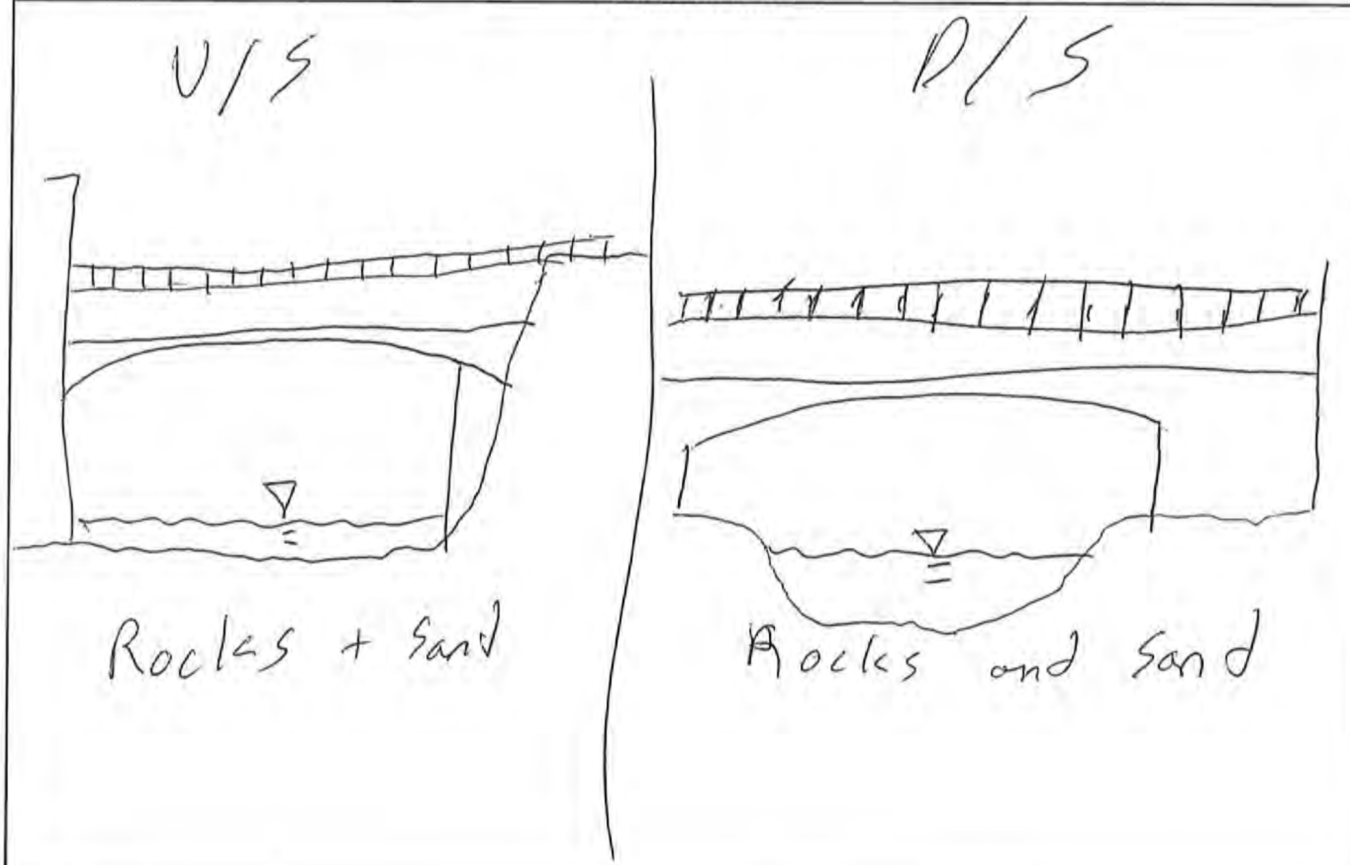
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

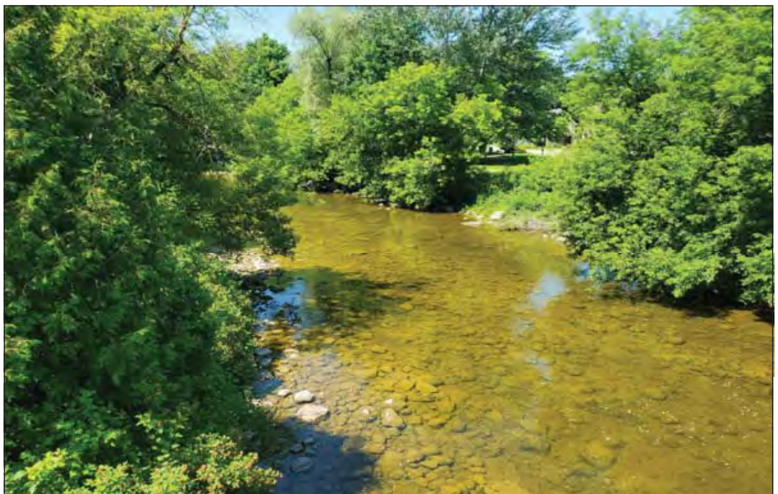
d (m)
s (H:V)
b (m)

Sketch and Notes

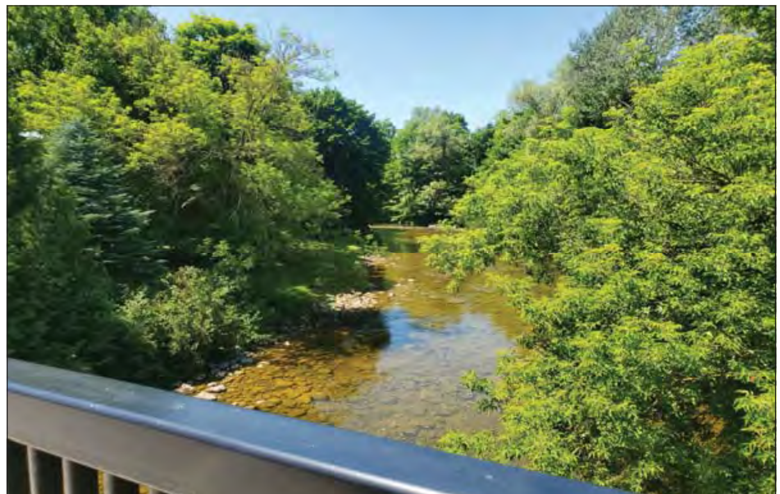


Filename: 20230707_122654.jpg Photo 187 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Upstream Face

Filename: 20230707_122818.jpg Photo 188 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Looking Upstream

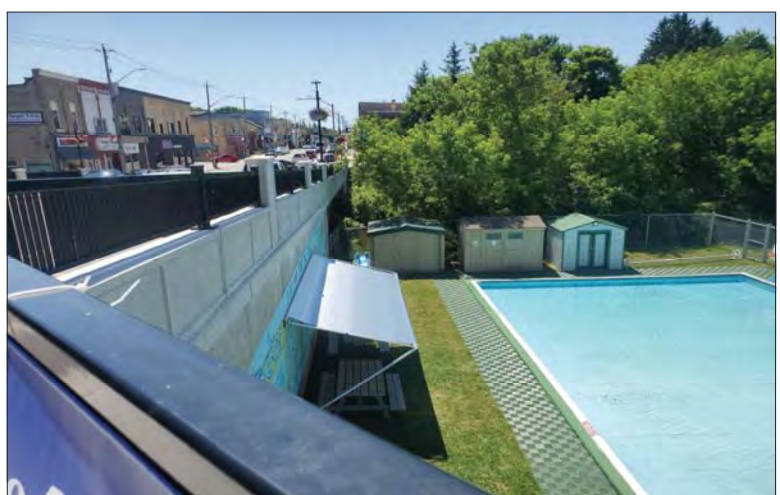


Filename: 20230707_123034.jpg Photo 189 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Looking Downstream



Filename: 20230707_123053.jpg Photo 190 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Looking Downstream

Filename: 20230707_122929.jpg Photo 191 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Downstream Face



Filename: 20230707_122551.jpg Photo 192 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Downstream Face

Filename: 20230707_122557.jpg Photo 193 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge North Abutment Looking West Along George St W

Filename: 20230707_122601.jpg Photo 194 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge North Abutment Looking North

Filename: 20230707_122604.jpg Photo 195 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge North Abutment Looking East

Filename: 20230707_122612.jpg Photo 196 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge North Abutment Looking South

Filename: 20230707_122805.jpg Photo 197 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Upstream South Bank

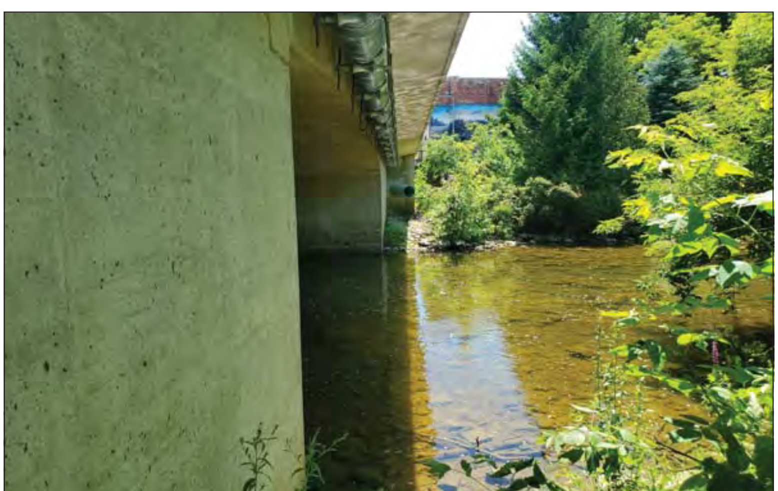
Filename: 20230707_122826.jpg Photo 198 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Upstream North Bank

Filename: 20230707_122940.jpg Photo 199 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge South Abutment Looking North

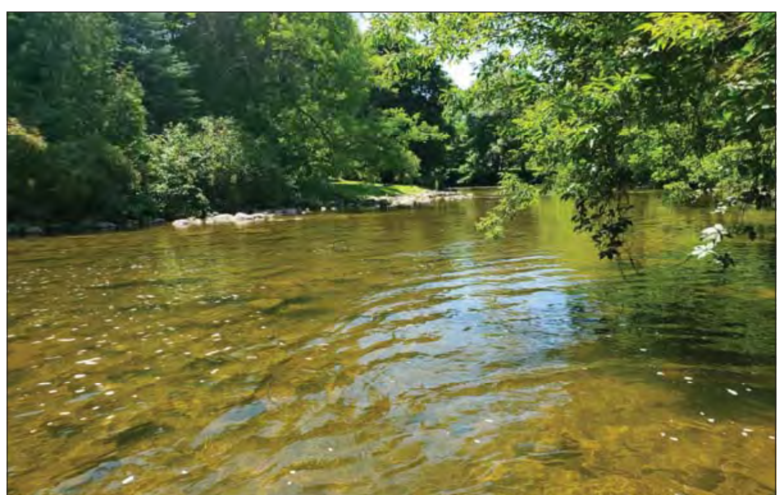
Filename: 20230707_122934.jpg Photo 200 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge South Abutment Looking South

Filename: 20230707_122842.jpg Photo 201 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge South Abutment Looking North

Filename: 20230707_133916.jpg Photo 202 - October 26, 2023
Durham Creek Flood Plain Mapping



Filename: 20230707_133940.jpg Photo 203 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Downstream Opening



Filename: 20230707_134053.jpg Photo 204 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Highway 6 Bridge Looking Downstream

Filename: 20230707_134007.jpg Photo 205 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Highway 6 Bridge Soffit Looking Upstream

Filename: 20230707_134142.jpg Photo 206 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Highway 6 Bridge Soffit Looking Upstream

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Pedestrian Bridge
Township:
Highway ID:
Chainage or LHRS:
Type:
Location: LT/RT:

Physical Characteristics

Structure: Bridge Pedestrian
Desc: ~~0~~ Wood Piers
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

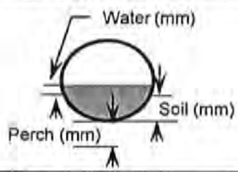
GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

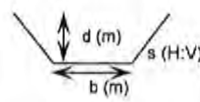
Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

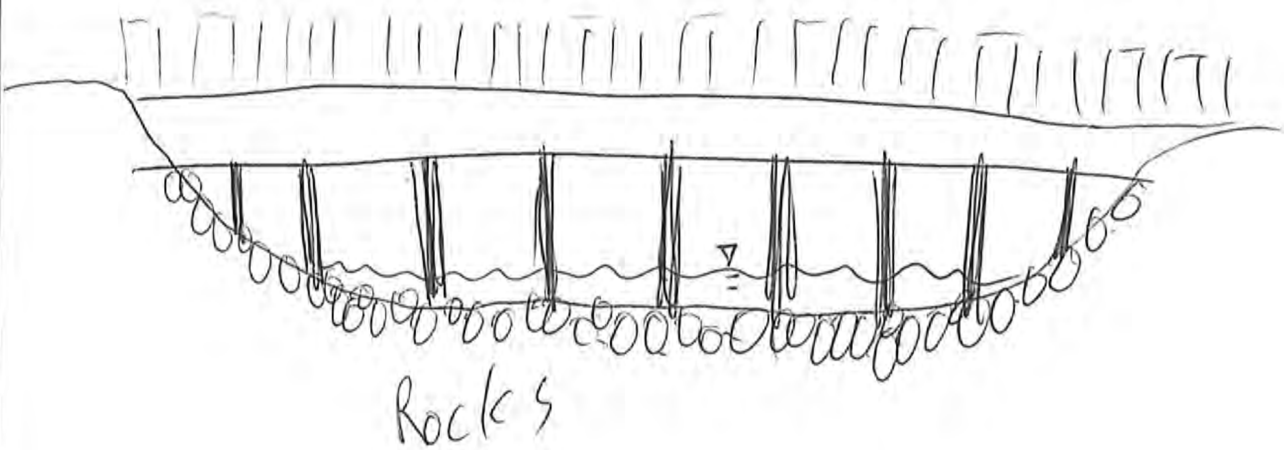


Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

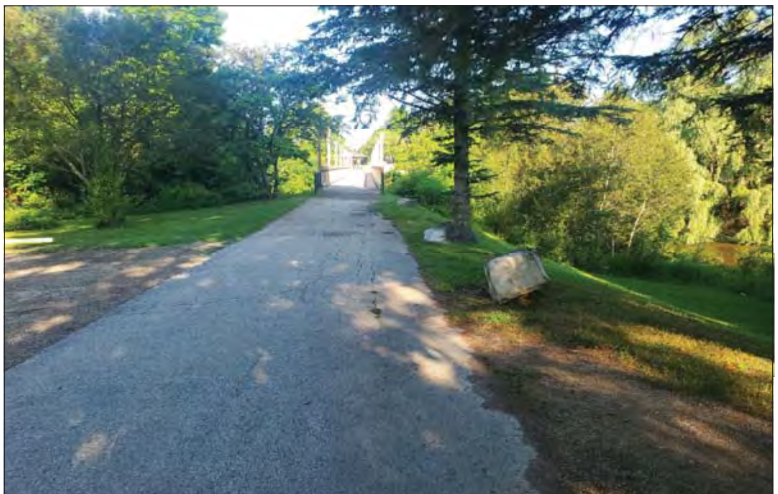


Sketch and Notes



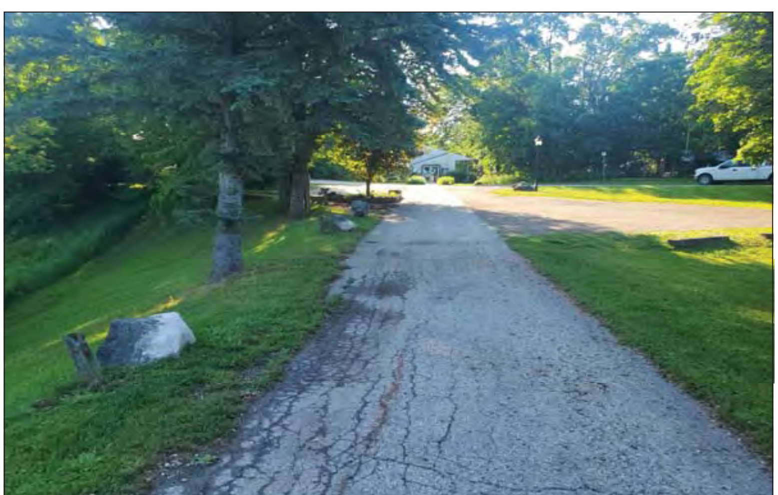
Filename: 20230707_105916.jpg Photo 211 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Upstream Face

Filename: 20230707_081601.jpg Photo 212 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking Upstream



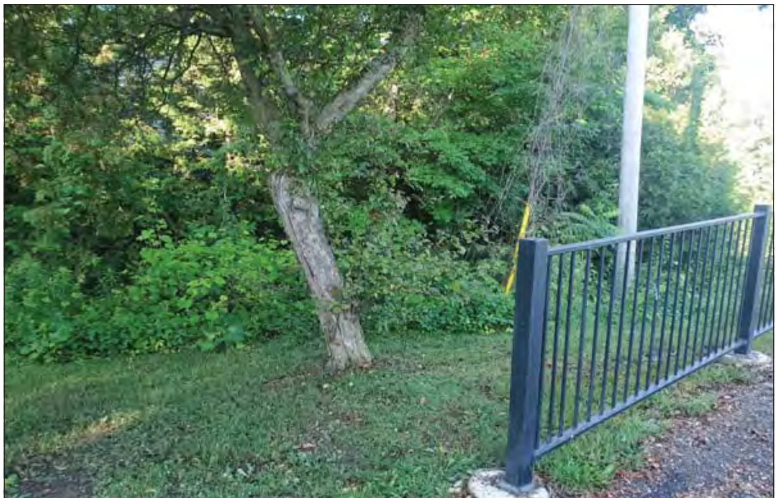
Filename: 20230707_081452.jpg Photo 213 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge East Approach

Filename: 20230707_081519.jpg Photo 214 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge East Abutment Looking West

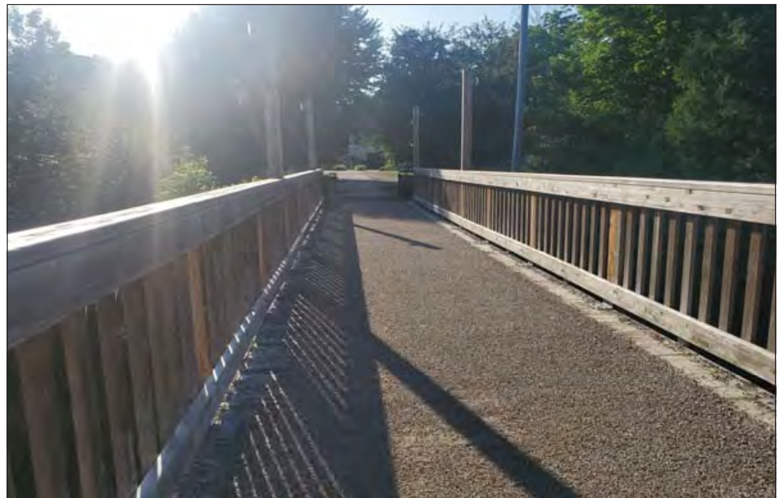


Filename: 20230707_081523.jpg Photo 215 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge East Abutment Looking East

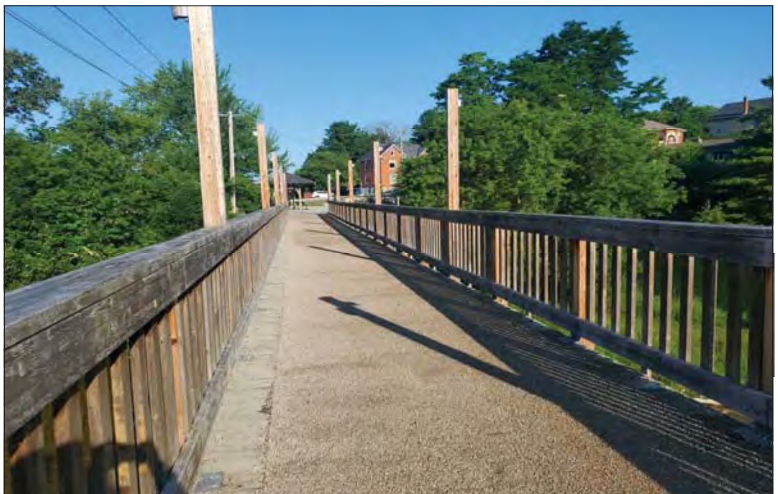
Filename: 20230707_081526.jpg Photo 216 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge East Abutment Looking North



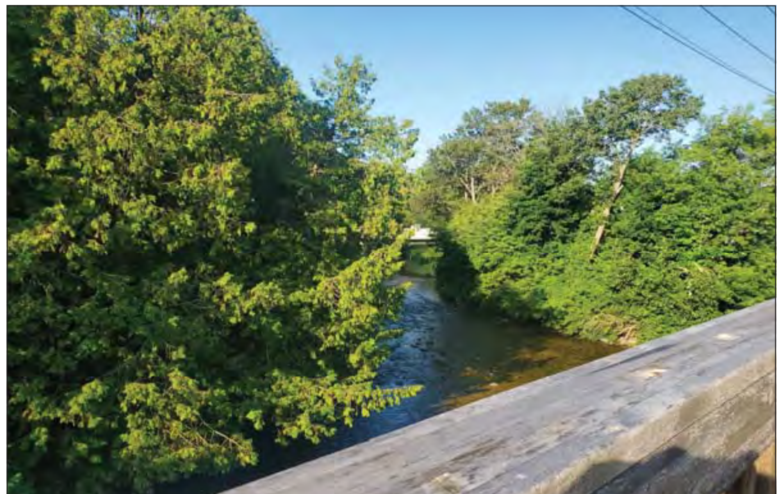
Filename: 20230707_081531.jpg Photo 217 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge East Abutment Looking South



Filename: 20230707_081604.jpg Photo 218 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Deck Looking East

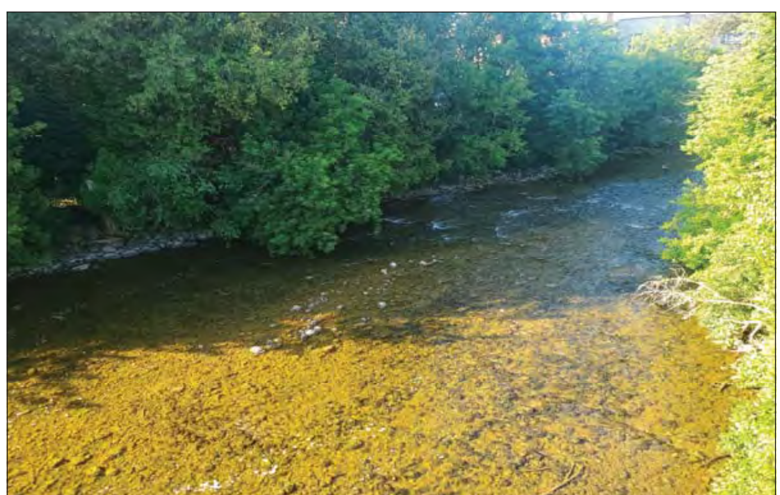


Filename: 20230707_081613.jpg Photo 219 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Deck Looking West



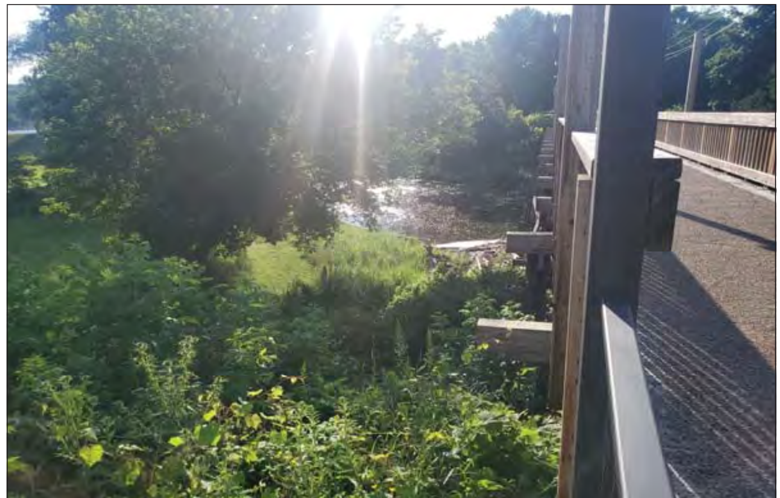
Filename: 20230707_081611.jpg Photo 220 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking Downstream

Filename: 20230707_081622.jpg Photo 221 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking Downstream



Filename: 20230707_081712.jpg Photo 222 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking Downstream

Filename: 20230707_081650.jpg Photo 223 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking North



Filename: 20230707_081748.jpg Photo 224 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge

Filename: 20230707_081752.jpg Photo 225 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking at Middle Durham Dam North Embankment

Filename: 20230707_081825.jpg Photo 226 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge West Stairs to River

Filename: 20230707_081830.jpg Photo 227 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Looking North from West Stairs

Filename: 20230707_112804.jpg Photo 228 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Heritage Walkway Bridge Piers

Filename: 20230707_112808.jpg Photo 229 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Heritage Walkway Bridge West Bank

Filename: 20230707_112812.jpg Photo 230 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Heritage Walkway Bridge East Bank

Crossing Data Sheet:

WILLS

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Middle Dam
Township:
Highway ID:
Chainage or LHRS:
Type:
Location: LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Dam, Conc
Desc: 0
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark:
(% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

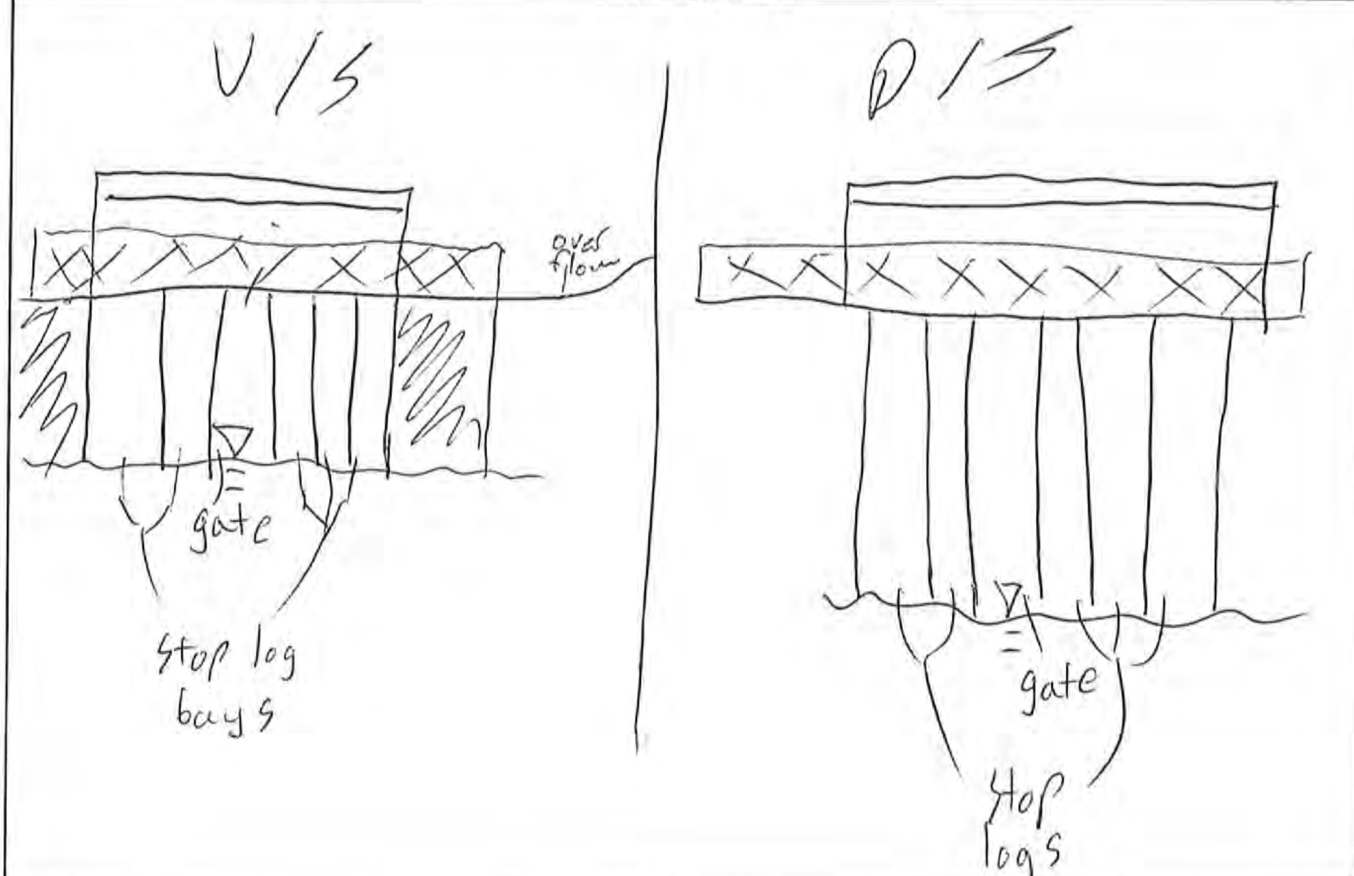
Water (mm)
Soil (mm)
Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

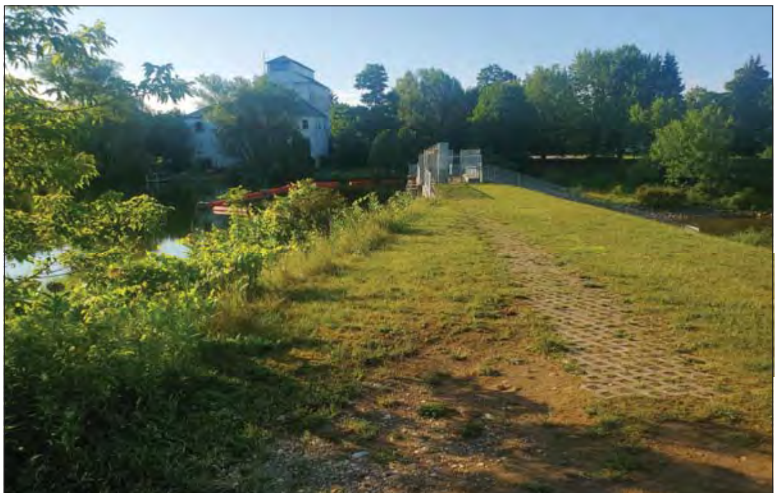
d (m)
s (H:V)
b (m)

Sketch and Notes



Filename: 20230707_080256.jpg Photo 235 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Upstream Face

Filename: 20230707_081324.jpg Photo 236 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Upstream Face



Filename: 20230707_080212.jpg Photo 237 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Southeast

Filename: 20230707_080215.jpg Photo 238 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Southwest

Filename: 20230707_080220.jpg Photo 239 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Northwest

Filename: 20230707_080234.jpg Photo 240 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Northeast

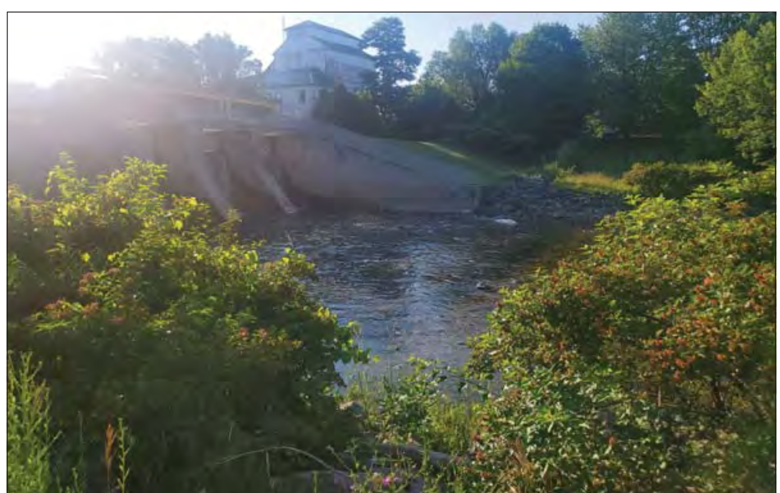
Filename: 20230707_075358.jpg Photo 241 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream of Dam Looking North

Filename: 20230707_075354.jpg Photo 242 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream of Dam Looking Northwest

Filename: 20230707_075341.jpg Photo 243 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream Face

Filename: 20230707_075413.jpg Photo 244 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream Face

Filename: 20230707_075420.jpg Photo 245 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream Face



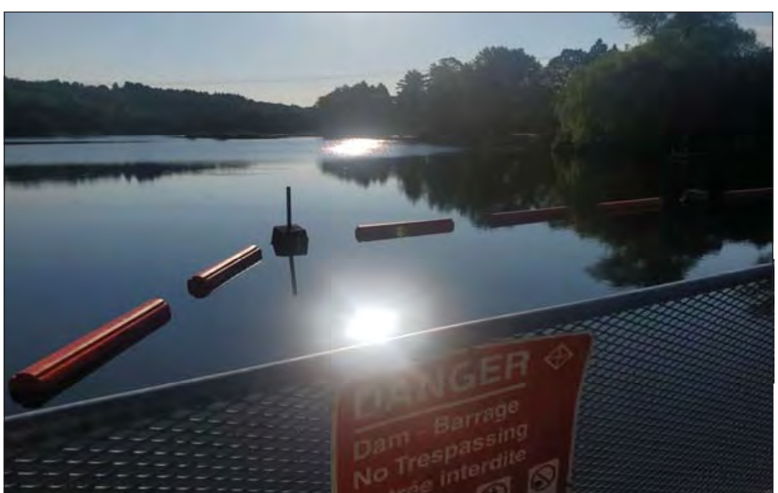
Filename: 20230707_075349.jpg Photo 246 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking at Downstream South Bank

Filename: 20230707_075439.jpg Photo 247 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Middle Durham Dam Looking at Downstream South Bank

Filename: 20230707_075503.jpg Photo 248 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Middle Durham Dam Looking Downstream

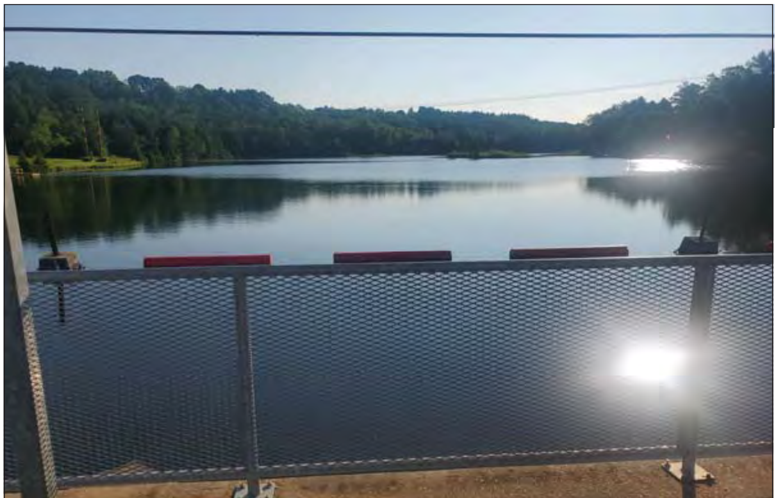
Filename: 20230707_075616.jpg Photo 249 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Middle Durham Dam Looking Northwest

Filename: 20230707_075659.jpg Photo 250 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Middle Durham Dam Northwest Access Gate



Filename: 20230707_075631.jpg Photo 251 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Middle Durham Dam Looking Upstream

Filename: 20230707_075654.jpg Photo 252 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Middle Durham Dam Looking Downstream



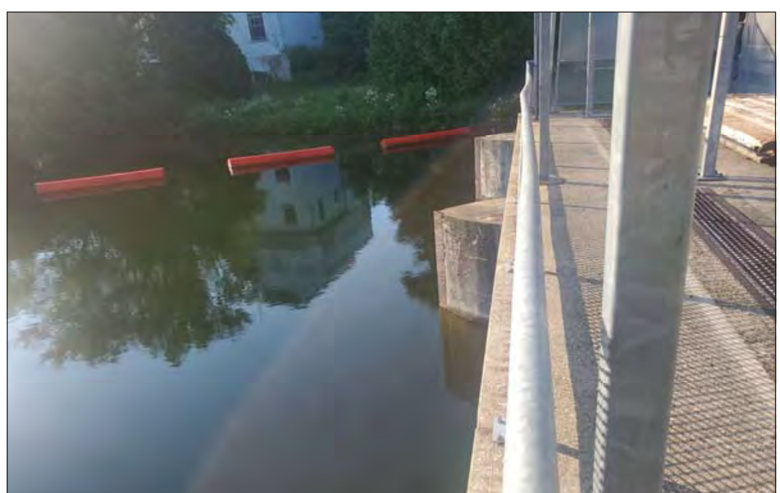
Filename: 20230707_075703.jpg Photo 253 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Upstream

Filename: 20230707_075707.jpg Photo 254 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Deck Looking Southeast

Filename: 20230707_075734.jpg Photo 255 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Sluice Gate

Filename: 20230707_075753.jpg Photo 256 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Deck Looking Southeast

Filename: 20230707_075809.jpg Photo 257 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking at Downstream South Bank



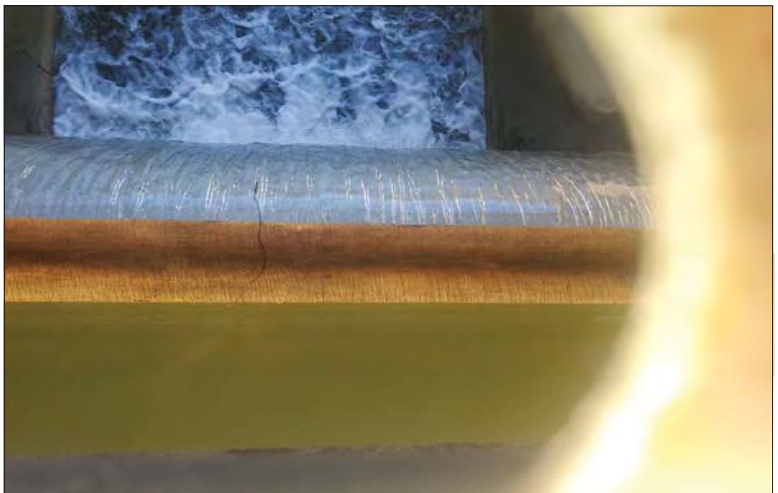
Filename: 20230707_075822.jpg Photo 258 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Upstream Piers and Railing

WILLS Saugeen Conservation

Filename: 20230707_080523.jpg Photo 259 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Stoplogs

WILLS Saugeen Conservation

Filename: 20230707_080044.jpg Photo 260 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Stoplog Channel

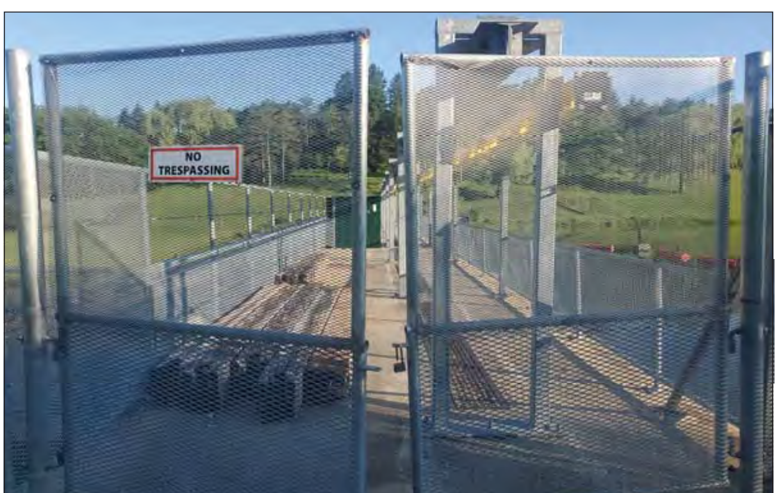


WILLS Saugeen Conservation

Filename: 20230707_080056.jpg Photo 261 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Stoplog

WILLS Saugeen Conservation

Filename: 20230707_080014.jpg Photo 262 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Tailwater

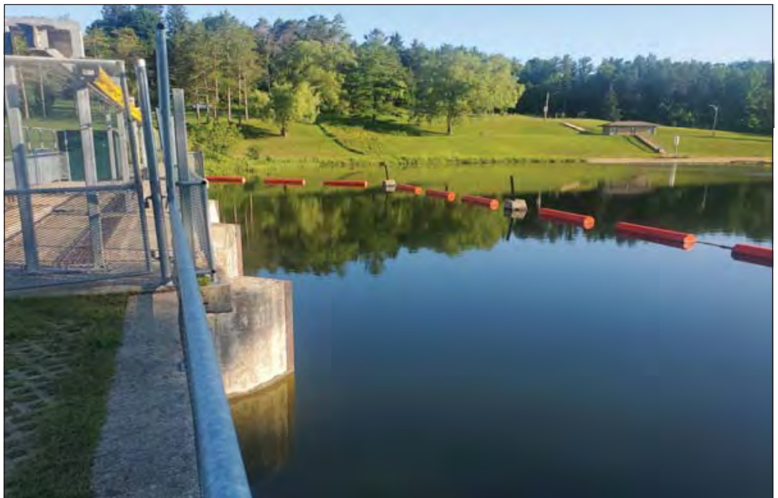


WILLS Saugeen Conservation

Filename: 20230707_075845.jpg Photo 263 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Southeast Access Gate

WILLS Saugeen Conservation

Filename: 20230707_075850.jpg Photo 264 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Danger Sign



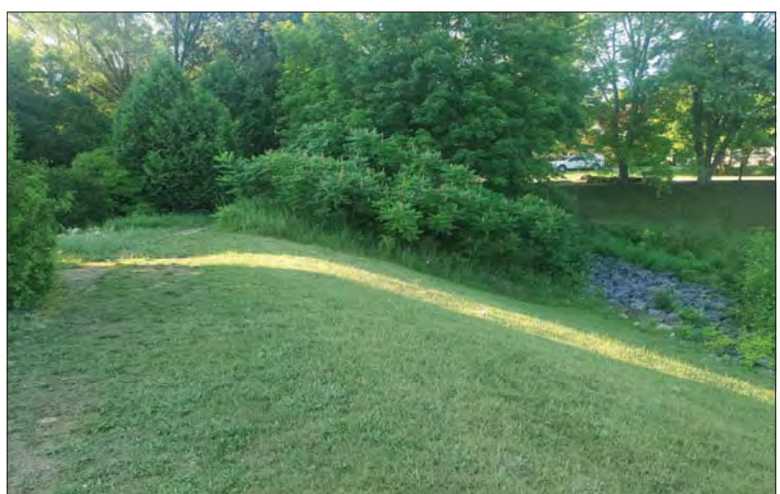
WILLS Saugeen Conservation
Filename: 20230707_075857.jpg Photo 265 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Headpond

WILLS Saugeen Conservation
Filename: 20230707_075900.jpg Photo 266 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Reservoir

WILLS Saugeen Conservation
Filename: 20230707_075908.jpg Photo 267 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Downstream from South Bank

WILLS Saugeen Conservation
Filename: 20230707_080018.jpg Photo 268 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Downstream

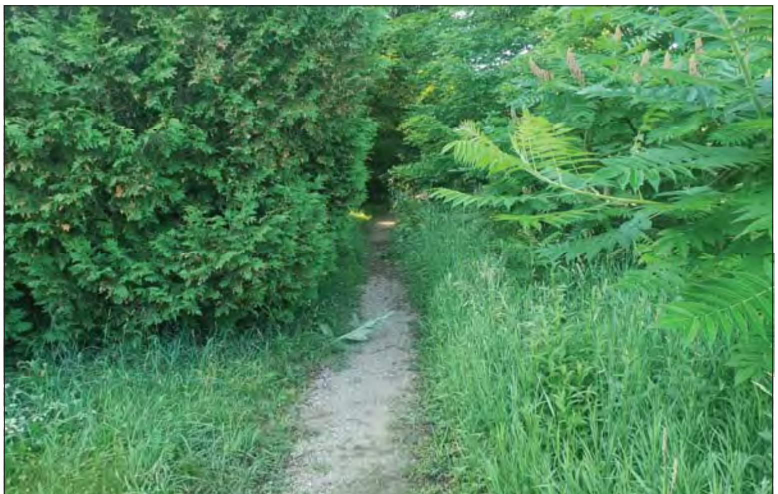
WILLS Saugeen Conservation
Filename: 20230707_080022.jpg Photo 269 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream South Bank



WILLS Saugeen Conservation
Filename: 20230707_075912.jpg Photo 270 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Southeast

Filename: 20230707_075933.jpg Photo 271 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Looking Northwest

Filename: 20230707_075946.jpg Photo 272 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam South Bank Looking Upstream



Filename: 20230707_075937.jpg Photo 273 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam South Bank Trail to Parking Area

Filename: 20230707_081410.jpg Photo 274 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam South Bank Parking Area

Filename: 20230707_112758.jpg Photo 275 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Middle Durham Dam Downstream Face

WILLS

Crossing Data Sheet:

Agreement No.: SVCA
Assignment No.: 5591
Project Limits: Durham Ck

Date:
Weather:
Inspectors: JTF/MK

Location

Culvert ID: Day 3 Upper Dam
Township:
Highway ID:
Chainage or LHRS:
Type:
Location: LT/RT:

Physical Characteristics

Structure: ~~Bridge~~ Dam
Desc: ~~0~~ Concrete + steel deck
Size (mm): (dia. or span x rise)
Cover (m): (Approx.)
Length (m): (Approx.)
Fill Type: Extensions:

Flow Information

Flow Type:
Type of Water Feature:
Flow Direction:
(Approx.) Flow Velocity: m/s
High Water Mark: (% of culvert height)

Samples:
[ ] Water
[ ] Soil

Geomatics

GPS Coord System: Lat / Long: Dec. - Deg.
RT: Lat LT: Lat
RT: Long LT: Long

Environmental Considerations

[ ] Fish Observed [ ] Navigable [ ] Nesting Structure
[ ] Beaver Evidence [ ] Animal Grate [ ] Sensitive Env or Pollutant
[ ] Groundwater Above Invert [ ] Local Wells~200m

Water / Sediment Measurements

Water Rt:
Soil Rt:
Perch Rt:
Water Lt:
Soil Lt:
Perch Lt:

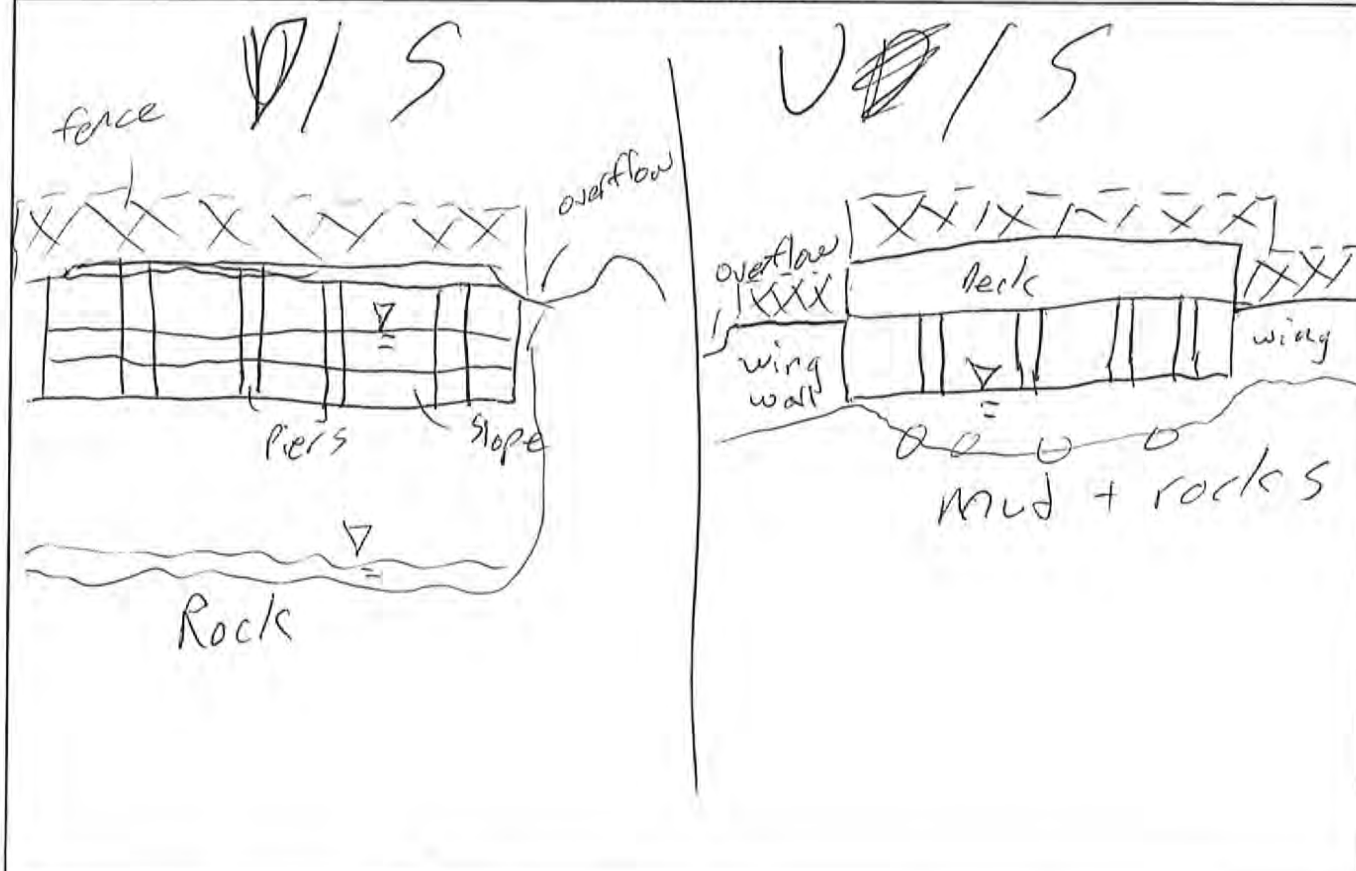
Water (mm) Soil (mm) Perch (mm)

Downstream Channel Section ()

Open Outlet :
Bottom Width (b):
Depth (d):
(Approx. Rt-Lt) Slopes (s):
(Approx.) T/W Depth:

d (m) s (H:V) b (m)

Sketch and Notes



WILLS Saugeen Conservation

Filename: 20230706_112101.jpg Photo 277 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream Face

WILLS Saugeen Conservation

Filename: 20230706_111333.jpg Photo 278 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam From Downstream

WILLS Saugeen Conservation

Filename: 20230706_111340.jpg Photo 279 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam From Downstream

WILLS Saugeen Conservation

Filename: 20230706_111409.jpg Photo 280 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam

WILLS Saugeen Conservation

Filename: 20230706_111414.jpg Photo 281 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Downstream Face

WILLS Saugeen Conservation

Filename: 20230706_111417.jpg Photo 282 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Downstream Area

Filename: 20230706_111524.jpg Photo 283 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Upper Durham Dam Looking Downstream

Filename: 20230706_111527.jpg Photo 284 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Upper Durham Dam Looking Downstream

Filename: 20230706_111536.jpg Photo 285 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Upper Durham Dam Looking Upstream

Filename: 20230706_111545.jpg Photo 286 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Upper Durham Dam Looking Upstream

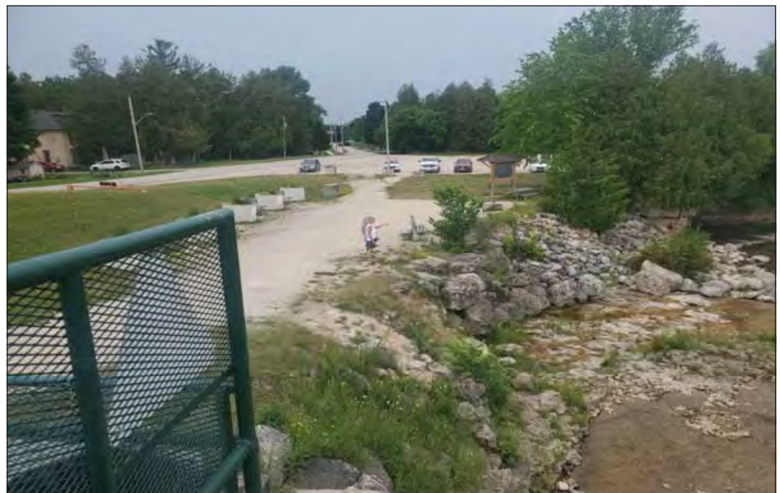
Filename: 20230706_111604.jpg Photo 287 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Upper Durham Dam

Filename: 20230706_111625.jpg Photo 288 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen Conservation
Saugeen River: Upper Durham Dam Deck

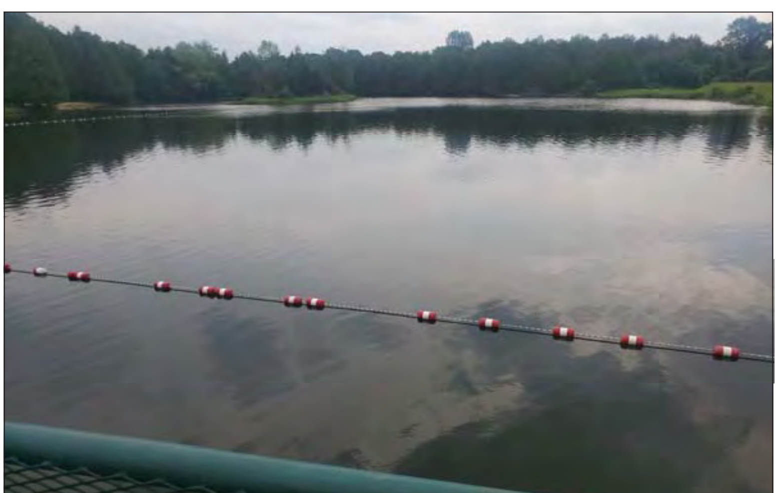
Filename: 20230706_111632.jpg Photo 289 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck Signs

Filename: 20230706_111638.jpg Photo 290 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Looking Downstream

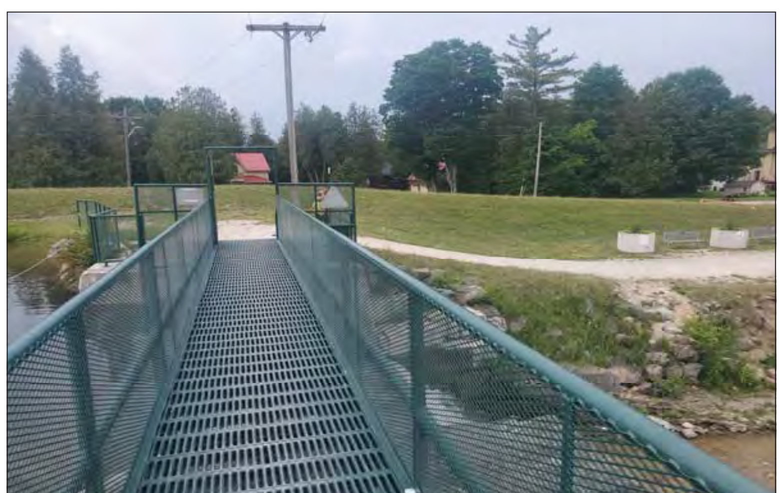
Filename: 20230706_111641.jpg Photo 291 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck



Filename: 20230706_111650.jpg Photo 292 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Downstream South Bank



Filename: 20230706_111656.jpg Photo 293 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Looking Upstream



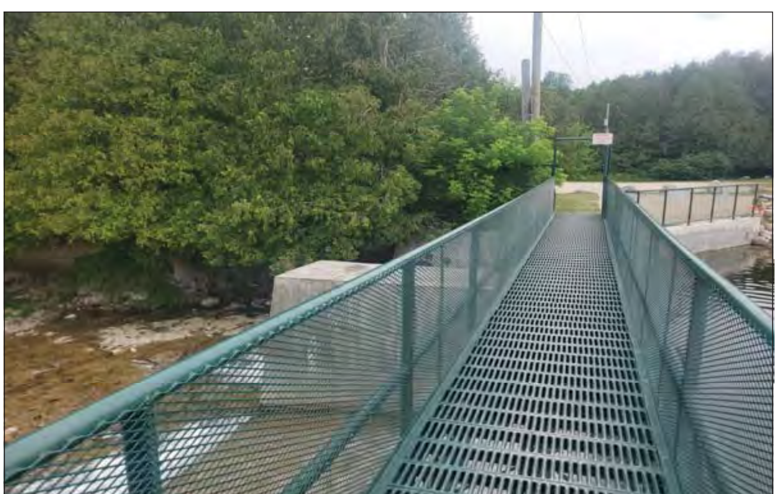
Filename: 20230706_111715.jpg Photo 294 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck and Earth Berm

Filename: 20230706_111719.jpg Photo 295 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream South Bank and Earth Berm

Filename: 20230706_111722.jpg Photo 296 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Looking Upstream

Filename: 20230706_111725.jpg Photo 297 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck

Filename: 20230706_111747.jpg Photo 298 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream Face



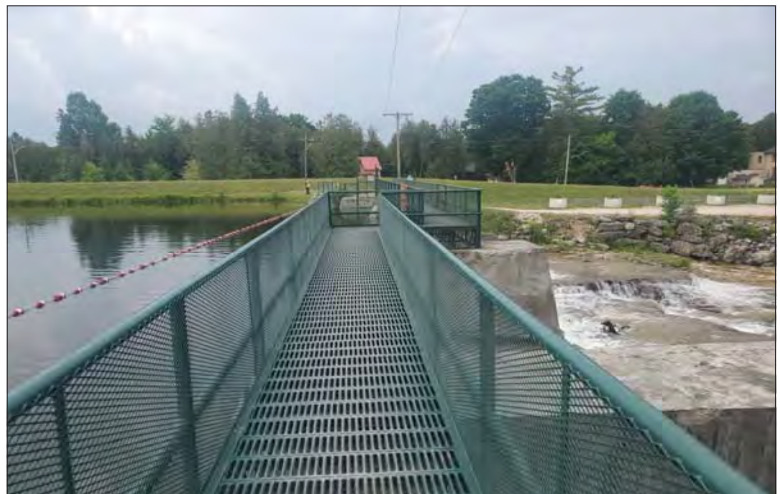
Filename: 20230706_111755.jpg Photo 299 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck Looking North

Filename: 20230706_111805.jpg Photo 300 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream Face of Middle Spillway

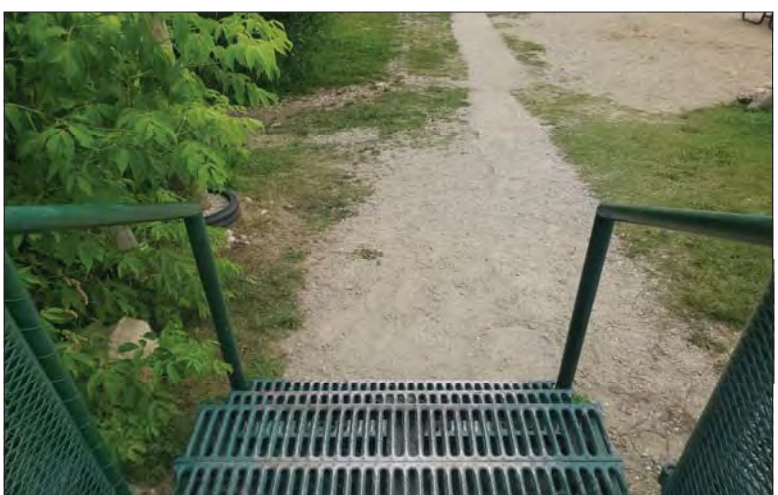
Filename: 20230706_111813.jpg Photo 301 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Downstream Face of North Spillways

Filename: 20230706_111821.jpg Photo 302 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Immediately Downstream

Filename: 20230706_111825.jpg Photo 303 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Immediately Downstream



Filename: 20230706_111850.jpg Photo 304 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck Looking South



Filename: 20230706_111902.jpg Photo 305 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Deck Stairs North Side

Filename: 20230706_111905.jpg Photo 306 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Looking North From Deck

WILLS | Saugeen Conservation

Filename: 20230706_111910.jpg Photo 307 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam Looking Downstream

WILLS | Saugeen Conservation

Filename: 20230706_111922.jpg Photo 308 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam Warning Signs

WILLS | Saugeen Conservation

Filename: 20230706_111925.jpg Photo 309 - October 26, 2023

Durham Creek Flood Plain Mapping

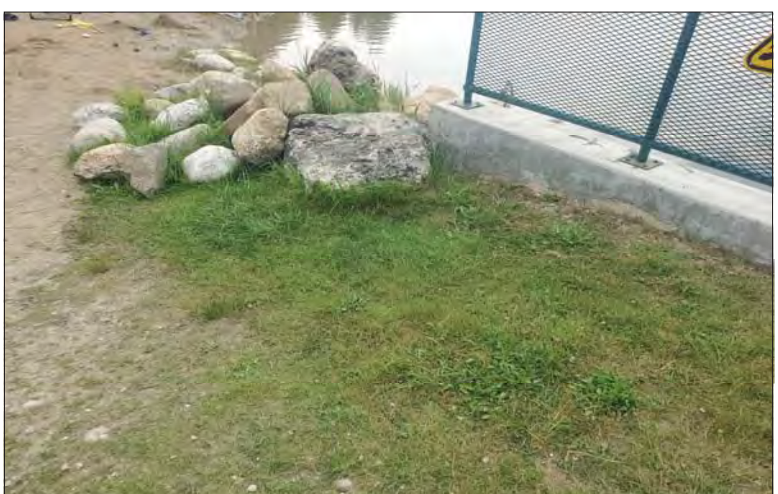
Saugeen River: Upper Durham Dam North End of Deck

WILLS | Saugeen Conservation

Filename: 20230706_111933.jpg Photo 310 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam Warning Signs



WILLS | Saugeen Conservation

Filename: 20230706_111945.jpg Photo 311 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam Upstream Wingwall North Bank

WILLS | Saugeen Conservation

Filename: 20230706_112032.jpg Photo 312 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam View From the North

Filename: 20230706_112105.jpg Photo 313 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Reservoir Swimming Area

Filename: 20230706_112108.jpg Photo 314 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Reservoir Swimming Area

Filename: 20230706_112635.jpg Photo 315 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream North Bank

Filename: 20230706_112844.jpg Photo 316 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam North Bays

Filename: 20230706_112909.jpg Photo 317 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Middle Bays

Filename: 20230706_112917.jpg Photo 318 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam South Bay

Filename: 20230706_112923.jpg Photo 319 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Downstream South Bank

Filename: 20230706_112930.jpg Photo 320 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Downstream South Bank

Filename: 20230706_113117.jpg Photo 321 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream South Bank and Earth Berm

Filename: 20230706_113127.jpg Photo 322 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream Side

Filename: 20230706_113202.jpg Photo 323 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream South Bank and Earth Berm

Filename: 20230706_113206.jpg Photo 324 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam South of Earth Berm

Filename: 20230706_113209.jpg Photo 325 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam South of Earth Berm

Filename: 20230706_113211.jpg Photo 326 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm

Filename: 20230706_113215.jpg Photo 327 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Reservoir and North Bank

Filename: 20230706_113218.jpg Photo 328 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Upstream

Filename: 20230706_113303.jpg Photo 329 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm

Filename: 20230706_113306.jpg Photo 330 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam South of Earth Berm

Filename: 20230706_113309.jpg Photo 331 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam South of Earth Berm

Filename: 20230706_113312.jpg Photo 332 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm

Filename: 20230706_113315.jpg Photo 333 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam View from Earth Berm

Filename: 20230706_113318.jpg Photo 334 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam View from Earth Berm

Filename: 20230706_113355.jpg Photo 335 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earthen Berm Cover Plate

Filename: 20230706_113401.jpg Photo 336 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm Overflow Pipe Inlet

Filename: 20230706_113409.jpg Photo 337 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm Overflow Pipe Outlet

Filename: 20230706_113413.jpg Photo 338 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm Looking West

Filename: 20230706_113503.jpg Photo 339 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm Looking North at Overflow Pipe

Filename: 20230706_113836.jpg Photo 340 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir Looking North

Filename: 20230706_113841.jpg Photo 341 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir Looking South

Filename: 20230706_113930.jpg Photo 342 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir Looking North

Filename: 20230706_113926.jpg Photo 343 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

Filename: 20230706_113948.jpg Photo 344 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

Filename: 20230706_113956.jpg Photo 345 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

Filename: 20230706_114001.jpg Photo 346 - October 26, 2023
Durham Creek Flood Plain Mapping
Welcome to Durham Sign

Filename: 20230706_114006.jpg Photo 347 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

Filename: 20230706_114202.jpg Photo 348 - October 26, 2023
Durham Creek Flood Plain Mapping
Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

WILLS Saugeen Conservation

Filename: 20230706_114205.jpg Photo 349 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

WILLS Saugeen Conservation

Filename: 20230706_114208.jpg Photo 350 - October 26, 2023

Durham Creek Flood Plain Mapping

Saugeen River: Upper Durham Dam Earth Berm South of Reservoir at End of Berm at Grey County Road 4

Appendix B

Hydrology

Appendix B1

Rainfall

Active coordinate

44° 10' 15" N, 80° 33' 45" W (44.170833,-80.562500)

Retrieved: Fri, 08 Sep 2023 18:05:51 GMT

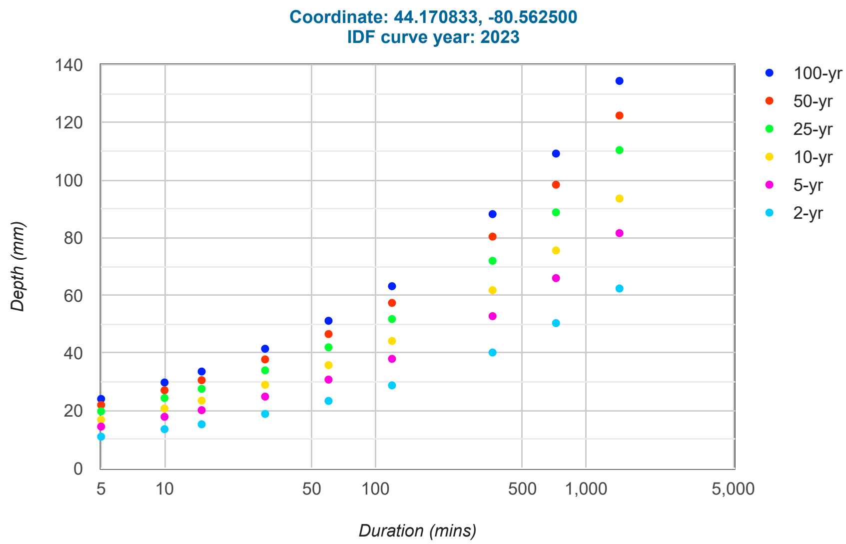
Location summary

These are the locations in the selection.

IDF Curve: 44° 10' 15" N, 80° 33' 45" W (44.170833,-80.562500)

Results

An IDF curve was found.



Coefficient summary

IDF Curve: 44° 10' 15" N, 80° 33' 45" W (44.170833,-80.562500)

Retrieved: Fri, 08 Sep 2023 18:05:51 GMT

Data year: 2010
IDF curve year: 2023

Statistics

Rainfall intensity (mm hr^{-1})

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	131.9	81.4	61.3	37.8	23.4	14.4	6.7	4.2	2.6
5-yr	173.9	107.2	80.8	49.9	30.8	19.0	8.8	5.5	3.4
10-yr	202.3	124.7	94.0	58.0	35.8	22.1	10.3	6.3	3.9
25-yr	237.5	146.4	110.3	68.0	42.0	25.9	12.0	7.4	4.6
50-yr	263.7	162.5	122.5	75.5	46.6	28.7	13.4	8.2	5.1
100-yr	289.8	178.6	134.6	83.0	51.2	31.6	14.7	9.1	5.6

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	11.0	13.6	15.3	18.9	23.4	28.8	40.2	50.4	62.4
5-yr	14.5	17.9	20.2	24.9	30.8	38.0	52.8	66.0	81.6
10-yr	16.9	20.8	23.5	29.0	35.8	44.2	61.8	75.6	93.6
25-yr	19.8	24.4	27.6	34.0	42.0	51.8	72.0	88.8	110.4
50-yr	22.0	27.1	30.6	37.8	46.6	57.4	80.4	98.4	122.4
100-yr	24.1	29.8	33.6	41.5	51.2	63.2	88.2	109.2	134.4

Terms of Use

6 hr SCS Type 2 Distribution for Durham Creek FPM

1

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Data Year (MTO)	2010	**Lat**	44.170833	**Areal Reduction Factor:**	1.0
Climate Year (ECCC)	2051	**Long**	-80.5625	**rcp45_tg_mean_delta7100_**	2.94

Rainfall

	Incremental 6 HR SCS (mm)								
Time (hrs)	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**25-Year CC**	**50-Year CC**	**100-Year CC**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.45	0.59	0.70	0.81	0.90	0.99	0.99	1.10	1.21
0.50	0.46	0.60	0.70	0.82	0.91	1.00	0.99	1.11	1.22
0.75	0.47	0.61	0.72	0.84	0.93	1.02	1.02	1.14	1.25
1.00	0.52	0.68	0.79	0.93	1.03	1.13	1.13	1.26	1.38
1.25	0.58	0.76	0.89	1.04	1.16	1.28	1.27	1.42	1.56
1.50	0.66	0.87	1.02	1.18	1.32	1.45	1.44	1.61	1.77
1.75	0.76	1.00	1.17	1.36	1.52	1.67	1.66	1.86	2.04
2.00	0.89	1.17	1.37	1.60	1.79	1.96	1.95	2.18	2.39
2.25	1.08	1.42	1.66	1.94	2.16	2.37	2.36	2.64	2.89
2.50	1.39	1.83	2.14	2.49	2.79	3.06	3.04	3.40	3.73
2.75	3.36	4.42	5.17	6.02	6.73	7.38	7.35	8.21	9.00
3.00	13.50	17.73	20.75	24.18	27.00	29.61	29.50	32.94	36.13
3.25	6.97	9.15	10.71	12.48	13.93	15.28	15.22	17.00	18.65
3.50	1.98	2.60	3.05	3.55	3.97	4.35	4.33	4.84	5.31
3.75	1.27	1.66	1.95	2.27	2.53	2.78	2.77	3.09	3.39
4.00	1.04	1.36	1.60	1.86	2.08	2.28	2.27	2.53	2.78
4.25	0.86	1.13	1.33	1.54	1.72	1.89	1.88	2.10	2.31
4.50	0.76	1.00	1.17	1.36	1.52	1.67	1.66	1.85	2.03
4.75	0.66	0.87	1.02	1.19	1.32	1.45	1.45	1.62	1.77
5.00	0.59	0.78	0.91	1.06	1.18	1.30	1.29	1.44	1.58
5.25	0.53	0.69	0.81	0.94	1.05	1.16	1.15	1.29	1.41
5.50	0.50	0.66	0.77	0.89	1.00	1.10	1.09	1.22	1.34
5.75	0.47	0.62	0.73	0.85	0.95	1.04	1.03	1.16	1.27
6.00	0.45	0.59	0.69	0.81	0.90	0.99	0.98	1.10	1.20
Total	**40.20**	**52.80**	**61.80**	**72.00**	**80.40**	**88.20**	**87.85**	**98.09**	**107.61**

Hurricane Hazel for Durham Creek FPM

1

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: MC
Date: 14-Dec-23

Data Year	1954	lat	44.20833321	Areal Reduction Factor:	0.766
Climate Chang	2051	long	-80.79166908	rcp45_tg_mean_delta7100_p50:	2.94

Rainfall

Time (hrs)	Hazel (mm)	Hazel (mm) with ARF=1 and Climate Change ΔT=2.94	Hazel (mm) with Areal Reduction Factor =0.766	Hazel (mm) with ARF=0.766 and Climate Change ΔT=2.94
0.00	0.0	0.00	0.00	0.00
1.00	2.0	2.44	1.53	1.87
2.00	2.0	2.44	1.53	1.87
3.00	2.0	2.44	1.53	1.87
4.00	2.0	2.44	1.53	1.87
5.00	2.0	2.44	1.53	1.87
6.00	2.0	2.44	1.53	1.87
7.00	2.0	2.44	1.53	1.87
8.00	2.0	2.44	1.53	1.87
9.00	2.0	2.44	1.53	1.87
10.00	2.0	2.44	1.53	1.87
11.00	2.0	2.44	1.53	1.87
12.00	2.0	2.44	1.53	1.87
13.00	2.0	2.44	1.53	1.87
14.00	2.0	2.44	1.53	1.87
15.00	2.0	2.44	1.53	1.87
16.00	2.0	2.44	1.53	1.87
17.00	2.0	2.44	1.53	1.87
18.00	2.0	2.44	1.53	1.87
19.00	2.0	2.44	1.53	1.87
20.00	2.0	2.44	1.53	1.87
21.00	2.0	2.44	1.53	1.87
22.00	2.0	2.44	1.53	1.87
23.00	2.0	2.44	1.53	1.87
24.00	2.0	2.44	1.53	1.87
25.00	2.0	2.44	1.53	1.87
26.00	2.0	2.44	1.53	1.87
27.00	2.0	2.44	1.53	1.87
28.00	2.0	2.44	1.53	1.87
29.00	2.0	2.44	1.53	1.87
30.00	2.0	2.44	1.53	1.87
31.00	2.0	2.44	1.53	1.87
32.00	2.0	2.44	1.53	1.87
33.00	2.0	2.44	1.53	1.87
34.00	2.0	2.44	1.53	1.87
35.00	2.0	2.44	1.53	1.87
36.00	3.0	3.66	2.30	2.80
37.00	6.0	7.32	4.60	5.61
38.00	4.0	4.88	3.06	3.74
39.00	6.0	7.32	4.60	5.61
40.00	13.0	15.86	9.96	12.15
41.00	17.0	20.74	13.02	15.89
42.00	13.0	15.86	9.96	12.15
43.00	23.0	28.06	17.62	21.50
44.00	13.0	15.86	9.96	12.15
45.00	13.0	15.86	9.96	12.15
46.00	53.0	64.66	40.60	49.53
47.00	38.0	46.36	29.11	35.51
48.00	13.0	15.86	9.96	12.15
Total	**285.0**	**347.7**	**218.3**	**266.4**

Areal Reduction Factors Hazel	
Equivalent Circle Diamter (km^2)	Areal Reduction Factor
0 to 25	100.00
26 to 45	99.20
46 to 65	98.20
66 to 90	97.10
91 to 115	96.30
116 to 140	95.40
141 to 165	94.80
166 to 195	94.20
196 to 220	93.50
221 to 245	92.70
246 to 270	92.00
271 to 450	89.40
451 to 575	86.70
576 to 700	84.00
701 to 850	82.40
851 to 1000	80.80
1001 to 1200	79.30
1201 to 1500	76.60
1501 to 1700	74.40
1701 to 2000	73.30
2001 to 2200	71.70
2201 to 2500	70.20
2501 to 2700	69.00
2701 to 4500	64.40
4501 to 6000	61.40
6001 to 7000	58.90
7001 to 8000	57.40

Appendix B2

Time of Concentration and
HEC-HMS Model Parameter Calculations

Time of Concentration Calculations

1

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_101

				X	Y	
SubBasin_101				18580.13	524.53	
				18470.46	524.47	
		Sheet Flow	**Slope AB**	**0.000547096**		
				18470.46	524.47	
				10917.1	522.16	
		Shallow Concentrated Flow	**Slope BC**	**0.000305823**		
				10917.08	522.16	
				2833	507.12	
		Channel flow	**Slope CD**	**0.001860447**		
				2833	507.12	
				0	493.18	
		Channel flow	**Slope DE**	**0.004920579**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	109.67	0	359.81	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.001	0	0.001	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**8.36**	**#DIV/0!**	**8.36**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	7553.4	0	24781.43	0.00	
9. Watercourse slope, s	s	0.000305823	0	0.000306	0.00	
10. Average velocity, V (figure 3-1)	V	N/A		0.28	0.00	
Unpaved $V = 16.1345S^{0.5}$						
Paved V= $20.3282S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			24.40	#DIV/0!	**24.40**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	6.16	83.16	66.31	895.08	
13. Wetted perimeter, pw	p_w	12.25	54.69	40.19	179.44	
14. Hydraulic radius, r= Compute r	r			1.65	4.99	
15 Channel slope, s	s			0.002	0.005	
16. Manning's roughness coefficient, n	n	0.035	0.035	0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			2.56	8.72	
18. Flow length, L	L	8084.08	2833	26522.57	9294.62	
19 $T_t = \frac{L}{3600V}$	T_channel			2.87	0.30	**3.17**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**35.92**
					Tc (mins)	**2155.38**

Time of Concentration Calculations

2

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_102

				X	Y	
SubBasin_102				9973.49	539.13	
				9874.21	538.1	
		Sheet Flow	**Slope AB**	**0.010374698**		
				9874.21	538.1	
				5625.4	520.7	
		Shallow Concentrated Flow	**Slope BC**	**0.004095264**		
				5625.4	520.7	
				2180.5	497.74	
		Channel flow	**Slope CD**	**0.006664925**		
				2180.5	497.74	
				0	493.06	
		Channel flow	**Slope DE**	**0.002146297**		
		Sheet Flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.170	0	0.170	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.28	0	325.72	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.40	0	2.457	0.00	
5. Land slope, s	Land Slope	0.0104	0	0.0104	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.69**	**#DIV/0!**	**0.69**
		Shallow Concentrated Flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	4248.8	0	13939.67	0.00	
9. Watercourse slope, s	s	0.0041	0	0.004	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V= 20.3282S^{0.5}$	V	N/A		1.03	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			3.75	#DIV/0!	**3.75**
		Channel flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.23	3.44	13.25	37.03	
13. Wetted perimeter, pw	p_w	10.27	7.06	33.70	23.17	
14. Hydraulic radius, r= Compute r	r			0.39	1.60	
15 Channel slope, s	s			0.0067	0.0021	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			1.87	2.70	
18. Flow length, L	L	3444.9	2180.5	11302.17	7153.87	
19 $T_t = \frac{L}{3600V}$	T_channel			1.68	0.74	**2.42**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**6.86**
					Tc (mins)	**411.54**

Time of Concentration Calculations

3

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_103

				X	Y	
SubBasin_103				14717.92	530.7	
				14612.87	529.45	
		Sheet Flow	**Slope AB**	**0.011899096**		
				14612.87	529.45	
				8350.7	507.23	
		Shallow Concentrated Flow	**Slope BC**	**0.003548262**		
				8350.65	507.23	
				0	492.03	
		Channel flow	**Slope CD**	**0.001820218**		
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	105.05	0	344.65	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.0119	0	0.0119	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.68**	**#DIV/0!**	**0.68**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	6262.2	0	20545.34	0.00	
9. Watercourse slope, s	s	0.0035	0.0000	0.004	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		0.96	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			5.94	#DIV/0!	**5.94**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	11.94	0.00	128.53	0.00	
13. Wetted perimeter, pw	p_w	11.91	0.00	39.07	0.00	
14. Hydraulic radius, r= Compute r	r			3.29	#DIV/0!	
15 Channel slope, s	s			0.002	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			4.02	#DIV/0!	
18. Flow length, L	L	8350.65	0	27397.15	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			1.89	#DIV/0!	**1.89**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**8.51**
					Tc (mins)	**510.89**

Time of Concentration Calculations

4

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_104

				X	Y	
SubBasin_104				3451.69	507.86	
				3350.42	499.52	
		Sheet Flow	**Slope AB**	**0.082354103**		
				3350.42	499.52	
				3250.6	496.6	
		Shallow Concentrated Flow	**Slope BC**	**0.029246795**		
				3250.58	496.6	
				1612.24	493.05	
		Shallow Concentrated Flow	**Slope CD**	**0.002166827**		
				1612.24	493.05	
				0	491.71	
		Channel flow	**Slope DE**	**0.000831142**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	101.27	0	332.25	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.082	0	0.08	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**1.06**	**#DIV/0!**	**1.06**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	99.8	1638.34	327.56	5375.13	
9. Watercourse slope, s	s	0.0292	0.0022	0.029	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		2.76	0.95	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.03	1.58	**1.61**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	2.60	0.00	28.03	0.00	
13. Wetted perimeter, pw	p_w	16.81	0.00	55.16	0.00	
14. Hydraulic radius, r= Compute r	r			0.51	#DIV/0!	
15 Channel slope, s	s			0.001	0.001	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.78	#DIV/0!	
18. Flow length, L	L	1612.24	0	5289.50	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			1.88	#DIV/0!	**1.88**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**4.55**
					Tc (mins)	**272.75**

Time of Concentration Calculations

5

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_105

				X	Y	
SubBasin_105				11064.03	516.89	
				10959.18	513.12	
		Sheet Flow	**Slope AB**	**0.035956128**		
				10959.18	513.12	
				6165.9	494.64	
		Shallow Concentrated Flow	**Slope BC**	**0.003855398**		
				6165.9	494.64	
				2750	480.66	
		Channel flow	**Slope CD**	**0.004092626**		
				2750	480.66	
				0	478.15	
		Channel flow	**Slope DE**	**0.000912727**		
		Sheet Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	104.85	0	344.00	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.036	0	0.04	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.44**	**#DIV/0!**	**0.44**
		Shallow Concentrated Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	4793.3	0	15725.98	0.00	
9. Watercourse slope, s	s	0.003855398	0	0.004	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.00	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			4.36	#DIV/0!	**4.36**
		Channel flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	4.48	5.43	48.19	58.40	
13. Wetted perimeter, pw	p_w	10.79	11.14	35.41	36.54	
14. Hydraulic radius, r= Compute r	r			1.36	1.60	
15 Channel slope, s	s			0.004	0.001	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			3.34	1.76	
18. Flow length, L	L	3415.9	2750	11207.02	9022.31	
19 $T_t = \frac{L}{3600V}$	T_channel			0.93	1.43	**2.36**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**7.15**
					Tc (mins)	**429.26**

Time of Concentration Calculations	6

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_106

				X	Y	
SubBasin_106				11730.82	520.34	
				11646.32	518.93	
		Sheet Flow	**Slope AB**	**0.016686391**		
				11646.32	518.93	
				4978.0	495.55	
		Shallow Concentrated Flow	**Slope BC**	**0.003506146**		
				4978.03	495.55	
				0	478.18	
		Channel flow	**Slope CD**	**0.003489332**		
				0	478.18	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	84.5	0	277.23	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.017	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.50**	**#DIV/0!**	**0.50**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	6668.3	0	21877.59	0.00	
9. Watercourse slope, s	s	0.003506146	0	0.004	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved V= $20.3282S^{0.5}$	V	N/A		0.96	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			6.36	#DIV/0!	**6.36**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.04	0.00	11.18	0.00	
13. Wetted perimeter, pw	p_w	9.90	0.00	32.48	0.00	
14. Hydraulic radius, r= Compute r	r			0.34	#DIV/0!	
15 Channel slope, s	s			0.003	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			1.24	#DIV/0!	
18. Flow length, L	L	4978.03	0	16332.12	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			3.67	#DIV/0!	**3.67**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**10.54**
					Tc (mins)	**632.11**

Time of Concentration Calculations

7

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_107

				X	Y	
SubBasin_107				13754.54	504.23	
				13645.04	500.67	
		Sheet Flow	**Slope AB**	**0.032511416**		
				13645.04	500.67	
				11107.2	491.65	
		Shallow Concentrated Flow	**Slope BC**	**0.00355419**		
				11107.19	491.65	
				0	472.71	
		Channel flow	**Slope CD**	**0.001705202**		
				0	472.71	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	109.5	0	359.25	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.033	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**1.63**	**#DIV/0!**	**1.63**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	2537.9	0	8326.28	0.00	
9. Watercourse slope, s	s	0.00355419	0	0.004	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		0.96	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			2.40	#DIV/0!	**2.40**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	29.97	0.00	322.62	0.00	
13. Wetted perimeter, pw	p_w	45.83	0.00	150.38	0.00	
14. Hydraulic radius, r= Compute r	r			2.15	#DIV/0!	
15 Channel slope, s	s			0.002	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.92	#DIV/0!	
18. Flow length, L	L	11107.19	0	36440.91	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			3.46	#DIV/0!	**3.46**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**7.49**
					Tc (mins)	**449.70**

Time of Concentration Calculations

8

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_108

				X	Y	
SubBasin_108				5667.38	494.04	
				5567.21	491.5	
		Sheet Flow	**Slope AB**	**0.025356893**		
				5567.21	491.5	
				3153.1	478.23	
		Shallow Concentrated Flow	**Slope BC**	**0.00549685**		
				3153.1	478.23	
				0	472.69	
		Channel flow	**Slope CD**	**0.001757001**		
				0	472.69	
		N/A	**Slope DE**	**#DIV/0!**		
		Sheet Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.17	0	328.64	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.025	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.49**	**#DIV/0!**	**0.49**
		Shallow Concentrated Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	2414.1	0	7920.31	0.00	
9. Watercourse slope, s	s	0.00549685	0	0.005	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.20	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			1.84	#DIV/0!	**1.84**
		Channel flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	38.00	0.00	409.07	0.00	
13. Wetted perimeter, pw	p_w	26.93	0.00	88.35	0.00	
14. Hydraulic radius, r= Compute r	r			4.63	#DIV/0!	
15 Channel slope, s	s			0.002	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			4.96	#DIV/0!	
18. Flow length, L	L	3153.1	0	10344.82	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.58	#DIV/0!	**0.58**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**2.90**
					Tc (mins)	**174.25**

Time of Concentration Calculations

9

Project No:	5591
Project Name:	Durham Creek FPM
Designed/Checked By:	JTF/MC
Date:	12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_109

				X	Y	
SubBasin_109				7868.75	486.97	
				7768.76	484.45	
		Sheet Flow	**Slope AB**	**0.02520252**		
				7768.76	484.45	
				7594.4	479.57	
		Shallow Concent	**Slope BC**	**0.027988071**		
				7594.4	479.57	
				4431.66	474.87	
		Shallow Concent	**Slope CD**	**0.001486053**		
				4431.66	474.87	
				0	469.85	
		Channel flow	**Slope DE**	**0.001132758**		
		Sheet Flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.99	0	328.05	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.025	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**1.68**	**#DIV/0!**	**1.68**
		Shallow Concentrated Flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	174.4	3162.74	572.05	10376.44	
9. Watercourse slope, s	s	0.027988071	0.001486053	0.028	0.00	
10. Average velocity, V (figure 3-1)	V	N/A		2.70	0.78	
Unpaved $V = 16.1345 S^{0.5}$						
Paved $V = 20.3282 S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			0.06	3.68	**3.74**
		Channel flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	3.49	0.00	37.57	0.00	
13. Wetted perimeter, pw	p_w	26.86	0.00	88.11	0.00	
14. Hydraulic radius, r= Compute r	r			0.43	#DIV/0!	
15 Channel slope, s	s			0.001	0.001	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.81	#DIV/0!	
18. Flow length, L	L	4431.66	0	14539.57	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			4.98	#DIV/0!	**4.98**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**10.39**
					Tc (mins)	**623.38**

Time of Concentration Calculations

10

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_110

				X	Y	
SubBasin_110				11593.2	505.09	
				11493.96	500.22	
		Sheet Flow	**Slope AB**	**0.049072954**		
				11493.96	500.22	
				7933.2	479.95	
		Shallow Concentrated Flow	**Slope BC**	**0.005692541**		
				7933.16	479.95	
				6272.96	472.34	
		Channel flow	**Slope CD**	**0.004583785**		
				6272.96	472.34	
				0	469.6	
		Channel flow	**Slope DE**	**0.000436795**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.24	0	325.59	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.049	0	0.05	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.37**	**#DIV/0!**	**0.37**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	3560.8	0	11682.41	0.00	
9. Watercourse slope, s	s	0.005692541	0	0.006	0.00	
10. Average velocity, V (figure 3-1)	V	N/A		1.22	0.00	
Unpaved $V = 16.1345S^{0.5}$						
Paved $V = 20.3282S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			2.67	#DIV/0!	**2.67**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.03	25.95	11.04	279.32	
13. Wetted perimeter, pw	p_w	9.33	34.73	30.61	113.94	
14. Hydraulic radius, r= Compute r	r			0.36	2.45	
15 Channel slope, s	s			0.005	0.000	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			1.46	1.62	
18. Flow length, L	L	1660.2	6272.96	5446.85	20580.58	
19 $T_t = \frac{L}{3600V}$	T_channel			1.04	3.53	**4.57**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**7.61**
					Tc (mins)	**456.37**

Time of Concentration Calculations	11

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_111

				X	Y	
SubBasin_111				14002.32	501.06	
				13898.72	499.08	
		Sheet Flow	**Slope AB**	**0.019111969**		
				13898.72	499.08	
				12652.5	491.96	
		Shallow Concentrated Flow	**Slope BC**	**0.005713277**		
				12652.5	491.96	
				3886.36	476.02	
		Shallow Concentrated Flow	**Slope CD**	**0.00181836**		
				3886.36	476.02	
				0	468.53	
		Channel flow	**Slope DE**	**0.001927253**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	103.6	0	339.90	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.019	0	0.02	0.00	
$T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.56**	**#DIV/0!**	**0.56**
6						
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1246.2	8766.14	4088.65	28760.30	
9. Watercourse slope, s	s	0.005713277	0.00181836	0.006	0.002	
10. Average velocity, V (figure 3-1)	V	N/A		1.22	0.688	
Unpaved $V = 16.1345S^{0.5}$						
Paved V= $20.3282S^{0.5}$						
$T_t = \frac{L}{3600V}$	T_shallow			0.93	11.61	**12.54**
11						
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.03	0.00	11.04	0.00	
13. Wetted perimeter, pw	p_w	9.33	0.00	30.61	0.00	
14. Hydraulic radius, r= Compute r	r			0.36	#DIV/0!	
15 Channel slope, s	s			0.002	0.002	
16. Manning's roughness coefficient, n	n			0.035	0.035	
$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.95	#DIV/0!	
17						
18. Flow length, L	L	3886.36		12750.52	0.00	
$T_t = \frac{L}{3600V}$	T_channel			3.74	#DIV/0!	**3.74**
19						
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**16.84**
					Tc (mins)	**1010.56**

Time of Concentration Calculations

12

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_112

				X	Y	
SubBasin_112				8104.34	485.88	
				8003.48	483.47	
		Sheet Flow	**Slope AB**	**0.023894507**		
				8003.48	483.47	
				7630.3	474.39	
		Shallow Concentrated Flow	**Slope BC**	**0.02433077**		
				7630.29	474.39	
				4445.14	470.07	
		Shallow Concentrated Flow	**Slope CD**	**0.001356294**		
				4445.14	470.07	
				0	468.53	
		Channel flow	**Slope DE**	**0.000346446**		
		Sheet Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.86	0	330.91	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.024	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.50**	**#DIV/0!**	**0.50**
		Shallow Concentrated Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	373.2	3185.15	1224.38	10449.97	
9. Watercourse slope, s	s	0.02433077	0.001356294	0.024	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		2.52	0.59	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.14	4.89	**5.02**
		Channel flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.03	0.00	11.04	0.00	
13. Wetted perimeter, pw	p_w	9.33	0.00	30.61	0.00	
14. Hydraulic radius, r= Compute r	r			0.36	#DIV/0!	
15 Channel slope, s	s			0.000	0.000	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.40	#DIV/0!	
18. Flow length, L	L	4445.14		14583.79	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			10.09	#DIV/0!	**10.09**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**15.61**
					Tc (mins)	**936.80**

Time of Concentration Calculations

13

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_113

				X	Y	
SubBasin_113				6550.01	494.52	
				6450.85	490.65	
		Sheet Flow	**Slope AB**	**0.039027834**		
				6450.85	490.65	
				1452.3	473.2	
		Shallow Concentrated Flow	**Slope BC**	**0.003491012**		
				1452.3	473.2	
				0	467.42	
		Channel flow	**Slope CD**	**0.003979894**		
				0	467.42	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.16	0	325.33	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.039	0	0.04	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**1.40**	**#DIV/0!**	**1.40**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	4998.6	0	16399.44	0.00	
9. Watercourse slope, s	s	0.003491012	0	0.003	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		0.95	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			4.78	#DIV/0!	**4.78**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	4.22	0.00	45.43	0.00	
13. Wetted perimeter, pw	p_w	12.67	0.00	41.57	0.00	
14. Hydraulic radius, r= Compute r	r			1.09	#DIV/0!	
15 Channel slope, s	s			0.004	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.85	#DIV/0!	
18. Flow length, L	L	1452.3		4764.76	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.46	#DIV/0!	**0.46**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**6.64**
					Tc (mins)	**398.50**

Time of Concentration Calculations	14

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_114

				X	Y	
SubBasin_114				7766.77	492.84	
				7666.68	491.36	
		Sheet Flow	**Slope AB**	**0.014786692**		
				7666.68	491.36	
				5974.7	477.56	
		Shallow Concentrated Flow	**Slope BC**	**0.008155932**		
				5974.66	477.56	
				0	467.31	
		Channel flow	**Slope CD**	**0.001715579**		
				0	467.31	
		N/A	**Slope DE**	**#DIV/0!**		
		Sheet Flow				
	Segment I	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.09	0	328.38	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.015	0	0.01	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**2.08**	**#DIV/0!**	**2.08**
		Shallow Concentrated Flow				
	Segment I	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	1692.0	0	5551.25	0.00	
9. Watercourse slope, s	s	0.008155932	0	0.008	0.00	
10. Average velocity, V (figure 3-1)	V	N/A		1.46	0.00	
Unpaved $V = 16.1345 S^{0.5}$ Paved $V = 20.3282 S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			1.06	#DIV/0!	**1.06**
		Channel flow				
	Segment I	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.09	0.00	11.74	0.00	
13. Wetted perimeter, pw	p_w	8.41	0.00	27.58	0.00	
14. Hydraulic radius, r= Compute r	r			0.43	#DIV/0!	
15 Channel slope, s	s			0.002	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			1.00	#DIV/0!	
18. Flow length, L	L	5974.66		19601.90	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			5.46	#DIV/0!	**5.46**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**8.59**
					Tc (mins)	**515.56**

Time of Concentration Calculations	15

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_115

				X	Y	
SubBasin_115				3274.56	490.71	
				3174.4	487.52	
		Sheet Flow	**Slope AB**	**0.031849042**		
				3174.4	487.52	
				343.8	467.29	
		Shallow Concentrated Flow	**Slope BC**	**0.007146819**		
				343.77	467.29	
				0	467.28	
		Channel flow	**Slope CD**	**2.90892E-05**		
				0	467.28	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.16	0	328.61	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.032	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.44**	**#DIV/0!**	**0.44**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	2830.6	0	9286.84	0.00	
9. Watercourse slope, s	s	0.007146819	0	0.007	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.36	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			1.89	#DIV/0!	**1.89**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	14.45	0.00	155.56	0.00	
13. Wetted perimeter, pw	p_w	29.53	0.00	96.89	0.00	
14. Hydraulic radius, r= Compute r	r			1.61	#DIV/0!	
15 Channel slope, s	s			0.000	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.31	#DIV/0!	
18. Flow length, L	L	343.77		1127.85	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			1.00	#DIV/0!	**1.00**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**3.33**
					Tc (mins)	**199.77**

Time of Concentration Calculations	16

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_116

				X	Y	
SubBasin_116				3227.34	489.66	
				3127.13	486.87	
		Sheet Flow	**Slope AB**	**0.027841533**		
				3127.13	486.87	
				436.5	469.87	
		Shallow Concentrated Flow	**Slope BC**	**0.006318223**		
				436.5	469.87	
				0	466.51	
		Channel flow	**Slope CD**	**0.007697595**		
				0	466.51	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.21	0	328.77	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.028	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.47**	**#DIV/0!**	**0.47**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	2690.6	0	8827.53	0.00	
9. Watercourse slope, s	s	0.006318223	0	0.006	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V= 20.3282S^{0.5}$	V	N/A		1.28	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			1.91	#DIV/0!	**1.91**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	0.00	0.00	0.00	0.00	
13. Wetted perimeter, pw	p_w	0.00	0.00	0.00	0.00	
14. Hydraulic radius, r= Compute r	r			#DIV/0!	#DIV/0!	
15 Channel slope, s	s			0.008	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			#DIV/0!	#DIV/0!	
18. Flow length, L	L	436.5		1432.09	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			#DIV/0!	#DIV/0!	**0.00**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**2.38**
					Tc (mins)	**142.78**

Time of Concentration Calculations

17

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_117

				X	Y	
SubBasin_117				10892.38	492.75	
				10792.02	490.57	
		Sheet Flow	**Slope AB**	**0.021721802**		
				10792.02	490.57	
				9538.7	483.18	
		Shallow Concentrated Flow	**Slope BC**	**0.005896339**		
				9538.7	483.18	
				1219.93	459.2	
		Shallow Concentrated Flow	**Slope CD**	**0.002882638**		
				1219.93	459.2	
				0	456.48	
		Channel flow	**Slope DE**	**0.002229636**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.36	0	329.27	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.022	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.52**	**#DIV/0!**	**0.52**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	1253.3	8318.77	4111.94	27292.55	
9. Watercourse slope, s	s	0.005896339	0.002882638	0.006	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.24	1.09	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.92	6.95	**7.87**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	4.17	0.00	44.88	0.00	
13. Wetted perimeter, pw	p_w	20.36	0.00	66.79	0.00	
14. Hydraulic radius, r= Compute r	r			0.67	#DIV/0!	
15 Channel slope, s	s			0.002	0.002	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			1.54	#DIV/0!	
18. Flow length, L	L	1219.93		4002.40	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.72	#DIV/0!	**0.72**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**9.11**
					Tc (mins)	**546.37**

Time of Concentration Calculations	18

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_118

				X	Y	
SubBasin_118				9267.13	491.28	
				9167.52	490.05	
		Sheet Flow	**Slope AB**	**0.012348158**		
				9167.52	490.05	
				7302.5	466.07	
		Shallow Concentrated Flow	**Slope BC**	**0.012857978**		
				7302.53	466.07	
				0	456.49	
		Channel flow	**Slope CD**	**0.001311874**		
				0	456.49	
		N/A	**Slope DE**	**#DIV/0!**		
			Sheet Flow			
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.61	0	326.80	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.012	0	0.01	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.64**	**#DIV/0!**	**0.64**
			Shallow Concentrated Flow			
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	1865.0	0	6118.73	0.00	
9. Watercourse slope, s	s	0.012857978	0	0.013	0.00	
10. Average velocity, V (figure 3-1)	V	N/A		1.83	0.00	
Unpaved $V = 16.1345S^{0.5}$ Paved V= $20.3282S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			0.93	#DIV/0!	**0.93**
			Channel flow			
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	46.24	0.00	497.69	0.00	
13. Wetted perimeter, pw	p_w	40.24	0.00	132.03	0.00	
14. Hydraulic radius, r= Compute r	r			3.77	#DIV/0!	
15 Channel slope, s	s			0.001	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			3.73	#DIV/0!	
18. Flow length, L	L	7302.53		23958.43	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			1.78	#DIV/0!	**1.78**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**3.36**
					Tc (mins)	**201.32**

Time of Concentration Calculations

19

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_119

				X	Y	
SubBasin_119				4587.17	489.45	
				4487.78	487.04	
		Sheet Flow	**Slope AB**	**0.024247912**		
				4487.78	487.04	
				2101.6	466.2	
		Shallow Concentrated Flow	**Slope BC**	**0.008733588**		
				2101.59	466.2	
				1133.44	454.8	
		Channel flow	**Slope CD**	**0.011775035**		
				1133.44	454.8	
				0	451.78	
		Channel flow	**Slope DE**	**0.002664455**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.39	0	326.08	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.024	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$	T_sheet			**0.49**	**#DIV/0!**	**0.49**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	2386.2	0	7828.71	0.00	
9. Watercourse slope, s	s	0.008733588	0	0.009	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.51	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			1.44	#DIV/0!	**1.44**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	32.32	254.94	347.88	2744.17	
13. Wetted perimeter, pw	p_w	34.41	125.66	112.89	412.27	
14. Hydraulic radius, r= Compute r	r			3.08	6.66	
15 Channel slope, s	s			0.012	0.003	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			9.78	7.78	
18. Flow length, L	L	968.15	1133.44	3176.35	3718.64	
19 $T_t = \frac{L}{3600V}$	T_channel			0.09	0.13	**0.22**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**2.16**
					Tc (mins)	**129.38**

Time of Concentration Calculations

20

Project No:	5591
Project Name:	Durham Creek FPM
Designed/Checked By:	JTF/MC
Date:	12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_120

				X	Y	
SubBasin_120				6026.88	480.27	
				5926.75	477.95	
		Sheet Flow	**Slope AB**	**0.023169879**		
				5926.75	477.95	
				4492.3	473.31	
		Shallow Concentrated Flow	**Slope BC**	**0.003234779**		
				4492.34	473.31	
				0	456.48	
		Channel flow	**Slope CD**	**0.003746377**		
				0	456.48	
		N/A	**Slope DE**	**#DIV/0!**		
		Sheet Flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.13	0	328.51	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.023	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.50**	**#DIV/0!**	**0.50**
		Shallow Concentrated Flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	1434.4	0	4706.07	0.00	
9. Watercourse slope, s	s	0.003234779	0	0.003	0.00	
10. Average velocity, V (figure 3-1)	V	N/A		0.92	0.00	
Unpaved $V = 16.1345S^{0.5}$						
Paved V= $20.3282S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			1.42	#DIV/0!	**1.42**
		Channel flow				
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	32.32	0.00	347.88	0.00	
13. Wetted perimeter, pw	p_w	34.41	0.00	112.89	0.00	
14. Hydraulic radius, r= Compute r	r			3.08	#DIV/0!	
15 Channel slope, s	s			0.004	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			5.52	#DIV/0!	
18. Flow length, L	L	4492.34	0	14738.65	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.74	#DIV/0!	**0.74**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**2.67**
					Tc (mins)	**160.17**

Time of Concentration Calculations

21

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_121

				X	Y	
SubBasin_121				10892.38	492.75	
				10792.42	490.57	
		Sheet Flow	**Slope AB**	**0.021808723**		
				10792.42	490.57	
				7150.2	479.76	
		Shallow Concentrated Flow	**Slope BC**	**0.002968003**		
				7150.24	479.76	
				2686.89	463.08	
		Shallow Concentrated Flow	**Slope CD**	**0.003737103**		
				2686.89	463.08	
				0	456.5	
		Channel flow	**Slope DE**	**0.002448928**		
			Sheet Flow			
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.96	0	327.95	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.022	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.51**	**#DIV/0!**	**0.51**
			Shallow Concentrated Flow			
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	3642.2	4463.35	11949.41	14643.54	
9. Watercourse slope, s	s	0.002968003	0.003737103	0.003	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		0.88	1.24	
11 $T_t = \frac{L}{3600V}$	T_shallow			3.78	3.27	**7.05**
			Channel flow			
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	27.98	0.00	301.19	0.00	
13. Wetted perimeter, pw	p_w	30.48	0.00	99.99	0.00	
14. Hydraulic radius, r= Compute r	r			3.01	#DIV/0!	
15 Channel slope, s	s			0.002	0.002	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			4.39	#DIV/0!	
18. Flow length, L	L	2686.89	2686.89	8815.26	8815.26	
19 $T_t = \frac{L}{3600V}$	T_channel			0.56	#DIV/0!	**0.56**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**8.12**
					Tc (mins)	**487.28**

Time of Concentration Calculations

22

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_122

				X	Y	
SubBasin_122				4557.55	474.31	
				4450.35	473.68	
		Sheet Flow	**Slope AB**	**0.005876866**		
				4450.35	473.68	
				1926.4	458.76	
		Shallow Concentrated Flow	**Slope BC**	**0.005911393**		
				1926.41	458.76	
				207.53	443.13	
		Shallow Concentrated Flow	**Slope CD**	**0.00909313**		
				207.53	443.13	
				0	443.06	
		Channel flow	**Slope DE**	**0.000337301**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	107.2	0	351.71	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.006	0	0.01	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.92**	**#DIV/0!**	**0.92**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	2523.9	1718.88	8280.64	5639.37	
9. Watercourse slope, s	s	0.005911393	0.00909313	0.006	0.01	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.24	1.94	
11 $T_t = \frac{L}{3600V}$	T_shallow			1.85	0.81	**2.66**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1150.01	0.00	12378.62	0.00	
13. Wetted perimeter, pw	p_w	207.41	0.00	680.48	0.00	
14. Hydraulic radius, r= Compute r	r			18.19	#DIV/0!	
15 Channel slope, s	s			0.000	0.000	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			5.41	#DIV/0!	
18. Flow length, L	L	207.53	0	680.87	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.03	#DIV/0!	**0.03**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**3.62**
					Tc (mins)	**217.01**

Time of Concentration Calculations

23

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_123

				X	Y	
SubBasin_123				12398.15	466.08	
				12294.51	464.15	
		Sheet Flow	**Slope AB**	**0.018622154**		
				12294.51	464.15	
				10666.5	442.32	
		Shallow Concentrated Flow	**Slope BC**	**0.013408844**		
				10666.48	442.32	
				0	392.52	
		Channel flow	**Slope CD**	**0.004668832**		
				0	392.52	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	103.64	0	340.03	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.019	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**1.95**	**#DIV/0!**	**1.95**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	1628.0	0	5341.31	0.00	
9. Watercourse slope, s	s	0.013408844	0	0.013	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved V= $20.3282S^{0.5}$	V	N/A		1.87	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.79	#DIV/0!	**0.79**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	942.14	0.00	10141.12	0.00	
13. Wetted perimeter, pw	p_w	168.58	0.00	553.09	0.00	
14. Hydraulic radius, r= Compute r	r			18.34	#DIV/0!	
15 Channel slope, s	s			0.005	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49r^{\frac{2}{3}}s^{\frac{1}{2}}}{n}$	V			20.23	#DIV/0!	
18. Flow length, L	L	10666.48	0	34995.01	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.48	#DIV/0!	**0.48**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**3.22**
					Tc (mins)	**193.37**

Time of Concentration Calculations

24

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_124

				X	Y	
SubBasin_124				7728.3	467.94	
				7628.56	466.95	
		Sheet Flow	**Slope AB**	**0.009925807**		
				7628.56	466.95	
				814.3	397.95	
		Shallow Concentrated Flow	**Slope BC**	**0.010125884**		
				814.34	397.95	
				0	392.36	
		Channel flow	**Slope CD**	**0.006864455**		
				0	392.36	
		N/A	**Slope DE**	**#DIV/0!**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	99.74	0	327.23	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.010	0	0.01	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.70**	**#DIV/0!**	**0.70**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	6814.2	0	22356.36	0.00	
9. Watercourse slope, s	s	0.010125884	0	0.010	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.62	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			3.82	#DIV/0!	**3.82**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	2.50	0.00	26.92	0.00	
13. Wetted perimeter, pw	p_w	13.54	0.00	44.42	0.00	
14. Hydraulic radius, r= Compute r	r			0.61	#DIV/0!	
15 Channel slope, s	s			0.007	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.53	#DIV/0!	
18. Flow length, L	L	814.34	0	2671.72	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.29	#DIV/0!	**0.29**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**4.82**
					Tc (mins)	**289.35**

Time of Concentration Calculations

25

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_125

				X	Y	
SubBasin_125				8021.68	442.7	
				7920.91	431.95	
		Sheet Flow	**Slope AB**	**0.106678575**		
				7920.91	431.95	
				4183.9	391.97	
		Shallow Concentrated Flow	**Slope BC**	**0.010698249**		
				4183.85	391.97	
				3520.44	388.3	
		Channel flow	**Slope CD**	**0.005532024**		
				3520.44	388.3	
				0	374.04	
		Channel flow	**Slope DE**	**0.00405063**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.77	0	330.61	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.107	0	0.11	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.95**	**#DIV/0!**	**0.95**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	3737.1	0	12260.70	0.00	
9. Watercourse slope, s	s	0.010698249	0	0.011	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved V= $20.3282S^{0.5}$	V	N/A		1.67	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			2.04	#DIV/0!	**2.04**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	6.23	29.61	67.05	318.69	
13. Wetted perimeter, pw	p_w	13.81	31.60	45.31	103.66	
14. Hydraulic radius, r= Compute r	r			1.48	3.07	
15 Channel slope, s	s			0.006	0.004	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			4.11	5.73	
18. Flow length, L	L	663.41	3520.44	2176.54	11550.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.15	0.56	**0.71**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**3.70**
					Tc (mins)	**221.73**

Time of Concentration Calculations

26

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_126

				X	Y	
SubBasin_126				7003.33	416.95	
				6902.18	412.33	
		Sheet Flow	**Slope AB**	**0.04567474**		
				6902.18	412.33	
				6640.2	398.3	
		Shallow Concentrated Flow	**Slope BC**	**0.053551662**		
				6640.19	398.3	
				3142.74	385.93	
		Shallow Concentrated Flow	**Slope CD**	**0.003536863**		
				3142.74	385.93	
				0	373.98	
		Channel flow	**Slope DE**	**0.003802414**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	101.15	0	331.86	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.046	0	0.05	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.39**	**#DIV/0!**	**0.39**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	N/A	Unpaved	N/A	
8. Flow length, L	L	262.0	3497.45	859.55	11474.57	
9. Watercourse slope, s	s	0.053551662	0.003536863	0.054	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		3.73	1.21	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.06	2.64	**2.70**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	3.94	0.00	42.42	0.00	
13. Wetted perimeter, pw	p_w	13.41	0.00	44.00	0.00	
14. Hydraulic radius, r= Compute r	r			0.96	#DIV/0!	
15 Channel slope, s	s			0.004	0.004	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.56	#DIV/0!	
18. Flow length, L	L	3142.74	0	10310.83	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			1.12	#DIV/0!	**1.12**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**4.20**
					Tc (mins)	**252.30**

Time of Concentration Calculations	27

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_127

				X	Y	
SubBasin_127				7287.21	401.09	
				7186.08	399.81	
		Sheet Flow	**Slope AB**	**0.012656976**		
				7186.08	399.81	
				6037.9	378.25	
		Shallow Concentrated Flow	**Slope BC**	**0.018777217**		
				6037.88	378.25	
				4357.78	370	
		Shallow Concentrated Flow	**Slope CD**	**0.004910422**		
				4357.78	370	
				0	362.25	
		Channel flow	**Slope DE**	**0.001778428**		
		Sheet Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	101.13	0	331.79	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.013	0	0.01	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.65**	**#DIV/0!**	**0.65**
		Shallow Concentrated Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1148.2	1680.1	3767.06	5512.14	
9. Watercourse slope, s	s	0.018777217	0.004910422	0.019	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved V= $20.3282S^{0.5}$	V	N/A		2.21	1.13	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.47	1.35	**1.83**
		Channel flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	2.04	0.00	21.98	0.00	
13. Wetted perimeter, pw	p_w	17.03	0.00	55.86	0.00	
14. Hydraulic radius, r= Compute r	r			0.39	#DIV/0!	
15 Channel slope, s	s			0.002	0.002	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.96	#DIV/0!	
18. Flow length, L	L	4357.78	0	14297.18	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			4.12	#DIV/0!	**4.12**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**6.59**
					Tc (mins)	**395.55**

Time of Concentration Calculations	28

Project No:	5591
Project Name:	Durham Creek FPM
Designed/Checked By:	JTF/MC
Date:	12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_128

				X	Y	
SubBasin_128				4562.58	405.38	
				4461.69	401.68	
		Sheet Flow	**Slope AB**	**0.036673605**		
				4461.69	401.68	
				3312.2	376.61	
		Shallow Concentrated Flow	**Slope BC**	**0.021810241**		
				3312.23	376.61	
				2619.64	371.33	
		Shallow Concentrated Flow	**Slope CD**	**0.007623558**		
				2619.64	371.33	
				0	362.27	
		Channel flow	**Slope DE**	**0.00345849**		
		Sheet Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.89	0	331.00	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.037	0	0.04	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.42**	**#DIV/0!**	**0.42**
		Shallow Concentrated Flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1149.5	692.59	3771.19	2272.28	
9. Watercourse slope, s	s	0.021810241	0.007623558	0.022	0.01	
10. Average velocity, V (figure 3-1)	V	N/A		2.38	1.41	
Unpaved $V = 16.1345 S^{0.5}$ Paved $V = 20.3282 S^{0.5}$						
11 $T_t = \frac{L}{3600V}$	T_shallow			0.44	0.45	**0.89**
		Channel flow				
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	16.45	0.00	177.07	0.00	
13. Wetted perimeter, pw	p_w	26.98	0.00	88.52	0.00	
14. Hydraulic radius, r= Compute r	r			2.00	#DIV/0!	
15 Channel slope, s	s			0.003	0.003	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			3.97	#DIV/0!	
18. Flow length, L	L	2619.64	0	8594.62	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.60	#DIV/0!	**0.60**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**1.91**
					Tc (mins)	**114.57**

Time of Concentration Calculations	29

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_129

				X	Y	
SubBasin_129				15686.98	477.16	
				15574.58	476.18	
		Sheet Flow	**Slope AB**	**0.008718861**		
				15574.58	476.18	
				10755.7	457.16	
		Shallow Concentrated Flow	**Slope BC**	**0.003946959**		
				10755.68	457.16	
				3834.59	415.52	
		Channel flow	**Slope CD**	**0.006016393**		
				3834.59	415.52	
				0	374.29	
		Channel flow	**Slope DE**	**0.010752127**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	112.4	0	368.77	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.009	0	0.01	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.82**	**#DIV/0!**	**0.82**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	4818.9	0	15810.04	0.00	
9. Watercourse slope, s	s	0.003946959	0	0.004	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345 S^{0.5}$ Paved $V = 20.3282 S^{0.5}$	V	N/A		1.01	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			4.33	#DIV/0!	**4.33**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	5.47	30.43	58.86	327.50	
13. Wetted perimeter, pw	p_w	28.79	50.35	94.46	165.18	
14. Hydraulic radius, r= Compute r	r			0.62	1.98	
15 Channel slope, s	s			0.006	0.011	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.41	6.97	
18. Flow length, L	L	6921.09	3834.59	22706.99	12580.68	
19 $T_t = \frac{L}{3600V}$	T_channel			2.62	0.50	**3.12**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**8.27**
					Tc (mins)	**496.08**

Time of Concentration Calculations

30

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_130

				X	Y	
SubBasin_130				6049.21	431.78	
				5948.00	429.03	
		Sheet Flow	**Slope AB**	**0.027171228**		
				5948.00	429.03	
				4625.89	399.30	
		Shallow Concentrated Flow	**Slope BC**	**0.022486782**		
				4625.89	399.30	
				832.62	374.85	
		Shallow Concentrated Flow	**Slope CD**	**0.006445626**		
				832.62	374.85	
				0	374.29	
		Channel flow	**Slope DE**	**0.000672576**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	101.21	0	332.05	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.027	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.48**	**#DIV/0!**	**0.48**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1322.1	3793.27	4337.63	12445.11	
9. Watercourse slope, s	s	0.022486782	0.006445626	0.022	0.01	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		2.42	1.30	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.50	2.67	**3.17**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	1.21	0.00	12.99	0.00	
13. Wetted perimeter, pw	p_w	20.12	0.00	66.02	0.00	
14. Hydraulic radius, r= Compute r	r			0.20	#DIV/0!	
15 Channel slope, s	s			0.001	0.001	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			0.37	#DIV/0!	
18. Flow length, L	L	832.62	0	2731.69	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			2.03	#DIV/0!	**2.03**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**5.67**
					Tc (mins)	**340.43**

Time of Concentration Calculations	31

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_131

				X	Y	
SubBasin_131				5704.39	401.55	
				5603.83	398.66	
		Sheet Flow	**Slope AB**	**0.028739061**		
				5603.83	398.66	
				4006.36	374.20	
		Shallow Concentrated Flow	**Slope BC**	**0.015311712**		
				4006.36	374.20	
				1126.79	367.84	
		Channel flow	**Slope CD**	**0.002208663**		
				1126.79	367.84	
				0	353.75	
		Channel flow	**Slope DE**	**0.012504548**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.56	0	329.92	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.029	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.46**	**#DIV/0!**	**0.46**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1597.5	0	5241.04	0.00	
9. Watercourse slope, s	s	0.015311712	0	0.015	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		2.00	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.73	#DIV/0!	**0.73**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	749.50	273.60	8067.59	2944.98	
13. Wetted perimeter, pw	p_w	186.09	195.10	610.53	640.09	
14. Hydraulic radius, r= Compute r	r			13.21	4.60	
15 Channel slope, s	s			0.002	0.013	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			11.18	13.17	
18. Flow length, L	L	2879.57	1126.79	9447.41	3696.82	
19 $T_t = \frac{L}{3600V}$	T_channel			0.23	0.08	**0.31**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**1.50**
					Tc (mins)	**90.29**

Time of Concentration Calculations

32

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_132

				X	Y	
SubBasin_132				3948.47	401.51	
				3848.27	399.38	
		Sheet Flow	**Slope AB**	**0.021257485**		
				3848.27	399.38	
				3242.00	388.41	
		Shallow Concentrated Flow	**Slope BC**	**0.018094248**		
				3242.00	388.41	
				2902.07	362.32	
		Shallow Concentrated Flow	**Slope CD**	**0.076751096**		
				2902.07	362.32	
				0	353.76	
		Channel flow	**Slope DE**	**0.002949619**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.2	0	328.74	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.021	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.52**	**#DIV/0!**	**0.52**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	606.3	339.93	1989.07	1115.26	
9. Watercourse slope, s	s	0.018094248	0.076751096	0.018	0.08	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345 S^{0.5}$ Paved $V = 20.3282 S^{0.5}$	V	N/A		2.17	4.47	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.25	0.07	**0.32**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	26.79	0.00	288.42	0.00	
13. Wetted perimeter, pw	p_w	38.78	0.00	127.23	0.00	
14. Hydraulic radius, r= Compute r	r			2.27	#DIV/0!	
15 Channel slope, s	s			0.003	0.003	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			3.99	#DIV/0!	
18. Flow length, L	L	2902.07	0	9521.23	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.66	#DIV/0!	**0.66**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**1.51**
					Tc (mins)	**90.46**

Time of Concentration Calculations

33

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_133

				X	Y	
SubBasin_133				3495.41	380.61	
				3395.01	377.38	
		Sheet Flow	**Slope AB**	**0.032171315**		
				3395.01	377.38	
				2929.14	367.68	
		Shallow Concentrated Flow	**Slope BC**	**0.020821259**		
				2929.14	367.68	
				697.06	352.80	
		Shallow Concentrated Flow	**Slope CD**	**0.006666428**		
				697.06	352.80	
				0	350.80	
		Channel flow	**Slope DE**	**0.002869193**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.4	0	329.40	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.032	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.44**	**#DIV/0!**	**0.44**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	465.9	2232.08	1528.44	7323.10	
9. Watercourse slope, s	s	0.020821259	0.006666428	0.021	0.01	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		2.33	1.32	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.18	1.54	**1.73**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	211.82	0.00	2279.96	0.00	
13. Wetted perimeter, pw	p_w	133.27	0.00	437.24	0.00	
14. Hydraulic radius, r= Compute r	r			5.21	#DIV/0!	
15 Channel slope, s	s			0.003	0.003	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			6.86	#DIV/0!	
18. Flow length, L	L	697.06	0	2286.94	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.09	#DIV/0!	**0.09**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**2.26**
					Tc (mins)	**135.67**

Time of Concentration Calculations	34

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_134

				X	Y	
SubBasin_134				1696.83	360.48	
				1595.14	358.41	
		Sheet Flow	**Slope AB**	**0.020355984**		
				1595.14	358.41	
				344.79	350.83	
		Shallow Concentrated Flow	**Slope BC**	**0.006062303**		
				344.79	350.83	
				45.78	342.48	
		Shallow Concentrated Flow	**Slope CD**	**0.027925487**		
				45.78	342.48	
				0	342.20	
		Channel flow	**Slope DE**	**0.006116208**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Heavy Underbush	N/A	Heavy Underbush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.8	0	0.80	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	101.69	0	333.63	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.020	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**1.85**	**#DIV/0!**	**1.85**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1250.4	299.01	4102.20	981.00	
9. Watercourse slope, s	s	0.006062303	0.027925487	0.006	0.03	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.26	2.70	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.91	0.10	**1.01**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	0.30	0.00	3.23	0.00	
13. Wetted perimeter, pw	p_w	1.70	0.00	5.58	0.00	
14. Hydraulic radius, r= Compute r	r			0.58	#DIV/0!	
15 Channel slope, s	s			0.006	0.006	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.31	#DIV/0!	
18. Flow length, L	L	45.78	0	150.20	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.02	#DIV/0!	**0.02**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**2.88**
					Tc (mins)	**172.66**

Time of Concentration Calculations

35

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_135

				X	Y	
SubBasin_135				1115.94	358.66	
				1015.19	355.59	
		Sheet Flow	**Slope AB**	**0.030471464**		
				1015.19	355.59	
				957.00	353.13	
		Shallow Concentrated Flow	**Slope BC**	**0.042275305**		
				957.00	353.13	
				28.24	342.76	
		Shallow Concentrated Flow	**Slope CD**	**0.011165425**		
				28.24	342.76	
				8.54	340.34	
		Channel flow	**Slope DE**	**0.12284264**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Dense grasses, including species	N/A	Dense grasses, including s	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.24	0	0.24	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.75	0	330.54	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.030	0	0.03	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.60**	**#DIV/0!**	**0.60**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	58.2	928.76	190.91	3047.11	
9. Watercourse slope, s	s	0.042275305	0.011165425	0.042	0.01	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		3.32	1.70	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.02	0.50	**0.51**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	0.07	0.00	0.72	0.00	
13. Wetted perimeter, pw	p_w	4.43	0.00	14.54	0.00	
14. Hydraulic radius, r= Compute r	r			0.05	#DIV/0!	
15 Channel slope, s	s			0.123	0.123	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			2.00	#DIV/0!	
18. Flow length, L	L	19.7	0	64.63	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.01	#DIV/0!	**0.01**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**1.12**
					Tc (mins)	**67.10**

Time of Concentration Calculations	36

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_136

				X	Y	
SubBasin_136				3340.56	390.39	
				3237.03	388.58	
		Sheet Flow	**Slope AB**	**0.017482855**		
				3237.03	388.58	
				1860.38	377.05	
		Shallow Concentrated Flow	**Slope BC**	**0.008375404**		
				1860.38	377.05	
				1211.83	341.29	
		Shallow Concentrated Flow	**Slope CD**	**0.055138386**		
				1211.83	341.29	
				0	333.32	
		Channel flow	**Slope DE**	**0.00657683**		
Sheet Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Residue cover > 20%	N/A	Residue cover > 20%	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.17	0	0.17	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	103.53	0	339.67	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.017	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.58**	**#DIV/0!**	**0.58**
Shallow Concentrated Flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	1376.7	648.55	4516.57	2127.79	
9. Watercourse slope, s	s	0.008375404	0.055138386	0.008	0.06	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		1.48	3.79	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.85	0.16	**1.01**
Channel flow						
	Segment ID	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	85.58	0.00	921.14	0.00	
13. Wetted perimeter, pw	p_w	59.10	0.00	193.91	0.00	
14. Hydraulic radius, r= Compute r	r			4.75	#DIV/0!	
15 Channel slope, s	s			0.007	0.007	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			9.76	#DIV/0!	
18. Flow length, L	L	1211.83	0	3975.82	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.11	#DIV/0!	**0.11**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**1.70**
					Tc (mins)	**101.82**

Time of Concentration Calculations	37

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_137

				X	Y	
SubBasin_137				1277.00	359.32	
				1175.43	348.6	
		Sheet Flow	**Slope AB**	**0.105542975**		
				1175.43	348.6	
				605.42	339.46	
		Shallow Concentrated Flow	**Slope BC**	**0.016034806**		
				605.42	339.46	
				0	333.30	
		Channel flow	**Slope CD**	**0.010174755**		
				0	333.30	
				0	0.00	
		N/A	**Slope DE**	**#DIV/0!**		
			Sheet Flow			
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Light underbrush	N/A	Light underbrush	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.4	0	0.40	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	101.57	0	333.23	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.106	0	0.11	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.55**	**#DIV/0!**	**0.55**
			Shallow Concentrated Flow			
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	570.0	0	1870.11	0.00	
9. Watercourse slope, s	s	0.016034806	0	0.016	0.00	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		2.04	0.00	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.25	#DIV/0!	**0.25**
			Channel flow			
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	2.40	0.00	25.85	0.00	
13. Wetted perimeter, pw	p_w	7.29	0.00	23.93	0.00	
14. Hydraulic radius, r= Compute r	r			1.08	#DIV/0!	
15 Channel slope, s	s			0.010	#DIV/0!	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			4.52	#DIV/0!	
18. Flow length, L	L	605.42	0	1986.29	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			0.12	#DIV/0!	**0.12**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**0.93**
					Tc (mins)	**55.58**

Time of Concentration Calculations	38

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: JTF/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Durham

Time of Concentration TR55 SubBasin_138

				X	Y	
SubBasin_138				6096.55	382.16	
				5995.78	379.75	
		Sheet Flow	**Slope AB**	**0.023915848**		
				5995.78	379.75	
				5349.21	349.30	
		Shallow Concentrated Flow	**Slope BC**	**0.047094669**		
				5349.21	349.30	
				3814.17	332.11	
		Shallow Concentrated Flow	**Slope CD**	**0.011198405**		
				3814.17	332.11	
				0	330.63	
		Channel flow	**Slope DE**	**0.000388027**		
Sheet Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
1. Surface description (table 3-1)		Dense grasses, including species	N/A	Dense grasses, including s	N/A	
2. Manning's roughness coefficient, n (table 3-1)	n	0.24	0	0.24	0.00	
3. Flow length, L (total L ≤ 300 ft)	L	100.77	0	330.61	0.00	
4. Two-year 24-hour rainfall, P2	P_2	62.4	0	2.46	0.00	
5. Land slope, s	Land Slope	0.024	0	0.02	0.00	
6 $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	T_sheet			**0.66**	**#DIV/0!**	**0.66**
Shallow Concentrated Flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
7. Surface description (paved or unpaved)		Unpaved	Unpaved	Unpaved	Unpaved	
8. Flow length, L	L	646.6	1535.04	2121.29	5036.22	
9. Watercourse slope, s	s	0.047094669	0.011198405	0.047	0.01	
10. Average velocity, V (figure 3-1) Unpaved $V = 16.1345S^{0.5}$ Paved $V = 20.3282S^{0.5}$	V	N/A		3.50	1.71	
11 $T_t = \frac{L}{3600V}$	T_shallow			0.17	0.82	**0.99**
Channel flow						
	Segment II	Segment 1 (SI)	Segment 2 (SI)	Segment 1 (Imperial)	Segment 2 (Imperial)	
12. Cross sectional flow area, a	area	23.78	0.00	255.94	0.00	
13. Wetted perimeter, pw	p_w	25.74	0.00	84.46	0.00	
14. Hydraulic radius, r= Compute r	r			3.03	#DIV/0!	
15 Channel slope, s	s			0.000	0.000	
16. Manning's roughness coefficient, n	n			0.035	0.035	
17 $V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$	V			1.76	#DIV/0!	
18. Flow length, L	L	3814.17	0	12513.68	0.00	
19 $T_t = \frac{L}{3600V}$	T_channel			1.98	#DIV/0!	**1.98**
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)					Tc (Hr)	**3.62**
					Tc (mins)	**217.49**

Loss Method Watershed Parameters															
Subbasin	Texture Code	Texture	HYDRO Class	Porosity	Effective Porosity	Soil Suction Head at the wetting front (mm) (Low)	Soil Suction Head at the wetting front (mm) (Average)	Soil Suction Head at the wetting front (mm) (High)	Saturated Hydraulic Conductity (mm/h)	Field Capacity Θ_o	Wilting Point Θ_w	Area Watershed (km2)	Area Watershed (ha)	Area Soil Texture (ha)	Percentage of Watershed
Subbasin_101	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	36.117	3611.7	60.11	1.66%
Subbasin_101	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	36.117	3611.7	69.08	1.91%
Subbasin_101	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	36.117	3611.7	126.54	3.50%
Subbasin_101	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	36.117	3611.7	1391.18	38.52%
Subbasin_101	SL	Sandy Loam	B	0.453	0.412	110	180	250	11	0.19	0.085	36.117	3611.7	17.65	0.49%
Subbasin_101	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	36.117	3611.7	292.70	8.10%
Subbasin_101	S	Sand	C	0.437	0.417	49	99.5	150	120	0.062	0.024	36.117	3611.7	34.33	0.95%
Subbasin_101	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	36.117	3611.7	76.78	2.13%
Subbasin_101	CL	Clay Loam	D	0.464	0.309	210	210	210	1	0.31	0.187	36.117	3611.7	52.96	1.47%
Subbasin_101	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	36.117	3611.7	1489.60	41.24%
Subbasin_102	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	12.722	1272.2	10.21	0.80%
Subbasin_102	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	12.722	1272.2	8.20	0.64%
Subbasin_102	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	12.722	1272.2	280.39	22.04%
Subbasin_102	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	12.722	1272.2	637.21	50.09%
Subbasin_102	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	12.722	1272.2	28.33	2.23%
Subbasin_102	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	12.722	1272.2	0.12	0.01%
Subbasin_102	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	12.722	1272.2	307.63	24.18%
Subbasin_103	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	24.35	2435	7.29	0.30%
Subbasin_103	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	24.35	2435	244.52	10.04%
Subbasin_103	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	24.35	2435	1425.16	58.53%
Subbasin_103	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	24.35	2435	221.07	9.08%
Subbasin_103	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	24.35	2435	42.63	1.75%
Subbasin_103	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	24.35	2435	494.07	20.29%
Subbasin_104	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	1.18	118	0.36	0.31%
Subbasin_104	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	1.18	118	3.11	2.64%
Subbasin_104	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	1.18	118	59.72	50.61%
Subbasin_104	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	1.18	118	6.25	5.29%
Subbasin_104	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	1.18	118	48.55	41.15%
Subbasin_105	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	20.996	2099.6	0.36	0.02%
Subbasin_105	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	20.996	2099.6	118.21	5.63%
Subbasin_105	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	20.996	2099.6	963.79	45.90%
Subbasin_105	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	20.996	2099.6	184.68	8.80%
Subbasin_105	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	20.996	2099.6	3.91	0.19%
Subbasin_105	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	20.996	2099.6	828.16	39.44%
Subbasin_106	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	18.315	1831.5	0.00	0.00%
Subbasin_106	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	18.315	1831.5	139.85	7.64%
Subbasin_106	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	18.315	1831.5	1139.79	62.23%
Subbasin_106	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	18.315	1831.5	234.52	12.80%
Subbasin_106	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	18.315	1831.5	89.31	4.88%
Subbasin_106	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	18.315	1831.5	227.75	12.44%
Subbasin_107	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	20.669	2066.9	16.40	0.79%
Subbasin_107	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	20.669	2066.9	211.98	10.26%
Subbasin_107	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	20.669	2066.9	1169.14	56.56%
Subbasin_107	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	20.669	2066.9	176.27	8.53%
Subbasin_107	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	20.669	2066.9	101.24	4.90%
Subbasin_107	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	20.669	2066.9	391.88	18.96%
Subbasin_108	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	3.3357	333.57	2.96	0.89%
Subbasin_108	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	3.3357	333.57	21.37	6.41%

Loss Method Watershed Parameters															
Subbasin	Texture Code	Texture	HYDRO Class	Porosity	Effective Porosity	Soil Suction Head at the wetting front (mm) (Low)	Soil Suction Head at the wetting front (mm) (Average)	Soil Suction Head at the wetting front (mm) (High)	Saturated Hydraulic Conductity (mm/h)	Field Capacity Θ_o	Wilting Point Θ_w	Area Watershed (km2)	Area Watershed (ha)	Area Soil Texture (ha)	Percentage of Watershed
Subbasin_108	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	3.3357	333.57	118.37	35.48%
Subbasin_108	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	3.3357	333.57	148.58	44.54%
Subbasin_108	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	3.3357	333.57	41.73	12.51%
Subbasin_108	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	3.3357	333.57	0.56	0.17%
Subbasin_109	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	11.359	1135.9	173.17	15.24%
Subbasin_109	S	Sand	A	0.437	0.417	49	99.5	150	120	0.062	0.024	11.359	1135.9	8.35	0.73%
Subbasin_109	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	11.359	1135.9	158.33	13.94%
Subbasin_109	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	11.359	1135.9	83.59	7.36%
Subbasin_109	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	11.359	1135.9	177.91	15.66%
Subbasin_109	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	11.359	1135.9	223.04	19.64%
Subbasin_109	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	11.359	1135.9	1.71	0.15%
Subbasin_109	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	11.359	1135.9	309.77	27.27%
Subbasin_110	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	9.4843	948.43	16.66	1.76%
Subbasin_110	S	Sand	A	0.437	0.417	49	99.5	150	120	0.062	0.024	9.4843	948.43	2.15	0.23%
Subbasin_110	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	9.4843	948.43	2.37	0.25%
Subbasin_110	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	9.4843	948.43	155.47	16.39%
Subbasin_110	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	9.4843	948.43	331.15	34.92%
Subbasin_110	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	9.4843	948.43	228.83	24.13%
Subbasin_110	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	9.4843	948.43	39.52	4.17%
Subbasin_110	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	9.4843	948.43	172.27	18.16%
Subbasin_111	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	25.593	2559.3	108.21	4.23%
Subbasin_111	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	25.593	2559.3	353.14	13.80%
Subbasin_111	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	25.593	2559.3	980.37	38.31%
Subbasin_111	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	25.593	2559.3	191.75	7.49%
Subbasin_111	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	25.593	2559.3	56.46	2.21%
Subbasin_111	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	25.593	2559.3	868.66	33.94%
Subbasin_112	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	6.8095	680.95	86.10	12.64%
Subbasin_112	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	6.8095	680.95	17.30	2.54%
Subbasin_112	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	6.8095	680.95	239.44	35.16%
Subbasin_112	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	6.8095	680.95	22.12	3.25%
Subbasin_112	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	6.8095	680.95	10.08	1.48%
Subbasin_112	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	6.8095	680.95	305.91	44.92%
Subbasin_113	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	7.99	799	57.69	7.22%
Subbasin_113	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	7.99	799	79.03	9.89%
Subbasin_113	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	7.99	799	222.02	27.79%
Subbasin_113	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	7.99	799	202.50	25.34%
Subbasin_113	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	7.99	799	98.59	12.34%
Subbasin_113	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	7.99	799	43.47	5.44%
Subbasin_113	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	7.99	799	95.70	11.98%
Subbasin_114	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	16.996	1699.6	35.72	2.10%
Subbasin_114	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	16.996	1699.6	87.93	5.17%
Subbasin_114	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	16.996	1699.6	145.31	8.55%
Subbasin_114	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	16.996	1699.6	965.86	56.83%
Subbasin_114	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	16.996	1699.6	150.69	8.87%
Subbasin_114	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	16.996	1699.6	5.59	0.33%
Subbasin_114	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	16.996	1699.6	307.91	18.12%
Subbasin_115	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	1.3733	137.33	71.67	52.19%
Subbasin_115	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	1.3733	137.33	22.31	16.24%

Loss Method Watershed Parameters

Subbasin	Texture Code	Texture	HYDRO Class	Porosity	Effective Porosity	Soil Suction Head at the wetting front (mm) (Low)	Soil Suction Head at the wetting front (mm) (Average)	Soil Suction Head at the wetting front (mm) (High)	Saturated Hydraulic Conductity (mm/h)	Field Capacity Θ_o	Wilting Point Θ_w	Area Watershed (km2)	Area Watershed (ha)	Area Soil Texture (ha)	Percentage of Watershed
Subbasin_115	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	1.3733	137.33	10.70	7.79%
Subbasin_115	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	1.3733	137.33	13.43	9.78%
Subbasin_115	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	1.3733	137.33	19.22	13.99%
Subbasin_116	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	1.2656	126.56	70.43	55.65%
Subbasin_116	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	1.2656	126.56	3.88	3.06%
Subbasin_116	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	1.2656	126.56	18.14	14.33%
Subbasin_116	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	1.2656	126.56	34.12	26.96%
Subbasin_117	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	9.505	950.5	417.96	43.97%
Subbasin_117	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	9.505	950.5	142.86	15.03%
Subbasin_117	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	9.505	950.5	91.88	9.67%
Subbasin_117	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	9.505	950.5	44.14	4.64%
Subbasin_117	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	9.505	950.5	67.14	7.06%
Subbasin_117	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	9.505	950.5	186.30	19.60%
Subbasin_118	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	9.2346	923.46	336.35	36.42%
Subbasin_118	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	9.2346	923.46	184.11	19.94%
Subbasin_118	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	9.2346	923.46	193.81	20.99%
Subbasin_118	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	9.2346	923.46	55.77	6.04%
Subbasin_118	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	9.2346	923.46	102.39	11.09%
Subbasin_118	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	9.2346	923.46	51.03	5.53%
Subbasin_119	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	4.4575	445.75	341.29	76.56%
Subbasin_119	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	4.4575	445.75	45.55	10.22%
Subbasin_119	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	4.4575	445.75	34.02	7.63%
Subbasin_119	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	4.4575	445.75	24.81	5.57%
Subbasin_120	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	3.2915	329.15	225.59	68.54%
Subbasin_120	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	3.2915	329.15	4.83	1.47%
Subbasin_120	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	3.2915	329.15	5.80	1.76%
Subbasin_120	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	3.2915	329.15	0.94	0.28%
Subbasin_120	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	3.2915	329.15	91.85	27.90%
Subbasin_121	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	14.987	1498.7	766.79	51.16%
Subbasin_121	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	14.987	1498.7	11.85	0.79%
Subbasin_121	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	14.987	1498.7	341.55	22.79%
Subbasin_121	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	14.987	1498.7	102.35	6.83%
Subbasin_121	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	14.987	1498.7	103.30	6.89%
Subbasin_121	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	14.987	1498.7	67.46	4.50%
Subbasin_121	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	14.987	1498.7	105.13	7.01%
Subbasin_122	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	4.2171	421.71	282.47	66.98%
Subbasin_122	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	4.2171	421.71	47.19	11.19%
Subbasin_122	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	4.2171	421.71	9.16	2.17%
Subbasin_122	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	4.2171	421.71	13.06	3.10%
Subbasin_122	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	4.2171	421.71	58.26	13.81%
Subbasin_122	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	4.2171	421.71	11.56	2.74%
Subbasin_123	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	9.5452	954.52	738.06	77.32%
Subbasin_123	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	9.5452	954.52	19.73	2.07%
Subbasin_123	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	9.5452	954.52	0.31	0.03%
Subbasin_123	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	9.5452	954.52	28.50	2.99%
Subbasin_123	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	9.5452	954.52	152.23	15.95%
Subbasin_123	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	9.5452	954.52	15.70	1.65%
Subbasin_124	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	5.4237	542.37	454.99	83.89%

Loss Method Watershed Parameters															
Subbasin	Texture Code	Texture	HYDRO Class	Porosity	Effective Porosity	Soil Suction Head at the wetting front (mm) (Low)	Soil Suction Head at the wetting front (mm) (Average)	Soil Suction Head at the wetting front (mm) (High)	Saturated Hydraulic Conductity (mm/h)	Field Capacity Θ_o	Wilting Point Θ_w	Area Watershed (km2)	Area Watershed (ha)	Area Soil Texture (ha)	Percentage of Watershed
Subbasin_124	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	5.4237	542.37	15.18	2.80%
Subbasin_124	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	5.4237	542.37	21.62	3.99%
Subbasin_124	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	5.4237	542.37	1.91	0.35%
Subbasin_124	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	5.4237	542.37	48.60	8.96%
Subbasin_125	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	9.0317	903.17	603.41	66.81%
Subbasin_125	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	9.0317	903.17	144.16	15.96%
Subbasin_125	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	9.0317	903.17	7.79	0.86%
Subbasin_125	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	9.0317	903.17	108.71	12.04%
Subbasin_125	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	9.0317	903.17	39.08	4.33%
Subbasin_126	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	7.7236	772.36	171.95	22.26%
Subbasin_126	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	7.7236	772.36	127.80	16.55%
Subbasin_126	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	7.7236	772.36	276.94	35.86%
Subbasin_126	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	7.7236	772.36	74.42	9.64%
Subbasin_126	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	7.7236	772.36	13.65	1.77%
Subbasin_126	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	7.7236	772.36	107.45	13.91%
Subbasin_127	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	11.403	1140.3	436.44	38.27%
Subbasin_127	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	11.403	1140.3	22.15	1.94%
Subbasin_127	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	11.403	1140.3	122.98	10.78%
Subbasin_127	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	11.403	1140.3	313.17	27.46%
Subbasin_127	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	11.403	1140.3	19.59	1.72%
Subbasin_127	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	11.403	1140.3	2.55	0.22%
Subbasin_127	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	11.403	1140.3	223.12	19.57%
Subbasin_128	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	1.8478	184.78	130.03	70.37%
Subbasin_128	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	1.8478	184.78	10.60	5.74%
Subbasin_128	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	1.8478	184.78	44.14	23.89%
Subbasin_128	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	1.8478	184.78	0.00	0.00%
Subbasin_129	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	24.814	2481.4	1995.01	80.40%
Subbasin_129	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	24.814	2481.4	108.42	4.37%
Subbasin_129	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	24.814	2481.4	139.06	5.60%
Subbasin_129	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	24.814	2481.4	88.74	3.58%
Subbasin_129	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	24.814	2481.4	149.04	6.01%
Subbasin_130	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	5.4488	544.88	390.66	71.70%
Subbasin_130	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	5.4488	544.88	86.98	15.96%
Subbasin_130	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	5.4488	544.88	67.24	12.34%
Subbasin_131	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	3.1071	310.71	139.91	45.03%
Subbasin_131	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	3.1071	310.71	91.72	29.52%
Subbasin_131	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	3.1071	310.71	1.66	0.54%
Subbasin_131	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	3.1071	310.71	5.64	1.82%
Subbasin_131	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	3.1071	310.71	71.64	23.06%
Subbasin_132	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	2.1852	218.52	46.21	21.15%
Subbasin_132	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	2.1852	218.52	27.08	12.39%
Subbasin_132	L	Loam	B	0.463	0.434	89	219.5	350	3	0.232	0.116	2.1852	218.52	70.72	32.36%
Subbasin_132	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	2.1852	218.52	21.32	9.76%
Subbasin_132	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	2.1852	218.52	0.94	0.43%
Subbasin_132	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	2.1852	218.52	38.46	17.60%
Subbasin_132	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	2.1852	218.52	13.75	6.29%
Subbasin_133	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	2.5688	256.88	161.19	62.75%
Subbasin_133	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	2.5688	256.88	16.73	6.51%

Loss Method Watershed Parameters																
Subbasin	**Texture Code**	**Texture**	**HYDRO Class**	**Porosity**	**Effective Porosity**	**Soil Suction Head at the wetting front (mm) (Low)**	**Soil Suction Head at the wetting front (mm) (Average)**	**Soil Suction Head at the wetting front (mm) (High)**	**Saturated Hydraulic Conductity (mm/h)**	**Field Capacity Θ_o**	**Wilting Point Θ_w**	**Area Watershed (km2)**	**Area Watershed (ha)**	**Area Soil Texture (ha)**	**Percentage of Watershed**
Subbasin_133	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	2.5688	256.88	23.01	8.96%
Subbasin_133	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	2.5688	256.88	39.65	15.43%
Subbasin_133	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	2.5688	256.88	16.08	6.26%
Subbasin_134	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	0.2685	26.85	26.77	99.71%
Subbasin_135	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	0.3158	31.58	31.51	99.78%
Subbasin_136	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	1.7062	170.62	5.38	3.16%
Subbasin_136	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	1.7062	170.62	135.26	79.28%
Subbasin_136	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	1.7062	170.62	29.97	17.56%
Subbasin_137	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	0.282	28.2	0.11	0.38%
Subbasin_137	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	0.282	28.2	27.97	99.18%
Subbasin_137	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	0.282	28.2	0.02	0.09%
Subbasin_138	L	Loam	A	0.463	0.434	89	219.5	350	3	0.232	0.116	4.8845	488.45	174.07	35.64%
Subbasin_138	SL	Sandy Loam	A	0.453	0.412	110	180	250	11	0.19	0.085	4.8845	488.45	28.37	5.81%
Subbasin_138	SIL	Silt Loam	B	0.501	0.486	170	170	170	7	0.284	0.135	4.8845	488.45	195.56	40.04%
Subbasin_138	L	Loam	C	0.463	0.434	89	219.5	350	3	0.232	0.116	4.8845	488.45	29.86	6.11%
Subbasin_138	SICL	Silty Clay Loam	C	0.471	0.432	270	270	270	1	0.342	0.21	4.8845	488.45	57.07	11.68%
Subbasin_138	ORG	Organic	D	0.56	0.56	180	200	220	0.1	0.46	0.27	4.8845	488.45	3.19	0.65%

Percent Impervious and Initial Abstraction Basin Parameters											
Subbasin ID	**gridcode**	**Land Cover**	**Percent Impervious**	**Canopy Storage (mm)**	**Depression Storage (mm)**	**Total Abstraction (mm)**	**Area Watershed (km2)**	**Area Watershed (ha)**	**Area Soil Texture (ha)**	**Impervious Area (ha)**	**Percentage of Watershed**
Subbasin_101	1	Forest	0	5	5	10	36.117	3611.7	30.26	0.00	0.84%
Subbasin_101	2	Agriculture	0	1	6	7	36.117	3611.7	1843.58	0.00	51.04%
Subbasin_101	3	Wetland	0	3	15	18	36.117	3611.7	1670.72	0.00	46.26%
Subbasin_101	4	Open Water	100	0	0	0	36.117	3611.7	2.47	2.47	0.07%
Subbasin_101	5	Transportation	100	1	1	2	36.117	3611.7	61.70	61.70	1.71%
Subbasin_102	1	Forest	0	5	5	10	12.722	1272.2	23.24	0.00	1.83%
Subbasin_102	2	Agriculture	0	1	6	7	12.722	1272.2	773.32	0.00	60.79%
Subbasin_102	3	Wetland	0	3	15	18	12.722	1272.2	445.91	0.00	35.05%
Subbasin_102	4	Open Water	100	0	0	0	12.722	1272.2	1.84	1.84	0.14%
Subbasin_102	5	Transportation	100	1	1	2	12.722	1272.2	25.91	25.91	2.04%
Subbasin_103	1	Forest	0	5	5	10	24.35	2435	66.80	0.00	2.74%
Subbasin_103	2	Agriculture	0	1	6	7	24.35	2435	1667.91	0.00	68.50%
Subbasin_103	3	Wetland	0	3	15	18	24.35	2435	648.75	0.00	26.64%
Subbasin_103	4	Open Water	100	0	0	0	24.35	2435	2.16	2.16	0.09%
Subbasin_103	5	Transportation	100	1	1	2	24.35	2435	48.60	48.60	2.00%
Subbasin_104	1	Forest	0	5	5	10	1.18	118	3.27	0.00	2.77%
Subbasin_104	2	Agriculture	0	1	6	7	1.18	118	67.03	0.00	56.80%
Subbasin_104	3	Wetland	0	3	15	18	1.18	118	45.88	0.00	38.88%
Subbasin_104	4	Open Water	100	0	0	0	1.18	118	1.55	1.55	1.32%
Subbasin_104	5	Transportation	100	1	1	2	1.18	118	0.24	0.24	0.20%
Subbasin_105	1	Forest	0	5	5	10	20.996	2099.6	30.47	0.00	1.45%
Subbasin_105	2	Agriculture	0	1	6	7	20.996	2099.6	1287.12	0.00	61.30%
Subbasin_105	3	Wetland	0	3	15	18	20.996	2099.6	722.18	0.00	34.40%
Subbasin_105	4	Open Water	100	0	0	0	20.996	2099.6	3.75	3.75	0.18%
Subbasin_105	5	Transportation	100	1	1	2	20.996	2099.6	50.91	50.91	2.42%
Subbasin_105	7	Built -Up Area – Impervious	45	1	1	2	20.996	2099.6	3.71	1.67	0.18%
Subbasin_106	1	Forest	0	5	5	10	18.315	1831.5	45.32	0.00	2.47%
Subbasin_106	2	Agriculture	0	1	6	7	18.315	1831.5	1440.96	0.00	78.68%
Subbasin_106	3	Wetland	0	3	15	18	18.315	1831.5	297.60	0.00	16.25%
Subbasin_106	4	Open Water	100	0	0	0	18.315	1831.5	8.99	8.99	0.49%
Subbasin_106	5	Transportation	100	1	1	2	18.315	1831.5	37.18	37.18	2.03%
Subbasin_106	7	Built -Up Area – Impervious	45	1	1	2	18.315	1831.5	0.65	0.29	0.04%
Subbasin_107	1	Forest	0	5	5	10	20.669	2066.9	86.51	0.00	4.19%
Subbasin_107	2	Agriculture	0	1	6	7	20.669	2066.9	1274.41	0.00	61.66%
Subbasin_107	3	Wetland	0	3	15	18	20.669	2066.9	653.40	0.00	31.61%
Subbasin_107	4	Open Water	100	0	0	0	20.669	2066.9	18.61	18.61	0.90%
Subbasin_107	5	Transportation	100	1	1	2	20.669	2066.9	32.27	32.27	1.56%
Subbasin_108	1	Forest	0	5	5	10	3.3357	333.57	0.30	0.00	0.09%
Subbasin_108	2	Agriculture	0	1	6	7	3.3357	333.57	298.60	0.00	89.52%
Subbasin_108	3	Wetland	0	3	15	18	3.3357	333.57	28.97	0.00	8.68%
Subbasin_108	4	Open Water	100	0	0	0	3.3357	333.57	0.02	0.02	0.00%
Subbasin_108	5	Transportation	100	1	1	2	3.3357	333.57	5.68	5.68	1.70%
Subbasin_109	1	Forest	0	5	5	10	11.359	1135.9	20.75	0.00	1.83%
Subbasin_109	2	Agriculture	0	1	6	7	11.359	1135.9	545.89	0.00	48.06%
Subbasin_109	3	Wetland	0	3	15	18	11.359	1135.9	511.39	0.00	45.02%
Subbasin_109	4	Open Water	100	0	0	0	11.359	1135.9	17.38	17.38	1.53%
Subbasin_109	5	Transportation	100	1	1	2	11.359	1135.9	20.41	20.41	1.80%
Subbasin_109	6	Built -Up Area – Pervious	10	1	4	5	11.359	1135.9	18.53	1.85	1.63%
Subbasin_110	1	Forest	0	5	5	10	9.4843	948.43	17.73	0.00	1.87%
Subbasin_110	2	Agriculture	0	1	6	7	9.4843	948.43	611.46	0.00	64.47%
Subbasin_110	3	Wetland	0	3	15	18	9.4843	948.43	287.65	0.00	30.33%
Subbasin_110	4	Open Water	100	0	0	0	9.4843	948.43	14.91	14.91	1.57%
Subbasin_110	5	Transportation	100	1	1	2	9.4843	948.43	16.07	16.07	1.69%
Subbasin_111	1	Forest	0	5	5	10	25.593	2559.3	66.67	0.00	2.60%
Subbasin_111	2	Agriculture	0	1	6	7	25.593	2559.3	1492.83	0.00	58.33%
Subbasin_111	3	Wetland	0	3	15	18	25.593	2559.3	945.06	0.00	36.93%
Subbasin_111	4	Open Water	100	0	0	0	25.593	2559.3	7.74	7.74	0.30%
Subbasin_111	5	Transportation	100	1	1	2	25.593	2559.3	37.13	37.13	1.45%
Subbasin_111	7	Built -Up Area – Impervious	45	1	1	2	25.593	2559.3	1.53	0.69	0.06%
Subbasin_111	8	Extraction – Aggregate	0	0	5	5	25.593	2559.3	6.13	0.00	0.24%
Subbasin_112	1	Forest	0	5	5	10	6.8095	680.95	10.97	0.00	1.61%
Subbasin_112	2	Agriculture	0	1	6	7	6.8095	680.95	347.09	0.00	50.97%
Subbasin_112	3	Wetland	0	3	15	18	6.8095	680.95	303.82	0.00	44.62%
Subbasin_112	4	Open Water	100	0	0	0	6.8095	680.95	11.27	11.27	1.65%
Subbasin_112	5	Transportation	100	1	1	2	6.8095	680.95	7.81	7.81	1.15%
Subbasin_113	1	Forest	0	5	5	10	7.99	799	28.52	0.00	3.57%
Subbasin_113	2	Agriculture	0	1	6	7	7.99	799	551.58	0.00	69.03%
Subbasin_113	3	Wetland	0	3	15	18	7.99	799	192.17	0.00	24.05%
Subbasin_113	4	Open Water	100	0	0	0	7.99	799	6.00	6.00	0.75%
Subbasin_113	5	Transportation	100	1	1	2	7.99	799	20.71	20.71	2.59%
Subbasin_114	1	Forest	0	5	5	10	16.996	1699.6	55.00	0.00	3.24%
Subbasin_114	2	Agriculture	0	1	6	7	16.996	1699.6	1116.39	0.00	65.69%
Subbasin_114	3	Wetland	0	3	15	18	16.996	1699.6	489.28	0.00	28.79%
Subbasin_114	4	Open Water	100	0	0	0	16.996	1699.6	1.09	1.09	0.06%
Subbasin_114	5	Transportation	100	1	1	2	16.996	1699.6	35.35	35.35	2.08%

Percent Impervious and Initial Abstraction Basin Parameters												
Subbasin ID	gridcode	Land Cover	Percent Impervious	Canopy Storage (mm)	Depression Storage (mm)	Total Abstraction (mm)	Area Watershed (km2)	Area Watershed (ha)	Area Soil Texture (ha)	Impervious Area (ha)	Percentage of Watershed
Subbasin_114	7	Built -Up Area – Impervious	45	1	1	2	16.996	1699.6	0.54	0.24	0.03%
Subbasin_115	1	Forest	0	5	5	10	1.3733	137.33	3.05	0.00	2.22%
Subbasin_115	2	Agriculture	0	1	6	7	1.3733	137.33	101.94	0.00	74.23%
Subbasin_115	3	Wetland	0	3	15	18	1.3733	137.33	27.82	0.00	20.26%
Subbasin_115	4	Open Water	100	0	0	0	1.3733	137.33	1.72	1.72	1.25%
Subbasin_115	5	Transportation	100	1	1	2	1.3733	137.33	2.79	2.79	2.03%
Subbasin_116	1	Forest	0	5	5	10	1.2656	126.56	5.74	0.00	4.53%
Subbasin_116	2	Agriculture	0	1	6	7	1.2656	126.56	81.62	0.00	64.49%
Subbasin_116	3	Wetland	0	3	15	18	1.2656	126.56	34.88	0.00	27.56%
Subbasin_116	4	Open Water	100	0	0	0	1.2656	126.56	1.28	1.28	1.01%
Subbasin_116	5	Transportation	100	1	1	2	1.2656	126.56	3.04	3.04	2.40%
Subbasin_117	1	Forest	0	5	5	10	9.505	950.5	128.15	0.00	13.48%
Subbasin_117	2	Agriculture	0	1	6	7	9.505	950.5	511.52	0.00	53.82%
Subbasin_117	3	Wetland	0	3	15	18	9.505	950.5	285.42	0.00	30.03%
Subbasin_117	4	Open Water	100	0	0	0	9.505	950.5	1.37	1.37	0.14%
Subbasin_117	5	Transportation	100	1	1	2	9.505	950.5	22.07	22.07	2.32%
Subbasin_117	7	Built -Up Area – Impervious	45	1	1	2	9.505	950.5	1.20	0.54	0.13%
Subbasin_118	1	Forest	0	5	5	10	9.2346	923.46	135.49	0.00	14.67%
Subbasin_118	2	Agriculture	0	1	6	7	9.2346	923.46	635.37	0.00	68.80%
Subbasin_118	3	Wetland	0	3	15	18	9.2346	923.46	118.91	0.00	12.88%
Subbasin_118	4	Open Water	100	0	0	0	9.2346	923.46	15.54	15.54	1.68%
Subbasin_118	5	Transportation	100	1	1	2	9.2346	923.46	16.22	16.22	1.76%
Subbasin_118	7	Built -Up Area – Impervious	45	1	1	2	9.2346	923.46	1.80	0.81	0.19%
Subbasin_119	1	Forest	0	5	5	10	4.4575	445.75	29.13	0.00	6.54%
Subbasin_119	2	Agriculture	0	1	6	7	4.4575	445.75	259.92	0.00	58.31%
Subbasin_119	3	Wetland	0	3	15	18	4.4575	445.75	73.78	0.00	16.55%
Subbasin_119	4	Open Water	100	0	0	0	4.4575	445.75	5.73	5.73	1.28%
Subbasin_119	5	Transportation	100	1	1	2	4.4575	445.75	23.43	23.43	5.26%
Subbasin_119	6	Built -Up Area – Pervious	10	1	4	5	4.4575	445.75	22.98	2.30	5.16%
Subbasin_119	7	Built -Up Area – Impervious	45	1	1	2	4.4575	445.75	30.28	13.62	6.79%
Subbasin_120	1	Forest	0	5	5	10	3.2915	329.15	34.02	0.00	10.34%
Subbasin_120	2	Agriculture	0	1	6	7	3.2915	329.15	163.23	0.00	49.59%
Subbasin_120	3	Wetland	0	3	15	18	3.2915	329.15	125.11	0.00	38.01%
Subbasin_120	4	Open Water	100	0	0	0	3.2915	329.15	2.18	2.18	0.66%
Subbasin_120	5	Transportation	100	1	1	2	3.2915	329.15	3.19	3.19	0.97%
Subbasin_120	7	Built -Up Area – Impervious	45	1	1	2	3.2915	329.15	0.72	0.32	0.22%
Subbasin_121	1	Forest	0	5	5	10	14.987	1498.7	123.18	0.00	8.22%
Subbasin_121	2	Agriculture	0	1	6	7	14.987	1498.7	980.06	0.00	65.39%
Subbasin_121	3	Wetland	0	3	15	18	14.987	1498.7	359.65	0.00	24.00%
Subbasin_121	4	Open Water	100	0	0	0	14.987	1498.7	5.50	5.50	0.37%
Subbasin_121	5	Transportation	100	1	1	2	14.987	1498.7	28.07	28.07	1.87%
Subbasin_122	1	Forest	0	5	5	10	4.2171	421.71	57.20	0.00	13.56%
Subbasin_122	2	Agriculture	0	1	6	7	4.2171	421.71	250.13	0.00	59.31%
Subbasin_122	3	Wetland	0	3	15	18	4.2171	421.71	99.73	0.00	23.65%
Subbasin_122	4	Open Water	100	0	0	0	4.2171	421.71	8.12	8.12	1.93%
Subbasin_122	5	Transportation	100	1	1	2	4.2171	421.71	6.53	6.53	1.55%
Subbasin_123	1	Forest	0	5	5	10	9.5452	954.52	412.12	0.00	43.18%
Subbasin_123	2	Agriculture	0	1	6	7	9.5452	954.52	289.92	0.00	30.37%
Subbasin_123	3	Wetland	0	3	15	18	9.5452	954.52	204.29	0.00	21.40%
Subbasin_123	4	Open Water	100	0	0	0	9.5452	954.52	27.39	27.39	2.87%
Subbasin_123	5	Transportation	100	1	1	2	9.5452	954.52	20.81	20.81	2.18%
Subbasin_124	1	Forest	0	5	5	10	5.4237	542.37	145.51	0.00	26.83%
Subbasin_124	2	Agriculture	0	1	6	7	5.4237	542.37	207.50	0.00	38.26%
Subbasin_124	3	Wetland	0	3	15	18	5.4237	542.37	173.53	0.00	31.99%
Subbasin_124	4	Open Water	100	0	0	0	5.4237	542.37	3.94	3.94	0.73%
Subbasin_124	5	Transportation	100	1	1	2	5.4237	542.37	10.34	10.34	1.91%
Subbasin_125	1	Forest	0	5	5	10	9.0317	903.17	149.39	0.00	16.54%
Subbasin_125	2	Agriculture	0	1	6	7	9.0317	903.17	510.54	0.00	56.53%
Subbasin_125	3	Wetland	0	3	15	18	9.0317	903.17	214.80	0.00	23.78%
Subbasin_125	4	Open Water	100	0	0	0	9.0317	903.17	9.07	9.07	1.00%
Subbasin_125	5	Transportation	100	1	1	2	9.0317	903.17	19.17	19.17	2.12%
Subbasin_126	1	Forest	0	5	5	10	7.7236	772.36	70.39	0.00	9.11%
Subbasin_126	2	Agriculture	0	1	6	7	7.7236	772.36	467.73	0.00	60.56%
Subbasin_126	3	Wetland	0	3	15	18	7.7236	772.36	220.92	0.00	28.60%
Subbasin_126	4	Open Water	100	0	0	0	7.7236	772.36	2.29	2.29	0.30%
Subbasin_126	5	Transportation	100	1	1	2	7.7236	772.36	9.41	9.41	1.22%
Subbasin_127	1	Forest	0	5	5	10	11.403	1140.3	169.05	0.00	14.83%
Subbasin_127	2	Agriculture	0	1	6	7	11.403	1140.3	685.51	0.00	60.12%
Subbasin_127	3	Wetland	0	3	15	18	11.403	1140.3	264.93	0.00	23.23%
Subbasin_127	4	Open Water	100	0	0	0	11.403	1140.3	1.25	1.25	0.11%
Subbasin_127	5	Transportation	100	1	1	2	11.403	1140.3	17.33	17.33	1.52%
Subbasin_128	1	Forest	0	5	5	10	1.8478	184.78	41.54	0.00	22.48%
Subbasin_128	2	Agriculture	0	1	6	7	1.8478	184.78	100.05	0.00	54.14%
Subbasin_128	3	Wetland	0	3	15	18	1.8478	184.78	33.29	0.00	18.01%
Subbasin_128	4	Open Water	100	0	0	0	1.8478	184.78	6.03	6.03	3.26%

Percent Impervious and Initial Abstraction Basin Parameters											
Subbasin ID	gridcode	Land Cover	Percent Impervious	Canopy Storage (mm)	Depression Storage (mm)	Total Abstraction (mm)	Area Watershed (km2)	Area Watershed (ha)	Area Soil Texture (ha)	Impervious Area (ha)	Percentage of Watershed
Subbasin_128	5	Transportation	100	1	1	2	1.8478	184.78	3.88	3.88	2.10%
Subbasin_129	1	Forest	0	5	5	10	24.814	2481.4	439.54	0.00	17.71%
Subbasin_129	2	Agriculture	0	1	6	7	24.814	2481.4	1538.66	0.00	62.01%
Subbasin_129	3	Wetland	0	3	15	18	24.814	2481.4	416.17	0.00	16.77%
Subbasin_129	4	Open Water	100	0	0	0	24.814	2481.4	14.98	14.98	0.60%
Subbasin_129	5	Transportation	100	1	1	2	24.814	2481.4	53.10	53.10	2.14%
Subbasin_129	8	Extraction – Aggregate	0	0	5	5	24.814	2481.4	15.67	0.00	0.63%
Subbasin_130	1	Forest	0	5	5	10	5.4488	544.88	94.83	0.00	17.40%
Subbasin_130	2	Agriculture	0	1	6	7	5.4488	544.88	294.48	0.00	54.05%
Subbasin_130	3	Wetland	0	3	15	18	5.4488	544.88	133.51	0.00	24.50%
Subbasin_130	4	Open Water	100	0	0	0	5.4488	544.88	0.02	0.02	0.00%
Subbasin_130	5	Transportation	100	1	1	2	5.4488	544.88	12.58	12.58	2.31%
Subbasin_130	8	Extraction – Aggregate	0	0	5	5	5.4488	544.88	9.46	0.00	1.74%
Subbasin_131	1	Forest	0	5	5	10	3.1071	310.71	72.72	0.00	23.40%
Subbasin_131	2	Agriculture	0	1	6	7	3.1071	310.71	136.58	0.00	43.96%
Subbasin_131	3	Wetland	0	3	15	18	3.1071	310.71	91.05	0.00	29.30%
Subbasin_131	4	Open Water	100	0	0	0	3.1071	310.71	1.31	1.31	0.42%
Subbasin_131	5	Transportation	100	1	1	2	3.1071	310.71	8.70	8.70	2.80%
Subbasin_132	1	Forest	0	5	5	10	2.1852	218.52	52.49	0.00	24.02%
Subbasin_132	2	Agriculture	0	1	6	7	2.1852	218.52	128.94	0.00	59.00%
Subbasin_132	3	Wetland	0	3	15	18	2.1852	218.52	25.78	0.00	11.80%
Subbasin_132	4	Open Water	100	0	0	0	2.1852	218.52	5.55	5.55	2.54%
Subbasin_132	5	Transportation	100	1	1	2	2.1852	218.52	5.33	5.33	2.44%
Subbasin_133	1	Forest	0	5	5	10	2.5688	256.88	47.57	0.00	18.52%
Subbasin_133	2	Agriculture	0	1	6	7	2.5688	256.88	119.27	0.00	46.43%
Subbasin_133	3	Wetland	0	3	15	18	2.5688	256.88	50.50	0.00	19.66%
Subbasin_133	4	Open Water	100	0	0	0	2.5688	256.88	2.46	2.46	0.96%
Subbasin_133	5	Transportation	100	1	1	2	2.5688	256.88	8.08	8.08	3.15%
Subbasin_133	6	Built -Up Area – Pervious	10	1	4	5	2.5688	256.88	9.76	0.98	3.80%
Subbasin_133	7	Built -Up Area – Impervious	45	1	1	2	2.5688	256.88	10.07	4.53	3.92%
Subbasin_133	8	Extraction – Aggregate	0	0	5	5	2.5688	256.88	7.85	0.00	3.06%
Subbasin_134	1	Forest	0	5	5	10	0.2685	26.85	2.11	0.00	7.86%
Subbasin_134	2	Agriculture	0	1	6	7	0.2685	26.85	0.07	0.00	0.26%
Subbasin_134	3	Wetland	0	3	15	18	0.2685	26.85	3.82	0.00	14.22%
Subbasin_134	5	Transportation	100	1	1	2	0.2685	26.85	4.41	4.41	16.42%
Subbasin_134	6	Built -Up Area – Pervious	10	1	4	5	0.2685	26.85	2.89	0.29	10.76%
Subbasin_134	7	Built -Up Area – Impervious	45	1	1	2	0.2685	26.85	13.36	6.01	49.77%
Subbasin_135	1	Forest	0	5	5	10	0.3158	31.58	2.21	0.00	7.00%
Subbasin_135	2	Agriculture	0	1	6	7	0.3158	31.58	4.89	0.00	15.49%
Subbasin_135	5	Transportation	100	1	1	2	0.3158	31.58	3.15	3.15	9.98%
Subbasin_135	7	Built -Up Area – Impervious	45	1	1	2	0.3158	31.58	20.38	9.17	64.54%
Subbasin_135	8	Extraction – Aggregate	0	0	5	5	0.3158	31.58	0.71	0.00	2.26%
Subbasin_136	1	Forest	0	5	5	10	1.7062	170.62	20.49	0.00	12.01%
Subbasin_136	2	Agriculture	0	1	6	7	1.7062	170.62	65.23	0.00	38.23%
Subbasin_136	3	Wetland	0	3	15	18	1.7062	170.62	12.15	0.00	7.12%
Subbasin_136	4	Open Water	100	0	0	0	1.7062	170.62	3.89	3.89	2.28%
Subbasin_136	5	Transportation	100	1	1	2	1.7062	170.62	15.09	15.09	8.85%
Subbasin_136	6	Built -Up Area – Pervious	10	1	4	5	1.7062	170.62	11.16	1.12	6.54%
Subbasin_136	7	Built -Up Area – Impervious	45	1	1	2	1.7062	170.62	42.40	19.08	24.85%
Subbasin_137	1	Forest	0	5	5	10	0.282	28.2	0.25	0.00	0.88%
Subbasin_137	2	Agriculture	0	1	6	7	0.282	28.2	0.87	0.00	3.08%
Subbasin_137	5	Transportation	100	1	1	2	0.282	28.2	7.09	7.09	25.15%
Subbasin_137	7	Built -Up Area – Impervious	45	1	1	2	0.282	28.2	19.68	8.86	69.80%
Subbasin_138	1	Forest	0	5	5	10	4.8845	488.45	83.65	0.00	17.13%
Subbasin_138	2	Agriculture	0	1	6	7	4.8845	488.45	226.02	0.00	46.27%
Subbasin_138	3	Wetland	0	3	15	18	4.8845	488.45	69.77	0.00	14.28%
Subbasin_138	4	Open Water	100	0	0	0	4.8845	488.45	7.57	7.57	1.55%
Subbasin_138	5	Transportation	100	1	1	2	4.8845	488.45	23.19	23.19	4.75%
Subbasin_138	6	Built -Up Area – Pervious	10	1	4	5	4.8845	488.45	13.79	1.38	2.82%
Subbasin_138	7	Built -Up Area – Impervious	45	1	1	2	4.8845	488.45	62.73	28.23	12.84%

Appendix B3

Model Results

Hydrologic Peak Flow Results - Existing Conditions	1

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Calibrated

Areal Reduction Factor: Hazel 0.766; Durham 1.0

Peak Flow Results

Hazel ARF Durham=1, ARF Saugeen=0.766					1% AEP 6 Hour SCS Type 2 - ARF Durham=1, ARF Saugeen=1				
Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)	Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.8	37.1	17 October 1954, 03:15	168.38	Subbasin_129	24.8	15.4	1 January 2100, 09:00	51.38
Subbasin_130	5.4	10.8	17 October 1954, 01:40	198.08	Subbasin_130	5.4	4.6	1 January 2100, 07:05	60.70
Junction_116	30.3	47.5	17 October 1954, 02:45	173.73	Junction_116	30.3	19.8	1 January 2100, 08:25	53.06
Subbasin_101	36.1	10.6	17 October 1954, 23:00	62.35	Subbasin_101	36.1	4.4	2 January 2100, 04:55	16.55
Subbasin_102	12.7	18.9	17 October 1954, 02:30	156.41	Subbasin_102	12.7	8.2	1 January 2100, 08:00	49.48
Junction_101	48.8	25.3	17 October 1954, 03:50	86.85	Junction_101	48.8	10.7	1 January 2100, 09:20	25.13
Reach_1001	48.8	25.2	17 October 1954, 05:00	86.17	Reach_1001	48.8	10.7	1 January 2100, 10:35	24.75
Subbasin_103	24.4	28.4	17 October 1954, 03:35	131.80	Subbasin_103	24.4	12.6	1 January 2100, 09:10	43.27
Subbasin_104	1.2	2.7	17 October 1954, 01:00	219.76	Subbasin_104	1.2	1.2	1 January 2100, 06:20	68.98
Junction_102	74.4	55.5	17 October 1954, 04:10	103.23	Junction_102	74.4	24.1	1 January 2100, 09:35	31.52
Reach_1002	74.4	55.4	17 October 1954, 07:35	100.50	Reach_1002	74.4	24.1	1 January 2100, 12:20	29.79
Subbasin_105	21.0	33.0	17 October 1954, 02:35	168.17	Subbasin_105	21.0	14.0	1 January 2100, 08:10	52.37
Subbasin_106	18.3	17.1	17 October 1954, 05:00	114.09	Subbasin_106	18.3	7.7	1 January 2100, 10:35	38.88
Junction_103	39.3	49.5	17 October 1954, 03:10	142.98	Junction_103	39.3	21.5	1 January 2100, 08:50	46.08
Reach_1003	39.3	49.4	17 October 1954, 03:50	141.82	Reach_1003	39.3	21.5	1 January 2100, 09:35	45.34
Subbasin_107	20.7	27.3	17 October 1954, 02:55	143.11	Subbasin_107	20.7	12.0	1 January 2100, 08:25	46.37
Subbasin_108	3.3	10.3	17 October 1954, 00:05	270.26	Subbasin_108	3.3	5.2	1 January 2100, 05:05	93.06
Junction_104	137.7	131.0	17 October 1954, 04:40	122.80	Junction_104	137.7	58.0	1 January 2100, 10:30	38.25
Reach_1004	137.7	127.1	17 October 1954, 10:25	117.18	Reach_1004	137.7	55.9	1 January 2100, 15:55	34.71
Subbasin_109	11.4	10.8	17 October 1954, 04:55	116.45	Subbasin_109	11.4	4.7	1 January 2100, 10:30	37.50
Subbasin_110	9.5	13.4	17 October 1954, 02:55	154.66	Subbasin_110	9.5	5.8	1 January 2100, 08:30	48.82
Junction_105	158.5	146.0	17 October 1954, 09:55	119.37	Junction_105	158.5	64.1	1 January 2100, 15:35	35.76
Reach_1005	158.5	119.5	17 October 1954, 18:15	109.54	Reach_1005	158.5	52.7	1 January 2100, 24:00	30.75
Subbasin_111	25.6	17.1	17 October 1954, 09:20	100.47	Subbasin_111	25.6	7.0	1 January 2100, 15:10	31.53
Subbasin_112	6.8	4.8	17 October 1954, 08:25	103.04	Subbasin_112	6.8	2.0	1 January 2100, 14:20	32.45
Junction_106	190.9	138.6	17 October 1954, 17:45	108.09	Junction_106	190.9	60.6	1 January 2100, 23:40	30.91
Reach_1006	190.9	138.3	17 October 1954, 18:30	106.65	Reach_1006	190.9	60.4	2 January 2100, 00:40	29.94
Subbasin_113	8.0	12.3	17 October 1954, 02:20	160.52	Subbasin_113	8.0	5.4	1 January 2100, 07:50	51.50
Junction_107	198.9	142.5	17 October 1954, 18:30	108.81	Junction_107	198.9	62.2	2 January 2100, 00:40	30.81
Reach_1007	198.9	142.0	17 October 1954, 18:55	108.23	Reach_1007	198.9	61.5	2 January 2100, 01:25	30.44
Subbasin_114	17.0	18.5	17 October 1954, 03:45	122.99	Subbasin_114	17.0	8.3	1 January 2100, 09:15	41.24
Subbasin_115	1.4	4.4	17 October 1954, 00:20	285.25	Subbasin_115	1.4	2.1	1 January 2100, 05:25	92.47
Junction_108	217.3	151.1	17 October 1954, 18:15	110.50	Junction_108	217.3	65.3	2 January 2100, 01:00	31.68
Reach_1008	217.3	151.1	17 October 1954, 18:20	110.36	Reach_1008	217.3	65.3	2 January 2100, 01:10	31.58
Subbasin_116	1.3	5.2	16 October 1954, 23:50	355.19	Subbasin_116	1.3	2.7	1 January 2100, 04:50	121.30
Junction_109	218.6	152.7	17 October 1954, 18:20	111.78	Junction_109	218.6	66.1	2 January 2100, 01:05	32.10
Reach_1009	218.6	152.6	17 October 1954, 19:45	109.76	Reach_1009	218.6	66.0	2 January 2100, 02:50	30.77
Subbasin_117	9.5	13.1	17 October 1954, 03:50	160.85	Subbasin_117	9.5	5.4	1 January 2100, 09:35	48.83
Subbasin_118	9.2	28.1	17 October 1954, 00:20	274.14	Subbasin_118	9.2	13.4	1 January 2100, 05:30	90.29

Junction_110	237.3	166.9	17 October 1954, 19:15	118.20	Junction_110	237.3	72.2	2 January 2100, 02:35	33.81
Reach_1010	237.3	166.9	17 October 1954, 19:30	117.76	Reach_1010	237.3	72.2	2 January 2100, 02:55	33.51
Subbasin_119	4.5	19.6	16 October 1954, 23:40	383.41	Subbasin_119	4.5	11.0	1 January 2100, 04:40	141.07
Subbasin_120	3.3	13.1	16 October 1954, 24:00	348.28	Subbasin_120	3.3	6.4	1 January 2100, 05:05	115.00
Junction_111	245.0	176.8	17 October 1954, 19:25	125.68	Junction_111	245.0	77.4	2 January 2100, 02:50	36.56
Reach_1011	245.0	176.8	17 October 1954, 19:55	124.70	Reach_1011	245.0	77.4	2 January 2100, 03:30	35.87
Subbasin_121	15.0	21.9	17 October 1954, 03:10	163.02	Subbasin_121	15.0	9.0	1 January 2100, 08:55	49.50
Subbasin_122	4.2	12.8	17 October 1954, 00:25	277.94	Subbasin_122	4.2	5.8	1 January 2100, 05:40	87.47
Junction_112	264.2	188.4	17 October 1954, 19:50	129.31	Junction_112	264.2	82.2	2 January 2100, 03:30	37.46
Reach_1012	264.2	188.4	17 October 1954, 20:50	127.07	Reach_1012	264.2	82.2	2 January 2100, 05:05	35.92
Subbasin_123	9.5	32.1	17 October 1954, 00:15	303.51	Subbasin_123	9.5	15.1	1 January 2100, 05:25	97.45
Subbasin_124	5.4	12.8	17 October 1954, 01:05	227.50	Subbasin_124	5.4	5.4	1 January 2100, 06:30	68.33
Junction_113	279.2	202.3	17 October 1954, 20:40	135.05	Junction_113	279.2	88.4	2 January 2100, 05:00	38.66
Reach_1013	279.2	202.3	17 October 1954, 21:15	134.24	Reach_1013	279.2	88.4	2 January 2100, 05:30	38.08
Subbasin_125	9.0	25.6	17 October 1954, 00:30	259.35	Subbasin_125	9.0	11.7	1 January 2100, 05:45	81.91
Subbasin_126	7.7	18.2	17 October 1954, 00:45	218.94	Subbasin_126	7.7	8.1	1 January 2100, 06:05	69.15
Junction_114	296.0	216.0	17 October 1954, 20:35	140.27	Junction_114	296.0	94.4	2 January 2100, 05:25	40.23
Reach_1014	296.0	216.0	17 October 1954, 21:05	139.22	Reach_1014	296.0	94.4	2 January 2100, 06:10	39.51
Subbasin_127	11.4	19.0	17 October 1954, 02:15	173.26	Subbasin_127	11.4	8.1	1 January 2100, 07:45	53.97
Subbasin_128	1.8	8.8	16 October 1954, 23:30	404.61	Subbasin_128	1.8	5.0	1 January 2100, 04:30	151.46
Junction_115	309.2	224.9	17 October 1954, 20:55	142.06	Junction_115	309.2	98.4	2 January 2100, 06:05	40.71
Reach_1015	309.2	224.8	17 October 1954, 21:35	141.28	Reach_1015	309.2	98.4	2 January 2100, 06:50	40.25
Subbasin_132	2.2	10.8	16 October 1954, 23:15	408.21	Subbasin_132	2.2	6.8	1 January 2100, 04:05	166.65
Saugeen Flow Gauge	311.4	228.0	17 October 1954, 21:30	143.16	Saugeen Flow Gauge	311.4	100.3	2 January 2100, 06:50	41.14
Reach_1016	30.3	47.5	17 October 1954, 03:55	172.59	Reach_1016	30.3	19.8	1 January 2100, 09:35	52.41
Subbasin_131	3.1	17.0	16 October 1954, 23:15	116.15	Subbasin_131	3.1	10.4	1 January 2100, 04:15	45.75
Junction_117	344.8	273.0	17 October 1954, 04:25	145.50	Junction_117	344.8	112.4	1 January 2100, 09:50	42.17
Reach_1017	344.8	272.9	17 October 1954, 04:35	145.21	Reach_1017	344.8	112.4	1 January 2100, 10:00	41.97
Subbasin_133	2.6	10.0	16 October 1954, 23:45	332.75	Subbasin_133	2.6	5.3	1 January 2100, 04:40	118.55
Junction_118	347.3	276.4	17 October 1954, 04:35	146.59	Junction_118	347.3	114.2	1 January 2100, 10:00	42.53
Reach_1018	347.3	276.4	17 October 1954, 04:50	146.21	Reach_1018	347.3	114.2	1 January 2100, 10:15	42.27
Subbasin_136	1.7	7.6	16 October 1954, 23:20	107.63	Subbasin_136	1.7	5.2	1 January 2100, 04:15	48.41
Subbasin_134	0.3	2.3	17 October 1954, 00:05	206.89	Subbasin_134	0.3	1.4	1 January 2100, 05:05	61.15
Junction_119	0.3	2.3	17 October 1954, 00:05	206.89	Junction_119	0.3	1.4	1 January 2100, 05:05	61.15
Reach_1019	0.3	2.3	17 October 1954, 00:15	206.74	Reach_1019	0.3	1.4	1 January 2100, 05:20	60.96
Subbasin_135	0.3	3.2	16 October 1954, 22:35	153.49	Subbasin_135	0.3	3.0	1 January 2100, 03:45	52.00
Junction_120	0.6	4.6	16 October 1954, 23:10	177.96	Junction_120	0.6	3.4	1 January 2100, 03:50	56.12
Reach_1020	0.6	4.6	16 October 1954, 23:20	177.97	Reach_1020	0.6	3.4	1 January 2100, 04:00	56.14
Subbasin_137	0.3	3.2	16 October 1954, 22:25	191.88	Subbasin_137	0.3	3.4	1 January 2100, 03:40	62.65
OutflowDurham	0.9	7.4	16 October 1954, 22:45	182.50	OutflowDurham	0.9	6.3	1 January 2100, 03:50	58.26
Junction_121	349.9	277.7	17 October 1954, 04:45	146.11	Junction_121	349.9	114.9	1 January 2100, 10:15	42.34
Reach_1021	349.9	275.2	17 October 1954, 05:45	143.89	Reach_1021	349.9	111.6	1 January 2100, 12:10	40.77
Subbasin_138	4.9	23.7	17 October 1954, 00:35	400.74	Subbasin_138	4.9	15.8	1 January 2100, 05:35	171.83
Sink-1	354.8	283.4	17 October 1954, 05:45	147.42	Sink-1	354.8	116.9	1 January 2100, 12:10	42.58

Hydrologic Peak Flow Results - Existing Conditions

2

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Calibrated
Areal Reduction Factor: 1.0

Peak Flow Results

2% AEP 6 Hour SCS Type 2

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.8	13.2	1 January 2100, 09:00	43.98
Subbasin_130	5.4	3.9	1 January 2100, 07:05	51.64
Junction_116	30.3	16.9	1 January 2100, 08:25	45.35
Subbasin_101	36.1	3.7	2 January 2100, 04:55	13.93
Subbasin_102	12.7	6.9	1 January 2100, 08:00	41.75
Junction_101	48.8	9.1	1 January 2100, 09:20	21.18
Reach_1001	48.8	9.0	1 January 2100, 10:30	20.87
Subbasin_103	24.4	10.6	1 January 2100, 09:10	36.60
Subbasin_104	1.2	1.0	1 January 2100, 06:20	58.54
Junction_102	74.4	20.4	1 January 2100, 09:35	26.62
Reach_1002	74.4	20.3	1 January 2100, 12:25	25.16
Subbasin_105	21.0	12.0	1 January 2100, 08:10	44.58
Subbasin_106	18.3	6.6	1 January 2100, 10:35	33.06
Junction_103	39.3	18.3	1 January 2100, 08:50	39.21
Reach_1003	39.3	18.3	1 January 2100, 09:40	38.57
Subbasin_107	20.7	10.2	1 January 2100, 08:25	39.15
Subbasin_108	3.3	4.4	1 January 2100, 05:05	79.20
Junction_104	137.7	49.0	1 January 2100, 10:35	32.40
Reach_1004	137.7	47.2	1 January 2100, 16:15	29.34
Subbasin_109	11.4	3.9	1 January 2100, 10:30	31.53
Subbasin_110	9.5	4.9	1 January 2100, 08:30	41.48
Junction_105	158.5	54.0	1 January 2100, 15:55	30.23
Reach_1005	158.5	44.0	2 January 2100, 01:05	25.86
Subbasin_111	25.6	5.9	1 January 2100, 15:10	26.67
Subbasin_112	6.8	1.7	1 January 2100, 14:20	27.43
Junction_106	190.9	50.5	2 January 2100, 00:45	26.03
Reach_1006	190.9	50.3	2 January 2100, 01:45	25.19
Subbasin_113	8.0	4.6	1 January 2100, 07:50	43.67
Junction_107	198.9	51.8	2 January 2100, 01:45	25.94
Reach_1007	198.9	51.3	2 January 2100, 02:30	25.61
Subbasin_114	17.0	7.0	1 January 2100, 09:15	34.76
Subbasin_115	1.4	1.8	1 January 2100, 05:25	79.15
Junction_108	217.3	54.3	2 January 2100, 02:30	26.67
Reach_1008	217.3	54.3	2 January 2100, 02:35	26.58
Subbasin_116	1.3	2.3	1 January 2100, 04:45	103.47
Junction_109	218.6	55.0	2 January 2100, 02:35	27.03
Reach_1009	218.6	54.9	2 January 2100, 04:15	25.85
Subbasin_117	9.5	4.6	1 January 2100, 09:35	41.52
Subbasin_118	9.2	11.5	1 January 2100, 05:25	77.29

4% AEP 6 Hour SCS Type 2

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.8	10.8	1 January 2100, 09:00	36.21
Subbasin_130	5.4	3.2	1 January 2100, 07:05	42.12
Junction_116	30.3	13.9	1 January 2100, 08:25	37.27
Subbasin_101	36.1	3.0	2 January 2100, 04:55	11.18
Subbasin_102	12.7	5.6	1 January 2100, 08:00	33.69
Junction_101	48.8	7.3	1 January 2100, 09:20	17.04
Reach_1001	48.8	7.3	1 January 2100, 10:30	16.81
Subbasin_103	24.4	8.6	1 January 2100, 09:10	29.54
Subbasin_104	1.2	0.8	1 January 2100, 06:20	47.53
Junction_102	74.4	16.5	1 January 2100, 09:35	21.47
Reach_1002	74.4	16.4	1 January 2100, 12:35	20.29
Subbasin_105	21.0	9.8	1 January 2100, 08:10	36.36
Subbasin_106	18.3	5.3	1 January 2100, 10:35	26.78
Junction_103	39.3	14.9	1 January 2100, 08:50	31.90
Reach_1003	39.3	14.9	1 January 2100, 09:40	31.36
Subbasin_107	20.7	8.2	1 January 2100, 08:25	31.53
Subbasin_108	3.3	3.6	1 January 2100, 05:05	64.70
Junction_104	137.7	39.6	1 January 2100, 10:40	26.21
Reach_1004	137.7	38.0	1 January 2100, 16:45	23.70
Subbasin_109	11.4	3.1	1 January 2100, 10:30	25.16
Subbasin_110	9.5	4.0	1 January 2100, 08:30	33.76
Junction_105	158.5	43.4	1 January 2100, 16:20	24.41
Reach_1005	158.5	34.4	2 January 2100, 02:15	20.58
Subbasin_111	25.6	4.8	1 January 2100, 15:10	21.56
Subbasin_112	6.8	1.4	1 January 2100, 14:20	22.13
Junction_106	190.9	39.4	2 January 2100, 01:50	20.77
Reach_1006	190.9	39.3	2 January 2100, 03:00	20.09
Subbasin_113	8.0	3.7	1 January 2100, 07:50	35.42
Junction_107	198.9	40.5	2 January 2100, 02:55	20.70
Reach_1007	198.9	40.2	2 January 2100, 03:40	20.43
Subbasin_114	17.0	5.6	1 January 2100, 09:15	27.70
Subbasin_115	1.4	1.4	1 January 2100, 05:25	65.14
Junction_108	217.3	42.5	2 January 2100, 03:40	21.29
Reach_1008	217.3	42.5	2 January 2100, 03:45	21.21
Subbasin_116	1.3	1.9	1 January 2100, 04:45	85.13
Junction_109	218.6	43.1	2 January 2100, 03:45	21.58
Reach_1009	218.6	43.0	2 January 2100, 05:30	20.58
Subbasin_117	9.5	3.8	1 January 2100, 09:35	34.08
Subbasin_118	9.2	9.5	1 January 2100, 05:25	63.60

Junction_110	237.3	60.0	2 January 2100, 04:10	28.48
Reach_1010	237.3	60.0	2 January 2100, 04:30	28.21
Subbasin_119	4.5	9.5	1 January 2100, 04:35	122.01
Subbasin_120	3.3	5.5	1 January 2100, 05:00	97.97
Junction_111	245.0	64.4	2 January 2100, 04:25	30.86
Reach_1011	245.0	64.4	2 January 2100, 05:05	30.25
Subbasin_121	15.0	7.7	1 January 2100, 08:55	42.21
Subbasin_122	4.2	5.0	1 January 2100, 05:40	74.77
Junction_112	264.2	68.5	2 January 2100, 05:00	31.63
Reach_1012	264.2	68.5	2 January 2100, 06:40	30.28
Subbasin_123	9.5	13.0	1 January 2100, 05:25	83.54
Subbasin_124	5.4	4.6	1 January 2100, 06:30	58.09
Junction_113	279.2	73.7	2 January 2100, 06:30	32.64
Reach_1013	279.2	73.7	2 January 2100, 07:00	32.13
Subbasin_125	9.0	9.9	1 January 2100, 05:45	69.73
Subbasin_126	7.7	6.9	1 January 2100, 06:05	58.47
Junction_114	296.0	78.7	2 January 2100, 06:55	33.97
Reach_1014	296.0	78.7	2 January 2100, 07:40	33.33
Subbasin_127	11.4	6.9	1 January 2100, 07:45	45.85
Subbasin_128	1.8	4.3	1 January 2100, 04:25	130.20
Junction_115	309.2	82.1	2 January 2100, 07:35	34.37
Reach_1015	309.2	82.1	2 January 2100, 08:15	33.99
Subbasin_132	2.2	5.8	1 January 2100, 04:05	143.01
Saugeen Flow Gauge	311.4	83.7	2 January 2100, 08:15	34.75
Reach_1016	30.3	16.9	1 January 2100, 09:30	44.80
Subbasin_131	3.1	9.0	1 January 2100, 04:10	39.02
Junction_117	344.8	95.5	1 January 2100, 09:55	35.67
Reach_1017	344.8	95.5	1 January 2100, 10:10	35.49
Subbasin_133	2.6	4.5	1 January 2100, 04:40	101.33
Junction_118	347.3	97.0	1 January 2100, 10:10	35.98
Reach_1018	347.3	97.0	1 January 2100, 10:20	35.74
Subbasin_136	1.7	4.6	1 January 2100, 04:15	42.36
Subbasin_134	0.3	1.3	1 January 2100, 05:05	54.41
Junction_119	0.3	1.3	1 January 2100, 05:05	54.41
Reach_1019	0.3	1.2	1 January 2100, 05:20	54.25
Subbasin_135	0.3	2.6	1 January 2100, 03:45	46.22
Junction_120	0.6	3.0	1 January 2100, 03:50	49.91
Reach_1020	0.6	3.0	1 January 2100, 04:00	49.93
Subbasin_137	0.3	3.0	1 January 2100, 03:40	56.28
OutflowDurham	0.9	5.6	1 January 2100, 03:50	52.00
Junction_121	349.9	97.6	1 January 2100, 10:20	35.82
Reach_1021	349.9	94.7	1 January 2100, 12:20	34.44
Subbasin_138	4.9	13.6	1 January 2100, 05:35	148.32
Sink-1	354.8	99.3	1 January 2100, 12:20	36.01

Junction_110	237.3	47.2	2 January 2100, 05:25	22.79
Reach_1010	237.3	47.2	2 January 2100, 05:45	22.56
Subbasin_119	4.5	8.0	1 January 2100, 04:35	102.10
Subbasin_120	3.3	4.5	1 January 2100, 05:00	80.03
Junction_111	245.0	50.8	2 January 2100, 05:40	24.78
Reach_1011	245.0	50.8	2 January 2100, 06:30	24.26
Subbasin_121	15.0	6.3	1 January 2100, 08:55	34.50
Subbasin_122	4.2	4.1	1 January 2100, 05:40	61.42
Junction_112	264.2	54.1	2 January 2100, 06:25	25.43
Reach_1012	264.2	54.1	2 January 2100, 08:10	24.29
Subbasin_123	9.5	10.7	1 January 2100, 05:25	68.84
Subbasin_124	5.4	3.8	1 January 2100, 06:30	47.26
Junction_113	279.2	58.3	2 January 2100, 08:05	26.26
Reach_1013	279.2	58.3	2 January 2100, 08:40	25.81
Subbasin_125	9.0	8.1	1 January 2100, 05:45	56.95
Subbasin_126	7.7	5.6	1 January 2100, 06:05	47.27
Junction_114	296.0	62.3	2 January 2100, 08:30	27.32
Reach_1014	296.0	62.3	2 January 2100, 09:20	26.79
Subbasin_127	11.4	5.6	1 January 2100, 07:45	37.32
Subbasin_128	1.8	3.6	1 January 2100, 04:25	108.27
Junction_115	309.2	65.1	2 January 2100, 09:15	27.67
Reach_1015	309.2	65.0	2 January 2100, 09:55	27.35
Subbasin_132	2.2	4.8	1 January 2100, 04:05	117.96
Saugeen Flow Gauge	311.4	66.4	2 January 2100, 09:55	27.99
Reach_1016	30.3	13.9	1 January 2100, 09:30	36.81
Subbasin_131	3.1	7.4	1 January 2100, 04:10	32.08
Junction_117	344.8	77.8	1 January 2100, 10:05	28.80
Reach_1017	344.8	77.7	1 January 2100, 10:20	28.65
Subbasin_133	2.6	3.7	1 January 2100, 04:40	83.30
Junction_118	347.3	79.0	1 January 2100, 10:20	29.05
Reach_1018	347.3	79.0	1 January 2100, 10:35	28.85
Subbasin_136	1.7	3.8	1 January 2100, 04:15	35.79
Subbasin_134	0.3	1.1	1 January 2100, 05:05	47.26
Junction_119	0.3	1.1	1 January 2100, 05:05	47.26
Reach_1019	0.3	1.1	1 January 2100, 05:20	47.11
Subbasin_135	0.3	2.3	1 January 2100, 03:45	39.95
Junction_120	0.6	2.6	1 January 2100, 03:50	43.24
Reach_1020	0.6	2.6	1 January 2100, 04:00	43.26
Subbasin_137	0.3	2.7	1 January 2100, 03:40	49.42
OutflowDurham	0.9	4.8	1 January 2100, 03:50	45.27
Junction_121	349.9	79.5	1 January 2100, 10:30	28.92
Reach_1021	349.9	77.1	1 January 2100, 12:30	27.76
Subbasin_138	4.9	11.2	1 January 2100, 05:40	122.75
Sink-1	354.8	80.9	1 January 2100, 12:30	29.07

Hydrologic Peak Flow Results - Existing Conditions | 3

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Calibrated **Areal Reduction Factor:** 1.0

Peak Flow Results

10% AEP 6 Hour SCS Type 2

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.8	8.1	1 January 2100, 09:00	27.10
Subbasin_130	5.4	2.3	1 January 2100, 07:10	30.92
Junction_116	30.3	10.4	1 January 2100, 08:25	27.79
Subbasin_101	36.1	2.1	2 January 2100, 05:00	7.84
Subbasin_102	12.7	3.9	1 January 2100, 08:00	23.83
Junction_101	48.8	5.1	1 January 2100, 09:20	12.00
Reach_1001	48.8	5.1	1 January 2100, 10:25	11.85
Subbasin_103	24.4	6.1	1 January 2100, 09:10	20.87
Subbasin_104	1.2	0.6	1 January 2100, 06:20	34.58
Junction_102	74.4	11.6	1 January 2100, 09:30	15.16
Reach_1002	74.4	11.6	1 January 2100, 12:45	14.33
Subbasin_105	21.0	7.2	1 January 2100, 08:10	26.69
Subbasin_106	18.3	3.8	1 January 2100, 10:40	19.13
Junction_103	39.3	10.8	1 January 2100, 08:50	23.17
Reach_1003	39.3	10.8	1 January 2100, 09:45	22.76
Subbasin_107	20.7	5.7	1 January 2100, 08:25	22.15
Subbasin_108	3.3	2.6	1 January 2100, 05:05	46.86
Junction_104	137.7	28.2	1 January 2100, 11:10	18.70
Reach_1004	137.7	27.0	1 January 2100, 17:25	17.01
Subbasin_109	11.4	2.2	1 January 2100, 10:35	17.35
Subbasin_110	9.5	2.9	1 January 2100, 08:30	24.48
Junction_105	158.5	30.6	1 January 2100, 17:05	17.48
Reach_1005	158.5	24.5	2 January 2100, 03:15	14.78
Subbasin_111	25.6	3.5	1 January 2100, 15:10	15.55
Subbasin_112	6.8	1.0	1 January 2100, 14:20	15.88
Junction_106	190.9	28.0	2 January 2100, 02:45	14.93
Reach_1006	190.9	27.7	2 January 2100, 04:45	14.36
Subbasin_113	8.0	2.7	1 January 2100, 07:50	25.28
Junction_107	198.9	28.6	2 January 2100, 04:40	14.80
Reach_1007	198.9	28.4	2 January 2100, 05:15	14.60
Subbasin_114	17.0	3.9	1 January 2100, 09:15	19.32
Subbasin_115	1.4	1.1	1 January 2100, 05:25	48.69
Junction_108	217.3	30.1	2 January 2100, 05:10	15.19
Reach_1008	217.3	30.1	2 January 2100, 05:20	15.13
Subbasin_116	1.3	1.4	1 January 2100, 04:45	63.34
Junction_109	218.6	30.5	2 January 2100, 05:20	15.41
Reach_1009	218.6	30.5	2 January 2100, 07:00	14.64
Subbasin_117	9.5	2.8	1 January 2100, 09:35	25.29
Subbasin_118	9.2	7.1	1 January 2100, 05:30	47.54

20% AEP 6 Hour SCS Type 2

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.8	5.8	1 January 2100, 09:00	19.22
Subbasin_130	5.4	1.6	1 January 2100, 07:10	21.04
Junction_116	30.3	7.3	1 January 2100, 08:30	19.55
Subbasin_101	36.1	1.3	2 January 2100, 05:00	4.99
Subbasin_102	12.7	2.6	1 January 2100, 08:00	15.71
Junction_101	48.8	3.4	1 January 2100, 09:20	7.78
Reach_1001	48.8	3.4	1 January 2100, 10:05	7.69
Subbasin_103	24.4	4.1	1 January 2100, 09:10	14.10
Subbasin_104	1.2	0.4	1 January 2100, 06:20	23.19
Junction_102	74.4	7.8	1 January 2100, 09:20	10.03
Reach_1002	74.4	7.8	1 January 2100, 12:55	9.48
Subbasin_105	21.0	4.9	1 January 2100, 08:15	18.16
Subbasin_106	18.3	2.7	1 January 2100, 10:40	13.32
Junction_103	39.3	7.4	1 January 2100, 08:50	15.91
Reach_1003	39.3	7.4	1 January 2100, 09:55	15.63
Subbasin_107	20.7	3.9	1 January 2100, 08:30	14.85
Subbasin_108	3.3	1.8	1 January 2100, 05:10	32.67
Junction_104	137.7	19.0	1 January 2100, 11:15	12.60
Reach_1004	137.7	18.0	1 January 2100, 18:25	11.58
Subbasin_109	11.4	1.4	1 January 2100, 10:35	11.39
Subbasin_110	9.5	2.0	1 January 2100, 08:35	16.51
Junction_105	158.5	20.3	1 January 2100, 18:05	11.86
Reach_1005	158.5	16.7	2 January 2100, 04:35	10.14
Subbasin_111	25.6	2.3	1 January 2100, 15:10	10.21
Subbasin_112	6.8	0.6	1 January 2100, 14:20	10.34
Junction_106	190.9	18.9	2 January 2100, 04:00	10.15
Reach_1006	190.9	18.8	2 January 2100, 05:25	9.75
Subbasin_113	8.0	1.8	1 January 2100, 07:50	17.38
Junction_107	198.9	19.4	2 January 2100, 05:20	10.06
Reach_1007	198.9	19.3	2 January 2100, 05:55	9.91
Subbasin_114	17.0	2.6	1 January 2100, 09:15	12.96
Subbasin_115	1.4	0.8	1 January 2100, 05:30	34.34
Junction_108	217.3	20.4	2 January 2100, 05:50	10.31
Reach_1008	217.3	20.4	2 January 2100, 06:00	10.26
Subbasin_116	1.3	1.0	1 January 2100, 04:45	44.82
Junction_109	218.6	20.7	2 January 2100, 06:00	10.46
Reach_1009	218.6	20.7	2 January 2100, 07:55	9.90
Subbasin_117	9.5	2.0	1 January 2100, 09:35	17.83
Subbasin_118	9.2	5.0	1 January 2100, 05:30	33.29

Junction_110	237.3	33.5	2 January 2100, 06:50	16.34
Reach_1010	237.3	33.5	2 January 2100, 07:15	16.16
Subbasin_119	4.5	6.1	1 January 2100, 04:35	78.57
Subbasin_120	3.3	3.3	1 January 2100, 05:00	59.48
Junction_111	245.0	36.2	2 January 2100, 07:10	17.88
Reach_1011	245.0	36.2	2 January 2100, 08:05	17.49
Subbasin_121	15.0	4.6	1 January 2100, 08:55	25.45
Subbasin_122	4.2	3.1	1 January 2100, 05:40	45.74
Junction_112	264.2	38.6	2 January 2100, 07:55	18.39
Reach_1012	264.2	38.6	2 January 2100, 09:55	17.52
Subbasin_123	9.5	8.0	1 January 2100, 05:25	51.55
Subbasin_124	5.4	2.7	1 January 2100, 06:30	34.53
Junction_113	279.2	41.7	2 January 2100, 09:45	19.01
Reach_1013	279.2	41.7	2 January 2100, 10:25	18.66
Subbasin_125	9.0	6.0	1 January 2100, 05:45	41.91
Subbasin_126	7.7	4.0	1 January 2100, 06:05	33.63
Junction_114	296.0	44.6	2 January 2100, 10:15	19.76
Reach_1014	296.0	44.6	2 January 2100, 11:10	19.36
Subbasin_127	11.4	4.1	1 January 2100, 07:45	27.24
Subbasin_128	1.8	2.7	1 January 2100, 04:25	82.11
Junction_115	309.2	46.6	2 January 2100, 11:05	20.03
Reach_1015	309.2	46.6	2 January 2100, 11:35	19.79
Subbasin_132	2.2	3.6	1 January 2100, 04:05	87.76
Saugeen Flow Gauge	311.4	47.5	2 January 2100, 11:35	20.27
Reach_1016	30.3	10.4	1 January 2100, 09:25	27.44
Subbasin_131	3.1	5.6	1 January 2100, 04:10	24.05
Junction_117	344.8	57.0	1 January 2100, 10:20	20.93
Reach_1017	344.8	57.0	1 January 2100, 10:35	20.82
Subbasin_133	2.6	2.7	1 January 2100, 04:40	61.26
Junction_118	347.3	57.9	1 January 2100, 10:35	21.12
Reach_1018	347.3	57.9	1 January 2100, 10:50	20.95
Subbasin_136	1.7	3.0	1 January 2100, 04:15	28.26
Subbasin_134	0.3	0.9	1 January 2100, 05:05	38.72
Junction_119	0.3	0.9	1 January 2100, 05:05	38.72
Reach_1019	0.3	0.9	1 January 2100, 05:20	38.60
Subbasin_135	0.3	1.8	1 January 2100, 03:45	32.26
Junction_120	0.6	2.1	1 January 2100, 03:50	35.17
Reach_1020	0.6	2.0	1 January 2100, 04:05	35.19
Subbasin_137	0.3	2.2	1 January 2100, 03:40	41.01
OutflowDurham	0.9	3.9	1 January 2100, 03:50	37.09
Junction_121	349.9	58.2	1 January 2100, 10:45	21.03
Reach_1021	349.9	56.8	1 January 2100, 12:45	20.14
Subbasin_138	4.9	8.4	1 January 2100, 05:40	92.26
Sink-1	354.8	59.7	1 January 2100, 12:40	21.13

Junction_110	237.3	22.8	2 January 2100, 07:45	11.13
Reach_1010	237.3	22.8	2 January 2100, 08:15	10.99
Subbasin_119	4.5	4.6	1 January 2100, 04:40	58.24
Subbasin_120	3.3	2.3	1 January 2100, 05:00	41.89
Junction_111	245.0	24.8	2 January 2100, 08:05	12.27
Reach_1011	245.0	24.8	2 January 2100, 09:05	11.98
Subbasin_121	15.0	3.2	1 January 2100, 08:55	17.51
Subbasin_122	4.2	2.1	1 January 2100, 05:40	32.15
Junction_112	264.2	26.4	2 January 2100, 08:55	12.62
Reach_1012	264.2	26.4	2 January 2100, 11:05	11.99
Subbasin_123	9.5	5.7	1 January 2100, 05:25	36.61
Subbasin_124	5.4	1.9	1 January 2100, 06:35	23.44
Junction_113	279.2	28.6	2 January 2100, 10:55	13.05
Reach_1013	279.2	28.6	2 January 2100, 11:35	12.79
Subbasin_125	9.0	4.1	1 January 2100, 05:45	28.64
Subbasin_126	7.7	2.6	1 January 2100, 06:05	22.37
Junction_114	296.0	30.5	2 January 2100, 11:30	13.52
Reach_1014	296.0	30.5	2 January 2100, 12:25	13.24
Subbasin_127	11.4	2.8	1 January 2100, 07:50	18.40
Subbasin_128	1.8	2.0	1 January 2100, 04:25	59.79
Junction_115	309.2	31.8	2 January 2100, 12:20	13.71
Reach_1015	309.2	31.8	2 January 2100, 12:50	13.52
Subbasin_132	2.2	2.5	1 January 2100, 04:10	62.05
Saugeen Flow Gauge	311.4	32.6	1 January 2100, 10:20	13.86
Reach_1016	30.3	7.3	1 January 2100, 09:20	19.30
Subbasin_131	3.1	4.0	1 January 2100, 04:10	17.25
Junction_117	344.8	40.2	1 January 2100, 10:15	14.37
Reach_1017	344.8	40.1	1 January 2100, 10:30	14.29
Subbasin_133	2.6	1.9	1 January 2100, 04:40	43.40
Junction_118	347.3	40.8	1 January 2100, 10:30	14.51
Reach_1018	347.3	40.8	1 January 2100, 10:50	14.38
Subbasin_136	1.7	2.3	1 January 2100, 04:20	22.12
Subbasin_134	0.3	0.7	1 January 2100, 05:05	31.18
Junction_119	0.3	0.7	1 January 2100, 05:05	31.18
Reach_1019	0.3	0.7	1 January 2100, 05:20	31.09
Subbasin_135	0.3	1.4	1 January 2100, 03:45	25.37
Junction_120	0.6	1.6	1 January 2100, 03:50	28.00
Reach_1020	0.6	1.6	1 January 2100, 04:05	28.02
Subbasin_137	0.3	1.8	1 January 2100, 03:40	33.51
OutflowDurham	0.9	3.0	1 January 2100, 03:50	29.81
Junction_121	349.9	41.0	1 January 2100, 10:45	14.46
Reach_1021	349.9	39.9	1 January 2100, 13:00	13.81
Subbasin_138	4.9	6.3	1 January 2100, 05:40	68.68
Sink-1	354.8	42.0	1 January 2100, 12:55	14.56

Hydrologic Peak Flow Results - Existing Conditions

4

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Calibrated

Areal Reduction Factor: 1.0

Peak Flow Results

50% AEP 6 Hour SCS Type 2

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.8	2.8	1 January 2100, 09:05	9.34
Subbasin_130	5.4	0.7	1 January 2100, 07:10	9.31
Junction_116	30.3	3.5	1 January 2100, 08:35	9.33
Subbasin_101	36.1	0.4	2 January 2100, 05:05	1.55
Subbasin_102	12.7	0.9	1 January 2100, 08:05	5.59
Junction_101	48.8	1.2	1 January 2100, 09:15	2.60
Reach_1001	48.8	1.2	1 January 2100, 09:55	2.57
Subbasin_103	24.4	1.5	1 January 2100, 09:15	5.21
Subbasin_104	1.2	0.2	1 January 2100, 06:25	9.10
Junction_102	74.4	2.8	1 January 2100, 09:20	3.54
Reach_1002	74.4	2.8	1 January 2100, 13:00	3.35
Subbasin_105	21.0	2.1	1 January 2100, 08:15	7.69
Subbasin_106	18.3	1.1	1 January 2100, 10:40	5.39
Junction_103	39.3	3.1	1 January 2100, 08:50	6.62
Reach_1003	39.3	3.1	1 January 2100, 10:10	6.51
Subbasin_107	20.7	1.4	1 January 2100, 08:35	5.22
Subbasin_108	3.3	0.8	1 January 2100, 05:10	14.42
Junction_104	137.7	7.3	1 January 2100, 11:20	4.80
Reach_1004	137.7	6.6	1 January 2100, 16:55	4.23
Subbasin_109	11.4	0.4	1 January 2100, 10:40	3.32
Subbasin_110	9.5	0.8	1 January 2100, 08:35	6.89
Junction_105	158.5	7.5	1 January 2100, 16:05	4.32
Reach_1005	158.5	6.5	2 January 2100, 01:25	3.72
Subbasin_111	25.6	0.9	1 January 2100, 15:15	3.91
Subbasin_112	6.8	0.2	1 January 2100, 14:25	3.78
Junction_106	190.9	7.4	2 January 2100, 01:00	3.75
Reach_1006	190.9	7.4	2 January 2100, 02:40	3.59
Subbasin_113	8.0	0.7	1 January 2100, 07:55	6.93
Junction_107	198.9	7.6	2 January 2100, 02:40	3.73
Reach_1007	198.9	7.6	2 January 2100, 03:10	3.66
Subbasin_114	17.0	0.8	1 January 2100, 09:20	4.02
Subbasin_115	1.4	0.4	1 January 2100, 05:30	16.40
Junction_108	217.3	8.0	2 January 2100, 03:10	3.77
Reach_1008	217.3	8.0	2 January 2100, 03:20	3.75
Subbasin_116	1.3	0.5	1 January 2100, 04:50	20.71
Junction_109	218.6	8.1	2 January 2100, 03:20	3.85
Reach_1009	218.6	8.1	2 January 2100, 05:50	3.66
Subbasin_117	9.5	0.9	1 January 2100, 09:40	8.05
Subbasin_118	9.2	2.4	1 January 2100, 05:35	16.41

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)

Junction_110	237.3	9.2	2 January 2100, 05:35	4.33						
Reach_1010	237.3	9.2	2 January 2100, 06:10	4.28						
Subbasin_119	4.5	2.5	1 January 2100, 04:40	32.05						
Subbasin_120	3.3	1.0	1 January 2100, 05:00	18.27						
Junction_111	245.0	10.2	2 January 2100, 06:00	4.97						
Reach_1011	245.0	10.2	2 January 2100, 07:05	4.87						
Subbasin_121	15.0	1.4	1 January 2100, 08:55	7.87						
Subbasin_122	4.2	1.0	1 January 2100, 05:45	15.14						
Junction_112	264.2	11.0	2 January 2100, 06:55	5.20						
Reach_1012	264.2	11.0	2 January 2100, 09:10	4.95						
Subbasin_123	9.5	2.8	1 January 2100, 05:30	18.07						
Subbasin_124	5.4	0.8	1 January 2100, 06:35	9.99						
Junction_113	279.2	12.0	2 January 2100, 09:00	5.50						
Reach_1013	279.2	12.0	2 January 2100, 09:55	5.39						
Subbasin_125	9.0	1.8	1 January 2100, 05:50	12.92						
Subbasin_126	7.7	1.0	1 January 2100, 06:10	8.40						
Junction_114	296.0	13.2	1 January 2100, 09:25	5.69						
Reach_1014	296.0	13.2	1 January 2100, 10:20	5.58						
Subbasin_127	11.4	1.2	1 January 2100, 07:50	7.93						
Subbasin_128	1.8	1.0	1 January 2100, 04:30	30.50						
Junction_115	309.2	14.6	1 January 2100, 10:20	5.82						
Reach_1015	309.2	14.6	1 January 2100, 10:50	5.73						
Subbasin_132	2.2	1.2	1 January 2100, 04:10	30.63						
Saugeen Flow Gauge	311.4	15.1	1 January 2100, 10:50	5.91						
Reach_1016	30.3	3.5	1 January 2100, 09:30	9.21						
Subbasin_131	3.1	1.9	1 January 2100, 04:10	8.13						
Junction_117	344.8	18.6	1 January 2100, 10:45	6.22						
Reach_1017	344.8	18.6	1 January 2100, 11:00	6.18						
Subbasin_133	2.6	0.9	1 January 2100, 04:45	20.49						
Junction_118	347.3	18.9	1 January 2100, 11:00	6.29						
Reach_1018	347.3	18.9	1 January 2100, 11:20	6.23						
Subbasin_136	1.7	1.4	1 January 2100, 04:20	13.38						
Subbasin_134	0.3	0.5	1 January 2100, 05:05	21.44						
Junction_119	0.3	0.5	1 January 2100, 05:05	21.44						
Reach_1019	0.3	0.5	1 January 2100, 05:20	21.40						
Subbasin_135	0.3	0.8	1 January 2100, 03:45	15.86						
Junction_120	0.6	0.9	1 January 2100, 03:50	18.40						
Reach_1020	0.6	0.9	1 January 2100, 04:05	18.42						
Subbasin_137	0.3	1.2	1 January 2100, 03:40	23.10						
OutflowDurham	0.9	1.9	1 January 2100, 03:50	19.94						
Junction_121	349.9	19.0	1 January 2100, 11:20	6.30						
Reach_1021	349.9	18.5	1 January 2100, 13:40	6.04						
Subbasin_138	4.9	3.2	1 January 2100, 05:40	35.42						
Sink-1	354.8	19.6	1 January 2100, 13:40	6.45						

Hydrologic Peak Flow Results - Climate Change

5

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Calibrated

Areal Reduction Factor: Hazel 0.766; Durham 1.0

Peak Flow Results

Regional Storm - Hurricane Hazel - Climate Change ΔT=2.94

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.81	49.400	17 October 1954, 03:10	225.2
Subbasin_130	5.45	14.420	17 October 1954, 01:35	266.7
Junction_116	30.26	63.360	17 October 1954, 02:40	232.7
Subbasin_101	36.12	14.740	17 October 1954, 22:50	87.3
Subbasin_102	12.72	26.110	17 October 1954, 02:20	217.1
Junction_101	48.84	35.030	17 October 1954, 03:45	121.1
Reach_1001	48.84	34.950	17 October 1954, 04:55	120.1
Subbasin_103	24.35	39.820	17 October 1954, 03:25	185.5
Subbasin_104	1.18	3.670	17 October 1954, 00:55	296.6
Junction_102	74.37	77.340	17 October 1954, 04:00	144.3
Reach_1002	74.37	77.160	17 October 1954, 06:55	140.7
Subbasin_105	21.00	44.420	17 October 1954, 02:30	227.6
Subbasin_106	18.32	24.120	17 October 1954, 04:50	161.9
Junction_103	39.31	67.800	17 October 1954, 03:05	197.0
Reach_1003	39.31	67.740	17 October 1954, 03:45	195.5
Subbasin_107	20.67	38.170	17 October 1954, 02:45	201.0
Subbasin_108	3.34	13.900	17 October 1954, 00:05	367.7
Junction_104	137.68	182.470	17 October 1954, 05:05	170.9
Reach_1004	137.68	175.910	17 October 1954, 09:50	163.4
Subbasin_109	11.36	15.280	17 October 1954, 04:45	164.7
Subbasin_110	9.48	18.310	17 October 1954, 02:50	211.9
Junction_105	158.53	202.840	17 October 1954, 09:25	166.4
Reach_1005	158.53	168.310	17 October 1954, 17:20	155.1
Subbasin_111	25.59	23.400	17 October 1954, 09:10	137.6
Subbasin_112	6.81	6.620	17 October 1954, 08:15	141.5
Junction_106	190.93	194.870	17 October 1954, 17:00	152.3
Reach_1006	190.93	194.340	17 October 1954, 17:40	150.5
Subbasin_113	7.99	16.920	17 October 1954, 02:10	222.9
Junction_107	198.92	200.140	17 October 1954, 17:40	153.4
Reach_1007	198.92	199.300	17 October 1954, 18:05	152.6
Subbasin_114	17.00	26.410	17 October 1954, 03:35	176.7
Subbasin_115	1.37	5.700	17 October 1954, 00:15	377.4
Junction_108	217.29	212.800	17 October 1954, 17:30	155.9
Reach_1008	217.29	212.790	17 October 1954, 17:35	155.7
Subbasin_116	1.27	6.710	16 October 1954, 23:50	463.6
Junction_109	218.56	214.870	17 October 1954, 17:35	157.5
Reach_1009	218.56	214.680	17 October 1954, 18:50	154.8
Subbasin_117	9.51	17.490	17 October 1954, 03:40	215.1
Subbasin_118	9.23	37.120	17 October 1954, 00:15	365.3

1% AEP 6 Hour SCS Type 2 Climate Change (ΔT=2.94), ARF Durham=1, ARF Saugeen=1

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.81	21.300	1 January 2100, 09:00	71.1
Subbasin_130	5.45	6.410	1 January 2100, 07:10	84.7
Junction_116	30.26	27.440	1 January 2100, 08:30	73.6
Subbasin_101	36.12	6.220	2 January 2100, 04:55	23.5
Subbasin_102	12.72	11.500	1 January 2100, 08:00	69.6
Junction_101	48.84	15.130	1 January 2100, 09:20	35.5
Reach_1001	48.84	15.090	1 January 2100, 10:40	34.9
Subbasin_103	24.35	17.570	1 January 2100, 09:10	60.5
Subbasin_104	1.18	1.700	1 January 2100, 06:20	97.0
Junction_102	74.37	33.830	1 January 2100, 09:40	44.3
Reach_1002	74.37	33.740	1 January 2100, 13:00	41.9
Subbasin_105	21.00	19.660	1 January 2100, 08:15	73.3
Subbasin_106	18.32	10.760	1 January 2100, 10:35	54.1
Junction_103	39.31	30.080	1 January 2100, 08:50	64.3
Reach_1003	39.31	30.050	1 January 2100, 09:35	63.4
Subbasin_107	20.67	16.860	1 January 2100, 08:25	65.0
Subbasin_108	3.34	7.170	1 January 2100, 05:10	128.9
Junction_104	137.68	81.420	1 January 2100, 10:20	53.6
Reach_1004	137.68	79.470	1 January 2100, 14:55	49.0
Subbasin_109	11.36	6.580	1 January 2100, 10:30	53.0
Subbasin_110	9.48	8.070	1 January 2100, 08:30	68.2
Junction_105	158.53	91.620	1 January 2100, 14:35	50.4
Reach_1005	158.53	75.100	1 January 2100, 22:20	43.5
Subbasin_111	25.59	9.850	1 January 2100, 15:10	44.4
Subbasin_112	6.81	2.800	1 January 2100, 14:20	45.7
Junction_106	190.93	86.560	1 January 2100, 22:05	43.7
Reach_1006	190.93	86.250	1 January 2100, 23:00	42.4
Subbasin_113	7.99	7.530	1 January 2100, 07:50	71.7
Junction_107	198.92	88.840	1 January 2100, 23:00	43.6
Reach_1007	198.92	88.000	1 January 2100, 23:40	43.1
Subbasin_114	17.00	11.740	1 January 2100, 09:15	58.1
Subbasin_115	1.37	2.840	1 January 2100, 05:30	127.9
Junction_108	217.29	94.090	1 January 2100, 23:15	44.8
Reach_1008	217.29	94.080	1 January 2100, 23:20	44.7
Subbasin_116	1.27	3.660	1 January 2100, 04:50	167.3
Junction_109	218.56	95.210	1 January 2100, 23:20	45.4
Reach_1009	218.56	95.090	2 January 2100, 00:55	43.7
Subbasin_117	9.51	7.470	1 January 2100, 09:40	67.8
Subbasin_118	9.23	18.540	1 January 2100, 05:30	124.5

Junction_110	237.30	234.120	17 October 1954, 18:25	165.4
Reach_1010	237.30	234.110	17 October 1954, 18:45	164.9
Subbasin_119	4.46	25.180	16 October 1954, 23:40	496.0
Subbasin_120	3.29	16.800	16 October 1954, 24:00	452.4
Junction_111	245.04	246.980	17 October 1954, 18:40	174.8
Reach_1011	245.04	246.960	17 October 1954, 19:05	173.5
Subbasin_121	14.99	29.310	17 October 1954, 03:05	219.2
Subbasin_122	4.22	16.810	17 October 1954, 00:25	367.8
Junction_112	264.25	262.830	17 October 1954, 18:30	179.2
Reach_1012	264.25	262.810	17 October 1954, 19:30	176.3
Subbasin_123	9.55	41.820	17 October 1954, 00:15	398.9
Subbasin_124	5.42	16.970	17 October 1954, 01:00	303.9
Junction_113	279.22	281.270	17 October 1954, 19:20	186.4
Reach_1013	279.22	281.260	17 October 1954, 20:00	185.4
Subbasin_125	9.03	33.960	17 October 1954, 00:25	346.6
Subbasin_126	7.72	24.700	17 October 1954, 00:45	299.4
Junction_114	295.97	299.680	17 October 1954, 19:50	193.3
Reach_1014	295.97	299.680	17 October 1954, 20:20	192.0
Subbasin_127	11.40	25.650	17 October 1954, 02:10	235.5
Subbasin_128	1.85	11.190	16 October 1954, 23:30	522.4
Junction_115	309.22	311.590	17 October 1954, 20:15	195.6
Reach_1015	309.22	311.560	17 October 1954, 20:45	194.5
Subbasin_132	2.19	13.980	16 October 1954, 23:15	534.0
Saugeen Flow Gauge	311.41	315.690	17 October 1954, 20:45	196.9
Reach_1016	30.26	63.340	17 October 1954, 03:45	231.1
Subbasin_131	3.11	21.460	16 October 1954, 23:15	154.1
Junction_117	344.78	376.030	17 October 1954, 03:35	199.5
Reach_1017	344.78	375.930	17 October 1954, 03:40	199.1
Subbasin_133	2.57	13.080	16 October 1954, 23:45	441.6
Junction_118	347.35	381.500	17 October 1954, 03:40	200.9
Reach_1018	347.35	381.480	17 October 1954, 03:55	200.4
Subbasin_136	1.71	9.900	16 October 1954, 23:20	145.9
Subbasin_134	0.27	2.870	17 October 1954, 00:05	261.3
Junction_119	0.27	2.870	17 October 1954, 00:05	261.3
Reach_1019	0.27	2.840	17 October 1954, 00:15	261.1
Subbasin_135	0.32	4.040	16 October 1954, 22:35	204.8
Junction_120	0.58	5.890	16 October 1954, 23:10	230.7
Reach_1020	0.58	5.890	16 October 1954, 23:20	230.7
Subbasin_137	0.28	3.980	16 October 1954, 22:25	246.4
OutflowDurham	0.87	9.450	16 October 1954, 22:40	235.8
Junction_121	349.92	384.310	17 October 1954, 03:50	200.2
Reach_1021	349.92	377.780	17 October 1954, 05:05	197.4
Subbasin_138	4.88	30.880	17 October 1954, 00:30	528.4
Sink-1	354.80	388.410	17 October 1954, 05:05	202.0

Junction_110	237.30	104.160	2 January 2100, 00:40	47.8
Reach_1010	237.30	104.150	2 January 2100, 01:00	47.4
Subbasin_119	4.46	14.870	1 January 2100, 04:40	190.4
Subbasin_120	3.29	8.820	1 January 2100, 05:10	158.8
Junction_111	245.04	111.340	2 January 2100, 00:55	51.5
Reach_1011	245.04	111.330	2 January 2100, 01:30	50.6
Subbasin_121	14.99	12.580	1 January 2100, 08:55	69.1
Subbasin_122	4.22	8.090	1 January 2100, 05:45	121.3
Junction_112	264.25	118.240	2 January 2100, 01:25	52.8
Reach_1012	264.25	118.220	2 January 2100, 02:55	50.8
Subbasin_123	9.55	20.850	1 January 2100, 05:25	134.4
Subbasin_124	5.42	7.590	1 January 2100, 06:35	95.7
Junction_113	279.22	126.980	2 January 2100, 02:50	54.5
Reach_1013	279.22	126.970	2 January 2100, 03:15	53.8
Subbasin_125	9.03	16.210	1 January 2100, 05:45	113.9
Subbasin_126	7.72	11.420	1 January 2100, 06:05	97.1
Junction_114	295.97	135.500	2 January 2100, 03:10	56.8
Reach_1014	295.97	135.500	2 January 2100, 03:45	55.9
Subbasin_127	11.40	11.320	1 January 2100, 07:50	75.4
Subbasin_128	1.85	6.790	1 January 2100, 04:30	205.5
Junction_115	309.22	141.200	2 January 2100, 03:40	57.5
Reach_1015	309.22	141.190	2 January 2100, 04:25	56.8
Subbasin_132	2.19	9.230	1 January 2100, 04:10	227.7
Saugeen Flow Gauge	311.41	143.840	2 January 2100, 04:20	58.0
Reach_1016	30.26	27.430	1 January 2100, 09:35	72.7
Subbasin_131	3.11	14.080	1 January 2100, 04:15	63.3
Junction_117	344.78	157.630	1 January 2100, 09:30	59.3
Reach_1017	344.78	157.550	1 January 2100, 09:40	59.1
Subbasin_133	2.57	7.310	1 January 2100, 04:40	163.0
Junction_118	347.35	160.100	1 January 2100, 09:40	59.9
Reach_1018	347.35	160.050	1 January 2100, 10:00	59.5
Subbasin_136	1.71	6.890	1 January 2100, 04:15	63.7
Subbasin_134	0.27	1.830	1 January 2100, 05:05	78.6
Junction_119	0.27	1.830	1 January 2100, 05:05	78.6
Reach_1019	0.27	1.790	1 January 2100, 05:20	78.4
Subbasin_135	0.32	3.880	1 January 2100, 03:45	66.9
Junction_120	0.58	4.380	1 January 2100, 03:50	72.2
Reach_1020	0.58	4.380	1 January 2100, 04:00	72.2
Subbasin_137	0.28	4.330	1 January 2100, 03:40	78.9
OutflowDurham	0.87	8.070	1 January 2100, 03:50	74.4
Junction_121	349.92	161.100	1 January 2100, 10:00	59.6
Reach_1021	349.92	157.680	1 January 2100, 12:20	57.6
Subbasin_138	4.88	21.340	1 January 2100, 05:40	232.7
Sink-1	354.80	164.850	1 January 2100, 12:20	60.0

Hydrologic Peak Flow Results - Climate Change

6

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model: Saugeen_HMS_Calibrated **Areal Reduction Factor:** 1.0

Peak Flow Results

2% AEP 6 Hour SCS Type 2 Climate Change (ΔT=2.94), ARF Durham=1, ARF Saugeen=1

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.81	18.370	1 January 2100, 09:00	61.4
Subbasin_130	5.45	5.500	1 January 2100, 07:10	72.6
Junction_116	30.26	23.630	1 January 2100, 08:25	63.4
Subbasin_101	36.12	5.300	2 January 2100, 04:55	20.0
Subbasin_102	12.72	9.840	1 January 2100, 08:00	59.5
Junction_101	48.84	12.930	1 January 2100, 09:20	30.3
Reach_1001	48.84	12.900	1 January 2100, 10:35	29.8
Subbasin_103	24.35	15.090	1 January 2100, 09:10	52.0
Subbasin_104	1.18	1.460	1 January 2100, 06:20	83.1
Junction_102	74.37	29.000	1 January 2100, 09:40	37.9
Reach_1002	74.37	28.950	1 January 2100, 12:15	35.9
Subbasin_105	21.00	16.880	1 January 2100, 08:10	62.9
Subbasin_106	18.32	9.260	1 January 2100, 10:35	46.5
Junction_103	39.31	25.840	1 January 2100, 08:50	55.3
Reach_1003	39.31	25.820	1 January 2100, 09:35	54.4
Subbasin_107	20.67	14.470	1 January 2100, 08:25	55.8
Subbasin_108	3.34	6.180	1 January 2100, 05:05	111.1
Junction_104	137.68	69.750	1 January 2100, 10:25	46.0
Reach_1004	137.68	68.120	1 January 2100, 14:55	41.9
Subbasin_109	11.36	5.630	1 January 2100, 10:30	45.3
Subbasin_110	9.48	6.910	1 January 2100, 08:30	58.4
Junction_105	158.53	78.490	1 January 2100, 14:40	43.1
Reach_1005	158.53	64.150	1 January 2100, 23:05	37.2
Subbasin_111	25.59	8.410	1 January 2100, 15:10	37.9
Subbasin_112	6.81	2.390	1 January 2100, 14:20	39.1
Junction_106	190.93	73.770	1 January 2100, 22:50	37.3
Reach_1006	190.93	73.510	1 January 2100, 23:45	36.2
Subbasin_113	7.99	6.480	1 January 2100, 07:50	61.7
Junction_107	198.92	75.720	1 January 2100, 23:45	37.2
Reach_1007	198.92	74.940	2 January 2100, 00:25	36.8
Subbasin_114	17.00	10.050	1 January 2100, 09:15	49.8
Subbasin_115	1.37	2.450	1 January 2100, 05:30	110.4
Junction_108	217.29	79.870	1 January 2100, 24:00	38.3
Reach_1008	217.29	79.870	2 January 2100, 00:10	38.2
Subbasin_116	1.27	3.170	1 January 2100, 04:50	144.6
Junction_109	218.56	80.840	2 January 2100, 00:10	38.8
Reach_1009	218.56	80.730	2 January 2100, 01:45	37.2
Subbasin_117	9.51	6.430	1 January 2100, 09:40	58.4
Subbasin_118	9.23	15.980	1 January 2100, 05:30	107.3

4% AEP 6 Hour SCS Type 2 Climate Change (ΔT=2.94), ARF Durham=1, ARF Saugeen=1

Hydrologic Element	Drainage Area	Peak Discharge	Time of Peak	Volume (mm)
Subbasin_129	24.81	15.280	1 January 2100, 09:00	51.0
Subbasin_130	5.45	4.560	1 January 2100, 07:05	60.3
Junction_116	30.26	19.650	1 January 2100, 08:25	52.7
Subbasin_101	36.12	4.350	2 January 2100, 04:55	16.4
Subbasin_102	12.72	8.120	1 January 2100, 08:00	49.1
Junction_101	48.84	10.660	1 January 2100, 09:20	25.0
Reach_1001	48.84	10.640	1 January 2100, 10:35	24.6
Subbasin_103	24.35	12.470	1 January 2100, 09:10	43.0
Subbasin_104	1.18	1.200	1 January 2100, 06:20	68.5
Junction_102	74.37	23.950	1 January 2100, 09:35	31.3
Reach_1002	74.37	23.910	1 January 2100, 12:20	29.6
Subbasin_105	21.00	13.950	1 January 2100, 08:10	52.0
Subbasin_106	18.32	7.680	1 January 2100, 10:35	38.6
Junction_103	39.31	21.390	1 January 2100, 08:50	45.8
Reach_1003	39.31	21.370	1 January 2100, 09:35	45.0
Subbasin_107	20.67	11.940	1 January 2100, 08:25	46.0
Subbasin_108	3.34	5.140	1 January 2100, 05:05	92.4
Junction_104	137.68	57.550	1 January 2100, 10:30	38.0
Reach_1004	137.68	55.530	1 January 2100, 15:55	34.5
Subbasin_109	11.36	4.620	1 January 2100, 10:30	37.2
Subbasin_110	9.48	5.740	1 January 2100, 08:30	48.5
Junction_105	158.53	63.640	1 January 2100, 15:35	35.5
Reach_1005	158.53	52.350	1 January 2100, 24:00	30.5
Subbasin_111	25.59	6.950	1 January 2100, 15:10	31.3
Subbasin_112	6.81	1.980	1 January 2100, 14:20	32.2
Junction_106	190.93	60.100	1 January 2100, 23:45	30.7
Reach_1006	190.93	59.900	2 January 2100, 00:45	29.7
Subbasin_113	7.99	5.370	1 January 2100, 07:50	51.2
Junction_107	198.92	61.710	2 January 2100, 00:40	30.6
Reach_1007	198.92	61.050	2 January 2100, 01:25	30.2
Subbasin_114	17.00	8.270	1 January 2100, 09:15	41.0
Subbasin_115	1.37	2.040	1 January 2100, 05:25	91.8
Junction_108	217.29	64.830	2 January 2100, 01:05	31.5
Reach_1008	217.29	64.820	2 January 2100, 01:10	31.4
Subbasin_116	1.27	2.640	1 January 2100, 04:50	120.4
Junction_109	218.56	65.620	2 January 2100, 01:10	31.9
Reach_1009	218.56	65.540	2 January 2100, 02:55	30.6
Subbasin_117	9.51	5.340	1 January 2100, 09:35	48.5
Subbasin_118	9.23	13.360	1 January 2100, 05:30	89.7

Junction_110	237.30	88.320	2 January 2100, 01:30	40.8
Reach_1010	237.30	88.310	2 January 2100, 01:50	40.5
Subbasin_119	4.46	13.000	1 January 2100, 04:40	166.2
Subbasin_120	3.29	7.640	1 January 2100, 05:05	137.1
Junction_111	245.04	94.520	2 January 2100, 01:45	44.1
Reach_1011	245.04	94.510	2 January 2100, 02:25	43.3
Subbasin_121	14.99	10.810	1 January 2100, 08:55	59.3
Subbasin_122	4.22	6.980	1 January 2100, 05:40	104.5
Junction_112	264.25	100.400	2 January 2100, 02:20	45.2
Reach_1012	264.25	100.390	2 January 2100, 03:50	43.4
Subbasin_123	9.55	18.020	1 January 2100, 05:25	116.1
Subbasin_124	5.42	6.510	1 January 2100, 06:30	82.0
Junction_113	279.22	107.870	2 January 2100, 03:45	46.6
Reach_1013	279.22	107.870	2 January 2100, 04:10	46.0
Subbasin_125	9.03	13.920	1 January 2100, 05:45	97.8
Subbasin_126	7.72	9.780	1 January 2100, 06:05	83.1
Junction_114	295.97	115.120	2 January 2100, 04:05	48.5
Reach_1014	295.97	115.110	2 January 2100, 04:45	47.7
Subbasin_127	11.40	9.700	1 January 2100, 07:45	64.6
Subbasin_128	1.85	5.920	1 January 2100, 04:30	178.9
Junction_115	309.22	119.980	2 January 2100, 04:45	49.1
Reach_1015	309.22	119.950	2 January 2100, 05:30	48.5
Subbasin_132	2.19	8.000	1 January 2100, 04:10	197.2
Saugeen Flow Gauge	311.41	122.230	2 January 2100, 05:30	49.6
Reach_1016	30.26	23.620	1 January 2100, 09:35	62.6
Subbasin_131	3.11	12.270	1 January 2100, 04:15	54.5
Junction_117	344.78	134.950	1 January 2100, 09:40	50.8
Reach_1017	344.78	134.880	1 January 2100, 09:50	50.5
Subbasin_133	2.57	6.320	1 January 2100, 04:40	140.9
Junction_118	347.35	137.080	1 January 2100, 09:50	51.2
Reach_1018	347.35	137.050	1 January 2100, 10:10	50.9
Subbasin_136	1.71	6.070	1 January 2100, 04:15	56.1
Subbasin_134	0.27	1.630	1 January 2100, 05:05	70.0
Junction_119	0.27	1.630	1 January 2100, 05:05	70.0
Reach_1019	0.27	1.590	1 January 2100, 05:20	69.8
Subbasin_135	0.32	3.430	1 January 2100, 03:45	59.5
Junction_120	0.58	3.880	1 January 2100, 03:50	64.2
Reach_1020	0.58	3.880	1 January 2100, 04:00	64.2
Subbasin_137	0.28	3.870	1 January 2100, 03:40	70.8
OutflowDurham	0.87	7.160	1 January 2100, 03:50	66.4
Junction_121	349.92	137.900	1 January 2100, 10:10	51.0
Reach_1021	349.92	134.390	1 January 2100, 12:10	49.2
Subbasin_138	4.88	18.580	1 January 2100, 05:35	202.7
Sink-1	354.80	140.650	1 January 2100, 12:10	51.3

Junction_110	237.30	71.630	2 January 2100, 02:40	33.6
Reach_1010	237.30	71.620	2 January 2100, 03:00	33.3
Subbasin_119	4.46	10.970	1 January 2100, 04:40	140.2
Subbasin_120	3.29	6.370	1 January 2100, 05:05	114.2
Junction_111	245.04	76.780	2 January 2100, 02:55	36.3
Reach_1011	245.04	76.780	2 January 2100, 03:35	35.6
Subbasin_121	14.99	8.960	1 January 2100, 08:55	49.2
Subbasin_122	4.22	5.800	1 January 2100, 05:40	86.9
Junction_112	264.25	81.610	2 January 2100, 03:30	37.2
Reach_1012	264.25	81.600	2 January 2100, 05:05	35.7
Subbasin_123	9.55	15.030	1 January 2100, 05:25	96.8
Subbasin_124	5.42	5.390	1 January 2100, 06:30	67.9
Junction_113	279.22	87.750	2 January 2100, 05:05	38.4
Reach_1013	279.22	87.750	2 January 2100, 05:35	37.8
Subbasin_125	9.03	11.580	1 January 2100, 05:45	81.4
Subbasin_126	7.72	8.080	1 January 2100, 06:05	68.7
Junction_114	295.97	93.690	2 January 2100, 05:30	39.9
Reach_1014	295.97	93.680	2 January 2100, 06:15	39.2
Subbasin_127	11.40	8.050	1 January 2100, 07:45	53.6
Subbasin_128	1.85	4.990	1 January 2100, 04:30	150.5
Junction_115	309.22	97.690	2 January 2100, 06:10	40.4
Reach_1015	309.22	97.670	2 January 2100, 06:50	40.0
Subbasin_132	2.19	6.720	1 January 2100, 04:05	165.6
Saugeen Flow Gauge	311.41	99.560	2 January 2100, 06:50	40.8
Reach_1016	30.26	19.640	1 January 2100, 09:35	52.1
Subbasin_131	3.11	10.350	1 January 2100, 04:15	45.4
Junction_117	344.78	111.640	1 January 2100, 09:50	41.9
Reach_1017	344.78	111.590	1 January 2100, 10:00	41.7
Subbasin_133	2.57	5.280	1 January 2100, 04:40	117.8
Junction_118	347.35	113.420	1 January 2100, 10:00	42.2
Reach_1018	347.35	113.400	1 January 2100, 10:20	42.0
Subbasin_136	1.71	5.190	1 January 2100, 04:15	48.1
Subbasin_134	0.27	1.420	1 January 2100, 05:05	60.8
Junction_119	0.27	1.420	1 January 2100, 05:05	60.8
Reach_1019	0.27	1.390	1 January 2100, 05:20	60.6
Subbasin_135	0.32	2.960	1 January 2100, 03:45	51.7
Junction_120	0.58	3.360	1 January 2100, 03:50	55.8
Reach_1020	0.58	3.360	1 January 2100, 04:00	55.8
Subbasin_137	0.28	3.390	1 January 2100, 03:40	62.4
OutflowDurham	0.87	6.220	1 January 2100, 03:50	58.0
Junction_121	349.92	114.100	1 January 2100, 10:15	42.0
Reach_1021	349.92	110.850	1 January 2100, 12:10	40.5
Subbasin_138	4.88	15.650	1 January 2100, 05:35	170.8
Sink-1	354.80	116.120	1 January 2100, 12:10	42.3

Sensitivity Analysis Results

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model Saugeen_HMS_Calibrated **Areal Reduction Factor:** 0.766

Peak Flow and Runoff Volume Percent Change

Hydrologic Element	Drainage Area (km^2)	Hazel 75% Hydraulic		Hazel 125% Hydraulic		Hazel 75% Wetting Front		Hazel 125% Wetting Front		Hazel 75% Initial Water		Hazel 125% Initial Water	
		Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)
Subbasin_129	24.80	3.3	15.4	-2.8	-13.0	1.1	5.0	-0.9	-4.3	-1.2	-5.6	1.4	6.6
Subbasin_130	5.40	1.0	19.8	-1.0	-18.4	0.3	5.9	-0.3	-5.7	-0.4	-8.0	0.4	8.6
Junction_116	30.30	4.3	16.2	-3.7	-14.0	1.4	5.1	-1.2	-4.6	-1.6	-6.0	1.9	7.0
Subbasin_101	36.10	1.5	9.0	-1.5	-8.9	0.4	2.2	-0.4	-2.1	-0.8	-4.8	0.9	5.2
Subbasin_102	12.70	2.5	21.3	-2.5	-20.9	0.7	5.8	-0.6	-5.6	-1.1	-9.5	1.2	10.1
Junction_101	48.80	3.4	12.2	-3.4	-12.0	0.9	3.1	-0.9	-3.0	-1.6	-6.0	1.7	6.5
Reach_1001	48.80	3.4	12.1	-3.4	-11.9	0.9	3.1	-0.9	-3.0	-1.6	-6.0	1.7	6.4
Subbasin_103	24.40	4.3	20.3	-4.2	-20.0	1.1	5.4	-1.1	-5.2	-1.8	-8.8	2.0	9.5
Subbasin_104	1.20	0.3	23.4	-0.3	-22.1	0.1	5.5	-0.1	-5.3	-0.2	-12.5	0.2	13.7
Junction_102	74.40	7.9	15.0	-7.8	-14.7	2.1	3.9	-2.1	-3.8	-3.6	-7.0	3.9	7.5
Reach_1002	74.40	8.0	14.6	-7.8	-14.4	2.1	3.8	-2.1	-3.7	-3.6	-6.8	3.9	7.4
Subbasin_105	21.00	3.4	18.0	-3.2	-17.0	0.9	4.5	-0.8	-4.3	-1.8	-9.3	1.9	10.2
Subbasin_106	18.30	2.8	19.1	-2.8	-18.7	0.7	5.0	-0.7	-4.8	-1.2	-8.0	1.2	8.5
Junction_103	39.30	6.2	18.5	-5.9	-17.8	1.6	4.7	-1.5	-4.6	-2.9	-8.7	3.1	9.4
Reach_1003	39.30	6.2	18.4	-5.9	-17.6	1.6	4.7	-1.5	-4.5	-2.9	-8.6	3.1	9.3
Subbasin_107	20.70	4.0	21.6	-4.0	-21.2	1.1	5.8	-1.0	-5.6	-1.8	-9.5	1.9	10.2
Subbasin_108	3.30	1.1	32.0	-1.1	-31.4	0.3	9.4	-0.3	-9.1	-0.4	-12.4	0.4	13.0
Junction_104	137.70	17.6	17.2	-16.6	-16.7	3.8	4.5	-4.0	-4.3	-6.9	-7.9	7.8	8.5
Reach_1004	137.70	16.8	16.5	-16.4	-16.0	4.2	4.3	-4.0	-4.2	-7.2	-7.5	7.9	8.1
Subbasin_109	11.40	1.7	18.3	-1.7	-17.8	0.4	4.9	-0.4	-4.7	-0.8	-8.2	0.8	8.7
Subbasin_110	9.50	1.6	18.7	-1.6	-18.3	0.4	5.1	-0.4	-5.0	-0.7	-8.7	0.8	9.2
Junction_105	158.50	19.4	16.8	-18.6	-16.3	4.9	4.4	-4.6	-4.2	-8.2	-7.6	9.1	8.2
Reach_1005	158.50	17.6	16.2	-16.4	-15.3	4.6	4.2	-4.3	-4.0	-7.7	-7.3	8.4	7.9
Subbasin_111	25.60	2.0	11.9	-1.9	-11.4	0.5	3.2	-0.5	-3.1	-1.0	-5.9	1.1	6.3
Subbasin_112	6.80	0.6	12.6	-0.6	-12.2	0.2	3.2	-0.1	-3.1	-0.3	-6.6	0.3	7.1
Junction_106	190.90	19.9	15.5	-18.3	-14.7	5.2	4.0	-4.9	-3.9	-8.8	-7.1	9.7	7.6
Reach_1006	190.90	19.8	15.4	-18.2	-14.5	5.1	4.0	-4.9	-3.8	-8.8	-7.0	9.6	7.6
Subbasin_113	8.00	1.6	22.0	-1.6	-21.5	0.5	6.5	-0.5	-6.2	-0.6	-8.7	0.7	9.3
Junction_107	198.90	20.4	15.6	-18.8	-14.8	5.3	4.1	-5.0	-3.9	-9.0	-7.1	9.9	7.6
Reach_1007	198.90	20.3	15.5	-18.7	-14.7	5.3	4.1	-5.0	-3.9	-8.9	-7.0	9.8	7.6
Subbasin_114	17.00	3.2	22.1	-3.2	-21.6	0.9	5.9	-0.8	-5.7	-1.3	-9.0	1.4	9.5
Subbasin_115	1.40	0.3	23.7	-0.3	-21.7	0.1	7.1	-0.1	-6.6	-0.1	-10.2	0.2	11.4
Junction_108	217.30	21.8	16.1	-19.8	-15.3	5.7	4.2	-5.4	-4.1	-9.5	-7.2	10.4	7.8
Reach_1008	217.30	21.8	16.1	-19.8	-15.3	5.7	4.2	-5.4	-4.1	-9.5	-7.2	10.4	7.8
Subbasin_116	1.30	0.3	23.9	-0.3	-21.5	0.1	7.6	-0.1	-7.3	-0.1	-10.2	0.1	11.3
Junction_109	218.60	21.9	16.1	-19.9	-15.3	5.7	4.3	-5.4	-4.1	-9.5	-7.2	10.5	7.8
Reach_1009	218.60	21.9	15.9	-19.8	-15.1	5.7	4.2	-5.4	-4.0	-9.5	-7.1	10.5	7.7
Subbasin_117	9.50	1.1	14.5	-1.0	-12.1	0.3	4.1	-0.3	-4.0	-0.5	-6.4	0.6	7.6
Subbasin_118	9.20	2.4	25.3	-2.3	-24.4	0.7	7.5	-0.7	-7.2	-1.0	-10.7	1.1	11.4
Junction_110	237.30	23.2	16.2	-20.7	-15.4	6.0	4.3	-5.7	-4.2	-10.0	-7.2	11.1	7.8
Reach_1010	237.30	23.1	16.2	-20.7	-15.3	6.0	4.3	-5.7	-4.2	-10.0	-7.2	11.1	7.8
Subbasin_119	4.50	1.0	23.0	-1.0	-20.6	0.3	7.4	-0.3	-6.8	-0.4	-8.8	0.4	10.0
Subbasin_120	3.30	0.7	21.2	-0.7	-19.5	0.2	7.0	-0.2	-6.6	-0.4	-10.9	0.4	12.6
Junction_111	245.00	23.7	16.4	-21.2	-15.5	6.2	4.4	-5.9	-4.2	-10.2	-7.3	11.3	7.9
Reach_1011	245.00	23.7	16.3	-21.1	-15.4	6.2	4.4	-5.9	-4.2	-10.2	-7.2	11.3	7.9
Subbasin_121	15.00	2.1	15.7	-1.9	-14.3	0.6	4.9	-0.6	-4.6	-0.8	-6.3	0.9	6.9
Subbasin_122	4.20	0.9	22.4	-0.9	-19.5	0.3	7.4	-0.3	-6.5	-0.4	-8.5	0.4	9.9
Junction_112	264.20	24.7	16.4	-21.7	-15.4	6.5	4.5	-6.2	-4.3	-10.6	-7.2	11.8	7.8
Reach_1012	264.20	24.7	16.1	-21.7	-15.2	6.5	4.4	-6.2	-4.2	-10.6	-7.1	11.8	7.7
Subbasin_123	9.50	2.2	22.6	-2.0	-19.8	0.7	7.5	-0.7	-6.8	-0.9	-8.8	1.0	10.0
Subbasin_124	5.40	1.1	20.2	-1.0	-18.0	0.4	6.7	-0.3	-6.0	-0.4	-7.4	0.5	8.6
Junction_113	279.20	25.7	16.4	-22.4	-15.4	6.9	4.5	-6.5	-4.3	-10.9	-7.2	12.2	7.8
Reach_1013	279.20	25.7	16.4	-22.4	-15.3	6.9	4.5	-6.5	-4.3	-10.9	-7.1	12.2	7.8
Subbasin_125	9.00	2.2	24.1	-2.1	-22.7	0.7	7.4	-0.6	-7.1	-0.9	-9.7	0.9	10.2
Subbasin_126	7.70	2.1	26.2	-2.0	-25.7	0.6	7.7	-0.6	-7.4	-0.8	-10.9	0.9	11.4
Junction_114	296.00	27.1	16.9	-23.5	-15.8	7.3	4.7	-6.8	-4.5	-11.4	-7.3	12.8	8.0
Reach_1014	296.00	27.1	16.8	-23.5	-15.7	7.3	4.7	-6.8	-4.5	-11.4	-7.3	12.8	7.9
Subbasin_127	11.40	2.0	19.4	-2.0	-18.6	0.6	5.5	-0.6	-5.3	-0.9	-8.5	1.0	9.1
Subbasin_128	1.80	0.4	23.5	-0.4	-21.1	0.1	7.2	-0.1	-6.9	-0.2	-10.4	0.2	11.6
Junction_115	309.20	27.9	16.9	-24.2	-15.9	7.5	4.7	-7.0	-4.5	-11.7	-7.3	13.1	8.0
Reach_1015	309.20	27.9	16.8	-24.2	-15.8	7.5	4.7	-7.0	-4.5	-11.7	-7.3	13.1	7.9
Subbasin_132	2.20	0.7	31.1	-0.7	-30.3	0.2	8.8	-0.2	-8.5	-0.3	-13.2	0.3	14.2
Saugeen Flow Gauge	311.40	28.1	16.9	-24.4	-15.9	7.5	4.7	-7.0	-4.5	-11.8	-7.3	13.2	8.0
Reach_1016	30.30	4.3	16.1	-3.7	-13.9	1.4	5.1	-1.2	-4.6	-1.6	-6.0	1.8	6.9
Subbasin_131	3.10	0.7	9.3	-0.6	-7.7	0.2	3.1	-0.2	-2.6	-0.3	-4.2	0.4	5.5
Junction_117	344.80	28.1	16.8	-26.4	-15.6	8.6	4.7	-8.1	-4.5	-11.8	-7.2	12.9	7.9
Reach_1017	344.80	28.0	16.7	-26.4	-15.6	8.6	4.7	-8.1	-4.5	-11.8	-7.2	12.8	7.8
Subbasin_133	2.60	0.8	29.7	-0.8	-29.0	0.2	9.4	-0.2	-9.0	-0.3	-10.8	0.3	11.3
Junction_118	347.30	28.3	16.8	-26.7	-15.7	8.7	4.8	-8.2	-4.5	-11.9	-7.2	12.9	7.9
Reach_1018	347.30	28.3	16.8	-26.7	-15.7	8.6	4.8	-8.2	-4.5	-11.9	-7.2	12.9	7.9
Subbasin_136	1.70	0.6	12.7	-0.6	-12.0	0.2	3.3	-0.1	-3.1	-0.2	-5.0	0.3	5.4
Subbasin_134	0.30	0.0	7.4	0.0	-6.3	0.0	2.3	0.0	-2.1	0.0	-2.3	0.0	2.7
Junction_119	0.30	0.0	7.4	0.0	-6.3	0.0	2.3	0.0	-2.1	0.0	-2.3	0.0	2.7
Reach_1019	0.30	0.0	7.4	0.0	-6.3	0.0	2.3	0.0	-2.1	0.0	-2.4	0.0	2.7
Subbasin_135	0.30	0.2	16.7	-0.2	-6.8	0.1	3.3	0.0	-1.9	0.0	-1.7	0.0	2.8
Junction_120	0.60	0.2	12.4	-0.2	-6.6	0.0	2.8	0.0	-2.0	0.0	-2.0	0.0	2.8
Reach_1020	0.60	0.2	12.4	-0.2	-6.6	0.0	2.8	0.0	-2.0	0.0	-2.0	0.0	2.8
Subbasin_137	0.30	0.1	11.7	-0.1	-4.7	0.0	2.2	0.0	-1.2	0.0	-1.0	0.0	1.9
OutflowDurham	0.90	0.4	12.2	-0.3	-6.0	0.1	2.6	-0.1	-1.7	-0.1	-1.7	0.1	2.5
Junction_121	349.90	28.7	16.8	-26.9	-15.6	8.7	4.8	-8.3	-4.5	-12.0	-7.2	13.1	7.8
Reach_1021	349.90	28.2	16.6	-26.3	-15.4	8.6	4.7	-8.1	-4.4	-11.7	-7.1	12.8	7.8
Subbasin_138	4.90	1.8	34.9	-1.7	-34.2	0.5	9.5	-0.4	-9.1	-0.6	-12.4	0.6	13.1
Sink-1	354.80	28.9	16.8	-26.9	-15.7	8.7	4.8	-8.3	-4.5	-11.9	-7.1	13.0	7.8
	Maximum	28.9	34.9	0.0	-4.7	8.7	9.5	0.0	-1.2	0.0	-1.0	13.2	14.2
	Minimum	0.0	7.4	-26.9	-34.2	0.0	2.2	-8.3	-9.1	-12.0	-13.2	0.0	1.9

Sensitivity Analysis Results

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model Saugeen_HMS_Calibrated **Areal Reduction Factor:** 0.766

Peak Flow and Runoff Volume Percent Change

Hydrologic Element	Drainage Area (km^2)	Hazel 75% Hydraulic		Hazel 125% Hydraulic		Hazel 75% Wetting Front		Hazel 125% Wetting Front		Hazel 75% Initial Water		Hazel 125% Initial Water	
		Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume
Subbasin_129	24.80	8.8%	9.1%	-7.5%	-7.7%	2.9%	3.0%	-2.5%	-2.6%	-3.2%	-3.3%	3.8%	3.9%
Subbasin_130	5.40	9.5%	10.0%	-9.0%	-9.3%	2.8%	3.0%	-2.8%	-2.9%	-3.9%	-4.1%	4.1%	4.3%
Junction_116	30.30	9.0%	9.3%	-7.9%	-8.0%	2.9%	3.0%	-2.5%	-2.6%	-3.4%	-3.5%	3.9%	4.0%
Subbasin_101	36.10	14.3%	14.5%	-14.1%	-14.3%	3.5%	3.5%	-3.3%	-3.4%	-7.6%	-7.7%	8.2%	8.3%
Subbasin_102	12.70	13.2%	13.6%	-13.0%	-13.4%	3.5%	3.7%	-3.4%	-3.6%	-5.8%	-6.0%	6.2%	6.5%
Junction_101	48.80	13.6%	14.1%	-13.3%	-13.9%	3.6%	3.6%	-3.4%	-3.5%	-6.4%	-6.9%	6.9%	7.5%
Reach_1001	48.80	13.6%	14.1%	-13.5%	-13.8%	3.6%	3.6%	-3.5%	-3.5%	-6.5%	-6.9%	6.9%	7.5%
Subbasin_103	24.40	15.0%	15.4%	-14.8%	-15.2%	4.0%	4.1%	-3.8%	-4.0%	-6.5%	-6.7%	7.0%	7.2%
Subbasin_104	1.20	10.2%	10.6%	-9.5%	-10.0%	2.2%	2.5%	-2.2%	-2.4%	-5.5%	-5.7%	5.8%	6.2%
Junction_102	74.40	14.3%	14.5%	-14.1%	-14.3%	3.8%	3.8%	-3.8%	-3.6%	-6.6%	-6.8%	7.0%	7.3%
Reach_1002	74.40	14.4%	14.6%	-14.0%	-14.3%	3.8%	3.8%	-3.7%	-3.7%	-6.5%	-6.8%	7.0%	7.3%
Subbasin_105	21.00	10.4%	10.7%	-9.8%	-10.1%	2.6%	2.7%	-2.5%	-2.6%	-5.3%	-5.5%	5.9%	6.0%
Subbasin_106	18.30	16.4%	16.7%	-16.1%	-16.4%	4.3%	4.4%	-4.2%	-4.2%	-6.8%	-7.0%	7.3%	7.4%
Junction_103	39.30	12.5%	13.0%	-12.0%	-12.4%	3.2%	3.3%	-3.1%	-3.2%	-5.9%	-6.1%	6.3%	6.6%
Reach_1003	39.30	12.5%	13.0%	-12.0%	-12.4%	3.2%	3.3%	-3.1%	-3.2%	-5.9%	-6.1%	6.3%	6.6%
Subbasin_107	20.70	14.6%	15.1%	-14.5%	-14.8%	3.9%	4.0%	-3.8%	-3.9%	-6.4%	-6.6%	6.8%	7.1%
Subbasin_108	3.30	10.8%	11.9%	-10.6%	-11.6%	3.2%	3.5%	-3.0%	-3.4%	-4.1%	-4.6%	4.4%	4.8%
Junction_104	137.70	13.4%	14.0%	-12.7%	-13.6%	2.9%	3.7%	-3.0%	-3.5%	-5.3%	-6.4%	5.9%	6.9%
Reach_1004	137.70	13.2%	14.1%	-12.9%	-13.6%	3.3%	3.7%	-3.2%	-3.5%	-5.7%	-6.4%	6.2%	6.9%
Subbasin_109	11.40	15.4%	15.7%	-15.2%	-15.3%	4.1%	4.2%	-4.0%	-4.0%	-7.0%	-7.1%	7.3%	7.5%
Subbasin_110	9.50	11.8%	12.1%	-11.5%	-11.9%	3.2%	3.3%	-3.1%	-3.2%	-5.4%	-5.6%	5.7%	5.9%
Junction_105	158.50	13.3%	14.0%	-12.8%	-13.6%	3.3%	3.7%	-3.2%	-3.6%	-5.6%	-6.4%	6.2%	6.9%
Reach_1005	158.50	14.7%	14.8%	-13.7%	-14.0%	3.8%	3.8%	-3.6%	-3.7%	-6.5%	-6.6%	7.1%	7.2%
Subbasin_111	25.60	11.7%	11.9%	-11.2%	-11.4%	3.2%	3.2%	-3.0%	-3.1%	-5.7%	-5.8%	6.2%	6.3%
Subbasin_112	6.80	12.0%	12.2%	-11.8%	-11.9%	3.1%	3.1%	-2.9%	-3.0%	-6.4%	-6.4%	6.8%	6.9%
Junction_106	190.90	14.4%	14.3%	-13.2%	-13.6%	3.7%	3.7%	-3.5%	-3.6%	-6.4%	-6.5%	7.0%	7.1%
Reach_1006	190.90	14.3%	14.4%	-13.2%	-13.6%	3.7%	3.8%	-3.5%	-3.6%	-6.4%	-6.6%	7.0%	7.1%
Subbasin_113	8.00	13.3%	13.7%	-13.1%	-13.4%	3.8%	4.0%	-3.8%	-3.9%	-5.2%	-5.4%	5.6%	5.8%
Junction_107	198.90	14.3%	14.4%	-13.2%	-13.6%	3.7%	3.8%	-3.5%	-3.6%	-6.3%	-6.5%	6.9%	7.0%
Reach_1007	198.90	14.3%	14.4%	-13.2%	-13.6%	3.7%	3.8%	-3.5%	-3.6%	-6.3%	-6.5%	6.9%	7.0%
Subbasin_114	17.00	17.5%	18.0%	-17.3%	-17.6%	4.7%	4.8%	-4.5%	-4.7%	-7.1%	-7.3%	7.4%	7.7%
Subbasin_115	1.40	7.6%	8.3%	-7.1%	-7.6%	2.3%	2.5%	-2.3%	-2.3%	-3.4%	-3.6%	3.4%	4.0%
Junction_108	217.30	14.4%	14.6%	-13.1%	-13.9%	3.8%	3.8%	-3.6%	-3.7%	-6.3%	-6.5%	6.9%	7.0%
Reach_1008	217.30	14.4%	14.6%	-13.1%	-13.9%	3.7%	3.8%	-3.6%	-3.7%	-6.3%	-6.5%	6.9%	7.0%
Subbasin_116	1.30	6.0%	6.7%	-5.4%	-6.1%	1.9%	2.1%	-1.7%	-2.0%	-2.5%	-2.9%	2.9%	3.2%
Junction_109	218.60	14.3%	14.4%	-13.0%	-13.7%	3.7%	3.8%	-3.5%	-3.7%	-6.2%	-6.5%	6.9%	7.0%
Reach_1009	218.60	14.3%	14.5%	-13.0%	-13.8%	3.7%	3.8%	-3.5%	-3.7%	-6.2%	-6.5%	6.9%	7.0%
Subbasin_117	9.50	8.7%	9.0%	-7.3%	-7.5%	2.5%	2.6%	-2.4%	-2.5%	-3.8%	-4.0%	4.6%	4.7%
Subbasin_118	9.20	8.5%	9.2%	-8.3%	-8.9%	2.5%	2.7%	-2.4%	-2.6%	-3.6%	-3.9%	3.8%	4.2%
Junction_110	237.30	13.9%	13.7%	-12.4%	-13.0%	3.6%	3.7%	-3.4%	-3.5%	-6.0%	-6.1%	6.6%	6.6%
Reach_1010	237.30	13.9%	13.7%	-12.4%	-13.0%	3.6%	3.7%	-3.4%	-3.5%	-6.0%	-6.1%	6.6%	6.6%
Subbasin_119	4.50	5.2%	6.0%	-4.9%	-5.4%	1.7%	1.9%	-1.6%	-1.8%	-2.1%	-2.3%	2.2%	2.6%
Subbasin_120	3.30	5.3%	6.1%	-5.0%	-5.6%	1.7%	2.0%	-1.6%	-1.9%	-2.7%	-3.1%	3.1%	3.6%
Junction_111	245.00	13.4%	13.0%	-12.0%	-12.3%	3.5%	3.5%	-3.3%	-3.4%	-5.8%	-5.8%	6.4%	6.3%
Reach_1011	245.00	13.4%	13.1%	-12.0%	-12.3%	3.5%	3.5%	-3.3%	-3.4%	-5.8%	-5.8%	6.4%	6.3%
Subbasin_121	15.00	9.4%	9.6%	-8.5%	-8.7%	2.9%	3.0%	-2.7%	-2.8%	-3.7%	-3.8%	4.1%	4.2%
Subbasin_122	4.20	7.4%	8.1%	-6.6%	-7.0%	2.4%	2.7%	-2.2%	-2.4%	-2.8%	-3.1%	3.3%	3.5%
Junction_112	264.20	13.1%	12.6%	-11.5%	-11.9%	3.5%	3.4%	-3.3%	-3.3%	-5.6%	-5.6%	6.2%	6.1%
Reach_1012	264.20	13.1%	12.7%	-11.5%	-11.9%	3.5%	3.5%	-3.3%	-3.3%	-5.6%	-5.6%	6.2%	6.1%
Subbasin_123	9.50	6.8%	7.4%	-6.1%	-6.5%	2.2%	2.5%	-2.1%	-2.2%	-2.6%	-2.9%	3.0%	3.3%
Subbasin_124	5.40	8.3%	8.9%	-7.6%	-7.9%	2.7%	2.9%	-2.6%	-2.7%	-3.1%	-3.3%	3.5%	3.8%
Junction_113	279.20	12.7%	12.2%	-11.1%	-11.4%	3.4%	3.4%	-3.2%	-3.2%	-5.4%	-5.3%	6.0%	5.8%
Reach_1013	279.20	12.7%	12.2%	-11.1%	-11.4%	3.4%	3.4%	-3.2%	-3.2%	-5.4%	-5.3%	6.0%	5.8%
Subbasin_125	9.00	8.7%	9.3%	-8.2%	-8.8%	2.7%	2.9%	-2.5%	-2.8%	-3.5%	-3.7%	3.7%	3.9%
Subbasin_126	7.70	11.3%	12.0%	-11.0%	-11.7%	3.3%	3.5%	-3.2%	-3.4%	-4.6%	-5.0%	4.9%	5.2%
Junction_114	296.00	12.5%	12.0%	-10.9%	-11.3%	3.4%	3.4%	-3.1%	-3.2%	-5.3%	-5.2%	5.9%	5.7%
Reach_1014	296.00	12.5%	12.0%	-10.9%	-11.3%	3.4%	3.4%	-3.1%	-3.2%	-5.3%	-5.2%	5.9%	5.7%
Subbasin_127	11.40	10.8%	11.2%	-10.4%	-10.7%	3.1%	3.2%	-3.0%	-3.1%	-4.7%	-4.9%	5.0%	5.2%
Subbasin_128	1.80	4.9%	5.8%	-4.6%	-5.2%	1.6%	1.8%	-1.4%	-1.7%	-2.2%	-2.6%	2.4%	2.9%
Junction_115	309.20	12.4%	11.9%	-10.8%	-11.2%	3.3%	3.3%	-3.1%	-3.2%	-5.2%	-5.2%	5.8%	5.6%
Reach_1015	309.20	12.4%	11.9%	-10.8%	-11.2%	3.3%	3.3%	-3.1%	-3.2%	-5.2%	-5.2%	5.8%	5.6%
Subbasin_132	2.20	6.6%	7.6%	-6.4%	-7.4%	1.9%	2.1%	-1.8%	-2.1%	-2.7%	-3.2%	3.0%	3.5%
Saugeen Flow Gauge	311.40	12.3%	11.8%	-10.7%	-11.1%	3.3%	3.3%	-3.1%	-3.2%	-5.2%	-5.1%	5.8%	5.6%
Reach_1016	30.30	9.0%	9.3%	-7.9%	-8.0%	2.9%	3.0%	-2.5%	-2.6%	-3.4%	-3.5%	3.9%	4.0%
Subbasin_131	3.10	3.9%	8.0%	-3.8%	-6.6%	1.2%	2.7%	-1.2%	-2.2%	-1.9%	-3.6%	2.1%	4.7%
Junction_117	344.80	10.3%	11.5%	-9.7%	-10.7%	3.1%	3.3%	-3.0%	-3.1%	-4.3%	-4.9%	4.7%	5.4%
Reach_1017	344.80	10.3%	11.5%	-9.7%	-10.7%	3.1%	3.3%	-3.0%	-3.1%	-4.3%	-4.9%	4.7%	5.4%
Subbasin_133	2.60	8.0%	8.9%	-7.9%	-8.7%	2.4%	2.8%	-2.4%	-2.7%	-2.9%	-3.2%	3.0%	3.4%
Junction_118	347.30	10.2%	11.5%	-9.7%	-10.7%	3.1%	3.3%	-3.0%	-3.1%	-4.3%	-4.9%	4.7%	5.4%
Reach_1018	347.30	10.2%	11.5%	-9.7%	-10.7%	3.1%	3.3%	-3.0%	-3.1%	-4.3%	-4.9%	4.7%	5.4%
Subbasin_136	1.70	8.5%	11.8%	-8.6%	-11.1%	2.0%	3.0%	-2.0%	-2.9%	-3.0%	-4.6%	3.3%	5.0%
Subbasin_134	0.30	1.7%	3.6%	-2.2%	-3.1%	0.4%	1.1%	-0.9%	-1.0%	-0.9%	-1.1%	0.4%	1.3%
Junction_119	0.30	1.7%	3.6%	-2.2%	-3.1%	0.4%	1.1%	-0.9%	-1.0%	-0.9%	-1.1%	0.4%	1.3%
Reach_1019	0.30	1.7%	3.6%	-1.7%	-3.1%	0.4%	1.1%	-0.4%	-1.0%	-0.4%	-1.1%	0.4%	1.3%
Subbasin_135	0.30	6.0%	10.8%	-4.8%	-4.4%	1.6%	2.1%	-1.0%	-1.2%	-1.0%	-1.1%	1.3%	1.9%
Junction_120	0.60	4.5%	7.0%	-4.5%	-3.7%	0.9%	1.6%	-1.1%	-1.1%	-0.9%	-1.1%	0.9%	1.6%
Reach_1020	0.60	4.5%	7.0%	-4.5%	-3.7%	0.9%	1.6%	-1.1%	-1.1%	-1.1%	-1.1%	0.9%	1.6%
Subbasin_137	0.30	3.5%	6.1%	-3.2%	-2.4%	0.9%	1.1%	-0.6%	-0.6%	-0.6%	-0.5%	0.6%	1.0%
OutflowDurham	0.90	4.7%	6.7%	-4.2%	-3.3%	1.2%	1.4%	-0.8%	-0.9%	-0.8%	-0.9%	1.1%	1.4%
Junction_121	349.90	10.3%	11.5%	-9.7%	-10.7%	3.1%	3.3%	-3.0%	-3.1%	-4.3%	-4.9%	4.7%	5.4%
Reach_1021	349.90	10.3%	11.5%	-9.6%	-10.7%	3.1%	3.3%	-2.9%	-3.1%	-4.3%	-4.9%	4.6%	5.4%
Subbasin_138	4.90	7.5%	8.7%	-7.3%	-8.5%	1.9%	2.4%	-1.9%	-2.3%	-2.5%	-3.1%	2.7%	3.3%
Sink-1	354.80	10.2%	11.4%	-9.5%	-10.6%	3.1%	3.2%	-2.9%	-3.1%	-4.2%	-4.9%	4.6%	5.3%
	Maximum	17.5%	18.0%	-1.7%	-2.4%	4.7%	4.8%	-0.4%	-0.6%	-0.4%	-0.5%	8.2%	8.3%
	Minimum	1.7%	3.6%	-17.3%	-17.6%	0.4%	1.1%	-4.5%	-4.7%	-7.6%	-7.7%	0.4%	1.0%

Sensitivity Analysis Results

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model Saugeen_HMS_Calibrated **Areal Reduction Factor:** 0.766

Peak Flow and Runoff Volume Percent Change

Hydrologic Element	Drainage Area (km^2)	Hazel 75% Percent		Hazel 125% Percent		Hazel 75% Lag Time		Hazel 125% Lag Time		Hazel 75% Channel Slope		Hazel 125% Channel Slope	
		Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)
Subbasin_129	24.80	-0.2	-1.0	0.1	1.0	11.1	31.6	-7.0	-20.3	0.0	-0.1	0.0	-0.1
Subbasin_130	5.40	0.0	-1.0	0.0	1.0	3.0	38.8	-2.0	-25.4	0.0	0.0	0.0	0.0
Junction_116	30.30	-0.2	-1.0	0.2	1.0	14.0	32.9	-8.9	-21.2	0.0	-0.1	0.0	-0.1
Subbasin_101	36.10	-0.1	-0.5	0.1	0.4	3.5	11.3	-2.1	-9.8	0.0	0.0	0.0	0.0
Subbasin_102	12.70	-0.1	-1.0	0.1	1.0	5.6	31.1	-3.6	-19.7	0.0	0.1	0.0	0.1
Junction_101	48.80	-0.1	-0.6	0.1	0.6	7.9	16.4	-4.9	-12.4	0.0	0.0	0.0	0.0
Reach_1001	48.80	-0.1	-0.6	0.1	0.6	7.8	16.4	-4.9	-12.3	-0.1	-0.4	0.0	0.1
Subbasin_103	24.40	-0.1	-0.9	0.1	0.9	8.8	25.4	-5.4	-15.9	0.0	0.0	0.0	0.0
Subbasin_104	1.20	0.0	-0.7	0.0	0.7	0.7	43.1	-0.5	-28.9	0.0	-0.1	0.0	-0.1
Junction_102	74.40	-0.3	-0.7	0.3	0.7	16.8	19.8	-10.6	-13.8	-0.3	-0.3	0.1	0.1
Reach_1002	74.40	-0.3	-0.7	0.3	0.7	16.7	19.6	-10.4	-13.6	-0.4	-0.7	0.2	0.3
Subbasin_105	21.00	-0.1	-1.1	0.1	1.1	9.7	32.7	-6.2	-20.9	0.0	0.1	0.0	0.1
Subbasin_106	18.30	-0.1	-1.1	0.1	1.1	5.4	20.8	-3.3	-13.2	0.0	-0.1	0.0	-0.1
Junction_103	39.30	-0.3	-1.1	0.3	1.1	15.0	27.1	-9.4	-17.3	0.0	0.0	0.0	0.0
Reach_1003	39.30	-0.3	-1.1	0.3	1.1	14.9	26.9	-9.4	-17.1	0.0	-0.1	0.0	0.1
Subbasin_107	20.70	-0.2	-1.2	0.2	1.1	8.3	28.2	-5.2	-17.7	0.0	0.0	0.0	0.0
Subbasin_108	3.30	0.0	-1.0	0.0	0.9	2.3	47.8	-1.6	-34.3	0.0	0.0	0.0	0.0
Junction_104	137.70	-0.6	-0.9	0.6	0.9	34.8	23.6	-22.7	-15.7	-3.7	-0.4	2.2	0.2
Reach_1004	137.70	-0.6	-0.9	0.6	0.8	30.2	22.7	-21.0	-15.0	-5.0	-1.0	3.6	0.9
Subbasin_109	11.40	-0.1	-1.5	0.1	1.5	3.4	21.3	-2.1	-13.4	0.0	0.0	0.0	0.0
Subbasin_110	9.50	-0.1	-1.4	0.1	1.4	4.0	29.9	-2.5	-18.9	0.0	0.1	0.0	0.1
Junction_105	158.50	-0.8	-0.9	0.8	0.9	32.8	23.1	-22.9	-15.1	-6.3	-0.8	5.2	0.8
Reach_1005	158.50	-0.7	-0.9	0.8	0.9	21.2	22.3	-15.4	-14.0	-15.9	-2.9	5.5	1.4
Subbasin_111	25.60	-0.1	-0.6	0.1	0.6	5.5	16.2	-3.4	-10.4	0.0	0.0	0.0	0.0
Subbasin_112	6.80	0.0	-1.0	0.0	0.9	1.6	16.9	-1.0	-10.8	0.0	0.0	0.0	0.0
Junction_106	190.90	-0.8	-0.9	0.9	0.9	24.4	21.3	-18.0	-13.4	-16.7	-2.4	6.2	1.2
Reach_1006	190.90	-0.8	-0.9	0.8	0.9	24.2	21.1	-17.9	-13.3	-16.8	-2.7	6.2	1.2
Subbasin_113	8.00	-0.1	-1.6	0.1	1.6	3.6	31.6	-2.3	-20.3	0.0	-0.2	0.0	-0.2
Junction_107	198.90	-0.8	-0.9	0.9	0.9	25.3	21.5	-18.5	-13.6	-16.9	-2.6	6.2	1.2
Reach_1007	198.90	-0.8	-0.9	0.9	0.9	25.0	21.3	-18.3	-13.5	-17.2	-2.8	6.2	1.2
Subbasin_114	17.00	-0.1	-1.0	0.1	1.0	5.7	23.8	-3.6	-14.8	0.0	0.1	0.0	0.1
Subbasin_115	1.40	0.0	-1.5	0.0	1.5	0.9	49.2	-0.7	-35.6	0.0	0.0	0.0	0.0
Junction_108	217.30	-0.9	-0.9	0.9	0.9	25.9	21.7	-17.9	-13.7	-18.3	-2.5	7.1	1.1
Reach_1008	217.30	-0.9	-0.9	0.9	0.9	25.8	21.7	-17.9	-13.7	-18.3	-2.5	7.1	1.1
Subbasin_116	1.30	0.0	-1.5	0.0	1.5	1.0	53.6	-0.7	-39.4	0.0	-0.1	0.0	-0.1
Junction_109	218.60	-0.9	-0.9	0.9	0.9	26.1	21.9	-18.1	-13.9	-18.3	-2.5	7.1	1.1
Reach_1009	218.60	-0.9	-0.9	0.9	0.9	26.1	21.6	-18.1	-13.6	-18.3	-2.8	7.1	1.3
Subbasin_117	9.50	0.0	-0.9	0.0	0.9	4.0	29.8	-2.5	-19.0	0.0	0.0	0.0	0.0
Subbasin_118	9.20	-0.1	-1.7	0.1	1.7	6.2	47.9	-4.5	-34.5	0.0	0.0	0.0	0.0
Junction_110	237.30	-1.0	-0.9	1.0	0.9	28.2	22.9	-18.9	-14.7	-19.1	-2.6	7.8	1.2
Reach_1010	237.30	-1.0	-0.9	1.0	0.9	28.2	22.8	-18.9	-14.6	-19.1	-2.7	7.8	1.3
Subbasin_119	4.50	-0.1	-4.5	0.1	4.5	3.4	54.3	-2.5	-39.8	0.0	0.0	0.0	0.0
Subbasin_120	3.30	0.0	-0.7	0.0	0.7	2.4	52.9	-1.8	-39.9	0.0	0.0	0.0	0.0
Junction_111	245.00	-1.0	-1.0	1.1	1.0	30.0	23.8	-20.2	-15.4	-19.2	-2.6	8.0	1.2
Reach_1011	245.00	-1.0	-1.0	1.1	1.0	30.0	23.7	-20.2	-15.3	-19.2	-2.7	8.0	1.3
Subbasin_121	15.00	-0.1	-0.9	0.1	0.9	6.6	30.9	-4.1	-19.8	0.0	-0.1	0.0	-0.1
Subbasin_122	4.20	0.0	-1.5	0.0	1.5	2.9	49.1	-2.1	-35.0	0.0	0.0	0.0	0.0
Junction_112	264.20	-1.1	-1.0	1.1	1.0	32.7	24.5	-19.7	-15.9	-19.4	-2.5	8.9	1.2
Reach_1012	264.20	-1.0	-1.0	1.1	1.0	32.7	24.1	-19.7	-15.7	-19.4	-2.8	8.9	1.4
Subbasin_123	9.50	-0.1	-2.2	0.1	2.2	6.7	50.2	-5.0	-36.8	0.0	0.1	0.0	0.1
Subbasin_124	5.40	0.0	-1.1	0.0	1.1	3.4	43.7	-2.3	-29.4	0.0	-0.1	0.0	-0.1
Junction_113	279.20	-1.1	-1.0	1.2	1.0	35.6	25.4	-21.6	-16.6	-19.6	-2.6	9.2	1.3
Reach_1013	279.20	-1.1	-1.0	1.1	1.0	35.6	25.3	-21.6	-16.6	-19.6	-2.7	9.2	1.4
Subbasin_125	9.00	-0.1	-1.5	0.1	1.5	6.0	47.2	-4.3	-33.3	0.0	0.0	0.0	0.0
Subbasin_126	7.70	0.0	-0.8	0.0	0.8	4.7	43.0	-3.2	-29.0	0.0	0.0	0.0	0.0
Junction_114	296.00	-1.2	-1.0	1.2	1.0	38.7	26.4	-23.6	-17.4	-19.9	-2.6	9.4	1.3
Reach_1014	296.00	-1.2	-1.0	1.2	1.0	38.7	26.3	-23.6	-17.3	-19.9	-2.7	9.4	1.4
Subbasin_127	11.40	-0.1	-0.7	0.1	0.7	5.5	34.0	-3.5	-22.0	0.0	-0.1	0.0	-0.1
Subbasin_128	1.80	0.0	-2.3	0.0	2.3	1.4	55.5	-1.1	-41.2	0.0	0.1	0.0	0.1
Junction_115	309.20	-1.2	-1.0	1.2	1.0	42.4	26.7	-24.9	-17.6	-10.9	-2.6	9.6	1.3
Reach_1015	309.20	-1.2	-1.0	1.2	1.0	41.7	26.6	-24.9	-17.5	-11.3	-2.7	9.6	1.4
Subbasin_132	2.20	0.0	-2.7	0.0	2.7	1.7	55.0	-1.3	-42.1	0.0	0.1	0.0	0.1
Saugeen Flow Gauge	311.40	-1.2	-1.0	1.2	1.0	42.9	26.8	-25.2	-17.6	-10.7	-2.7	9.6	1.4
Reach_1016	30.30	-0.2	-1.0	0.2	1.0	14.0	32.6	-8.9	-21.0	0.0	-0.2	0.0	0.0
Subbasin_131	3.10	0.0	-0.8	0.0	0.8	2.4	0.0	-1.9	0.0	0.0	0.0	0.0	0.0
Junction_117	344.80	-2.1	-1.0	2.0	1.0	60.7	27.0	-39.6	-17.8	-7.3	-2.5	6.0	1.3
Reach_1017	344.80	-2.1	-1.0	2.0	1.0	60.5	27.0	-39.6	-17.8	-7.3	-2.5	6.1	1.3
Subbasin_133	2.60	-0.1	-3.4	0.1	3.4	1.9	52.8	-1.4	-37.6	0.0	0.2	0.0	0.2
Junction_118	347.30	-2.1	-1.0	2.1	1.0	61.2	27.2	-39.9	-17.9	-7.3	-2.5	6.2	1.3
Reach_1018	347.30	-2.1	-1.0	2.1	1.0	61.1	27.1	-39.8	-17.9	-7.3	-2.5	6.2	1.3
Subbasin_136	1.70	-0.2	-8.1	0.2	8.1	1.3	0.1	-1.0	0.1	0.0	0.0	0.0	0.0
Subbasin_134	0.30	0.0	-12.7	0.0	12.7	0.3	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
Junction_119	0.30	0.0	-12.7	0.0	12.7	0.3	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
Reach_1019	0.30	0.0	-12.7	0.0	12.7	0.3	-0.1	-0.2	0.0	0.0	-0.2	0.0	0.1
Subbasin_135	0.30	-0.1	-20.8	0.1	20.9	0.3	-0.1	-0.2	-0.1	0.0	-0.1	0.0	-0.1
Junction_120	0.60	-0.1	-17.1	0.1	17.1	0.4	-0.1	-0.3	0.0	0.0	-0.1	0.0	0.0
Reach_1020	0.60	-0.1	-17.1	0.1	17.1	0.4	-0.1	-0.3	0.0	0.0	-0.1	0.0	0.0
Subbasin_137	0.30	-0.2	-30.0	0.2	30.0	0.2	0.1	-0.2	0.1	0.0	0.1	0.0	0.1
OutflowDurham	0.90	-0.3	-21.3	0.3	21.3	0.5	0.0	-0.4	0.0	0.0	-0.1	0.0	0.0
Junction_121	349.90	-2.2	-1.1	2.1	1.1	61.0	26.9	-39.6	-17.7	-7.6	-2.5	6.5	1.3
Reach_1021	349.90	-2.1	-1.1	2.1	1.1	56.1	26.5	-38.9	-17.5	-9.5	-2.8	7.3	1.6
Subbasin_138	4.90	-0.3	-7.6	0.3	7.6	4.2	60.2	-3.1	-44.7	0.0	0.0	0.0	0.0
Sink-1	354.80	-2.2	-1.2	2.1	1.2	57.5	27.0	-39.9	-17.8	-9.6	-2.8	7.4	1.5
	Maximum	0.0	-0.5	2.1	30.0	61.2	60.2	-0.2	0.1	0.0	0.2	9.6	1.6
	Minimum	-2.2	-30.0	0.0	0.4	0.2	-0.1	-39.9	-44.7	-19.9	-2.9	0.0	-0.2

Sensitivity Analysis Results

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model Saugeen_HMS_Calibrated **Areal Reduction Factor:** 0.766

Peak Flow and Runoff Volume Percent Change

Hydrologic Element	Drainage Area (km^2)	Hazel 75% Percent		Hazel 125% Percent		Hazel 75% Lag Time		Hazel 125% Lag Time		Hazel 75% ChanSlope		Hazel 125% ChanSlope	
		Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume
Subbasin_129	24.80	-0.4%	-0.6%	0.4%	0.6%	29.8%	18.8%	-18.9%	-12.0%	-0.1%	-0.1%	-0.1%	-0.1%
Subbasin_130	5.40	-0.4%	-0.5%	0.3%	0.5%	27.9%	19.6%	-18.2%	-12.8%	-0.1%	0.0%	-0.1%	0.0%
Junction_116	30.30	-0.4%	-0.6%	0.4%	0.6%	29.5%	18.9%	-18.8%	-12.2%	0.0%	0.0%	0.0%	0.0%
Subbasin_101	36.10	-0.6%	-0.7%	0.7%	0.7%	33.1%	18.0%	-19.8%	-15.7%	0.0%	0.0%	0.0%	0.0%
Subbasin_102	12.70	-0.4%	-0.6%	0.4%	0.6%	29.8%	19.9%	-18.8%	-12.6%	0.1%	0.0%	0.1%	0.0%
Junction_101	48.80	-0.5%	-0.7%	0.6%	0.7%	31.2%	18.9%	-19.2%	-14.2%	0.0%	0.0%	0.0%	0.0%
Reach_1001	48.80	-0.5%	-0.7%	0.6%	0.7%	31.0%	19.1%	-19.2%	-14.3%	-0.3%	-0.4%	0.0%	0.1%
Subbasin_103	24.40	-0.5%	-0.7%	0.5%	0.7%	30.8%	19.2%	-19.1%	-12.1%	0.0%	0.0%	0.0%	0.0%
Subbasin_104	1.20	0.0%	-0.3%	0.4%	0.3%	26.3%	19.6%	-17.5%	-13.1%	0.0%	0.0%	0.0%	0.0%
Junction_102	74.40	-0.6%	-0.7%	0.5%	0.7%	30.3%	19.2%	-19.0%	-13.3%	-0.6%	-0.2%	0.1%	0.1%
Reach_1002	74.40	-0.6%	-0.7%	0.5%	0.7%	30.2%	19.5%	-18.9%	-13.5%	-0.8%	-0.7%	0.3%	0.3%
Subbasin_105	21.00	-0.4%	-0.7%	0.5%	0.7%	29.5%	19.4%	-18.7%	-12.4%	0.1%	0.1%	0.1%	0.1%
Subbasin_106	18.30	-0.7%	-0.9%	0.7%	0.9%	31.4%	18.2%	-19.3%	-11.5%	0.0%	-0.1%	0.0%	-0.1%
Junction_103	39.30	-0.5%	-0.8%	0.5%	0.8%	30.2%	19.0%	-19.0%	-12.1%	0.0%	0.0%	0.0%	0.0%
Reach_1003	39.30	-0.5%	-0.8%	0.5%	0.8%	30.1%	18.9%	-18.9%	-12.1%	-0.1%	-0.1%	0.0%	0.1%
Subbasin_107	20.70	-0.6%	-0.8%	0.5%	0.8%	30.3%	19.7%	-19.0%	-12.4%	0.0%	0.0%	0.0%	0.0%
Subbasin_108	3.30	-0.2%	-0.4%	0.3%	0.4%	21.9%	17.7%	-15.7%	-12.7%	0.0%	0.0%	0.0%	0.0%
Junction_104	137.70	-0.5%	-0.7%	0.4%	0.7%	26.6%	19.2%	-17.3%	-12.8%	-2.8%	-0.3%	1.6%	0.2%
Reach_1004	137.70	-0.5%	-0.7%	0.5%	0.7%	23.8%	19.4%	-16.5%	-12.8%	-4.0%	-0.8%	2.9%	0.8%
Subbasin_109	11.40	-0.9%	-1.3%	0.9%	1.3%	31.4%	18.3%	-19.4%	-11.5%	0.0%	0.0%	0.0%	0.0%
Subbasin_110	9.50	-0.7%	-0.9%	0.6%	0.9%	30.0%	19.3%	-18.9%	-12.2%	0.0%	0.1%	0.0%	0.1%
Junction_105	158.50	-0.5%	-0.8%	0.5%	0.8%	22.5%	19.3%	-15.7%	-12.7%	-4.3%	-0.7%	3.6%	0.7%
Reach_1005	158.50	-0.6%	-0.8%	0.6%	0.8%	17.7%	20.3%	-12.9%	-12.8%	-13.3%	-2.7%	4.6%	1.3%
Subbasin_111	25.60	-0.4%	-0.6%	0.5%	0.6%	32.4%	16.1%	-19.6%	-10.4%	0.1%	0.0%	0.1%	0.0%
Subbasin_112	6.80	-0.8%	-0.9%	0.6%	0.9%	32.1%	16.4%	-19.7%	-10.5%	0.0%	0.0%	0.0%	0.0%
Junction_106	190.90	-0.6%	-0.8%	0.6%	0.8%	17.6%	19.7%	-13.0%	-12.4%	-12.0%	-2.2%	4.4%	1.1%
Reach_1006	190.90	-0.6%	-0.8%	0.6%	0.8%	17.5%	19.7%	-12.9%	-12.5%	-12.2%	-2.5%	4.5%	1.2%
Subbasin_113	8.00	-0.7%	-1.0%	0.7%	1.0%	29.4%	19.7%	-18.7%	-12.7%	-0.1%	-0.1%	-0.1%	-0.1%
Junction_107	198.90	-0.6%	-0.8%	0.6%	0.8%	17.8%	19.7%	-13.0%	-12.5%	-11.9%	-2.4%	4.4%	1.1%
Reach_1007	198.90	-0.6%	-0.8%	0.6%	0.8%	17.6%	19.7%	-12.9%	-12.5%	-12.1%	-2.6%	4.4%	1.1%
Subbasin_114	17.00	-0.6%	-0.8%	0.5%	0.8%	31.0%	19.4%	-19.2%	-12.1%	0.1%	0.1%	0.1%	0.1%
Subbasin_115	1.40	-0.5%	-0.5%	0.2%	0.5%	21.6%	17.2%	-15.9%	-12.5%	0.0%	0.0%	0.0%	0.0%
Junction_108	217.30	-0.6%	-0.8%	0.6%	0.8%	17.1%	19.6%	-11.9%	-12.4%	-12.1%	-2.3%	4.7%	1.0%
Reach_1008	217.30	-0.6%	-0.8%	0.6%	0.8%	17.1%	19.7%	-11.9%	-12.4%	-12.1%	-2.3%	4.7%	1.0%
Subbasin_116	1.30	-0.2%	-0.4%	0.4%	0.4%	18.5%	15.1%	-13.3%	-11.1%	0.0%	0.0%	0.0%	0.0%
Junction_109	218.60	-0.6%	-0.8%	0.6%	0.8%	17.1%	19.6%	-11.9%	-12.4%	-12.0%	-2.3%	4.6%	1.0%
Reach_1009	218.60	-0.6%	-0.8%	0.6%	0.8%	17.1%	19.6%	-11.9%	-12.4%	-12.0%	-2.6%	4.7%	1.2%
Subbasin_117	9.50	-0.3%	-0.6%	0.4%	0.5%	30.3%	18.5%	-19.0%	-11.8%	0.1%	0.0%	0.1%	0.0%
Subbasin_118	9.20	-0.4%	-0.6%	0.4%	0.6%	22.2%	17.5%	-16.1%	-12.6%	0.0%	0.0%	0.0%	0.0%
Junction_110	237.30	-0.6%	-0.8%	0.6%	0.8%	16.9%	19.4%	-11.3%	-12.4%	-11.4%	-2.2%	4.7%	1.0%
Reach_1010	237.30	-0.6%	-0.8%	0.6%	0.8%	16.9%	19.4%	-11.3%	-12.4%	-11.4%	-2.3%	4.7%	1.1%
Subbasin_119	4.50	-0.7%	-1.2%	0.7%	1.2%	17.3%	14.2%	-12.6%	-10.4%	0.0%	0.0%	0.0%	0.0%
Subbasin_120	3.30	-0.1%	-0.2%	0.2%	0.2%	18.6%	15.2%	-14.0%	-11.4%	0.0%	0.0%	0.0%	0.0%
Junction_111	245.00	-0.6%	-0.8%	0.6%	0.8%	16.9%	18.9%	-11.4%	-12.3%	-10.9%	-2.0%	4.5%	1.0%
Reach_1011	245.00	-0.6%	-0.8%	0.6%	0.8%	16.9%	19.0%	-11.4%	-12.3%	-10.9%	-2.2%	4.5%	1.1%
Subbasin_121	15.00	-0.3%	-0.5%	0.4%	0.5%	29.9%	19.0%	-18.9%	-12.2%	0.0%	-0.1%	0.0%	-0.1%
Subbasin_122	4.20	-0.3%	-0.6%	0.3%	0.6%	22.7%	17.7%	-16.2%	-12.6%	0.0%	0.0%	0.0%	0.0%
Junction_112	264.20	-0.6%	-0.8%	0.6%	0.8%	17.4%	18.9%	-10.4%	-12.3%	-10.3%	-1.9%	4.7%	0.9%
Reach_1012	264.20	-0.6%	-0.8%	0.6%	0.8%	17.4%	19.0%	-10.4%	-12.3%	-10.3%	-2.2%	4.7%	1.1%
Subbasin_123	9.50	-0.4%	-0.7%	0.4%	0.7%	20.9%	16.6%	-15.4%	-12.1%	0.0%	0.0%	0.0%	0.0%
Subbasin_124	5.40	-0.3%	-0.5%	0.3%	0.5%	26.3%	19.2%	-17.7%	-12.9%	-0.1%	-0.1%	-0.1%	-0.1%
Junction_113	279.20	-0.5%	-0.8%	0.6%	0.8%	17.6%	18.8%	-10.7%	-12.3%	-9.7%	-1.9%	4.5%	1.0%
Reach_1013	279.20	-0.5%	-0.8%	0.6%	0.8%	17.6%	18.9%	-10.7%	-12.3%	-9.7%	-2.0%	4.5%	1.0%
Subbasin_125	9.00	-0.4%	-0.6%	0.4%	0.6%	23.5%	18.2%	-16.6%	-12.8%	0.0%	0.0%	0.0%	0.0%
Subbasin_126	7.70	-0.2%	-0.4%	0.2%	0.4%	26.0%	19.6%	-17.5%	-13.2%	0.0%	0.0%	0.0%	0.0%
Junction_114	296.00	-0.5%	-0.7%	0.6%	0.7%	17.9%	18.8%	-10.9%	-12.4%	-9.2%	-1.8%	4.4%	0.9%
Reach_1014	296.00	-0.5%	-0.7%	0.6%	0.7%	17.9%	18.9%	-10.9%	-12.4%	-9.2%	-1.9%	4.4%	1.0%
Subbasin_127	11.40	-0.3%	-0.4%	0.3%	0.4%	29.0%	19.6%	-18.7%	-12.7%	-0.1%	-0.1%	-0.1%	-0.1%
Subbasin_128	1.80	-0.2%	-0.6%	0.3%	0.6%	16.4%	13.7%	-12.1%	-10.2%	0.1%	0.0%	0.1%	0.0%
Junction_115	309.20	-0.5%	-0.7%	0.5%	0.7%	18.9%	18.8%	-11.1%	-12.4%	-4.8%	-1.8%	4.3%	0.9%
Reach_1015	309.20	-0.5%	-0.7%	0.5%	0.7%	18.6%	18.8%	-11.1%	-12.4%	-5.0%	-1.9%	4.3%	1.0%
Subbasin_132	2.20	-0.4%	-0.7%	0.4%	0.7%	15.7%	13.5%	-12.0%	-10.3%	0.0%	0.0%	0.0%	0.0%
ugeen Flow Gau	311.40	-0.5%	-0.7%	0.5%	0.7%	18.8%	18.7%	-11.1%	-12.3%	-4.7%	-1.9%	4.2%	1.0%
Reach_1016	30.30	-0.4%	-0.6%	0.4%	0.6%	29.5%	18.9%	-18.7%	-12.2%	0.0%	-0.1%	0.0%	0.0%
Subbasin_131	3.10	-0.2%	-0.7%	0.1%	0.7%	14.3%	0.0%	-11.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Junction_117	344.80	-0.8%	-0.7%	0.8%	0.7%	22.2%	18.6%	-14.5%	-12.2%	-2.7%	-1.7%	2.2%	0.9%
Reach_1017	344.80	-0.8%	-0.7%	0.7%	0.7%	22.2%	18.6%	-14.5%	-12.2%	-2.7%	-1.7%	2.2%	0.9%
Subbasin_133	2.60	-0.7%	-1.0%	0.6%	1.0%	19.2%	15.9%	-13.8%	-11.3%	0.0%	0.1%	0.0%	0.1%
Junction_118	347.30	-0.8%	-0.7%	0.7%	0.7%	22.1%	18.5%	-14.4%	-12.2%	-2.6%	-1.7%	2.2%	0.9%
Reach_1018	347.30	-0.8%	-0.7%	0.7%	0.7%	22.1%	18.5%	-14.4%	-12.2%	-2.6%	-1.7%	2.2%	0.9%
Subbasin_136	1.70	-2.8%	-7.5%	2.8%	7.5%	17.4%	0.1%	-12.7%	0.1%	0.0%	0.0%	0.0%	0.0%
Subbasin_134	0.30	-1.7%	-6.1%	1.3%	6.1%	12.1%	0.0%	-10.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Junction_119	0.30	-1.7%	-6.1%	1.3%	6.1%	12.1%	0.0%	-10.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Reach_1019	0.30	-1.3%	-6.1%	1.3%	6.1%	11.8%	0.0%	-10.0%	0.0%	-1.3%	-0.1%	0.4%	0.0%
Subbasin_135	0.30	-3.5%	-13.6%	3.8%	13.6%	8.6%	0.0%	-6.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Junction_120	0.60	-3.2%	-9.6%	3.0%	9.6%	9.1%	0.0%	-6.7%	0.0%	-0.6%	-0.1%	0.2%	0.0%
Reach_1020	0.60	-3.2%	-9.6%	3.0%	9.6%	9.1%	0.0%	-6.7%	0.0%	-0.6%	-0.1%	0.2%	0.0%
Subbasin_137	0.30	-4.7%	-15.6%	4.7%	15.6%	6.9%	0.0%	-6.0%	0.0%	0.0%	0.0%	0.0%	0.0%
OutflowDurham	0.90	-4.0%	-11.7%	4.0%	11.7%	7.1%	0.0%	-5.1%	0.0%	-0.1%	0.0%	0.3%	0.0%
Junction_121	349.90	-0.8%	-0.8%	0.8%	0.8%	22.0%	18.4%	-14.3%	-12.1%	-2.7%	-1.7%	2.4%	0.9%
Reach_1021	349.90	-0.8%	-0.8%	0.7%	0.8%	20.4%	18.4%	-14.1%	-12.1%	-3.5%	-2.0%	2.7%	1.1%
Subbasin_138	4.90	-1.2%	-1.9%	1.1%	1.9%	17.7%	15.0%	-13.1%	-11.2%	0.0%	0.0%	0.0%	0.0%
Sink-1	354.80	-0.8%	-0.8%	0.8%	0.8%	20.3%	18.3%	-14.1%	-12.1%	-3.4%	-1.9%	2.6%	1.0%
	Maximum	0.00%	-0.20%	4.73%	15.62%	33.08%	20.31%	-5.11%	0.06%	0.11%	0.11%	4.71%	1.28%
	Minimum	-4.73%	-15.62%	0.12%	0.20%	6.94%	-0.04%	-19.81%	-15.67%	-13.26%	-2.67%	-0.11%	-0.09%

Sensitivity Analysis Results

WILLS

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model Saugeen_HMS_Calibrated **Areal Reduction Factor:** 0.766

Peak Flow and Runoff Volume Percent Change

Hydrologic Element	Drainage Area (km^2)	Hazel 75% Canopy Storage		Hazel 125% Canopy Storage		Hazel 75% Depression		Hazel 125% Depression	
		Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)	Difference in Peak Flow (m^3/s)	Difference in Volume (mm)
Subbasin_129	24.80	0.0	0.1	0.0	-0.2	0.5	2.6	-0.5	-2.7
Subbasin_130	5.40	0.0	0.1	0.0	-0.2	0.2	3.4	-0.2	-3.4
Junction_116	30.30	0.0	0.1	0.0	-0.2	0.7	2.7	-0.7	-2.8
Subbasin_101	36.10	0.0	0.1	0.0	0.0	0.3	1.8	-0.3	-1.8
Subbasin_102	12.70	0.0	0.2	0.0	-0.1	0.4	3.7	-0.4	-3.6
Junction_101	48.80	0.0	0.1	0.0	0.0	0.6	2.3	-0.6	-2.3
Reach_1001	48.80	0.0	0.1	0.0	0.0	0.6	2.3	-0.6	-2.3
Subbasin_103	24.40	0.0	0.1	0.0	-0.1	0.6	3.1	-0.6	-3.0
Subbasin_104	1.20	0.0	0.1	0.0	-0.2	0.0	4.3	-0.1	-4.5
Junction_102	74.40	0.1	0.1	0.0	-0.1	1.3	2.6	-1.3	-2.5
Reach_1002	74.40	0.0	0.1	0.0	-0.1	1.3	2.5	-1.3	-2.5
Subbasin_105	21.00	0.0	0.1	0.0	-0.1	0.6	3.6	-0.6	-3.5
Subbasin_106	18.30	0.0	0.0	0.0	-0.2	0.3	2.3	-0.3	-2.5
Junction_103	39.30	0.0	0.1	0.0	-0.1	0.9	3.0	-1.0	-3.0
Reach_1003	39.30	0.0	0.1	0.0	-0.1	0.9	3.0	-1.0	-3.0
Subbasin_107	20.70	0.0	0.2	0.0	-0.1	0.6	3.4	-0.6	-3.3
Subbasin_108	3.30	0.0	0.1	0.0	-0.1	0.1	3.1	-0.1	-3.2
Junction_104	137.70	0.1	0.1	-0.1	-0.1	2.2	2.8	-2.3	-2.8
Reach_1004	137.70	0.1	0.1	-0.1	-0.1	2.4	2.7	-2.4	-2.6
Subbasin_109	11.40	0.0	0.1	0.0	-0.1	0.3	3.2	-0.3	-3.2
Subbasin_110	9.50	0.0	0.2	0.0	-0.1	0.3	3.3	-0.3	-3.2
Junction_105	158.50	0.1	0.1	-0.1	-0.1	2.8	2.8	-2.8	-2.7
Reach_1005	158.50	0.1	0.1	0.0	-0.1	2.8	2.6	-2.7	-2.6
Subbasin_111	25.60	0.0	0.1	0.0	0.0	0.4	2.5	-0.4	-2.4
Subbasin_112	6.80	0.0	0.1	0.0	-0.1	0.1	2.7	-0.1	-2.7
Junction_106	190.90	0.1	0.1	-0.1	-0.1	3.2	2.6	-3.2	-2.6
Reach_1006	190.90	0.1	0.1	-0.1	-0.1	3.2	2.6	-3.1	-2.6
Subbasin_113	8.00	0.0	0.0	0.0	-0.2	0.2	3.1	-0.2	-3.3
Junction_107	198.90	0.1	0.1	-0.1	-0.1	3.3	2.6	-3.2	-2.6
Reach_1007	198.90	0.1	0.1	-0.1	-0.1	3.3	2.6	-3.2	-2.6
Subbasin_114	17.00	0.0	0.2	0.0	0.0	0.4	3.2	-0.4	-3.0
Subbasin_115	1.40	0.0	0.1	0.0	-0.1	0.0	3.5	0.0	-3.5
Junction_108	217.30	0.1	0.1	-0.1	-0.1	3.4	2.7	-3.4	-2.6
Reach_1008	217.30	0.1	0.1	-0.1	-0.1	3.4	2.7	-3.4	-2.6
Subbasin_116	1.30	0.0	0.1	0.0	-0.2	0.0	3.4	0.0	-3.6
Junction_109	218.60	0.1	0.1	-0.1	-0.1	3.5	2.7	-3.4	-2.6
Reach_1009	218.60	0.1	0.1	-0.1	-0.1	3.5	2.6	-3.4	-2.6
Subbasin_117	9.50	0.0	0.1	0.0	-0.2	0.2	2.9	-0.2	-3.0
Subbasin_118	9.20	0.0	0.1	0.0	-0.2	0.2	3.0	-0.3	-3.2
Junction_110	237.30	0.1	0.1	-0.1	-0.1	3.6	2.7	-3.6	-2.6
Reach_1010	237.30	0.1	0.1	-0.1	-0.1	3.6	2.6	-3.6	-2.6
Subbasin_119	4.50	0.0	0.2	0.0	-0.2	0.1	2.4	-0.1	-2.5
Subbasin_120	3.30	0.0	0.2	0.0	-0.3	0.1	3.9	-0.1	-4.1
Junction_111	245.00	0.1	0.1	-0.1	-0.1	3.7	2.7	-3.6	-2.6
Reach_1011	245.00	0.1	0.1	-0.1	-0.1	3.7	2.6	-3.6	-2.6
Subbasin_121	15.00	0.0	0.0	0.0	-0.2	0.4	2.9	-0.4	-3.0
Subbasin_122	4.20	0.0	0.2	0.0	-0.2	0.1	3.6	-0.1	-3.6
Junction_112	264.20	0.1	0.1	-0.1	-0.1	3.8	2.7	-3.8	-2.7
Reach_1012	264.20	0.1	0.1	-0.1	-0.1	3.9	2.6	-3.8	-2.6
Subbasin_123	9.50	0.0	0.4	0.0	-0.2	0.3	3.3	-0.2	-3.1
Subbasin_124	5.40	0.0	0.2	0.0	-0.3	0.2	3.7	-0.2	-3.9
Junction_113	279.20	0.1	0.1	-0.1	-0.1	4.0	2.7	-3.9	-2.7
Reach_1013	279.20	0.1	0.1	-0.1	-0.1	4.0	2.7	-3.9	-2.7
Subbasin_125	9.00	0.0	0.1	0.0	-0.2	0.3	3.5	-0.3	-3.7
Subbasin_126	7.70	0.0	0.2	0.0	-0.2	0.3	3.9	-0.3	-4.0
Junction_114	296.00	0.1	0.1	-0.1	-0.1	4.2	2.7	-4.1	-2.7
Reach_1014	296.00	0.1	0.1	-0.1	-0.1	4.2	2.7	-4.1	-2.7
Subbasin_127	11.40	0.0	0.1	0.0	-0.2	0.3	3.2	-0.3	-3.3
Subbasin_128	1.80	0.0	0.3	0.0	-0.2	0.0	2.6	0.0	-2.6
Junction_115	309.20	0.1	0.1	-0.1	-0.1	4.3	2.7	-4.2	-2.7
Reach_1015	309.20	0.1	0.1	-0.1	-0.1	4.3	2.7	-4.2	-2.7
Subbasin_132	2.20	0.0	0.3	0.0	-0.2	0.0	2.2	0.0	-2.2
ugeen Flow Ga	311.40	0.1	0.1	-0.1	-0.1	4.3	2.7	-4.2	-2.7
Reach_1016	30.30	0.0	0.1	0.0	-0.2	0.7	2.7	-0.7	-2.8
Subbasin_131	3.10	0.0	0.1	0.0	-0.2	0.0	2.0	0.0	-2.0
Junction_117	344.80	0.2	0.1	-0.2	-0.1	4.6	2.7	-4.6	-2.7
Reach_1017	344.80	0.2	0.1	-0.2	-0.1	4.6	2.7	-4.6	-2.7
Subbasin_133	2.60	0.0	0.4	0.0	-0.1	0.0	2.9	-0.1	-2.9
Junction_118	347.30	0.2	0.1	-0.2	-0.1	4.6	2.7	-4.7	-2.7
Reach_1018	347.30	0.2	0.1	-0.2	-0.1	4.6	2.7	-4.6	-2.7
Subbasin_136	1.70	0.0	0.2	0.0	-0.1	0.0	0.9	0.0	-0.8
Subbasin_134	0.30	0.0	0.2	0.0	-0.2	0.0	0.6	0.0	-0.5
Junction_119	0.30	0.0	0.2	0.0	-0.2	0.0	0.6	0.0	-0.5
Reach_1019	0.30	0.0	0.2	0.0	-0.2	0.0	0.5	0.0	-0.5
Subbasin_135	0.30	0.0	0.1	0.0	-0.2	0.0	0.2	0.0	-0.4
Junction_120	0.60	0.0	0.1	0.0	-0.2	0.0	0.4	0.0	-0.5
Reach_1020	0.60	0.0	0.1	0.0	-0.2	0.0	0.4	0.0	-0.5
Subbasin_137	0.30	0.0	0.2	0.0	-0.1	0.0	0.5	0.0	-0.2
OutflowDurham	0.90	0.0	0.2	0.0	-0.2	0.0	0.4	0.0	-0.4
Junction_121	349.90	0.2	0.1	-0.2	-0.1	4.7	2.7	-4.7	-2.7
Reach_1021	349.90	0.2	0.1	-0.2	-0.1	4.6	2.7	-4.6	-2.7
Subbasin_138	4.90	0.0	0.3	0.0	-0.1	0.0	1.7	0.0	-1.6
Sink-1	354.80	0.2	0.1	-0.2	-0.1	4.6	2.7	-4.6	-2.7
	Maximum	0.2	0.4	0.0	0.0	4.7	4.3	0.0	-0.2
	Minimum	0.0	0.0	-0.2	-0.3	0.0	0.2	-4.7	-4.5

Sensitivity Analysis Results

Project No: 5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: 12-Dec-23

Basin Model Saugeen_HMS_Calibrated **Areal Reduction Factor:** 0.766

Peak Flow and Runoff Volume Percent Change

Hydrologic Element	Drainage Area (km^2)	Hazel 75% Canopy Storage		Hazel 125% Canopy		Hazel 75% Depression		Hazel 125% Depression	
		Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume	Percent Difference in Peak Flow	Percent Difference in Volume
Subbasin_129	24.80	0.1%	0.0%	-0.1%	-0.1%	1.4%	1.5%	-1.4%	-1.6%
Subbasin_130	5.40	0.0%	0.1%	-0.1%	-0.1%	1.4%	1.7%	-1.6%	-1.7%
Junction_116	30.30	0.1%	0.1%	-0.1%	-0.1%	1.4%	1.6%	-1.5%	-1.6%
Subbasin_101	36.10	0.1%	0.1%	0.0%	-0.1%	2.8%	2.9%	-2.7%	-2.9%
Subbasin_102	12.70	0.1%	0.1%	-0.1%	-0.1%	2.1%	2.3%	-2.1%	-2.3%
Junction_101	48.80	0.1%	0.1%	0.0%	-0.1%	2.4%	2.6%	-2.3%	-2.6%
Reach_1001	48.80	0.1%	0.1%	0.0%	-0.1%	2.4%	2.6%	-2.5%	-2.6%
Subbasin_103	24.40	0.1%	0.1%	0.0%	-0.1%	2.1%	2.3%	-2.1%	-2.3%
Subbasin_104	1.20	0.0%	0.0%	0.0%	-0.1%	1.5%	2.0%	-1.8%	-2.0%
Junction_102	74.40	0.1%	0.1%	-0.1%	-0.1%	2.3%	2.5%	-2.4%	-2.5%
Reach_1002	74.40	0.1%	0.1%	-0.1%	-0.1%	2.3%	2.5%	-2.3%	-2.5%
Subbasin_105	21.00	0.1%	0.1%	0.0%	0.0%	1.9%	2.1%	-1.9%	-2.1%
Subbasin_106	18.30	0.1%	0.0%	-0.1%	-0.1%	1.9%	2.1%	-2.0%	-2.2%
Junction_103	39.30	0.1%	0.1%	-0.1%	-0.1%	1.9%	2.1%	-1.9%	-2.1%
Reach_1003	39.30	0.0%	0.1%	-0.1%	-0.1%	1.9%	2.1%	-1.9%	-2.1%
Subbasin_107	20.70	0.1%	0.1%	0.0%	0.0%	2.1%	2.4%	-2.1%	-2.3%
Subbasin_108	3.30	0.1%	0.0%	0.0%	-0.1%	0.8%	1.1%	-0.9%	-1.2%
Junction_104	137.70	0.1%	0.1%	-0.1%	-0.1%	1.7%	2.3%	-1.8%	-2.2%
Reach_1004	137.70	0.1%	0.1%	-0.1%	-0.1%	1.9%	2.3%	-1.9%	-2.3%
Subbasin_109	11.40	0.1%	0.1%	-0.1%	-0.1%	2.6%	2.8%	-2.7%	-2.8%
Subbasin_110	9.50	0.1%	0.1%	-0.1%	0.0%	1.9%	2.1%	-1.9%	-2.1%
Junction_105	158.50	0.1%	0.1%	0.0%	-0.1%	1.9%	2.3%	-1.9%	-2.3%
Reach_1005	158.50	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.3%	-2.4%
Subbasin_111	25.60	0.1%	0.1%	0.0%	0.0%	2.3%	2.4%	-2.3%	-2.4%
Subbasin_112	6.80	0.0%	0.1%	0.0%	-0.1%	2.5%	2.6%	-2.5%	-2.6%
Junction_106	190.90	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.3%	-2.4%
Reach_1006	190.90	0.1%	0.1%	-0.1%	-0.1%	2.3%	2.4%	-2.3%	-2.4%
Subbasin_113	8.00	0.0%	0.0%	-0.1%	-0.1%	1.7%	1.9%	-1.8%	-2.1%
Junction_107	198.90	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.3%	-2.4%
Reach_1007	198.90	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.2%	-2.4%
Subbasin_114	17.00	0.1%	0.2%	-0.1%	0.0%	2.3%	2.6%	-2.3%	-2.5%
Subbasin_115	1.40	0.0%	0.0%	-0.2%	0.0%	0.9%	1.2%	-0.9%	-1.2%
Junction_108	217.30	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.2%	-2.4%
Reach_1008	217.30	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.2%	-2.4%
Subbasin_116	1.30	0.2%	0.0%	0.0%	-0.1%	0.6%	1.0%	-0.6%	-1.0%
Junction_109	218.60	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.2%	-2.4%
Reach_1009	218.60	0.1%	0.1%	0.0%	-0.1%	2.3%	2.4%	-2.2%	-2.4%
Subbasin_117	9.50	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.8%	-1.7%	-1.9%
Subbasin_118	9.20	0.0%	0.0%	-0.1%	-0.1%	0.8%	1.1%	-0.9%	-1.2%
Junction_110	237.30	0.1%	0.1%	0.0%	-0.1%	2.2%	2.3%	-2.1%	-2.2%
Reach_1010	237.30	0.1%	0.1%	0.0%	-0.1%	2.2%	2.2%	-2.1%	-2.2%
Subbasin_119	4.50	0.0%	0.0%	-0.1%	0.0%	0.4%	0.6%	-0.4%	-0.7%
Subbasin_120	3.30	0.1%	0.0%	-0.1%	-0.1%	0.7%	1.1%	-0.8%	-1.2%
Junction_111	245.00	0.1%	0.1%	0.0%	-0.1%	2.1%	2.1%	-2.1%	-2.1%
Reach_1011	245.00	0.1%	0.1%	0.0%	-0.1%	2.1%	2.1%	-2.1%	-2.1%
Subbasin_121	15.00	0.0%	0.0%	-0.1%	-0.1%	1.6%	1.8%	-1.6%	-1.9%
Subbasin_122	4.20	0.1%	0.1%	-0.1%	-0.1%	0.9%	1.3%	-1.0%	-1.3%
Junction_112	264.20	0.1%	0.1%	0.0%	-0.1%	2.0%	2.1%	-2.0%	-2.1%
Reach_1012	264.20	0.1%	0.1%	0.0%	-0.1%	2.0%	2.1%	-2.0%	-2.1%
Subbasin_123	9.50	0.1%	0.1%	-0.1%	-0.1%	0.8%	1.1%	-0.7%	-1.0%
Subbasin_124	5.40	0.0%	0.1%	-0.2%	-0.1%	1.3%	1.6%	-1.5%	-1.7%
Junction_113	279.20	0.1%	0.1%	0.0%	-0.1%	2.0%	2.0%	-1.9%	-2.0%
Reach_1013	279.20	0.1%	0.1%	0.0%	-0.1%	2.0%	2.0%	-1.9%	-2.0%
Subbasin_125	9.00	0.0%	0.1%	-0.1%	-0.1%	1.1%	1.4%	-1.1%	-1.4%
Subbasin_126	7.70	0.1%	0.1%	-0.1%	-0.1%	1.5%	1.8%	-1.5%	-1.8%
Junction_114	296.00	0.1%	0.1%	-0.1%	-0.1%	1.9%	2.0%	-1.9%	-1.9%
Reach_1014	296.00	0.1%	0.1%	-0.1%	-0.1%	1.9%	2.0%	-1.9%	-2.0%
Subbasin_127	11.40	0.0%	0.1%	-0.1%	-0.1%	1.6%	1.8%	-1.7%	-1.9%
Subbasin_128	1.80	0.1%	0.1%	0.0%	0.0%	0.3%	0.6%	-0.2%	-0.6%
Junction_115	309.20	0.1%	0.1%	-0.1%	-0.1%	1.9%	1.9%	-1.9%	-1.9%
Reach_1015	309.20	0.1%	0.1%	-0.1%	-0.1%	1.9%	1.9%	-1.9%	-1.9%
Subbasin_132	2.20	0.1%	0.1%	0.0%	0.0%	0.2%	0.5%	-0.2%	-0.5%
Saugeen Flow Gauge	311.40	0.1%	0.1%	-0.1%	-0.1%	1.9%	1.9%	-1.8%	-1.9%
Reach_1016	30.30	0.0%	0.1%	-0.1%	-0.1%	1.4%	1.6%	-1.5%	-1.6%
Subbasin_131	3.10	0.0%	0.1%	-0.1%	-0.1%	0.2%	1.7%	-0.2%	-1.7%
Junction_117	344.80	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.9%	-1.7%	-1.9%
Reach_1017	344.80	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.9%	-1.7%	-1.9%
Subbasin_133	2.60	0.0%	0.1%	-0.1%	0.0%	0.5%	0.9%	-0.6%	-0.9%
Junction_118	347.30	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.8%	-1.7%	-1.9%
Reach_1018	347.30	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.8%	-1.7%	-1.9%
Subbasin_136	1.70	0.0%	0.2%	0.0%	-0.1%	0.3%	0.9%	-0.1%	-0.8%
Subbasin_134	0.30	0.0%	0.1%	0.0%	-0.1%	0.0%	0.3%	0.0%	-0.3%
Junction_119	0.30	0.0%	0.1%	0.0%	-0.1%	0.0%	0.3%	0.0%	-0.3%
Reach_1019	0.30	0.0%	0.1%	0.0%	-0.1%	0.0%	0.3%	0.0%	-0.3%
Subbasin_135	0.30	0.0%	0.1%	0.0%	-0.1%	0.0%	0.2%	0.0%	-0.3%
Junction_120	0.60	0.0%	0.1%	0.0%	-0.1%	0.0%	0.2%	0.0%	-0.3%
Reach_1020	0.60	0.0%	0.1%	0.0%	-0.1%	0.0%	0.2%	0.0%	-0.3%
Subbasin_137	0.30	0.0%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	-0.1%
OutflowDurham	0.90	0.0%	0.1%	0.0%	-0.1%	0.1%	0.2%	0.0%	-0.2%
Junction_121	349.90	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.8%	-1.7%	-1.8%
Reach_1021	349.90	0.1%	0.1%	-0.1%	-0.1%	1.7%	1.8%	-1.7%	-1.9%
Subbasin_138	4.90	0.0%	0.1%	0.0%	0.0%	0.1%	0.4%	-0.1%	-0.4%
Sink-1	354.80	0.1%	0.1%	-0.1%	-0.1%	1.6%	1.8%	-1.6%	-1.8%
	Maximum	0.2%	0.2%	0.0%	0.0%	2.8%	2.9%	0.0%	-0.1%
	Minimum	0.0%	0.0%	-0.2%	-0.1%	0.0%	0.2%	-2.7%	-2.9%

Appendix B4

Single Station Frequency Analysis

Linear Regression Analysis

1

Project No: 5591
Project Name: Durham FPM
Designed/Checked By: SO/MC
Date: 18-Dec-23

Linear Regression Analysis Flow Data

Flow Data					
Max Instantaneous			Max Daily		
Year	MM--DD	MAX Flow (m^3/s)	Year	MM--DD	MAX Flow (m3/s)
1977	03--15	126	1977	03--15	104
1978	04--13	80.1	1978	04--13	77
1979	04--15	91.6	1979	04--15	81.6
1980	03--21	70.6	1980	03--21	32.3
1981	02--22	97.7	1981	02--22	92.6
1982	04--18	87.1	1982	04--18	84.1
1983	03--08	22.1	1983	03--08	21.1
1984	12--30	81.2	1984	12--30	73.5
1987	03--26	41.7	1987	03--26	39.6
1988	03--27	42.1	1988	03--27	40
1990	03--13	108	1990	03--14	86.9
1992	11--14	54.1	1992	11--14	49.5
1993	01--05	61.5	1993	01--05	54.9
1994	04--04	27.2	1994	04--05	24.3
1995	11--12	31.9	1995	11--12	30.6
1996	01--19	62.6	1996	01--20	49.2
1998	03--28	78.7	1998	03--28	65.5
2005	04--01	63.7	2005	04--02	45
2007	03--27	53.2	2007	03--27	50.9
2012	03--14	42.9	2012	03--14	40
2014	04--14	73	2014	04--14	63.5
2015	04--11	30.1	2015	04--11	29.3
2016	04--01	88.6	2016	04--01	85.9
2017	02--25	56.4	2017	02--25	53.7
2018	02--21	124	2018	02--21	104
2021	03--12	61	2021	03--13	48.6

Single Station Frequency Analysis Data

1

WILLS

Project No: 5591
Project Name: Durham FPM
Designed/Checked By: SO/MC
Date: 18-Dec-23

Single Station Frequency Analysis Flow Data

Flow Data					
Max Instantaneous			Max Daily		
Year	MM--DD	MAX Flow (m^3/s)	Year	MM--DD	MAX Flow (m3/s)
1977	03--15	126	1977	03--15	104
1978	04--13	80.1	1978	04--13	77
1979	04--15	91.6	1979	04--15	81.6
1980	03--21	70.6	1980	03--21	32.3
1981	02--22	97.7	1981	02--22	92.6
1982	04--18	87.1	1982	04--18	84.1
1983	03--08	22.1	1983	03--08	21.1
1984	12--30	81.2	1984	12--30	73.5
1985	04--06	51	1985	03--30	46.5
1987	03--26	41.7	1987	03--26	39.6
1988	03--27	42.1	1988	03--27	40
1989	03--29	129.0	1989	03--29	115
1990	03--13	108	1990	03--14	86.9
1991	03--29	68.4	1991	04--10	61.7
1992	11--14	54.1	1992	11--14	49.5
1993	01--05	61.5	1993	01--05	54.9
1994	04--04	27.2	1994	04--05	24.3
1995	11--12	31.9	1995	11--12	30.6
1996	01--19	62.6	1996	01--20	49.2
1998	03--28	78.7	1998	03--28	65.5
2005	04--01	63.7	2005	04--02	45
2006	03--14	90.8	2006	03--14	80
2007	03--27	53.2	2007	03--27	50.9
2008	12--29	94.9	2008	12--29	83.8
2009	02--13	57.6	2009	02--13	49.6
2010	03--15	61.4	2010	03--15	53.1
2011	03--19	37.7	2011	03--19	31.4
2012	03--14	42.9	2012	03--14	40
2014	04--14	73	2014	04--14	63.5
2015	04--11	30.1	2015	04--11	29.3
2016	04--01	88.6	2016	04--01	85.9
2017	02--25	56.4	2017	02--25	53.7
2018	02--21	124	2018	02--21	104
2019	03--16	53.0	2019	03--16	45.4
2020	03--30	41.9	2020	01--12	37.8
2021	03--12	61	2021	03--13	48.6

Estimated

Station Frequency Analysis for Saugeen River

Project No: 23-5591
Project Name: Durham Creek FPM
Designed/Checked By: SO/MC
Date: December 12, 2023

Hydrologic Properties of Catchment Area

Catchment Name	Saugeen River
Catchment Area	347.3 km^2
Hydrology Model Catchment ID	-

Hydrometric (Gauging Station) Data

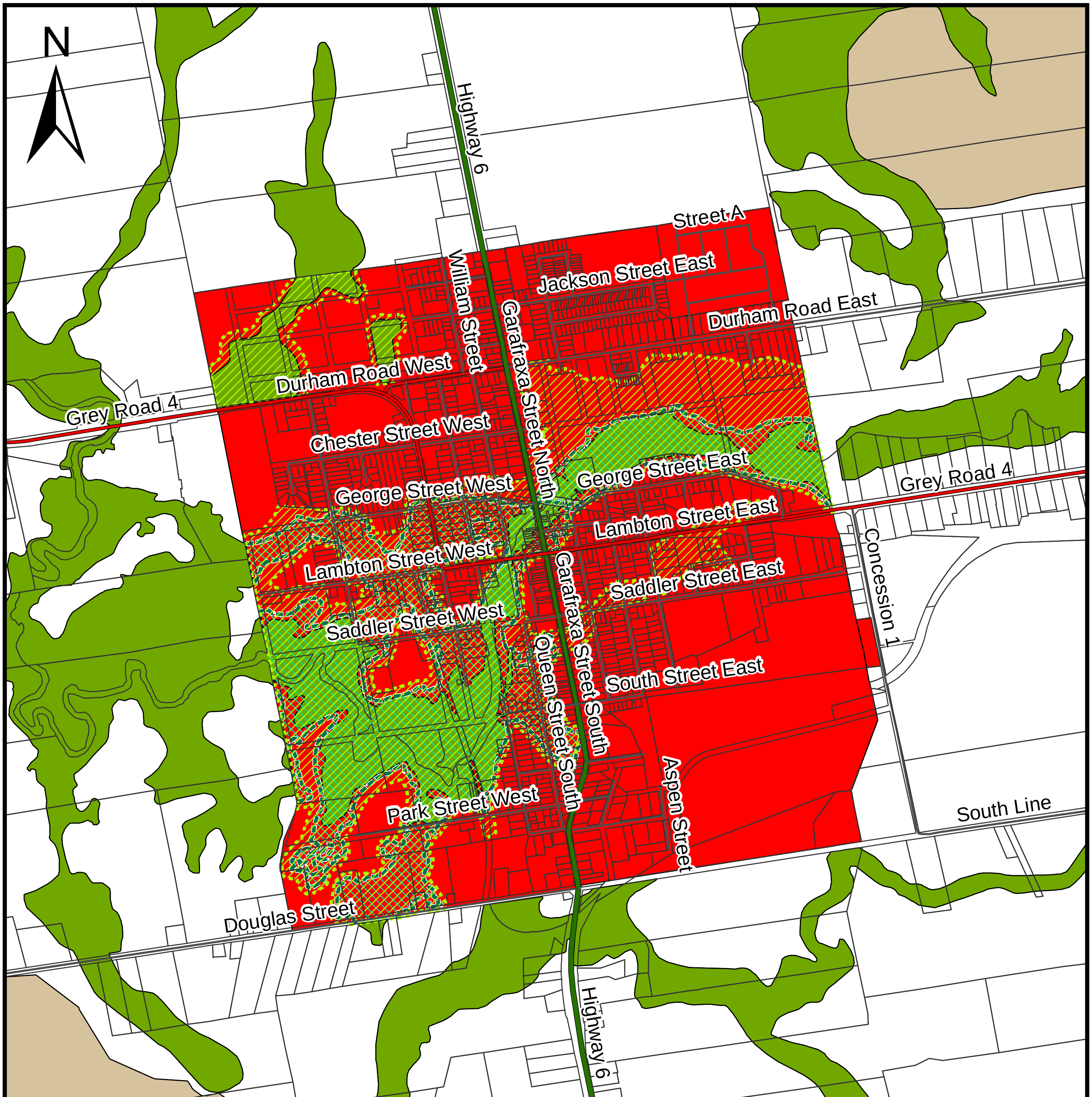
Station Number	Station Name	Period of Record	Drainage Area (km^2)	Source
02FC016	SAUGEEN RIVER ABOVE DURHAM	44	311.4	Water Survey of Canada
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

HEC-SSP Results

Percent Chance Exceedance	Return Period (years)	Probability	Peak Flow (cms)					
			02FC016					
50	2	0.5	62.2					
20	5	0.2	90.3					
10	10	0.1	109.8					
4	25	0.04	135.1					
2	50	0.02	154.6					
1	100	0.01	174.4					
0.1	1000	0.001	244.7					

Appendix B5

Official Plan and Zoning



LEGEND

- Provincial Highway
- County Road
- Local Road
- Seasonal Road
- Agricultural
- Special Agricultural
- Rural
- Primary Settlement Area
- Secondary Settlement Area
- Inland Lakes and Shoreline Settlement Area
- Regulated Area
- Flood Fringe
- Recreational Resort Settlement Area
- Sunset Strip Settlement Area
- Industrial Business Park Settlement Area
- Space Extensive Industrial and Commercial
- Niagara Escarpment Plan Boundary **
- Niagara Escarpment Development Control Area
- Escarpment Natural Area
- Escarpment Recreation Area
- Hazard Lands
- Provincially Significant Wetlands
- Hurricane Hazel Flood Event Standard

*** certain settlement areas within the Niagara Escarpment Plan Boundary may be subject to Development Control.*

THE COUNTY OF GREY OFFICIAL PLAN

SECONDARY SCHEDULE

Land Use Types

MAP 3I

DURHAM

SCALE 1:20 000

INTERACTIVE MAP: geo.grey.ca

DOWNLOAD PDF: grey.ca/planning-development

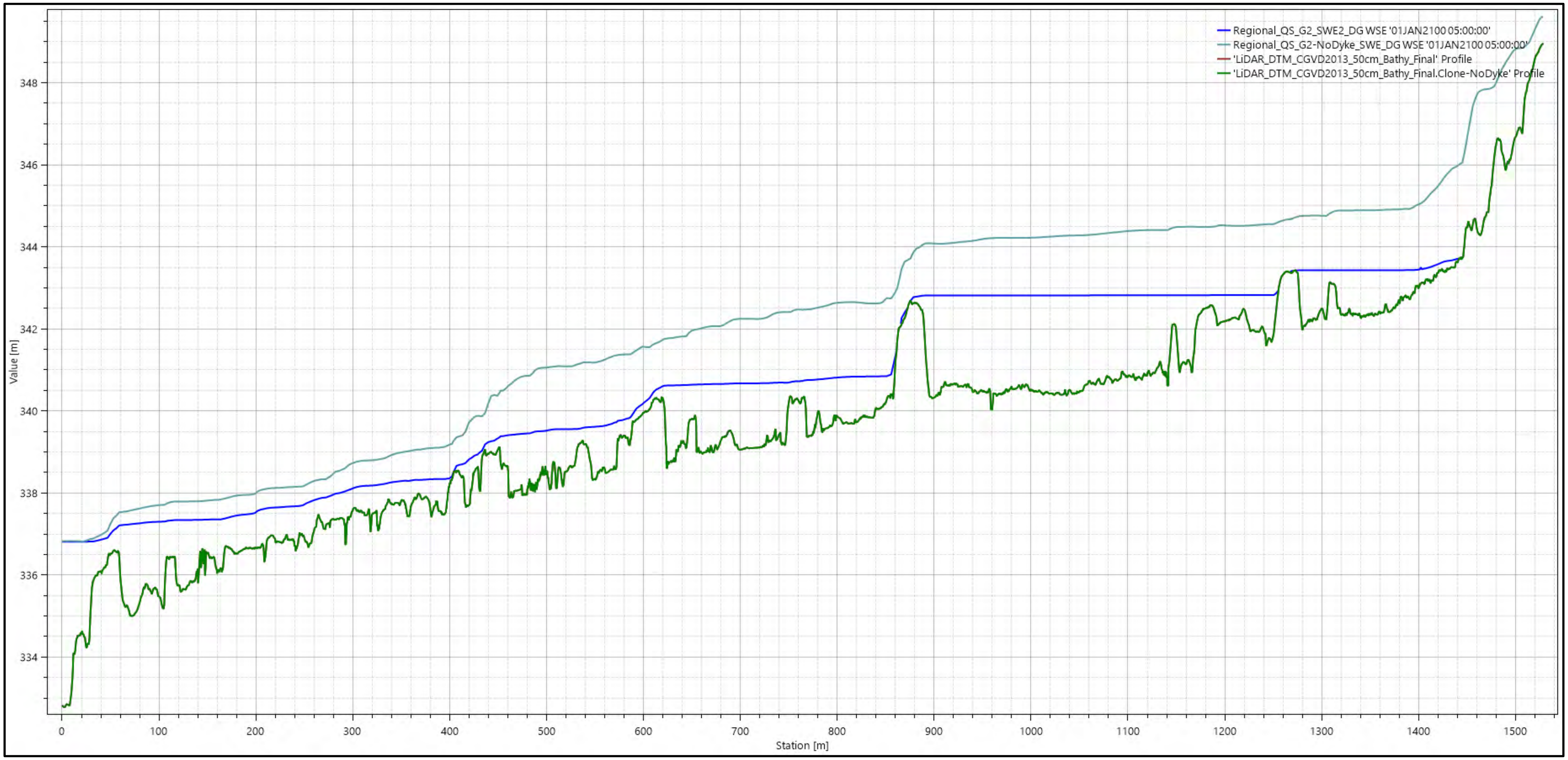
GR_OP_SecSched_Map3IDurhamX11.mxd

This map is for illustrative purposes only. Do not rely on this map as being a precise indicator of routes, location of features or surveying purposes. This map may contain cartographical errors or omissions.

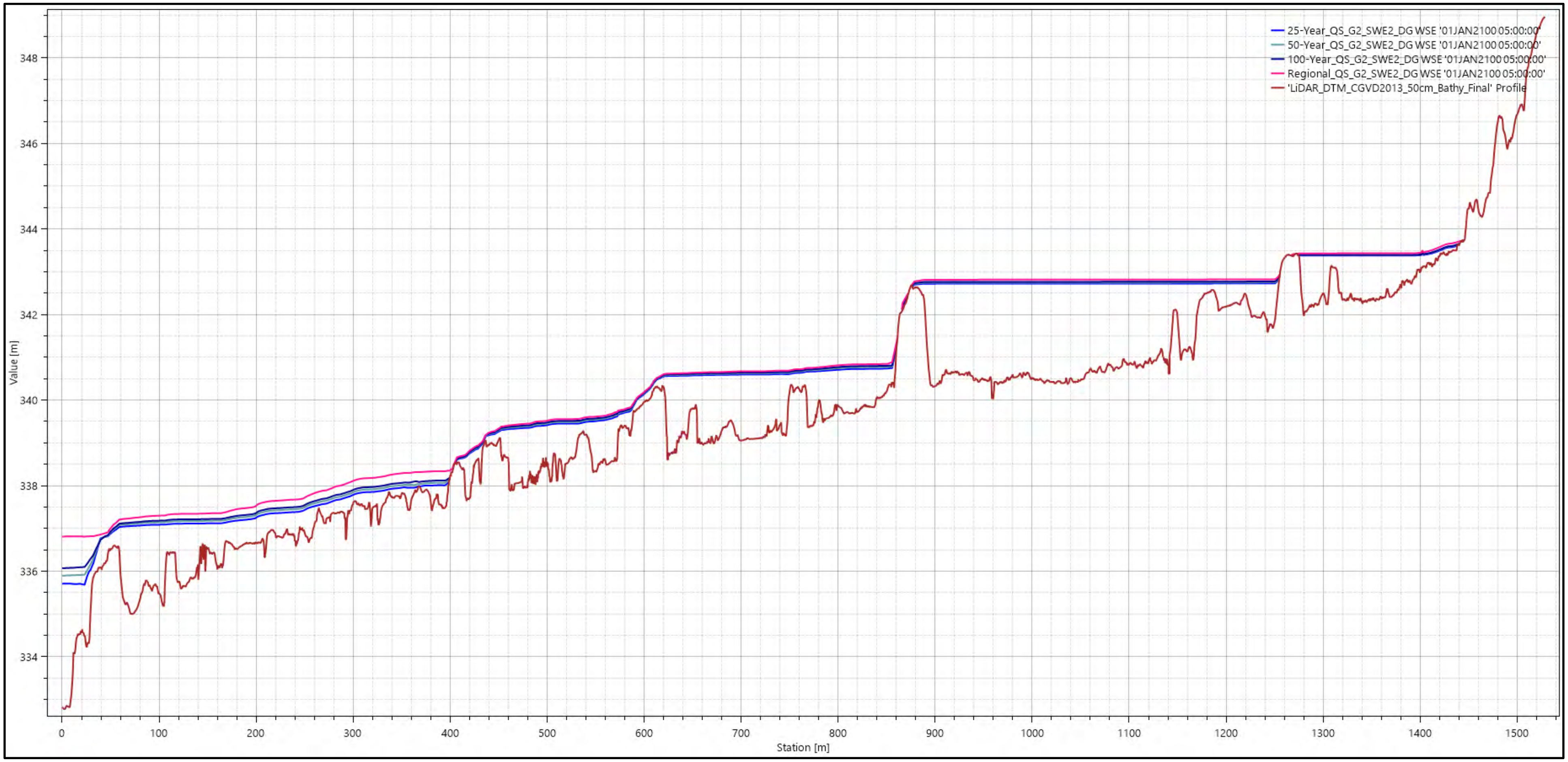
Appendix C

Hydraulic Study

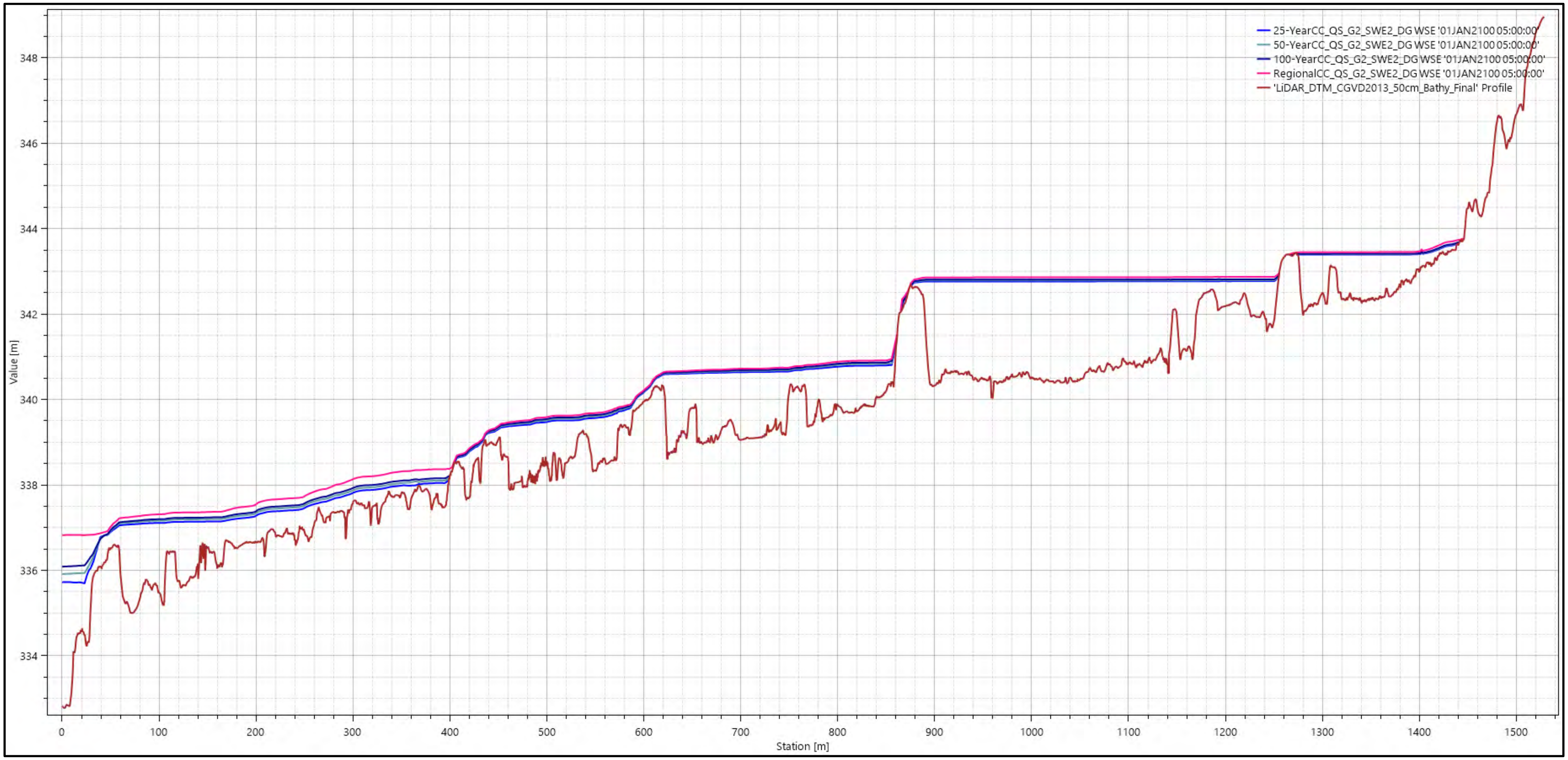
Profile Along Durham Creek Showing Hurricane Hazel and Hurricane Hazel with Saugeen River Spill Results



Profile Along Durham Creek Showing 25-Year, 50-Year, 100-Year, and Hurricane Hazel Results

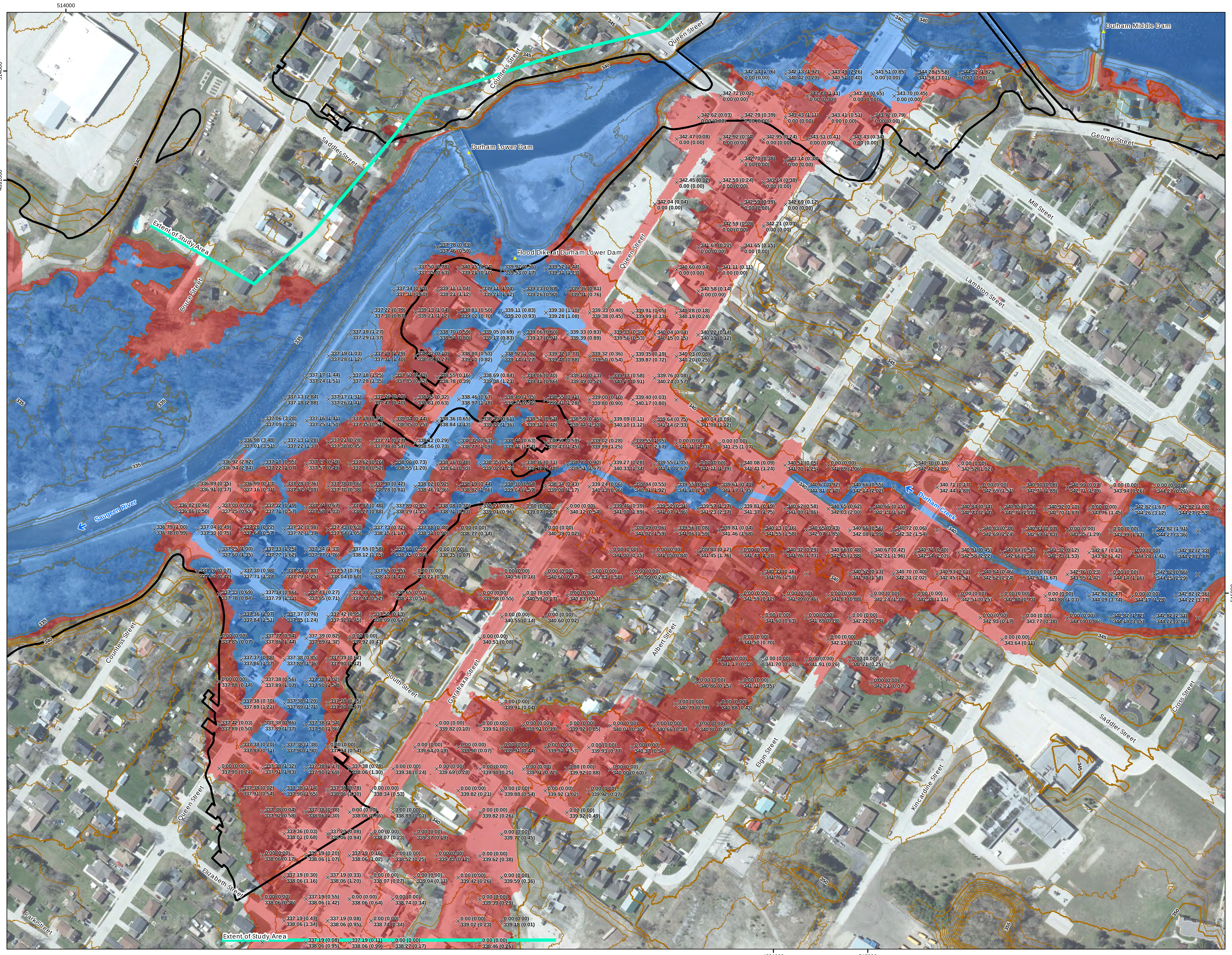


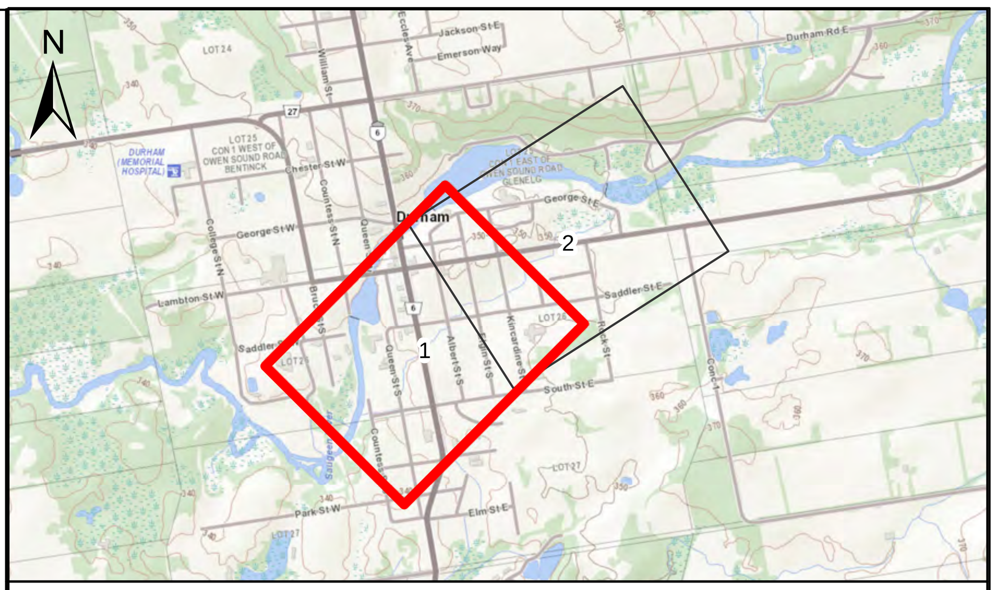
Profile Along Durham Creek Showing 50-Year, 100-Year, and Hurricane Hazel Climate Change Results



Appendix D

Floodplain Mapping





Legend

- Extent of Study Area
- Existing SVCA Saugeen River Floodline
- Hurricane Hazel Floodway
- Hurricane Hazel Flood Fringe
- Contours (1m)
- Contours (5m)

True North

NAD83 UTM Zone 17 North

CGVD 2013

Scales:

ANSI D (Full Size) (22x34): 1:1500

1:1,500

1 cm = 15 m

0 15 30 60 90 120 Meters

2D Flow Area Flood Elevation Labelling

100.00 (1.00)
101.00 (1.01)

- Hurricane Hazel Water Surface Elevation (m)
- Hurricane Hazel Flood Depth (m)
- Hurricane Hazel with Saugeen Spill Flood Depth (m)
- Hurricane Hazel with Saugeen Spill Water Surface Elevation (m)

Revisions

No.	Description	By	Date
0	DRAFT FLOOD HAZARD MAPS	DG	02/26/24
1	FINAL FLOOD HAZARD MAPS	DG	03/01/24

Notes:

1. Modeled in ArcMap 10.7, HEC-RAS Version 6.4.1 (2D Flow Regime).
2. All units are metric and in meters unless otherwise specified.
3. Aerial imagery from SWOOP 2020.
4. Contours derived from 2022 LiDAR DTM (DEDSFM Huron-Georgian Bay Project).
5. The LiDAR DTM base data is from the DEDSFM Huron-Georgian Bay 2022 project which has a 8.5 cm non-vegetated vertical accuracy and a 10.06 cm vegetated vertical accuracy which conforms to Level 1 Risk Criteria outlined in MNRF Technical Bulletin Flooding Hazards: Data Survey and Mapping Specification 2023.
6. This Flood Hazard Map is for Durham Creek only. The Flood Hazard Limits for the Saugeen River remain as per the 1991 Flood Hazard Mapping.

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LICENSED PROFESSIONAL ENGINEER M. J. CHURCY 100508019 03-01-2024 PROVINCE OF ONTARIO

Saugeen CONSERVATION

West Grey

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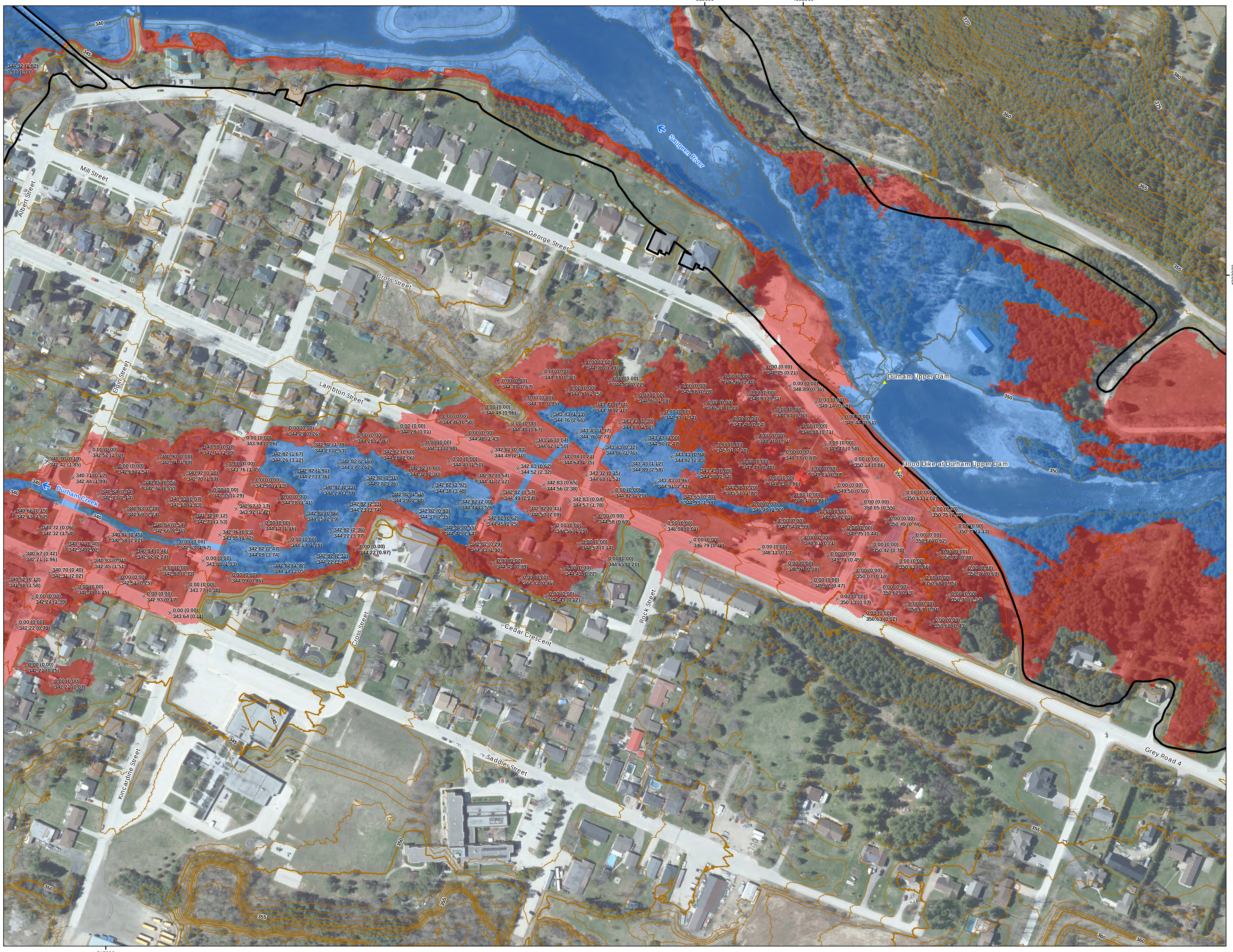
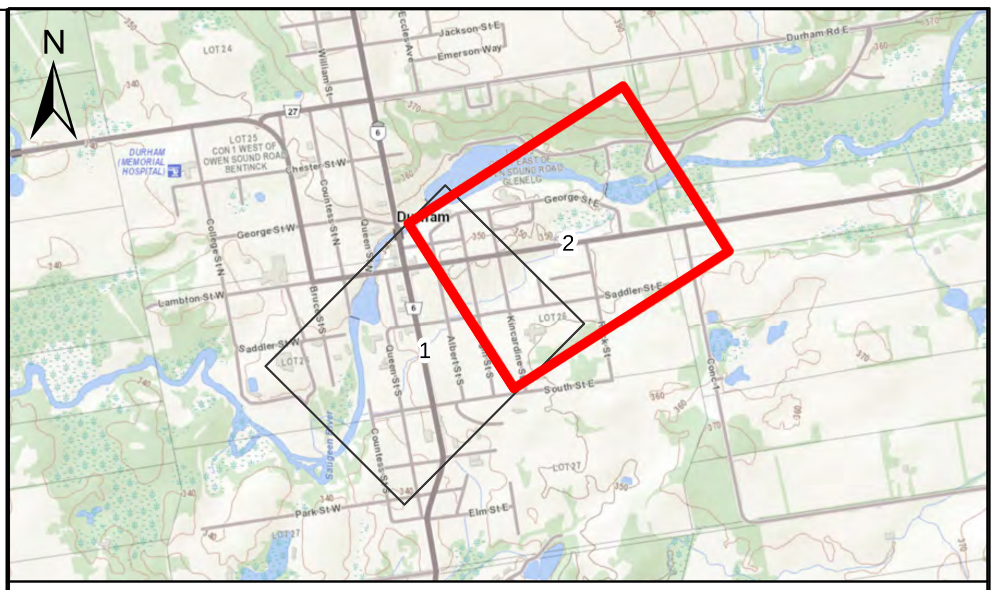
Engineer: MC	
Designed By: MC	
Checked By: DG	
Date: 03/01/24	
Project No. 23-5591	
Map File No. Draft FPM	

Durham Creek Flood Hazard Mapping

Saugeen Valley Conservation Authority
Municipality of West Grey

Hurricane Hazel Map Sheet 1





Legend

- Extent of Study Area
- Existing SVCA Saugeen River Floodline
- Hurricane Hazel Floodway
- Hurricane Hazel Flood Fringe
- Contours (1m)
- Contours (5m)

True North

NAD83 UTM
Zone 17 North

CGVD 2013

Scales:

ANSI D (Full Size)
(22x34): 1:1500

1:1,500

1 cm = 15 m

0 15 30 60 90 120
Meters

2D Flow Area Flood Elevation Labelling

100.00 (1.00)
101.00 (1.01)

- Hurricane Hazel Water Surface Elevation (m)
- Hurricane Hazel Flood Depth (m)
- Hurricane Hazel with Saugeen Spill Flood Depth (m)
- Hurricane Hazel with Saugeen Spill Water Surface Elevation (m)

Revisions

No.	Description	By	Date
0	DRAFT FLOOD HAZARD MAPS	DG	02/26/24
1	FINAL FLOOD HAZARD MAPS	DG	03/01/24

Notes:

1. Modeled in ArcMap 10.7, HEC-RAS Version 6.4.1 (2D Flow Regime).
2. All units are metric and in meters unless otherwise specified.
3. Aerial imagery from SWOOP 2020.
4. Contours derived from 2022 LiDAR DTM (DEDSFM Huron-Georgian Bay Project).
5. The LiDAR DTM base data is from the DEDSFM Huron-Georgian Bay 2022 project which has a 8.5 cm non-vegetated vertical accuracy and a 10.06 cm vegetated vertical accuracy which conforms to Level 1 Risk Criteria outlined in MNRF Technical Bulletin Flooding Hazards: Data Survey and Mapping Specification 2023.
6. This Flood Hazard Map is for Durham Creek only. The Flood Hazard Limits for the Saugeen River remain as per the 1991 Flood Hazard Mapping.

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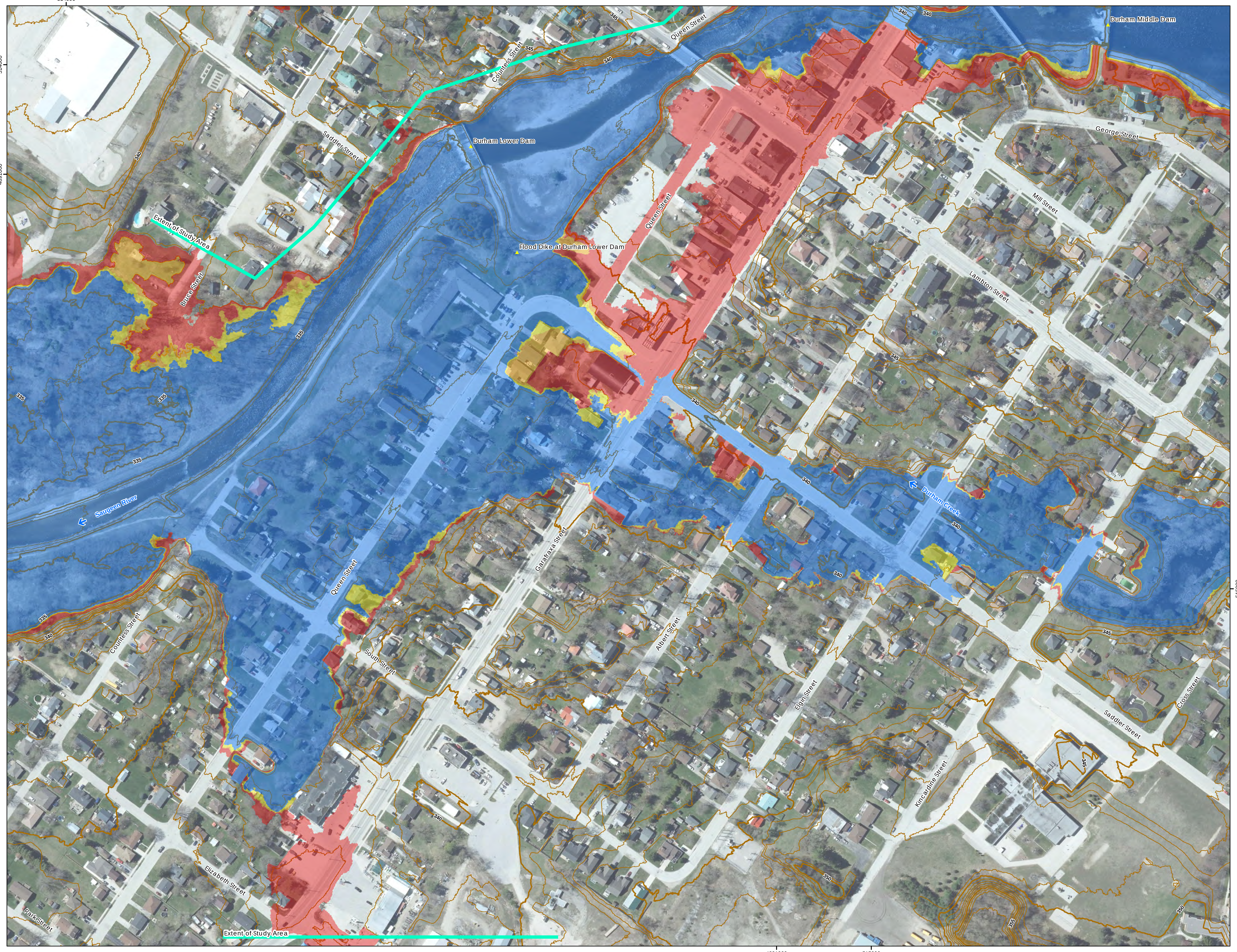
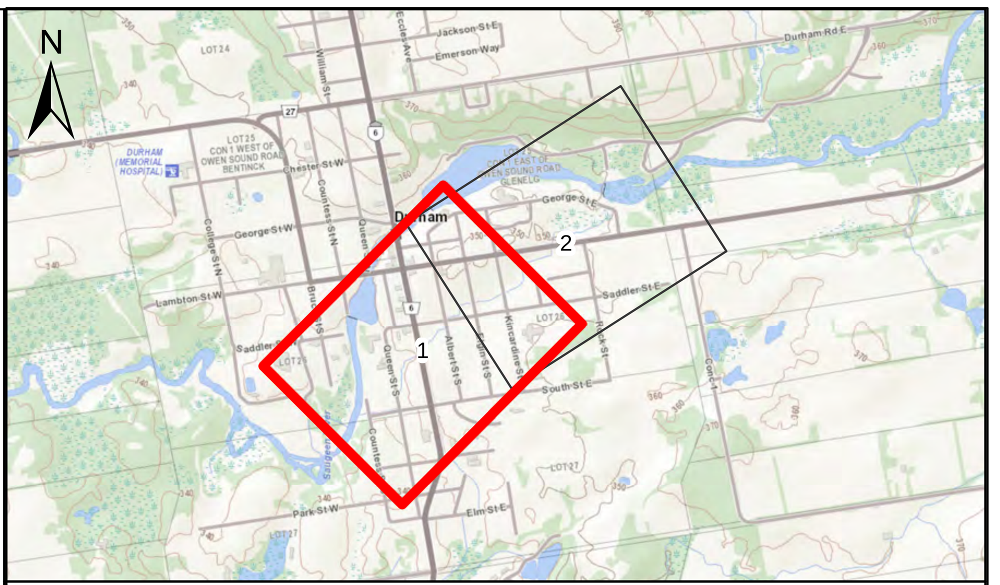
Engineer: MC
Designed By: MC
Checked By: DG
Date: 03/01/24
Project No. 23-5591
Map File No. Draft FPM

Durham Creek Flood Hazard Mapping

Saugeen Valley Conservation Authority
Municipality of West Grey

Hurricane Hazel Map Sheet 2





Legend

- Extent of Study Area
- 25-Year Inundation Boundary
- 50-Year Inundation Boundary
- 100-Year Inundation Boundary
- Regional Inudation Boundary
- Contours (1m)
- Contours (5m)

True North

NAD83 UTM
Zone 17 North

CGVD 2013

Scales:

ANSI D (Full Size)
(22x34): 1:1500

0 15 30 60 90 120
Meters

1:1,500

1 cm = 15 m

Revisions

No.	Description	By	Date
0	DRAFT FLOOD RISK MAPS	DG	02/27/24
1	FINAL FLOOD RISK MAPS	DG	03/01/24

Notes:

1. Modeled in ArcMap 10.7, HEC-RAS Version 6.4.1 (2D Flow Regime).
2. All units are metric and in meters unless otherwise specified.
3. Aerial imagery from SWOOP 2020.
4. Contours derrived from 2022 LiDAR DTM (DEDSFM Huron-Georgian Bay Project).
5. The LiDAR DTM base data is from the DEDSFM Huron-Georgian Bay 2022 project which has a 8.5 cm non-vegetated vertical accuracy and a 10.06 cm vegetated vertical accuracy which conforms to Level 1 Risk Criteria outlined in MNRF Technical Bulletin Flooding Hazards: Data Survey and Mapping Specification 2023.
6. This Flood Hazard Map is for Durham Creek only. The Flood Hazard Limits for the Saugeen River remain as per the 1991 Flood Hazard Mapping.

LICENSED PROFESSIONAL ENGINEER
D. M. GREEN
100149331
03/01/24
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M. J. CHURLY
100508019
03-01-2024
PROVINCE OF ONTARIO

Saugeen CONSERVATION

West Grey

WILLS

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Peterborough, Ontario
K9J 0B9

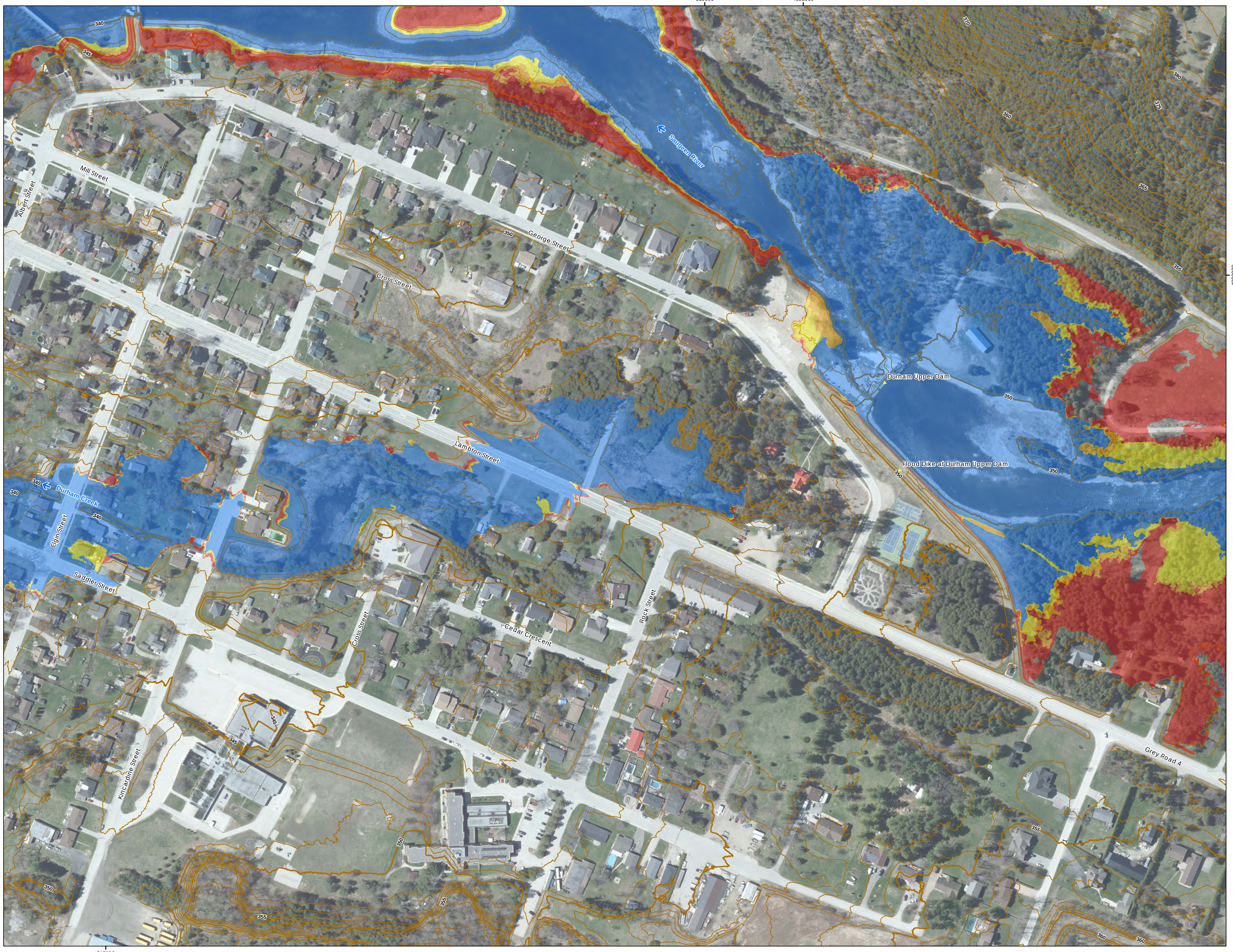
P. 705.742.2297
F. 705.741.3568
E. wills@dmwills.com

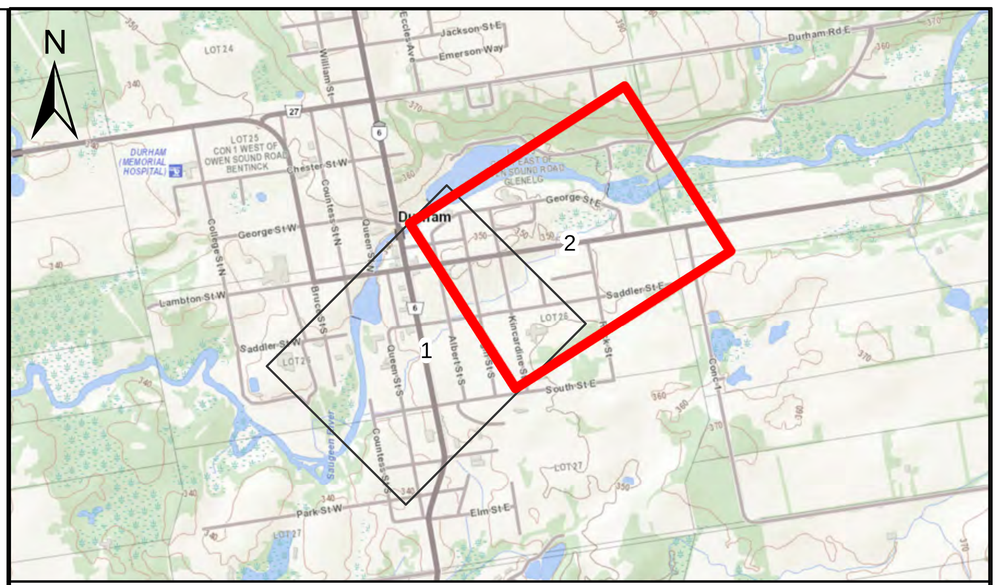
Engineer: MC	
Designed By: MC	
Checked By: DG	
Date: 03/01/24	
Project No. 23-5591	
Map File No. Draft FPM	

Durham Creek Flood Hazard Mapping

Saugeen Valley Conservation Authority
Municipality of West Grey

Flood Risk Map Sheet 1





Legend

- Extent of Study Area
- 25-Year Inundation Boundary
- 50-Year Inundation Boundary
- 100-Year Inundation Boundary
- Regional Inudation Boundary
- Contours (1m)
- Contours (5m)

True North

NAD83 UTM Zone 17 North

CGVD 2013

Scales:

ANSI D (Full Size) (22x34): 1:1500

0 15 30 60 90 120 Meters

1:1,500

1 cm = 15 m

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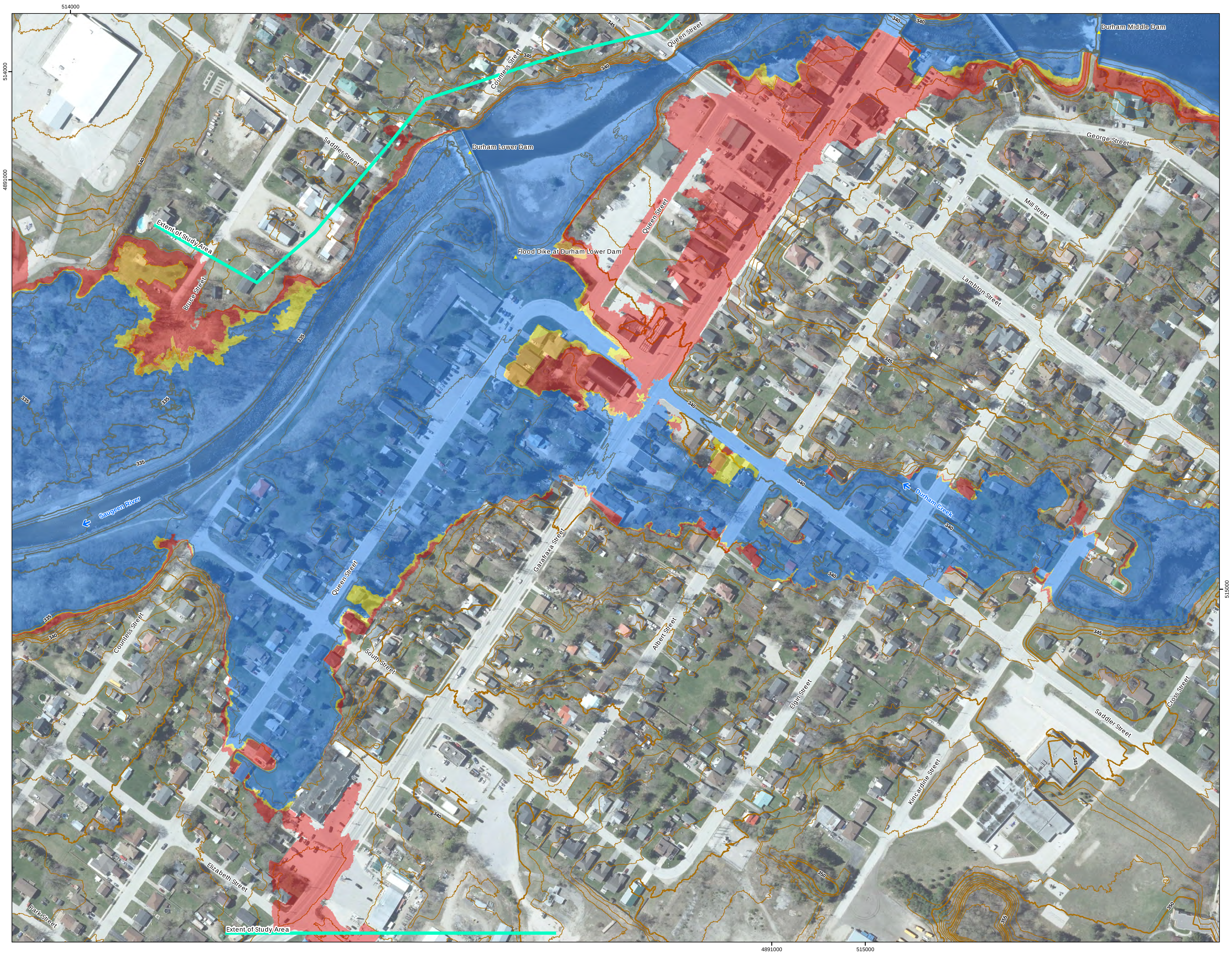
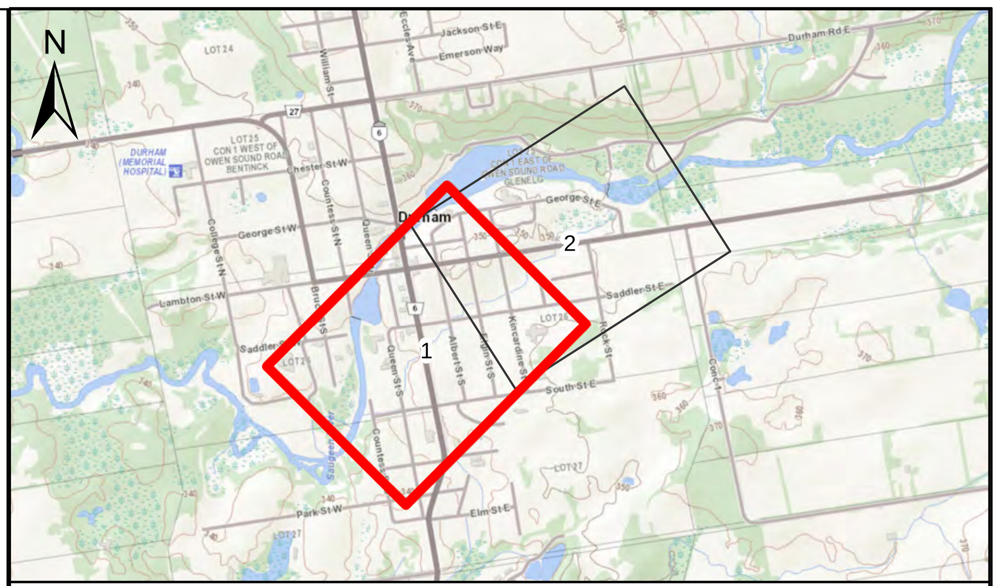
Durham Creek Flood Hazard Mapping

Saugeen Valley Conservation Authority
Municipality of West Grey

Flood Risk Map Sheet 2





Legend

- Extent of Study Area
- 25-Year Climate Change Inundation Boundary
- 50-Year Climate Change Inundation Boundary
- 100-Year Climate Change Inundation Boundary
- Regional Climate Change Inudation Boundary
- Contours (1m)
- Contours (5m)

True North

NAD83 UTM
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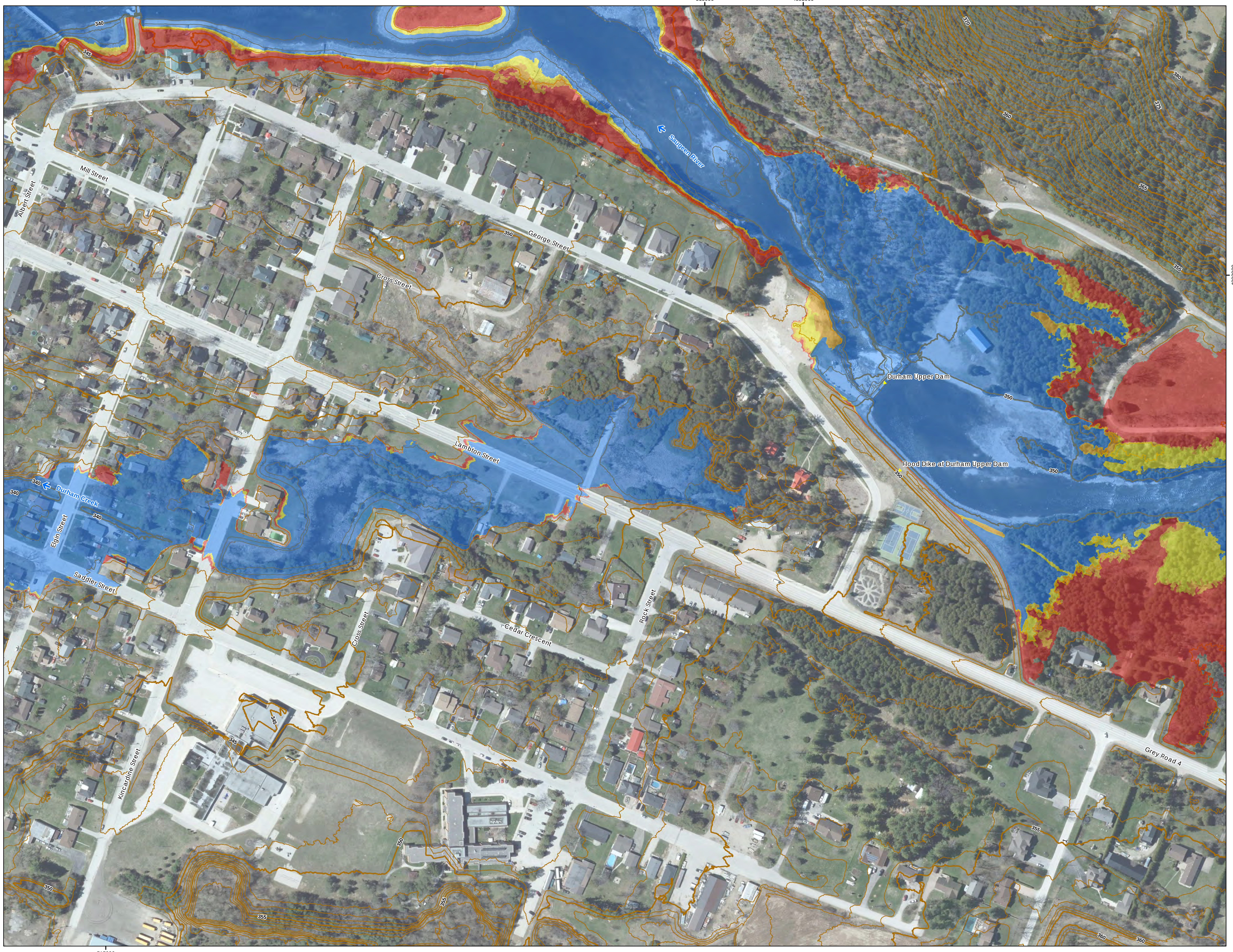
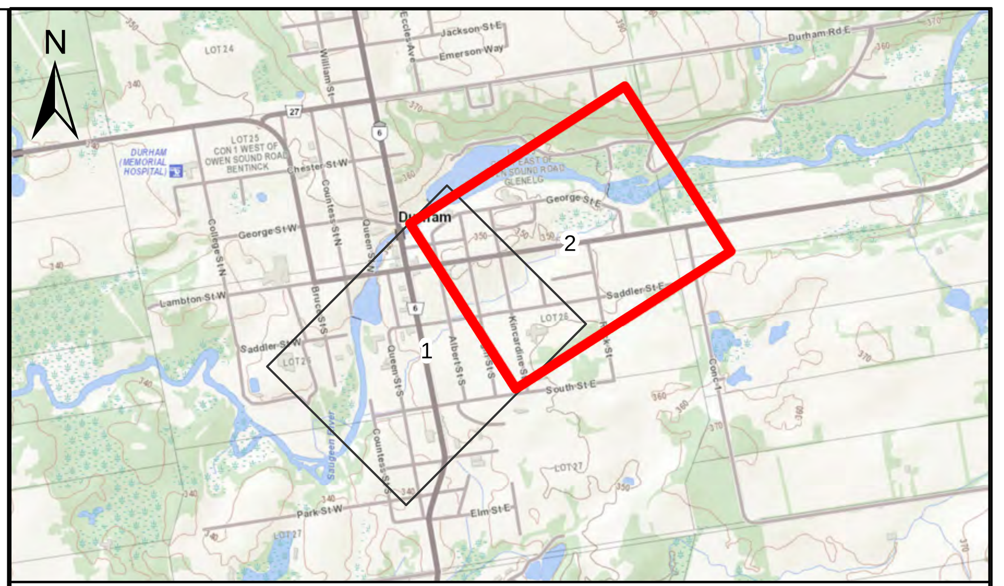
Durham Creek Flood Hazard Mapping

Saugeen Valley Conservation Authority
Municipality of West Grey

Climate Change Flood Risk Map Sheet 1





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Municipality of West Grey

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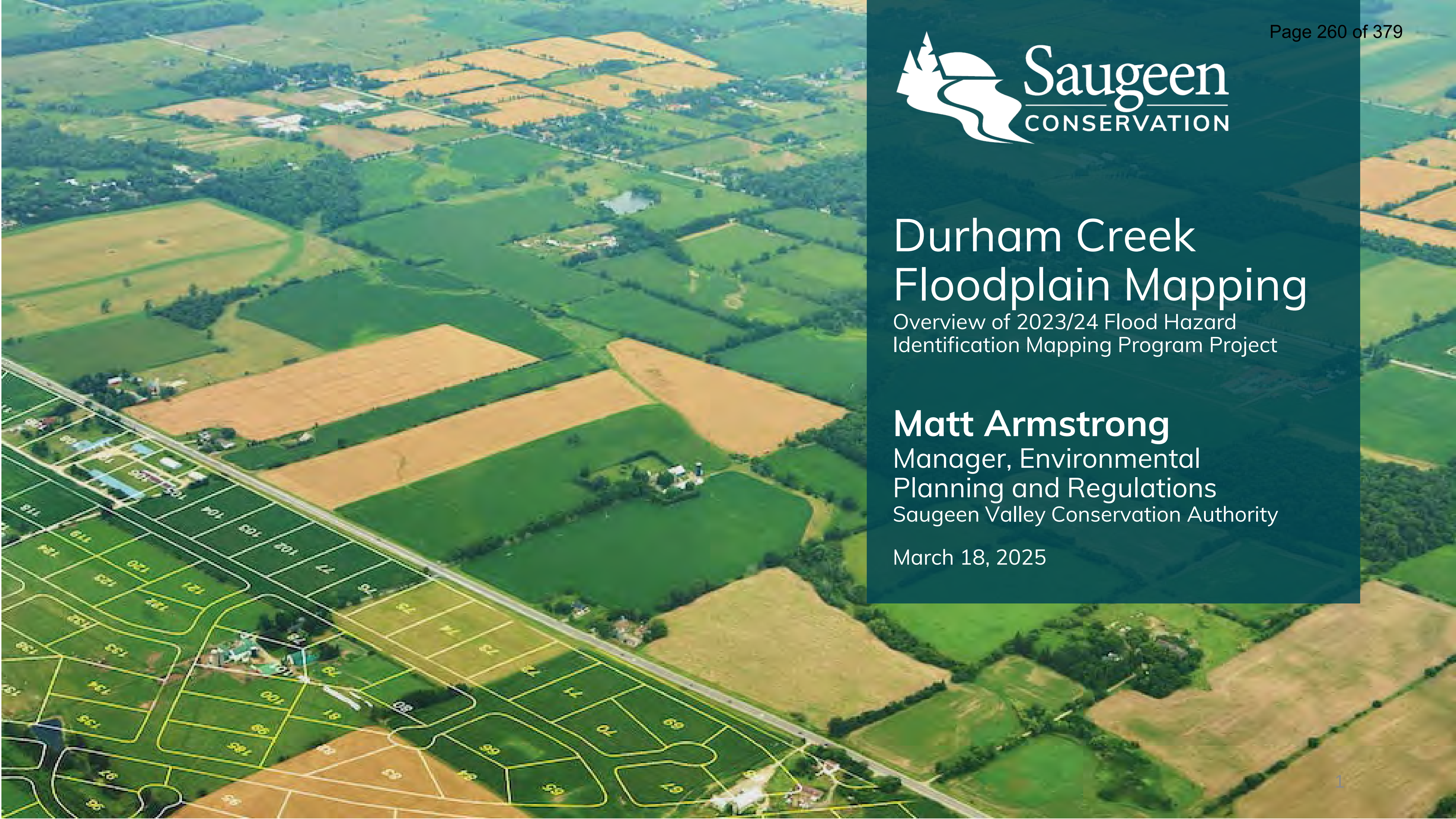


Saugeen CONSERVATION

Durham Creek Floodplain Mapping

Overview of 2023/24 Flood Hazard Identification Mapping Program Project

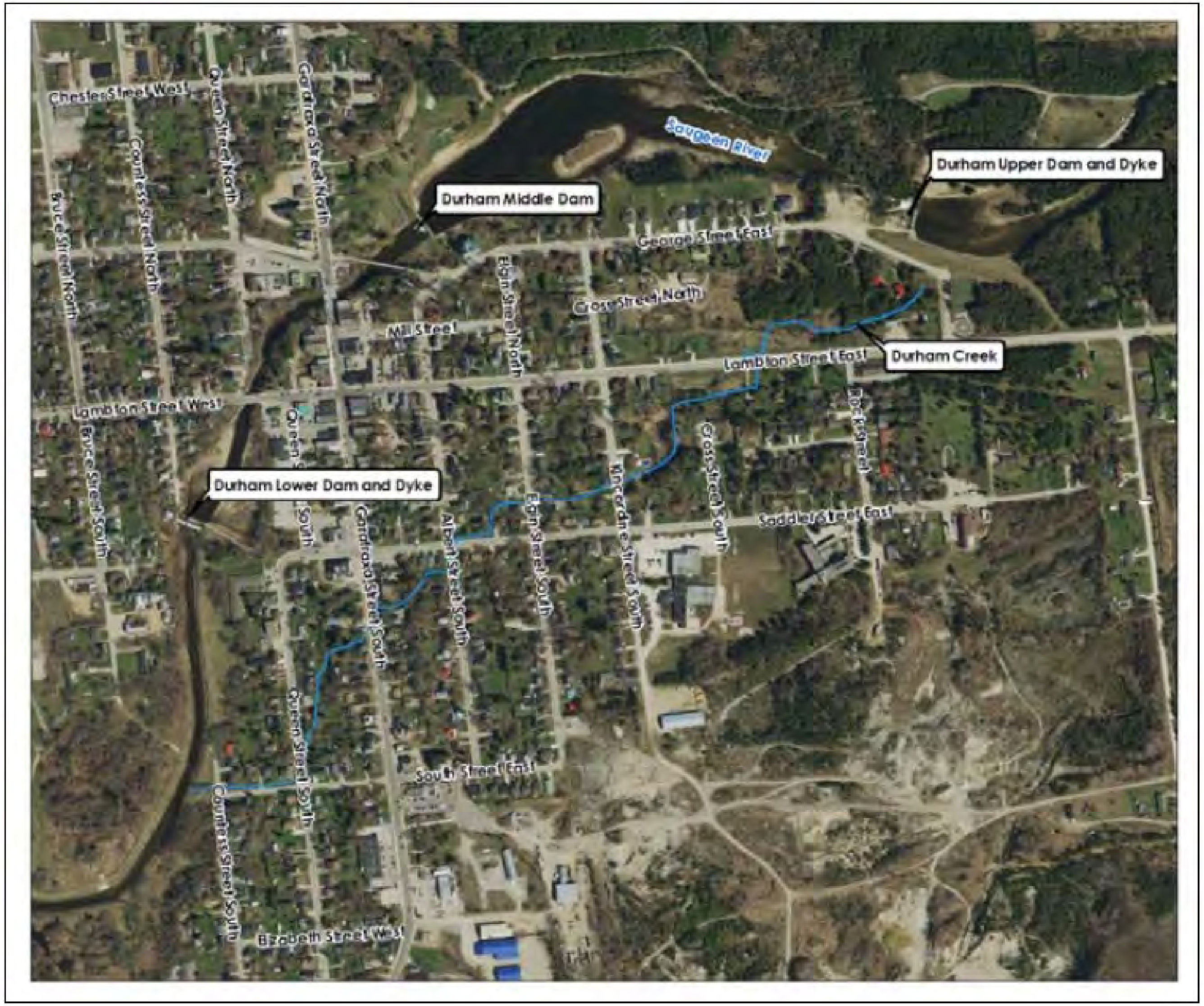
Matt Armstrong
Manager, Environmental Planning and Regulations
Saugeen Valley Conservation Authority

March 18, 2025

FHIMP Overview

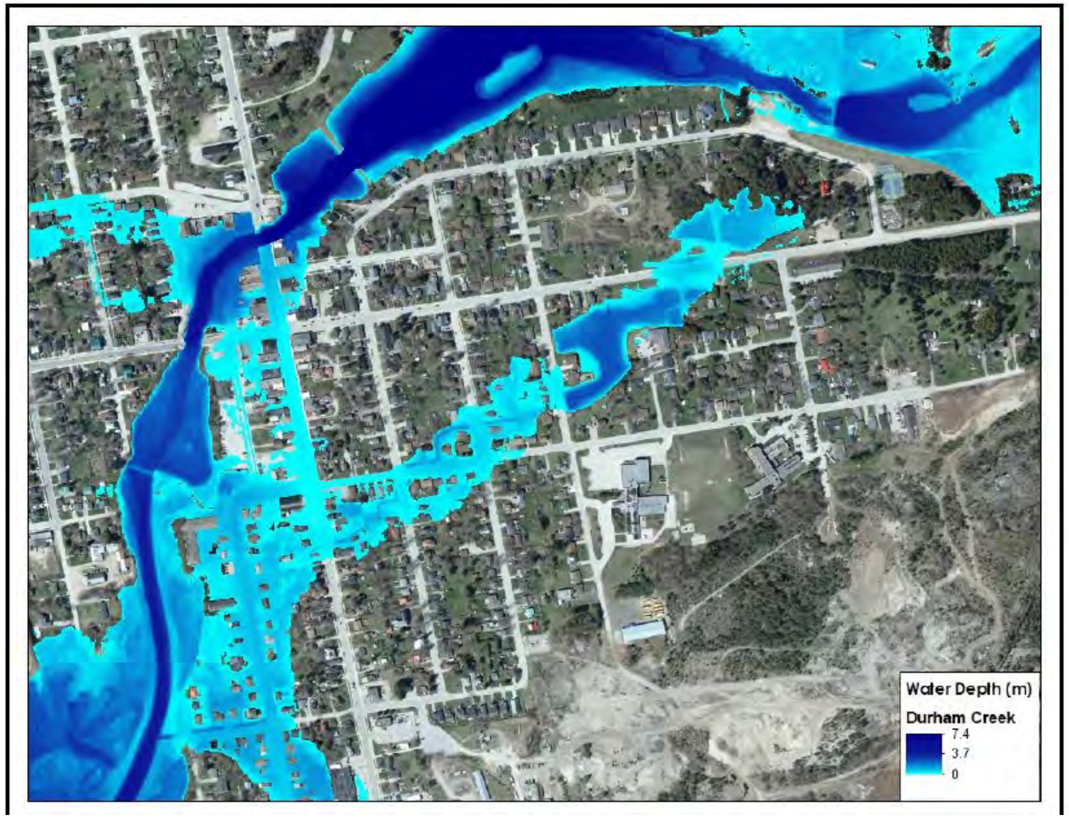
- In January 2022, Natural Resources Canada launched the Flood Hazard Identification and Mapping Program (FHIMP)
- Up to 50% matched federal funding to provinces and territories for eligible flood mapping projects (until 2028)
- SVCA partnered with West Grey, Huron-Kinloss, and Saugeen Shores to have updated or new floodplain mapping produced
- Durham Creek was identified as a priority area for West Grey

Durham Creek

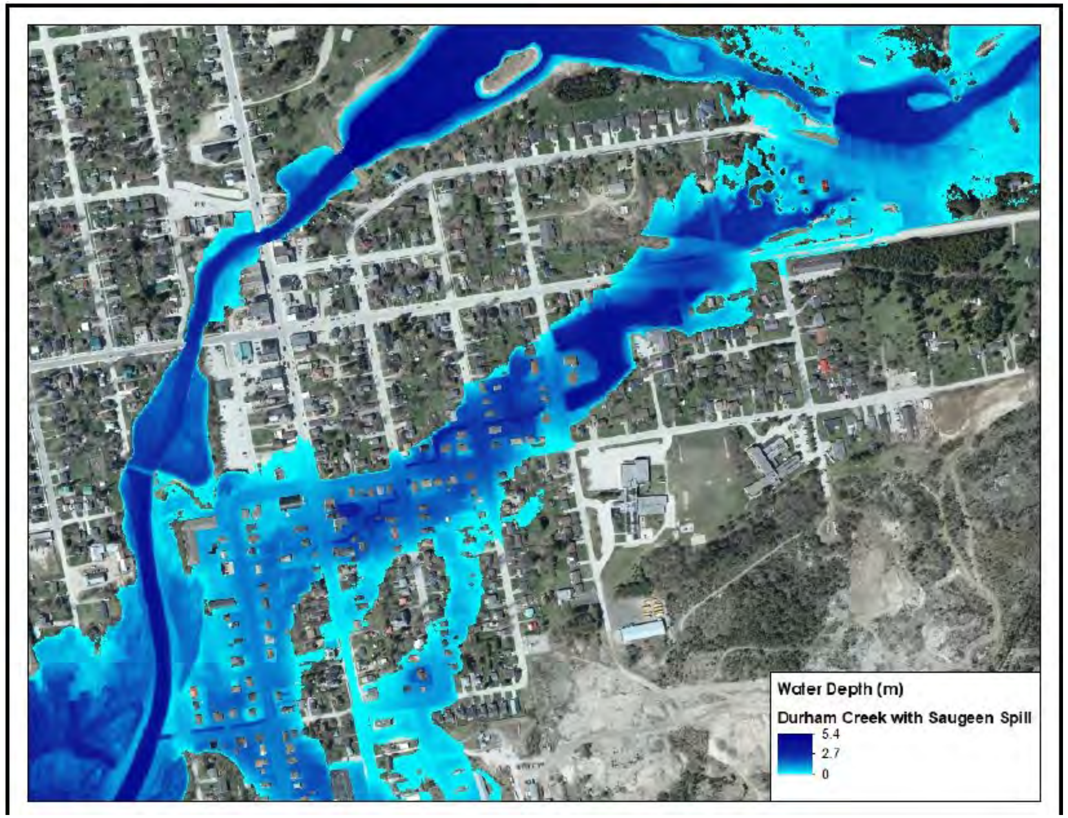


- Durham Creek flows through the east side of Durham, outlets to Saugeen River below Lower Dam
- No previous engineered floodplain mapping for Durham Creek
- DM Wills Associates Ltd. created hydrologic and hydraulic models to produce floodplain mapping
- Saugeen River influences Durham Creek Floodplain and was also modelled

Hydraulic Model Results

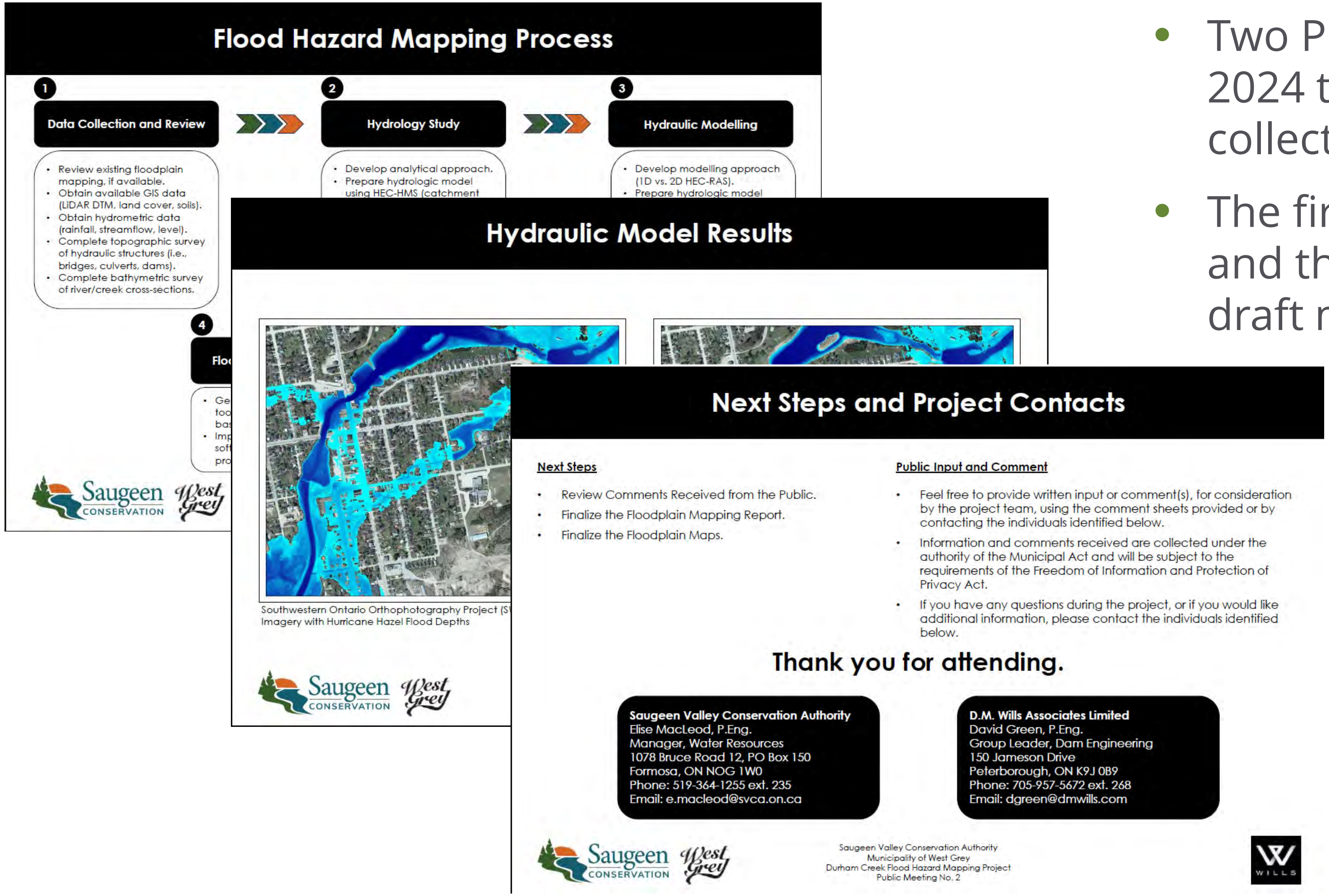


Floodplain without spill from Saugeen River at Upper Durham Dam



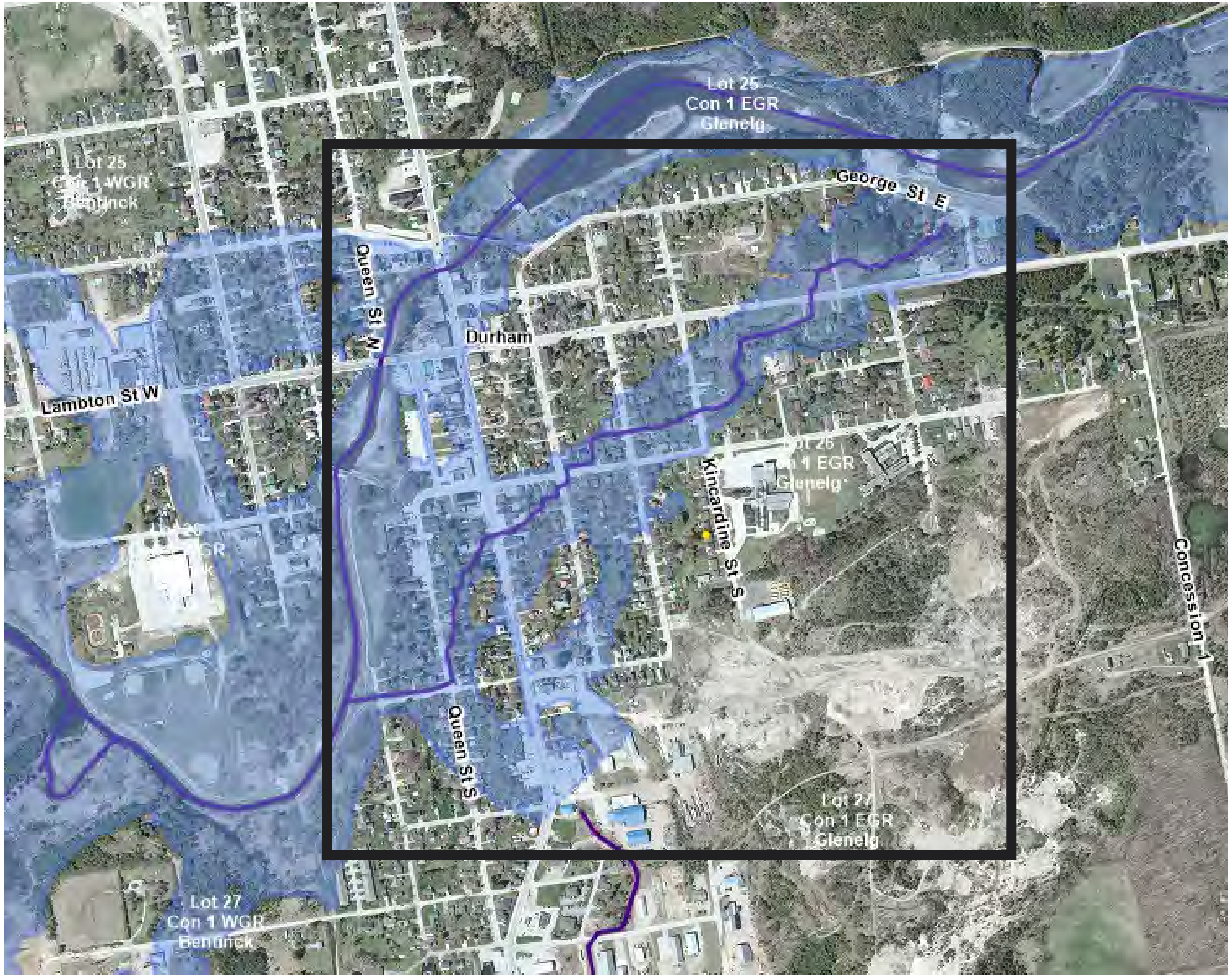
Floodplain with spill from Saugeen River at Upper Durham Dam

Public Information Centres (PICs)

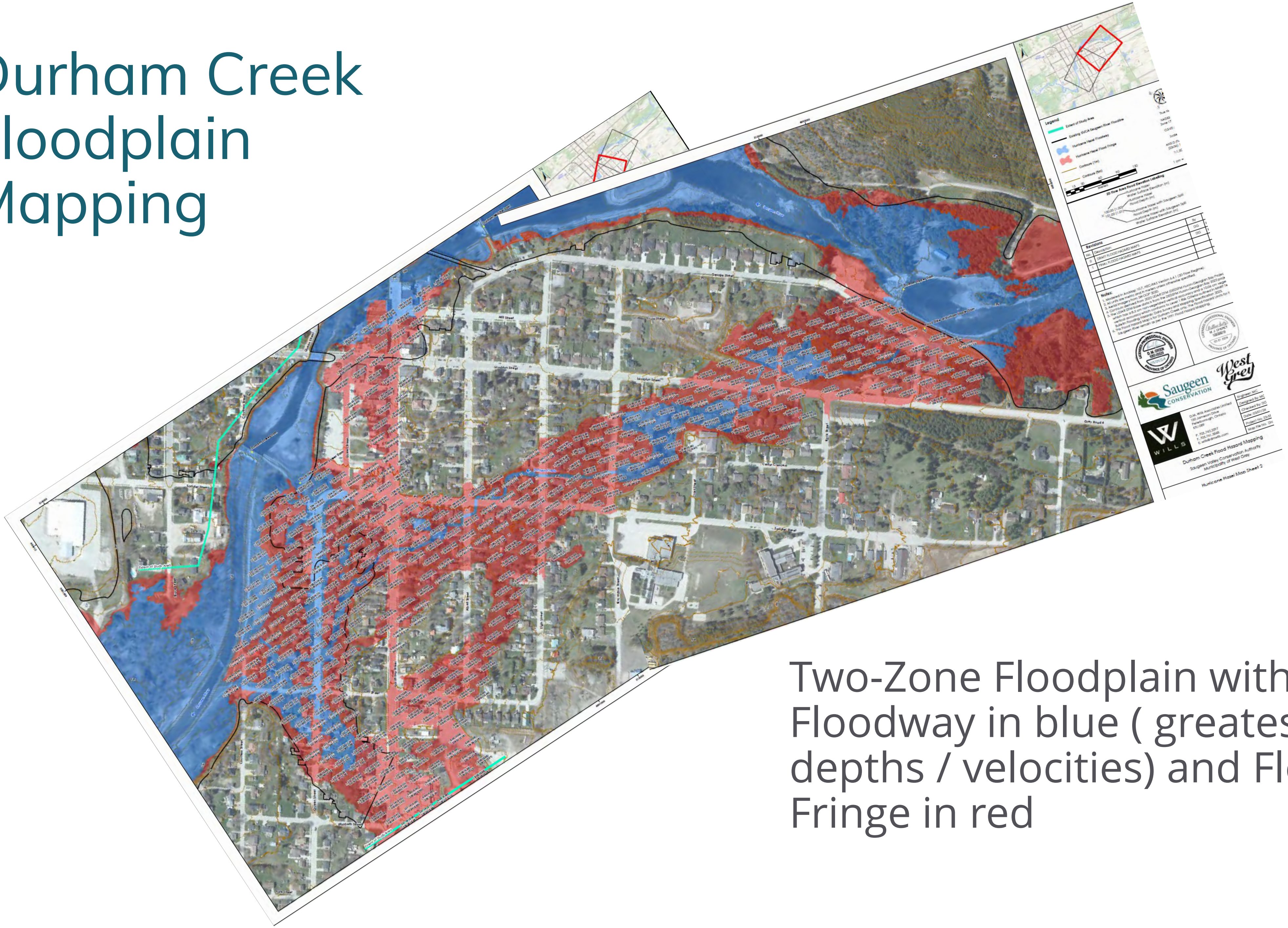


- Two PICs were held in 2023 & 2024 to educate residents and collect feedback
- The first PIC introduced FHIMP and the second presented draft mapping results

Durham Floodplain Mapping



Durham Creek Floodplain Mapping



Two-Zone Floodplain with Floodway in blue (greatest depths / velocities) and Flood Fringe in red

Report Recommendations

1) SVCA and the Municipality of West Grey update the floodplain mapping for the Saugeen River and then consider updates to their Two-Zone floodplain planning policies and development approvals processes for both Durham Creek and the Saugeen River together.

2) Given the potential significant impacts of a failure of the dike at the Durham Upper Dam, the SVCA and Municipality of West Grey should consider the development of an Emergency Preparedness and Response Plan (EPRP) for the structure.


Saugeen
CONSERVATION
Thank you.

Minutes

Council meeting

Municipality of West Grey

Tuesday, March 4, 2025, 9 a.m.
West Grey municipal office, council chambers and virtual

Members present:	Mayor Kevin Eccles Deputy Mayor Tom Hutchinson Councillor Scott Foerster Councillor Doug Hutchinson Councillor Joyce Nuhn Councillor Geoffrey Shea Councillor Doug Townsend
Staff present:	Michele Harris, Chief Administrative Officer Jamie Eckenswiller, Director of Legislative Services/Clerk Kerri Mighton, Director of Finance/Treasurer Karl Schipprack, Director of Community and Development Services/CBO Ashley Noble, Communications Coordinator Krista House Langdon, Legislative Services Coordinator

---

1. Call to order

Mayor Eccles called the meeting to order at 9:00 a.m.

2. Moment of reflection

Mayor Eccles called for a moment of reflection.

3. Declarations of interest

There were no declarations of interest.

4. Delegations and presentations

4.1 Delegation from Rose Austin Re: Saugeen Connects 2024 Year in Review

Rose Austin, Saugeen Economic Development Corporation, provided a delegation regarding Saugeen Connects' 2024 Year in Review.

Ms. Austin advised that Saugeen Connects is a collaborative initiative, comprised of the Saugeen Economic Development Corporation and several member municipalities, including West Grey, that supports regional economic growth and development.

5. Public meetings

There were no public meetings.

6. Comment period

There were no public comments.

7. Adoption of minutes

7.1 Minutes of the Regular Council Meeting held on February 18, 2025

7.2 Minutes of the Public Council Meeting held on February 18, 2025

R-250304-001
Moved by Deputy Mayor Hutchinson
Seconded by Councillor Foerster

"THAT the minutes of the regular Council meeting and the public planning meeting held on February 18, 2025, be adopted."

Carried

8. Committee and board reports

8.1 Minutes of the West Grey Public Library Board Meeting held on January 8, 2025

8.2 Minutes of the SMART Board Meeting held on January 17, 2025

8.3 Minutes of the SVCA Board Meeting held on January 17, 2025

8.4 Highlights of the Grey County Council Meeting held on February 13, 2025

8.5 Minutes of the Saugeen Municipal Airport Board Meeting held on February 19, 2025

8.6 Minutes of the Durham BIA Board Meeting held on February 24, 2025

R-250304-002
Moved by Councillor Shea
Seconded by Councillor Hutchinson

"THAT the minutes of the committees and boards are hereby received."

Carried

9. Correspondence

9.1 Correspondence received for which direction of Council is required

9.1.1 Autism Ontario Re: World Autism Day Proclamation 2025

R-250304-003
Moved by Councillor Shea
Seconded by Deputy Mayor Hutchinson

“THAT in consideration of correspondence received from Autism Ontario respecting a request to proclaim April 2, 2025, as World Autism Day, Council proclaims April 2, 2025, as World Autism Day.”

Carried

9.1.2 Durham BIA Re: Request for Board Appointment

R-250304-004
Moved by Councillor Hutchinson
Seconded by Councillor Townsend

“THAT in consideration of correspondence received from the Durham Business Improvement Area Board respecting a request to appoint a member to the Durham BIA Board, Council appoints Nancy Nurse to the Durham BIA Board for the remainder of the 2022-2026 term, effective immediately.”

Carried

9.1.3 Reflections Festival Fundraiser Re: Noise Exemption Permit Request (May 16-19, 2025)

R-250304-005
Moved by Councillor Hutchinson
Seconded by Councillor Nuhn

"THAT in consideration of correspondence received from Kevin Lawson, co-founder of the Reflections Festival respecting a noise bylaw exemption request, Council directs staff to bring forward a report respecting the request for a noise exemption."

Carried

9.2 Correspondence received which is presented for the information of Council

R-250304-006
Moved by Councillor Townsend
Seconded by Councillor Hutchinson

"THAT Council receives all correspondence not otherwise dealt with."

Carried

10. Staff reports

10.1 Director of Community and Development Services/CBO

10.1.1 Animal Control Officer - MSS Contract

The Director of Community and Development Services/CBO provided an overview of the report.

R-250304-007
Moved by Councillor Shea
Seconded by Councillor Townsend

"That in consideration of staff report 'Animal Control Services Contract – Municipal Support Services' Council:

1. **Authorizes the Mayor and Clerk to enter into an agreement with Municipal Support Services for animal control services; and**
2. **Direct staff to bring forward a bylaw to amend the fees and charges bylaw to increase dog tags by $5.00 per tag effective April 1, 2025."**

Carried

10.2 Director of Legislative Services/Clerk

10.2.1 Delegation of Authority to Appoint Municipal Law Enforcement Officers

The Director of Legislative Services/Clerk provided an overview of the report.

R-250304-008
Moved by Deputy Mayor Hutchinson
Seconded by Councillor Townsend

"THAT in consideration of staff report 'Delegation of Authority to Appoint Municipal Law Enforcement Officers, Council direct staff to bring forward a bylaw to delegate Council's authority to appoint municipal law enforcement officers to the Clerk."

Carried

11. Questions

Councillor Foerster asked for an update related to a motion passed at the Council meeting held on March 19, 2024, which declared Neustadt industrial park lands as surplus to the Municipality and directed staff to proceed with disposal. Staff advised that the process is moving forward, albeit slowly, due to the time required to confirm surveys and prepare the appraisal.

Councillor Foerster asked for an update related to a motion passed at the Council meeting held on December 5, 2023, which directed staff to work with a developer regarding the creation of a potential new subdivision at 451 Durham Road West. Staff advised that a report will be brought forward at an upcoming meeting.

12. Motions for which notice was previously given

There were no notices of motion for which notice was previously given.

13. Notices of motion

There were no notices of motion.

14. Announcements

Mayor Eccles advised that the Trinity Lutheran Church in Ayton will hold their annual pancake supper on March 4, 2025.

Mayor Eccles advised that the Neustadt and District Lions Club hosted a successful chicken wing dinner on March 1, 2025.

15. Closed session

There was no closed session.

16. Report from closed session

There was no closed session.

17. Bylaws

17.1 Bylaw No. 2025-014

"A bylaw to confirm the proceedings of the regular and public meetings of the Council of the Corporation of the Municipality of West Grey."

17.2 Bylaw No. 2025-015

"A bylaw to provide for the indemnification and defence of current and former employees, members of local boards, and members of Council against loss or liability in certain circumstances arising out of acts or omissions done while acting on behalf of the Corporation."

17.3 Bylaw No. 2025-016

"A bylaw to amend the Municipality of West Grey Comprehensive Zoning Bylaw No. 37-2006, as amended, as it relates to ZA10.2024."

17.4 Bylaw No. 2025-017

"A bylaw to designate lands as a site plan control area."

17.5 Bylaw No. 2025-018

"A bylaw to authorize the conveyance of lands legally described as PT BLK 72 PL 1097 PTS 4, 8, 9 PL 16R-12167; S/T BE 20524; WEST GREY being PIN 37215-0063 PT LT 20 CON 10 NDR PTS 1, 2, 3, 5, 7 PL 16R-12167; PT BLK 66 + 67 PL 1097 PTS 1, 2, 5, 6 PL 16R-12167; S/T BE 20524; WEST GREY being PIN 37216-0052 in the geographic Township of Bentinck to the Canadian Lemkos Association in exchange for Part 1, Part of block 60 PL 1097, PL 16R-12048, being part of PIN 37215-0064 in the geographic Township of Bentinck."

17.6 Bylaw No. 2025-019

"A bylaw to provide for the delegation of Council’s authority to appoint municipal law enforcement officers."

R-250304-009
Moved by Deputy Mayor Hutchinson
Seconded by Councillor Hutchinson

"THAT Bylaw Numbers 2025-014, 2025-015, 2025-016, 2025-017, 2025-018, and 2025-019 be passed and enacted."

Carried

18. Adjournment

The business contained on the agenda having been completed, Mayor Eccles adjourned the meeting at 10:00 a.m.

Mayor Kevin Eccles

Jamie M. Eckenswiller, Clerk

Minutes

Special Council meeting

Municipality of West Grey

Tuesday, March 11, 2025, 9 a.m.
West Grey municipal office, council chambers

Members present:	Mayor Kevin Eccles Deputy Mayor Tom Hutchinson Councillor Scott Foerster Councillor Doug Hutchinson Councillor Geoffrey Shea Councillor Doug Townsend
Members absent:	Councillor Joyce Nuhn
Staff present:	Michele Harris, Chief Administrative Officer Jamie Eckenswiller, Director of Legislative Services/Clerk Kerri Mighton, Director of Finance/Treasurer Geoff Aitken, Director of Infrastructure and Public Works Ashley Noble, Communications Coordinator Krista House Langdon, Legislative Services Coordinator

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1. Call to order

Mayor Eccles called the meeting to order at 9:01 a.m.

2. Declaration of interest and general nature thereof

There were no declarations of interest.

3. Staff reports

3.1 Director of Finance/Treasurer

3.1.1 Bridge Financing Strategy

The Director of Finance/Treasurer provided an overview of the report.

S-250311-001
Moved by Councillor Shea
Seconded by Councillor Townsend

"THAT in consideration of staff report 'Bridge Financing Strategy', Council adopts the 10-year Bridge Financing Strategy in principle."

Carried

4. Bylaws

4.1 Bylaw No. 2025-020

"A bylaw to confirm the proceedings of the special meeting of the Council of the Corporation of the Municipality of West Grey."

S-250311-002
Moved by Councillor Foerster
Seconded by Deputy Mayor Hutchinson

"THAT Bylaw Number 2025-020 be passed and enacted."

Carried

5. Adjournment

The business contained on the agenda having been completed, Mayor Eccles adjourned the meeting at 10:08 a.m.

Mayor Kevin Eccles	Clerk Jamie M. Eckenswiller

www.grey.ca/news

Grey County Council met February 27, 2025, in the Grey County Council Chamber and virtually on Zoom. The meeting was immediately followed by a session of Committee of the Whole. A recording of the meeting can be found on the Grey County YouTube Channel.

County Council

- Council accepted the minutes of the February 13 County Council and Committee of the Whole meetings. Council Committee
- Council received a verbal update on the 2025 Regional Job Fair. The event on February 20th attracted more than 600 job seekers and dozens of employers.
- Council received a verbal update on the *Gather* campaign which launched earlier in the month. *Gather* is a celebration of local food and producers staring culinary ambassador and celebrity chef Roger Mooking. The campaign and video series can be viewed at www.GatherInGrey.ca.

Committee of the Whole

- Council heard highlights from the minutes of the February 20 Budget and Finance Committee meeting and February 12 Joint Accessibility Advisory Committee meeting. Budget Committee Accessibility Committee
- Grey County will work with the Municipality of Grey Highlands to acquire land in Feversham for a new paramedic services base. A base is needed in the area to enhance response times and meet the increased and projected volume of calls for service. The need was identified as part of the 2023 Paramedic Services Comprehensive Service Review and is part of Grey County's plan to improve coverage in rural areas where distance is a factor. The report also informed Council of a likely need to relocate the paramedic base in Dundalk in the future. The current facility is shared with the Dundalk Fire Department, and they expect to need more space as their community grows. Report

- Council received an update on the progress of the local licensed childcare growth plan. In 2023, Grey County was allocated a total of 504 spaces as part of the directed growth plan. Since the Canada-Wide Early Learning and Child Care (CWELCC) program was launched, Grey County has seen an increase of 516 CWEL spaces. At the end of 2024, more than 2,000 children under the age of 6 remain on the waitlists of local childcare operators. More childcare providers have asked to enroll in the CWELCC program in Grey but all funded spaces have already been committed. Staff have notified the Ministry of Education of the additional interest. Report

The Clerk's Department maintains the official record for Grey County. This publication is intended to provide meeting highlights only. For official records, please refer to the meeting minutes, or contact the Clerk's Department at 1-800-567-4739.

BRUCE GREY POVERTY TASK FORCE
Our Voice is Power

United Way Bruce Grey

6 March 2025

To: Mayor and Council

We are sharing with you our Annual Report for 2024 to highlight the work of the Bruce Grey Poverty Task Force. The Bruce Grey Poverty Task Force works in partnership with 90+ community-based agencies, planning tables, community groups, universities, institutes, and policy-makers. The Poverty Task Force is led by the United Way of Bruce Grey along with leadership from Bruce and Grey Counties.

We have created a platform that allows for meaningful dialogue, education, and purposeful partnerships that address the root causes of poverty in Grey and Bruce Counties. Our objective is to spark and inform public debate and to engage the social, academic, and policy communities around important issues of poverty reduction in rural communities.

The Poverty Task Force works in partnership to address poverty-related issues facing Grey Bruce – housing, income security, employment security, health equity, community voices, and transportation. We promote high-level discussion among Grey Bruce municipal and provincial governments, carry out local participatory research with universities, the Four County Labour Market Planning Board, and other research partners, and take action with social service agencies and community leaders. We are an action table of the Community Safety and Well-Being Strategy.

The Poverty Task Force is funded by Grey County, Bruce County, and the United Way of Bruce Grey. The United Way of Bruce Grey is the administrative lead and employs a Coordinator. The Poverty Task Force currently meets monthly virtually.

We have significantly benefited from the participation of councillors at the lower-tier municipalities to engage in poverty-reduction strategies. We are asking that you formally adopt the Bruce Grey Poverty Task Force as a committee that a member of your council attends. We believe that this formal representation will improve communication and engagement between our respective organizations. Your municipality's participation would be invaluable in strengthening our collective efforts to address poverty in our communities.

We invite you to join us in this important work and look forward to your response.

Yours Sincerely,

Jill Umbach
Planning Network Coordinator
Bruce Grey Poverty Task Force/United Way of Bruce Grey
povertytaskforce@unitedwaybg.com, 519-377-9406

Francesca Dobbyn
Executive Director
United Way of Bruce Grey

2024

Bruce Grey Poverty Task Force Annual Report

BRUCE GREY
POVERTY
TASK FORCE
Our Voice is Power

ACKNOWLEDGMENT

This report was prepared by Jill Umbach, Coordinator, Bruce Grey Poverty Task Force on the work of the Poverty Task Force in 2024.

The report reflects the advocacy, public awareness, cross-sector collaboration, knowledge sharing and interagency coordination of 92+ social service organizations to meet our communities' basic needs and to address systemic poverty.

The Poverty Task Force is grateful for the continued support of the Grey County, Bruce County and the United Way of Bruce Grey in the work that we do and for the leadership and ongoing partnership to address poverty in Bruce and Grey Counties.

Poverty is a systemic issue that impacts every aspect of society and cannot be solved without collective action.

Advocacy, Bridging and Collaboration are the basic ABCs that guide the work of the Bruce Grey Poverty Task Force. Bringing together 92+ non-profit, government, health and research organizations over the past 12 years has proven that **our voices do have power**.

Our collaborations have been data driven with our local experiences featured at Poverty Task Force monthly meetings and shared with 23 local, provincial and national planning tables, most notably in 2024 with Grey Bruce Community Safety & Well-Being Plan, RentSafe Ontario and the Tamarack Institute.

In 2024, we expanded our data collection and analysis of the Grey Bruce Community Volunteer Income Tax Program. Featuring the work of the Bruce County Public Library and The Meeting Place Tobermory in our report *Reducing Poverty Through Volunteers: the impact of CVITP in Grey Bruce,* the 2 organizations combined brought $2 million dollars back into Bruce County households.

We are in a housing crisis with chronic homelessness and social housing waitlists increasing for both Counties. Our Housing Community of Practice has created a safe space for housing outreach workers to support each other, raising complex cases and engaging with housing services to find solutions. In 2024, the RentSafe Owen Sound Collaborative released our *Owen Sound Landlord-Tenant Survey* resulting in a motion to form a City of Owen Sound Rental Housing Task Force.

Food insecurity has worsened in Bruce Grey, with household rates rising to 18.3% in 2023. 30.7% of children are living in food insecure households. Food insecurity is a symptom of broader economic issues like inadequate income, unaffordable housing and rising living costs. In 2024, we launched a public awareness campaign *“Income Solutions to Food Insecurity”* to educate policy makers and the public on the unsustainable load carried by charities to feed people without seeing a change in food security and to advocate for income solutions such as increased social assistance rates.

INTRODUCTION

PTF 2024 GOALS

The Poverty Task Force Goals for 2024 were based on the collaborative work identified by our Action Groups.

Goal: build resiliency, hold space and promote collaboration with partners.

- Create safe spaces for meaningful exchange to build resiliency, hold space and build collaboration for solutions.
- Contribute to collective action for GB CVITP Network FILE Project, RentSafe Tenant-LandlordSurvey engagement, Living Wage campaign, GB Good Food Box and Financial Inclusion Study.

Goal: increase the number of government partners leading on poverty reduction.

- Contribute to social plans that integrate poverty as a central theme such as the Community Safety and Well-Being Plan, Vital Signs Report 2024, etc.
- Ensure formal representation/annual funding from Bruce County and Grey County.
- Formal representation of lower-tier municipalities – assigned representatives and PTF minutes are submitted to Council packages.

Goal: develop a sustainable funding strategy for all elements of the Poverty Task Force

- Develop strategy for PTF collective work to be funded.
- Develop new model and funding strategy for Community Voices.

Goal: increase public education and awareness on homelessness, harm reduction approaches, food security, hunger, etc. to reduce stigma

- Participate in public messaging, education, awareness and forums as content expert.
- Create "income solutions addressing food insecurity" awareness campaign around the release of the Nutritious Food Basket.

Goal: increase engagement of people with lived/living experience

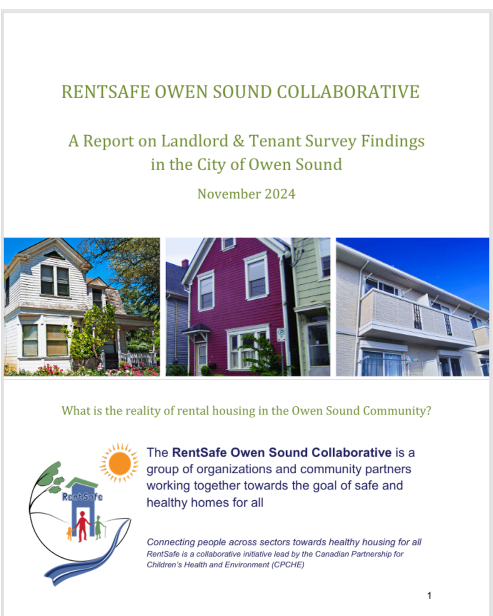
- Ensure diversity, equity and inclusion is a central strategy to the work we do.
- Support the Giiwe Sharing Circle model and identify opportunities to improve Indigenous
- relationships.
- Partner with programs such as "Making Your Way" to develop a new Community Voices
- group.

Housing Security

The deepening homelessness and opioid crisis has been on every agenda and will continue to be so as rates of poverty and homelessness increase. In 2024, affordable and supportive housing has been advocated for in every statement coming from the Poverty Task Force at national, provincial and local policy advocacy opportunities such as the Ontario budget consultations with the Ministry of Finance.

Members of the Housing Community of Practice (CoP) may think that they are constantly “holding the line” or “trying to keep people from dying”, but their work has not gone unnoticed. The Poverty Task Force recognizes all partners who are on the frontlines saving lives, feeding the hungry and keeping people housed. The Housing CoP met weekly throughout the year (50 weeks) to address immediate housing needs of individuals. ODSP case workers as well as financial advisors have broadened the table and the engagement with housing directors deepens partnerships and cross-sector collaboration to tackle issues holistically.

Giiwe Sharing Circles led by M’Wikwedong Indigenous Friendship Program’s Housing program was supported by the Poverty Task Force for 6 years. In March 2024, the last Giiwe Circle was hosted by the Friendship Centre. Funding will be directed to emergency housing. Recognizing that the impact of colonization and generational trauma has lowered the levels of trust of Indigenous people to engage with “the system”, Indigenous housing workers at the Housing CoP continue to advocate the need for more equitable access to programs and services.


RENTSAFE OWEN SOUND COLLABORATIVE

A Report on Landlord & Tenant Survey Findings in the City of Owen Sound

November 2024

What is the reality of rental housing in the Owen Sound Community?

The **RentSafe Owen Sound Collaborative** is a group of organizations and community partners working together towards the goal of safe and healthy homes for all

Connecting people across sectors towards healthy housing for all

RentSafe is a collaborative initiative lead by the Canadian Partnership for Children's Health and Environment (CPCHE)

1

In 2024, we released the RentSafe Owen Sound Collaborative’s *Landlord-Tenant Survey* findings at the Healthy Communities Partnership table, the Poverty Task Force table, the Corporate Services Committee and to the Strategic Planning Committee of the City of Owen Sound.

36 landlords responsible for 800 rental units (estimated to be 40% of the rental market) and 545 Owen Sound tenants responded. A good representation of Indigenous and Newcomers provided their lived experience. The City of Owen Sound received the report and a motion was passed to form a Rental Housing Task Force.

We welcome you to read the findings and recommendations in the full report. https://povertytaskforce.com/publications/

Food Security

Food insecurity is more than hunger. Households who struggle to pay for food also struggle to pay for the other costs of living, like housing, utilities, medications and transportation. Presenting food charity as a solution to food insecurity is misinformation that reduces support for real solutions. Food charity cannot be expected to fix an income problem.

We launched our "Income Solutions to Food Insecurity" awareness campaign with the release of the *Monitoring Food Affordability in Grey Bruce* by the Grey Bruce Public Health. This report formed the basis for a series of social media blog posts, media interviews and invitations to speak to community groups across Bruce and Grey Counties, including in Kincardine and Port Elgin, as well as at various planning tables such as the GB Community Safety & Well-Being Plan.

We welcome you to read the full report and go to our website to find the full series of social media posts at: https://povertytaskforce.com/food-security/income-solutions-to-food-insecurity/

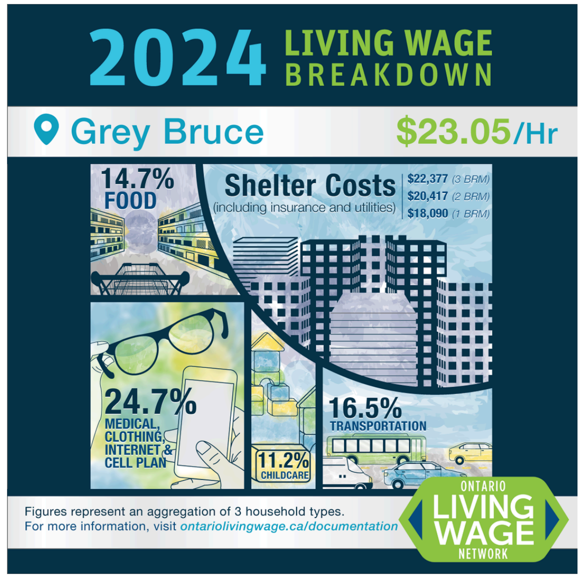
The Food Security Action Group meets monthly to bring together community food programs to exchange knowledge, technical expertise and share resources. For example, the Poverty Task Force made connections and supported collaboration with The Bridge on Main Street/Kincardine Food Bank and the Grey Bruce Food Share program resulting in the formation of a new food rescue program in Kincardine.

The Poverty Task Force supports the collection of data posted on the Food Bruce Grey Dashboard to monitor food hunger response in Grey Bruce. Data is collected from community meal programs, food banks, Grey Bruce Community Garden Network (produce donated to meal programs/food banks), food rescue including the Grey Bruce Food Share and the Grey Bruce Good Food Box. This Dashboard is available to the public and is used by community food programs and municipal councilors to create reports specific to their area of service to generate policy discussions. https://www.foodbrucegrey.com

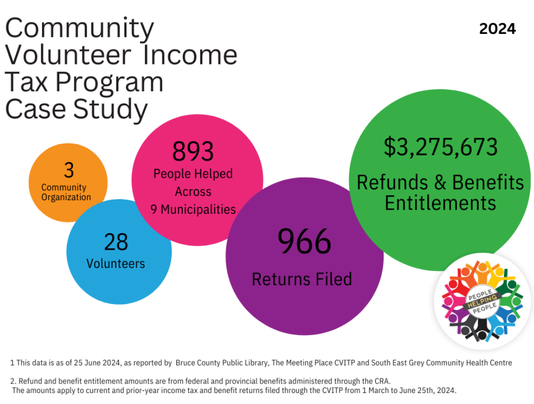
Income Security

In addition to the "Income Solutions to Food Insecurity" awareness campaign the Poverty Task Force in partnership with the United Way of Bruce Grey and the Ontario Living Wage Network calculated and released the 2024 Grey Bruce Living Wage. At $23.05/hr it is the second highlight rate in Ontario and reflects a 1.3% increase from the 2023 rate of $22.75.

In 2024, our Income & Employment Security Action Group partners, including the Four County Labour Planning Market Board, engaged with employers on the value of retaining employees by paying a living wage and educating job seekers. https://povertytaskforce.com/living-wage/



The living wage is based on the actual costs of living in Grey Bruce, including housing, food, childcare and transportation. The media release highlighted challenges with a lack of overall childcare spaces, the goal of $10/day getting close to $22/day for all and long waitlists (1,254 children in Bruce County and 2,129 in Grey County (December 2023). The waitlist is impacted by a shortage of Early Childhood Educators, many of whom are not being paid a living wage and an increase in local child care demands.



In 2024, the Poverty Task Force and Bruce County Public Library hosted the Annual Gathering of the Grey Bruce Community Volunteer Income Tax Program (CVITP) Network in Walkerton. The results of the case studies and the gathering with CVITP organizations, representatives from MP Alex Ruff's office and the CRA were released in the report *Reducing Poverty Through Volunteers: the impact of CVITP in Grey Bruce.* Evidence proving CVITP's role as an essential poverty reduction strategy.

Two CVITP organizations in Bruce County combined brought $2 million dollars back into Bruce County households. The Poverty Task Force supported the recruitment of 14 volunteers, however, due to delays in CRA registration many were too late to participate in the 2023 Tax Season and have been contact again for 2024 Tax Season in 2025. Read how we are building collaboration for income solutions and recommendations in the full report here: https://povertytaskforce.com/income-security/doing-more-to-increase-income-or-why-you-should-file-your-income-tax/

Health Equity & Community Voices

The Poverty Task Force support initiatives to collect and generate local Grey Bruce data to inform our collective work. The voices of people with lived experience and their stories are critical to the work of the Poverty Task Force. Collecting data helps us tell our stories better.

The Poverty Task Force Coordinator is the co-chair of BGDISC (Bruce Grey Data and Information Sharing Collaborative) - our Bruce Grey open data portal. The Collaborative mobilizes community decision-makers, including the Corporation of Bruce County, to share vital local rural data to better inform regional programming, polices, funding and social services to support prosperity, sustainability and the well-being of the community. In 2024, we engaged with the Rural Ontario Institute and the Grey Bruce Community Safety and Well-Being Plan on ways to access more local data and create interactive dashboards. https://www.bgdisc.ca/

The Poverty Task Force Coordinator sits on the Vital Signs Advisory Committee and the Data Working Group. The Community Foundation Grey Bruce's Vital Signs Reports focus on the status of Bruce Grey against the UN Sustainable Development Goals. In 2024, we identified priority sectors such as poverty, and began to collect local data and stories for the report. The data sets shall be uploaded to BGDISC. The Vital Signs Report 2024 has moved to a release date in 2025.

The Community Voices group did not meet in 2024. However, former members participated in Poverty Task Force meetings, the RentSafe Owen Sound Collaborative Landlord-Tenant Survey and Tamarack Institute's Financial Inclusion Project. The Project is a partnership with Toronto-Dominion (TD) Bank and a multi-sector Working Group to identify solutions to increase the financial inclusion of the "working poor". This work highlights unique levers for-profit businesses have for reducing poverty. https://www.tamarackcommunity.ca/multimedia/webinar-businesses-reducing-poverty

The Bruce Grey Poverty Task Force successfully obtained funding from the Grey Bruce Ontario Health Team (OHT) to fund a part-time peer support facilitator and the formation of a new group of Community Voices members to attend regular group meetings and engage with the Poverty Task Force in 2025.

Health equity issues are a priority for the Poverty Task Force. During the pandemic our Health Equity Action Group members were focused on COVID response. In 2025, we shall be refreshing the group in partnership with the Grey Bruce Ontario Health Team and its partners. The Grey Bruce Public Health and Poverty Task Force Coordinator will take leadership roles as co-chairs with admin support from the GB OHT, reporting to the GB OHT and the Poverty Task Force.

SOCIAL ENGAGEMENT IN 2024

The Poverty Task Force (PTF) maintains a list of 92+ member organizations with a contact list of 330 people. Representatives from 23 planning tables/working groups either participated in various PTF action groups, communities of practice and/or Poverty Task Force meetings or the PTF Coordinator participated in their meetings and/or strategic planning exercises. In 2024, the PTF participated in 5 meetings of the Community Safety & Well-Being Plan as an Action Table.

We provided 1 Bridges Out of Poverty workshop with 20 organizations in Saugeen Shores (Southampton) and moderated 3 Anti-Human Trafficking public information sessions (Kincardine, Port Elgin and Owen Sound.)

Our minutes are circulated to members and key elements included in our Community Updates. Our minutes are included in the City of Owen Sound's Consent Agenda.

In 2024, we released 12 community updates and press releases. We have 1,400 Facebook followers, 1,266 website subscribers and 670 Twitter followers. We were in the news speaking on income tax filing, CVITP volunteer recruitment, income solutions to food security, living wage and poverty strategies for rural communities.

PTF FINANCIAL REPORT 2024

In 2024, funding went towards:

- Wages & Benefits of a full-time Planning Network Coordinator
- PTF admin costs
- PTF website design & maintenance/CVITP URL purchases
- Tamarack membership
- Grey Bruce CVITP Network and RentSafe OS Collaborative research

Bruce County ($20,000). Grey County ($20,000) and the United Way of Bruce Grey ($50,249.60) provided the remaining core operational funding for an annual operating budget of $93,998.83. Note: this total now includes contributions by employer.

In addition, Community Foundation Grey Bruce funded the GB CVITP FILE Project ($3,000) study. The CRA/CVITP program reimbursed costs previously paid for by the Poverty Task Force for the Owen Sound CVITP organization ($644.86).

THE NUMBERS

BRUCE GREY POVERTY TASK FORCE
Our Voice is Power

COLLECTIVE IMPACT FRAMEWORK

Our collective impact efforts seek to inform policies and support upstream interventions to address poverty-related community issues. Together we have a common agenda, mutually reinforcing activities, continuous communication and backbone infrastructure.

January 2025

Collective Action

The Poverty Task Force is made up of 90+ organizations that work across priority sectors to reinforce activities that contribute to reducing poverty.

Evidence-informed/best practices

We draw upon local and national best practices; examine and test them in Grey Bruce context.

Data Driven

We collect local data on social determinants of health, including housing/homelessness, food insecurity, employment and income.

HOUSING SECURITY

Engage with City of Owen Sound on recommendations from Rentsafe Tenant-Landlord Survey and formation of Rental Housing Task Force.

Create safe spaces for meaningful exchange to build resiliency, hold space and build collaboration for solutions.

COMMUNITY VOICES

Develop election education awareness material and advocacy oriented website.

Start up new Community Voices group and ensure they are actively engaged with PTF and GB Ontario Health Team.

Increase municipality leadership engagement as Action Table of the Community Safety & Well-Being Plan Grey Bruce.

FOOD SECURITY

Promote income solutions to food insecurity awareness campaign as part of federal and provincial election education.

Contribute to the governance, sustainability and promotion of the Grey Bruce Good Food Box.

INCOME SECURITY

Support volunteer recruitment and promotion of the Grey Bruce Community Volunteer Income Tax Program in partnership with CVITP Network partners.

Contribute to Grey Bruce Living Wage calculation and employer certification to reduce precarious employment.

DATA

Contribute to participatory data collection and analysis on poverty-related issues such as living wage, CVITP dollar value, housing, precarious work, etc.

Contribute poverty related data to Grey Bruce open-data portal BGDISC and Vital Signs 2025.

HEALTH EQUITY

Start up new Health Equity Action Group in partnership with GB Ontario Health Team.

Contribute to addressing health equity issues from a poverty lens with GB Ontario Health Team partners.

TRUTH & RECONCILIATION CALL TO ACTIONS

We shall build better relations . The following OFIFC principles will guide our work:

- **Build trust and relations through Indigenous partner engagement**
- **Respect Indigenous culture and spiritualities as a foundation for Indigenous identity.**
- **Understand and respect Indigenous leadership; respond to Indigenous-led community priorities**
- **Collaborate and co-develop programs with Indigenous communities**
- **Respect Indigenous Diversity - no pan-Indigenous programming**
- **Ensure equity for all Indigenous people including women, Two Spirit, Indigi-queer and LGBTQQIA+**

MUNICIPALITY OF West Grey

CORRESPONDENCE ITEMS PRESENTED FOR INFORMATION
March 18, 2025

(To jump to the information, just click the item)

---

1. Notice from the Town of Hanover regarding a special Council meeting to discuss the Town of Hanover's Official Plan review.

2. Correspondence from the City of Toronto encouraging all Ontario municipalities to join them in a "Buy Local, Buy Canadian" campaign.

3. Correspondence from the Regional Municipality of Durham supporting B'Nai Brith's call to the Government of Canada to pass legislation banning, with exceptions for certain educational and artistic purposes, the public display of Nazi symbols and iconography, including the Nazi swastika (Hakenkreuz).

4. Grey County's Economic Development, Tourism, and Culture 2024 Annual Report.

5. Correspondence from the City of Sarnia asking the federal government to stop the 20 percent increase to the carbon tax scheduled to be implemented April 1, 2025.

6. Letter of introduction from Paul Vickers, MPP for Bruce-Grey-Owen Sound.

Hanover
Ontario, Canada

Town of Hanover
341 10th Street Hanover, ON N4N1P5
Tel: 519.364.2780
Toll free: 1.888.HANOVER

Notice of Special Meeting

Town of Hanover Official Plan Review

Take Notice that the Council of the Corporation of the Town of Hanover has initiated a review of its Official Plan and will hold a Special Meeting of Council pursuant to Section 26 of the Planning Act, R.S.O. 1990 as amended on:

TUESDAY, APRIL 8, 2025, at 4:00 P.M.
Municipal Council Chambers, Civic Centre
341 10th Street, Hanover

Purpose:

Please be advised that the Town of Hanover Official Plan came into effect in 2016 and that under Section 26 of the Planning Act, R.S.O. 1990, as amended, the Council of the town who adopted the Official Plan shall revise the Official Plan to ensure that it conforms with the provincial plans, has regard to matters of provincial interest, and is consistent with policy statements issued by the province.

The community is invited to share ideas about their vision for the town and the policy direction to manage future land use and growth.

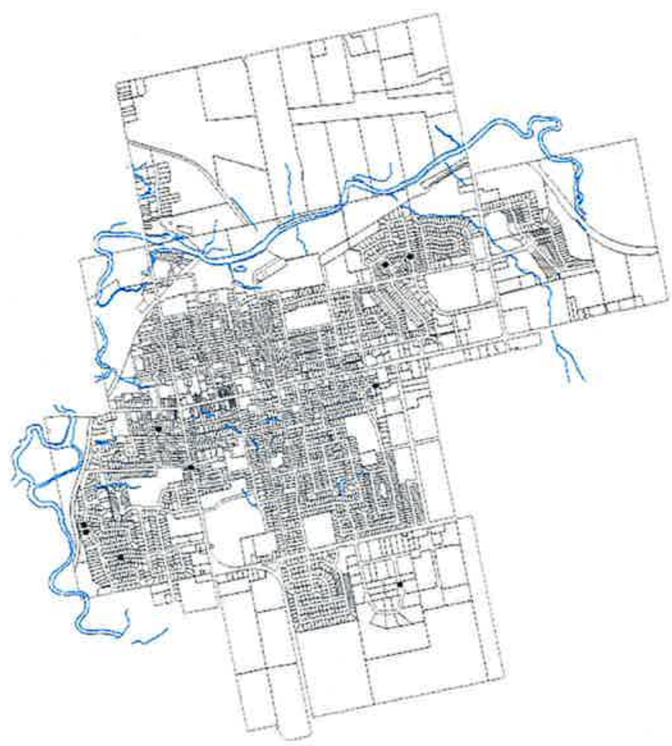
Written comments can be sent:

Via email to **vmcdonald@hanover.ca**
or mail to
Vicki McDonald,
Clerk, Town of Hanover,
341 10th Street, Hanover,
ON, N4N 1P5
by noon on **Tuesday, April 8, 2025**.

Description of Lands:

The Official Plan Review applies to all lands within the limits of the Town of Hanover.

KEY MAP



How can I Participate?

This meeting will be offered both electronically and in-person. For those persons who wish to participate electronically at the meeting, please email **Tanya Patterson, Deputy Clerk at tpatterson@hanover.ca** before **noon** on **April 8, 2025**. All public meetings will be live streamed and available at the Town of Hanover's Facebook page.
Members of the public are also encouraged to provide written comments to Council prior to and after the Special Meeting.

Want to be notified?

If you wish to be notified of future open houses or public meetings for the Official Plan Review, you must make a written request to Town of Hanover.

Dated this 27th day of February 2025.

TORONTO

John D. Elvidge
City Clerk

City Clerk's Office

Secretariat
Sylwia Przezdziecki
Council Secretariat Support
City Hall, 12th Floor, West
100 Queen Street West
Toronto, Ontario M5H 2N2

Tel: 416-392-7032
Fax: 416-392-2980
e-mail: Sylwia.Przezdziecki@toronto.ca
web: www.toronto.ca

In reply please quote:
Ref.: 25-MM26.7

(Sent by Email)

February 28, 2025

ALL ONTARIO MUNICIPALITIES:

Subject: **Member Motion Item 26.7**
Creation of a City of Toronto "Buy Local, Buy Canadian" Campaign - by Councillor Mike Colle, seconded by Councillor Jennifer McKelvie (Ward All)

City Council on February 5, 2025, adopted Item MM26.7 as amended and, in so doing, has forwarded the Item to all Ontario municipalities and encouraged them to join Toronto in a "Buy Local, Buy Canadian" campaign.

Yours sincerely,

Przezdziecki

for City Clerk

S. Przezdziecki/mp

Attachment

c. City Manager

TORONTO Decisions

City Council

Member Motions - Meeting 26

MM26.7	ACTION	Amended		Ward: All

Creation of a City of Toronto "Buy Local, Buy Canadian" Campaign - by Councillor Mike Colle, seconded by Councillor Jennifer McKelvie

City Council Decision

City Council on February 5, 2025, adopted the following:

1. City Council request the City Manager, and relevant Divisions to develop a comprehensive, multifaceted "Buy Local, Buy Canadian" campaign in response to the potential 25-percent tariffs announced by the Trump Administration, such campaign to encourage Toronto residents and businesses to join the City of Toronto's divisions and its agencies and corporations in purchasing locally made Canadian goods and services in order to protect local jobs in Toronto and Ontario where the proposed punitive tariffs would result in hundreds of thousands of job losses if imposed on Canada.

2. City Council direct the Chief Financial Officer and Treasurer and the City Manager, in consultation with the Chief Procurement Officer and the General Manager, Economic Development and Culture, to accelerate the development of local procurement approaches as set out in Sidewalks to Skylines: A Ten-Year Action Plan for Toronto's Economy to strengthen local businesses and protect local jobs.

3. City Council request the Federal Government to develop a standard recognizable label to be placed on all Canadian goods in clear, readable fonts that clearly shows percentages of Canadian content and any and all foreign content.

4. City Council forward the Item to all Ontario municipalities and encourage them to join Toronto in a "Buy Local, Buy Canadian" campaign.

City Council Decision Advice and Other Information

City Council considered the following Items together:

MM26.7 headed "Creation of a City of Toronto "Buy Local, Buy Canadian" Campaign - by Councillor Mike Colle, seconded by Councillor Jennifer McKelvie"; and

MM26.13 headed "Affirming Our Canadian Independence - by Councillor Stephen Holyday, seconded by Councillor Vincent Crisanti".

Summary

With recent threats from President Donald Trump to impose a 25 percent tariff on Canadian products and services, it is important that municipalities, businesses, and residents across Canada stand up for our country, our economy, and our businesses.

The City of Toronto, Canada's largest municipality, has an opportunity to encourage residents, businesses, and cities across Canada to create and participate in a "Buy Local, Buy Canadian" campaign to ensure that we support local products, local businesses, and local growth.

This motion requests that the City Manager and relevant City Divisions develop a comprehensive "Buy Local, Buy Canadian" campaign that will encourage spending to further develop our own local economies through the purchasing of local goods and services when available.

Background Information (City Council)

Member Motion MM26.7
(https://www.toronto.ca/legdocs/mmis/2025/mm/bgrd/backgroundfile-252857.pdf)

Communications (City Council)

(February 2, 2025) E-mail from George Bell (MM.Supp)

Sent Via Email

DURHAM REGION

The Regional Municipality of Durham

Corporate Services Department – Legislative Services Division

605 Rossland Rd. E.
Level 1
PO Box 623
Whitby, ON L1N 6A3
Canada

905-668-7711
1-800-372-1102

durham.ca

Alexander Harras M.P.A.
Director of Legislative Services & Regional Clerk

February 28, 2025

The Honourable Arif Virani
Minister of Justice
House of Commons
Ottawa, ON K1A 0A6

Dear Minister Virani:

RE: Motion regarding Protecting Canadian Values: Ban the Nazi Swastika in Canada, Our File: C00

Council of the Region of Durham, at its meeting held on February 26, 2025, adopted the following recommendations of the Committee of the Whole, as amended:

“Whereas in recent years, Nazi iconography has surfaced with alarming frequency in the public sphere, used by an increasing number of groups and individuals to promote hate and instill fear within Canadian society; and

Whereas since the atrocities of WWII, the Nazi swastika, also known as the hakenkreuze, has become universally synonymous with systematic violence, terror and hate. Its growing presence in our country poses a threat to every single Canadian citizen, undermining the core values of equality, diversity, and inclusion that define our nation, and

Whereas eighteen countries have already taken action to ban these symbols, it is imperative that Canada follow suit;

Therefore be it resolved, that Durham Region Council supports B’Nai Brith’s call to the Government of Canada to pass legislation banning, with exceptions for certain educational and artistic purposes, the public display of Nazi symbols and iconography, including the Nazi swastika (hakenkreuze). Specifically, demanding that the Government of Canada immediately:

1. Ban the Nazi swastika (hakenkreuze)

2. Ban all Nazi symbols and iconography

Durham Region Council agrees that the people of Canada are counting on the federal government to ensure a future free from hate, where every Canadian is protected, valued, and respected; and

That a copy of this motion is sent to all Canadian Municipalities."

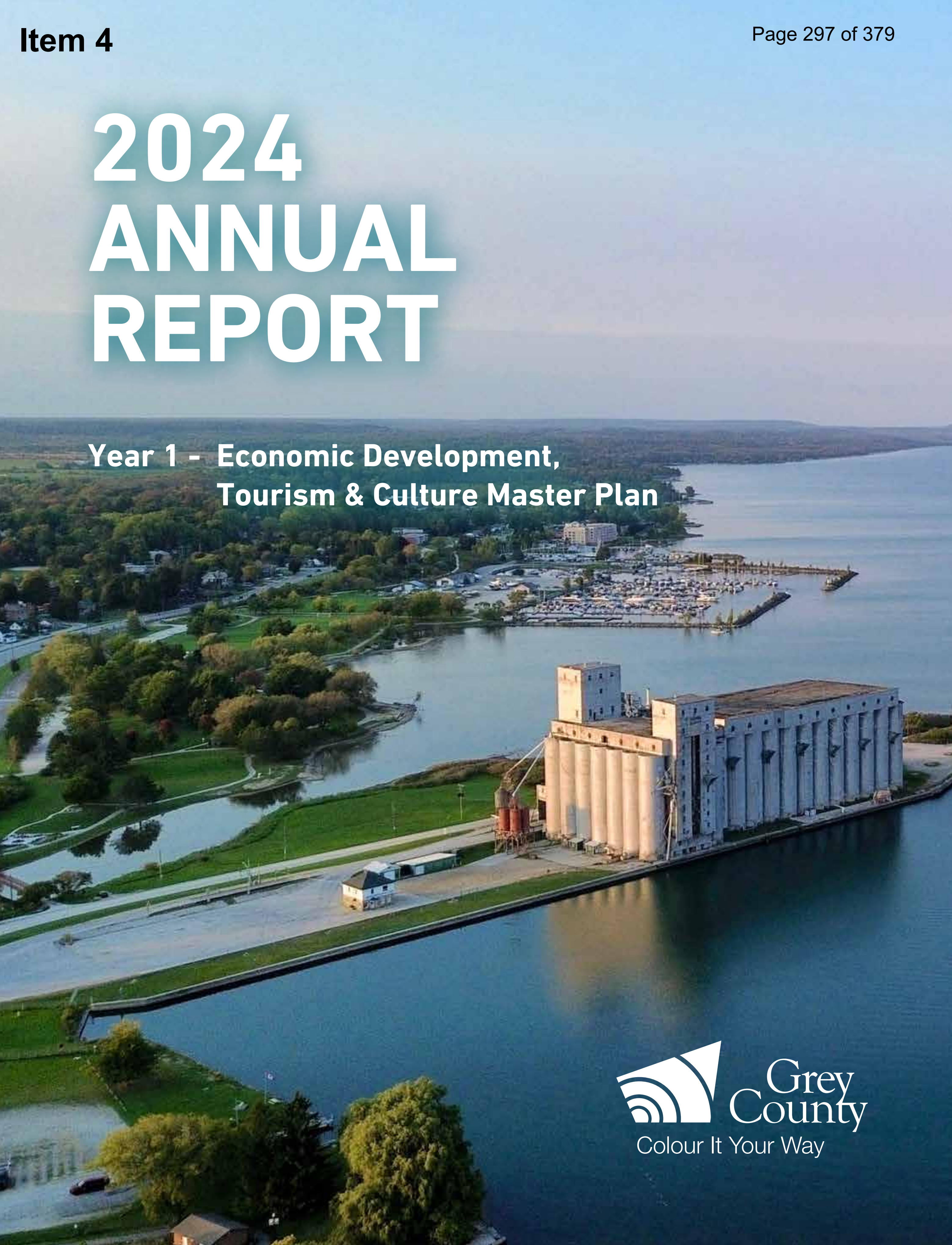
Alexander Harras

Alexander Harras, M.P.A.
Director of Legislative Services & Regional Clerk
AH/tf

c: B'nai Brith Canada
All Canadian Municipalities

2024 ANNUAL REPORT

Year 1 - Economic Development, Tourism & Culture Master Plan



Grey County

Colour It Your Way

ECONOMIC DEVELOPMENT, TOURISM & CULTURE TEAM

Savanna Myers, Director
Kim Trombley, Administrative Assistant

Steve Furness, Manager of Economic Development & Tourism
Kaleena Sanford, Economic Development Officer
Jacinda Rudolph, Economic Development Officer
Heather Aljoe, Tourism Development Officer

Courtney Miller, Business Enterprise Manager
Linnea Catalan, Business Enterprise Coordinator
Taylor Corfield, Campus Manager

Jill Paterson, Manager of Museum & Archives
Sim Salata, Curator
Nikita Johnston, Assistant Curator
Karin Noble, Archivist
Zak Erb, Public Relations Coordinator
Barb McCallum, Visitor Services
Sharon Bye, Visitor Services
Laura Arnold, Programs Coordinator
Doug Cleverley, Events Coordinator
Bianca Nam, Museum Assistant
Allan O'Neill, Facilities Technician
Stephen Melville, Facilities Technician

Deepikaa Gupta, Local Immigration Partnership Manager
May Ip, Local Immigration Partnership Coordinator

GREY COUNTY

ECONOMIC DEVELOPMENT, TOURISM & CULTURE DEPARTMENT

595 9th Avenue East
Owen Sound ON N4k 3E3

P: 519-372-0219

ecdev@grey.ca
madeingrey.ca
visitgrey.ca

GREY ROOTS MUSEUM & ARCHIVES

102599 Grey Road 18, RR4,
Owen Sound, ON, N4K 5N6

P: 519-376-3690

info@greyroots.com
greyroots.com

SYDENHAM CAMPUS

1130 8th Street East,
Owen Sound, ON N4K 5N8

P: 519-374-9567

sydenhamcampus@grey.ca

TABLE OF CONTENTS

"As the EDTC team, we will foster a systems approach and work in concert with our colleagues and partners to share resources, build capacity and bring value. We will focus on internal and external communications and be the best leaders, ambassadors, and champions we can possibly be"

– EDTC Master Plan.

EXECUTIVE SUMMARY

Collectively, the EDTC team works to create an enabling environment for people and businesses to invest. We also work to create a sense of pride and belonging in our communities, where our people can enjoy their lived experience.

Year one of EDTC Master Plan implementation focused on performing foundational work, providing the base tools and frameworks, necessary to enable our collective efforts and strategic maturing over the life of the Plan.

In 2024, staff focused on building capacity internally within our teams, and for our member municipalities and community partners across the region. For Economic Development and Tourism, this meant pulling ourselves out of the weeds and focusing on a high-level regional role. For Grey Roots, this meant shifting our focus to place a higher priority on supporting community partners through programs and events.

As per the Master Plan, a conscious effort is made to look inward at Grey County. We focus, specifically and strategically, on who we are and what we have to offer. The people, the pride and the resources available here, in Grey County. External influence—regional, provincial, national and global—is always considered, but only as it applies to what is happening and what could happen locally.

Don't lament what you don't have. Take inventory of what you do".

– Dan Mathieson
Former Mayor, City of Stratford

As highlighted in the department's first annual report, staff found success in this approach. In this first, foundational year, staff across the department did the work to unpack the situation on the ground, using and developing data to inform decision making. They built further relationships with the business community, industry representatives and community groups. They focused on partnerships and programs to seed mutual success.

Now, through the first year of implementation, the dedication and expertise of the EDTC team, gives great confidence, that together, we are moving forward in a meaningful and impactful way, to care for our people and place – past, present, and future.

Savanna Myers

Director, Economic Development, Tourism & Culture

"Be bold. Make a long-term vision and understand that some decisions you make today will have some incredible unintended consequences for the better as you go along your journey. Communicate well. Build a big tent. Get lots of partners in there. Nobody's in a silo".

– Dan Mathieson

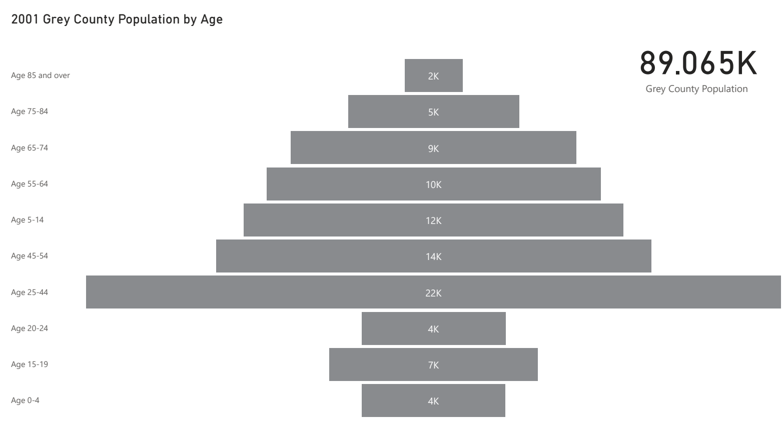
REGIONAL OVERVIEW

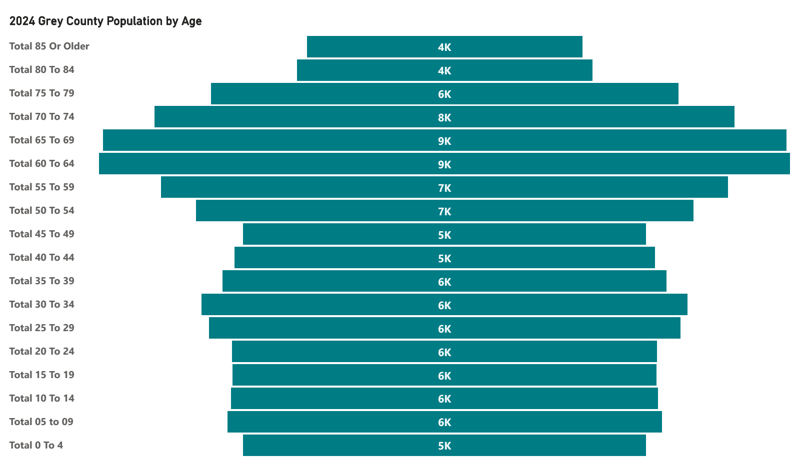
Data analysis drove foundational work in 2024. This included procuring and developing shared tools and resources to enable real time understanding of regional demographics and sectors. Grey County has seen record growth, which began ahead of the pandemic, and continued through to today. This has been felt and noted across the County, particularly across our younger generations. That said, when we look at the population pyramid, it becomes exceptionally clear that it is not enough to maintain our population, let alone grow.

It is no surprise that our County has an aging population, but the extent to which it is aging out, is now being understood more broadly, beyond staff. When we compare the this to the demographic pyramid in 2021, we see a stark difference. At that time, the boomers were our key workforce, today, the last cohort is preparing to retire.

The EDTC Master Plan identifies a path forward, and it is now clearer than ever, the urgency of action required. By 2030, in the next term of Council, we will begin to feel the shock.

By working as a region, alongside our partners, we can make a positive impact, and build communities for the future.





EXCELLENCE IN MANUFACTURING CONSORTIUM
GREY AGRICULTURAL SERVICES
CLEAN ENERGY FRONTIER BRUCE • GREY • HURON
WOOD MANUFACTURING CLUSTER of Ontario
REGIONAL TOURISM ORGANIZATION 7
Georgian
WESTERN ONTARIO WOWC WARDENS CAUCUS

CORE SECTORS

AGRICULTURE	MANUFACTURING	TOURISM
$240.5M EXPORTS	**$1.8B** EXPORTS	**$1.19B** ANNUAL SPEND
2,246 JOBS	**2,739** JOBS	**8,337** JOBS
1,869 BUSINESSES	**544** BUSINESSES	**908** BUSINESSES

109,825 POPULATION

3M UNIQUE VISITORS

21M TOTAL DAY VISITS

13K BUSINESS

LARGEST EMPLOYERS

EXCELDOR FOODS LTD.

BTI BREAKER TECHNOLOGY

ICE RIVER SUSTAINABLE SOLUTIONS

CHAPMAN'S

Durham Furniture Renowned for Solid Wood Since 1899

VIKING CIVES

tc TRANSCONTINENTAL

MacLean Performance. Reliability. Innovation.

walker

Caframo

GREY COUNTY'S LARGEST ATTRACTION AND TOURISM EMPLOYER

BLUE MOUNTAIN VILLAGE

10-YEAR VISION

PER THE EDTC MASTER PLAN, 10 YEARS FROM NOW...

ECONOMIC DEVELOPMENT AND TOURISM

Grey County in connection with our Member Municipalities will be active as Team Grey, where we collaborate through trust and seed mutual success. We will speak with one voice and achieve goals effectively, in a timely manner and with fewer resources. Grey County will share a cohesive vision that is carried out through effective and true collaboration to benefit us all.

Grey County and its partners will have access to shared tools and resources at their fingertips and have moved from investment readiness to attraction.

Grey County will further diversify, moving clean energy, healthcare and culture industries from emerging to core sectors, joining alongside agriculture, manufacturing and tourism as our robust and foundational economy.

Grey County and its partners will continue to flex their innovative and entrepreneurial muscle through Sydenham Campus, to feed thriving regional networks.

Our world-class four-season destination is being built through well planned investment, enriching the lives and experience of all visitors and residents alike.

GREY ROOTS

Grey Roots sits in the foreground of culture and connection in the region, leading by example and assisting others to build capacity.

Diverse relationships and partnerships are established and incorporated into the heart of operations of Grey Roots.

Experiential learning is achieved through workshops, interactive displays and different methods of programming using arts, technology, and skills.

Grey Roots is a top-of-mind destination for tourists and residents to learn, experience, connect and reflect.

Grey Roots has more control over site use and can generate more revenue through diverse offerings, driving increased attendance.

ECONOMIC DEVELOPMENT & TOURISM

BUILDING COMMUNITUES FOR THE FUTURE

1. LEADERSHIP AND COLLABORATION

PRIORITY 1

GOAL: BUILD COHESION Grey County takes a regional approach to economic development, tourism and culture working on behalf of all nine of our member municipalities. Everything we do happens in our municipalities for our people. Our top priority is therefore building Team Grey, where we focus on collaboration, not competition, to build trust and seed success. Collectively, we carry a stronger voice and better the likelihood of achieving goals more effectively, in a timely manner and with fewer resources required. A cohesive vision, followed by effective and true collaboration will benefit us all.

	ACTION	24	25	26	27	28
1.1	Host an **Annual Economic Development Leadership Forum** to build regional perspective, cohesion and pride among CAOs, senior leadership and elected officials.	■				
1.2	Conduct regular environmental scans to assess trends and pursue **strategic advocacy** opportunities as Grey County, with the support of municipalities and partners.	■				
1.3	Develop **municipal partnership and boundary adjustment case studies** to unleash mutually beneficial development and resource sharing opportunities; coordinate research; and site tours of best practice examples.		■			
1.4	Develop and sign a '**Team Grey' Memorandum of Understanding** with member municipalities to clearly define roles, responsibilities, resources, and expectations.		■			

ECONOMIC DEVELOPMENT LEADERSHIP FORUM (1.1)

Together, we are stronger.
We need to think and act as a region, Team Grey.

On November 21, 2024 Grey County hosted its Inaugural Economic Development Leadership Forum. The event welcomed elected officials and senior staff from all nine Member Municipalities and the County. The theme, Building Communities for the Future was thread throughout the day, as delegates were inspired by keynote Dan Mathieson, Stefano Sanguini (Invest Ontario), Luigi Presta (Think Compass), Dave Shorey (Georgian College) and James Sconjack (Bruce Power). Economic Development staff also shared regional demographics and employment lands, drawing an eye to regional economic development potential.

A DEMOGRAPHIC CHALLENGE, IS AN ECONOMIC CHALLENGE.

35% OF THE POPULATION IS 60 YEARS +

59 POTENTIAL SITES 1+ ACRE EXIST IN GREY

7 ARE INVESTMENT READY

It's the actions and decisions we make now that will have defining impacts on our region for years to come. Economic development takes time and we need to be thinking ahead and making investments now to benefit our future.

STRATEGIC ADVOCACY (1.2)

In 2024, staff advocacy efforts focused on the Ministry of Rural Affairs' Rural Economic Development Strategy, Ministry of Economic Development, Job Creation and Trade's Provincial Program Review of Small Business Enterprise Centres and Immigration, Refugees and Citizenship Canada's Three Year Immigration Targets Level Plan impacts on post-secondary education and rural workforce development.

"Do not shirk away from the long-term investments because they are really the ones that set the next generation up for success". - Dan Mathieson

2. INVESTMENT READY

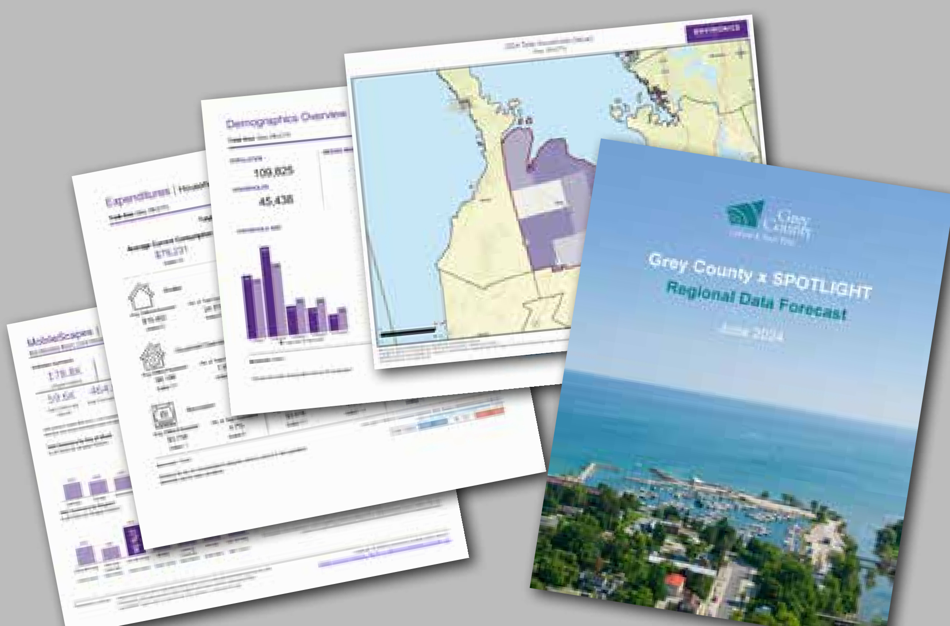
PRIORITY 2

GOAL: BUILD CAPACITY Grey County is uniquely situated to help build capacity with and among our partners. We are the great connectors. Taking a systems approach, we can follow the trends and lead in the development of resources. This is an important role understanding that our partners are running at full capacity, yet all investment, activity and experience happens on the ground, in our municipalities.

	ACTION	24	25	26	27	28
2.1	Collate, research and prepare data reports to develop a **data sharing program** to serve member municipalities, partners, and businesses.	■				
2.2	Engage in systems mapping to identify the most relevant municipal, provincial, federal and industry programs that strategically align with our core and emerging sectors.		□			
2.3	Build **shared tools and templates** at the county level to support municipal and partner efforts, as collectively identified, from policy frameworks, such as the CIP Program, to digital marketing assets.	■				
2.4	Explore options to create **municipally owned employment lands**, including three large-scale industrial parks strategically positioned across the Region.		□			
2.5	Identify and resource **significant regional economic development projects** that will generate generational wealth, to positively impact Grey and its member municipalities.	■				
2.6	Strengthen **welcoming communities' infrastructure** to meaningfully integrate and retain residents.	■				

SPOTLIGHT

The SPOTLIGHT platform by Environics Analytics was purchased through EDCO on behalf of our municipalities. Within a two percent variance, this platform can forecast demographics and provide real time spending data, to assist staff and partners in market analysis, trends analysis and forecasting.



DATA SHARING PROGRAM (2.1)

COMMUNITY PROFILE

In partnership with the County's GIS team, staff developed a digital dashboard to centralize key demographic information for Grey County and its member municipalities, featuring real-time updates, interactive visualizations, and seamless website integration.

LIGHTCAST

The license available through OMAFA is utilized by staff to monitor business counts, and regional market data, including municipal runs.

TOOLS & TEMPLATES (2.4)

DIGITAL ASSET LIBRARY

This tool was developed as an internal municipal tool. It hosts photos and video made accessible to our member municipalities, including drone video, point of view and professional photography. These assets can be used for advertising and marketing, including attraction efforts geared towards physicians, students and newcomers.

SECTOR PROFILES

Grey County's leading sectors: Agriculture, Tourism and Manufacturing. The purpose is to communicate regional facts and figures that build a better understanding of our foundational economy, and support municipalities, partners and businesses in accessing data to better plan for the future.

INDUSTRIAL LAND TOOL

In partnership with the County's GIS team, staff developed an internal Industrial Land Tool to identify vacant lands based on MPAC definitions and zoning.

The digital tool is intended for internal staff to use to collectively verify, examine and disperse information with the goal of understanding the true availability of industrial lands and furthermore, determine which parcels are investment ready or have the potential to become investment ready.

SIGNIFICANT REGIONAL ECONOMIC DEVELOPMENT PROJECTS (2.5)

Grey County is continuing its work with Think Compass in 2024 on four major economic development projects, either in play or proposed, across the region.

Staff also sit at several regional tables and working groups. Those specific to significant regional economic development projects include: Clean Energy Frontier, Southwestern Ontario Isotope Coalition, TC Energy Working Group.

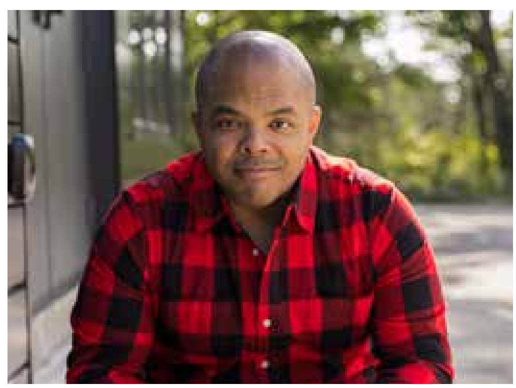
3. BUSINESS RETENTION & EXPANSION

PRIORITY 3

GOAL: BUILD PRIDE Caring for the businesses who call Grey County home is first and foremost. Here, we listen, learn, and take action in support of business. Through programs and partnerships, we set an enabling environment for our businesses to invest, create jobs and build strong, inclusive communities. With understanding, we tackle broad issues with partners and employers to build capacity and take steps toward solving workforce, housing, childcare and transportation challenges. We also celebrate and champion our partners, businesses, and people, to build community pride.

	ACTION	24	25	26	27	28
3.1	Develop, celebrate, and promote a Made in Grey Program, inclusive of regular networking and education events, workshops and mixers, marketing communication campaigns and exhibits.	■				
3.2	Host regional sector roundtables, tours and BR+E programs with member municipalities and community partners to understand current trends, challenges and opportunities.	■				
3.3	Focus investment efforts on core and emerging sectors in Agriculture, Tourism, Manufacturing, Healthcare, Clean Energy, and Culture Industries.		■			
3.4	Collaborate with and support Georgian College's growth as a change engine in the region through program development, capital investment and capacity building.	■				

MADE IN GREY PROGRAM (3.1)



Partnering with the internationally renowned Chef & Artist, Roger Mooking, Grey County proudly introduces its first Culinary Ambassador.

This campaign marks the beginning of a multi-year effort to leverage Grey County's strengths in agriculture and tourism. The objective is to attract visitors and new residents by showcasing the region's beauty and sustainable lifestyle, while also fostering community pride and excitement among locals. Through engaging storytelling and digital content, the campaign aims to position Grey County as a premier destination for food tourism and a vibrant place to live.

7 VIDEOS **14** LOCATIONS

[gath-er]

NETWORKING & EDUCATION EVENTS

REGIONAL GREY COUNTY JOB FAIR

94 EMPLOYERS
725 JOB SEEKERS

POST JOB FAIR EVENTS:
18 EMPLOYERS REPORTED: 71 INTERVIEWS. 52 HIRED.

M.S. CHI-CHEEMAUN CRUISE AND CONNECT

350 PROFESSIONALS

YOUNG PROFESSIONALS NETWORK (YPN) MIXER

75 YOUNG PROFESSIONALS

TEENY TINY SUMMIT SERIES

Partnership between OMAFRA, Grey County and Southgate, funded by ROMA. The theme was Community Wealth and Well-Being and was the first of the three in-person sessions held throughout Ontario.

REGIONAL SECTOR ROUNDTABLES, TOURS AND BR+E PROGRAMS (3.2)

4
SECTOR SUMMITS: SMALL BUSINESS, TOURISM, AGRICULTURE AND MANUFACTURING.

54
RETENTION VISITS

18
REGIONAL EVENTS ATTENDED

13
REGIONAL COMMITTEES

4. ENTREPRENEURSHIP & INNOVATION

PRIORITY 4

GOAL: BUILD NETWORKS Honing our entrepreneurial spirit is the cornerstone of this priority. It's about building networks, services, and partnerships to meet the evolving needs of our clients. As we've learned, innovation is the only competitive advantage, everything else can be duplicated or replicated, so it's about doing things differently and creating that Made in Grey solution.

	ACTION	24	25	26	27	28
4.1	Position the **Business Enterprise Centre and Catapult Grey Bruce** as the region's leader to support entrepreneurs to start, expand and scale their business; strengthen the regional entrepreneurial ecosystem.	■				
4.2	Facilitate a regional training and innovation network through **Sydenham Campus** to coordinate resources, support local hubs and create a custom and direct pipeline to employment.	■				
4.3	Facilitate connections to encourage **information sharing and multisolving** on common problems facing Grey County (internal), member municipalities and partners (external).		■			

BUSINESS ENTERPRISE CENTRE (4.1)

A new plus-one transfer payment agreement for the Business Enterprise Centre was executed for 2024-2026, including an additional $50,000 in funding towards grants and programming funds as announced through the Ontario 2024 budget. Summer Company and Starter Company programs were oversubscribed, and all grants were filled.

New trends in clientele demographics and food businesses reemerged this year. Additionally, the Centre saw an increase in consults, though the trend is surrounding individuals trying to supplement income instead of jumping full time into self-employment. Many of these individuals are on ODSP or OW.

Staff continue to meet with the Province, participating in the Provincial SBEC Program review, advocating in support of the SBEC network, recognizing the critical role it plays in community economic development.

BEC HOSTED WORKSHOPS

25 GENERAL WORKSHOPS

596 PEOPLE REGISTERED

1 SMALL BUSINESS CELEBRATION EVENT

119 REGISTERED

1 BUSINESS BOOTCAMP

8 REGISTERED

2024
RETURN ON INVESTMENT:
3.7:1

$60,000 invested through Provincial grant funding leveraged **$222,000** invested privately into the local businesses.

SUMMER COMPANY

5 **SUMMER COMPANY IN-SCHOOL PRESENTATIONS**

4 **SUMMER COMPANY TRAINING SESSIONS**

8 **PARTICIPANTS**

7 **GRANTS**

STARTER COMPANY

5 **STARTER COMPANY PLUS TRAINING SESSIONS**

33 **PARTICIPANTS**

15 **GRANTS**

JANUARY 1 TO DECEMBER 31, 2024 STATISTICS

42 BUSINESSES STARTED

39 BUSINESSES SUSTAINED

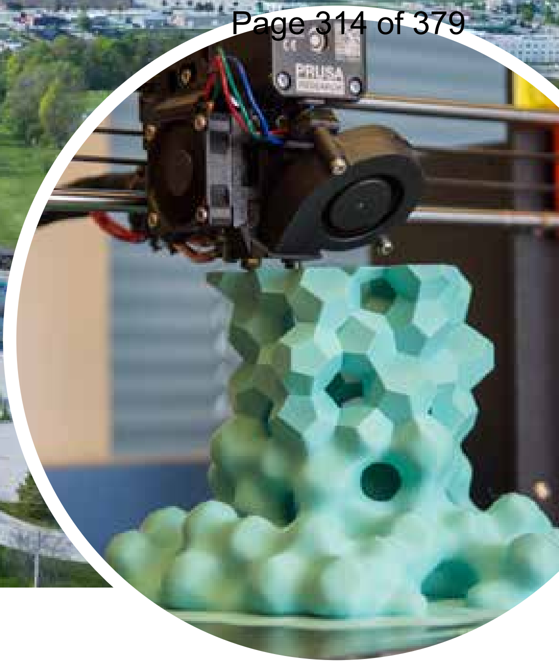
14 BUSINESSES EXPANDED

495 INQUIRIES

179 CONSULTATIONS

7 BUSINESSES PURCHASED

54 JOBS CREATED



SYDENHAM CAMPUS

The partners and tenants of the Sydenham Campus form a collection of trainers and businesses that support workers, entrepreneurs, and local organizations by providing access to education and training, business services, labs, and technology. The Campus provides employees and businesses with the skills and advantages they need to succeed in a rapidly changing world.

315 RENTALS IN 2024

Short-term rentals continue to increase, as long-term lease space remains at capacity. All Campus users, including short-term rentals fit the following categories: training, education, research and innovation, entrepreneurs, business/employee support services and government services.

BRINGING THREE YEAR TOTAL TO MORE THAN 1,000.

Tenant Changes in 2024:

DEPARTED: YMCA Employment Services, Catapult Grey Bruce, A.I. Vali Inc., Eat Local Grey Bruce

JOINED: Georgian College Early Childhood Education, Educational Assistant, Child Development Practitioner, Henry Bernick Entrepreneurship Centre, STEMVOX

EXPANDED: Reading Rescue, STEMVOX

GRAND OPENING

On Thursday, May 30, Grey County proudly celebrated the official grand opening of the Sydenham Campus in Owen Sound.

A pivotal component of this milestone is the unveiling of the eagerly anticipated 8,000-sq.-ft. makerspace, a dynamic addition equipped with eight dedicated fabrication zones catering to woodwork, metalwork, clean lab environments, digital technology, and marketing. The membership-driven makerspace supports two key functions for entrepreneurship and industry through prototyping and training.

More than $1 million was invested by the Government of Canada through the Federal Economic Development Agency for Southern Ontario (FedDev Ontario) to support Catapult Grey Bruce and the makerspace.

The Ontario Ministry of Agriculture, Food and Rural Affairs invested more than $100,000 in the facility and equipment.

ONTARIO YOUTH APPRENTICESHIP SKILLS COMPETITION, MARCH 1

50+ COMPETITORS who participated in the welding, electrical installations, hairstyling, culinary and carpentry groups. The awards ceremony and electrical installations competitions were held at Sydenham.

NUCLEAR INDUSTRY JOB FAIR, MARCH 27

15 NUCLEAR SUPPLIERS

187 JOB SEEKERS

SYDENHAM CAMPUS GRAND OPENING & COMMUNITY OPEN HOUSE, MAY 30

100 DELEGATES

150 COMMUNITY MEMBERS

SYDENHAM FALL FAIR, SEPTEMBER 19

800+ STUDENTS

from East Ridge Community School

MARKERS MARKET AND COMMUNITY OPEN HOUSE, NOVEMBER 23

468 VISITORS 25 VENDORS

CRICKET PITCH PILOT

Students from Georgian were able to play three games of cricket in the rear yard of the Campus.

Georgian

700

APPRENTICES (UP FROM 100 IN 2017)

2,100 MARINERS trained

22% INCREASE

in enrollment

39% INCREASE

in domestic enrollment

HENRY BERNICK ENTREPRENEURSHIP CENTRE (4.2)

With the strategic vision and support of Grey County, entrepreneurs in the region have new services to support them through the various stages of their entrepreneurial journeys – from training and networking to funding and mentorship – via Georgian College's Henry Bernick Entrepreneurship Centre (HBEC).

HBEC first launched at Georgian's Barrie Campus more than a decade ago, and, following its successful programming in Simcoe County, opened a second location out of a dedicated space at Sydenham Campus. This collaboration builds on the strong foundation of Catapult Grey Bruce and highlights a shared commitment to nurturing the region's entrepreneurial ecosystem and bringing vital business development resources to the region.

Amanda Mejia, Business Development Manager for Georgian College's Henry Bernick Entrepreneurship Centre (HBEC)

GREY BRUCE MAKERS (4.2)

In the past six months, Grey Bruce Makers has made incredible strides in growth and community impact. Their membership has climbed to 58 active members, reflecting a growing interest in the makerspace. They have hosted an impressive 62 courses, with 195 participants benefiting from hands-on learning and skill development. Beyond programming, they continued to solidify their role as a vital community resource, offering valuable skills training and fostering connections that empower individuals and strengthen the region. These achievements are a testament to the dedication of the team of volunteers and the enthusiasm of the members and participants.

GBM
GREY BRUCE MAKERS

MEMBERSHIP OVERVIEW

1 CORPORATE MEMBER

4 ENTREPRENEURS

50 HOBBYISTS

3 STUDENTS

NOTABLE! GBM has launched a student membership to make the space more available to youth 16-23, and turned the wall of the main hallway into a gallery space for members and local artists to showcase and sell their work.

GREY BRUCE LOCAL IMMIGRATION PARTNERSHIP

67 COMMUNITY PARTNERS, INCLUDING ALL 17 MEMBER MUNICIPALITIES IN GREY AND BRUCE COUNTIES.

2024 HIGHLIGHTS

CONVERSATIONS FOR A MORE INCLUSIVE AND WELCOMING COMMUNITY: Equity Diversity and Inclusion Trainer Project has trained over 340 individuals from more than 50 organizations. This included individuals from service providers, municipalities, non-profits, and community groups.

#IMMIGRANTSWORK PROJECT: Grey-Bruce is one of five communities in Canada participating in the program to help community partners collaborate with local employers in designing solutions to identify, recruit, hire, and retain local immigrant talent.

FIRST IMMIGRANT SURVEY: This survey was launched to understand the varied experiences of diverse groups and extract research findings that will inform how service providers, multi-tier government, businesses and the community at large can foster a more welcoming and inclusive space for immigrants and newcomer. Through the sharing of this report, GBLIP intends to support organizations who have a direct impact on these findings to grow their capacity to develop policies and programs.

DIVERSITY AND BELONGING CONFERENCE: This Conference marks a significant first step towards engaging a diverse range of participants to maximize its impact, with aim to promote a more inclusive, collaborative, and culturally sensitive approach to their services. This will lead to better outcomes and greater trust within the community. Additionally, it will encourage dialogue, shared learning, and joint efforts to address the diverse needs of the community.

6 PARTNERS. 150 ATTENDEES.

SMART21 INTELLIGENT COMMUNITY

For the second consecutive year and third time since 2017, Grey County was named one of the world's Smart21 communities of the year by the Intelligent Community Forum (ICF). The annual competition recognizes communities that embrace technology to realize economic, social, and cultural growth.

EDTC MASTER PLAN WINS EDCO AWARD

Grey County was recognized with an Award of Excellence for its Economic Development, Tourism and Culture (EDTC) Master Plan by the Economic Developer's Council of Ontario. EDCO Awards identify unique ideas that lead economic development best practices of the future. The EDTC Master Plan, known as 'The Grey't Reset', was recognized in the Excellence for Planning and Strategic Development – Urban category.

5. DESTINATION DEVELOPMENT

PRIORITY 5

GOAL: BUILD PLACE Grey County covers a significant geographic area with a diverse natural landscape; from Georgian Bay waterfront to the Niagara Escarpment to farmland, forests, and water ways, as well as urban centres, villages, and hamlets. We are a leader in tourism, attracting nearly three million visitors each year, and playing an important role in wealth creation for the region. Tourism and culture go hand in hand, and both play a crucial role in community development and retention. It is here where the lived experience of everyday life is created and enjoyed.

	ACTION	24	25	26	27	28
5.1	Work with the Outdoor Management Group (OMG), municipal partners and Destination Marketing Organizations (DMOs) to develop destination protocols, including consistent facilities, wayfinding, messaging to improve the visitor experience and balance carrying capacity.	■				
5.2	Facilitate strategic investment in tourism infrastructure, particularly accommodations and demand generators to build-out a four-season destination.		■			
5.3	Lead regional destination marketing, including new product development and out of market promotions.	■				
5.4	Communicate, promote and celebrate our diverse communities, so visitors and new residents can see themselves here.	■				

DESTINATION PROTOCOLS (5.1)

OUTDOOR MANAGEMENT GROUP

County Planning and Economic Development, Tourism staff facilitate an Outdoor Management Group (OMG) inclusive of landowners, trail user groups, tourism organizations, conservation authorities, municipal and provincial representatives to share information and coordinate management protocols/actions since no single authority owns, manages and markets these spaces.

CYCLING ROUTES

Share the Road and Route signs were installed on northern county roads in 2024. The project will be completed in 2025 with sign installation on southern county roads. Signs were delivered to participating municipalities at the end of 2024 for installation on local roads.

Continuing to strengthen our role in regional destination marketing, staff adjusted development tactics in 2024, and once again began flexing to reaching out of market.

SHARE THE ROAD

Supported by the Agriculture Advisory Committee, the seasonally focused multi-media campaign continued into year two, with billboards, radio and digital mediums.

REGIONAL DESTINATION MARKETING (5.3)

Continuing to strengthen our role in regional destination marketing, staff adjusted development tactics in 2024, and once again began flexing to reaching out of market.

OUT OF MARKET TRADESHOWS

Staff attended Toronto Auto Show in partnership with Cobble Beach and the Outdoor Adventure Show alongside regional neighbours and partners. More than 4,000 brochures were distributed.

ANNUAL GREY BRUCE BROCHURE SWAP

Hosted in partnership with Bruce County on May 7 at Saugeen First Nation with Cultural Demonstration and Pow Wow Regalia Fashion Show. More than 130 representatives participated in the event.

DIGITAL MARKETING

- 14 Feature Website Blogs
- 3 Weekly Instagram Features
- 2,000 Recipients of weekly events newsletters
- 3 Collaborations: Cobble Beach, Apple Pie Trail, and the Ontario Culinary Alliance

CAMPAIGNS:

Maple – Spring Marketing Campaign

March 1 to April 15, featuring six local events, eight maple producers and seven additional businesses that sell/produce or feature local maple syrup.

ACCOUNTS REACHED: 530,000

(up from 340,000 in 2023).

Boundless Living – Fall Social Media Campaign

(Instagram)

The fall campaign strategically targeted couples, highlighting regional destinations. These included: Owen Sound Salmon Tour, Meaford Scarecrow and Apple Harvest, Fall Colours/ Hiking/Wine, Scandinave Spa, Holiday Magic at Blue, Neustadt Springs Brewery, Gateway Casino and Match Pub, Cobble Beach, Station 87 and Back 40 Glamping.

ACCOUNTS REACHED: 641,332

PLAYS: 806,471

MIXED MEDIA

Grey Bruce Kids, Boomers Summer Edition and Sydenham Sportsmen Salmon Spectacular Magazine. The largest mixed media effort came with participation in Global Heroes, Ontario August Edition. The target was specific to the GTA and Ontario, with a total reach (print & digital) of just under 1.6 million.

VISIT GREY STATISTICS

Staff strategically supported a website content driven summer, with less emphasis on social media given the noise and dilution.

WEBSITE 276,529 USERS

(up 28% from 2023)

FACEBOOK 474,833 REACH

(down 39% from 2023)

INSTAGRAM 238,115 REACH

(down 6% from 2023)

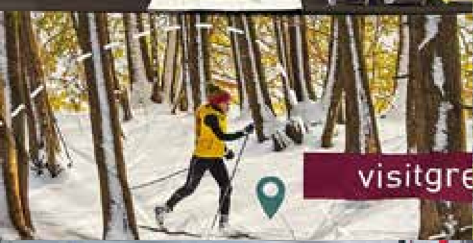
REGIONAL BROCHURES

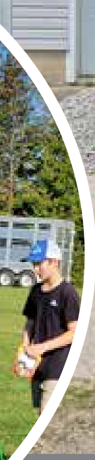
In coordination with member municipalities, staff developed a brand-new product for the market: Community Trails brochure, alongside an update to the Regional Map and Cycling Map. In place of Made in Grey Magazine, the Gather digest was developed to support the broader regional campaign. Distribution is scheduled for 2025.


TORONTO
Capital One
DESTINATION ONTARIO
MICHELIN 2024
MICHELIN
2024


visitgrey.ca


Economic
Developers






Live the skilled life!
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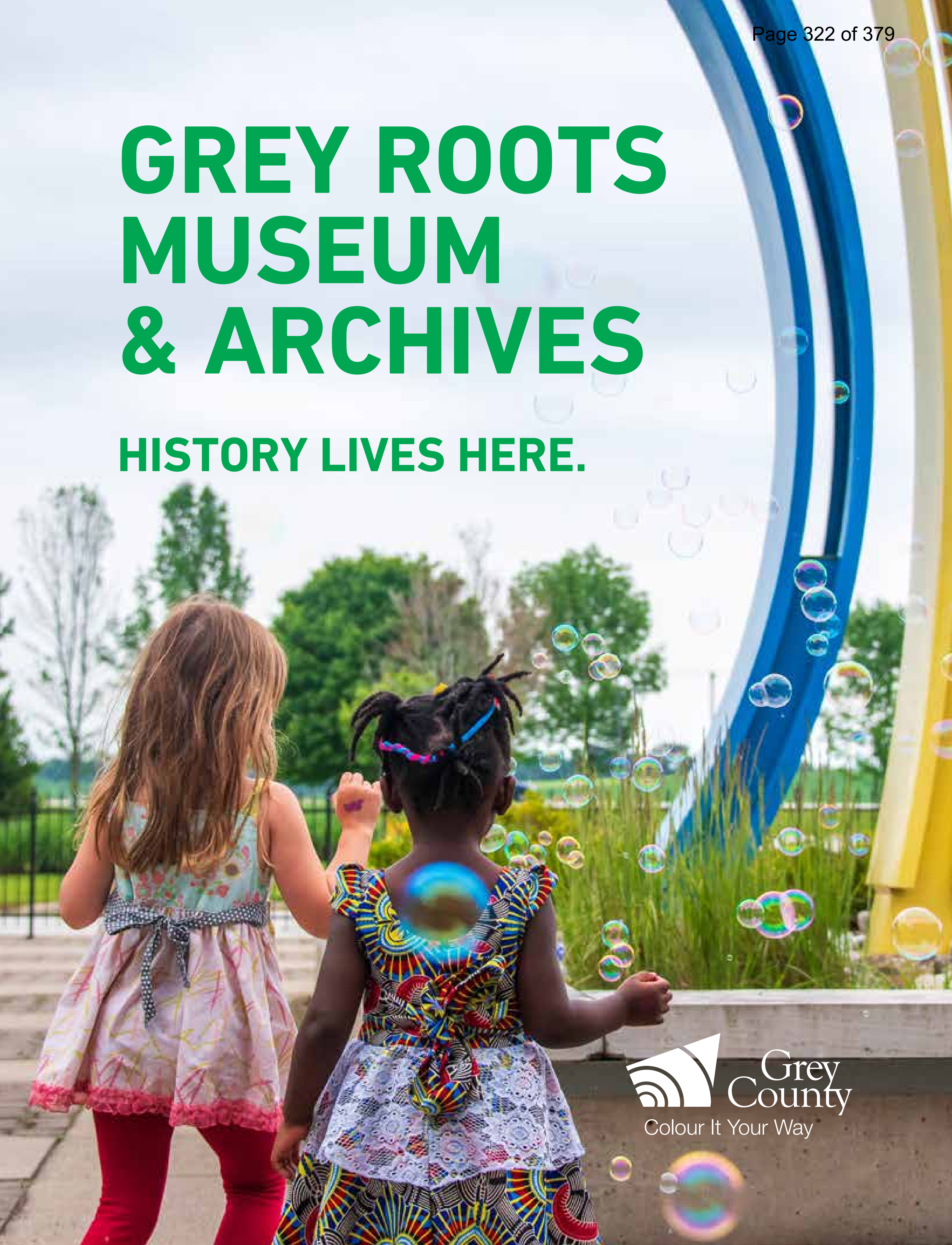
WWW.OYAP.COM

GREY ROOTS MUSEUM & ARCHIVES

HISTORY LIVES HERE.



Grey County
Colour It Your Way

GREY ROOTS MUSEUM & ARCHIVES

2024 marks the 20th Anniversary of Grey Roots Museum & Archives—Twenty years of presenting world class exhibitions, events and programming to visitors and residents of Grey County. Two decades of developing Moreston Heritage Village into a beloved living history site, of providing exceptional service to any and all, from simple tourism inquiries to generation spanning research projects. Over the last twenty years, we've been honoured to work alongside a multitude of exceptional volunteers, community organizations, cultural institutions and municipalities - following our vision to help build better communities.

The milestone year was celebrated through a variety of events and experiences including a PA Day kick-off event featuring family activities and complimentary ice cream; The Roots of Grey Roots lecture by historian and author, Richard Thomas who presented a look back on the origin and early years of Grey Roots Museum & Archives; 20th Anniversary Fundraising Gala - a grand soirée celebrating twenty years; and seven special admission by donation days throughout the year - our way of saying thank you to our visitors for all their support.

I contacted GRMA to inquire about historical photographs of Owen Sound related to businesses owned by my family to use in my Greek Community video project. Staff informed me of their process to accommodate my request and I was impressed with the efficiency and the information they provided, so much so that I asked to volunteer in 'The Archives'. Thank you for preserving our past.

- Lili Anne Holding

Visiting the Bruce Peninsula? Don't miss Grey Roots Museum! Our visit to Grey Roots was an incredibly enjoyable experience. The grounds are well-kept, the buildings and displays laid out well. But most of all, we were impressed by the enthusiastic, knowledgeable volunteers we met inside these buildings! Fabulous! Although we know the area well and have visited several pioneer villages/museums, we learned a lot about the Indigenous residents and settlers, and their struggles to live on the Bruce Peninsula. We also learned about the impact of various technological advancements. So glad we went!

- Trip Advisor Review – July 2024

1. LEADERSHIP AND COLLABORATION

PRIORITY 1

Positioning Grey Roots in the foreground of culture and connection in the region, reflective of community and visitor interests, is the cornerstone of this priority. We will work to be recognized as a community cultural hub that sparks curiosity and a love of human and natural history and local culture.

	ACTION	24	25	26	27	28
1.1	Foster a hub and spoke model to lead by example and nurture and support regional museums, community organizations and aspiring individuals to build capacity.					
1.2	Establish relationships with the business and arts communities to enable public-private partnerships that support enhanced delivery of service.					
1.3	Lead as cultural development officers to cultivate and connect culture industries and talent across the region; promote the diverse offerings in Grey.					
1.4	Be expert stewards in the collection, storage and display of human, natural and living history stories and collections.					

COLLECTION AND EXHIBITS (1.4)

Grey Roots accepted an estimated 155 items across 49 accessions. In 2024, Council approved a deaccession as staff work to bring the collection in line with our mandate.

10
IN-HOUSE EXHIBITS

- YEAR OF THE DRAGON – LUNAR NEW YEAR 2024
- BLACK HISTORY MONTH DISPLAY
- ERSKINE BROWN: CARVING MEMORIES
- ARTEFACT FOCUS – GREY ROOTS 20TH ANNIVERSARY
- CARRYING CULTURE: NEWCOMER KEEPSAKES FROM HOME
- CRUISING THE COUNTY: THE HISTORY OF THE CAR IN GREY
- MEAFORD 150TH
- GREY COUNTY GALLERY – CONNECTION
- GREY COUNTY GALLERY – PERMANENCE
- 20 YEARS IN 20 OBJECTS

CARRYING CULTURE: NEWCOMER KEEPSAKES FROM HOME
was developed in collaboration with Grey Bruce Settlement & Language Services and the YMCA of Owen Sound Grey Bruce. This exhibit focused on what newcomers to the area brought with them from their home countries and their stories of relocation and hopes for the future in Grey County. We had 14 participants loan over 40 items that were shown from May to October.

MEAFORD 150TH
was developed and cross-promoted in collaboration with the Meaford Museum which mounted their own original version at Meaford Hall for the summer months. Curatorial Information 2024

GREY COUNTY GALLERY

There are now 278 of our own artefacts on exhibit in the Grey County Gallery.

Alongside loans from the Ministry of Natural Resources, the Community Waterfront Heritage Centre and a local Quilting Masters group.

The exhibit includes: 25 archival pieces, 110 historic and modern images and maps, 7 newly created Grey County maps showing various features and 5 infographics.

JUST FOR INTEREST!

WHEN WE COMPLETE HOPE IN 2025, THE GREY COUNTY GALLERY WILL TOTAL EXACTLY

300 ARTEFACTS

ON EXHIBIT.

ARCHIVES

2024 COMMUNITY AND HERITAGE ORGANIZATION SUPPORT EXAMPLES:

- *Northern Terminus: The African Canadian History Journal*
- 'Road Warriors' Negro Creek Road event at Williamsford. Presentation on Grey Roots' archival resources relevant to Negro Creek includingresearch support and maps of Negro Creek and Negro Lakes
- Owen Sound Emancipation Festival
- Supporting the Georgian Bay Folk Society's '50 Years of Summerfolk Over 50 Weeks' social media campaign.
- 175 Markdale Jubilee – Holidays in the Highlands
- S.S. #11 Bentinck School Reunion
- South Grey WWI Home Front performance
- 4th Canadian Training Division, Meaford, 1995 Freedom of the City ceremony
- Grey Bruce Local Immigration Partnership – historical immigrant groups research projects
- Nahneebahweequay/Catharine Sutton research or image queries: Moccasin Identifier project and related video creation project by Bawaadan Collective, Pier 21, Parks Canada, Changing the Narrative Project, Western University Indigenous Studies, Rural Voice

In addition to ongoing municipal inquiries, research assistance in 2024 included complex and professional research or image queries: ex. fiction and non-fiction books, textbooks, newspaper, magazine and journal articles, websites and other online portals, film creators; environmental, architectural and heritage reviews and assessment reports; student projects and teaching at all levels through postsecondary, committed genealogists and local history pursuits. We've noticed out of area and out of province research is returning post-pandemic.

At 4,497.93 square kilometers (1,736.66 square miles) Grey County is the 4th largest county in Ontario. Both Collections and Archives have a geographic collecting scope which is the entire County, with an objective to represent the County as a whole, includingeach of its nine municipalities, past and present. We collect materials that speak both to the area's human and natural history on the topics of **community life, government, communication, local organizations, families, business, industry, military, transportation, cultural groups, Indigenous peoples, settlement** and **immigration**, and beyond.

BEHIND-THE-SCENES:

Grey Roots' permanent collections are securely stored in a temperature, humidity, and light-controlled environment where they are protected from handling, fire, mold, pests, pollution, and environmental disasters. The goal of these preventative conservation measures is to care for and prolong the lives of the materials for as long as possible. Following receipt of a donation (or municipal transfer) and signed Deed of Gift, processing must be completed before the material is fully available for use.

FACILITIES SPECIAL PROJECTS

VILLAGE

- General Store - extend deck, wrap porch posts, eavestrough
- Sewing Shop Sign Install
- School House Water Heater & Circulation Pump Replacement
- Replace Bandstand Roof
- Farm House Repairs - Front porch stairs and railings, window replacement
- Install wooden floor in wood shop
- Caboose - Painting and finishing exterior
- Install internet sensor on barn, trench for wires to SH.
- Barn Quilt installed on Big Red Shed
- Repair shingles blacksmith shop.
- Remove chimney log woodworking shop

MAIN BUILDING PROJECTS

- Grey County Gallery Demolition
- Flat Roof Replacement (Section 2 of 3)
- Refurbish Package Rooftop Units

2. INCLUSIVE STORYTELLING

PRIORITY 2:

Connecting with our diverse community including Indigenous, Black, Immigrant and Newcomer groups is the critical first step in engaging new audiences and presenting a more complete history. Building strong and meaningful relationships may evolve into partnerships over time, producing a more inclusive and diverse representation of Grey County.

	ACTION	24	25	26	27	28
2.1	Continue to work with the Indigenous Advisory Circle for guidance and feedback to increase the representation of Indigenous history and culture in programs, exhibits, events, and capital projects.	■				
2.2	Invite authentic and diverse voices to influence, collaborate and lead programs, exhibits, events, and capital projects.	■				
2.3	Enhance community cultural programming and use of the site by community partners.	■				
2.4	Nurture continued dialogue with communities; encourage discussions; ask for advice and sincerely consider feedback.	■				

INDIGENOUS ADVISORY CIRCLE

The Indigenous Advisory Circle met twice in 2024 - April 2 and October 16. Two individual meetings were also held with Elders Shirley John and Miptoon (Anthony Chegano). The focus of these meetings was the development of content for the Grey County Gallery as we discussed the best way to share the stories of the impact of residential schools on local First Nations, the displacement of the Anishinaabe village at Nawash (Owen Sound), disputes around fishing rights, and the Anishinaabe cultural significance of the land and waters in Grey. Advisory Circle members were invited to write sections of the exhibit text to create space for authentic representation of local First Nations. The group also advised staff on the refresh of the medicine garden at the front of the Grey Roots main building, and IAC member, Robyn Jones was invited in January 2024 to share a best practices presentation on land acknowledgements with Grey County Council.

Each summer, Grey Roots staff participate in interpretive hikes at Cape Croker Park, through the Anishinaabe Cultural Experiences program. These hikes have been valuable learning opportunities for our team. The knowledge and stories shared by Anishinaabe guides deepen our understanding of the rich, long-standing First Nations history in this area.

GREY COUNTY COMMUNITY CULTURAL INITIATIVES FUND

$5,000 in support was provided to the Negro Creek Descendants and Community Friends Group. As appropriate land is confirmed, the group will focus on the development and fundraising for a monument to recognize the historic Black settler communities on Negro Creek Road and recognize the historic Black settler communities on Negro Creek Road. The initiative will culminate in an unveiling celebration planned for 2025. These funds are being held by the Township of Chatsworth who are assisting in the financial management of the project.

BLUEWATER DISTRICT SCHOOL BOARD PARTNERSHIPS

Grey Roots collaborated with John Diefenbaker Senior School to host and promote 'Bringing History to Life', a 10th grade history project on local WWI soldiers.

SPECIALIST HIGH SKILLS MAJOR – AGRICULTURE PROGRAM

Bluewater District School Board entered into a pilot agreement in 2024 to move its SHSM Program In Agriculture to Grey Roots. The program combines theoretical and practical teachings through classroom learning and onsite in the barn, greenhouse and maple syrup production facility, to allow students to explore various career paths in food production, raising livestock, crop management and horticulture.

HIGHLIGHT! Grey Roots' displays on Black History are drawing interest from outside the area. The two visits by the Toronto-based Afrika Outbound youth group in 2024 were preceded by their first visit in the fall of 2023, and they promise to return. Each visit is co-hosted with a volunteer from the local Black descendants community. We also arranged for a volunteer to co-host the two tours from the Unifor BIWOC Committee, based in Kitchener.

8 GROUP TOURS

3. INTERACTIVE EXPERIENCES

PRIORITY 3

This priority focuses on further embedding interactive experiences throughout Grey Roots. This engagement model appeals to a variety of learners and can create more diverse access, both on and off-site, led by Grey Roots staff or others, to encourage memorable and connected experiences.

ACTION	24	25	26	27	28
3.1 Continue to develop new interactive experiences throughout Grey Roots for diverse visitors of all ages and abilities—physically across the site and digitally.					
3.2 Develop expert partnerships with individuals and community groups to lead and implement interactive, diverse programming.					
3.3 Introduce more young family and youth focused products and experiences to better serve and grow the priority target segments.					
3.4 Develop a roadshow and travelling exhibit series to embed products and experiences offsite, across the region.					

29
WORKSHOPS

32 SCHOOLS
43 PROGRAMS
1,530 STUDENTS

41
KIDS PROGRAMS

WORKSHOPS

PIEROGI, PASTA, PICKLES, PEACHES, SALSA, PIZZA, CREATIVE BAKING

The introduction of workshops was a strategic focus in 2024. Participants joined from across Grey, Bruce, Simcoe and Huron, and as far as Florida. Ages ranged from children and youth to adults and seniors. Children participated with parents, aunts, grandparents, and we saw many groups book together as families, friends and working colleagues who coordinated schedules. Two Syrian participants were booked in by residents who were helping the girls learn English and traditions.

EDUCATION PROGRAMS

Students travel from across Grey and Bruce to attend Grey Roots Education Programs. 2024 curated programs included: Animated Village Exploration, Designed by Nature, Settler Savvy, Cooking by the Calendar, Doing the Chores, and Keeping with Tradition.

- Toddlers Take the Museum (with EarlyON)

  PA Day Activities
- March Break
- Christmas Break

KIDSCAMP

In 2024, KidsCamp supported 63 different families, and attracted 32 returning campers.

Nine spots were earmarked for BWDSB special programming, After School & Summer Partnership Program led by Deborah Richardson, Behaviour Expertise Professional with BWDSB. These are students with exceptionalities who may not always be able to attend traditional camp spaces.

Two spots were donated to Big Brothers Big Sisters of Grey Bruce and Western Simcoe.

Four Specialized Programs:
Cooking Quest
Nature's Rhythm
S.T.E.A.M. Fusion
Our Community In Motion

7 WEEKS **85** KIDS

31
RENTALS

29
EVENTS

5,439
ATTENDEES

8
EVENT SPONSORS, TOTALING
$14,000

SPECIAL EVENTS

Lunar New Year

Family Day – Black History Event

Bluewater Railday

Our Roots Are Showing Concert Series (4)

Members Preview

Specialist High Skills Major Open House

Spring Into Moreston

Multicultural Day

20th Anniversary Celebration

Delton Becker Day

Emancipation Speaker's Corner

Emancipation Gospel Sunday

Antique & Classic Car Show

Welcoming Week

Harvest Fest

Spring and Fall Lecture Series (7)

Halloween Fright Night

20th Anniversary Gala

Moreston by Candlelight (2)

** Bold are community partnered events, hosted at Grey Roots*

COMMUNITY EVENT PARTICIPATION

- Owen Sound Pride Parade
- Cars and Coffee Car Show
- Concourse d'Elegance Car Show
- Owen Sound Santa Claus Parade
- Owen Sound Volunteer Fair

4. DESTINATION DEVELOPMENT

PRIORITY 4

Recognizing Grey Roots as a key tourism asset in Grey County, as both destination and hub of information and access underpins this priority. It's about inspiring return visits and positioning Grey Roots as top-of-mind among our community and visitors by sharing key tourism information and offering unique experiences.

	ACTION	24	25	26	27	28
4.1	Establish Grey Roots as Grey County's foremost tourism information hub.	■	■			
4.2	Utilize the substantial outdoor property to create year-round roadside and outdoor attraction experiences.					
4.3	Investigate opportunities to curate an itinerary of experiences between Grey Roots and other attractions, helping to attract overnight visitor stays		■			
4.4	Explore the possibility of creating a connecting trail link between Grey Roots and Inglis Falls, in conjunction with the Bruce Trail to provide day long or multi day experiences.					

TRAVELLING EXHIBIT

Inspiring Nature, Inspired Techno ran at Grey Roots from May to September. The family-friendly exhibit explored the intersection between nature and transportation technologies. Hands-on, interactive components and eye-catching displays showcased numerous technologies inspired by the natural world.

TOURISM INFORMATION HUB

Hub development began with a greater tourism presence in 2024. Grey County's two Tourism Summer Students spent more time at Grey Roots, setting up a visitor booth, sharing information and answering questions for guests looking to explore the region. In addition to having more readily available tourism information, a new regional map wall was installed as the first permanent installation of the transformation.

5. INNOVATIVE PRACTICES

PRIORITY 5

Through this priority, we look internally at our operations to consider how we do business, and how we can continue to do things differently. It's also about making sure all our people can access the products and services we so proudly offer.

	ACTION	24	25	26	27	28
5.1	Prioritize programming over new construction to increase visitation and revenue, fully utilizing the assets already at Grey Roots.	■				
5.2	Work with the Niagara Escarpment Commission (NEC) to amend property permissions and enable further use of the property, including Moreston Heritage Village.		■			
5.3	Perform an annual operations review to understand trends, refine the business model, explore new revenue generation tools and plan for sustainable growth.	■				
5.4	Explore methods of improved access and inclusion across product and service offerings.	■				
5.5	Enhance strategic target marketing to residents and visitors, encouraging greater participation in product and service offerings, and boosting customer relationship longevity.		■			
5.6	In conjunction with economic development and tourism, develop a Made in Grey program that celebrates our present – people, place and business - bringing to life our motto, 'History Lives Here'.		■			

LEAN PROJECT

Staff engaged Lean Advisors to assist in planning Village operations for 2025. The project consulted staff, volunteers and the public to recommend an operating model that better aligns with current experience and future trends.

MUSEUM ASSISTANT

Bianca Nam was hired in November 2024 in a purposeful adjustment to continue the course of prioritizing programming, enabling coordinated delivery every Saturday at the museum. One student position was realigned to assist with program delivery and support education programs and special programming across PA Days, March Break and Christmas Break.

FRIENDS OF MORESTON

The Friends of Moreston is a volunteer-driven, not-for-profit organization dedicated to supporting Moreston Heritage Village at Grey Roots Museum. This group plays a vital role in preserving, maintaining, and promoting the village, which is constantly evolving. The Friends undertake a variety of projects, such as gardening, construction, cleaning, painting, and fundraising. They organize seasonal workdays in the spring and fall to help keep the village in excellent condition year-round. Additionally, the group holds quarterly meetings, during which Grey Roots staff provide updates on museum plans and activities, seeking feedback and recommendations from the Friends to guide future initiatives.

VOLUNTEER COORDINATION

Volunteers at Grey Roots are essential to everything we do. Whether presenting Grey County's history to the public, supporting the museum's artifact and archival collections, restoring antique vehicles, assisting with exhibit changeovers, or contributing to educational programs, our volunteers play a vital role.

In 2024, we have made it a priority to keep our volunteers informed about museum plans and to maintain strong connections throughout the year. This includes sharing updates on performance measures, discussing future plans, and gathering va,luable feedback and input from our dedicated and experienced volunteers.

86 ACTIVE VOLUNTEERS

4,327 VOLUNTEER HOURS

DIGITAL STATISTICS

WEBSITE

204,316 views
85,871 sessions
67,470 users

Most visited pages

- Homepage
- Hours/Directions/ Admissions
- Events
- Exhibits
- Archives

FACEBOOK

628,006 views
418,516 reach
26,906 interactions

INSTAGRAM

67,064 views
26,161 reach
4,239 interactions

GRANTS, CAPITAL SPONSORSHIPS & DONATIONS

$ 203,978.00
Federal Funding:

Canada Cultural Spaces

$63,500
Provincial Funding: Community Museum Operating Grant

$15,716.98
Donations:

Pay by Donations days, donations in memory of loved one

Capital Sponsorship:

Thomas Wheildon - $50,000 for Theatre Upgrades $10,000 per year over 5 years.
Wheildon Investments Inc - $8,000 in year four of $40,000 Arnott General Store.
Fairmount Security - $3,500 in year four of $20,000 Children's Gallery.

2024 TOTALS

280 MEMBERS

21,259 ATTENDEES

$166,904 REVENUE

(30% PROGRAMS, 19% GENERAL ADMISSION, 16% SPECIAL EVENTS, 16% MUSEUM STORE, 12% MEMBERSHIPS, 7% RENTALS AND TOURS)


HATE
HAS
NO
HOME
HERE


Paige
Warner

Grey County

Colour It Your Way

THE CORPORATION OF THE CITY OF SARNIA
Office of the City Clerk

March 6, 2025

The Right Honourable Justin Trudeau, P.C., M.P.
Prime Minister of Canada
Office of the Prime Minister
80 Wellington Street
Ottawa, ON K1A 0A2
Justin.trudeau@parl.gc.ca

Re: Carbon Tax

Dear Prime Minister,

At the meeting of Sarnia City Council held on March 3, 2025, the following resolution was adopted:

That given the advent of the US tariffs and the economic impact on Canadians it is even more critical at this time to petition our own Federal liberal government to put a stop the 20 percent increase to the carbon tax scheduled to be implemented April 1, 2025. The vast majority of Canadians do not support the carbon tax, and the timing could not be worse for the impact to our citizens; and

That the resolution be forwarded to the Prime Minister, his Cabinet, Leaders of Opposition, our MP, and All Ontario Municipalities.

Your consideration of this matter is respectfully requested.

Yours sincerely,

Amy Burkhart
City Clerk

Cc: Cabinet Ministers
The Honourable Pierre Poilievre, M.P.
The Honourable Marilyn Gladu, M.P.
All Ontario Municipalities

PAUL VICKERS
MPP - BRUCE-GREY-OWEN SOUND

105 - 345 8th Street East, Owen Sound, ON N4K 1L3
P: 519-371-2421 or 1-800-461-2664 | F: 519-371-0953
E: paul.vickers@pc.ola.org | W: paulvickersmpp.ca

Re: Letter of Introduction – Paul Vickers, MPP for Bruce—Grey—Owen Sound

March 10, 2025

Dear Bruce—Grey—Owen Sound Municipalities,

I am pleased to share with you that on February 27, 2025, I was elected by the constituents of Bruce—Grey—Owen Sound to serve as their next Member of Provincial Parliament. This is an incredible honour that I do not take lightly.

For those of you who do not yet know me, I am a lifelong resident of our constituency in the Meaford area. I have dedicated my life to agriculture and community service, having operated our family's dairy farm ever since my graduation from the Ontario Agricultural College at the University of Guelph. I have served on the Board of Directors for Gay-Lea Foods Co-operative, including serving as Chair for two years, and on the Board of the Ontario Federation of Agriculture, where I was most recently a Vice-President.

I have also served as a Councillor for the Municipality of Meaford. Through this experience, I understand the challenges our local municipalities face. I am aware that our communities are grappling with mounting infrastructure costs and capital deficits, are at the forefront of an unprecedented pace of development and are navigating new social challenges. Please be assured that we are on the same team when it comes to making our community a better place. These challenges may be complex, but together, we can get it done for our communities.

Please be assured that my office is open and is a resource for you. As your MPP, I am committed to helping you navigate the provincial government when help is needed. I am also committed to being a presence in our community and pride myself on approachability. Don't be shy to pick up the phone for a chat or send an email if you have an issue to bring to my attention.

I look forward to working with all of you over the next four years, as we work collectively to make Bruce—Grey—Owen Sound an even better place to call home!

Yours in service,

Paul Vickers, MPP
Bruce—Grey—Owen Sound

MUNICIPALITY OF West Grey nestled in nature

Staff Report

Report To: Council

Report From: David Smith, Manager Planning and Development

Meeting Date: March 18, 2025

Subject: ZA06.2024 – Site Plan Control (DJ Land)

Recommendations:

That in consideration of staff report 'ZA06.2024 – Site Plan Control (DJ Land)', Council directs staff to bring forward a bylaw to implement site plan control as it relates to lands zoned 'R3-519 High Density Residential Exception'.

Highlights:

- The purpose of the bylaw would be to implement Site Plan Control on those lands currently zoned 'R3-519 High Density Residential Exception' in West Grey Comprehensive Zoning Bylaw 37-2006.
- Site specific Bylaw No. 2024-082, passed October 1, 2024, included a typographical error that established site plan control on lands zoned 'R3-Y'.
- Site specific Bylaw No. 2024-082 should have referenced the lands zoned 'R3-519 High Density Residential Exception' [a future high density townhouse or apartment block] in the proposed Saddler Street subdivision.
- Municipal address: Not assigned.
- Under the Planning Act, RSO 1990 as amended there is no public notice and no public meeting required for a site plan control bylaw.

Previous Report/Authority:

ZA06.2024 - DJ Land (Saddler) Zoning Report Sept 17, 2024

Analysis:

Planning Act, RSO 1990 as amended (Planning Act)

Section 41 of the Planning Act allows a municipality to designate a site plan control area for residential development provided that:

i) there is an Official Plan policy in place; and

ii) the residential development within the site plan control area contains more than 10 units.

The Grey County Official Plan and the West Grey Official Plan both provide designate/describe the land within the geographic town of Durham as a site plan control area.

The lands proposed to be subject to the site plan control bylaw are proposed by the owner/developer for more than 10 residential units.

The Manager of Planning and Development is satisfied that the requirements and/or limitations of the Planning Act regarding site plan control have been met.

Provincial Planning Statement 2024 (PPS)

The PPS does not provide specific direction on site plan control. This is left to the implementing Official Plan(s) to regulate.

The Manager of Planning and Development is of the opinion that the site plan control bylaw is consistent with the policies of the PPS.

Grey County Official Plan (Grey OP)

Section 9.11 Site Plan Control of the Grey OP states that

1) The entire County of Grey is designated as a proposed Site Plan Control Area. Site Plan Control will not apply to land used for agriculture, single detached or two-unit dwellings except for the purpose of fulfilling policies related to Natural Grey.

2) Local municipal Council may through by-law designate areas where Site Plan Control will be in effect as provided in the Planning Act, R.S.O. 1990, as amended.

The lands that would be subject to the site plan control bylaw are zoned R3-519 Exception. Single detached or two-unit dwellings are not permitted in the R3-519 Exception zone.

The Manager of Planning and Development is satisfied that the general intent and purpose of the Grey OP is being maintained.

West Grey Official Plan for the Settlement Areas of Durham and Neustadt (West Grey OP)

Section F8.3 Site Plan Control states that:

All lands within Durham and Neustadt shall be designated as a Site Plan Control Area, meaning that the Municipality may require a Site Plan Control Agreement for any development or redevelopment of any property within these settlement areas.

That notwithstanding, the Municipality shall use its discretion to determine which development proposals shall be subject to a Site Plan Control Agreement.

The Manager of Planning and Development is satisfied that the general intent and purpose of the West Grey OP is being maintained.

Financial Implications:

None.

Climate and Environmental Implications:

None.

Communication Plan:

As required under the Planning Act, R.S.O. 1990, as amended.

Consultation:

None.

Attachments:

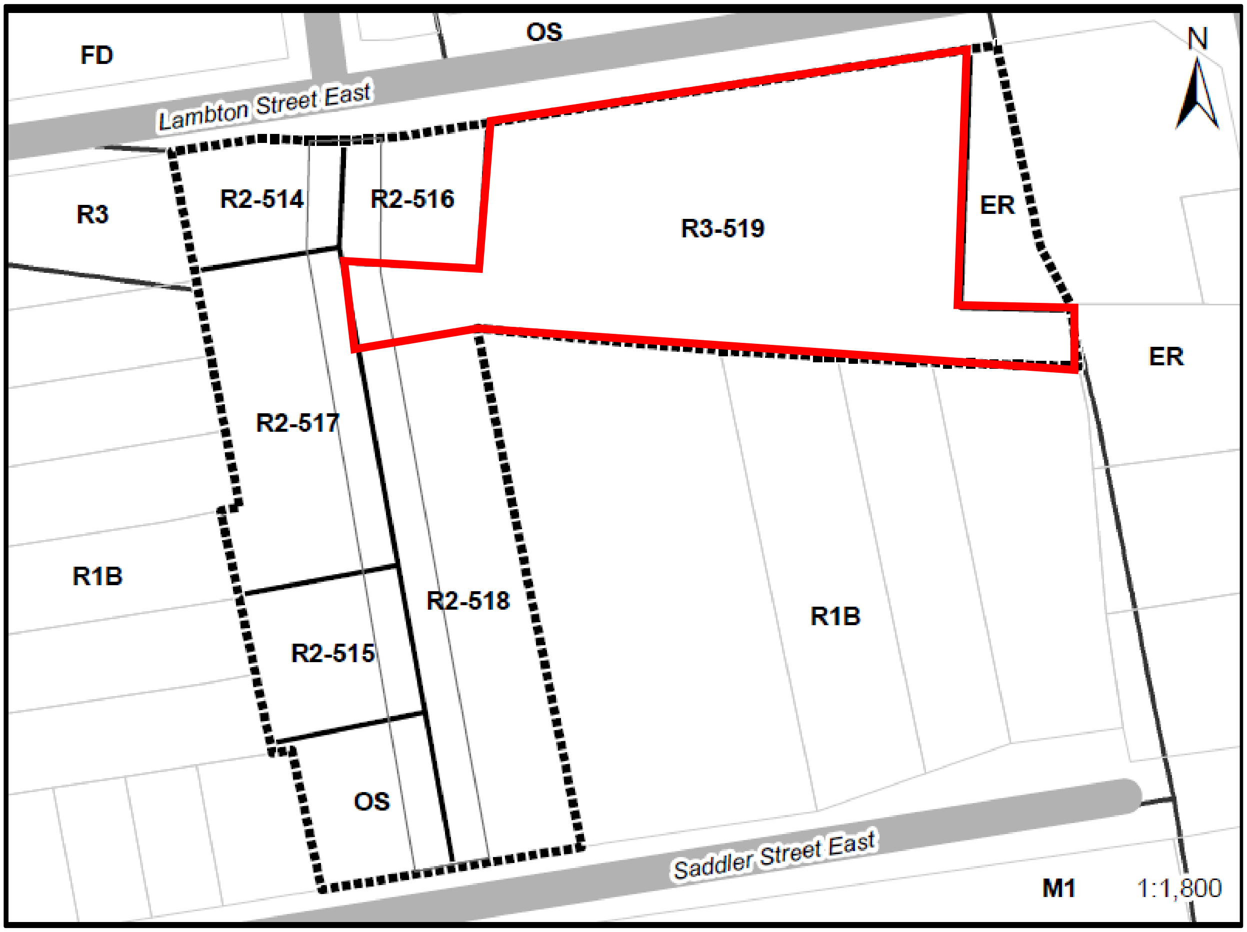
Schedule 'A' – Site Plan Control Area (DJ Land)

Recommended by:
David Smith, RPP, MCIP, Manager of Planning and Development

Submission reviewed by:
Michele Harris, Chief Administrative Officer

For more information on this report, please contact David Smith, Manager of Planning and Development at planning@westgrey.com or 519-369-2200 Ext. 236.

Schedule A – Site Plan Control Area (DJ Land)



R3-519 High Density Residential Exception Subject to Site Plan Control

MUNICIPALITY OF West Grey nestled in nature

Staff Report

Report To: Council

Report From: Geoff Aitken, CET – Director, Infrastructure & Public Works

Meeting Date: March 18, 2025

Subject: IPW-2025-07 – 2024 Drinking Water Systems-Annual/Summary Reports

Recommendations:

That in consideration of staff report 'IPW-2025-07 – 2024 Drinking Water Systems-Annual/Summary Reports', Council receives the report for information purposes.

Highlights:

- Both Drinking Water Systems (Durham and Neustadt) operated within the constraints of provincial requirements.
- Both Drinking Water Systems (Durham and Neustadt) operated within their respective Drinking Water Works Permits.
- Both Drinking Water Systems (Durham and Neustadt) operated within their respective Municipal Drinking Water Licenses.
- Both Drinking Water Systems (Durham and Neustadt) operated within their respective Permits to Take Water.

Previous Report/Authority:

2023 Drinking Water Systems – Annual/Summary Reports

2022 Drinking Water Systems – Annual/Summary Reports

Analysis:

In Ontario, Municipal Drinking Water Systems are governed by Ontario Regulation (O. Reg.) 170/03, titled *Drinking Water Systems*, as currently amended to O. Reg. 269/22. Section 11, titled *Annual Reports*, requires that an annual report be prepared each year, covering the period from January 1 to December 31 and be prepared by February 28 of the following year. Further, Schedule 22 of the same regulation, titled *Summary Reports* *for Municipalities*, requires that a summary report be prepared for the preceding calendar (January 1 to December 31) and that the said report be issued not later than March 31 of the following year.

The annual report focuses on and summarizes: the treatment system and chemicals used; reports made to the Ministry; results of tests required by the regulation, approval, and license etc.; any corrective actions taken, any major expenses incurred; where the summary report is available for review; and the number of sample locations for lead. The summary report lists: the requirements of the Act, approvals, water works permit, license etc. For any clause not met in the requirements, it specifies the duration of the failure and the measures taken to correct the failure; a summary of the quantities and flow rates of the water supplied; and a comparison of the flow data with the rated capacity of the system.

The preparation of both the annual report and the summary report is part of the service agreement with Veolia Water Canada (Veolia). The discussion in the annual report and the discussion in the summary report naturally overlap; therefore, most operating authorities produce one report titled *Annual/Summary Report.* This is the case for both the Durham Drinking Water System (DWS) and the Neustadt DWS.

Neustadt Drinking Water System

The 2024 annual/summary report for the Neustadt DWS meets the requirements of both the annual and summary reports. In 2024 there were no issues of non-compliance. All microbiological and physical/chemical sampling occurred as per O. Reg. 170/03 and were found to be within compliance.

The 2024 treated water flow data is as follows: total flow for the year, 44,712 m^3; average day flow was 122.2 m^3/day, which is 13.3 percent of the rated capacity. The max day, 662.3 m^3 occurred on September 6, 2024, while refilling the water tower over the course of three days. However, the data recorded while refilling the tower is considered an outlier to a normal consideration of max day, based on demand. See attached updated Reserve Capacity assessment for the Neustadt water works. The max day based on demand was 339.2 m^3 which occurred in October 2024. The total volume of water treated, the average day, and the max day flows are reasonable considering the population served.

For 2024, the major capital investment in the Neustadt DWS was the refurbishment of the water tower itself. A tender was issued and awarded. Construction was completed in September 2024. Additionally, during 2024, the Permit to Take Water (PTTW) and the Drinking Water License were renewed.

Durham Drinking Water System

The 2024 annual/summary report for the Durham DWS meets the requirements of both the annual and summary reports. In 2024 there were no issues of non-compliance. All microbiological and physical/chemical sampling occurred as per O. Reg. 170/03 and were found to be within compliance.

The 2024 treated water flow data is as follows: total flow for the year, 330,784 m^3; average day flow was 904 m^3/day, which is 30.0 percent of the rated capacity. The max day occurred in December and was 1,192 m^3, which is 39.6 percent of the capacity. The total volume of water treated, the average day, and the max day flows are high considering the population served.

Caution should be used when reviewing the flow data, caution should be used as a portion of the flow is committed. See attached 2024 Reserve Capacity Assessment which shows that there is capacity for approximately 100 houses. This is an improvement over 2023 but is attributed to the allocation reduction to one of the proposed developments. To address the capacity issue, the Municipality of West Grey (West Grey) initiated a Municipal Class Environmental Assessment (EA) to increase hydraulic reserve capacity. To create capacity, three actions need to occur: add another source (a well); expand pumphouse two; and add water storage. Further, West Grey has enhanced the ultrasonic leak detection survey to minimize water loss. This will likely result in the need to replace aged cast iron watermains.

Some monies were allotted in the 2024 capital budget to further the EA process and a new well was drilled. An aggressive schedule to full build-out of the well and pumphouse is three years with an estimated budget of +/- $3 million. Additionally, the Durham standpipe is past its expected service life and is in very poor condition. Replacement of some description is a needed. The estimated cost is a minimum of $6 million. During 2024, the Drinking Water License was renewed. The primary focus of 2025 is to complete the PTTW application for the new well and complete the design of the addition to the South Street pumphouse.

Financial Implications:

There is no direct cost as the result of the 2024 annual/summary reports. In 2024, major expenses were $1.6 million to refurbishing the Neustadt Water Tower; $313,000 for the Durham DWS to drill a new well; $440,000 for various works associated with servicing Rockwood Terrace; and, $150,000 to replace the UV unit at Pumphouse two.

In 2024, there were two funding opportunities through Housing Enabling Water System Fund. The Durham waterworks fit the criteria and was an ideal candidate. Specifically, drilling the well, addition to the pumphouse and water storage were all considered. Neither application was successful.

Climate and Environmental Implications:

The most significant climate and environmental implications are found around the concepts of environmental stewardship and public health and safety. In fact, some might argue that public health and safety is directly connected to being good environmental stewards. It begins with the wells themselves: the construction of a well so it is secure from contamination, setting the pump at an elevation where there is sufficient capacity to serve the community while balancing those needs against the aquifer and its importance to the various ecosystems that rely on it.

Sound environmental stewardship is the guiding principle for developing a source supply of water for the community while ensuring the health and safety of the community. Failure to construct, maintain and operate the source supply (in the case of both Durham and Neustadt) in a responsible manner would have repercussions for both the environment and those served by the water system.

Communication Plan:

Communication of this report is through the posting of council meeting agendas on the Municipality of West Grey's website. Upon approval, staff will post the annual/summary reports on West Grey's website.

Consultation:

Supervisor, Urban Operations, Infrastructure and Development

Veolia North America

Attachments:

2024 Annual/Summary Report – Neustadt Drinking Water System

2024 Annual/Summary Report – Durham Drinking Water System

Reserve Capacity Assessment – Durham Water Works

Reserve Capacity Assessment – Neustadt Water Works

Recommended by:

Geoff Aitken, CET, Director, Infrastructure and Public Works

Submission approved by:
Michele Harris, Chief Administrative Officer

For more information on this report, please contact Geoff Aitken, Director, Infrastructure & Public Works at publicworks@westgrey.com or 519-369-2200 Ext. 227.

February 24, 2025
Municipality of West Grey
402813 Grey Road 4
RR#2
Durham, ON
N0G 1R0

Attention: Geoff Aitken, Manager of Public Works

RE: Durham Drinking Water System
2024 Annual and Summary Reports

Geoff,

Please find attached the 2024 Annual and Summary Reports for the Durham Drinking Water System, in accordance with Section 11(1) of O. Reg. 170/03. This report covers the period from January 1 to December 31, 2024 and meets the requirement of being prepared by February 28 of this year.

Please ensure that a copy of this report is given, without charge, to every person who requests a copy. In addition, please make certain that effective steps are taken to advise residents that copies of the report are available, and of how a copy can be obtained.

Finally, as per Schedule 22 of O. Reg. 170/03, please ensure that at least a copy of the Summary Report is given to the members of municipal council no later than March 31, 2025.

If you have any questions regarding the report, we would be pleased to address them and you should contact the undersigned accordingly.

Sincerely,

Scott Gowan
Project Manager

Veolia North America
555 Rene-Levesque Blvd W
Montreal, QC H2Z 1B1
www.Veolianorthamerica.com

Part 1 - ANNUAL REPORT (as required by O. Reg 170/03, Section 11)

Drinking-Water System Number:	220001771
Drinking-Water System Name:	Durham Drinking Water System
Drinking-Water System Owner:	Municipality of West Grey
Drinking-Water System Category:	Large Municipality Residential
Period being reported:	January 1 - December 31, 2024

Complete if your Category is Large Municipal Residential or Small Municipal Residential		Complete for all other Categories	
Does your Drinking-Water System serve more than 10,000 people?	☐ Yes ☑ No	Number of Designated Facilities served:	n/a
Is your annual report available to the public at no charge on a website on the Internet?	☑ Yes ☐ No	Did you provide a copy of your annual report to all Designated Facilities you serve?	☐ Yes ☐ No
Location where Summary Report required under O.Reg. 170/03 Schedule 22 will be available for inspection. **Municipality of West Grey** **402813 Grey Road #4** **Durham, ON N0G 1R0**		Number of Designated Facilities served:	n/a
		Did you provide a copy of your annual report to all Interested Authorities you report to for each Designated Facility?	☐ Yes ☐ No

List all Drinking-Water Systems (if any), which receive all of their drinking water from your system:	
Drinking Water System Name	**Drinking Water System Number**
n/a	

Did you provide a copy of your annual report to all Drinking-Water System owners that are connected to you and to whom you provide all of its drinking water?
n/a

Indicate how you notified system users that your annual report is available, and is free of charge.		
☑ Public access/notice via the Web	☑ Public access/notice via Government Office	☐ Public access/notice via a newspaper
☐ Public access/notice via the Public Request	☐ Public access/notice via a Public Library	☐ Public access/notice via other method

Describe your Drinking Water System

Well No. 1B Pumphouse

A GUDI well, 300mm diameter and 77 m deep equipped with a VFD submersible well pump rated at 15.9 L/s at a TDH of 71-133 m. The pumphouse enclosure building is 4.9 m x 3.1 m x 3.3 m high and houses the water treatment equipment including, but not limited to, flow meters, UV disinfection system, cartridge filters, sodium hypochlorite disinfection system, online chlorine and turbidity analyzers, low level alarms, autodialer and backup diesel generator.

Well No. 2 Pumphouse

A GUDI well, 300mm diameter and 74.7 m deep equipped with a VFD submersible well pump rated at 17 L/s at a TDH of 75-139 m. The pumphouse contains the water treatment equipment including, but not limited to, flow meters, UV disinfection system, cartridge filters, sodium hypochlorite disinfection system, online chlorine and turbidity analyzers, low level alarms, autodialer and backup power source available.

Well #2A is located just outside the well#2 pumphouse. It is 250mm diameter well about 68m deep. The variable speed submersible pump has a capacity of 1134L/min. The capacity of the wellhouse is 18.9L/s.

List all water treatment chemicals used over this reporting period
Sodium Hypochlorite - 12%

Please provide a brief description and a breakdown of monetary expenses incurred
A new Turbidity analyzer was installed at Well 1B Replaced the Control Board for the Diesel Generator Watermain repairs took place on Queen Street and Garafraxa Street. An additional Well has been drilled, which will potentially be added as an additional source for the community.

Provide details on the notices submitted in accordance with subsection 18(1) of the Safe Drinking-Water Act or section 16-4 of Schedule 16 of 0.Reg. 170/03 and reported to Spills Action Centre				
Incident Date	**Parameter**	**Result**	**Corrective Action**	**Corrective Action Date**
NA				

Microbiological testing done under the Schedule 10, 11, 12 of Regulation 170/03, during this reporting period					
	Number of Samples	**Range of E.Coli Results** (min #) - (max #)	**Range of Total Coliform Results** (min #) - (max #)	**Number of HPC Samples**	**Range of HPC Results** (min #) - (max #)
Raw (Well 1B)	53	0 - 0	0 - 0	n/a	n/a
Raw (Well 2)	53	0 - 0	0 - 1	n/a	n/a
Raw (Well 2A)	53	0 - 0	0 - 0	n/a	n/a
Treated POE 1	53	0 - 0	0 - 0	53	<10 - 50
Treated POE 2	53	0 - 0	0 - 0	53	<10 - 50
Distribution	159	0 - 0	0 - 0	53	10 - 10

Operational testing under Schedule 7, 8, or 9 of Regulation 170/03 during the period covered			
	Number of Grab Samples	**Range of Results** (min #) - (max #)	**Units**
Turbidity - Well 1B Treated	8760*	0.01 - 1.71 *	NTU
Turbidity - Well 2 Treated	8760*	0.02 - 2.00 **	NTU
Chlorine - Well 1B Treated	8760*	0.50 - 2.00 *** A max of 2.00 occurs due to a chlorine spike when the well starts. The max the SCADA will record is 2.00 mg/L.	mg/L
Chlorine - Well 2 Treated	8760*	0.50 - 2.00 *** A max of 2.00 occurs due to a chlorine spike when the well starts. The max the SCADA will record is 2.00 mg/L	mg/L
Chlorine - Distribution	468	0.76 - 1.42	mg/L

*** For continuous monitors use 8760 as the number of samples**

****high turbidity incidents were either too short to be reportable (<15min) or occurred when system was off**

*****Minimum Chlorine residual required to meet CT is 0.44 mg/l for Well 1, and 0.39 mg/l for Well 2 (@10 l/s). Wells both lock out at 0.50 mg/l**

There were no instances of untreated water being delivered into the distribution system. Well pumps automatically shut off when chlorine levels drop below a preset value (0.5 mg/l), or if Turbidity exceeds 1.0NTU for 10 minutes. SCADA system reads all values, even when well pumps are off or equipment service is being conducted.

Summary of additional testing and sampling carried out in accordance with the requirement of an approval, order or other legal instrument				
Date of legal instrument issued	**Parameter**	**Date Sampled**	**Range of Results**	**Units of Measure**
December 1, 2009	UV Transmittance (#1B)	Jan-Dec 2024	97.0-99.0	% Transmittance
December 1, 2009	UV Transmittance (#2)	Jan-Dec 2024	98.0-100.0	% Transmittance

Summary of Inorganic parameters tested during this reporting period or the most recent sample results						
Parameter	**Sample Date**	**Result Value POE 1**	**Result Value POE 2**	**Distribution**	**Unit of Measure**	**Exceedance**
Alkalinity	Mar. 25, 2024 Sep. 9, 2024	-	-	281 271 288 265	mg/L	No
Antimony	Aug. 12, 2024	<0.6	<0.6	-	µg/L	No
Arsenic	Aug. 12, 2024	<0.2	<0.2	-	µg/L	No
Barium	Aug. 12, 2024	14.9	14.5	-	µg/L	No
Boron	Aug. 12, 2024	10	20	-	µg/L	No
Cadmium	Aug. 12, 2024	0.007	0.006	-	µg/L	No
Chromium	Aug. 12, 2024	0.19	0.15	-	µg/L	No
Lead-see summary below						
Mercury	Aug. 12, 2024	<0.01	<0.01	-	µg/L	No
Selenium	Aug. 12, 2024	0.81	0.99	-	µg/L	No
Sodium	Aug. 4, 2020	6.2	11.0	-	mg/L	No
Uranium	Aug. 12, 2024	2.16	3.54	-	µg/L	No
Fluoride	Aug. 30, 2021	0.20	0.67	-	mg/L	No
Nitrite	Feb. 12, 2024 May 13, 2024 Aug. 5, 2024 Nov. 4, 2024	<0.003 <0.003 <0.003 <0.003	<0.003 <0.003 <0.003 <0.003	-	mg/L	No
Nitrate	Feb. 12, 2024 May 13, 2024 Aug. 5, 2024 Nov. 4, 2024	1.45 1.44 1.48 1.61	0.890 0.575 0.870 0.773	-	mg/L	No

Summary of Lead Results during this reporting period (Winter: Dec. 15/21 - Apr. 15/22; Summer: June 15/22- Oct. 15/22)				
Sampling Period	**Range of Results (µg/L) from Residential Samples** (# of Samples Taken)	**Distribution Locations**	**Distribution System ug/L**	**Any Adverse Water Quality Incidents?**
Winter April 11, 2022	n/a	WWTP County Shed	0.12 0.19	NO
Summer October 3, 2022	n/a	WWTP County Shed	0.17 0.88	NO

Summary of Organic parameters sampled during this reporting period or the most recent sample results					
Parameter	**Sample Date**	**Result Value POE 1**	**Result Value POE 2**	**Unit of Measure**	**Exceedance**
Alachlor	Aug. 12, 2024	<0.02	<0.02	µg/L	No
Atrazine + N-dealkylated metabolites	Aug. 12, 2024	<0.01	<0.01	µg/L	No
Azinphos-methyl	Aug. 12, 2024	<0.05	<0.05	µg/L	No
Benzene	Aug. 12, 2024	<0.32	<0.32	µg/L	No
Benzo(a)pyrene	Aug. 12, 2024	<0.004	<0.004	µg/L	No
Bromoxynil	Aug. 12, 2024	<0.33	<0.33	µg/L	No
Carbaryl	Aug. 12, 2024	<0.05	<0.05	µg/L	No
Carbofuran	Aug. 12, 2024	<0.01	<0.01	µg/L	No
Carbon Tetrachloride	Aug. 12, 2024	<0.17	<0.17	µg/L	No
Chlorpyrifos	Aug. 12, 2024	<0.02	<0.02	µg/L	No
Diazinon	Aug. 12, 2024	<0.02	<0.02	µg/L	No
Dicamba	Aug. 12, 2024	<0.20	<0.20	µg/L	No
1,2-Dichlorobenzene	Aug. 12, 2024	<0.41	<0.41	µg/L	No
1,4-Dichlorobenzene	Aug. 12, 2024	<0.36	<0.36	µg/L	No
1,2-Dichloroethane	Aug. 12, 2024	<0.35	<0.35	µg/L	No
1,1-Dichloroethylene (vinylidene chloride)	Aug. 12, 2024	<0.33	<0.33	µg/L	No

Dichloromethane	Aug. 12, 2024	<0.35	<0.35	µg/L	No
2-4 Dichlorophenol	Aug. 12, 2024	<0.15	<0.15	µg/L	No
2,4-Dichlorophenoxy acetic acid (2,4-D)	Aug. 12, 2024	<0.19	<0.19	µg/L	No
Diclofop-methyl	Aug. 12, 2024	<0.40	<0.40	µg/L	No
Dimethoate	Aug. 12, 2024	<0.06	<0.06	µg/L	No
Diquat	Aug. 12, 2024	<1.0	<1.0	µg/L	No
Diuron	Aug. 12, 2024	<0.03	<0.03	µg/L	No
Glyphosate	Aug. 12, 2024	<1.0	<1.0	µg/L	No
HAA	Feb. 12, 2024 May 13, 2024 Aug. 5, 2024 Nov. 4, 2024	<5.30 (distribution) <5.30 (distribution) <5.30 (distribution) <5.30 (distribution)		µg/L	No
Malathion	Aug. 12, 2024	<0.02	<0.02	µg/L	No
MCPA	Aug. 12, 2024	<0.00012	<0.00012	µg/L	No
Metolachlor	Aug. 12, 2024	<0.01	<0.01	µg/L	No
Metribuzin	Aug. 12, 2024	<0.02	<0.02	µg/L	No
Monochlorobenzene	Aug. 12, 2024	<0.30	<0.30	µg/L	No
Paraquat	Aug. 12, 2024	<1.0	<1.0	µg/L	No
Pentachlorophenol	Aug. 12, 2024	<0.15	<0.15	µg/L	No
Phorate	Aug. 12, 2024	<0.01	<0.01	µg/L	No
Picloram	Aug. 12, 2024	<1.0	<1.0	µg/L	No
Polychlorinated Biphenyls(PCB)	Aug. 12, 2024	<0.04	<0.04	µg/L	No
Prometryne	Aug. 12, 2024	<0.03	<0.03	µg/L	No
Simazine	Aug. 12, 2024	<0.01	<0.01	µg/L	No
THM (NOTE: show latest annual average)	**2024 Average**	3.33 (distribution)		µg/L	No
Terbufos	Aug. 12, 2024	<0.01	<0.01	µg/L	No
Tetrachloroethylene	Aug. 12, 2024	<0.35	<0.35	µg/L	No
2,3,4,6-Tetrachlorophenol	Aug. 12, 2024	<0.20	<0.20	µg/L	No
Triallate	Aug. 12, 2024	<0.01	<0.01	µg/L	No

Trichloroethylene	Aug. 12, 2024	<0.44	<0.44	µg/L	No
2,4,6-Trichlorophenol	Aug. 12, 2024	<0.25	<0.25	µg/L	No
Trifluralin	Aug. 12, 2024	<0.02	<0.02	µg/L	No
Vinyl Chloride	Aug. 12, 2024	<0.17	<0.17	µg/L	No

List any Inorganic or Organic parameter(s) that exceeded half the standard prescribed in Schedule 2 of Ontario Drinking Water Quality Standards.				
Parameter	**Sample Date**	**Result Value**	**Unit of Measure**	**ODWS Criteria**
n/a				

Part 2 - SUMMARY REPORT (as required by O. Reg 170/03, Section 22)

Non-Compliance with Legislations, Regulations, Approvals & Orders
During this period, the Facility was operated in full compliance with the Act, the regulations and the Facility's approval, save and except for the following:

During the MECP Inspection for the period of November 21, 2023 - October 9, 2024, there were no Non-Compliance issues or Recommendations identified.

Permit to Take Water (PTTW) Flow Comparison

Well #1 Raw Water Flow

Month	Raw Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	448	517	13,892
Feb '24	468	536	13,573
Mar '24	408	457	12,647
Apr '24	417	488	12,495
May '24	446	515	13,817
Jun '24	452	554	13,566
Jul '24	461	556	14,282
Aug '24	489	586	15,148
Sep '24	471	552	14,131
Oct '24	428	570	13,266
Nov '24	399	518	11,972
Dec '24	418	593	12,944
Annual Summary			
Average	442		
Maximum		593	
Total			161,732
PTTW Capacity	1375	1375	
% Capacity	32.1	43.1	

Well #2 Raw Water Flow

Month	Raw Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	225	286	6,987
Feb '24	216	294	6,266
Mar '24	200	242	6,188
Apr '24	210	278	6,304
May '24	220	293	6,834
Jun '24	219	341	6,565
Jul '24	244	472	7,565
Aug '24	242	416	7,503
Sep '24	256	466	7,669
Oct '24	204	287	6,324
Nov '24	217	489	6,502
Dec '24	302	864	9,354
Annual Summary			
Average	230		
Maximum		864	
Total			84,059
PTTW Capacity	1634	1634	
% Capacity	14.1	52.9	

Well #2A Raw Water Flow

Month	Raw Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	215	332	6,669
Feb '24	246	424	7,138
Mar '24	213	313	6,597
Apr '24	203	241	6,098
May '24	223	393	6,920
Jun '24	231	341	6,925
Jul '24	234	410	7,250
Aug '24	250	454	7,742
Sep '24	219	405	6,582
Oct '24	217	300	6,716
Nov '24	213	452	6,399
Dec '24	240	499	7,429
Annual Summary			
Average	225		
Maximum		499	
Total			82,462
PTTW Capacity	1634	1634	
% Capacity	13.8	30.5	

Combined Raw Water Flow

Month	Raw Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	889	985	27,548
Feb '24	930	1,073	26,977
Mar '24	820	911	25,431
Apr '24	830	938	24,897
May '24	889	1,026	27,570
Jun '24	902	1,103	27,056
Jul '24	939	1,234	29,097
Aug '24	980	1,173	30,393
Sep '24	946	1,103	28,381
Oct '24	849	959	26,306
Nov '24	829	1,033	24,872
Dec '24	959	1,182	29,727
Annual Summary			
Average	897		
Maximum		1,234	
Total			328,253
PTTW Capacity	3009	3009	
% Capacity	29.8	41.0	

Municipal Drinking Water Licence (MDWL) Flow Comparison

Well #1 Treated Water Flow

Month	Treated Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	455	526	14,116
Feb '24	475	543	13,774
Mar '24	415	464	12,872
Apr '24	422	496	12,651
May '24	452	522	14,001
Jun '24	459	565	13,766
Jul '24	468	566	14,522
Aug '24	496	595	15,373
Sep '24	481	561	14,429
Oct '24	435	582	13,470
Nov '24	405	526	12,140
Dec '24	424	602	13,134
Annual Summary			
Average	449		
Maximum		602	
Total			164,247
Rated Capacity	1375	1375	
% Capacity	32.6	43.8	

Well #2 Treated Water Flow

Month	Treated Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	442	492	13,707
Feb '24	464	538	13,452
Mar '24	411	456	12,737
Apr '24	413	469	12,392
May '24	445	513	13,789
Jun '24	451	549	13,522
Jul '24	469	592	14,551
Aug '24	494	587	15,328
Sep '24	473	555	14,176
Oct '24	422	482	13,081
Nov '24	432	648	12,953
Dec '24	543	871	16,848
Annual Summary			
Average	455		
Maximum		871	
Total			166,536
Rated Capacity	1636	1636	
% Capacity	27.8	53.2	

Combined Treated Water Flow

Month	Treated Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	898	995	27,823
Feb '24	939	1,081	27,226
Mar '24	826	919	25,609
Apr '24	835	946	25,043
May '24	896	1,035	27,790
Jun '24	910	1,114	27,288
Jul '24	938	1,120	29,073
Aug '24	990	1,182	30,701
Sep '24	953	1,116	28,604
Oct '24	856	973	26,550
Nov '24	836	1,042	25,093
Dec '24	967	1,192	29,982
Annual Summary			
Average	904		
Maximum		1,192	
Total			330,784
Rated Capacity	3011	3011	
% Capacity	30.0	39.6	

February 24, 2025
Municipality of West Grey
402813 Grey Road 4
RR#2
Durham, ON
N0G 1R0

Attention: Geoff Aitken, Manager of Public Works

RE: Neustadt Drinking Water System
2024 Annual and Summary Reports

Geoff,

Please find attached the 2024 Annual and Summary Reports for the Neustadt drinking water system, in accordance with Section 11(1) of O. Reg. 170/03. This report covers the period from January 1 to December 31, 2024 and meets the requirement of being prepared by February 28 of this year.

Please ensure that a copy of this report is given, without charge, to every person who requests a copy. In addition, please make certain that effective steps are taken to advise residents that copies of the report are available, and of how a copy can be obtained.

Finally, as per Schedule 22 of O. Reg. 170/03, please ensure that at least a copy of the Summary Report is given to the members of municipal council no later than March 31, 2024.

If you have any questions regarding the report, we would be pleased to address them and you should contact the undersigned accordingly.

Sincerely,

Scott Gowan - Project Manager

Veolia North America
555 Rene-Levesque Blvd W
Montreal, QC H2Z 1B1
www.Veolianorthamerica.com

Part 1 - ANNUAL REPORT (as required by O. Reg 170/03, Section 11)

Drinking-Water System Number:	220002147
Drinking-Water System Name:	Neustadt Drinking Water System
Drinking-Water System Owner:	Municipality of West Grey
Drinking-Water System Category:	Large Municipality Residential
Period being reported:	January 1 - December 31, 2024

Complete if your Category is Large Municipal Residential or Small Municipal Residential		Complete for all other Categories	
Does your Drinking-Water System serve more than 10,000 people?	☐ Yes ☑ No	Number of Designated Facilities served:	n/a
Is your annual report available to the public at no charge on a website on the Internet?	☑ Yes ☐ No	Did you provide a copy of your annual report to all Designated Facilities you serve?	☐ Yes ☐ No
Location where Summary Report required under O.Reg. 170/03 Schedule 22 will be available for inspection. **Municipality of West Grey** **402813 Grey Road #4** **Durham, ON N0G 1R0**		Number of Designated Facilities served:	n/a
		Did you provide a copy of your annual report to all Interested Authorities you report to for each Designated Facility?	☐ Yes ☐ No

List all Drinking-Water Systems (if any), which receive all of their drinking water from your system:	
Drinking Water System Name	**Drinking Water System Number**
n/a	

Did you provide a copy of your annual report to all Drinking-Water System owners that are connected to you and to whom you provide all of its drinking water?
n/a

Indicate how you notified system users that your annual report is available, and is free of charge.		
☑ Public access/notice via the Web	☑ Public access/notice via Government Office	☐ Public access/notice via a newspaper
☐ Public access/notice via the Public Request	☐ Public access/notice via a Public Library	☐ Public access/notice via other method

Describe your Drinking Water System

Three GUDI wells: Well No. 2 with a capacity of delivering 10.6 L/s (well pump does not meet that capacity); Well No. 3 with a submersible pump capable of delivering 6.1 L/s; and Well No. 1 with a submersible pump capable of delivering 3.2 L/s. Pumping station No. 2 transfers flow monitored raw water from Well No. 2 and Well No. 3 (each well with online turbidity meters) to Well No. 1 pumphouse. Well No. 1 pumphouse contains the treatment equipment, including, but not limited to, flow meters, sodium hypochlorite disinfection system (primary disinfection), UV disinfection system, cartridge filters, online chlorine and turbidity analyzers, low level alarms and auto dialer.
There is a water tower with a volume of 1200m3. It is equipped with an on-line chlorine analyzer. Post chlorinators are in place to booster chlorine levels leaving the tower, if required. During the 2024 year, it was not required.

List all water treatment chemicals used over this reporting period

Sodium Hypochlorite - 12%

Please provide a brief description and a breakdown of monetary expenses incurred

Work was completed to set up a temporary tanker system while planned upgrades to the Water Tower took place.
Major Rehabilitation Work was completed on the Water Tower, including interior and exterior coating, as well as lightning and corrosion protection.
A new Turbidity Analyzer was installed at Well house #1

Provide details on the notices submitted in accordance with subsection 18(1) of the Safe Drinking-Water Act or section 16-4 of Schedule 16 of 0.Reg. 170/03 and reported to Spills Action Centre

Incident Date	Parameter	Result	Corrective Action	Corrective Action Date
May 16, 2024	Online Chlorine Analyzer	Loss of Communication	A blown fuse caused the loss of communication to the Online Chlorine Analyzer. Over the period of 1.5 hours, an Operator monitored the chlorine residual as repairs were being made. Once communication was reestablished, chlorine levels were monitored and everything returned to normal.	May 16, 2024

Microbiological testing done under the Schedule 10, 11, 12 of Regulation 170/03, during this reporting period					
	Number of Samples	**Range of E.Coli Results** (min #) - (max #)	**Range of Total Coliform Results** (min #) - (max #)	**Number of HPC Samples**	**Range of HPC Results** (min #) - (max #)
Raw Well #1	53	0 - 0	0 - 0	n/a	n/a
Raw Well #2	53	0 - 0	0 - 12	n/a	n/a
Raw Well #3	53	0 - 0	0 - 0	n/a	n/a
Treated POE	53	0 - 0	0 - 0	53	<10 - 20
Distribution	106	0 - 0	0 - 0	53	<10 - 20

Operational testing under Schedule 7, 8, or 9 of Regulation 170/03 during the period covered			
	Number of Grab Samples	**Range of Results** (min #) - (max #)	**Units**
Turbidity - Treated	8760*	0.01 - 5.0**	NTU
Chlorine - Treated	8760*	0.70 - 2.00*** A max of 2.00 occurs due to a chlorine spike when the well starts. The max the SCADA will record is 2.00 mg/L.	mg/L
Chlorine - Distribution	418	0.93 - 1.55	mg/L
Fluoride (if DWS provided fluoridation)	n/a	n/a	n/a

*** For continuous monitors use 8760 as the number of samples**
****high turbidity incidents were either too short to be reportable (<15min) or occurred when system was off**
*****Minimum Chlorine residual required to meet CT is 0.20 mg/l**

Summary of additional testing and sampling carried out in accordance with the requirement of an approval, order or other legal instrument				
Date of legal instrument issued	**Parameter**	**Date Sampled**	**Range of Results**	**Units of Measure**
December 1, 2009	UV Transmittance	2024 (monthly)	98.0-99.0	% Transmittance

Summary of Inorganic parameters tested during this reporting period or the most recent sample results					
Parameter	**Sample Date**	**Result**	**Distribution**	**Unit of Measure**	**Exceedance**
Alkalinity	Mar. 25, 2024 Sept. 3, 2024	-	266 266	mg/L	No

Antimony	Aug. 12, 2024	<0.6	-	µg/L	No
Arsenic	Aug. 12, 2024	1.3	-	µg/L	No
Barium	Aug. 12, 2024	88.7	-	µg/L	No
Boron	Aug. 12, 2024	26	-	µg/L	No
Cadmium	Aug. 12, 2024	0.062	-	µg/L	No
Chromium	Aug. 12, 2024	0.19	-	µg/L	No
Lead-see summary below					
Mercury	Aug. 12, 2024	<0.01	-	µg/L	No
Selenium	Aug. 12, 2024	<0.04	-	µg/L	No
Sodium	Aug. 4, 2020	5.3	-	mg/L	No
Uranium	Aug. 14, 2023	0.206	-	µg/L	No
Fluoride	Aug. 30, 2021	1.08	-	mg/L	No
Nitrite	Feb. 12, 2024 May 13, 2024 Aug. 5, 2024 Nov. 4, 2024	<0.003 <0.003 <0.003 <0.003	-	mg/L	No
Nitrate	Feb. 12, 2024 May 13, 2024 Aug. 5, 2024 Nov. 4, 2024	<0.006 <0.006 0.009 <0.006	-	mg/L	No

Summary of Lead Results during this reporting period (Winter: Dec. 15/21 - Apr. 15/22; Summer: June 15/22- Oct. 15/22)				
Sampling Period	**Range of Results (µg/L) from Residential Samples** (# of Samples Taken)	**Distribution Locations**	**Distribution System**	**Any Adverse Water Quality Incidents?**
Winter April 11, 2022	n/a	Firehall	0.14	No
Summer October 3, 2022	n/a	Firehall	0.24	No

Summary of Organic parameters sampled during this reporting period or the most recent sample results

Parameter	Sample Date	Result	Unit of Measure	Exceedance
Alachlor	Aug. 12, 2024	<0.02	µg/L	No
Atrazine + N-dealkylated metabolites	Aug. 12, 2024	<0.01	µg/L	No
Azinphos-methyl	Aug. 12, 2024	<0.05	µg/L	No
Benzene	Aug. 12, 2024	<0.32	µg/L	No
Benzo(a)pyrene	Aug. 12, 2024	<0.004	µg/L	No
Bromoxynil	Aug. 12, 2024	<0.33	µg/L	No
Carbaryl	Aug. 12, 2024	<0.05	µg/L	No
Carbofuran	Aug. 12, 2024	<0.01	µg/L	No
Carbon Tetrachloride	Aug. 12, 2024	<0.17	µg/L	No
Chlorpyrifos	Aug. 12, 2024	<0.02	µg/L	No
Diazinon	Aug. 12, 2024	<0.02	µg/L	No
Dicamba	Aug. 12, 2024	<0.20	µg/L	No
1,2-Dichlorobenzene	Aug. 12, 2024	<0.41	µg/L	No
1,4-Dichlorobenzene	Aug. 12, 2024	<0.36	µg/L	No
1,2-Dichloroethane	Aug. 12, 2024	<0.35	µg/L	No
1,1-Dichloroethylene (vinylidene chloride)	Aug. 12, 2024	<0.33	µg/L	No
Dichloromethane	Aug. 12, 2024	<0.35	µg/L	No
2-4 Dichlorophenol	Aug. 12, 2024	<0.15	µg/L	No
2,4-Dichlorophenoxy acetic acid (2,4-D)	Aug. 12, 2024	<0.19	µg/L	No
Diclofop-methyl	Aug. 12, 2024	<0.40	µg/L	No
Dimethoate	Aug. 12, 2024	<0.06	µg/L	No
Diquat	Aug. 12, 2024	<1.00	µg/L	No
Diuron	Aug. 12, 2024	<0.03	µg/L	No
Glyphosate	Aug. 12, 2024	<1.00	µg/L	No
HAA	Feb. 12, 2024 May 13, 2024 Aug. 5, 2024	<5.3 <5.3 <5.3	µg/L	No

	Nov. 4, 2024	<5.3		
Malathion	Aug. 12, 2024	<0.02	µg/L	No
MCPA	Aug. 12, 2024	<0.00012	µg/L	No
Metolachlor	Aug. 12, 2024	<0.01	µg/L	No
Metribuzin	Aug. 12, 2024	<0.02	µg/L	No
Monochlorobenzene	Aug. 12, 2024	<0.30	µg/L	No
Paraquat	Aug. 12, 2024	<1.00	µg/L	No
Pentachlorophenol	Aug. 12, 2024	<0.15	µg/L	No
Phorate	Aug. 12, 2024	<0.01	µg/L	No
Picloram	Aug. 12, 2024	<1.00	µg/L	No
Polychlorinated Biphenyls(PCB)	Aug. 12, 2024	<0.04	µg/L	No
Prometryne	Aug. 12, 2024	<0.03	µg/L	No
Simazine	Aug. 12, 2024	<0.01	µg/L	No
THM (NOTE: show latest annual average)	**2024 Average**	8.75 (distribution)	µg/L	No
Terbufos	Aug. 12, 2024	<0.01	µg/L	No
Tetrachloroethylene	Aug. 12, 2024	<0.35	µg/L	No
2,3,4,6-Tetrachlorophenol	Aug. 12, 2024	<0.20	µg/L	No
Triallate	Aug. 12, 2024	<0.01	µg/L	No
Trichloroethylene	Aug. 12, 2024	<0.44	µg/L	No
2,4,6-Trichlorophenol	Aug. 12, 2024	<0.25	µg/L	No
Trifluralin	Aug. 12, 2024	<0.02	µg/L	No
Vinyl Chloride	Aug. 12, 2024	<0.17	µg/L	No

List any Inorganic or Organic parameter(s) that exceeded half the standard prescribed in Schedule 2 of Ontario Drinking Water Quality Standards.

Parameter	Sample Date	Result Value	Unit of Measure	ODWS Criteria
n/a				

Part 2 - SUMMARY REPORT (as required by O. Reg 170/03, Section 22)

Non-Compliance with Legislations, Regulations, Approvals & Orders
During this period, the Facility was operated in full compliance with the Act, the regulations and the Facility's approval, save and except for the following:

No non-compliances in 2024 were reported.

VEOLIA 2024 ANNUAL REPORT FOR THE NEUSTADT WATER SYSTEM

West Grey

Permit to Take Water (PTTW) Flow Comparison

Well #1 Raw Water Flow

Month	Raw Water Flow		
	Average Daily	Maximum Daily	Monthly Total
	m3	m3	m3
Jan '24	24.3	78.4	752
Feb '24	26.1	55.2	756
Mar '24	20.6	62.8	638
Apr '24	24.1	69.9	724
May '24	111.1	196.5	3,444
Jun '24	141.2	180.7	4,236
Jul '24	132.6	153.0	4,112
Aug '24	135.1	155.2	4,188
Sep '24	59.1	172.0	1,773
Oct '24	29.6	83.0	917
Nov '24	24.1	69.8	723
Dec '24	23.2	52.7	718
Annual Summary			
Average	62.8		
Maximum		196.5	
Total			22,980
PTTW Capacity	276	276	
%Capacity	22.8	71.2	

Well #2 Raw Water Flow

Month	Raw Water Flow		
	Average Daily	Maximum Daily	Monthly Total
	m3	m3	m3
Jan '24	67.3	151.4	2,086
Feb '24	59.5	152.0	1,725
Mar '24	73.0	177.3	2,264
Apr '24	62.5	189.0	1,875
May '24	3.4	50.6	104
Jun '24	0.5	8.3	16
Jul '24	0.6	5.4	20
Aug '24	0.2	2.1	7
Sep '24	130.5	726.2	3,915
Oct '24	77.7	401.1	2,410
Nov '24	70.1	155.7	2,103
Dec '24	64.9	152.8	1,947
Annual Summary			
Average	50.6		
Maximum		726.2	
Total			18,472
PTTW Capacity	916	916	
%Capacity	5.5	79.3	

Well #3 Raw Water Flow

Month	Raw Water Flow		
	Average Daily	Maximum Daily	Monthly Total
	m3	m3	m3
Jan '24	39.4	144.2	1,220
Feb '24	44.8	112.5	1,299
Mar '24	34.8	106.3	1,080
Apr '24	35.2	107.0	1,057
May '24	0.4	3.6	11
Jun '24	0.4	3.3	11
Jul '24	0.3	2.9	10
Aug '24	0.3	2.5	8
Sep '24	26.7	290.9	801
Oct '24	50.6	142.2	1,569
Nov '24	41.5	119.6	1,244
Dec '24	41.9	99.3	1,300
Annual Summary			
Average	26.3		
Maximum		290.9	
Total			9,609
PTTW Capacity	527	527	
%Capacity	4.4	55.2	

Combined Raw Water Flow

Month	Combined Raw Water Flow		
	Average Daily	Maximum Daily	Monthly Total
	m3	m3	m3
Jan '24	130.9	222.6	4,059
Feb '24	130.3	162.5	3,780
Mar '24	128.4	177.3	3,982
Apr '24	121.8	189.0	3,655
May '24	114.8	196.5	3,560
Jun '24	142.1	180.7	4,263
Jul '24	133.6	156.8	4,141
Aug '24	135.6	155.2	4,203
Sep '24	216.3	796.0	6,490
Oct '24	157.9	401.1	4,896
Nov '24	135.6	189.3	4,069
Dec '24	132.2	152.8	3,965
Annual Summary			
Average	139.9		
Maximum		796.0	
Total			51,061
PTTW Capacity	1719	1719	
%Capacity	8.1	46.3	

Municipal Drinking Water Licence (MDWL) Flow Comparison

Month	Treated Water Flow		
	Average Daily m3	Maximum Daily m3	Monthly Total m3
Jan '24	109.8	189.8	3,404
Feb '24	108.0	127.7	3,132
Mar '24	107.8	147.1	3,343
Apr '24	102.6	170.0	3,077
May '24	106.2	184.1	3,293
Jun '24	131.0	170.9	3,929
Jul '24	125.0	145.1	3,874
Aug '24	127.9	147.0	3,965
Sep '24	191.8	662.3	5,753
Oct '24	134.2	339.2	4,159
Nov '24	113.4	160.7	3,402
Dec '24	109.1	127.7	3,381
Annual Summary			
Average	122.2		
Maximum		662.3	
Total			44,712
Rated Capacity	916	916	
%Capacity	13.3	72.3	

Treated Peak Flow Outliers

September 5/6/7 - Due to the Tower being filled after upgrades were completed, the peak flows on these days were **501.2m³**, **662.3m³**, **529.8m³**, respectively.

September 18 - Due to switching from the temporary tanker system back to regular Tower operation, the peak flow on this day was **446.0m³**.

With these four outliers removed, the maximum peak flow for September was **282.1m³**, and the annual peak flow for 2024 was **339.2m³** which is **37.0%** of the total capacity.

Revisions
December 4 ,2023
March 13, 2024
March 3, 2025

TABLE 1

2025 Reserve Capacity Assessment

Durham Water Works

21-036

1	Rated Capacity (m³/day)	3011
2	Max day demand (m³/day) 2013-2024	1756
3	Avg day demand (m³/day) 2013-2024	1074
4	**Reserve Capacity (m³/day) (1) - (2)**	**1255**
5	Max day factor (2) ÷ (3)	2
6	Approximate Billable Connections including commerical/institutional	1481
7	Equivalent Person per residential unit (2016 Census Data. Population: 2,609, Private Dwelling 1196)	2.2
8	Equivalent household average water demand (m³/day) (3) ÷ (6)	0.73
9	Actual average water demand per household (metered consumption ÷ number of metered residences) [4] (m³/day)	0.47
10	**Committed Capacity Summary (m³/day) using Max Day Factor of 2:**	
i)	Sunvale Subdivision: 456 persons [1] @ 450 lcpd	410
ii)	Broos Subdivision: 209 [2] persons @ 450 lcpd	188
iii)	Rockwood Terraces [3] (upgraded)	28
iv)	Infilling (m³/day) 50 units assumed (150 persons) @ 450 lcpd	135
11	**Total committed capacity (m³/day)**	**761**
12	**Committed Reserve Capacity for water works (m³/day) (4) - (11)**	**494**
13	**Developments under Review (m³/day)**	
i)	Khanani Subdivision: 317 persons @ 450 lcpd	286
ii)	Roseate Subdivision: 351 person @ 450 lcpd	316
iii)	Saddler Subdivision: 113 persons @ 450 lcpd	102
iv)	Bruce St. Residentical Development: 113 persons @ 450 lcpd	102
13	**Future Development Capacity needed (m³/day)**	**806**
14	**Shortfall in capacity (m³/day) (12) - (13)**	**-312**

1 Sunvale subdivision has 85 units out of 247 units, already constructed & connected to water & sewage system's. This spreadsheet forecast flows for remaining 162 residences @ 3 pph per Cobide Report.

2 Broos Subdivision has been allocated capacity for 209 persons only in 2025. There are more Homes that will be built in the subdivision.

3 New Rockwood Terrance shall have 128 beds as opposed to existing 100 bed that are already connected to water & sewage system. Flow forecast is for 28 beds only.

4 The actual water consumption of meterd residences based on 2014 - 2023 data.

Note: It is anticipated that New Drilled Well (PTTW not obtained) shall provide water supply in sufficient quantity and exceed shortfall in capacity outlined in line 14.

Revisions
March 22, 2022
February 27, 2025

Table 6.1
Community of Neustadt
Calculation of Water 2025 Reserve Capacity
Municipality of West Grey

21-039

	Description	
1	Design Capacity of Neustadt Water Treatment (m^3/day)	916
2	Current Max Day Demand (m^3/day)[1]	359
3	Average Day Demand (m^3/day)	126
4	Reserve Capacity (m^3/day) (1) - (2)	557
5	Max/Average Day Factor (2) ÷ (3)	2.85
6	Serviced ERU[2]	262
7	Persons per Equivalent Residential Unit (assumed)	3
8	Population Equivalent Served (6) X (7)	786
9	Current Maximum Day Demand[3] Per Capita (m^3/day) - ERU basis (2) ÷ (8)	0.457
10	Additional Population that can be Served on ERU basis (4) ÷ (9)	1,220
11	Additional Equivalent Residential Units that can be Served (10) ÷ (7)	407
12	Vacant Lots for infilling	21
13	**Proposed Development Under Review**	118
i)	Weltz - 8 units	
ii)	Subdivision 1 - 67 units	
iii)	Subdivision 2 - 43 units	
14	**Uncommitted Reserve Capacity to Support New ERU's (11) - (12) - (134)**	**268**

[1] Accurate Current Max Day information is not known due to flow meter issue

[2] Based on 249 residential customers and 4 commercial customers (equivalent to 13 residences)

[3] Calculated Max Day Demand Per Capita is a low number. This number shall increase to 0.549 m^3/day/capita, if "Persons per ERU" in (7) above is changed to 2.5

Notes:

A) West Grey can likely commit to Water Supply to Weltz Subdivision and two (2) other subdivisions with 67 and 43 proposed units. West Grey is advised to withhold commitments to any further developments until reliable "Max Day Demand" record is available.

MUNICIPALITY OF West Grey nestled in nature

Staff Report

Report To: Council

Report From: Kerri Mighton, Director of Finance/Treasurer

Meeting Date: March 18, 2025

Subject: Development Charges Bylaw Extension

Recommendations:

THAT in consideration of staff report 'Development Charges Bylaw Extension', Council directs staff to bring forward a bylaw to amend Development Charges Bylaw No. 31-2020 to repeal sections 7 and 7.1.

Highlights:

- The Municipality's current Development Charges bylaw expires April 28, 2025.
- Bill 185: *Cutting Red Tape to Build More Homes Act*, establishes a process to remove the expiry date.
- An updated Development Charges Background Study is underway, however it will not be completed before the current bylaw is set to expire.

Previous Report/Authority:

None.

Analysis:

On April 28, 2020, the Municipality of West Grey's Development Charge (DC) Bylaw 31-2020 came into force under the *Development Charges Act* (DCA). The bylaw imposes DCs on residential and non-residential uses. The Municipality has retained Watson & Associates Economists Ltd. (Watson) to undertake a DC background study and prepare a new DC bylaw. The expiry date of the current bylaw is April 28, 2025.

On June 6, 2024, the Province revised the DCA under Bill 185: *Cutting Red Tape to Build More Homes Act*. A summary of the changes currently in effect from Bill 185 are outlined below.

- Establishing a process for minor amendments to DC bylaws to remove the expiry date (further discussed below).
- A reduction of time for the DC rate freeze related to site plan and zoning bylaw amendment planning applications; and
- Modernizing public notice requirements.

Typically, section 19 of the DCA requires that a municipality must follow sections 10 through 18 of the Act (with necessary modifications) when amending a DC bylaw. These sections generally require the following:

- Completion of a DC background study, including the requirement to post the background study 60 days prior to passage of the DC bylaw;
- Passage of a DC bylaw within one year of the completion of the DC background study;
- A public meeting, including notice requirements; and
- The ability to appeal the bylaw to the OLT.

However, with the changes from Bill 185, municipalities have the ability to undertake a minor amendment to its DC bylaw to repeal the provision specifying the date the bylaw expires or to amend the provision to extend the expiry date (subject to the 10-year law term limitations provided in the DCA) without adherence to the requirements noted in sections 10 through 18 of the DCA.

Notice of bylaw passage requirements for this minor amendment are similar to the notice requirements in the DCA, with the exception of the requirement to identify the last day for appealing the bylaw (as these provisions do not apply).

In alignment with the legislative changes under Bill 185, it is recommended that the Municipality undertake a minor amendment to the DC bylaw to remove the expiry date. This will ensure the continued ability to collect DCs under the current bylaw while allowing the necessary time to complete updates to the DC background study and draft DC bylaw. An amending bylaw is included in the agenda for Council's consideration.

Financial Implications:

Removing the expiry date of the DC bylaw will ensure that DC can still be collected at the current rates until a new DC background study and bylaw are completed.

Climate and Environmental Implications:

None.

Communication Plan:

Notice will be given in accordance with the DCA.

Consultation:

None.

Attachments:

None.

Recommended by:
Kerri Mighton, Director of Finance/Treasurer

Submission approved by:
Michele Harris, Chief Administrative Officer

For more information on this report, please contact Kerri Mighton, Director of Finance/Treasurer at kmighton@westgrey.com or 519-369-2200 ext. 223.

MUNICIPALITY OF West Grey nestled in nature

Staff Report

Report To: Council

Report From: Jamie Eckenswiller, Director of Legislative Services/Clerk

Meeting Date: March 18, 2025

Subject: Statement of 2024 Council and Board Member Remuneration and Expenses

Recommendations:

THAT in consideration of staff report 'Statement of 2024 Council and Board Member Remuneration and Expenses, Council receives the report for information purposes.

Highlights:

- The *Municipal Act, 2001* requires municipalities to report on remuneration and expenses paid to members of Council.
- Council members were allocated $1,500.00 for conference registration. Expenses related to the conference such as meals, mileage, and accommodations are not included in the $1,500.00 allotment.
- Total remuneration and expenses paid to Council in 2024 is $222,622.10.
- Total remuneration and expenses paid to members of local boards in 2024 is $9,501.39.

Previous Report/Authority:

None.

Analysis:

The *Municipal Act, 2001* requires municipal treasurers to submit to council an itemized statement of remuneration and expenses paid to or on behalf of each council member and members of local boards. Specifically, section 284 (1) states that:

> "The treasurer of a municipality shall in each year on or before March 31 provide to the council of the municipality an itemized statement on remuneration and expenses paid in the previous year to,

a. each member of council in respect of his or her services as a member of the council or any other body, including a local board, to which the member has been appointed by council or on which the member holds office by virtue of being a member of council;
b. each member of council in respect of his or her services as an officer or employee of the municipality or other body described in clause (a); and
c. each person, other than a member of council, appointed by the municipality to serve as a member of any body, including a local board, in respect of his or her services as a member of the body.

West Grey Bylaw No. 2023-024 identifies the amount that each member of council is permitted to spend on conference registration, excluding expenses related to the conference. The allotment for each member in 2024 was $1,500.00. Additionally, members of council are permitted to claim expenses related to the conference such as meals, mileage, and accommodations. Members of council are also permitted to claim mileage expenses for travel to and from council meetings.

Financial Implications:

There are no direct financial implications associated with this report.

Climate and Environmental Implications:

None.

Communication Plan:

Council and board member remuneration and expenses will be posted to the West Grey website.

Consultation:

None.

Attachments:

Statement of 2024 Remuneration and Expenses

Recommended by:
Jamie Eckenswiller, AOMC, AMP
Director of Legislative Services/Clerk

Submission approved by:
Michele Harris, Chief Administrative Officer

For more information on this report, please contact Jamie Eckenswiller, Director of Legislative Services/Clerk at clerk@westgrey.com or 519-369-2200 Ext. 229.

2024 Council and Board Remuneration and Expenses

			COUNCIL							
Name		Position	Honorarium	Technology Allowance	Conference Per Diems	Subtotal	Mileage	Conference Expenses	Subtotal Expenses	TOTAL
Eccles	Kevin	Mayor	37,417.44	900.00	1,982.51	40,299.95	2,912.05	1,825.65	4,737.70	45,037.65
Foerster	Scott	Councillor	23,208.00	900.00	1,905.58	26,013.58		2,518.78	2,518.78	28,532.36
Hutchinson	Doug	Councillor	23,208.00	900.00	514.86	24,622.86	595.24	1,665.43	2,260.67	26,883.53
Hutchinson	Tom	Deputy Mayor	28,351.44	900.00	609.55	29,860.99		2,257.40	2,257.40	32,118.39
Nuhn	Joyce	Councillor	23,208.00	900.00	609.55	24,717.55	1,816.91	2,746.32	4,563.23	29,280.78
Shea	Geoffrey	Councillor	23,208.00	900.00	1,372.96	25,480.96	573.55	3,823.70	4,397.25	29,878.21
Townsend	Doug	Councillor	23,208.00	900.00	1,372.96	25,480.96	1,739.27	3,670.95	5,410.22	30,891.18
TOTAL			181,808.88	6,300.00	8,367.97	196,476.85	7,637.02	18,508.23	26,145.25	222,622.10
										-

			POLICE BOARD					
Name		Position	Per Diems	Mileage	Conference Expenses	Total Expenses		
Eccles	Kevin	Police Board			1,234.17	1,234.17		
Fawcett	David	Police Board	2,723.07	349.94	1,193.46	1,543.40		
McDonald	Filomena	Police Board			1,047.81	1,047.81		
Nuhn	Joyce	Police Board			-	-		
Cutting	Bev	Police Board	1,920.55	644.16	1,237.81	1,881.97		
TOTAL			4,643.62	994.10	4,713.25	5,707.35	-	-

			SVCA		
Name		Position	Per Diem	Mileage	Total
Eccles	Kevin	SVCA Member	935.00	182.00	1,117.00
Hutchinson	Tom	SVCA Member	2,390.00	287.04	2,677.04
TOTAL			3,325.00	469.04	3,794.04

MUNICIPALITY OF West Grey

The Corporation of the Municipality of West Grey
Bylaw No. 2025-021

A bylaw to confirm the proceedings of the regular meeting of the Council of the Corporation of the Municipality of West Grey.

WHEREAS Section 5(3) of the *Municipal Act, 2001*, as amended, provides that a municipal power, including a municipality's capacity, rights, powers and privileges under section 9, shall be exercised by bylaw unless the municipality is specifically authorized to do otherwise; and

WHEREAS Section 8 of the *Municipal Act, 2001*, as amended, provides that the powers of a municipality shall be interpreted broadly to enable it to govern its affairs as it considers appropriate and to enhance the municipality's ability to respond to municipal issues; and

WHEREAS the Council of the Corporation of the Municipality of West Grey deems it expedient to adopt, confirm and ratify matters dealt with at all meetings of Council;

NOW THEREFORE the Council of the Corporation of the Municipality of West Grey hereby enacts as follows:

1. That the proceedings and actions taken by the Council of the Municipality of West Grey at the regular Council meeting of March 18, 2025, and in respect of each report, motion, recommendation, bylaw and any other business conducted are, except where the prior approval of the Ontario Land Tribunal or other authority is required by law, hereby adopted and confirmed and shall have the same force and effect as if each and every one of them had been the subject matter of a separate bylaw duly enacted.

2. The Mayor and proper officials of the Corporation of the Municipality of West Grey are hereby authorized and directed to do all things necessary to give effect to the action of the Council of the Corporation of the Municipality of West Grey referred to in the preceding section thereof.

3. That on behalf of the Corporation of the Municipality of West Grey the Mayor or presiding officer of Council and the Clerk or CAO, where instructed to do so, are authorized and directed to execute all documents necessary, and to affix the seal of the Corporation of the Municipality of West Grey thereto.

4. That this bylaw shall come into force and take effect upon being passed by council.

Passed and enacted by the Council of the Municipality of West Grey this 18th day of March, 2025.

Mayor Kevin Eccles

Jamie M. Eckenswiller, Clerk

MUNICIPALITY OF West Grey

The Corporation of the Municipality of West Grey
Bylaw No. 2025-022

A bylaw to amend Development Charges Bylaw No. 31-2020 to remove the expiry date.

WHEREAS Section 2(1) of the *Development Charges Act, 1997*, S.O. 1997, c. 27, as amended (‘the Act’), provides that a municipality may enact a bylaw for the imposition of development charges against land to pay for increased capital costs required because of increased needs for services arising from development of the area to which the bylaw applies; and

WHEREAS on April 28, 2020, the Council of the Corporation of the Municipality of West Grey enacted Bylaw No. 31-2020 for the imposition of development charges against land; and

WHEREAS Section 19 of the Act provides that amendments to a bylaw for the imposition of development charges against land may be amened and that section 19(1) of the Act does not apply if the only effect of the amendment is to repeal a provision specifying the date on which the bylaw expires; and

WHEREAS the Council of the Corporation of the Municipality of West Grey deems it expedient to amend Bylaw No. 31-2020 to repeal section 7 and 7.1 respecting the date on which the bylaw expires;

NOW THEREFORE the Council of the Corporation of the Municipality of West Grey hereby enacts as follows:

1. That Bylaw No. 31-2020 is hereby amended to repeal sections 7 and 7.1.

2. That this bylaw shall come into force and take effect upon being passed by Council.

Passed and enacted by the Council of the Municipality of West Grey this 18th day of March, 2025.

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Mayor Kevin Eccles	Jamie M. Eckenswiller, Clerk

MUNICIPALITY OF West Grey

The Corporation of the Municipality of West Grey
Bylaw No. 2025-023

A bylaw to amend Fees and Charges Bylaw No. 2023-064 respecting dog tag fees.

WHEREAS Section 5(3) of the *Municipal Act, 2001*, as amended, provides that a municipal power, including a municipality's capacity, rights, powers and privileges under section 9, shall be exercised by bylaw unless the municipality is specifically authorized to do otherwise; and

WHEREAS section 391 of the Act authorizes a municipality to impose fees or charges on persons for services, activities and the use of property; and

WHEREAS on June 20, 2023, council passed Fees and Charges Bylaw No. 2023-064 to establish fees and charges for certain services provided by the Municipality of West Grey; and

WHEREAS on March 4, 2025, Council passed Resolution No. R-250304-007 directing staff to bring forward a bylaw to amend Fees and Charges Bylaw No. 2023-064 respecting dog tag fees; and

WHEREAS on March 5, 2025, public notice was given respecting the proposed changes to the fees and charges bylaw in accordance with Notice Bylaw No. 2023-020;

WHEREAS the Council of the Corporation of the Municipality of West Grey deems it expedient and necessary to adopt an amendment to the fees and charges bylaw respecting dog tag fees;

NOW THEREFORE the Council of the Corporation of the Municipality of West Grey hereby enacts as follows:

1. That schedule D – Animal Control be amended as follows:
   - Dog tag purchased before March 31 – first dog from $20.00 to $25.00
   - Dog tag purchased after March 31 – first dog from $25.00 to $30.00
   - Dog tag purchased before March 31 – second dog from $30.00 to $35.00
   - Dog tag purchased after March 31 – second dog from $35.00 to $40.00
   - Dog tag purchased before March 31 – third dog from $40.00 to $45.00
   - Dog tag purchased after March 31 – third dog from $45.00 to $50.00
   - Dog tag purchased before March 31 – fourth and each additional dog from $50.00 to $55.00
   - Dog tag purchased after March 31 – fourth and each additional dog from $55.00 to $60.00
2. That this bylaw shall come into force and take effect on April 1, 2025.

Passed and enacted by the Council of the Municipality of West Grey this 18th day of March, 2025.

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Mayor Kevin Eccles — Jamie M. Eckenswiller, Clerk